

# **Health Consultation**

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**FULLER HEIGHTS COMMUNITY**

**PRIVATE WELL RESULTS**

**MULBERRY, POLK COUNTY, FLORIDA**

**MARCH 9, 2006**

**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**

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

FULLER HEIGHTS COMMUNITY

PRIVATE WELLS RESULTS

MULBERRY, POLK COUNTY, FLORIDA

Prepared by:

Florida Department of Health  
Bureau of Community Environmental Health  
Under Cooperative Agreement with the  
U.S. Department of Health and Human Services  
Agency for Toxic Substances and Disease Registry

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## Foreword

This document evaluates private well sampling data from the Fuller Heights Community in Mulberry, Florida. The Florida Department of Health (DOH) evaluates site-related public health issues through the following processes:

- **Evaluating exposure:** Florida DOH scientists begin by reviewing available information about environmental conditions at the site. The first task is to find out how much contamination is present, where the contamination occurs, and how people might be exposed to it. Usually, the Florida DOH does not collect its own environmental sampling data. We rely on information provided by government agencies, businesses and the public. Polk County Health Department (CHD) and Florida Department of Environmental Protection (DEP) provided the information for this Health Consultation.
- **Evaluating health effects:** If there is evidence that people are being exposed, or could be exposed to hazardous substances in the future, Florida DOH scientists will determine whether that exposure could be harmful to human health. This report focuses on public health; that is, the health impacts on the community as a whole, and we base it on the available scientific information.
- **Developing recommendations:** In this evaluation report, the Florida DOH outlines its conclusions regarding any potential health threat posed by drinking water from private wells in the Fuller Heights community, and offers recommendations for reducing or eliminating human exposure to contaminants. The role of the Florida DOH in dealing with hazardous waste sites is primarily advisory. For that reason, the evaluation report will typically recommend actions other agencies, including the Florida DEP and Polk CHD, should take. If, however, an immediate health threat exists or is imminent, DOH will issue a public health advisory warning people of the danger, and will work to resolve the problem.
- **Soliciting community input:** The evaluation process is interactive. The Florida DOH starts by soliciting and evaluating information from various government agencies, individuals, or organizations responsible for cleaning up the site, and those living in communities near the site. We share any conclusions about the site with the groups and organizations providing the information. Once an evaluation report has been prepared, the Florida DOH seeks feedback from the public. *If you have questions or comments about this report, we encourage you to contact us.*

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## Summary and Statement of Issues

In August 2005, the Polk County Health Department (CHD) asked the Florida Department of Health (DOH) to evaluate the public health threat from drinking private well water in the Fuller Heights community in Mulberry, Florida. Some of the wells exceeded drinking water standards for arsenic, nitrates, radium 226/228, and thallium. This health consultation evaluated the public health threat from using water from private wells in the Fuller Heights community.

The Polk CHD and the Florida Department of Environmental Protection (DEP) took samples from private wells and tested for arsenic, bromodichloromethane, fluoride, nitrate, thallium, and other contaminants. This was part of an ongoing review and oversight of the environmental impacts associated with contaminated sites. Near the Fuller Heights community are the Kaiser industrial site, Purina, and a CSX railway. In June 2005, the DOH Radiological laboratory in Orlando, along with DEP Site Investigation Section (SIS), tested 10 private wells for radiological pollutants (gross alpha and radium 226/228). Earlier DEP had found radiological pollutants in three shallow monitoring wells (Florida DEP, 2005c).

*Future* exposures are a **public health hazard** for residents drinking unfiltered well water. Not all of the wells in the Fuller Heights neighborhood are contaminated. Only those wells that are contaminated have filters installed. Should contamination reach unfiltered wells at the highest arsenic and nitrate levels, there is a public health hazard for those residents. To minimize public risk, DEP is testing for contamination quarterly and installing appropriate filters on contaminated wells.

*Current* exposures are a **no apparent public health hazard** for residents drinking filtered well water. DEP has installed and maintained appropriate filters on all homes with contaminated wells. DEP is also working to connect those residents to city water. There is not a public health risk for residents drinking filtered water from their contaminated wells or using unfiltered water from wells that are not contaminated. However, if residents with the highest nitrate and arsenic levels choose to bypass their filters or otherwise not use them for drinking water, then there is a **public health hazard** for those residents. To minimize public risk, DEP is testing for contamination quarterly and encouraging residents with contaminated wells to use the installed filters.

*Past* exposures in the Fuller Heights community are a **public health hazard** if levels of contaminants were the same as the current highest levels for 30 years. However, we do not have private well sampling data prior to 2004. The source of the pollutants is unknown, so it is not possible to determine whether the levels of those contaminants have changed significantly through time. Thus, levels in the past could have been greater or less than the current levels.

Area residents are concerned that their water is not safe to drink because of these contaminants. The Florida DOH conducted this Health Consultation in cooperation with the federal Agency for Toxic Substances and Disease Registry (ATSDR). This report addresses data collected between December 2004 and October 2005 by DEP and the Polk CHD.

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## **Background**

### **Site Description and History**

The Fuller Heights community is across Old Highway 60 from the KC Industries property; one and one-half miles west of Mulberry in Polk County, Florida (refer to Figures 1-3). There are about 40 homes in the 0.2 mi<sup>2</sup> (square mile) Fuller Heights community (US Bureau of the Census, 2000).

Kaiser Aluminum and Chemical Corporation (KACC) formerly owned and operated a chemical manufacturing facility at 2420 Old Highway 60. In 1999, KC Industries purchased the KACC plant and business. Historically the plant discharged wastewaters to two mining pits and a drainfield on the north and east sides of the property. The two pits are called the North Pond and the South Pond. Water from the North Pond is normally pumped to the facility's South Pond then pumped into a permitted deep injection well. Cleanup of the property is proceeding under a DEP hazardous waste post-closure and corrective action permit.

In 2004, KC Industries notified DEP of surface water discharges from its North and South Ponds, which may have resulted from the previous year's hurricane season. DEP determined the facility had not maintained proper water levels in the ponds to prevent possible migration of contaminants into the surrounding groundwater and discharging to surface waters. To determine any effects on area potable and irrigation wells, DEP initiated a routine sampling program with Polk CHD.

DEP's Site Investigation Section (SIS) is currently defining the extent of the pollution. The pollution could be coming from the KC Industries property, the Purina property, the CSX railway property, from another source, or it may be naturally occurring (Florida DEP, 2005c).

### **Demographics**

In 2000, about 90 people lived in the Fuller Heights community. Approximately 91% of the community members were black or African American and 9% were white (US Bureau of the Census, 2000).

### **Community Health Concerns**

At a public meeting on August 4, 2005 in Fuller Heights, community members expressed concern that it was not safe to drink the water from their private wells. DEP has installed appropriate filters in all homes serviced by wells that do not meet drinking water standards. DEP is working to connect the community to the public water supply. As long as DEP maintains the filters, the community members' health will not be impacted. However, if residents drink unfiltered water, then the nitrate and arsenic contamination may impact their health.

