Health Consultation

MERCURY INVESTIGATION AT TWO PRIVATE RESIDENCES

MENOMONEE FALLS, WAUKESHA COUNTY, WISCONSIN

NOVEMBER 9, 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

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HEALTH CONSULTATION

MERCURY INVESTIGATION AT TWO PRIVATE RESIDENCES

MENOMONEE FALLS, WAUKESHA COUNTY, WISCONSIN

Prepared by:

Wisconsin Department of Health and Family Services
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

Summary
Health and environmental agencies collaborated to investigate reports of elevated mercury in and around a pond constructed next to a private residence in Menomonee Falls, Waukesha County, Wisconsin. The investigation documented mercury in fish, soil, groundwater, wetland sediments, and indoor air. The public health hazard from mercury in each of these environmental media varies. All of the fish from the pond that were analyzed by the Wisconsin Department of Natural Resources (WDNR) contained more mercury than is considered safe for consumption. Eating fish from the pond constitutes a *public health hazard*. The Department of Health and Family Services (DHFS) found mercury vapor within a house next to the pond. The levels found posed no *apparent health hazard*, but it was recommended that a basement utility sink that was an apparent source of mercury vapors be cleaned to remove mercury. The U.S. Environmental Protection Agency (EPA) evaluated soil and groundwater on earthen-filled and landscaped areas of the two adjacent residential properties for the presence of mercury. Trace amounts were found in soil on both properties, but *pose no apparent public health hazard*. Elevated mercury in a groundwater monitoring well, combined with trace mercury in a nearby private drinking water well constitute an *indeterminate public health hazard* that should be monitored. Mercury found in surface water and waste water on one of the properties is *not a public health hazard*.

Background and Statement of Issues
The Wisconsin Department of Health and Family Services (DHFS) was contacted by the Wisconsin Department of Natural Resources (WDNR) regarding a report of high levels of mercury contamination at a private residence in rural Waukesha County. The origin of the mercury is unknown, but possibilities include both contamination from unconfirmed reports of past recycling activities on the property, and possible contamination in landscaping soil brought to the properties from elsewhere. Both of these are under investigation. The report issued by an environmental consultant hired by the resident (Drake Environmental 2003) detailed mercury contamination in soil, groundwater, and fish. The WDNR had asked for DHFS assistance in evaluating two properties in proximity to where the samples were collected. DHFS, WDNR, the Waukesha County Health Department, and the U.S. Environmental Protection Agency (EPA) collaborated in investigating the property. This report evaluates public health hazards from mercury in fish, soil, surface water, groundwater, and indoor air at two adjacent private residences. For privacy reasons, these are referred to as Residence A and Residence B. Residence A is a recently built rural property with an artificial fish pond constructed next to the house and is the property where most of the mercury was detected. Residence B is an adjoining property, with an older house that is several hundred yards away from the house at Residence A. Areas of the Residence B acreage adjoining Residence A were also investigated for mercury contamination.

Methods
Fish assessment. The initial environmental assessment privately contracted by resident A (Drake Environmental, 2003) reports mercury-contaminated fish on their artificial landlocked pond, which is also registered as a fish farm with the Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP). The pond is approximately 0.4 acres in surface area. The

DATCP Fish Farm registration indicates the pond contained, at the time of the registration, blue gills, emerald shiner, green sunfish, largemouth bass, fathead minnows, perch, pumpkinseed, smallmouth bass and walleye. On May 18, 2005, WDNR collected 44 fish from the pond (see Appendix I for details of the fish collection). The four largest of the fish collected were culled for mercury analysis of fillet tissue, along with a composite sample of 4 pan fish. Total mercury in the fish tissue was analyzed by the Wisconsin State Laboratory of Hygiene, using method SW846 7470A, the standard method used in preparing the WDNR fish consumption advisory.

Airborne mercury. DHFS assessed Residences A and B for airborne mercury during a single visit on April 21, 2005. A portable mercury analyzer calibrated against an internal standard (Ohio Lumex model RA-915+) was used to record mercury in air indoors and outdoors on each property. Airborne mercury was recorded outdoors at the beginning of the survey, in each accessible room or area of the residence, and again outdoors at the end of the survey (Figures 1 and 2). Measurements were made at floor level and at about 5 feet above the floor in each room. Measurements were also made around floor drains, sink drains, clothes washers, and sumps. Outdoors, measurements were taken at locations corresponding to a previous environmental assessment of soil and groundwater (Drake Environmental 2003), and at accessible wellheads and septic vents. Air measured in the home was compared with health-based screening values (ATSDR 2000).

Clinical exposure assessment. All those living at residences A and B were invited by the Waukesha County Health Department to be screened for exposure to mercury. Those participating in the screening submitted "first morning" urine samples and had blood drawn at the Waukesha County Public Health clinic in May 2005 (Appendix II). The samples were analyzed at the Wisconsin State Laboratory of Hygiene using standard certified methods.

