Health Consultation

BELOIT PROFESSIONAL BUILDING

BELOIT, ROCK COUNTY, WISCONSIN

FEBRUARY 23, 2005

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

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Health Consultation

Beloit Professional Building

Beloit, Rock County, Wisconsin

Prepared by the
Wisconsin Department of Health and Family Services
Bureau of Environmental Health

Under a Cooperative Agreement With the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Summary
Tenants of a Beloit office building requested assistance from the Wisconsin Department of Health and Family Services (DHFS) in evaluating the human health implications of chemical contamination in the building's basement. Fuel oil periodically enters the basement from contaminated groundwater; when fuel oil odors are the strongest, vapors can pose a *short-term public health hazard* to visitors and employees. DHFS cannot estimate past levels of fuel oil exposures to building occupants; however, these exposures are unlikely to result in long-term health effects. If this problem is not addressed, it will persist, and heavy rains or high water table events could result in a *short-term public health hazard*. In this consultation, DHFS recommends both interim and long-term actions to address the source of chemical releases to indoor air in the building.

Background
Building tenants requested that DHFS assess the indoor air quality of the office building at 419 Pleasant Street in Beloit, Rock County, Wisconsin. The Beloit Professional Building is in the downtown business district of the City of Beloit. The front (main) entrance of the building is on Pleasant Street to the west, parking and a rear entrance are behind the building on the east. The Beloit City Library is south of the building, separated by a walkway of about 30–50 feet. A church is to the north across Public Avenue from the office building. The building has three stories of office space and a full basement. Much of the office space is vacant, although a number of businesses occupy the third and first floors.

The Beloit Fire Department initially was contacted about petroleum odors in the building in February 2004 when building tenants began noticing the odors. The fire department has visited the building multiple times since then and has documented the petroleum entry into the basement. Petroleum contamination with the appearance of a weathered fuel oil entered the portion of the basement that housed the utilities. This area on the eastern side of the building includes one main utility room with two smaller adjacent rooms at the same level. Fire department officials showed that petroleum vapors were present in the basement and, periodically, in upstairs office areas. Tenants have reported that odors are strongest in the stairwell area at the back of the building. Through testing, fire department officials ruled out a likelihood of a fire and explosion hazard. This is consistent with prior DHFS experience with indoor fuel oil contamination problems in general.

The Wisconsin Department of Natural Resources (DNR) was first contacted in April 2004 for assistance with this problem. DNR's spill-response contractor periodically has collected the visible oil that seeped into the basement through cracks and seams in the basement floor, which is lowest at the eastern edge where the problem appears to be. The DNR Spill Coordinator and DNR Cleanup Project Manager accompanied DHFS staff to the building on May 17, 2004. At that time, DNR staff used special oil-absorbent materials to again collect the visible oil material in several areas of the basement floor in the utility room area. After a previous event when oil entered the basement, DNR collected a sample of the oily material for evaluation by the Wisconsin Department of Commerce Petroleum Lab in Janesville. On the basis of a qualitative assessment of

properties, such as specific gravity and flash point, the lab technician determined the product was a heavier-end petroleum product (such as fuel oil or diesel fuel) and appeared to be significantly weathered. This characterization was relayed to DNR and then to DHFS. DNR staff have been, and will continue, working to get the appropriate parties to investigate the source of the contamination.

The Beloit health and fire departments and DNR have been collaborating to address this problem since early spring of 2004. At the time this report was written, an unknown quantity of a weathered fuel oil appears to be floating on the water table or trapped in deeper soils beneath the building. During snowmelts or rainfalls that periodically raise the water table, the oil contacts the foundation and collects on the basement floor. The oil may be from a former heating oil or diesel fuel storage tank, but the actual location and nature of the source has not yet been determined.