### **Discussion**

This section identifies levels of chemicals present in private wells, exposure pathways for people's contact with those chemicals, and evaluates whether people's typical daily private well use might cause illness. We attempt to moderate the uncertainties inherent in the health consultation process by using health protective assumptions when estimating or interpreting health risks. Therefore, we base our dose calculations on the highest measured levels of a chemical. Also, the health-based values (established by the federal ATSDR, US EPA and DEP)

we use to screen the data include wide margins of safety. The assumptions, interpretations, and recommendations in this public health consultation are protective of public health.

## **Environmental Contamination**

In the following sections, DOH discusses exposure levels and possible illnesses that might occur in people exposed to the contaminants of concern at the site. Also in this subsection, DOH discusses general ideas such as the risk of illness, dose response and thresholds, and uncertainty in health consultations as well.

To evaluate exposure, DOH estimates the daily dose of each contaminant of concern found at the site. Kamrin (1988) explains a dose in this manner:

“...all chemicals, no matter what their characteristics, are toxic in large enough quantities. Thus, the amount of a chemical to which a person is exposed is crucial in deciding the extent of toxicity that will occur. In attempting to place an exact number on the amount of a particular compound that is harmful, scientists recognize they much consider the size of an organism. It is unlikely, for example, that the same amount of a particular chemical that will cause toxic effects in a 1-pound rat will also cause toxicity in a 1-ton elephant.”

“Thus instead of using the amount that is administered or to which an organisms is exposed, it is more realistic to use the amount per weight of the organism. Thus, 1 ounce administered to a 1-pound rat is equivalent to 2000 ounces to a 2000-pound (1-ton) elephant. In each case, the amount per weight is the same: 1 ounce for each pound of animal. This amount per weight is the dose. We use dose in toxicology to compare the toxicity of different chemicals in different animals.”

In expressing the daily dose, we use milligrams of contaminant per kilogram of body weight per day (mg/kg/day). To calculate the daily dose of each contaminant, we use standard assumptions about body weight, ingestion and inhalation rates, exposure time length, and other factors needed for dose calculation (ATSDR, 2005a). In calculating the dose, DOH assumed people are exposed to the maximum concentration measured for each contaminant in the private drinking water wells.

In this section, DOH reviews private well sampling data collected between December 2004 and October 2005 by DEP and Polk CHD. During that time, DEP and Polk CHD sampled 63 Fuller Heights community potable wells. Twenty-four wells exceeded primary drinking water standards or Maximum Contaminant Levels (MCL): 13 for arsenic, 4 for thallium, and 11 for total nitrate (Table 1). As of October 2005, DEP installed water filters (reverse osmosis for nitrate, metal oxide media for arsenic, and ion exchange / softener for thallium) in the homes served by those 24 wells. Currently, DEP is still testing wells and installing filters when appropriate.

In June 2005, DEP tested 10 private wells for radiological pollutants. None exceeded the MCL for gross alpha. The DOH laboratory in Orlando further analyzed for radiological pollutants in 7 of the 10 wells with the highest gross alpha levels. Five of those wells exceeded the MCL of 5 pCi/L (picocuries per liter) for radium 226/228 (Table 1). Each of the homes served by those wells already has a reverse osmosis filter installed that will remove the radium 226/228 contamination.



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DEP is sampling wells without filters in the Fuller Heights community quarterly to ensure that the pollutant levels in these wells do not significantly change. DEP is also retesting those homes with filters to ensure the filters work as expected. Results from this sampling show the filters reduce levels of contaminants below the health-based standards (Florida DEP and Polk CHD, 2005).

Florida DOH used the following ATSDR (ATSDR, 2005c) and Florida DEP (Florida DEP, 2005a) standard comparison values, in order of priority, to select contaminants of concern:

1. CREGs (Cancer Risk Evaluation Guides) – A CREG is the contaminant concentration estimated to result in no more than one excess cancer per 1 million persons exposed during a lifetime (i.e., 70 years). ATSDR calculates CREGs from the EPA-established cancer slope factor.
2. EMEGs (Environmental Media Evaluation Guides) – ATSDR derives EMEGs from Minimal Risk Levels (MRLs) using standard exposure assumptions, such as ingestion of 2 liters of water per day and body weight of 70 kg for adults. MRLs are estimates of daily human exposure, generally for a year or longer, to a chemical likely to be without an appreciable risk of non-cancerous illnesses. EMEGs used in this report were either for chronic (>365 days), intermediate (15–364 days) or acute (<14 days) exposures, where established.
3. RMEGs (Reference Dose Media Evaluation Guides) – ATSDR derives RMEGs from EPA’s oral reference doses, which are developed based on EPA evaluations. RMEGs represent the concentration in water or soil at which daily human exposure is unlikely to result in adverse noncarcinogenic effects.
4. LTHAs (Lifetime Health Advisories) – ATSDR derives LTHAs based on EPA analyses of toxicity data.
5. MCLs (Maximum Contaminant Levels) – The Florida Department of Environmental Protection (DEP) derives MCLs from U.S. Environmental Protection Agency (EPA) standards or from health data compiled from state and federal resources. MCLs are fully enforceable standards and must be equal to or more stringent (i.e., lower) than federal MCLs (such as the EPA’s).

We evaluated the sampling adequacy and using the above criteria, identified arsenic, bromodichloromethane, fluoride, nitrate, radium 226/228, and thallium as contaminants of concern (Table 1). Arsenic, fluoride, nitrate, radium 226/228, and thallium are naturally occurring substances (ATSDR, 2000 and ATSDR, 2005b; ATSDR, 2003; ATSDR, 2001; ATSDR, 1990; ATSDR, 1992). Bromodichloromethane is a by-product formed when chlorine is added to drinking water, though some laboratories use it to make other chemicals (ATSDR, 1989). Some drinking water suppliers add fluoride to the water to prevent dental cavities. Some industries use fluoride, as well (ATSDR, 2003). Thallium enters the environment primarily from coal-burning and smelting (ATSDR, 1992).

Identification of a contaminant of concern in this section does not necessarily mean that exposure will cause illness. Rather, identification serves to narrow the focus of the health consultation to those contaminants most important to public health. DOH evaluates contaminants of concern to determine whether exposure is likely to cause illness (ATSDR, 2005a).

## **Exposure Pathways**

Most chemical contaminants in the environment will only harm people through direct exposure. It is essential to determine or estimate the frequency of contact people could have with hazardous substances in their environment in order to assess the public health significance of the contaminants.

Chemical contaminants in the environment can harm one's health under certain exposure characteristics which include sufficient dose, but only if one contacts those contaminants at a high enough concentration to cause a health effect. Knowing or estimating the frequency with which people could have contact with chemical contaminants is essential to assessing the public health importance of those contaminants.

To decide if people can contact contaminants at or near a site, DOH looks at human exposure pathways. An exposure pathway has five parts:

1. a source of contaminants;
2. an environmental medium such as, air, water, or soil that can hold or move the contamination;
3. a point at which people come in contact with a contaminated medium, such as in drinking water, or in soil in a garden;
4. an exposure route, such as drinking contaminated water from a well, or eating contaminated soil on homegrown vegetables; and
5. a population who could come in contact with the contaminants.

