



STATE OF MICHIGAN
DEPARTMENT OF COMMUNITY HEALTH
LANSING

Rick Snyder

~~XXXXXXXXXXXXXXXXXXXX~~
GOVERNOR

Olga Dazzo

~~XXXXXXXXXXXXXXXXXXXX~~
DIRECTOR

January 21, 2011

Fred Keeslar, Medical Officer/Director
Grand Traverse County Health Department
2325 Garfield Road North
Traverse City, MI 49686

Dear Mr. Keeslar:

Per your request, I have reviewed the environmental data for the Grand Traverse Overall Supply (GTOS) Superfund site in Greilickville, Leelanau County, Michigan (Figure 1) to determine if public health conclusions reached by the Michigan Department of Community Health (MDCH) in 2005 have changed. The U.S. Environmental Protection Agency (EPA) is proposing to amend the Record of Decision (ROD) for the site and excavate additional contaminated soil that was discovered during a time-critical removal action. *MDCH finds that this is a health-protective action and supports the ROD amendment.*

However, during review of the data, I found several issues that need clarification or further investigation before public-health implications can be clearly determined. Those issues are listed briefly here and discussed in detail below:

1. The data for ambient air samples taken during EPA's on-going monitoring should be listed separately from the soil-vapor data, to avoid confusion when evaluating the two different media.
2. Ambient air results for acrolein should be considered invalid, due to quality-control issues with equipment preparation, the calibration standard, and the analytical method.
3. The methodology for establishing the MDCH sub-slab screening levels is acceptable. However, MDCH established this methodology with the federal Agency for Toxic Substances and Disease Registry (ATSDR), not the EPA.
4. MDCH noted two errors in the values listed for the Michigan Department of Environmental Quality (MDEQ) comparison values and has notified EPA and the Michigan Department of Natural Resources and Environment (MDNRE, formerly the MDEQ) of these errors.
5. Benzene detections in sub-slab samples taken at the former Norris Elementary School need further investigation.
6. Elevated tetrachloroethene (PCE) and trichloroethene (TCE) in the soil-vapor samples taken next to the Harbor West Condominiums should be investigated further.
7. Sampling equipment should remain consistent.

In the matter of parents' concerns of previous exposure to students at Norris Elementary School, immediately to the east of the GTOS site, exposure to dry-cleaning related chemicals may have

occurred, but the duration and amount cannot be known with certainty. That information would be necessary to determine potential health outcomes.

Background and Statement of Issues

GTOS was a commercial laundry, beginning operations in 1953. Environmental investigations at the site began in 1978, following complaints of odors and unusual tastes in the water supply at Norris Elementary School. These investigations found PCE, TCE, and their breakdown products migrating from the site. In 1983, the GTOS site was placed on the National Priorities List (NPL, or “Superfund”), and a Remedial Investigation (RI) and Feasibility Study (FS) took place. The ROD, signed in early 2008, called for a “limited” excavation of contaminated soils, since it was assumed that an EPA time-critical removal, to be done that summer, would remove the majority of the contamination. However, during the time-critical removal, an area containing hydrocarbons and low levels of polychlorinated biphenyls (PCBs) was discovered. Due to budgetary and time constraints, and Michigan laws regarding hazardous waste, the additional contamination could not be fully addressed at that time. Therefore, the remaining contamination is to be addressed by the remedial branch of EPA Superfund, as outlined in the proposed ROD amendment (EPA 2010a).

EPA held a public meeting at the Elmwood Township Center Office in Traverse City, Michigan on November 9, 2010 to present the proposed changes to the ROD and take public comment. Following the meeting, local health departments were contacted by the media for more information. The Grand Traverse County Health Department asked MDCH for toxicological assistance in interpreting the more recent data. (Although the GTOS site is in Leelanau County, and therefore under the jurisdiction of the Benzie-Leelanau District Health Department, Norris Elementary School was part of the Traverse City school system, making it easy for one to assume it is within Grand Traverse County.) MDCH contacted EPA Remedial Project Manager Linda Martin and requested recent environmental data, particularly soil-gas and indoor-air results. MDCH and MDNRE conducted a conference call with EPA and their contractor on December 7, 2010 regarding the issues discussed below.

