Health Consultation

Review of
Indoor Air Sampling Inside One Home Downgradient of the Hamilton Standard Facility
Hartford County
Windsor Locks, Connecticut

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Prepared by
Connecticut Department of Public Health
Under Cooperative Agreement
With
The Agency For Toxic Substances and Disease Registry

The conclusions and recommendations in this health consultation are based on the data and information made available to the Connecticut Department of Public Health and the Agency for Toxic Substances and Disease Registry. The Connecticut Department of Public Health and the Agency for Toxic Substances and Disease Registry will incorporate additional information if it becomes available. The incorporation of additional data could change the conclusions and recommendations listed in this document.

BACKGROUND AND STATEMENT OF ISSUES

On April 5, 1996, the U.S. Environmental Protection Agency (EPA) requested that [1] the Agency for Toxic Substances and Disease Registry (ATSDR) examine the report entitled: "Indoor Air Sampling Report for Volatile Organic Compounds [1st Quarter (Annual) 1996 Sampling]" [2], and determine if contamination measured in the basement indoor air of one residence poses a public health hazard.

The report describes indoor air sampling of one residence on Rainbow Road in Windsor, Connecticut that is downgradient of a groundwater plume containing volatile organic compounds (VOCs). The likely source of the groundwater contamination is from the Hamilton Standard facility.

The Hamilton Standard facility comprises nearly 300 acres in northern Windsor Locks, Connecticut. Hamilton Standard has been in operation since the early 1950s [3]. This employer of approximately 8,000 people is engaged in the development, production, and sale of aerospace machinery. On May 21, 1980, the Windsor Health Department received complaints from residents living along Rainbow Road, south of the facility [3]. These complaints were specific to well water quality, and included complaints about taste and odor. During the next two months, water samples were collected from residents' wells along Rainbow Road. There are approximately twenty-one homes in the area identified as having a private well [3]. VOCs were detected in fourteen of these wells. A nearby fire hydrant was then used as an immediate alternate source of drinking water. In September of 1980, a public water line was extended to the affected residents [3]. In 1991, a plume of VOC-containing groundwater was detected in the Rainbow Road area.

Dissolved VOCs in groundwater can evaporate into the soil and air above the groundwater. When this process occurs near the foundation of a home or other building, the VOCs may penetrate the foundation and enter the building. During the winter when the furnace is in operation more VOCs can accumulate because of the negative pressure created in the home.

Indoor air sampling was conducted in 1991 and 1992, from the basements of eighteen homes along Rainbow Road. VOCs were detected in the indoor air of many homes. As a result of the indoor air contamination, basement sealing was voluntarily performed by Hamilton Standard in 1993 in five homes along Rainbow Road. During August of 1994, the indoor air of twenty-one homes was sampled for VOCs. During February and March of 1995, four homes along Rainbow Road had active sub-slab ventilation devices installed. One residence, (referred to as A-RRB03), required additional modifications in September of 1995, and January of 1996, in an effort to reduce the levels of VOCs in the basement [2]. This residence is the subject of this report.

DISCUSSION

INDOOR AIR SAMPLING OF A-RRB03

Indoor air sampling for VOCs was first conducted in February of 1991, in the basement of A-RRB03. Air sampling was then conducted in 1994 (January, June, August, September, and October), in 1995 (January, April, May, July, October, and November), and in 1996 (January and February).

After the 1991 sampling, basement sealing remedial activities were conducted in the fall of 1993. During the spring of 1995, additional remedial activities were completed, including the installation of an active soil gas ventilation system. In February of 1996, a higher flow rate fan was installed in the sub-slab ventilation system.

The sampling results are listed in Table 1. This table lists the chemical names, maximum concentrations, and relevant health comparison values[1]. Contaminants detected above the health comparison value are listed. Some contaminants have an ND (none detected) in the concentration column. This is an indication of a contaminant detected at least once above the health comparison value, but no subsequent detections were recorded. An N/A listed in the concentration column indicates that the contaminant was not included in the 1991 analysis, but was included starting in 1994. The results presented in this table are divided into four groups. The group divisions are defined below:

1) 1991: initial indoor air sampling in the basement;
2) fall of 1993: after basement sealing;
3) spring of 1995: after installation of the active soil gas ventilation system;
4) February of 1996: after installation of the higher flow rate fan within the sub-slab ventilation system.