DHFS Site Visit

On May 16, 2004, DHFS traveled to the site with a Beloit Deputy Fire Chief. At the site DHFS was joined by representatives of the DNR, Beloit City Health Department, and the consulting engineer. DHFS staff entered the building from a back door on the east side and noticed petroleum odors while descending the stairs to the basement. The odors were strongest in the utility area of the basement. A wet and musty odor also was evident. DHFS used a photoionization detector (PID) that reads total volatile organic compounds (VOCs) in the air (RaeSystems, 8/04). The PID read 0 parts per billion by volume (ppbv) in outdoor air and rose to 300–400 ppbv in the back stairway. Total VOC levels in the basement main utility room area were consistently around 3500 ppbv but ranged from approximately 2400 to 4000 ppbv. This room showed signs of chronic water seepage during high-water periods, with significant staining observed on the concrete floor and lower parts of the wall. Because the PID measures total VOCs and does not differentiate between individual chemical compounds, comparison of these measurements with air-quality thresholds or risk-based standards was not possible. Instead, the results were used to evaluate proportional air impacts from one area to another by comparing readings.

In the small room southeast of the main utility area, a pile of ash was observed next to a former incinerator that appeared to have fallen apart. This room had a slightly different (ammonia) odor in addition to the weathered fuel oil. The PID measurements suggested the ammonia odor came from the ash, which contacted water and presumably some of the oil contamination. The PID measured up to 40,000 ppbv (40 ppmv) right above this material. Another small room northeast of the main utility area contained a decommissioned 6000-gallon heating oil tank. Inspection of this tank found it was in generally good condition when decommissioned two months previously. PID measurements in this room were generally lower (2400 ppbv) than in other parts of the utility area. No oil was observed seeping into this room through the floor or walls.

The remaining parts of the basement are connected to the utility area through large open corridors and doorways. Despite this open relation, PID measurements were markedly lower in the remainder of the basement, even a short distance from the main utility area. This indicates that little, if any, air moves from one area to another in the basement.

PID measurements of total VOCs remained from 200 to 350 ppbv up to the third floor. In the third-floor corridor, VOC levels dropped to below 200 ppbv and continued to drop to under 100 ppbv at the front of the building. Levels at the front of the building on the second and first floors were consistently below 50 ppbv. Lower levels in this area may be due to a combination of greater distance from the source and proximity to the front doors where walk-in traffic may increase fresh air exchange.

While walking through the hallway near office areas on the third floor, DHFS staff noticed the odor of air fresheners. These areas also correlated to higher PID measurements. The use of cover scents such as chemical air fresheners and scented candles prevented us from noticing petroleum odors in these areas. This probably was the intent of their use. However, the characteristic odor of fuel oil releases is one of the best tools used by DHFS staff to identify a problem because they can often differentiate between types of VOC sources.

After the walk-through of the office building, DHFS, City Health Department, and Fire Department staff went to the First United Methodist Church across the street and, with their permission, inspected the church using visual observations and the PID readings. Similar inspection of the basement of the nearby public library indicated no indoor air problem in that building. Staff also inspected the basement of the First Federal Capital Bank across the parking lot southeast of the office building. The surface of some standing water in a sump pit in the bank basement had a slight sheen. No PID measurements were elevated in the basement. Without any other indication of a problem in that direction from the site, this sheen could be explained by the common presence of iron reducing bacteria in the sump water.

Indoor Air Sampling

On June 8, 2004, DHFS staff returned to the Beloit Professional Building to collect three air samples for VOC analysis. The primary purpose of the sampling was to provide assurance to tenants that when odors are absent, unsafe chemical exposures are not expected in the building. The secondary purpose for the sampling was to better characterize the chemical contaminants in the basement where the odors have persisted. Three evacuated SUMMA canisters were fitted with flow regulators that permit sample collection over a 24-hour period. The samples were taken from (1) the basement utility room, (2) the third-floor hallway near the stairwell (reported by tenants to have frequent odor problems), and (3) outdoor air near the building. On the day of this sample collection, no odors were noticeable in the upstairs occupied office areas on first, second, or third floors. Odors were evident in the basement utility room, although noticeably weaker than during the previous visit. This observation was consistent with lower PID readings during the second visit.

