

Health Consultation

AMBIENT AIR INVESTIGATION

EGYPTIAN LACQUER MANUFACTURING COMPANY, INC.

FRANKLIN, WILLIAMSON COUNTY, TENNESSEE

EPA FACILITY ID: TND093148682

Prepared by the
Tennessee Department of Health

JULY 23, 2008

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners 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 or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Foreword

This document summarizes an environmental public health investigation performed by the State of Tennessee Department of Health's Environmental Epidemiology Program. Our work is conducted under a Cooperative Agreement with the federal Agency for Toxic Substances and Disease Registry. In order for the Health Department to answer an environmental public health question, several actions are performed:

Evaluate Exposure: Tennessee health assessors begin by reviewing available information about environmental conditions at a site. We interpret environmental data, review site reports, and talk with environmental officials. Usually, we do not collect our own environmental sampling data. We rely on information provided by the Tennessee Department of Environment and Conservation, U.S. Environmental Protection Agency, and other government agencies, businesses, or the general public. We work to understand how much contamination may be present, where it is located on a site, and how people might be exposed to it. We look for evidence that people may have been exposed to, are being exposed to, or in the future could be exposed to harmful substances.

Evaluate Health Effects: If people could be exposed to contamination, then health assessors take steps to determine if it could be harmful to human health. We base our health conclusions on exposure pathways, risk assessment, toxicology, cleanup actions, and the scientific literature.

Make Recommendations: Based on our conclusions, we will recommend that any potential health hazard posed by a site be reduced or eliminated. These actions will prevent possible harmful health effects. The role of Environmental Epidemiology in dealing with hazardous waste sites is to be an advisor. Often, our recommendations will be actions items for other agencies. However, if there is an urgent public health hazard, the Tennessee Department of Health can issue a public health advisory warning people of the danger, and will work with other agencies to resolve the problem.

If you have questions or comments about this report, we encourage you to contact us.

Please write to: Environmental Epidemiology
 Tennessee Department of Health
 1st Floor Cordell Hull Building
 425 5th Avenue North
 Nashville TN 37243

Or call us at: 615-741-7247 or toll-free 1-800-404-3006 during normal business hours

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Figure 1: Initial Air Sampling Locations near BGA Lower School, Daniels Drive, Liberty Creek, and ELMCO, Franklin, Williamson County, Tennessee. (Figure credit: EnSafe 2009) 22

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SUMMARY

INTRODUCTION

Ensuring the wellbeing of those living in, working in, or visiting the city of Franklin is a priority of the Tennessee Department of Health's (TDH) Environmental Epidemiology Program (EEP).

EEP wrote this health consultation at the request of the Tennessee Department of Environment and Conservation (TDEC) State Remediation Program (SRP). The purpose of this health consultation is to document our review of supplied environmental ambient (outdoor) air sampling data collected near the Egyptian Lacquer Manufacturing Company (ELMCO). This site consists of a manufacturing facility and off-site areas including a downgradient residential neighborhood beneath which chemicals have migrated. The chemicals are coming out of the Liberty Creek bank and floating into the creek. On the other side of the creek, is a private elementary school which has a playground about 140 feet from the creek.

All data supplied for this health consultation was compared to air health comparison values provided by the Agency for Toxic Substance and Disease Registry (ATSDR). Screening levels are chemical concentrations based on toxicology below which no adverse health effects are predicted to occur. When a screening level is exceeded, it does not immediately indicate that people would be expected to develop adverse health effects. Instead, it simply means that the potential health risk requires further investigation.

CONCLUSION

EEP reached one important conclusion in this health consultation:

EEP concludes that toluene in ambient air in the vicinity of Daniels Drive or at the BGA Lower School is not expected to harm the health of adults or children.

Basis for Conclusion

Results of ambient air monitoring conducted by ELMCO in the vicinity of Liberty Creek in 2007 and 2008.

Next Steps

No additional ambient air monitoring is planned for the vicinity of the ELMCO site. TDEC is requiring ELMCO to clean up the site and prevent further migration of chemicals to Liberty Creek. If conditions should change or if invasive remediation activities are conducted, TDEC should encourage additional air monitoring activities to be conducted by ELMCO.

**FOR MORE
INFORMATION**

If you have any questions or concerns about your health, you should contact your healthcare provider. For more information on this site call TDH EEP at 615-741-7247 or toll free 1-800-404-3006, or TDEC at toll free 888-891-8332 during normal business hours.

Introduction

In December 2006 and January 2007, the City of Franklin, Williamson County, Tennessee, and the Tennessee Department of Environment and Conservation (TDEC) conducted sampling along Liberty Creek in response to complaints from citizens of strong odors coming from the creek. Analytical results confirmed the presence of acetone and toluene in both water and air samples. TDEC initiated emergency response actions to contain the chemicals using its emergency response contractors. Upon further investigation by TDEC, the acetone and toluene were found to be entering Liberty Creek through seeps along the banks of the creek. Liberty Creek enters the Harpeth River a short distance from where the seeps were found. The source of the chemical contamination entering the creek was a nearby the nearby paint and lacquer manufacturing facility. The responsible party was identified to be the Egyptian Lacquer Manufacturing Company (ELMCO) located at 113 Fort Granger Drive, Franklin, Tennessee.