Discussion: Issues and Recommendations

Health Implications of ROD Amendment

Issue: The proposed amendment to the ROD for the GTOS site maintains the same Remedial Action Objectives as the original ROD: to be protective of direct skin contact with the soil and prevent leaching to groundwater that is used for drinking water or vents to surface water (EPA 2010a). The GTOS site is now fenced; local planners are considering alternatives for reuse of the site, following EPA’s remedial work (L. Martin, EPA, personal communication, 2010). The laundry has closed and the building has been removed, so there are no air emissions. Use of the Norris Elementary building as a school stopped after 2008; it is still used on occasion for

meetings or community functions (L. Martin, EPA, personal communication, 2010). Homes and businesses that previously had been affected by contaminants in the groundwater plume now have deeper, unaffected wells or are served by municipal water (MDPH 1994, ATSDR 2005a). Therefore, there is infrequent, if any, exposure to the contaminants. The proposed amendment to the ROD will allow for reuse of the site that is protective of public health.

Recommendation: EPA should adopt the amendment to the ROD.

Presentation of Ambient Air Sampling Results

Issue: In the Summary Reports for the quarterly monitoring at the former Norris Elementary School, West Bay Covenant Church (south of the school), and Harbor West Condominiums (east of the school), ambient air results are listed in the same tables that show sub-slab soil vapor results. The tables do show the screening levels for soil gas but no screening levels for ambient air (McCarty 2009, 2010a-e). This may unintentionally cause the reader to compare ambient air data to soil gas screening levels, leading to incorrect conclusions.

Recommendation: The data for ambient air samples taken during EPA's on-going site monitoring should be listed separately from the soil vapor data. (This step was implemented in the December 2010 Summary Report [McCarty 2010e].) Although air data are not meant for air monitoring purposes but for quality control of the soil vapor monitoring, the ambient air results should be compared to the respective EPA Reference Concentrations (RfCs). (This will be implemented in future reports [L. Martin, EPA, personal communication, 2011].) Discussion of the findings should be added to the text of the reports, as necessary.

Acrolein Data

Issue: Occasionally, ambient air samples at the three sampling locations (school, church, and condos) indicated acrolein was present above the RfC of 0.009 ppb (McCarty 2009, 2010a-e). (Acrolein is *not* associated with past activities at the GTOS site.) MDCH discussed these findings with the MDNRE Air Quality Division (AQD), to determine how best to conduct follow-up investigation. Based on findings in the EPA's School Air Toxics Initiative (a national air-sampling program investigating ambient air quality near schools), *AQD has determined that acrolein cannot be measured in an accurate and valid way and recommends that all acrolein data from Michigan be voided* (M. Heindorf, MDNRE AQD, personal communication, 2010).

Acrolein is highly reactive and can react with other chemicals to form other compounds that complicate laboratory analysis. Also, other chemical compounds can react to form acrolein, potentially even within the canisters used for collecting air quality samples. Studies are being conducted to examine whether the type of canister used or the way it is prepared for sample collection is a factor in this anomaly (EPA 2010b). There may also be an issue with the calibration standard (M. Heindorf, MDNRE AQD, personal communication, 2010).

Fred Keeslar, GTCHD
Grand Traverse Overall Supply
January 21, 2011
Page 4

Recommendation: For the sake of transparency, the acrolein results should be reported in the tables, along with the EPA RfC, but a footnote should be added to the table, and discussion to the text, regarding the unreliability of the data. (This was implemented in the December 2010 Summary Report [McCarty 2010e].) Readers can be referred to the EPA website listed in the references for this letter.

MDCH Screening Levels

Issue: In the soil vapor tables, EPA uses sub-slab screening levels they attribute to EPA and MDCH (McCarty 2009, 2010a-d). The methodology for devising these screening levels was actually developed by ATSDR and MDCH when evaluating soil-gas and indoor air samples taken at Norris Elementary School in 2005. The methodology indicated multiplying indoor air screening values by 10 to reflect attenuation between indoor air and sub-slab, based on EPA vapor intrusion guidance at the time (ATSDR 2005a).

To ensure that EPA was using current guidance on attenuation factors, MDCH contacted Amy Salisbury, lead toxicologist at MDNRE for vapor intrusion issues. EPA has suggested that the attenuation coefficient for chlorinated solvents, such as PCE and TCE, sampled at any depth in the soil, remain at that ten-fold value (A. Salisbury, MDNRE, personal communication, 2010).

Recommendation: EPA should change the column heading for “EPA/MDCH Sub-Slab Screening Levels” to “ATSDR/MDCH Sub-Slab Screening Levels” and continue to use the methodology developed by ATSDR and MDCH to calculate the values. (This was implemented in the December 2010 Summary Report [McCarty 2010e].)