Environmental assessment. An environmental assessment of soil, groundwater, and surface water was conducted by the REAC (Response Engineering and Analytical Contract) team of the U.S. EPA on June 20, 2005. The assessment (EPA 2005) included 160 soil core samples, 2 surface water samples, and 3 groundwater monitoring well samples of the area covering approximately 200 feet on either side of the property line separating Residence A from Residence B.

Results

Fish assessment. Five fish from the artificial pond (4 game fish and one pan fish composite) were analyzed for total mercury (Table 1). All are above 1 µg/g (micrograms per gram, or parts per million), which is the *do not eat* concentration for sensitive individuals including women of childbearing age and children under 15 years old (WDNR 2004). Also, 4 of the 5 fish samples exceeded the *do not eat* concentration (2.81 ppm) for men and women beyond childbearing age. This is the criteria used by WDNR in issuing sport fish advisories on public waters, and is based upon the U.S. EPA reference dose for methyl mercury, 0.1 µg/kg/day. Appendix IV (WDNR, 2004)

Airborne mercury. Airborne mercury vapor was monitored on both properties in an attempt to learn more about the source of the mercury reported by Drake Environmental (2003). Numerous instrument readings were collected near the consultant's sample and well locations at Residence

A (Figure 1), and at Residence B (Figure 2). At Residence A, no outdoor measurements were above background levels found in outdoor air (Table 2). At Residence B, none of the indoor or outdoor mercury measurements were noticeably above background levels (Table 3). Within Residence A, mercury in air was higher than background at all locations measured in the lower (basement) level of the house (Figure 1, Table 2). Mercury levels in the basement, although higher than background, were within safe limits set by the Agency for Toxic Substances and Disease Registry (ATSDR 2000). Measurements throughout the basement indicated the left side of the utility sink and/or contents of the sink as having the highest concentration of mercury vapor in basement air. The sink is a possible source of the elevated mercury detected throughout the basement.

Plastic container lids found in the basement sink were contaminated with mercury. The level of mercury measured on the lids was *not an apparent health hazard*, and the containers were declared safe for re-use or disposal by the homeowner.

None of the air measurements indicated an outdoor source for the mercury found indoors. No airborne mercury was found above background at any outdoor location or on muddy boots or other outdoor items stored in the garage or basement.

Clinical assessment for mercury exposure. The results of all of the blood and urine samples for everyone at Residences A and B were unremarkable, meaning that the amount of mercury detected in each family member was within the normal range or less. The population-based normal range is 0-10 µg/ L (micrograms per liter) for blood and 0-20 µg/ L for urine (Wisconsin State Laboratory of Hygiene, 95% confidence interval). The actual results of the mercury analyses were forwarded to each resident and to the Waukesha County Health Department, following the guidelines of the Health Information Privacy Protection Act. The residents were invited to forward the results to their physicians and to direct questions about the results to the Bureau of Environmental and Occupational Health Chief Medical Officer.

Environmental assessment. The EPA (2005) environmental assessment revealed mercury in 25 of 160 soil locations sampled, one of three groundwater monitoring wells, four sediment sample locations, and one of three groundwater monitoring wells (Table 4). These results are discussed in more detail in the next section of this health consultation.

Discussion

In preparing this health consultation, several assumptions were made about the chemical forms of mercury present. In most cases, only total mercury was determined in the various samples. The health-based comparison values used in this assessment for the various sources of mercury contamination are not all based on the same chemical form of mercury, since different forms of mercury are expected in different compartments of the environment. Also, federal standards and health-based comparison values for metallic (elemental) mercury are currently under revision and are not available at this time. With these in mind, methyl mercury is the chemical form most likely present in fish. Volatile mercury measured indoors is assumed to be elemental mercury. The form of mercury found in soil and water is unknown. However, the amount found in unfiltered groundwater and wastewater samples exceeds the aqueous solubility of elemental mercury, indicating another form of mercury and/or mercury adsorbed to suspended solids. Past

activities on the property (unconfirmed) suggest that mercury in soil and groundwater could be an inorganic mercury salt. Therefore, these media are compared to table values for mercuric chloride.

The analytical assessment of mercury in fish from the artificial pond at Residence A indicates that eating these fish would constitute a **public health hazard**. Women of childbearing age and children under age 15 should not eat game fish or pan fish from this pond. Others should not eat game fish and no more than 1 meal per week of pan fish. Since this is a private pond with no public access, WDNR would not issue a "do not eat" advisory for this water body. DHFS has advised the property owner against eating fish from the pond, but the county health department will not require posting signs as might be done for publicly-accessible waters.