TDEC asked the Tennessee Department of Health's (TDH) Environmental Epidemiology Program (EEP) to help interpret air sampling results since the seepage of chemicals was first discovered. EEP has assisted TDEC by presenting information about the toxicity of toluene and acetone at a public meeting and by meeting with concerned parents and school administrators on several occasions to discuss possible adverse health effects on children. The purpose of this health consultation is to summarize information to date about the inhalation route of exposure near the site.

Background

ELMCO stored the solvents, acetone and toluene, in above-ground tanks on their property. ELMCO produces industrial coatings for a variety of products. Most of the acetone and toluene used by ELMCO was for manufacturing specialty paints and lacquers for the pencil industry. As part of ELMCO's former chemical storage process, these solvents were then piped underground to the factory. During the investigation for the source of acetone and toluene seeping into Liberty Creek, ELMCO discovered that elbow joints in their piping system had not been adequately sealed, allowing rust to form. Over the years, the rust caused the elbow joints to fail and leak solvents. Solvents traveled off the ELMCO site underground and reached Liberty Creek. No other pipes, ditches, or other drainage ways were discovered that could have delivered these chemicals to the creek.

In 2008, the clean up started at ELMCO. The underground piping from the above-ground solvent storage tanks to the factory has been removed. The tanks have been removed from the site. A product interceptor/recovery trench installed offsite has been put into operation. The trench is designed to intercept acetone and toluene migrating in the subsurface to Liberty Creek. The trench has since been converted to a closed product recovery system and no longer is open to the environment. A mobile soil vapor and liquid extraction system has been installed and has removed over 250 gallons of acetone and toluene from the subsurface as of November 2008 (TDEC 2008).

Groundwater, surface water, and air continue to be monitored on-site and off-site. Upgradient wells indicate benzene, toluene, ethylbenzene, and xylene contamination may be migrating onto the site from other unknown source(s).

Liberty Creek is a small stream located between a small residential subdivision, the Daniels Drive cul-de-sac, and a private elementary school, Battle Ground Academy (BGA) Lower School. See Figure 1 for a detailed aerial photo. An approximately 500 foot section of Liberty Creek is impacted by seepage from ELMCO before it enters the Harpeth River. Because of the creek's proximity to a residential neighborhood and the elementary school, residents, parents, and school officials were concerned about inhalation and ingestion exposure to acetone and toluene. A series of sampling programs were started by TDEC and ELMCO to evaluate the inhalation and ingestion pathway to nearby residents, and children and staff at the elementary school. Various indoor air, ambient air, and residential water well sampling investigations were conducted in 2007 and 2008.

Discussion

Introduction to Chemical Exposure

To determine whether persons have been or are likely to be exposed to chemicals, TDH EEP evaluates mechanisms that could lead to human exposure. An exposure pathway contains five parts:

- a source of contamination
- contaminant transport through an environmental medium
- a point of exposure
- a route of human exposure, and
- a receptor population.

An exposure pathway is considered complete if there is evidence that all five of these elements are, have been, or will be present at the site. A pathway is considered potential if there is a lower probability of exposure. If there is no evidence that at least one of the five elements listed is, has been, or will be present at the site, then it is considered an incomplete exposure pathway. For this site, there is a completed exposure pathway for the inhalation of air contaminated with volatile organic compounds (VOCs).

Physical contact alone with a potentially harmful chemical in the environment by itself does not necessarily mean that a person will develop adverse health effects. A chemical's ability to affect public health is controlled by a number of factors, including:

- the amount of the chemical that a person is exposed to (dose)
- the length of time that a person is exposed to the chemical (duration)
- the number of times a person is exposed to the chemical (frequency)
- the person's age and health status, and
- the person's diet and nutritional habits.

The main purpose of this public health consultation is to examine any potential effect from inhalation of VOCs in the ambient air in the vicinity of the ELMCO facility. Also, drinking water near the facility is reviewed.

To evaluate exposure to a hazardous substance, health assessors often use health comparison values. If the chemical concentrations are below the comparison value, then health assessors can be reasonably certain that no adverse health effects will occur in people who might be exposed. If concentrations are above the comparison values for a particular chemical (ATSDR 2007a, 2008), then further evaluation of that chemical is in order.

Solvent Explanation

Acetone is a manufactured chemical that is also found naturally in the environment. Acetone occurs naturally in plants, trees, volcanic gases, forest fires, and as a product of the breakdown of body fat. It evaporates easily, is flammable, and dissolves in water. Acetone is used to make plastic, fibers, drugs, and other chemicals. It is also used to dissolve other substances. It is a colorless liquid with a distinct smell and taste. It is present in vehicle exhaust, tobacco smoke, and landfill sites. Industrial processes contribute more acetone to the environment than natural processes (ATSDR 1994).

Toluene is a clear, colorless liquid with a distinctive smell. Toluene occurs naturally in crude oil and in the tolu tree. It is also produced in the process of making gasoline and other fuels from crude oil and making coke from coal. Toluene is used in making paints, paint thinners, fingernail polish, lacquers, adhesives, and rubber and in some printing and leather tanning processes (ATSDR 2000).

Site Environmental Sampling

Various environmental investigations have been conducted at and near the ELMCO facility. Among these investigations are ambient air sampling events that were conducted in the vicinity of the ELMCO facility. A focused indoor air sampling investigation was also conducted. A water well survey was also conducted early in the investigation of the Site to understand water use in the area. The investigations were conducted by ELMCO's consultant with oversight by TDEC. Each event is described below.