The Wisconsin State Laboratory of Hygiene analyzed samples for VOCs using Environmental Protection Agency Method TO-14a. When the laboratory prepared the samples for analysis, a problem with the valve on the container for the basement utility room sample resulted in the loss of the sample, and it could not be analyzed.

Discussion

Four chemicals were found in indoor air at levels above their comparison values (benzene, 1,3-butadiene, bromodichloromethane, and carbon tetrachloride) (Table 1). Two of those chemicals also were found in outdoor air at levels above their comparison values (benzene and carbon tetrachloride). Chemicals detected at levels above health-based comparison values should be evaluated further, but this does not mean that a health concern is likely. A DNR study of urban air quality from 1997 to 1998 found average benzene levels in Milwaukee and Wisconsin Rapids of 0.38 ppbv and 0.28 ppbv, respectively (DNR, 1998). The DNR sampled air outside an Eagle River school classroom in January 2000. Although the samples were taken because of concerns about possible exhaust from automobile and snowmobile traffic, the levels were 0.51–0.69 ppbv (DNR, 2000).

Table 1
Analyses of Volatile Organic Compounds in Air (WSLOH, 2004)
Beloit Professional Building, June 8, 2004

Chemical	Outdoor Air (ppbv)	3rd-Floor Hallway (ppbv)	Basement Utility Room (ppbv)	Comparison Value
Benzene	0.36	0.6	NA	0.03 [c]
1,3-Butadiene	ND	0.29	NA	0.003 [c]
Bromodichloromethane	ND	0.2	NA	0.1 [c]
Carbon tetrachloride	0.19	.014	NA	0.01 [c]
Chloromethane	0.4	0.51	NA	50 [n]
1,1-Dichloroethane	0.2	ND	NA	128 [n]
Ethyl benzene	ND	0.91	NA	230 [n]
Methylene chloride	0.22	ND	NA	0.9 [c]
n-Octane	ND	0.24	NA	n/a
Tetrachloroethylene	0.1	ND	NA	0.5 [c]
Toluene	0.36	1.0	NA	21 [n]
1,1,1-Trichloroethane	0.1	0.13	NA	700 [n]
Xylenes	0.34	3.35	NA	100 [n]
PID Measurement*	ND	ND	2,000	n/a

*PID measurement as total VOCs calibrated to isobutylene.
c: Cancer Risk Evaluation Guide. Levels above this threshold do not necessarily represent a health concern. However, exposures to lower concentrations are unlikely to pose an increased cancer risk. This level is based on a lifetime of continuous exposure, which does not reflect exposures in this situation.
n: Environmental Media Evaluation Guide. Exposure to concentrations below this threshold are very unlikely to cause non cancer health effects. Based on ATSDR Minimal Risk Level.
ppbv: parts per billion by volume.
NA: not analyzed.
n/a: no available comparison value.
ND: not detected.

Each of the three samples collected during the June 8 sampling event had a specific purpose. The basement sample would have been used to better characterize the chemical makeup of the petroleum impacts already identified by odors and general air monitoring. The upstairs sample was collected for comparison to the sample from the utility room to

identify impacts to air in the occupied parts of the building from the contamination entering the basement. Because more than 90% of the makeup air in a building typically comes from outdoor air, the third (outside) sample would indicate which chemicals identified in indoors came from outside rather than from the potential basement problem. Because of the many common household products and commercial/industrial sources, VOCs are ubiquitous in both indoor air and urban outdoor air.

The difference in the types of chemicals and concentrations in the indoor air sample in the professional building and what was found in the outdoor air sample is not great. However, a number of the petroleum-related chemicals appear slightly elevated inside the building (benzene, 1,3-butadiene, ethyl benzene, n-octane, toluene, and xylenes). Many common products in a building can be sources of petroleum chemicals in indoor air. This also might indicate the connection between basement air and the upstairs. The characteristic petroleum odors noted in the past already had established that connection.