MDEQ Comparison Values for 1,1,2-Trichloroethane and Benzene

Issue: There are two typographical errors in the soil vapor tables for the “MDEQ Parts 201 and 213 AIAC and ASGSC” (Acceptable Indoor Air Concentration and Acceptable Soil Gas Screening Concentration) for 1,1,2-trichloroethane and benzene. The concentrations are listed as 140 and 450 ppbv, respectively (McCarty 2009, 2010a-d). They should be 14 and 45 ppbv, respectively, based on the MDNRE June 2008 Peer Review Draft table for these values. While the correction for 1,1,2-trichloroethane does not result in exceedances of the MDNRE comparison values, the correction for benzene does result in exceedances.

Recommendation: EPA should ensure that all comparison values in the tables are correct. (This was implemented in the December 2010 Summary Report [McCarty 2010e].) As necessary, incorrect conclusions from past reports should be resolved in a memo to MDNRE.

Sub-Slab Benzene Detections at the Former Norris Elementary School

Issue: Benzene was detected in sub-slab vapor samples taken at the former Norris Elementary School, sometimes at levels above comparison values (McCarty 2009, 2010c-e). (Benzene is *not* associated with past activities at the GTOS site.) The report suggested that these detections were

attributable to the storage of lawn mowers near the sampling locations in the school. If this assumption is true, it is possible that the integrity of one or more seals in the sampling system is questionable and indoor air may be contaminating and diluting the sub-slab vapor samples. Another possibility is that the sampling line that attaches to the port for the sub-slab space needs to be purged before the vacuum is applied and a sample is drawn, as indicated in the Sampling and Analysis Plan.

Recommendation: The benzene detections should be investigated further to determine a source.

Elevated Soil-Vapor PCE and TCE at Condominiums

Issue: On several sampling occasions, elevated PCE and TCE soil vapor readings were detected at the north end of Harbor West Condominiums, at times above the comparison values. These samples were located outside of the condominiums and were not sub-slab, although near the edge of the building (McCarty 2009, 2010a-e). Therefore, the risk of vapor intrusion is unclear. The condo association has not allowed EPA to sample inside of the buildings (L. Martin, EPA, personal communication, 2010).

Recommendation: Part of the cleanup plan in the ROD included a soil-vapor extraction system, already in place at Norris Elementary School, and a groundwater extraction and treatment program, yet to be implemented. It is possible that, when groundwater extraction begins, soil gas concentrations will diminish. In the meantime, EPA should continue monitoring soil gas and strive to gain access to the condominiums to conduct sub-slab sampling.

Sampling Equipment

Issue: The sub-slab vapor and ambient air samples taken in 2009 were collected in amber bottles whereas the samples taken in 2010 were collected in SUMMA canisters. Also, a different laboratory took over analytical duties in 2010. Results from the amber bottles showed more chemical detections (McCarty 2009, 2010a-b). It is unclear whether the discrepancies were due to these chemicals actually being present in the vapor or air sampled, the integrity of the seal on the bottle being questionable and allowing contamination by surrounding air, or different handling procedures at the different labs.

Recommendation: Sampling equipment and procedures should remain consistent. However, MDCH understands that equipment logistics at the laboratory used in 2009 caused the need for using amber bottles. EPA has indicated that all future sub-slab vapor and ambient air samples will be taken with SUMMAs (L. Martin, EPA, personal communication, 2010). According to MDNRE, amber bottles are appropriate collection devices for vapor intrusion investigations in Michigan (M. Williams, MDNRE, personal communication, 2010).

Fred Keeslar, GTCHD
Grand Traverse Overall Supply
January 21, 2011
Page 6

Community Health Concerns

Issue: MDCH has learned that some community members have asked whether there will be health surveillance of children who attended Norris Elementary School in the 1970s, when the contamination was first discovered. To track health outcome data for sites of environmental contamination, it is necessary to know the extent (dose and duration) of exposure. However, exposure information is not known with certainty. More discussion on this issue is in the attached appendix.

Recommendation: Although students and staff may have been exposed to PCE and TCE at the school, the information needed to conduct a health study is not available and cannot be known with certainty at this time (i.e., after more than 30 years). People who were students at Norris Elementary between 1968 and 1978 may want to make sure their healthcare provider is aware of their exposure concerns.

Conclusions

1. MDCH finds the proposed amendment to the ROD to be health-protective and supports it.
2. There are several areas in the on-going EPA monitoring/sampling that need further investigation: sub-slab benzene detections at Norris Elementary, and soil-gas PCE and TCE detections at Harbor West Condominiums.
3. A health study of students who attended Norris Elementary before the contamination was discovered would not have sufficient scientific strength to be justified.