We eliminate an exposure pathway if at least one of the five parts is missing and will not occur in the future. Exposure pathways not eliminated are either completed or potential. For completed pathways, all five pathway parts must exist and exposure to a contaminant must have occurred, is occurring, or will occur. For potential pathways, at least one of the five parts is missing, but could exist. Also for potential pathways, exposure to a contaminant could have occurred, could be occurring, or could occur in the future.

This health consultation addresses the public health implications of drinking untreated groundwater. Filters reduced the amount of contaminant exposure by removing or lowering levels of contaminants prior to ingestion. Therefore, DOH calculated exposure doses assuming residents did not use filters for drinking water. This assures protection by assuming people ingested the maximum contaminant concentration. Thus, we base the potential expression of adverse health effects on the maximum dose (ATSDR, 2005a).

Fuller Heights residents use groundwater from private wells for drinking, showering, and other household uses. For past exposures, there is a completed pathway. Prior to 2004, the Polk CHD did not test the private wells in the Fuller Heights community, so we do not know how long residents were exposed.

Currently, there are appropriate filters in residents' homes that are using wells that exceed drinking water standards. As long as DEP maintains those filters, it is unlikely the exposure pathways will be completed. The filters are optional and residents can choose to bypass them. If residents choose to drink unfiltered water from their contaminated well, then exposure pathways will be completed and residents will be drinking water that exceeds safe drinking water standards. DEP is working to connect those homes to the public water supply. Residents whose

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wells exceed drinking water standards have the option to connect to the public water supply when it becomes available for free. Residents whose wells do not exceed drinking water standards may choose to connect to the public water supply for a fee (Florida DEP, 2005c).

## **Public Health Implications**

DOH evaluates exposures by estimating daily doses for children and adults (Table 2). Dose refers to the amount of chemical per weight; expressed in milligrams (mg) of contaminant per kilogram (kg) of body weight per day (mg/kg/day). A milligram is 1/1,000 of a gram; a kilogram is approximately 2 pounds.

To calculate the daily dose of each contaminant, DOH uses standard assumptions about body weight, ingestion and inhalation rates, and duration of exposure. We assume a person's exposures to the maximum concentrations measured at the site occur daily. Acute exposures are those with duration of 14 days or less; intermediate exposures are those with duration of 15 to 364 days; and chronic exposures are those that occur for 365 days or more (or an equivalent length for animal exposures).

To estimate exposure from drinking private well water, DOH used the following assumptions (ATSDR, 2005a):

- infants ingest an average of 0.64 liter of water per day for formula,
- children between the ages of 1 and 6 ingest an average of 1 liter of water per day,
- adults ingest an average of 2 liters of water per day,
- infants weigh an average of 4 kilograms (kg),
- children weigh an average of 15 kilograms (kg),
- adults weigh an average of 70 kg,
- children ingest contaminated groundwater at the maximum concentration measured for each contaminant for 3 years, and
- adults ingest contaminated groundwater at the maximum concentration measured for each contaminant for 30 years (a worst-case default assumption used because some residents have lived in the area longer than 30 years, and some have not).

To assist in the evaluation of potential health effects, ATSDR has developed Minimal Risk Levels (MRLs) for contaminants commonly found at hazardous waste sites. A MRL is an estimate of daily human exposure to a contaminant below which non-cancerous, adverse health effects are unlikely to occur. ATSDR might develop MRLs for each route of exposure, such as ingestion and inhalation. ATSDR also develops MRLs for the length of exposure, such as acute (less than 14 days), intermediate (15–364 days), and chronic (equal to or greater than 365 days).

ATSDR includes these MRLs in its toxicological profiles. These chemical-specific profiles provide information on health effects, environmental transport, human exposure, and regulatory status. Please refer to Table 2 and Table 3 for more information.

### ***Arsenic***

The highest measured arsenic concentration in a private drinking water well of 28.6 parts per billion (ppb) translates to an ingestion dose of 0.002 mg/kg/day for a child (the most sensitive population). This dose is at the lowest LOAEL (lowest observable adverse effect level) for non-cancerous effects. This dose (0.002 mg/kg/day) is associated with increased prevalence of stroke

in humans. The dose for adults (0.0008 mg/kg/day), however, is not likely to cause non-cancer illness.

One of the most common and characteristic effects of chronic exposure to arsenic from drinking water is the appearance of skin lesions (hyperkeratotic warts or corns) on the palms and soles. Other sensitive effects include generalized hyperkeratosis (thickening of the skin) and areas of hyperpigmentation (dark skin) interspersed with small areas of hypopigmentation (light skin) on the face, neck, and back. The lowest dose associated with these effects (0.01 mg/kg/day) is 5 times higher than the dose (0.002 mg/kg/day) for a child and 10 times higher than the dose (0.0008 mg/kg/day) for an adult. Although, these effects are not likely at the levels found in Fuller Heights, they indicate possible health effects from long-term arsenic exposure at higher levels.

At the highest arsenic level found, there is a 5 in 10,000 risk of cancer for adults drinking 2 liters of water daily for 30 years and a 1 in 10,000 risk of cancer for children. This is a low to moderate increased risk for cancer. Chronic exposure to low doses of arsenic in people has been linked to lung cancer.

Arsenic is not volatile, thus there would not be an inhalation (breathing) exposure to showering with water at this arsenic level. Arsenic is a metal and the skin does not absorb metals well. The average daily dose to arsenic from dermal exposure is 0.000003 mg/kg/day for a child and 0.000002 mg/kg/day for an adult. These doses are 2,000,000 times and 3,000,000 times, respectively, lower than the LOAEL (6 mg/kg/day) associated with gross hyperplasia and ulceration for intermediate exposure in mice. Therefore, no dermal or inhalation problems from showering with this water are likely (ATSDR, 2000 and ATSDR, 2005b).

### ***Bromodichloromethane***

Worst-case exposure scenarios for drinking bromodichloromethane did not generate doses for children or adults high enough to cause cancer or non-cancer health effects. The dose for an adult (0.00002 mg/kg/day) is about 1000 times lower than the chronic oral MRL (0.02 mg/kg/day). The dose for a child (0.00004 mg/kg/day) is about 500 times lower than the chronic oral MRL. The theoretical increased risk (less than 1 in 1,000,000) of cancer from consuming water with this level of bromodichloromethane for either children or adults is insignificant.

Bromodichloromethane is very volatile; however, no studies were located regarding toxic effects in humans or animals following inhalation exposure. Studies were not located regarding toxic effects in humans or animals following dermal exposure. Thus, it is unknown whether toxic effects will result from inhalation or dermal exposure to bromodichloromethane (ATSDR, 1989).

### ***Fluoride***

Worst-case exposure scenarios for drinking fluoride did not generate doses for children or adults high enough to cause non-cancer health effects. The dose for an adult (0.02 mg/kg/day) is 2.5 times lower than the chronic oral MRL (0.05 mg/kg/day). The dose for a child (0.04 mg/kg/day) is less than the chronic oral MRL (0.05 mg/kg/day). Fluoride is a naturally occurring substance that many cities add to the water supply to prevent dental cavities.