A number of common chlorinated solvents also were detected in the samples (carbon tetrachloride, chloromethane, 1,1-dichloroethane, methylene chloride, tetrachloroethylene, and 1,1,1-trichloroethane). The results generally indicated outdoor air as the source of these chlorinated solvents. Bromodichloromethane is a relatively common by-product of chlorine disinfection or chlorine containing cleaning products.

The musty odor noticed during site visits and recounted by some building tenants as having been there for many years probably resulted from the chronic water problem in the basement. These odors may mask some of the petroleum odors that otherwise might be noticeable at very low levels.

Public Health Implications

On the basis of contaminant characterization performed by the Department of Commerce Petroleum Lab, DHFS concluded that a weathered fuel oil product is present in the basement of the Beloit Professional Building. The specific grade and source of the product has not yet been determined. Fuel oils contain complex mixtures of petroleum-derived chemicals. These mixtures can vary significantly between formulations. Naphthalene and benzene tend to lead the greatest chemical health concerns about fuel oils. The benzene content of fuel oil is considerably lower than that of gasoline. In a weathered fuel oil, the benzene and some of the other lighter hydrocarbons are further reduced in proportion within the remaining mixture (ATSDR, 1995).

Fuel oil that contaminates the building and odors that are strong pose a *short-term public health hazard* to business occupants and people who visit the facility. If not addressed, this problem will create a *short-term public health hazard* with future heavy rain or high water table events. DHFS recommends that both interim and long-term actions be taken to address the source of chemical releases to indoor air in the building. Short-term exposures to strong odors or vapors from fuel oil spills commonly have been associated with headaches, nausea, light-headedness, poor coordination, upper respiratory irritation, increased blood pressure, and difficulty concentrating. In general, vapors from fuel oil affect the same organ systems in all exposed people. However, the seriousness of the

effects vary from person to person. With fuel oil vapors in particular, sensitivity varies widely among individuals. Persons with preexisting respiratory conditions such as asthma or other health complications may be more susceptible to stronger irritation responses at lower levels of vapors in the air. These irritation symptoms tend to be self-limiting, meaning that onset of the symptoms usually causes the person to move to fresh air, where the symptoms subside.

Interviews with building tenants indicated that multiple individuals experienced respiratory irritation as well as headache and nausea after exposure to vapors during one of the stronger odor events during the previous months. A DNR employee who visited the site in response to an odor complaint reported experiencing a headache after being in the basement for a period of approximately fifteen minutes. Because of the documented presence of the contaminants in indoor air, and without any other obvious explanation for those symptoms, exposure to the fuel oil vapors is the likely cause of those health effects.

Prolonged high-level exposures to fuel oil can cause kidney and liver damage, nervous system damage, increased blood pressure and reduced blood clotting. These health effects have been demonstrated only at high levels of exposure consistent with occupations involving frequent use of, and exposure to fuel oil. The International Agency for Research on Cancer (IARC) has determined that some fuel oils (heavy) might cause cancer in humans, but for other fuel oils (light), not enough information exists to make a determination. IARC also has determined that occupational exposures to fuel oils during petroleum refining are probably carcinogenic in humans. Some studies with mice have suggested that repeated contact with fuel oils may cause liver or skin cancer. However, other mouse studies have found this not to be the case. No studies are available in other animals or in people on the carcinogenic effects of fuel oils (ATSDR, 2004).

Although an accurate estimate is not possible of the levels of past exposure to fuel oil vapors by building occupants, past exposures does not appear likely to result in long-term health effects for occupants. One tenant indicated periodically smelling the characteristic fuel oil odors for the past year. This tenant has worked in the building since 1992. Other tenants reportedly did not notice the odors during this period until January 2004. Individuals' levels of sensitivity vary to different types of odors. This person probably smelled the vapors at levels less perceptible to others. Accurately estimating the level of past exposure for building occupants is not possible. However, the anecdotal information about how and when odors were noticed indicates that exposure levels would have been relatively low. At the levels of exposure most likely for business occupants of this building, long-term or lasting health problems from past exposures would not be likely. Tenants who are concerned about their personal health history or are experiencing health problems should consult their physician and mention this air-quality problem.