Sampling of contaminants in the basement indoor air of A-RRB03 may not reflect representative residential exposures. The selection of the basement as the sampling location to detect contaminant infiltration from the foundation is a valid approach. Since all indoor air sampling was collected from the basement, however, actual residential exposures may be lower if the main living areas do not include the basement.

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[1] Comparison values are not actual standards or used as indicators of levels beyond which adverse health effects will occur. Rather, they are used as screening values, exceedences of which indicate additional investigations of that compound are warranted.

Table 1
Maximum Indoor Air Concentration of Contaminants Sampled from 1991 through 1996
Above Health Comparison Screening Values in the Basement of the Residence
Referred to as A-RRB03 Located on Rainbow Road, Windsor Locks, Connecticut.

Chemical	Date	Maximum Concentration		Comparison Value	
		ppb	ug/m³	ug/m³	Source
Initial sampling (1991)					
Benzene	2/1/91	NA	NA	0.1	CREG
Carbon tetrachloride	2/1/91	24	150.98	0.07	CREG
Methylene chloride	2/1/91	NA	NA	3	CREG
Tetrachloroethylene	2/1/91	20	135.64	2	CREG
Trichloroethylene	2/1/91	160	859.75	0.6	CREG
Sampling After Basement Sealing (Fall of 1993)					
Benzene	1/1/95	3.6	11.50	0.1	CREG
Carbon tetrachloride	1/1/95	5.3	33.34	0.07	CREG
Methylene chloride	9/1/94	5.7	19.80	3	CREG
Tetrachloroethylene	10/1/94	5.1	34.59	2	CREG
Trichloroethylene	10/1/94	31	166.58	0.6	CREG
Sampling After Installation of the Active Soil Gas Ventilation System (Spring of 1995)					
Benzene	11/1/95	ND	ND	0.1	CREG
Carbon tetrachloride	11/1/95	3.8	23.91	0.07	CREG
Methylene chloride	7/1/95	2.9	10.07	3	CREG
Tetrachloroethylene	11/1/95	5.3	35.94	2	CREG
Trichloroethylene	11/1/95	14	75.23	0.6	CREG
Sampling After Installation of the Higher Flow Rate Fan Installed in Sub-Slab Ventilation System (February of 1996)					
Benzene	2/1/96	ND	ND	0.1	CREG
Carbon tetrachloride	2/1/96	ND	ND	0.07	CREG
Methylene chloride	2/1/96	ND	ND	3	CREG
Tetrachloroethylene	2/1/96	ND	ND	2	CREG
Trichloroethylene	2/1/96	2	10.75	0.6	CREG

CREG Cancer Risk Evaluation Guide
NA Not analyzed. This compound was not analyzed for in this sample.
ND None detected. This compound was not detected in the sample.
ppb parts per billion
ug/m³ Microgram per cubic meter

To evaluate health effects, the ATSDR has developed a Minimal Risk Level (MRL) for contaminants commonly detected at hazardous waste sites. The MRL is an estimate of daily human exposure to a contaminant below which non-cancerous, adverse health effects are unlikely to occur. MRLs are developed for each route of exposure such as ingestion, inhalation, and dermal absorption and for the length of exposure, such as acute (less than 15 days), intermediate (15 to 364 days), and chronic (greater than 364 days). The measured concentrations are then compared to a minimal risk level (MRL).

Current Exposures:

The sampling of indoor air in the basement indicate that the concentrations of contaminants have decreased. The decrease appears to coincide with the remediation efforts. Current exposures include only one compound, TCE, detected at 2 ppb.

Non-cancerous Health Effects: TCE

The concentration of TCE detected in the indoor air of the basement during February of 1996, (2 ppb), was below the acute (2,000 ppb) and intermediate (100 ppb) MRLs. There is no chronic MRL. In the past, TCE was commonly used as a human anesthetic. Consequently, most of the information about TCE exposure in humans is from studies describing the effects of inhalation of TCE. Exposures to TCE at 2 ppb are not reported to be associated with adverse health effects in humans. In order to determine whether this concentration is considered background in a residential home, the CT DPH examined an US Environmental Protection Agency report investigating background residential indoor air concentrations [4]. That investigation measured the indoor air of homes for numerous VOCs. Among the VOCs examined was TCE. The average concentration of TCE measured in the indoor air of homes sampled during the months of January and February was 0.3 ppb [4]. The concentration measured in A-RRB03 (2 ppb) was about seven times higher, and probably does not represent normal indoor background levels of this contaminant. However, this level is unlikely to cause any non-cancerous health effects.