If I may be of further assistance in this matter, please do not hesitate to contact me. Thank you.

Sincerely,



Christina Bush, Toxicologist
Toxicology and Response Section
Division of Environmental Health
Bureau of Epidemiology

bushcr@michigan.gov

V 517-335-9717

F 517-335-8800

Attachments

Fred Keeslar, GTCHD
Grand Traverse Overall Supply
January 21, 2011
Page 7

CC: William Crawford, Environmental Health Director, Benzie-Leelanau DHD
Cindy Fairbanks, Project Manager, MDNRE-RD
Linda Martin, Remedial Project Manager, EPA
Jack Kelly, Elmwood Township Supervisor

Figure 1. Grand Traverse Overall Supply site and vicinity, Leelanau County, Michigan. (Source: McCarty 2009)



Appendix: Exposure Dose Calculations for PCE and TCE at GTOS

Calculated doses, assuming exposure was to maximum concentrations found:

GTOS discharged its wastes to dry wells and lagoons from 1968 to 1977. When the groundwater contamination was first discovered in 1978, PCE and TCE concentrations in the drinking water at Norris Elementary were as high as 860 and 900 parts per billion (ppb) or micrograms per liter ($\mu\text{g/L}$), respectively. The school immediately stopped using its well for drinking water (MDPH 1994).

For this exposure-dose calculation exercise, MDCH used the EPA Child-Specific Exposure Factors Handbook (EPA 2008) to obtain the average body weight (BW) for a child, age 6 to less than 11 years, and the average amount of water consumed per day (IR, for intake rate) by a child in that same age range.

$$\begin{array}{lcl} \text{BW} & = & 31.8 \text{ kilograms (kg)} \\ \text{IR} & = & 480 \text{ milliliters per day (ml/day), or } 0.48 \text{ L/day} \end{array}$$

The maximum amount of PCE a child may have been drinking per 24-hour day, based on the 1978 concentration data from Norris Elementary, would have been

$$860 \mu\text{g} / \text{L} \times 0.48 \text{L} / \text{day} = 413 \mu\text{g} / \text{day PCE}$$

The previous calculation assumes that the child is obtaining *all* his drinking water at the school. Although a child would spend only one-third of a school day at school, MDCH assumes, for this exercise, that the child obtains *one-half* his drinking water there. This allows for extra consumption during gym class, at recess, and at on-site functions outside of the school day and is very protective. Therefore, the maximum amount of PCE a child may have been drinking while at school would be $206 \mu\text{g/day}$. Since the child would only spend about three-quarters of the year in school, *the time-weighted dose* (206×0.75) *would be* $154 \mu\text{g/day PCE}$.

A similar calculation exercise for TCE results in a *time-weighted dose of* $162 \mu\text{g/day TCE}$.

The Reference Dose (RfD) for PCE is $10 \mu\text{g/kg BW/day}$ (EPA 1988). An RfD is “an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime” (EPA 2011). The RfD for PCE for a child weighing 31.8 kg would be $318 \mu\text{g/day}$. *The estimated exposure dose for PCE for a student at Norris Elementary is less than the RfD.*

The developmental RfD for TCE derived by MDNRE is $1.7 \mu\text{g/kg BW/day}$ (A. Salibury, MDNRE, personal communication, 2010). Developmental toxicity is defined as adverse effects resulting from exposure that occurred pre-conception, *in utero*, or postnatally up until sexual maturation (EPA 2011). The RfD for TCE for a child weighing 31.8 kg would be $54 \mu\text{g/day}$. *The estimated exposure dose for TCE for a student at Norris Elementary is three times greater than the developmental RfD.*

Uncertainties/unknowns:

Although the exercise above suggests that drinking water containing up to 860 PCE does *not* exceed levels of concern, and drinking water with up to 900 ppb TCE *does* exceed levels of concern, there are several unknown variables that would affect public health conclusions:

- It is unknown what the actual highest concentrations of PCE and TCE were in the drinking water at Norris Elementary. The maximum concentrations could have been greater than 860 and 900 ppb, respectively.
- It is unknown how long exposure occurred. It is not known when the contaminants first appeared in the drinking water. Children may not have attended the school for all of their elementary education. Staff may have moved elsewhere during the time the contamination was present.
- It is unknown if children may have lived within the groundwater contamination plume and whether their homes had private wells.
- Inhalation of PCE and TCE in the air is another potential exposure pathway. It is unknown what air concentrations of PCE and TCE were being emitted by laundry processes at GTOS. People in the vicinity, especially downwind, of GTOS when it was in operation would have been exposed by inhalation. The first air monitoring done for the site was in 1988 and no chemicals were detected (MDPH 1994).