Initial Air Sampling

In January 2007, the City of Franklin contracted with Data Analysis Technologies, Inc. for air samples to be taken at Liberty Creek, Pinkerton Park (a municipal park located downstream along the Harpeth River), and at BGA Lower School. These results are summarized in Table 1 below. All units are reported in parts per million (ppm) in this consultation.

The sampling at Liberty Creek, Pinkerton Park, and BGA Lower School was conducted by City of Franklin personnel using SUMMA canisters. This early sampling event on January 19, 2007 did not include acetone as a chemical measured in air samples collected at Liberty Creek and Pinkerton Park. The only chemical identified in the air sample at Liberty Creek and Pinkerton Park was methylene chloride. The BGA school sample was collected after those collected at Liberty Creek and Pinkerton Park. The BGA school sample contained acetone, methylene chloride, and toluene. A duplicate sample was also collected at the school.

Table 1: Analytical results of air sampling of Liberty Creek and Pinkerton Park (January 19, 2007) and Battle Ground Academy Lower School (February 8, 2007) near Egyptian Lacquer Manufacturing Company, Franklin, Williamson County, TN. Units in parts per million (ppm). (City of Franklin 2007)

Compound	Liberty Creek	Pinkerton Park	BGA School	ATSDR EMEG	
				Acute	Chronic
Acetone	NR	NR	0.0043 (NR)	26	13
Methylene chloride	0.0044	0.002	0.0063 (0.0064)	0.6	0.3
Toluene	<0.0004	<0.0004	0.052 (0.053)	1	0.08

NR = Not reported
 ATSDR = Agency for Toxic Substance and Disease Registry
 EMEG = environmental media evaluation guide comparison value for acute (0 to 14 days) and chronic (greater than 365 days) exposure
 (0.053) = duplicate result

ATSDR has derived health guidance values, called Environmental Media Evaluation Guides (EMEGs) for soil, air, and water. EMEGs serve as screening guidance to help scientists look more closely at the people who might be exposed to harmful levels of chemicals. If concentrations are below the chronic EMEG for a particular chemical, scientists can be reasonably certain that no adverse health effects will occur in people who are exposed. Concentrations of chemicals detected at the creek, park, and at the school were well below both their respective acute and chronic EMEGs.

BGA Lower School contracted with EnSafe Inc. (EnSafe) on January 19, 2007, to measure volatile organic solvents at the surface of Liberty Creek and in a first grade and a third grade classrooms. These results are summarized in Table 2. All units are reported as ppm.

Table 2: Analytical results of air sampling at the surface of Liberty Creek (December 18, 2006) and in the 1st and 3rd grade classrooms at Battle Ground Academy Lower School (January 19, 2007), Franklin, Williamson County, TN. Units in parts per million (ppm). (EnSafe 2007).

Compound	Air at Liberty Creek surface	BGA 1st grade classroom	BGA 3rd grade classroom	ATSDR EMEG	
				Acute	Chronic
Acetone	0.372	0.018	0.016	26	13
Toluene	4.206	0.0056	0.0058	1	0.08

NR = Not reported
 ATSDR = Agency for Toxic Substance and Disease Registry
 EMEG = environmental media evaluation guide comparison value for acute (0 to 14 days) and chronic (greater than 365 days) exposure

The results of this sampling event indicated there were VOCs off-gassing at the surface of Liberty Creek. Higher concentrations of acetone and toluene were identified in the creek sample, as one would expect if these chemicals are seeping into the creek.

At the school, about 100 feet from the creek, the amount of VOCs was less. Sampling results from both the first and third grade classrooms show concentrations of both acetone and toluene well below their respective acute and chronic EMEGs.

These initial air data results indicated the chemical concentrations to be highest close to the source of the seeps at the creek surface and not farther away near the school. After the sampling results became available and were reviewed by the TDH, school officials and parents were reassured that their children were not receiving exposures within the school building to acetone or toluene that would result in any adverse health effects.

Site Safety and Health Plans

To avoid exposure to site workers trying to contain the chemicals near the creek, the contractor for ELMCO, TriAD Environmental Consultants, implemented site safety and health practices and plans for their on-site workers. During March through August 2007, TriAD walked a path along the creek taking instantaneous organic vapor monitor (OVM) readings with a Mini-RAE 2000 held 3 to 5 feet from the ground surface. Seep monitoring locations were monitored at the top of the stream bank. Air monitoring was completed while site work was in progress. The path of the monitoring locations was an oval, going from the former location of the Ops Construction Services (OCS) trailer, along the bank nearest BGA Lower School, crossing the creek at the upper corner of the school, continuing along the creek bank nearest Daniels Drive, and then crossing the creek again near the Harpeth River back to the OCS trailer (Figure 1).

The OVM was calibrated to isobutylene. To normalize readings to toluene, the OVM readings were multiplied by 0.5, as instructed by the manufacturer. The readings represent maximum instantaneous concentrations. Because of the instantaneous nature of the monitoring, results could not be compared with ATSDR minimal risk levels (MRLs) or EMEGs. Log notes maintained by ELMCO's consultant indicated that sustained (stable for greater than five minutes) breathing zone concentrations never approached the Emergency Response Planning Guideline, ERPG-1 concentration of 50 parts per million (AIHA 2008). This concentration is defined as the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.