The Agency for Toxic Substances and Disease Registry (ATSDR) recommends that residential indoor air have a mercury concentration of no more than 1,000 ng/m^3 (nanograms per cubic meter). Based on this recommendation, DHFS found **no apparent public health hazard** related to airborne mercury levels in either home or property. However, mercury in the basement air of some parts of the Residence A were higher than elsewhere in the house or outdoors. These readings indicated that the mercury was present in the basement laundry sink and on items stored in the sink. The amount of mercury detected on the items in the sink, although higher than normal, did not prohibit the safe re-use of these items. We did not observe visible mercury in the sink, but it is common for mercury spilled in a sink to settle in the plumbing trap. DHFS recommended that the owner of Residence A clean the basement utility sink in which mercury was detected. DHFS provided the owner with detailed instructions for cleaning the sink in an April 25, 2005 letter. The U.S. EPA REAC team disassembled the trap during field sampling on June 20, 2005, and found no evidence of mercury.

The locations where mercury was detected in soil are widely scattered across the sampling grid (EPA 2005). Consistent with the knowledge of past alterations of the topography of both properties, there is no obvious source or gradient in the pattern of mercury detection. The greatest amount of mercury detected in any of the soil samples, 0.306 mg/kg (milligrams per kilogram), is less than the ATSDR Reference Dose Media Evaluation Guide (RMEG) for ingestion, by children, of mercuric chloride in soil (20 mg/kg). The mercury found in sediment, (maximum 8.64 mg/kg), was in a small intermittent wetland area adjoining the two properties. The expected exposure scenario to these particular sediments would be the same as for soil and is less than the same RMEG used for exposure to soil, 20 mg/kg. This indicates that the amount of mercury in both soil and sediment is low enough to make it safe for children who would be expected to accidentally ingest small amounts of soil (200 milligrams per day), and poses no **apparent health hazard**.

Mercury was detected in one of the three groundwater monitoring wells tested (Table 4). The concentration of mercury in that well, 933 µg/L (micrograms per liter), exceeds the ATSDR RMEG for exposure to children from drinking water. Residence A obtains their drinking water from a private well on the property. A private analysis of their drinking water reported 0.3 µg/L mercury in December 2003 and below detection (detection limit 0.025 µg/L) in August 2004. 2.0 µg/L is the WDNR drinking water enforcement standard; 0.2 µg/L is the WDNR preventative action limit. Although mercury in Residence A drinking water does not require action at this time, the presence of mercury in one monitoring well and in one of two drinking

water samples indicates an ongoing need to monitor their drinking water for the presence of mercury. Because it is unclear whether mercury in groundwater will migrate toward the drinking water supply, DHFS concludes this is an **indeterminate public health hazard that should be monitored in the future.**

Mercury was also detected in several drain and waste water locations (Table 4). These samples do not reveal a discrete source of the mercury, and are not expected to be a recurring source of exposure. Mercury in these locations is **not an apparent public health hazard**. Finally, no mercury was found in the surface waters of the lined artificial pond, but the EPA REAC team detected mercury vapor (approximately 3000 ng/m^3) underneath the synthetic lining of the northeast corner of the pond. This concentration of mercury, which was briefly detectable after the pond liner was lifted, soon dissipated and is **not a public health hazard**. Trace amounts of mercury (0.068 milligrams per kilogram), were found in an adjacent soil sample.

Past, present, and future exposure pathways. Completed exposure pathways currently exist. Nine residents currently reside at these two homes. These residents are exposed to small amounts of mercury in air, water, and soil. In addition, one of the people at Residence A reports having eaten fish from the pond. The low levels of mercury in the clinical samples indicates that despite the presence of mercury in fish, soil, air, and water around Residence A, the residents have not had measurable past or present exposures. There is no potential long-term past exposure, as Residence A is a new building that has been occupied less than two years. This does not change the environmental hazard conclusions of this public health consultation, but indicates that the particular circumstances and behaviors of the residents results in their avoiding mercury exposure. Two potential future exposure pathways remain: the confirmed presence of contaminated fish, and the indeterminate presence of mercury in drinking water. Exposure to mercury in fish is easily avoided if the fish are not eaten by residents or visitors of the property. The private well at Residence A is currently safe from mercury contamination, but should be monitored to avoid to possibility of future exposure.

Child Health Considerations

Children at the property containing the fish pond may be potentially exposed to both elemental and inorganic mercury in air and soil, and to organic mercury in fish. All of the fish from the pond that were analyzed contained levels of mercury considered unsafe for consumption by children. Women of childbearing age and children should not eat fish from this pond. Within Residence A, the house adjacent to the pond, mercury vapors were detected, though not at concentrations considered unsafe for inhalation by children. The conclusion that mercury-contaminated soils are not an apparent public health hazard is based on health comparison values that are specifically protective of children. Appendix III contains additional statements about mercury toxicity.

Conclusions

- Eating fish from the pond constitutes a **public health hazard**. All of the fish from the pond that were analyzed contained more mercury than is considered safe for consumption. Sensitive groups include pregnant women, women of childbearing age, and children under age 15.

