February 11, 2013

C. Dewayne Tanner
District Environmental Health Director
Georgia Department of Public Health
Environmental Health Division
Southwest Health District
1109 Jackson Street
Albany, GA 31701

RE: Elevated Levels of Arsenic in Thomas County Water Wells

Dear Mr. Tanner,

The Georgia Department of Public Health (DPH) has evaluated private well water analyses results showing elevated levels of arsenic in several wells in Thomas County. After reviewing the area's history, local hydrogeology, and conferring with experts, it was determined that the arsenic is naturally occurring. While exposure to elevated levels of arsenic in drinking water for a short period of time is not an immediate health concern, arsenic may pose a health risk when the water is used for drinking and cooking over many years.

In response to potential health risks and community concerns, DPH conducted this health consultation. A health consultation is designed to provide information about the public health implications of a specific exposure, and to identify populations for which further health actions are needed. It is not intended to serve the purpose of or influence any other environmental investigation such as risk assessment or selection of remedial measures, or to address liability or other non-health issues. This document considers public health issues for human exposure that has or may have occurred, is or may be occurring, or may occur in the future.

It is essential to test all new water wells and all wells for toxic chemicals, including arsenic, every three years. Arsenic does not affect the color, odor, or taste of water, therefore testing is the only way to determine if arsenic is present. Although private water wells are not subject to the same regulatory standards as those set for public drinking water supplies, it is recommended for health purposes that private well owners use these standards to guide their water treatment decisions. If arsenic levels exceed the federal safe drinking water standards, DPH recommends water filtration or finding alternative sources of drinking water to reduce exposure levels.

For information about well testing and water filters, please contact the Thomas County Cooperative Extension at 229-225-4130. For information about this document, please contact:

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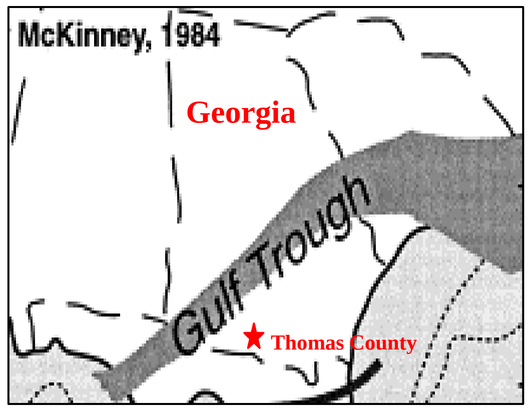
BACKGROUND

In October, 2011 DPH was notified by a resident that arsenic was found in private drinking water wells in Thomas County, Georgia at concentrations that exceed the federal drinking water standard. The resident described health problems and reported that neighbors have health complaints they think may be a result of arsenic exposure, including cancer, weight loss, difficulty swallowing, night blindness, fatigue, hair loss, stomach, kidney and bladder problems, and sick pets. The resident requested information about arsenic levels in the five surrounding counties (Lowndes, Colquitt, Decatur, Grady, and Brooks). DPH reviewed well water analyses results, the area's history, local hydrogeology, and conferred with experts, and determined that the arsenic is naturally occurring. The presence of arsenic is located in a region with a geological formation known as the 'Gulf Trough'. Major structural features that affect the geology and hydrogeology of South Georgia include the Gulf Trough, an area of increased clay content and decreased permeability in Coastal Plain sediments, and which could be of either structural or depositional origin.

If drinking water comes from a public (municipal) water system, it is routinely tested to ensure safe arsenic levels. The water supplier can provide a consumer confidence report for verification. Because the arsenic is naturally occurring, residents are responsible for the water quality of their well. DPH works with residents to address health concerns, including potential health effects from exposure to elevated levels of arsenic in well water.



In response to community concerns, the Thomas County Environmental Health Specialist visited with the resident and found no obvious or suspected surface contamination source. DPH staff conducted several activities:

- Reviewed the federal Superfund[1] and Georgia Hazardous Site Inventory (www.gaepd.org/documents/hazsiteinv) databases and searched Scorecard[2] to determine if a hazardous waste site or a known release might be a potential source of arsenic in groundwater. There are no federal or state listed hazardous waste sites or industries in Thomas County that have a known release of arsenic to soil or groundwater.
- Evaluated private well water sampling results provided by the University of Georgia Cooperative Extension (Appendix A).
- Developed Key Contacts Lists for Thomas County and five surrounding counties (Lowndes, Colquitt, Decatur, Grady, and Brooks) to share information and distribute health education materials with communities.
- Published a brochure, *Naturally-occurring Arsenic in Private Well Water* (Appendix B) and distributed it through the DPH website, local health departments, individual residents, the medical community and key contacts.