Cancer Risk Calculations: TCE

If the concentration of TCE, 2 ppb, were to remain constant for thirty more years, there would be an insignificant increased risk of developing cancer among the residents who live there.

Past Exposures:

Past exposures to VOCs in the basement indoor air were at levels almost one hundred times higher than the current levels. The CT DPH examined the historic air data. Since no sampling data is available prior to 1991, the CT DPH has assumed that the first odor complaints regarding well water quality in 1980, coincided with the groundwater plume arrival at residential foundations, and likely VOC infiltration through the foundations. The concentrations measured in 1991 were used as the best estimate for the data from 1980 through 1991. The CT DPH is unable to determine whether these estimated concentrations reflect actual past exposures.

Non-Cancerous Health Effects: Benzene

The concentration of benzene (3.6 ppb) measured in January of 1995. This was the only time benzene was detected. This value was below the acute MRL (50 ppb). Therefore, non-cancerous health effects may be characterized as unlikely for exposure occurring for a short period of time.

Non-Cancerous Health Effects: Carbon Tetrachloride
The concentration of carbon tetrachloride (24 ppb) measured in 1991, and estimated from 1980 through 1991, was below the intermediate (50 ppb) and acute (200 ppb) MRLs. There is no chronic MRL established for carbon tetrachloride. Based on the intermediate MRL, non-carcinogenic health effects resulting from exposure to carbon tetrachloride up to one year are unlikely. The CT DPH is unable to determine whether non-carcinogenic health effects will result from exposure beyond one year.

Non-Cancerous Health Effects: Methylene Chloride
The concentration of methylene chloride measured in September of 1994, at 5.7 ppb, was below the acute (400 ppb) and intermediate (30 ppb) MRLs. Therefore, non-cancerous health effects resulting from inhalation exposure to methylene chloride are unlikely. There was no indoor air sampling for this compound in 1991. If methylene chloride was present at 5.7 ppb during the period 1980 - 1991, the non-cancerous health effects would also be characterized as unlikely.

Non-Cancerous Health Effects: Tetrachloroethylene
The concentration of tetrachloroethylene as measured in 1991 (20 ppb), and estimated from 1980 through 1991, was below the chronic (40 ppb) and acute (200 ppb) MRLs. Therefore, non-cancerous health effects resulting from inhalation exposure to tetrachloroethylene during 1980 through 1995 are unlikely.

Non-Cancerous Health Effects: TCE
The concentration of TCE (160 ppb) as measured in 1991, and estimated for the period of 1980 through 1991, was above the intermediate MRL (100 ppb) [5]. Although the intermediate MRL was exceeded, a review of the scientific literature indicates that non-cancerous health effects may be characterized as minimal.

The levels of TCE have been reduced significantly as indicated by the most recent sampling results.

Cancer Risk Calculations: Benzene
Benzene was detected in January of 1995, at 3.6 ppb. Since this concentration is typical of indoor concentrations in homes, cancer risk calculations were not conducted.

Cancer Risk Calculations: Methylene Chloride
Methylene chloride was detected in two samples after the basement sealing was completed in the fall of 1993. The maximum concentration was 5.7 ppb. The cancer risk estimations based on a three month exposure to methylene chloride indicate that there is an insignificant increased risk of developing cancer. There was no indoor air sampling for this compound 1991 because methylene chloride was not considered to be a compound used by the facility. Consequently, the concentration of methylene chloride was assumed to be constant throughout the period from 1980-1991. The cancer risks associated with exposure to methylene chloride at 5.7 ppb from 1980 - 1991 is also characterized as insignificant. Data on typical indoor concentrations in homes is unavailable. However, a mean concentration of methylene chloride in suburban outdoor areas in the USA was reported as 1.9 ppb [6].