Fluoride is not classified based on its carcinogenicity. The highest calculated dose for an adult (0.02 mg/kg/day) is 130 times lower than the dose (2.4 mg/kg/day) that caused osteosarcoma (cancer) of bone in rats following oral exposure to sodium fluoride. The dose for a child (0.04

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mg/kg/day) is 50 times lower than the dose (2.4 mg/kg/day) that caused cancerous effects in rats following oral exposure to sodium fluoride. Thus, it is not likely that fluoride at levels found in the private wells in the Fuller Heights community is likely to cause cancer.

No inhalation problems from showering with this water are likely because fluoride is not volatile. The average daily dose to fluoride from dermal exposure is 0.00006 mg/kg/day for a child and 0.000043mg/kg/day for an adult. The only study located regarding effects following dermal exposure involved applying sodium fluoride (0.5 or 1.0%) to the abraded skin of rats. This is equivalent to applying 5,000,000 ppb of sodium fluoride to the skin. The highest concentration of fluoride in a Fuller Heights well is only 337 ppb. It is highly unlikely that toxic effects will result from dermal exposure to fluoride because it is a metal. The skin does not absorb metals well (ATSDR, 2003 and US EPA, 2005b).

### *Nitrate*

Worst-case exposure scenarios for nitrate in drinking water generated doses for infants high enough to cause non-cancer health effects. The highest measured nitrate concentration of 29,000 ppb translates to a dose of 4.6 mg/kg/day for an infant (the most sensitive population), which is higher than the lowest observable adverse effect level of 1.8 - 3.2 mg/kg/day. That nitrate level (29,000 ppb) is equivalent to a dose of 0.8 mg/kg/day for adults and a dose of 1.9 mg/kg/day for children 1-3 years old. The doses for adults and children 1-3 years old are unlikely to cause health effects, unless the person is particularly susceptible to nitrate levels as explained below.

Nitrates are hazardous when consumed by infants, which may cause acquired methemoglobinemia or “blue-baby” syndrome. Infants, especially those under 4 months old, have underdeveloped digestive systems that promote bacterial growth. These bacteria can convert ingested nitrates to nitrites. The nitrites can react with hemoglobin (the oxygen carrier in blood) to form methemoglobin. If enough hemoglobin transforms into methemoglobin, then oxygen deficiencies throughout the body can result because methemoglobin does not transport oxygen to the tissues. Oxygen deficiency can cause the baby to look blue, slate-grey, or chocolate brown (cyanosis) because there is too much methemoglobin (10-20% of total hemoglobin) in the blood. Other adverse reactions include labored breathing, headache, dizziness, nausea, vomiting, and diarrhea at methemoglobin levels between 20-45% of total hemoglobin. If concentrations of methemoglobin increase even further (45-55% of total hemoglobin), irregular heartbeat, shock, convulsions, or coma may result. At methemoglobin levels greater than 70%, death may result (ATSDR, 2001).

To prevent acquired methemoglobinemia, do not make formula or let infants less than 6 months (especially those under 4 months old) consume water with nitrate levels above 10,000 ppb. There are not any long term effects unless the methemoglobinemia is not treated, at which point death can occur. If your infant less than 6 months old is drinking unfiltered water with nitrate levels above 10,000 ppb and the skin of your infant turns a bluish, slate-grey, or chocolate brown color, then you should take your infant to the doctor. Treatment for methemoglobinemia includes methylene blue, exchange transfusion, and hyperbaric oxygen therapy. In severe cases, blood transfusion may be necessary (ATSDR, 2001).

There are not any effects associated with adults or children over 6 months of age from drinking groundwater with these nitrate levels, unless they are a particularly susceptible population. Sensitive populations include pregnant women around the 30<sup>th</sup> week of pregnancy (because their

methemoglobin level naturally increases) and adults with methemoglobin reductase enzyme deficiencies or an abnormal hemoglobin molecule as in hemoglobin M disease (ATSDR, 2001 and US EPA, 2005a). Other susceptible populations include adults with achlorhydria or atrophic gastritis or similar disease that increase the pH of the gastric fluids because this promotes conversion of nitrate to nitrites. This conversion within the body results in an increased risk of acquired methemoglobinemia. Nitrates have not been examined for their carcinogenicity (US EPA, 2005a).

Nitrates are not volatile compounds and thus inhalation effects from showering with water at the highest nitrate level are not likely. No studies were found detailing effects following nitrate dermal exposure. However, it is unlikely that nitrate would be absorbed well by the skin because it is not lipid soluble. Nitrates are very water soluble, which means it would wash right off your skin in the shower.

### ***Radium 226/228***

Worst-case exposure scenario for radium 226/228 in drinking water did not generate doses high enough to cause non-cancer health effects. The highest level of radium 226/228 found in the private wells in Fuller Heights was 6.9 pCi/L (picocuries per liter). This is only slightly higher than the radium standard of 5 pCi/L. If a person drinks water containing radium at the highest level found for 30 years, he or she is unlikely to experience health effects. The total dose of 0.002  $\mu\text{Ci/kg}$  (microcuries per kilogram) for an adult is 30 times less than the lowest dose (0.062  $\mu\text{Ci/kg}$ ), which caused melanosis (abnormally dark pigmentation) and intraocular melanoma (cancer of the eye) formation in the eyes of beagle dogs. The total dose (0.0005  $\mu\text{Ci/kg}$ ) for a child is 100 times less than the lowest dose (0.062  $\mu\text{Ci/kg}$ ) causing those sensitive effects.

Based on data from the radium dial painters, the lowest level (estimated) of radium associated with malignancy (bone sarcomas and head carcinomas) is 1.03  $\mu\text{Ci/kg}$ . This level is 500 times higher than the total dose (0.002  $\mu\text{Ci/kg}$ ) expected for an adult drinking unfiltered private well water for 30 years at the highest radium 226/228 level in Fuller Heights. The level associated with malignancy is 2000 times higher than the total dose (0.0005  $\mu\text{Ci/kg}$ ) for a child. Thus, it is unlikely that people drinking unfiltered well water will have an increased risk of developing cancer.

No inhalation effects from showering with this water are likely, because radium 226/228 are not volatile. No studies were located regarding health effects in humans or animals after dermal exposure to radium. Radium dial painters had chronic dermal exposure to radium on their lips and tongues. The literature has not described effects on the exposed skin of the workers. In addition, it is unlikely that radium will cause adverse health effects following dermal exposure because the skin does not absorb it well (ATSDR, 1990).

### ***Thallium***

Worst-case scenario exposure levels for thallium in drinking water are not likely to cause non-cancer health effects for either children or adults. The dose of thallium for a child (0.0003 mg/kg/day) from drinking water with the highest level (3.1 ppb) is approximately 250 times lower than the lowest LOAEL of 0.08 mg/kg/day associated with developmental performance deficits in rats for acute exposure. The dose of thallium for an adult (0.0001 mg/kg/day) is 800 times lower than the lowest LOAEL (0.08 mg/kg/day). The dose of thallium for a child (0.0003 mg/kg/day) is 700 times lower than the lowest NOAEL (no observable adverse effects level) of

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0.2 mg/kg/day for intermediate exposure, while the dose for an adult (0.0001 mg/kg/day) is 2,000 times lower. This NOAEL is protective of systemic and neurological effects. Thus, thallium is not likely to cause adverse health effects in children or adults. No studies were located regarding cancer effects in humans or animals after oral exposure to thallium.