Residential Basement Air Sampling

Basement and crawlspace air monitoring was conducted by EnSafe during the emergency response activities conducted when the ELMCO Site first became known. The air monitoring was conducted by instantaneous measurement using an OVM that was calibrated to isobutylene. Some homes along Daniels Drive have basements while the remaining homes on the cul-de-sac have crawl spaces. Subsequently, TriAD hired EnSafe to perform time-integrated air sampling of three specific residences on Daniels Drive in April 2007. The chemicals traveling underground from ELMCO to Liberty Creek were thought to migrate beneath these homes. Thus, these homes represented a worst-case scenario for indoor air measurement. The sampling was performed to evaluate if vapor intrusion into the residences would be a concern. Time-integrated (approximately 24 hour) air samples were collected from basements of two residences and the crawlspace of another residence. Results of this air sampling are shown in Table 3.

Table 3: Analytical results of air sampling in a home crawl space and two home basements located on Daniels Drive on April 12, 2007, Franklin, Williamson County, TN. Units in parts per million (ppm). Monitoring conducted by EnSafe using 3M 3500 time-integrated monitors (EnSafe 2007).

Compound	Residence 1 (Crawl Space)	Residence 2 (Basement)	Residence 3 (Basement)	ATSDR EMEG	
				Acute	Chronic
Acetone	0.027	<0.024	0.024	26	13
Isopropyl alcohol	<0.022	<0.022	<0.021	--	--
Toluene	<0.012	<0.012	0.019	1	0.08

ATSDR = Agency for Toxic Substance and Disease Registry
 EMEG = environmental media evaluation guide comparison value for acute (0 to 14 days) and chronic (greater than 365 days) exposure
 (--) Acute and chronic EMEG not established for this chemical

Results indicated only low concentrations of acetone and toluene detected in the crawlspace sample and one of the basement air samples. Because isopropyl alcohol was not detected it was ruled out as a chemical of concern at the site. The concentrations of acetone and toluene detected were well below both their respective acute and chronic EMEGs.

Continued Ambient Air Sampling

Earlier OVM readings taken by TriAD along Liberty Creek were not interpretable from a public health perspective. These early readings indicated that some instantaneous readings were high for isobutylene, while most were non-detectable. These readings, combined with the indoor sampling at BGA Lower School, did not raise concerns about air concentrations of toluene further from the banks of Liberty Creek. However, this kind of sampling could not be interpreted for the public. A plan for ambient air sampling that was able to be interpreted for public health implications was approved by TDEC. An initial air sampling was conducted in July, August, and December 2007. Based on these results, a more comprehensive and longer-term air sampling program began and was conducted from late-April to late-December 2008.

EnSafe, under contract with ELMCO, took 24-hour time-integrated air samples at four locations (TI-1, TI-2, TI-3, and TI-4 as shown on Figure 1) during July 16-17, August 1-2, and December 12-13, 2007. Sampling locations TI-1 and -2 were closest to the BGA school. TI-3 and -4 locations were closest to the residences near ELMCO. EnSafe used 3M 3500 organic vapor diffusion monitors to collect the samples. Galson Laboratories in Syracuse, New York, analyzed the samples for acetone, isopropyl alcohol, and toluene using gas chromatography / flame ionization detector methodology. Acetone and isopropyl alcohol were not detected in these samples.

In accordance with a revised sampling plan approved by TDEC, EnSafe began to take air samples as described above, with the addition of one new sampling point (TI-2A) and the relocation of one sampling point (TI-5). This continued ambient air sampling was conducted over eight months, from late April 2008 to late December 2008 (Table 4). Acetone, benzene, and toluene were monitored using 3M 3500 organic vapor diffusion monitors. The monitors

were left on-site for 1 week at a time resulting in an air concentration value for every 7 days over the sampling period. Galson Laboratories again analyzed the monitors, using the methods described above. The air monitoring locations were located downwind to obtain worst-case ambient air concentrations to evaluate if nearby residents and BGA Lower School students or staff might be exposed.

Acetone was one of the chemicals sampled because it was used in the manufacturing processes at ELMCO. Acetone had very few air detections (5 out of 30). Acetone concentrations in air samples where it was detected were at extremely low levels, well below any levels of health concern through the inhalation pathway.

Sampling for benzene was initiated because benzene was identified in low concentrations in on-site and off-site groundwater samples. Benzene was also found in trace amounts, as a contaminant, in the solvents utilized historically at ELMCO. Benzene was not detected in any of the ambient air samples collected in 2008 (EnSafe 2009).

Toluene was the chemical found most often in the continued ambient air sampling. Toluene measurements from July 16, 2007 to December 29, 2008 are summarized in Table 4.

These sampling results are well below the ATSDR chronic EMEG of 0.08 ppm for toluene, except for eleven samples taken over seven days. On August 1 – 2, 2007, the concentrations of toluene found at locations TI-1, TI-2, and TI-4 were above its chronic EMEG. At location TI-3 the concentration of toluene was higher than its acute EMEG of 1 ppm. In samples taken on April 21 – 28, May 12 – 19, June 30 – July 7, and July 7 – 14, 2008, the levels of toluene were slightly higher than the chronic EMEG at location TI-2A. For the samples taken October 7 – 14, 2008, the levels of toluene were also slightly higher than the chronic EMEG at locations TI-1 and TI-2A.