[1] Superfund is the common name for the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), a federal law to locate, investigate and clean up uncontrolled and abandoned toxic waste sites, and administered by the U.S. Environmental Protection Agency (www.epa.gov/superfund).

[2] Environmental Defense, a leading national nonprofit environmental advocacy group founded in 1967, launched Scorecard on April 22, 1998 as a free public-information service (www.scorecard.org).

- Distributed a fact sheet, *Elevated Levels of Arsenic in Some Private Well*s (Appendix C) to the medical community (including veterinarians) in the six county area.
- Analyzed applicable cancer and other health outcome incidence data for the six county area (Appendices E and F).

Health Effects of Arsenic

Arsenic is an element that occurs naturally in rocks and soil. Arsenic is the 20th most abundant element in the universe and has been used as a drug for more than 2,500 years [1]. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds that are much less harmful than inorganic arsenic. There are typically two forms of inorganic arsenic in water: "arsenic-III" and "arsenic-V," but arsenic-III often predominates in groundwater and is more toxic to humans. Any water filtration should remove both forms of arsenic. In this report, "arsenic" refers to inorganic arsenic.

When underground water flows over rocks and soil that contain arsenic, the arsenic slowly dissolves into the water. As a result, some private water wells in Georgia may exceed the federal drinking water standard set for arsenic in public water supplies. Arsenic in drinking water can get into the body by drinking, cooking in and preparing food with water containing arsenic. Arsenic is not easily absorbed by the skin, and does not "stick" easily to hard surfaces (such as dishes) or clothing, so cleaning, laundering, brushing teeth, and bathing are not considered routes of exposure.

Using water with high concentrations of arsenic for gardening or irrigating crops can result in the accumulation of arsenic in soil. Edible produce can take up and accumulate arsenic from soil and groundwater. Arsenic concentrations are usually highest at the roots and lowest in leaves and other edible plant parts. Fruiting plants (fruit trees, tomatoes, okra, corn, squash and beans) are least likely to accumulate arsenic in the edible parts, while roots (potatoes, carrots and beets) are more likely. Leafy green vegetables can accumulate soil dust on the edible leaves, which can pose a health risk if the dust has high levels of arsenic.

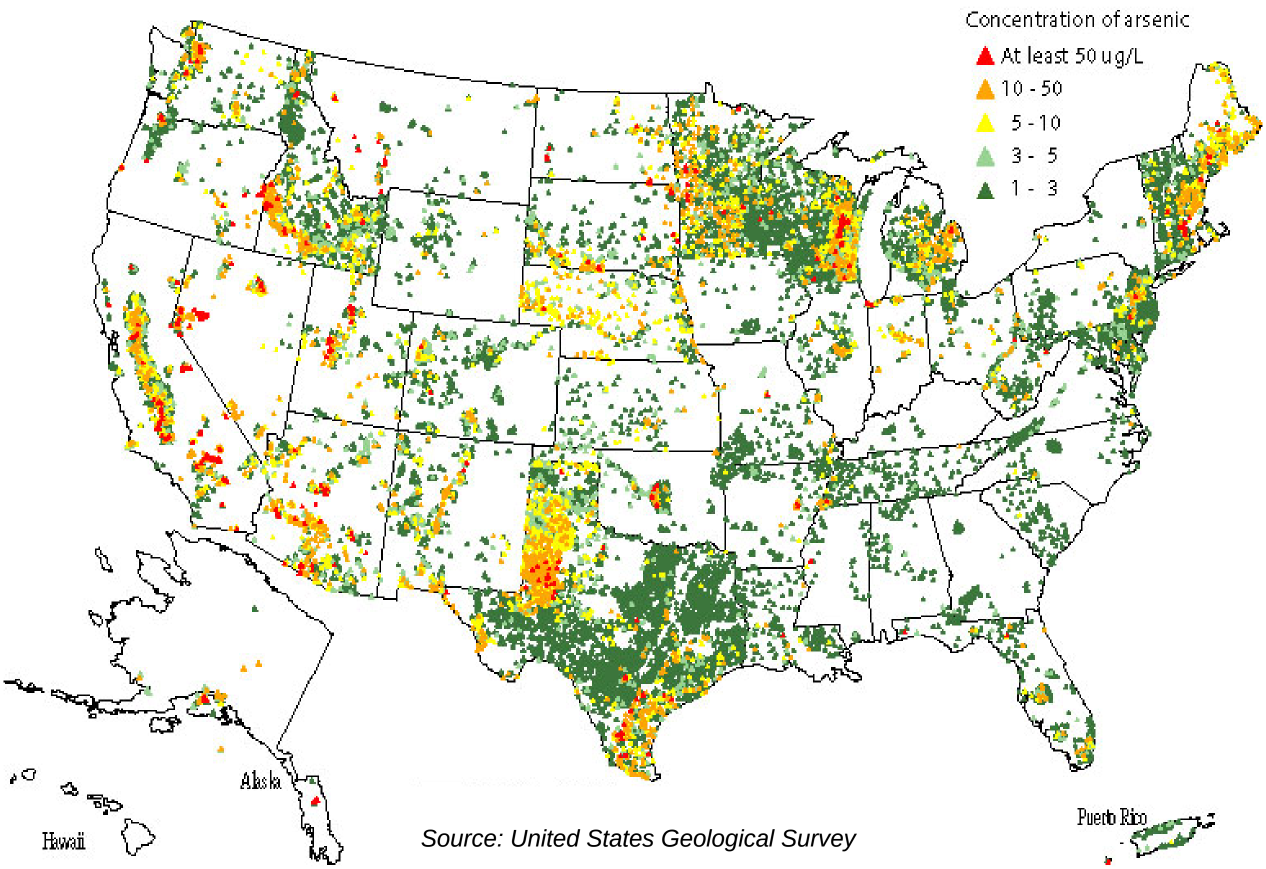
Arsenic has been used for centuries as an intentional poison, and ingesting very high levels of arsenic can result in death. When arsenic is ingested, most of it is excreted in the urine [2]. Health problems from drinking water containing arsenic depend on a person's general health, and people differ in their body's ability to excrete arsenic. Exposure to lower levels can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in the hands and feet. Ingesting low levels of arsenic for a long time can cause a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso. Skin contact with arsenic may cause redness and swelling. There is limited evidence that long-term exposure to arsenic by children may result in lower IQ scores, and that exposure to arsenic in the womb and early childhood may increase mortality in young adults [2]. The U.S. Department of Health and Human Services and the U.S. Environmental Protection Agency (EPA) have determined that inorganic arsenic is a known human carcinogen (causes cancer). Several studies have shown that ingestion of inorganic arsenic can increase the risk of skin cancer and cancer in the liver, bladder, and lungs [2].