- Airborne mercury was found throughout the Residence A family basement at levels higher than background air, but not higher than safe indoor recommendations for residences. There is **no apparent public health hazard** from airborne mercury within the Residence A.
- Trace levels of mercury in soil and sediment on the properties bordering Residences A and B are **not an apparent public health hazard**.
- Mercury in Residence A drinking water is an **indeterminant public health hazard in the future**, due to trace amounts in drinking water and elevated mercury in one monitoring well.
- **No public health hazard** was found from mercury in surface waters of the artificial pond.
- Mercury in several drain and wastewater locations is **not a public health hazard**, due to no expected exposure routes.

Recommendations

- Women of childbearing age and children under age 15 should not eat game fish or pan fish from this pond. Others should not eat game fish and no more than 1 meal per week of pan fish.
- DHFS recommended that Residence A clean a basement utility sink in which mercury was detected.
- Due to the presence of high levels of mercury in one monitoring well sample and trace levels of mercury in one of two drinking water samples at Residence A, it is recommended that Residence A annually monitor their drinking water for the presence of mercury.

References

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Report authors.

Robert Thiboldeaux
Jim Morrison
Bureau of Environmental and Occupational Health
Wisconsin Department of Health and Family Services

Table 1. Concentration of total mercury in fish taken from fish farm pond on private residence, Menomonee Falls, WI. All fish taken on May 18, 2005.

Sample ID	Species	Type of tissue	Fish weight (kilogram)	Mercury concentration* µg/g
IP027168	Rock Bass	Skin on fillet	0.38	5.2
IP027169	Small Mouth Bass	Skin on fillet	0.76	6.6
IP027170	Large Mouth Bass	Skin on fillet	1.30	4.0
IP027171	Walleye	Skin on fillet	0.80	9.3
IP027172	Blue Gill/Sunfish	Skin on fillet	0.31 (average of 4 fish)	1.5**

µg/g : micrograms per gram

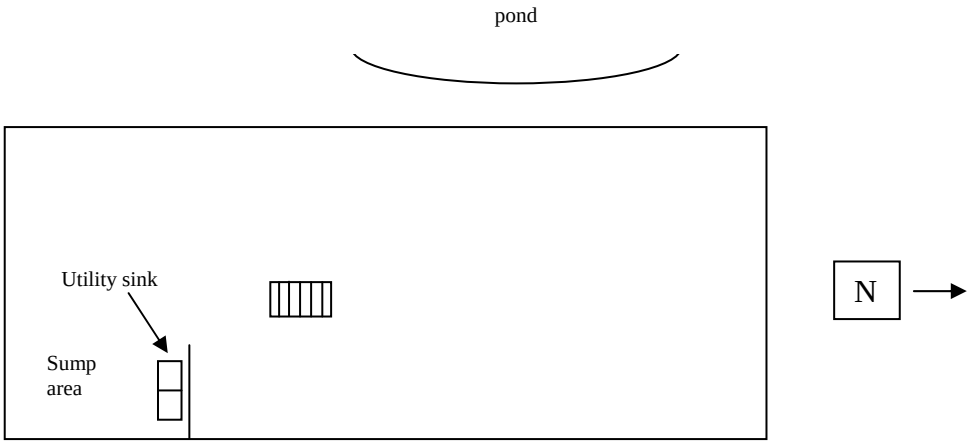
*The do not eat mercury concentration for game fish is 1 µg/g for women of childbearing age and children under 15. Others are advised to avoid game fish having more than 2.8 µg/g mercury.

** The do not eat mercury concentration for pan fish is >0.5 µg/g for women of childbearing age and children under 15. Others are advised to eat no more than 1 meal/week of pan fish with >0.5 µg/g mercury.

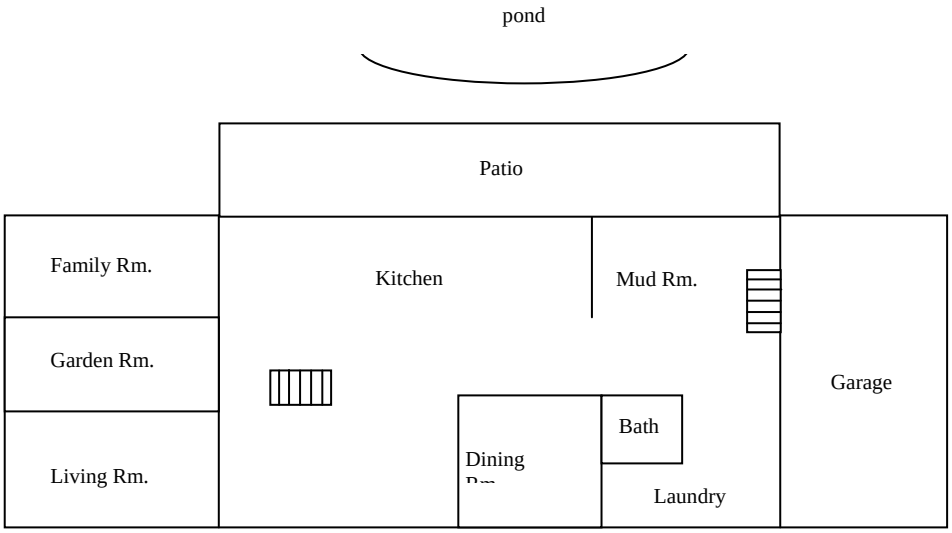
Limit of detection: 0.004 µg/g.