Chronic EMEGs are calculated for exposures lasting more than a year, while acute EMEGs are calculated for exposures up to 14 days. Measurements greater than the chronic EMEG on these seven days were not representative of concentrations found in more than eight months of continuous sampling. The one sample with concentrations greater than the acute EMEG (1.8 ppm versus 1 ppm) represented the conditions during just one day. That sample location is near the creek, but approximately 260 feet away from the school and approximately 100 feet from homes along Daniels Drive.

Table 4: Ambient air monitoring results for toluene, July 16, 2007 – December 29, 2008. Monitoring conducted by EnSafe Inc. for Egyptian Lacquer Manufacturing Corporation, Franklin, Williamson County, TN. All units in parts per million (ppm) (EnSafe 2007 and 2009). ATSDR acute EMEG for toluene = 1 ppm. ATSDR chronic EMEG for toluene = 0.08 ppm.

Dates / Sampling Station Identification	TI-1	TI-2	TI-2A	TI-3	TI-4	TI-5
7/16 - 7/17/2007	0.087	0.042	NS	0.074	0.038	NS
8/1 - 8/2/2007	0.14	0.23	NS	1.8	0.53	NS
12/12 - 12/13/2007	<0.03	<0.03	NS	<0.03	<0.03	NS
4/21 - 4/28/2008	0.067	NS	0.11	0.010	0.005	0.004
4/28 - 5/5/2008	0.035	NS	0.068	0.013	0.006	<0.004
5/5 - 5/12/2008	0.034	NS	0.072	0.016	0.008	0.004
5/12 - 5/19/2008	0.036	NS	0.085	0.014	0.007	<0.004
6/23 - 6/30/2008	0.0086	NS	0.053	0.01	0.005	<0.004
6/30 - 7/7/2008	0.023	NS	0.096	0.016	0.007	0.006
7/7 - 7/14/2008	0.018	NS	0.065	0.013	0.008	0.006
7/14 - 7/28/2008	0.017	NS	0.088	0.0062	0.004	0.0064
7/28 - 8/4/2008	0.009	NS	0.064	0.006	<0.004	<0.004
8/4 - 8/11/2008	0.006	NS	0.028	0.007	<0.004	<0.004
8/11 - 8/8/2008	0.008	NS	0.011	0.005	<0.004	<0.004
8/18 - 8/26/2008	0.017	NS	0.0085	0.0099	0.005	<0.004
8/26 - 9/2/2008	0.04	NS	0.067	0.0095	0.006	0.006
9/2 - 9/9/2008	0.021	NS	0.062	0.005	<0.004	<0.004
9/9 - 9/16/2008	0.011	NS	0.058	<0.004	<0.004	<0.004
9/16 - 9/23/2008	0.006	NS	0.018	<0.004	<0.004	<0.004
9/23 - 9/30/2008	0.011	NS	0.0085	0.004	<0.004	<0.004
9/30 - 10/7/2008	0.008	NS	0.006	<0.004	<0.004	<0.004
10/7 - 10/14/2008	0.092	NS	0.10	0.013	0.008	0.01
10/14 - 10/21/2008	0.017	NS	0.049	0.0095	0.005	<0.004
10/21 - 10/28/2008	0.049	NS	0.062	0.017	0.007	0.006
10/28 - 11/4/2008	0.046	NS	0.067	0.019	0.008	0.005
11/4 - 11/11/2008	0.014	NS	0.038	0.007	<0.004	0.005
11/11 - 11/19/2008	0.020	NS	0.056	0.014	0.005	0.007
11/19 - 11/25/2008	0.009	NS	0.026	0.007	<0.005	<0.005
11/25 - 12/2/2008	0.015	NS	0.041	0.097	0.005	0.005
12/2 - 12/9/2008	0.018	NS	0.034	0.017	0.005	<0.004

Table 4: Ambient air monitoring results for toluene, July 16, 2007 – December 29, 2008. Monitoring conducted by EnSafe Inc. for Egyptian Lacquer Manufacturing Corporation, Franklin, Williamson County, TN. All units in parts per million (ppm) (EnSafe 2007 and 2009). ATSDR acute EMEG for toluene = 1 ppm. ATSDR chronic EMEG for toluene = 0.08 ppm.

Dates / Sampling Station Identification	TI-1	TI-2	TI-2A	TI-3	TI-4	TI-5
12/9 – 12/16/2008	0.007	NS	0.012	0.004	<0.004	<0.004
12/16 – 12/22/2008	0.008	NS	0.011	0.007	<0.005	<0.005
12/22 -12/29/2008	0.006	NS	0.014	<0.004	<0.004	<0.004

Bold = value greater than the chronic ATSDR EMEG of 0.08 ppm (>365 days exposure)
Bold and italics = value greater than the acute ATSDR EMEG of 1 ppm (up to 14 days exposure)
 NS = not sampled
 <0.004 = less than the listed detection limit for the analysis.

Non-Cancer Evaluation

Environmental Media Evaluation Guides

The Agency for Toxic Substances and Disease Registry (ATSDR), an agency of the U.S. Department of Health and Human Services (HHS), is charged by Congress with providing support in the assessment of any health hazard posed by Superfund or other hazardous waste sites. For non-carcinogenic effects of toxic chemicals, ATSDR derives a minimal risk level (MRL) for each chemical using the environmental literature as the basis for their predictions of a level of that chemical that is without appreciable risk.