No inhalation effects from showering with water at the highest thallium levels are likely because thallium is not a volatile compound. No studies could be located regarding health effects in humans or animals after dermal exposure to thallium. However, it is unlikely that thallium would cause health effects after dermal exposure because it is a metal and not well absorbed by the skin (ATSDR, 1992).

## Child Health Considerations

ATSDR and DOH recognize the unique vulnerabilities of infants and children demand special attention. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than are adults; this means they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus, adults need as much information as possible to make informed decisions regarding their children's health.

In recognition of these concerns, the federal ATSDR developed the chemical screening values for children's exposures that DOH used in preparing this report.

Susceptible populations may have different or enhanced responses to toxic chemicals than will most persons exposed to the same levels of that chemical in the environment. Reasons may include genetic makeup, age, health, nutritional status, and exposure to other toxic substances (like cigarette smoke or alcohol). These factors may limit a susceptible persons' ability to detoxify or excrete harmful chemicals or may increase the effects of damage to their organs or systems.

Nitrate found in Fuller Heights groundwater is of special concern to infants less than 4 months old because of the risk of acquired methemoglobinemia, discussed earlier (ATSDR, 2001).

## Conclusions

The most important public health activities are to identify wells with elevated contaminant levels and to promote safe practices (e.g., limiting drinking water intake from the contaminated source).

1. *Past* exposures in the Fuller Heights community are a **public health hazard** if levels of contaminants were the same as the current highest levels for 30 years. However, we do not have private well sampling data prior to 2004. The source of the pollutants is unknown, so it is not possible to determine whether the levels of those contaminants have changed significantly through time. Levels in the past could have been higher or lower than current levels.
2. *Current* exposures are a **no apparent public health hazard** for residents drinking filtered well water. DEP has installed and maintained appropriate filters on all homes

with contaminated wells. DEP is also working to connect those residents to city water. There is not a public health risk for residents drinking filtered water from their contaminated wells or using unfiltered water from wells that are not contaminated. However, if residents with the highest nitrate and arsenic levels choose to bypass their filters or otherwise not use them for drinking water, then there is a **public health hazard** for those residents. To minimize public risk, DEP is testing for contamination quarterly and encouraging residents with contaminated wells to use the installed filters.

3. *Future* exposures are a **public health hazard** for residents drinking unfiltered well water. Not all of the wells in the Fuller Heights neighborhood are contaminated. Only those wells that are contaminated have filters installed. Should contamination reach unfiltered wells at the highest arsenic and nitrate levels, there is a public health hazard for those residents. To minimize public risk, DEP is testing for contamination quarterly and installing appropriate filters on contaminated wells.
4. DEP installed filters in homes served by wells that have elevated arsenic and nitrate levels. To protect public health from current and future exposures, these filters should be used. With those filters in place and working properly, people will not be exposed to the increased arsenic and nitrate levels. Thus, they are not likely to experience the adverse health effects associated with drinking water at the highest measured arsenic and nitrate levels. To prevent acquired methemoglobinemia, filtered drinking water should be used to make infant formula.

## Recommendations

1. Identify specific wells with elevated arsenic and nitrate concentrations in the Fuller Heights community. The Department of Environmental Protection is currently testing wells quarterly for arsenic and nitrate to identify specific wells with elevated contaminant levels.
2. Install and maintain appropriate filters for wells with arsenic and nitrate levels above drinking water standards. DEP has been doing this so that arsenic and nitrate levels are reduced to protect public health.
3. Parents should prevent their children from drinking unfiltered well water with arsenic or nitrate levels above the standards.
4. Pregnant women (30<sup>th</sup> week) and infants less than six months old (especially those less than 4 months old) should not drink unfiltered well water that contains nitrate at levels greater than 10,000 ppb. Do not prepare baby formula with unfiltered well water that contains nitrate at levels greater than 10,000 ppb.

## Public Health Action Plan

- DEP is testing the private wells in the Fuller Heights community quarterly for arsenic, nitrates, and thallium to identify wells that exceed the applicable standards. Homes that depend on the wells that exceed the standards are fitted with the appropriate filter based on the contamination.
- DEP is working to secure a reliable drinking water source for the Fuller Heights community by connecting them to the municipal water supply. Those residents whose



wells exceed applicable standards would be able to connect to the water supply for free. Other residents whose wells do not exceed applicable standards would be able to connect to the water supply for a fee.

- DOH will inform residents of Fuller Heights of the findings in this health consultation.
- DOH, Bureau of Community Environmental Health staff will evaluate additional test results as they become available.

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## References

- [ATSDR] Agency for Toxic Substances and Disease Registry. 1989. Toxicological profile for bromodichloromethane. Atlanta: U.S. Department of Health and Human Services.
- [ATSDR] Agency for Toxic Substances and Disease Registry. 1990. Toxicological profile for radium. Atlanta: U.S. Department of Health and Human Services.
- [ATSDR] Agency for Toxic Substances and Disease Registry. 1992. Toxicological profile for thallium. Atlanta: U.S. Department of Health and Human Services.
- [ATSDR] Agency for Toxic Substances and Disease Registry. 2000. Toxicological profile for arsenic. Atlanta: U.S. Department of Health and Human Services.
- [ATSDR] Agency for Toxic Substances and Disease Registry. 2001. Case study in environmental medicine. Nitrate/Nitrite Toxicity. Atlanta: U.S. Department of Health and Human Services.
- [ATSDR] Agency for Toxic Substances and Disease Registry. 2003. Toxicological profile for fluorides, hydrogen fluoride, and fluorine. Update. Atlanta: U.S. Department of Health and Human Services.
- [ATSDR] Agency for Toxic Substances and Disease Registry. 2005a. Public Health Assessment Guidance Manual. Update. Atlanta: U.S. Department of Health and Human Services.
- [ATSDR] Agency for Toxic Substances and Disease Registry. 2005b. Toxicological profile for arsenic. Draft for Public Comment. Atlanta: U.S. Department of Health and Human Services.
- [ATSDR] Agency for Toxic Substances and Disease Registry. 2005c. Water Comparison Values. Atlanta: U.S. Department of Health and Human Services.
- [FDEP] Florida Department of Environmental Protection. 2005a. Drinking water standards, monitoring and reporting for public drinking water systems. Chapter 62-550, Florida Administrative Code (F.A.C.). Tallahassee, Florida.
- [FDEP] Florida Department of Environmental Protection. 2005b. Fact Sheet: Fuller Heights Assessment, Polk County, March 2005.
- [FDEP] Florida Department of Environmental Protection. 2005c. Fact Sheet: Fuller Heights
- [FDEP and Polk CHD] Florida DEP and Polk County Health Department. 2005. December 2004 – October 2005 environmental sampling data, private drinking water well test results. Fuller Heights community, Mulberry, Florida.
- US Bureau of the Census. 2000. LandView@5 Software on DVD, A Viewer for EPA, Census and USGS Data and Maps. Washington, DC: US Department of Commerce.
- [US EPA] United States Environmental Protection Agency. 2005a. Integrated Risk Information System (IRIS) database. Nitrate. <http://www.epa.gov/iris/subst/0076.htm> accessed 10/12/05.
- [US EPA] United States Environmental Protection Agency. 2005b. Integrated Risk Information System (IRIS) database. Fluoride. <http://www.epa.gov/iris/subst/0053.htm> accessed 11/15/05.