Limit of quantitation: 0.013 µg/g

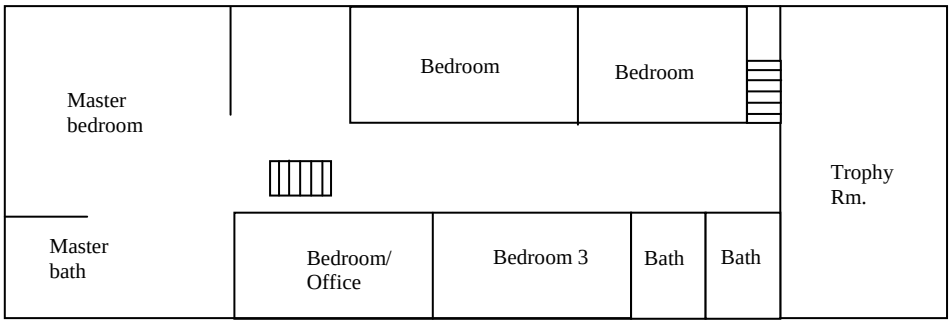
Figure 1. Building plan showing relative room locations (not to scale). Menomonee Falls, Waukesha County.



Basement Plan



1st Floor Plan



2nd Floor Plan

Table 2. Airborne mercury vapor concentrations in nanograms per cubic meter (ng/m^3). Residence A. April 21, 2005

Location	Mercury in air (ng/m^3)
Outdoors east- front door	4
Foyer	16
Living Rm.	17 to 19
Living Rm. @ floor	17
Garden Rm.	16
Family Rm. @ floor	13
Family Rm.	14
Family Rm. floor near chair	17
Kitchen	15
Dining Rm.	16
Mud Rm. floor	11 to 18
Mud Rm.	17
Laundry Rm.	18
Laundry Rm. floor	24
North stairway	15 to 17
Trophy Rm.	23 to 24
Bedroom 1	21 to 23
Bedroom 2	22
Bedroom 3	23
Bedroom/Office	20
Master Bedroom	11 to 14
Master bedroom floor	8
Master bath	7
Basement top of stairs	12
Basement stair surface	62
Basement west side	60
Basement sump pit	71 to 100
Basement east side utility area	70
Basement east side floor drain	78 to 100
Basement east side utility sink drain (right side)	75
Basement muddy boots	60
Basement sump re-test	50
Outdoors east- front door	2
Outdoors- north driveway	12
Outdoors- septic tank access pipe	14
Outdoors- septic drainfield vent pipe	14
Outdoors- drain tile outlet near septic drainfield	15
Garage	16
Garage- muddy boots	15
Outdoors- hole in ground north of pond	13
Outdoors- hole in ground north of pond, at water surface	13
Outdoors- field north of boulder	13

retaining wall	
Outdoors- outfall in boulder retaining wall	14
Outdoors north of boulder retaining wall	15
Outdoors- hole near well W-7	10
Outdoors- well W-7	12
Outdoors- drainage swale north of boulder retaining wall	7
Muddy booty from DPH investigator	7
Outdoors- drainage swale	1 to 6
Outdoors- drain tile inlet west side of house	3
Basement- retest	59
Basement- hip waders	36
Basement- sump area re-test	90
Basement sump- retest	50 to 100
Basement utility sink (left side with plastic container lids)	286
Plastic container lid (bagged)	1400
Outdoors- beach sand (bagged)	25

Figure 2. Building plan showing relative room locations (not to scale). Menomonee Falls, Waukesha County.