MRLs are derived from ‘no observed adverse effect levels’ (NOAELs) or from less serious ‘lowest observed adverse effect levels’ (LOAELs). NOAELs are the highest tested dose of a chemical that has been reported to have no harmful health effects on people or animals. A LOAEL is the lowest test dose of a chemical that has been reported to cause harmful health effects in people or animals.

From these MRLs, ATSDR has derived health guidance values, often called Environmental Media Evaluation Guides (EMEGs) for soil, air, and water. EMEGs serve as screening guidance to help scientists look more closely at the people who might be exposed to harmful levels of chemicals. To use these screening levels we must know how much of a chemical someone is exposed to, for how long that exposure has been or will be occurring, how frequent the exposure is or will be, and age of the exposed person. If concentrations are below the chronic EMEG for a particular chemical, scientists can be reasonably certain that no adverse health effects will occur in people who are exposed.

Comparisons of Data to EMEGs

Levels of toluene, acetone, and benzene in measured ambient air during the continuous ambient air sampling near the site from July 16, 2007 to December 29, 2008 were compared to ATSDR’s acute and chronic EMEGs to screen for the potential for adverse health effects. Acetone was always found at levels well below the chronic EMEG of 13 ppm. Most acetone samples were

below the detection limit. Therefore, acetone was ruled out as a chemical of concern for non-cancer health effects.

Benzene was identified once in an extremely low level inside a classroom sampled on January 19, 2007. The concentration was well below its chronic EMEG of 0.003 ppm. Benzene was not detected in the continued ambient air sampling that lasted from July 16, 2007 until December 29, 2008. Therefore, benzene is also not a chemical of concern for non-cancer health effects.

Most of the toluene concentrations found during the continued ambient air sampling were well below the chronic (365 days or more) inhalation exposure EMEG for toluene of 0.08 ppm. However, 11 detections of toluene were identified above its chronic EMEG. One of these detections was above the acute EMEG for toluene of 1 ppm. Some of these detections may have been associated with site cleanup activities. A groundwater and product recovery trench was closed upgradient from Liberty Creek during the August through September 2008 time period (TDEC 2008). Now that the trench is closed and underground piping installed, chemical vapors associated with work activities at the trench have been eliminated.

If the toluene detections are averaged over the duration of the testing, levels would be below both the acute and chronic EMEGs. That said, for a prudent public health evaluation of the risk associated with a person breathing air with these levels of toluene, the concentrations of toluene detected will be further evaluated below.

Cancer Evaluation

If a chemical is a probable or known human carcinogen, EPA derives a cancer risk value for that chemical. EPA uses data from animal studies (and human epidemiology studies, if they are available) to extrapolate from high doses with known carcinogenic end points to very low doses using complex models. For cancer effects, ATSDR uses US Environmental Protection Agency (EPA) information to set their cancer risk evaluation guidelines (CREGs) for lifetime exposure.

Because no long term testing has been done, it is unknown whether acetone would cause cancer after breathing it for very long periods. The Department of Health and Human Services (DHHS) and the International Agency for Research on Cancer (IARC) have not classified acetone for carcinogenic effects. The EPA has determined that acetone is not classifiable as to its human carcinogenicity (ATSDR 1994). Therefore, no cancer risk values have been established for acetone.

Benzene is a known human carcinogen. The detection limit for the analysis was 0.002 parts per million or 2 parts per billion (ppb). The ATSDR CREG comparison value for benzene is 0.04 ppb. This concentration is established for 1 additional cancer in 1,000,000 people, which is the lower end of the acceptable risk range of between 1 excess cancer in 10,000 (10^{-4}) to 1 excess cancer in 1,000,000 (10^{-6}). These cancer risk concentrations have been developed for chronic, lifelong exposure. Therefore, concentrations of benzene between 0.04 ppb and 4 ppb are acceptable. The detection limit of 2 ppb used for benzene in the air monitoring testing is within this range.

Studies in workers and animals exposed to toluene generally indicate that toluene does not cause cancer. The IARC and the DHHS have not classified toluene for carcinogenic effects. The EPA

has determined that toluene is not classifiable as to its human carcinogenicity. Because of the fact the studies mentioned above indicate toluene does not cause cancer, no cancer risk values have been established for toluene.

Toluene Metabolism

Animal studies have shown that toluene is absorbed less rapidly by the oral route (Ameno et al. 1992; Pyykko 1983b), while toluene is absorbed slowly through human skin (Dutkiewicz and Tyras 1968). Therefore, inhalation of toluene is considered the main route of exposure in the Liberty Creek area.

The mechanism by which acute exposure to toluene brings about neurological effects, such as central nervous system depression and narcosis, is generally thought to involve, at least in part, reversible interactions between toluene (the parent compound and not its metabolites) and components (lipids or proteins) of nervous system membranes.

Toluene Toxicity

The chronic inhalation MRL for toluene is based on a lowest observed adverse effect level (LOAEL) of 35 ppm toluene for color vision impairment in a group of toluene-exposed shoemakers studied by Zavalic et al. (1998a)¹ and an uncertainty factor of 100 (10 for the use of a LOAEL and 10 to account for human variability). The study examined color vision abilities in three groups of workers: (1) 46 shoemakers exposed for an average of 16 years to a median toluene concentration of 32 ppm; (2) 37 rotogravure printing workers exposed for an average of 18 years to a median toluene concentration of 132 ppm; and (3) 90 control workers without any known exposure to solvents or neurotoxic agents. Average scores in a color confusion index (based on results of color vision tests and adjusted for age and alcohol intake) were significantly increased in the toluene exposed shoemakers and printers compared with scores for control workers.