**Appendix A: Tables and Figures**

**Table 1: Contaminants of Concern in Fuller Heights Private Drinking Water Wells**

<i>Contaminant of Concern</i>	<i>Lowest Concentration</i>	<i>Average Concentration**</i>	<i>Highest Concentration</i>	<i>Comparison Value*</i>	<i>Source of Comparison Value</i>	<i>Number of Water Samples Above Comparison Value</i>
Arsenic	Below Detection Limit of 0.09 ppb	4.6 ppb	28.6 ppb	0.02 ppb	CREG	114/128
Bromodichloromethane	Below Detection Limit of 0.19 ppb	0.515 ppb	0.61 ppb	0.6 ppb	CREG	1/54
Fluoride	120 ppb	337 ppb	660 ppb	500 ppb	Child Chronic EMEG	9/55
Nitrate	Below Detection Limit of 18 ppb	7316 ppb	29,000 ppb	10,000 ppb	MCL	23/128
Radium 226/228	5 pCi/L	5.76 pCi/L	6.9 pCi/L	5 pCi/L	MCL	5/7
Thallium	Below Detection Limit of 0.19 ppb	0.96 ppb	3.9 ppb	0.5 ppb	LTHA	25/128

\* Florida DOH uses Comparison Values to select chemicals for further scrutiny, not for determining the possibility of illness.

\*\* Average is of all samples above the detection limit.

CREG – ATSDR Cancer Risk Evaluation Guide

EMEG – ATSDR Environmental Media Evaluation Guide

MCL – EPA Maximum Contaminant Level

LTHA – EPA Lifetime Health Advisory Level

pCi/L – picocuries per liter

ppb – parts per billion

Source of data: FDEP and Polk CHD, 2005.

**Table 2: Estimated Doses from Oral Exposure to Groundwater**

<i>Contaminant of Concern</i>	<i>Oral MRL (mg/kg/day)</i>	<i>Estimated Drinking Water Ingestion (mg/kg/day)</i>	
		Child	Adult
Arsenic	0.0003 Chronic	0.002	0.0008
Bromodichloromethane	0.02 Chronic	0.00004	0.00002
Fluoride	0.05 Chronic	0.04	0.02
Nitrate †	1.6 EPA RfD	1.9	0.8
Radium 226/228*	None	0.0005	0.002
Thallium	None	0.0003	0.0001

\* The Estimated Drinking Water Ingestion for radium, measured in total  $\mu\text{Ci}/\text{kg}$  (microcuries per kilogram), is the total amount of radiation ingested for a lifetime per body mass.

† No ATSDR Oral MRL available. EPA's Chronic Oral Reference Dose (RfD) used instead. Units are mg/kg/day (milligrams per kilograms per day).

Note: These are conservative estimates protective of human health and actual exposures will probably be lower because the Oral Average Daily Dose during the exposure period was used rather than the Oral Lifetime Daily Dose.

**Table 3: Estimated Doses from Inhalation Exposure to Groundwater**

<i>Contaminant of Concern*</i>	<i>Inhalation MRL (ppb)</i>	<i>Estimated Showering Inhalation (ppb)</i>	
		Children and Adults	
Bromodichloromethane	None	0.915	

\* Arsenic, fluoride, nitrate, radium 226/228, and thallium are not volatile. Thus, they are not an inhalation problem while showering. Note: These are conservative estimates protective of human health and actual exposures will probably be lower because the Oral Average Daily Dose during the exposure period was used rather than the Oral Lifetime Daily Dose.

**Table 4: Estimated Doses from Dermal Exposure to Groundwater**

<i>Contaminant of Concern *</i>	<i>Dermal MRL (mg/kg/day)</i>	<i>Estimated Showering Dermal Exposure (mg/kg/day)</i>	
		Child	Adult
Bromodichloromethane	None	0.000002	0.000001
Nitrate	None	0.002784	0.001906

\* Arsenic, fluoride, radium 226/228, and thallium are metals. Metals are poorly absorbed through the skin and thus do not constitute a health risk through dermal exposure while showering.

Note: These are conservative estimates protective of human health and actual exposures will probably be lower because the Oral Average Daily Dose during the exposure period was used rather than the Oral Lifetime Daily Dose.

# Map of Florida



**Figure 1: Polk County in Florida**

SOURCE: FLORIDA DOH FILES



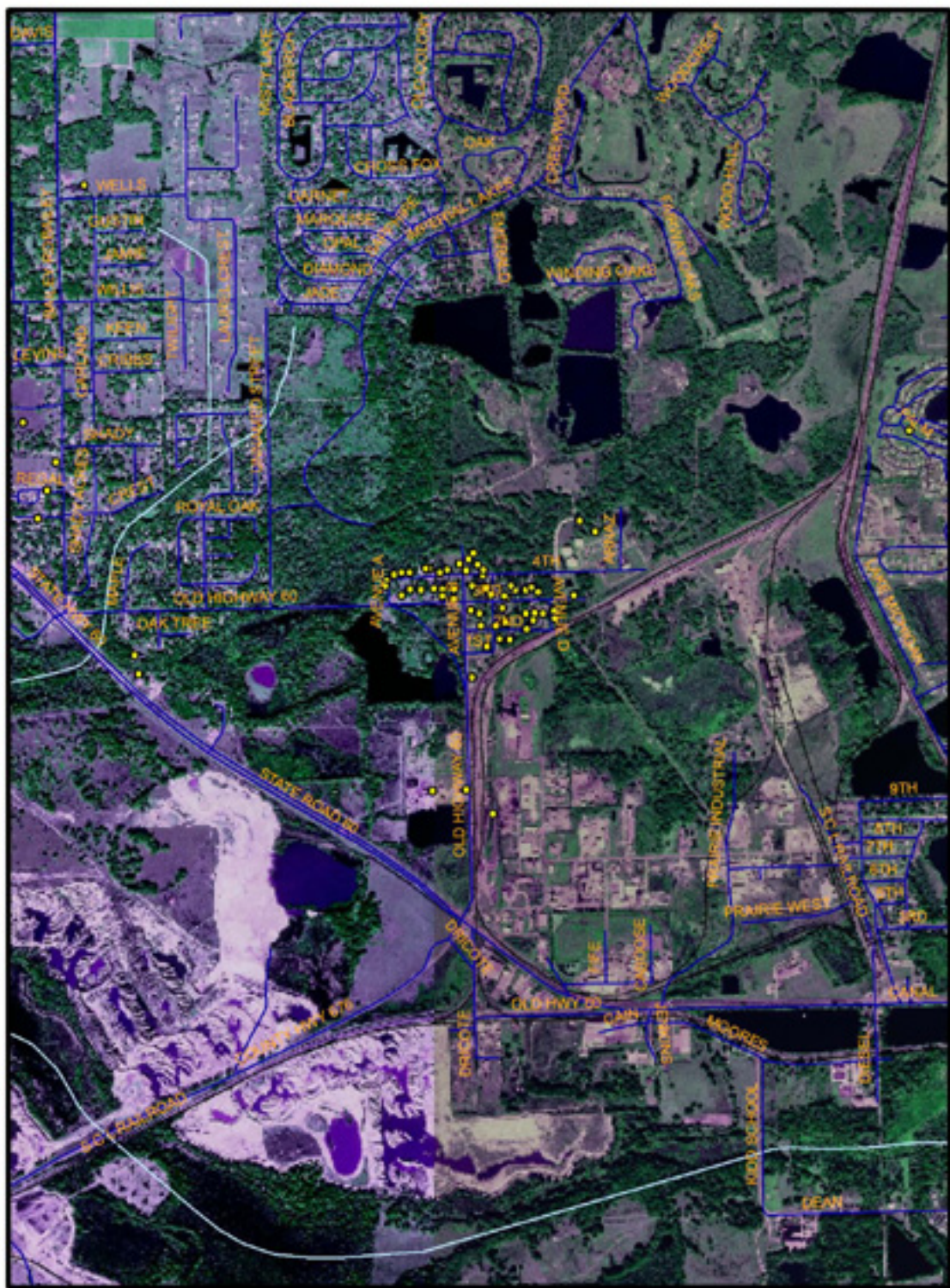
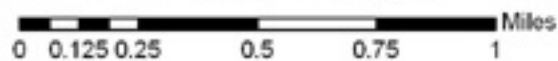