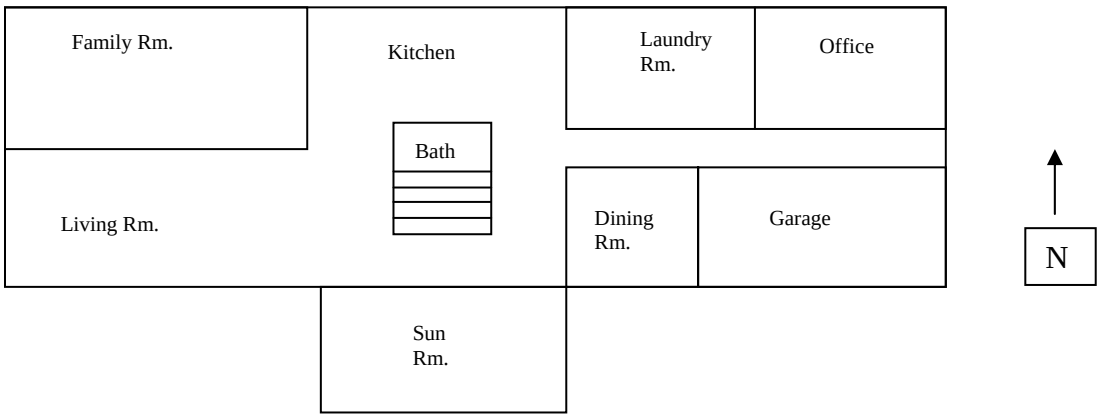


Table 3. Airborne mercury vapor concentrations in nanograms per cubic meter (ng/m^3). Residence B. April 21, 2005

Location	Mercury in air (ng/m^3)
Outdoors near garage	4
Sun Rm.	4
Foyer	3
Living Rm.	2
Family Rm.	3
Kitchen	2
Dining Rm.	2
Laundry Rm.	4 to 11
Office	16
Garage	0 to 6
Basement stairs	0
Basement	2
Basement floor drain	5 to 6
Basement laundry sink	6
Basement sump	6
Outdoors north yard septic vent	8
Outdoors north yard electric vent	9
Outdoors north yard	10
Outdoors west yard	9
Outdoors south yard	10
Barn north side	12 to13
Barn south side	12
Barn lower level entry access	12

Table 4. Summary of mercury detected in soil and water samples gathered by EPA , 20 June 2005.[a]

Location code	Concentration	Comparison value
Soil samples, mg/kg (milligrams per kilogram)		
SB014-4201	0.114	20[b]
SB023-4101	0.138	
SB033-3901	0.062	
SB043-3601	0.066	
SB044-3701	0.086	
SB052-2502	0.125	
SB053-3501	0.106	
SB054-3801	0.045	
SB063-3401	0.089	
SB064-3301	0.071	
SB074-3201	0.068	
SB075-4601	0.089	
SB075-4601D	0.070	
SB082-0501	0.052	
SB084-4702	0.053	
SB085-4902	0.042	
SB092-1302	0.306	
SB094-1302D	0.065	
SB102-0402	0.109	
SB103-2601	0.069	
Hill	0.066	
Hill D	0.063	
SS013-44	0.110	
SS024-43	0.093	
SS115-51	0.038	
Sediment samples, mg/kg		
SD103-02	2.04	20[c]
SD073-03	5.79	
SD093-04	8.64	
SD043-01D	0.075	
Groundwater samples, µg/L (micrograms per liter)		
MW1	933	3 (mercuric chloride)[d]
Other water samples, µg/L		
Waste water	412	na
Basement drain	3.22	na
Wipe sample, µg (micrograms) per wipe		
Drain 1	0.083	na

[a]Table from EPA. 2005. Sampling event and field investigation, One Mile Road site work assignment EAC00142- trip report. Lockheed Martin Technology Services REAC, Edison NJ. File 0142-DTRR1-090905.

[b]ATSDR RMEG for soil, child exposure

[c] ATSDR RMEG for soil, child exposure, specific to this exposure scenario.

[d]ATSDR RMEG for drinking water, child exposure

Appendix I. Fish collections at Residence A artificial pond.

The toxicologist for the DNR Fisheries Management and Habitat Protection Section, reviewed the fish collected and made recommendations for composite sampling based on fish size & type. The recommendations included analyzing the game fish first, since greater concentrations of methyl mercury are expected in those species. If needed, pan fish could then be screened in a second round of tests.

The fish sampled from the artificial pond include:

4.5" Blue Gill (BG)
7.4" BG
9.5" RB
9.9" RB
Five Green Sunfish xBG 5.6 to 6.4"
Five GRSunxBG 6.8 to 7.9"
Four GRSunxBG 8.3 to 9.1"
9.2" Small Mouth Bass (SMB)
13.5" SMB
15.2" SMB
15.2" SMB
15.2" SMB
15.5" Large Mouth Bass
16.5" LMB
17.1" LMB
17.8" LMB
17.9 " Walleye

The purpose of the sampling was to determine the concentration of mercury in the fish in the pond. For the first phase of analysis, the 4 largest game fish will be analyzed (9.9" rock bass, 15.2" small mouth bass, 17.8" large mouth bass & 17.9" walleye) and one pan fish (four Green Sunfish x Blue Gill 8.3 to 9.1"). Based on the results, further analysis may be warranted. The remainder of the prepared sample in the jar will be kept for future use, as well as the remaining fish.