The chronic LOAEL of 35 ppm is supported by observations of other subtle neurological effects in other groups of exposed workers including altered visual-evoked brainstem potentials in printing press workers exposed to 50 ppm for 30 years (Vrca et al. 1995, 1996, 1997a, 1997b); altered auditory-evoked brainstem potentials in printers exposed to 97 ppm for 12–14 years (Abbate et al. 1993); hearing loss in printers exposed to 0.04–245 ppm toluene (Morata et al. 1997); changes in electro-cardiographic R-R intervals in printers exposed to 83 ppm for 1–36 years (Murata et al. 1993), performance deficits in neurobehavioral tests in electronics workers exposed to 88–90 ppm (Boey et al. 1997, Foo et al. 1990); and increased incidence of self-reported neurasthenic symptoms in printers exposed to an average concentration of about 140 ppm over a 29-year period (Orbaek and Nise 1989).

Most of the data on health effects in humans exposed to toluene come from occupational studies or medical reports of solvent abusers. In both situations, concurrent exposure to other chemicals can limit the usefulness of the data for development of guidelines or standards. In addition, there are other confounding variables, especially in the occupational setting, such as alcohol consumption patterns, employment history, diet, use of medications, noise, and fluctuations in

¹ All references cited were taken from the text of the ATSDR Toxicological Profile for Toluene (ATSDR 2000). Original citations are listed to aid the reader in interpreting the discussion of toluene's toxicity.

atmospheric toluene levels during different portions of the day, all of which complicate evaluation of dose-response patterns. These limitations were considered in selecting the studies for derivation of the MRLs. The American Conference of Governmental Industrial Hygienists (ACGIH) has recommended a threshold limit value (TLV) of 50 ppm toluene based on reports of headache and irritation associated with 4–6 hours continuous inhalation of toluene (Andersen et al. 1983; Baelum et al. 1985; Echeverria et al. 1989; Wilson 1943). This value is designed to be protective for healthy adult workers exposed 8 hours/day, 5 days/week for up to 45 years. Adjusting the value for a continuous exposure lasting up to 70 years yields a value of 8 ppm ($50 \text{ ppm} \times 5 \text{ days}/7 \text{ days} \times 8 \text{ hours}/24 \text{ hours} \times 45 \text{ years}/70 \text{ years} = 8 \text{ ppm}$). This figure is somewhat higher than the current chronic-duration MRL, but does not include an uncertainty factor to protect susceptible populations. Use of an uncertainty factor of 100 (10 for human variability and 10 for use of a LOAEL) would arrive at a value to 0.08 ppm, which is identical to the current MRL derived by ATSDR.

Residential Drinking Water

As part of initial environmental investigations conducted at the ELMCO facility, ELMCO with oversight by TDEC, conducted a water well use survey within 1 mile of the Site (Ashley A. Holt, TDEC, personal communication). There was initial concern that groundwater at and near the site was heavily impacted and that residences nearby had wells that were used as the source of water for individual households.

Personnel from TriAD, ELMCO's environmental consultant, went door to door to residences and businesses within this mile radius to find out if the homes and businesses had a drinking water well. The use of any identified water well was noted during the survey, as was any information on how deep the well was, and when it was placed in service. All residents and businesses surveyed, except one, reported that they were supplied by municipal water from the City of Franklin, Tennessee. The City provides municipal water to homes near the ELMCO facility. All homes along Daniels drive are provided and use municipal water. Therefore, there are no impacts to drinking water supplies for residents of Daniels Drive. The one residential groundwater well identified is located within one-half mile of the Site and was previously used by an elderly resident. The resident recently has since relocated. There is no one currently living at the residence or using the water from this well. This residential well was sampled twice by ELMCO and results showed that all compounds analyzed were non-detect. The depth of the well is unknown. Residential drinking water wells are typically installed to greater depths to ensure a consistent supply of water for household purposes. Contamination at the ELMCO site has only been identified in shallow groundwater (Ashley A. Holt, TDEC, personal communication).

Children's Health Considerations

Children could be at greater risk than adults from certain kinds of exposure to hazardous substances (ATSDR 1997, 1998). Children have lower body weights than adults. Although children's lungs are usually smaller than adults, children breathe a greater relative volume of air compared to adults. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification.

Thus, adults need as much information as possible to make informed decisions regarding their children's health.

In preparation of this health document, the health of children was thoughtfully considered. Available information regarding age-related differences in toluene metabolism suggests that developing fetuses and children at very early stages of development may be more susceptible to toluene toxicity than adults, and that children past early neonatal periods may have the same capability as adults to dispose of toluene at low exposure levels (ATSDR 2000).

One of cytochrome P450 enzymes, Cyp2E1, the principal isozyme involved in the major toluene metabolic pathway (Nakajima et al. 1997; Tassaneeyakul et al. 1996), is expressed several hours after birth in humans and continues to increase during the first year of life (Vieira et al. 1996). Phase II enzymes involved in toluene metabolism (N-acetyl transferases, UDP-glucuronyl transferases, and sulfotransferases) also show changes during human neonatal development with adult activities present by 1-3 years of age (Leeder and Kearns 1997). These phase II enzymes form metabolites that can be easily excreted.