Cancer Risk Calculations: Carbon Tetrachloride, Tetrachloroethylene, and Trichloroethylene

The CT DPH conducted cancer risk estimations for these chemicals separately. These contaminants were selected for inclusion in the calculations since each was detected throughout the sampling period. The cancer risk estimation calculations were based on four exposure periods:

1) 1980 through 1991 (11 years);
2) 1991 through fall of 1993 (2.75 years);
3) fall of 1993 through spring of 1995 (1.5 years);
4) spring of 1995 through February of 1996 (1 year).

This approach was selected to reflect the changes in concentrations that resulted from remedial activities. Concentrations listed as ND were treated as zero. Each exposure period was assigned a concentration based on the arithmetic mean of all values (including zeros) reported during the period. Inhalation unit risk values were utilized throughout the cancer risk calculations. Daily exposure durations were based on a worst case scenario (24 hours per day), and an alternative scenario (16 hours per day).

Cancer Risk Calculations Results:

Carbon tetrachloride

Worst case scenario (24 hour daily exposure)

The cancer risk estimations based on continuous exposure to carbon tetrachloride indicates that there is a low increased risk of developing cancer.

Alternative exposure scenario (16 hours daily exposure)

The cancer risk estimations based on sixteen hours per day exposure to carbon tetrachloride indicate that there is also a low increased risk of developing cancer.

Trichloroethylene

Worst case scenario (24 hour daily exposure)

The cancer risk estimations based on continuous exposure to trichloroethylene indicates that there is a low increased risk of developing cancer.

Alternative exposure scenario (16 hours daily exposure)

The cancer risk estimations based on sixteen hours per day exposure to trichloroethylene indicate that there is also a low increased risk of developing cancer.

Tetrachloroethylene

Worst case scenario (24 hour daily exposure)

The cancer risk estimations based on continuous exposure to tetrachloroethylene indicates that there is no apparent increased risk of developing cancer.

Alternative exposure scenario (16 hours daily exposure)

The cancer risk estimations based on sixteen hours per day exposure to tetrachloroethylene indicate that there is an insignificant increased risk of developing cancer.

Conclusions

1) Residents who live in the residence referred to as A-RRB03 are currently exposed to one site-related contaminant, TCE, in the indoor air of their basement at levels that do not represent a current public health hazard;

2) Residents who live in the residence referred to as A-RRB03 were exposed in the past to two site-related contaminants, (carbon tetrachloride and trichloroethylene), in the indoor air of their basement at levels that represented a public health hazard. These past exposures present a low increased risk of developing cancer for those who lived in this home since 1980. Cancer risk estimations are based on long-term exposures. If the current occupants of A-RRB03 were living elsewhere during some of the exposure period (1980-1991), their exposure duration and hence cancer risks would be lower.

Recommendations

1) Continue sampling the indoor air in the basement of the residence referred to as A-RRB03.

2) Provide the CT DPH with the indoor air sampling results.

3) Educate the resident of A-RRB03 about the findings of this report.

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CERTIFICATION

The Hamilton Standard Facility Site Health Consultation was prepared by the Connecticut Department of Public Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the Health Consultation was initiated.

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The Division of Health Assessment and Consultation, ATSDR, has reviewed this Health Consultation and concurs with its findings.

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REFERENCES

1. Correspondence from: Aaron Gilbert (U.S. EPA Region 1), to: Louise House (ATSDR Regional Representative Region 1) on April 5, 1996.

2. United Technologies Hamilton Standard Report "Indoor Air Sampling Report for Volatile Organic Compounds [1st Quarter (Annual) 1996 Sampling]." March 1996.

3. ATSDR "Public Health Assessment for Hamilton Standard, Windsor Locks, Connecticut, CERCLIS NO. CTD001145341." September 18, 1989.

4. US EPA. The Total Exposure Assessment Methodology (TEAM) Study: Summary and Analysis: Volume 1. Office of Acid Deposition, Environmental Monitoring and Quality Assurance, Washington, DC. June 1987.

5. Agency for Toxic Substances and Disease Registry, "Toxicological Profile for Trichloroethylene," April 1993.

6. Agency for Toxic Substances and Disease Registry, "Toxicological Profile for Methylene chloride," April 1993.