Child Health Considerations

Because of their breathing rates and lower body weight, children are generally more highly exposed than adults to air pollutants (EPA, 2002). Childhood exposures to the contaminants of concern for indoor air at this site would result in similar levels of increased health risk as discussed in the previous section. However, children are less able

to indicate when they are uncomfortable from or experiencing symptoms from chemical exposures. The Beloit Professional Building has been used by businesses and organizations that involved regularly having children in the building for extended periods. No such uses currently are apparent in the building, although children can and do enter the building as part of the customer base for existing businesses.

Conclusions

- Fuel oil contamination that enters the building and strong odors pose a *short-term public health hazard* to business occupants and others who may visit the facility.
- Although accurately estimating the levels of past exposure to fuel oil vapors by building occupants is not possible, past exposures do not appear likely to result in long-term health effects for occupants.
- If not addressed, this problem will persist and create a *short-term public health hazard* with future heavy rain or high water table events.

Recommendations for Improving Indoor Air Quality

- DHFS recommends that the building owner take steps to prevent the source of contamination from impacting indoor air quality in the building. Some suggestions are included in the section below.

- Because permanent solutions to this type of problem can be difficult to identify and take time to implement, DHFS recommends that the building owner also take interim steps to control impacts to indoor air until a permanent solution is in place. The building owner already has taken measures to reduce impacts to indoor air.

Suggested Measures to Improve Indoor Air Quality
Our inspection of the building found a number of factors that may prove useful in improving indoor air quality for the tenants and their customers. The following recommended actions have been discussed with the City of Beloit health and dire departments, the DNR and building owner.

- Increase fresh air exchange to the maximum extent possible until more effective longer-term steps can be taken. Tenants have expressed concerns about both insufficient heating and air conditioning in parts of the building. The existing system may not be functioning at full capacity or may be inadequate for this building (in which case improvements should be made).

- If odors and vapors cannot be controlled in upstairs offices in the back of the building, occupants should be relocated to other apparently less affected parts of the building toward the front. This is not expected to be common unless contaminant entry to the building returns to the levels of the spring of 2004.

- Workers should ventilate the basement before and during work in the basement utility area. The fire department has offered the use of a confined-space fan with the manhole at the back of the building for this purpose. Workers should consider wearing respiratory protection when working for prolonged periods in the basement unless adequate ventilation can be created. Any long-term ventilation of the basement air to the outside should recognize and minimize the potential for exhaust air to degrade the air-intake source for this building, the intake of neighboring buildings, or breathing zone of passers by.

- An assessment of air exchange pathways between basement and upper floors may determine the practicality of ventilating the basement separately from the upstairs areas or maintaining the basement under negative pressure relative to the upper floors to minimize air flow from basement to upstairs areas.

- The building owner should explore options for preventing continued episodic re-entrance of fuel oil into the basement. These may include artificially maintaining a lower water table; removing unnecessary debris from the basement (particularly materials that may contact fuel oil) and cleaning floors completely; and identifying and sealing cracks and openings to the subsurface.

- Because fuel oil problems are notoriously recalcitrant, the above steps should be considered only as temporary measures until the problem can be fully investigated and cleaned up.

Public Health Action Plan

DHFS and the City of Beloit Health Department have been working with building tenants to address their specific health questions and concerns. The agencies will continue to work together to respond to questions.

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CERTIFICATION

This health consultation, **Beloit Professional Building**, was prepared by the Wisconsin Department of Health and Family Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). The health consultation is in accordance with ATSDR-approved methodology and procedures existing when the health consultation was begun.

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

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