Figure 2: Fuller Heights Community



Key: Each yellow circle is a gunshot well

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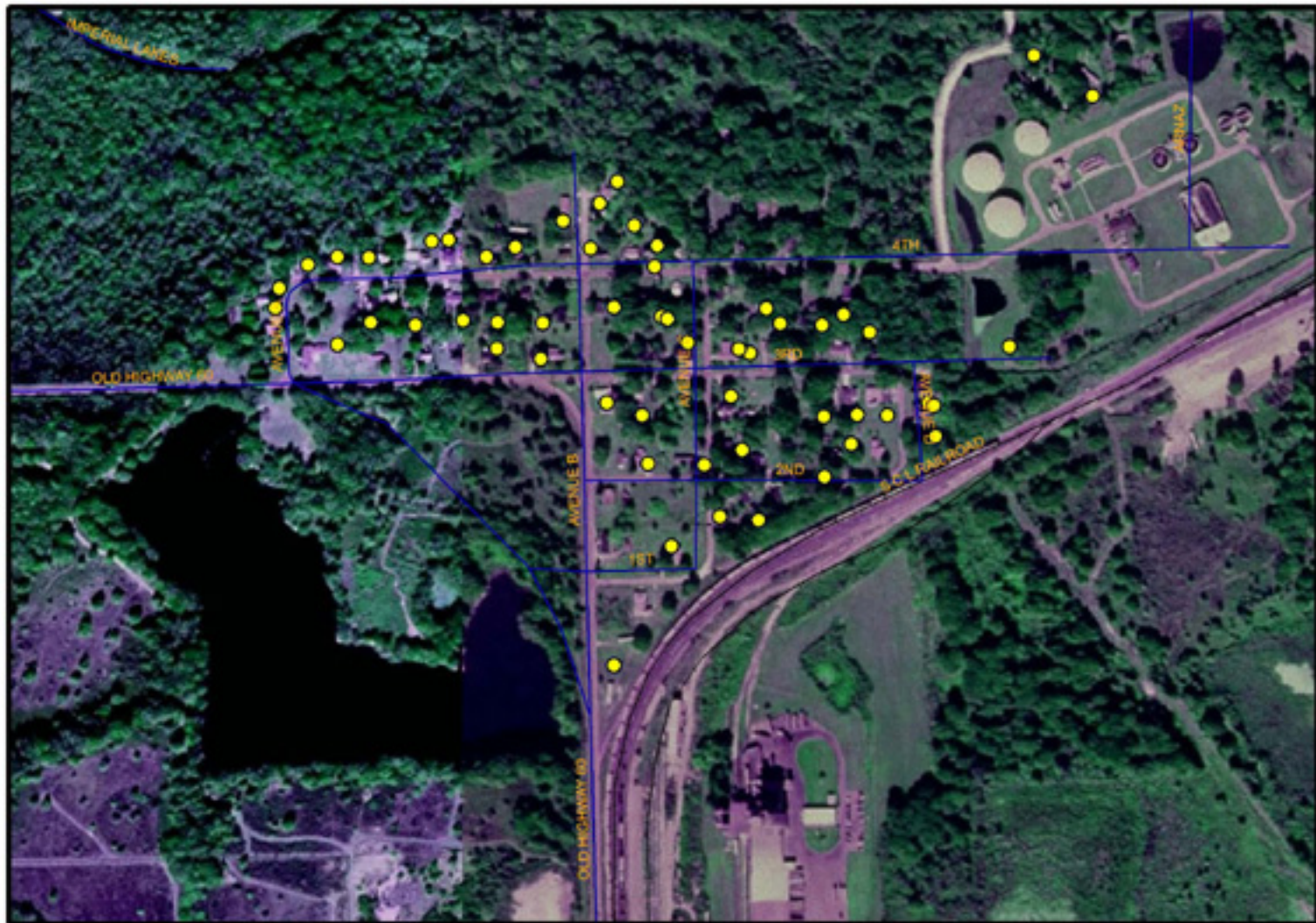


Figure 3: Fuller Heights Community



Key: Each yellow circle is a private well.

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## Appendix B: Glossary of Environmental Health Terms

This glossary defines words used by the Agency for Toxic Substances and Disease Registry (ATSDR) in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-422-8737.

### **Absorption**

The process of taking in. For a person or an animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

### **Acute**

Occurring over a short time [compare with chronic].

### **Acute exposure**

Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

### **Additive effect**

A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with antagonistic effect and synergistic effect].

### **Adverse health effect**

A change in body function or cell structure that might lead to disease or health problems

### **Aerobic**

Requiring oxygen [compare with anaerobic].

### **The Agency for Toxic Substances and Disease Registry (ATSDR)**

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances.

### **Ambient**

Surrounding (for example, *ambient* air).

### **Anaerobic**

Requiring the absence of oxygen [compare with aerobic].

### **Analyte**

A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

### **Analytic epidemiologic study**

A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

### **Antagonistic effect**

A biologic response to exposure to multiple substances that is **less** than would be expected if the known effects of the individual substances were added together [compare with additive effect and synergistic effect].