Reducing exposure to arsenic can reduce the risk of harmful health effects. While exposure to elevated levels of arsenic in drinking water for a short period of time is not an immediate health concern, arsenic may pose a health risk when the water is used for drinking and cooking over many years. Arsenic exposure can be reduced by substituting a portion of the well water used for drinking and cooking with bottled water, and by installing a point-of-use water filtrations system. If residents are concerned about current arsenic exposure, they can consult with a health care professional for medical evaluation and testing.

Arsenic in Groundwater

It is estimated that more than 25 million Americans are drinking excess arsenic from private wells that are not regulated by cities, states or the federal government [3]. Arsenic occurs in bedrock and shallow wells and the amount of arsenic in well water will vary greatly from place to place. Overall, Georgia has lower arsenic levels in the groundwater than other regions of the United States [United States Geological Survey, 2011] (Figure 1), and testing is the only way to determine if water contains arsenic.

Figure 1. Arsenic concentrations in groundwater *



Source: United States Geological Survey

* Figure 1 is a point-map that shows locations and arsenic concentrations for 31,000 wells and springs sampled between 1973 and 2000 (http://water.usgs.gov/nawqa/trace/pubs/geo_v46n11/).

Under the Safe Drinking Water Act, the EPA establishes maximum contaminant levels (MCLs) for contaminants in public drinking water supplies. MCLs are below levels at which health effects have been observed. Therefore, they are assumed to be protective of public health. In 2006, EPA lowered the MCL for arsenic in municipal drinking water systems from 50 parts per billion (ppb) to 10 ppb.

In March 2011, DPH conducted a health consultation for elevated levels of arsenic in well water in Cairo, Grady County, which is adjacent to Thomas County. The health consultation concluded that:

- Non-cancer adverse health effects from drinking arsenic contaminated water (i.e. arsenic-related skin lesions) are not expected to occur because the estimated exposure doses are many times below exposure doses shown to have adverse health effects in various human studies.
- Drinking water from wells with the highest levels of arsenic over a lifetime may increase the risk for developing cancer.

Laboratory Testing for Arsenic

Ingestion is the most common exposure route for arsenic. After arsenic enters the body it is excreted in the urine, primarily through the kidneys. Because arsenic is rapidly cleared from the blood, blood levels may be normal even when urine levels remain markedly elevated. There are tests available to measure arsenic in blood, urine, hair, and fingernails. The urine test is the most reliable test for arsenic exposure within the last few days. Tests on hair and fingernails can measure exposure to arsenic over the past 6 - 12 months. These tests can determine if exposure to arsenic has occurred. Tests cannot predict whether the arsenic levels present in the body will affect health.