Sample numbers assigned to each sample are listed below:

9.9" Rock Bass, - Label Jar as: 051805WP01
Weight = ___ kg

15.2 Smallmouth Bass (one of the) - Label Jar as: 051805WP02
Weight = ___ kg

17.8" Largemouth Bass - Label Jar as: 051805WP03
Weight = ___ kg

17.9" Walleye - Label Jar as: 051805WP04g
Weight = ___ kg

Four 8.3-9.1 " Green Sunfish x Blue Gill - Label Jar as: 051805WP05
Weight = ___ kg

Analytical method. The fish analysis (fillet & liver) by Northern Lake Services in December 2003, used a different method (SW846 7470) than the Wisconsin State Lab of Hygiene (SLoH). The SLoH uses Method SW846 7470A which is for total mercury in fish tissue, is used for WDNR fish consumption advisories.

SLoH has been asked to deliver analytical results by July 1, 2005.

Appendix II. Instructions for providing blood and urine samples for mercury analysis.

As part of an investigation into mercury contamination on your residence, members of your family has been offered a mercury exposure assessment provided by the Waukesha County and state health departments. The purpose of this is to determine whether anyone in your family has been exposed to mercury. Each family member that agrees to participate in the exposure assessment will provide voluntary samples of blood and urine.

Four steps are required to provide the samples:

1. Receive a urine sample vial for each family member. On April 21, 2005, state and local environmental and health officials will visit your residence, and will provide urine bottles for each family member. Please label each bottle with the name of one person in your family, but do not use the bottles until step 3.

2. Make an appointment to have blood drawn by the Waukesha County health staff.
For an appointment at the Waukesha County Health Clinic, contact:

Darren J. Rausch, M.S.
Epidemiologist
Waukesha County Public Health
615 W. Moreland Blvd.
Waukesha, WI 53188
Phone: 262/896-8430
Fax: (262) 896-8387
Email: drausch@waukeshacounty.gov

3. One the day of your appointment at the health clinic, fill the bottle with a sample of "first morning urine." To do this, each person should place the bottle where it is easily accessible on the night before the appointment. Upon waking on the day of the appointment, use the bottle when first emptying your bladder in the morning. This provides the most accurate urine sample for the test.

4. Bring the urine sample to the clinic when you go for the blood sample later in the day. The sample does not need refrigeration.

Results. The samples will be sent to the Wisconsin State Laboratory of Hygiene for analysis. The results will be provided to the state and local health departments, and to your personal doctor should you designate one. The chief medical officer of the Wisconsin Bureau of Environmental Health will be available to discuss these results with you by phone.

Sharing results with environmental agencies. The results are considered private health information. Health privacy laws prohibit sharing this information with any other agencies or parties without your written permission. However, the DNR and EPA are interested in this information for the purposes of their environmental investigation, and may ask your permission to receive the results.

Appendix III: Mercury toxicology and exposure limits.

A brief discussion of mercury toxicity. The chemical forms of mercury fall into three main categories: Elemental (metallic) mercury, mercury salts, and organic mercury. Mercury exerts many of its toxic effects after it enters the central nervous system. The different forms of mercury vary in their ability to penetrate nerve tissue. Organic mercury is most able to enter nerve tissue and fetal tissue and is therefore the most important source of mercury. Some types of bacteria produce organic mercury, particularly methyl mercury, from metallic mercury that enters the environment from natural and human sources. Organic mercury then accumulates in the food chain, becoming particularly concentrated in large fish. Methyl mercury consumed from fish and other sources has an affinity for the brain; it is there that most of the toxic effects from this form of mercury occur. The major effects are neurotoxicity in adults, and neurodevelopmental toxicity in fetuses of mothers exposed during pregnancy. Clinical observations in adults begin with peripheral numbness and progress towards ataxia, weakness, fatigue, inability to concentrate, vision and hearing loss, tremor, and coma (Klaassen 1996). High exposure to the developing fetus disrupts the organization and layering of brain neurons, leading to the neurodevelopmental defects seen in unusual exposure epidemics in Japan and Iraq.

Metallic mercury, the familiar "quick silver," is not readily absorbed into the body after being eaten, and has relatively low toxicity by that route of exposure. However, metallic mercury volatilizes into the air, where it is absorbed into the body via inhalation and can then affect the nervous system and kidneys. Elevated mercury concentrations in indoor air are primarily a problem in occupations involving the handling of mercury. Mercury exposure following a small mercury spill in a non-occupational setting are not usually acutely toxic, but can result in chronic exposure if not removed.

Mercuric salts have application in industry such as the manufacture of batteries and paper. Mercuric salts are quite corrosive and if eaten, quickly damage tissues of the digestive tract and kidneys.

The major sources of the public's exposure to mercury are through fish consumption and from spills of small amounts of metallic mercury such as might occur from breaking thermometers or from mercury stored in school laboratories. The main public health messages urge limiting consumption of certain types of fish, especially to children and women of child-bearing age, as well as the prevention and containment of metallic mercury spills.