Health outcome data review consideration

Several citizens have asked if former students and staff at Norris Elementary have been or will be tracked, as far as whether they suffered ill effects from any exposure they may have had to chemicals attributable to GTOS. The federal Agency for Toxic Substances and Disease Registry (ATSDR), for whom MDCH conducts public health assessments under a cooperative agreement, provides the following criteria when determining if a health-outcome data review is warranted (answers specific to the GTOS site follow each question):

1. **Are there one or more current or past potential or completed exposure pathways at the site?** Yes, for past exposures. People were potentially exposed to air emissions from GTOS when it was operating as a laundry. People were potentially exposed to drinking water contamination before the contamination was discovered.
2. **Can one determine the time period of exposure?** No. It is not known when the contamination of the drinking water occurred. After the contamination was discovered in 1978, the school stopped using the affected well. As stated previously, GTOS started discharging its waste to dry wells and lagoons in 1968. Therefore, the maximum duration of exposure could have been 10 years but was likely less, due to the time needed for the contamination to leach into the aquifer and travel through the groundwater to the well.
3. **Can one quantify the population that was, or is being, exposed?** One can reasonably assume that staff and students at Norris Elementary drank the water at the school, but as discussed in Point 2, it is not evident when the contamination first entered the drinking water.
4. **Are the estimated exposure doses(s) and the duration of exposure sufficient for a plausible, reasonable expectation of health effects?** This cannot be determined for air exposures because air emissions from GTOS were not measured until 1988 (and no chemicals were detected). For drinking water exposures, a time-weighted dose was calculated above, however that calculation, as discussed above, has much uncertainty.

5. **Are health outcome data available at a geographic level or with enough specificity (e.g., census tract or census block) to allow it to be correlated to the exposed population?** No. The Michigan Cancer Registry and other health-outcome databases typically provide statistics by county. Using county rates of disease when only a small percentage of the population may have been exposed to an environmental contaminant would not provide useful information. Health-outcome databases rarely have statistics for smaller geographic/demographic units. Also, it is probable that some students and staff no longer live in Grand Traverse or Leelanau counties. Cancer statistics are coded by the county in which one is living at the time of diagnosis, which may be different than the county in which one may have been exposed to a suspected carcinogen.
6. **Do the validated data sources or databases have information on the specific health outcomes or disease(s) of interest likely to occur from exposure to the site contaminants and are those data accessible?** Both PCE and TCE are “reasonably anticipated” to cause cancer in humans, according to the National Toxicology Program’s 11th Report on Carcinogens (2005). Studies of humans exposed occupationally to PCE show a positive association between exposure and the incidence of esophageal and cervical cancer and non-Hodgkin’s lymphoma (NHL). Studies of humans exposed occupationally to TCE show a positive association between exposure and the incidence of liver, kidney, and prostate cancers, NHL, and multiple myeloma. ATSDR has tracked nearly 5,000 registrants in the TCE National Exposure Registry since 1989. These registrants were exposed non-occupationally via drinking water. Health effects reported that were above the national average were anemia, cancer, skin rashes, urinary tract disorders, stroke, diabetes, liver disease, kidney disease, hearing impairment, and speech impairment (Schultz et al. 2010). MDCH is not aware of a national registry for persons exposed to PCE. Due to the uncertainty in exposure dose and duration, the likelihood of disease occurrence in students and staff exposed to PCE and TCE at Norris Elementary cannot be determined. People who were students or staff at Norris Elementary between 1968 and 1978 may want to discuss exposure concerns with their healthcare provider.

The ATSDR Public Health Assessment Guidance Manual (2005, see Chapter 8.6) goes into further detail when considering the above criteria. If any of the answers to the questions is “no,” a health outcome review is *not* conducted because there would not be enough scientific strength to the analysis. Therefore, MDCH cannot justify conducting a health outcome data review regarding students and staff at Norris Elementary.

References

Agency for Toxic Substances and Disease Registry (ATSDR). Health consultation concerning Norris Elementary School Indoor Air Assessment, Grand Traverse Overall Supply Company, Greilickville, Leelanau County, Michigan. Atlanta: US Department of Health and Human Services; 2005a November 8.

http://www.michigan.gov/documents/Norris_Elementary_School_Health_Consultation_142189_7.pdf

Agency for Toxic Substances and Disease Registry (ATSDR). Public health assessment guidance manual. Atlanta: US Department of Health and Human Services; 2005b.