**Background level**

An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

**Biodegradation**

Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

**Biologic indicators of exposure study**

A study that uses (a) biomedical testing or (b) the measurement of a substance [an analyte], its metabolite, or another marker of exposure in human body fluids or tissues to confirm human exposure to a hazardous substance [also see exposure investigation].

**Biologic monitoring**

Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

**Biologic uptake**

The transfer of substances from the environment to plants, animals, and humans.

**Biota**

Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

**CAP** [see Community Assistance Panel.]

**Cancer**

Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

**Cancer risk**

A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

**Carcinogen**

A substance that causes cancer.

**Case study**

A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

**Case-control study**

A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

**Central nervous system**

The part of the nervous system that consists of the brain and the spinal cord.

**CERCLA** [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980]

**Chronic**

Occurring over a long time [compare with acute].

**Chronic exposure**

Contact with a substance that occurs over a long time (more than 1 year) [compare with acute exposure and intermediate duration exposure]

**Cluster investigation**

A review of an unusual number, real or perceived, of health events (for example, reports of

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cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

**Community Assistance Panel (CAP)**

A group of people from a community and from health and environmental agencies who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

**Comparison value (CV)**

Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

**Completed exposure pathway** [see exposure pathway].

**Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)**

CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).

**Concentration**

The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

**Contaminant**

A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

**Delayed health effect**

A disease or an injury that happens as a result of exposures that might have occurred in the past.

**Dermal**

Referring to the skin. For example, dermal absorption means passing through the skin.

**Dermal contact**

Contact with (touching) the skin [see route of exposure].

**Descriptive epidemiology**

The study of the amount and distribution of a disease in a specified population by person, place, and time.

**Detection limit**

The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

**Dose (for chemicals that are not radioactive)**

The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated

water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An “exposure dose” is how much of a substance is encountered in the environment. An “absorbed dose” is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

**Dose (for radioactive chemicals)**

The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

**Dose-response relationship**

The relationship between the amount of exposure [dose] to a substance and the resulting changes in body function or health (response).

**Environmental media**

Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

**Environmental media and transport mechanism**

Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an exposure pathway.

**EPA**

United States Environmental Protection Agency.

**Epidemiologic surveillance** [see Public health surveillance].

**Epidemiology**

The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

**Exposure**

Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

**Exposure assessment**

The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

**Exposure-dose reconstruction**

A method of estimating the amount of people’s past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

**Exposure investigation**

The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

**Exposure pathway**

The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or

touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

**Exposure registry**

A system of ongoing follow up of people who have had documented environmental exposures.

**Feasibility study**

A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

**Groundwater**

Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].

**Hazard**

A source of potential harm from past, current, or future exposures.

**Hazardous Substance Release and Health Effects Database (HazDat)**

The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

**Hazardous waste**

Potentially harmful substances that have been released or discarded into the environment.

**Health investigation**

The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to evaluate the possible association between the occurrence and exposure to hazardous substances.

**Indeterminate public health hazard**

The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

**Incidence**

The number of new cases of disease in a defined population over a specific time period [contrast with prevalence].

**Ingestion**

The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].

**Inhalation**

The act of breathing. A hazardous substance can enter the body this way [see route of exposure].

**Intermediate duration exposure**

Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].

**In vitro**

In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with in vivo].

**In vivo**

Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with in vitro].

**Lowest-observed-adverse-effect level (LOAEL)**

The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

**Medical monitoring**

A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

**Metabolism**

The conversion or breakdown of a substance from one form to another by a living organism.

**Metabolite**

Any product of metabolism.

**mg/kg**

Milligram per kilogram.

**mg/cm<sup>2</sup>**

Milligram per square centimeter (of a surface).

**mg/m<sup>3</sup>**

Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

**Migration**

Moving from one location to another.

**Minimal risk level (MRL)**

An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

**National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)**

EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

**National Toxicology Program (NTP)**

Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.

**No apparent public health hazard**

A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

**No-observed-adverse-effect level (NOAEL)**

The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

**No public health hazard**

A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

**NPL** [see National Priorities List for Uncontrolled Hazardous Waste Sites]



**Plume**

A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

**Point of exposure**

The place where someone can come into contact with a substance present in the environment [see exposure pathway].

**Population**

A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

**Potentially responsible party (PRP)**

A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

**ppb**

Parts per billion.

**ppm**

Parts per million.

**Public availability session**

An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

**Public comment period**

An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

**Public health action**

A list of steps to protect public health.

**Public health advisory**

A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

**Public health assessment (PHA)**

An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health.

**Public health hazard**

A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.

**Public health hazard categories**

Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.

**Public health statement**

The first chapter of an ATSDR toxicological profile. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

**Public health surveillance**

The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

**Receptor population**

People who could come into contact with hazardous substances [see exposure pathway].

**Reference dose (RfD)**

An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

**Remedial investigation**

The CERCLA process of determining the type and extent of hazardous material contamination at a site.

**RfD** [see reference dose]**Risk**

The probability that something will cause injury or harm.

**Risk reduction**

Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

**Risk communication**

The exchange of information to increase understanding of health risks.

**Route of exposure**

The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].

**Safety factor** [see uncertainty factor]**SARA** [see Superfund Amendments and Reauthorization Act]**Sample**

A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

**Sample size**

The number of units chosen from a population or an environment.

**Source of contamination**

The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

**Special populations**

People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette

smoking). Children, pregnant women, and older people are often considered special populations.

**Statistics**

A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

**Substance**

A chemical.

**Superfund** [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)]

**Superfund Amendments and Reauthorization Act (SARA)**

In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

**Surface water**

Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

**Surveillance** [see public health surveillance]

**Survey**

A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see prevalence survey].

**Synergistic effect**

A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see additive effect and antagonistic effect].

**Teratogen**

A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

**Toxic agent**

Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

**Toxicological profile**

An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

**Toxicology**

The study of the harmful effects of substances on humans or animals.

**Tumor**

An abnormal mass of tissue that results from excessive cell division that is uncontrolled and

progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

**Uncertainty factor**

Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a safety factor].

**Urgent public health hazard**

A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

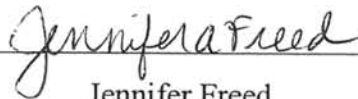
**Volatile organic compounds (VOCs)**

Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, and methylene chloride.

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## CERTIFICATION

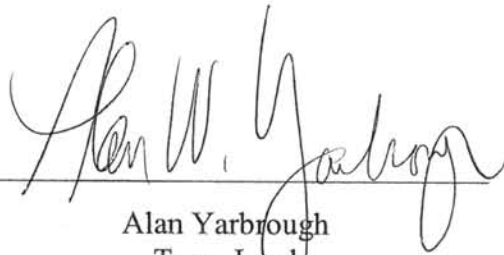
The Florida Department of Health, Bureau of Community Environmental Health prepared this Health Consultation under a cooperative agreement with the Agency for Toxic Substances and Disease Registry. It followed approved methodology and procedures existing at the time it began. The Cooperative Agreement Partner completed editorial review.



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Jennifer Freed  
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CAT, SPAB, DHAC

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



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Alan Yarbrough  
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CAT, SPAB, DHAC, ATSDR