As stated previously EMEGs are protective of children. Concentrations below the chronic EMEG for a particular chemical allow scientists to be reasonably certain that no adverse health effects will occur in those who are exposed. Overall, based on the data collected, toluene concentrations have not been measured consistently above the chronic EMEG levels in outdoor air near the ELMCO site. Furthermore, toluene is not thought to be carcinogenic.

The BGA Lower School, as a precautionary measure, has worked with ELMCO and installed equipment to monitor solvent vapor levels inside the BGA Lower School and on the Lower School Playground. The continuous air monitoring system will sound an alarm if levels present a human health concern (TDEC 2008).

All residences along Daniels Drive are provided municipal water. Therefore, homes along Daniels Drive will not have concentrations of site-related chemicals. The residential well supplying the home within one-half mile of the ELMCO site does not have facility-related chemicals in the water samples collected from it. Therefore, there are no concerns that Site-related chemicals will harm any children that may be visiting the homeowner.

Future Considerations

Additional investigatory and remediation activities are expected to continue at the ELMCO site and vicinity into the future. It is likely that chemicals will continue to be identified entering Liberty Creek. Remediation activities approved by TDEC for the ELMCO site should continue to be monitored such that they protect the health of site workers as well as the general public residing and attending school near the site. The recovery trench has been closed by filling it and converting groundwater and product collection into an underground piped recovery system. Future ambient air levels are expected to decrease with remediation activities being conducted at the site.

Drinking water from the private residential drinking water well located within one-half mile of the ELMCO site is not expected to harm the health of adults or children. Results of water samples collected from this well on two separate occasions indicated there were no Site-related compounds detected above laboratory detection limits. It would be prudent to continue to

monitor the water well that this household uses as its source of water. If water quality changes in the well consideration should be given to provide the homeowner an alternate water source, if there is anyone living in the home. It would be also prudent not to add any new household water wells within the extent of known and possible groundwater contamination from the ELMCO site.

Conclusions

EEP reached one important conclusion in this health consultation:

EEP concludes that toluene in ambient air in the vicinity of Daniels Drive or at the BGA Lower School is not expected to harm the health of adults or children. This is because ambient air monitoring conducted by ELMCO in the vicinity of Liberty Creek showed limited data points exceeding the acute and chronic environmental media evaluation guides. Given the worst case scenario, the conservatively estimated theoretical risk for adults and children exposed to toluene in the air is in the acceptable range.

Recommendations

The major focus of this health consultation is to make sure the ambient air health breathed by children and adults who live and go to school in the vicinity of the ELMCO facility is healthy. With that in mind, the following recommendations are believed to be appropriate based on EEP's review of the sampling data.

- It is recommended that the TDEC, the TDH, and other appropriate parties continue to work collaboratively to see that the public health continues to be protected during cleanup of the site.
- The TDH's EEP will be available to review additional environmental data collected, as requested.
- ELMCO should continue to continuously monitor solvent vapor levels inside the BGA Lower School and on the Lower School Playground. Students and their parents, and the staff of the elementary school should be warned if concentrations become too high. Vapor monitoring instruments at the school should be calibrated and maintained by qualified personnel.
- Site workers should continue to monitor ambient air in their work areas.
- The general public should be warned of the poor water quality in the vicinity of the chemical seeps in Liberty Creek through the posting of signs, at a minimum.

Public Health Action Plan

The public health action plan for the ELMCO site contains a list of actions that have been or will be taken by EEP and other agencies. The purpose of the public health action plan is to ensure that this health consultation identifies public health hazards and offers a plan of action designed to mitigate and prevent harmful health effects that result from breathing, eating, drinking, or touching hazardous substances in the environment. Included is a commitment on the part of EEP to follow up on this plan to ensure that it is implemented.

Public health actions that have been taken by TDH's EEP include:

- Review of ambient air data collected by ELMCO with oversight from TDEC.
- Participation in a public meeting with stakeholders in Franklin, Tennessee held on March 22, 2007.
- Preparation of a technical fact sheet and information used to make health decisions for handout at the public meeting held on March 22, 2007.
- Preparing/publishing this health consultation

Public health actions that will be taken include:

- TDH EEP will provide copies of this health consultation to state, federal, and local government, academia, environmental groups, community groups, and others interested in the ELMCO site.
- TDH EEP will maintain dialogue with ATSDR, TDEC, EPA, and other interested stakeholders to safeguard public health and to prevent people from future exposure to chemicals related to the ELMCO site.
- TDH EEP will be available to review any newly collected or additional environmental data, as requested by TDEC. TDH EEP will provide TDEC with interpretation of the data, as requested.

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Figure 1: Initial Air Sampling Locations near BGA Lower School, Daniels Drive, Liberty Creek, and ELMCO, Franklin, Williamson County, Tennessee. (Figure credit: EnSafe 2009)



Certification

This Public Health Consultation: *Ambient Air Investigations, Egyptian Lacquer Manufacturing Company, Inc., Franklin, Williamson County, Tennessee*, was prepared by the Tennessee Department of Health Environmental Epidemiology under a Cooperative Agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It was prepared in accordance with the approved methodology and procedures that existed at the time the health consultation was begun. Editorial review was completed by the Cooperative Agreement Partner.



Technical Project Officer, CAT, CAPEB, DHAC, ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health assessment and concurs with the findings.



Team Leader, CAT, CAPEB, DHAC, ATSDR