<http://www.atsdr.cdc.gov/HAC/PHAMannual/>

McCarty JL. June 2009 Soil Vapor and Ambient Air Data Summary Report, Grand Traverse Overall Supply Site, Greilickville, Michigan, Remedial Action Contract (RAC) 2, Contract No. EP-S5-06-02, Work Assignment No. 035-RARA-053G. Chicago (IL): SulTRAC; 2009 Dec.

McCarty JL. October 2009 Soil Vapor and Ambient Air Data Summary Report, Grand Traverse Overall Supply Site, Greilickville, Michigan, Remedial Action Contract (RAC) 2, Contract No. EP-S5-06-02, Work Assignment No. 035-RARA-053G. Chicago (IL): SulTRAC; 2010a Feb.

McCarty JL. December 2009 Soil Vapor and Ambient Air Data Summary Report, Grand Traverse Overall Supply Site, Greilickville, Michigan, Remedial Action Contract (RAC) 2, Contract No. EP-S5-06-02, Work Assignment No. 035-RARA-053G. Chicago (IL): SulTRAC; 2010b Apr.

McCarty JL. March 2010 Soil Vapor and Ambient Air Data Summary Report, Grand Traverse Overall Supply Site, Greilickville, Michigan, Remedial Action Contract (RAC) 2, Contract No. EP-S5-06-02, Work Assignment No. 035-RARA-053G. Chicago (IL): SulTRAC; 2010c May.

McCarty JL. June 2010 Soil Vapor and Ambient Air Data Summary Report, Grand Traverse Overall Supply Site, Greilickville, Michigan, Remedial Action Contract (RAC) 2, Contract No. EP-S5-06-02, Work Assignment No. 035-RARA-053G. Chicago (IL): SulTRAC; 2010d Sept.

McCarty JL. September 2010 Soil Vapor and Ambient Air Data Summary Report, Grand Traverse Overall Supply Site, Greilickville, Michigan, Remedial Action Contract (RAC) 2, Contract No. EP-S5-06-02, Work Assignment No. 035-RARA-053G. Chicago (IL): SulTRAC; 2010e Dec.

Michigan Department of Environmental Quality (MDEQ). 2008. Remediation and Redevelopment Division Operational Memorandum No. 4, Attachment 4, Soil Gas and Indoor Air, Appendix B: Parts 201 and 213 Acceptable Indoor Air Concentrations (AIACs) and Acceptable Soil Gas Screening Concentrations (ASGSCs). Peer Review Draft. Lansing (MI): MDEQ. June 2008.

Michigan Department of Public Health (MDPH). 1994. Grand Traverse Overall Supply Company, Greilickville, Leelanau County, Michigan. CERCLIS No. MID017418559. January 21, 1994.

National Toxicology Program. 11th Report on Carcinogens. US Department of Health and Human Services. 2005. <http://ntp.niehs.nih.gov/>

Schultz, Myron G., James H. Sapp II, Caroline D. Cusack, Jennifer M. Fink. 2010. The National Exposure Registry: history and lessons learned. J Environ Health 72(7):20-25.

U.S. Environmental Protection Agency (EPA). Integrated Risk Information System Glossary. Accessed 1/7/2011. http://www.epa.gov/iris/help_gloss.htm

U.S. Environmental Protection Agency (EPA). 1988. Integrated Risk Information System: Tetrachloroethylene (CASRN 127-18-4). <http://www.epa.gov/iris/subst/0106.htm>

U.S. Environmental Protection Agency (EPA). Child-Specific Exposure Factors Handbook. Washington, DC: National Center for Environmental Assessment, Office of Research and Development; 2008 September. Report No.: EPA/600/R-06/096F. <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=199243>

U.S. Environmental Protection Agency (EPA). 2010a. "EPA Proposes Change to Soil Cleanup Plan - Grand Traverse Overall Supply Site, Greilickville, Michigan. October 2010." http://www.epa.gov/region5/sites/grandtraverse/pdfs/gtos_fs_201010.pdf

U.S. Environmental Protection Agency (EPA). 2010b. "EPA Schools Monitoring Initiative Fact Sheet - March 2010 Update: Acrolein Monitoring Results Are Uncertain." <http://www.epa.gov/schoolair/pdfs/acroleinupdate.pdf>