Environmental Limits for Airborne Mercury Exposure

AGENCY	Exposure Limit (micrograms per cubic meter)	COMMENTS
National Institute of Occupational Safety and Health (NIOSH)	10,000 $\mu g/m^3$	Immediately Dangerous to Life or Health (IDLH) value allowable for a maximum of 30 minutes in emergency situations only
Occupational Safety and Health Administration (OSHA)	100 $\mu g/m^3$	Enforceable workplace standard, assuming 8 hours/day, 40 hours/week
NIOSH	50 $\mu g/m^3$	Workplace recommendation, assuming 8 hours/day, 40 hours/week
American Conference of Governmental Industrial Hygienists (ACGIH)	25 $\mu g/m^3$	Workplace recommendation, assuming 8 hours/day, 40 hours/week
Agency for Toxic Substances and Disease Registry (ATSDR)	10 $\mu g/m^3$	Level at which residents are advised to not occupy the affected area. Also a screening level for bagged clothes
ATSDR	3 $\mu g/m^3$	Target cleanup level for commercial environments
ATSDR	1 ug/m^3	Target cleanup level for residential environments
ATSDR	0.20 $\mu g/m^3$	Chronic level of exposure at which adverse effects would not be expected. Assumes exposure time of 24 hours/day for 30 years
None	0.01 $\mu g/m3$	Typical background level

Appendix IV. Wisconsin Fish Consumption Advisory Guidelines (from WDNR 2004)

Contaminant	Population	Concentration	Advice
PCB[1]	All	< 0.05 ppm	Unlimited Consumption
		0.05 – 0.2 ppm	1 meal/week or 52 meals/year
		0.2 – 1.0 ppm	1 meal/month or 12 meals/year
		1.0 – 1.9 ppm	6 meals/year
		> 1.9 ppm	Do Not Eat
Mercury General	Sensitive Group[2]	< 0.05 ppm	Unlimited Consumption
		0.05 – 0.22 ppm	1 meal/week or 52 meals/year
		0.22 – 1.0 ppm	1 meal/month or 12 meals/year
		(> 0.5 panfish and > 1.0 ppm gamefish)	*1 meal per month* *Do Not Eat*
	Others[2]	<0.16 ppm	Unlimited Consumption
		>0.16 ppm	1 meal/week or 52 meals/year
		(>0.5 panfish)	*1 meal/week*
Dioxin[3]	All	< 10 ppt	No Advice Given
		> 10 ppt	No one should eat
Chlordane	All	< 0.16 ppm	No advice given
		0.16 - 0.65 ppm	1 meal/week or 52 meals/year
		0.66-2.82 ppm	1 meal/month or 12 meals/year
		2.83-5.62 ppm	6 meals/year
		> 5.62 ppm	No one should eat

1. **PCBs** - Species-site specific advisories are provided. Although this advice is based on reproductive health effects, the same advice is given for women, children, and men to protect against other potential health effects such as immune suppression and cancer. The following values were used in deriving the fish tissue criteria for PCBs:

   Health Protection Value of 0.05 ug PCB/kg/day. Average Meal size = 227 g uncooked fish. Consumer = 70 kg adult for others, meal size is assumed proportional to body size). Meal rates defined in the advisory ranging from unrestricted (>225/yr) to none. Skinning/trimming/cooking reduction factor = 50%.

   The Health Protection Value is from the "Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory. Great Lakes Sport Fish Task Force. September 1993.

2. **Mercury** - Sensitive group includes pregnant women, women of childbearing age, and children under age 15. Others includes women beyond childbearing age and men.

   For the statewide general advisory, the RfD for the sensitive group is 0.1 ug/kg/day (EPA RfD) and for others it is 0.3 ug/kg/day (Irag 1990 RfD). Average Meal size = 227 g uncooked fish. Consumer = 70 kg adult (for others, meal size is assumed proportional to body size). Meal rates defined in the advisory ranging from unrestricted (>225/yr) to none.

   For the statewide general advisory, species were placed in a meal-category considering the distribution of concentrations for each species in the tissue criteria for each meal category, angler harvest, bag and size limitations, and other factors pertinent to consumption.

   In addition to the general advisory, advice is provided for species from specific waters where higher concentrations have been documented. For site specific mercury advisories beyond the statewide general advisory, a number of factors are examined including: maximum and average concentrations for a species in a waterbody or reach, concentration-size relationships, size range of the species expected to be harvested, angler harvest information, and other factors. Site specific advisories are either "do not eat" or "1 meal/month" for the sensitive population and "1 meal/week" for others.

3. Sum of total dioxin equivalence expressed as 2,3,7,8 TCDD based on dioxin and furan congeners and EPA human health TEFs.

Certification

This Health Consultation for the Menomonee Falls Mercury Investigation at Two Private residences 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). It is in accordance with the approved methodology and procedure existing at the time the Health Consultation was begun. Editorial review was completed by the Cooperative Agreement partner.

Jennifer a Freed

Technical Project Officer, CAT, SPAB, DHAC

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

Alan W. Yarbrough

Team Lead, CAT, SPAB, DHAC, ATSDR