EXPOSURE PATHWAY ANALYSIS

This health consultation contains information about arsenic in private well water, and conclusions about risks to public health. All applicable and valid environmental data are evaluated to determine what actions are needed to protect public health and/or inform communities. The DPH health consultation process emphasizes the importance of exposure dose, or the amount of a contaminant that people might come into contact with, and for how long, they are exposed. Exposure to a toxic chemical does not always result in negative health effects.

DPH evaluated groundwater data for six counties: Thomas, Lowndes, Colquitt, Decatur, Grady, and Brooks. DPH identifies pathways of human exposure by identifying environmental and human components that might lead to contact with contaminants in environmental media (e.g., groundwater). A pathways analysis considers five principle elements: a source of contamination, transport through an environmental medium, a point of exposure, a route of human exposure, and a receptor population. Completed exposure pathways are those in which all five elements are present, and indicate that exposure to a contaminant has occurred in the past, is presently occurring, or will occur in the future. DPH reviewed the available environmental sampling data and identified an exposure pathway that warranted consideration: groundwater from well water that is consumed.

Toxicologic Evaluation

DPH used the federal Agency for Toxic Substances and Disease Registry (ATSDR) comparison values to screen for contaminant levels that may warrant further evaluation. Comparison values (CVs) are concentrations of contaminants that can reasonably (and conservatively) be regarded as harmless, assuming default conditions of exposure. The CVs include ample safety factors to ensure protection of sensitive populations. Because CVs do not represent thresholds of toxicity, exposure to contaminant concentrations above CVs will not necessarily lead to adverse health effects. CVs used in this document are described in more detail in Appendix D. DPH then considers how people may come into contact with the contaminants. Because the level of exposure depends on the route, frequency of exposure, and the concentration of the contaminants, this exposure information is essential to determine if a public health hazard exists.

For Thomas County, the University of Georgia Cooperative Extension analyzed 36 private water samples for arsenic since 2007[3] [4]. Arsenic was detected in 25 samples (rate = 69%). Of these 25 samples, 18 exceeded the MCL of 10 ppb (rate = 73%), ranging from 10.5 ppb to 34.8 ppb. Statewide since 2007, 779 drinking water samples were analyzed for arsenic and detected in 147 samples (rate = 19%). Of those, 49 exceeded the MCL (rate = 33%) with concentrations above the MCL ranging from 10.2 to 122.4 ppb. Results indicate that arsenic was found approximately 4.5 times more often in Thomas County, and just over twice as many samples were above the MCL than throughout the rest of Georgia.

Note: The sampling results may reflect differences in seasonal rainfall where a dilution effect may be have been present during the sampling event.

Well water sampling results for the six counties (Thomas, Lowndes, Colquitt, Decatur, Grady, and Brooks) and the groundwater CVs for arsenic are summarized in Table 1.

TABLE 1. Arsenic levels in private water wells * and comparison values

County	Number of Samples	Number of Detections	Range of Concentrations (ppb)	Number Above MCL (10 ppb)	Health-Based CV (ppb)	Type of CV (Drinking Water)
Thomas	34	25	BRL – 34.8	17	10 3 / 10	MCL EMEG $_{c/a}$
Lowndes	33	33	negligible – 18.2	11		
Colquitt	16	16	negligible – 11.2	4		
Decatur	1	1	6.0	0		
Grady	5	5	negligible – 10.5	1		
Brooks	1	1	negligible	0		

ppb: parts per billion
MCL: Maximum Contaminant Level
BRL: Below Reporting Limit (1 ppb)
EMEG: Environmental Media Evaluation Guide (children/adults)
CV: Comparison Value; Source: ATSDR, Groundwater Comparison Values (August, 20012)
* Source: University of Georgia Cooperative Extension, *http://aesl.ces.uga.edu/water/asu.html*.

For the highest well sampling result (34.8 ppb) exceeding CVs (3 / 10 ppb), we calculated a child and adult exposure dose using assumptions regarding an individual's likelihood of coming into contact with known levels of arsenic in drinking water. The assumptions made for the purpose of calculating an exposure dose include water ingestion rates of one liter per day for a child and two liters per day for an adult, and using a child body weight of 16 kilograms (kg) and 70 kg for an adult body weight. The evaluation process used in this document is described in Appendix D.

[3] In 2007, the University of Georgia, Agricultural and Environmental Services Laboratory installed a Sensitive Instrument (ICPAVOES) to test for trace elements, including arsenic.

Noncancer Health Effects

The estimated exposure doses for both children and adults are slightly higher than the chronic, oral minimal risk level[4] (MRL) from consuming water from private drinking water well with an arsenic level of 34.8 ppb. The MRL is a chemical-specific, health-based value based on available scientific literature and is considered protective of human health. Non-carcinogenic effects, unlike carcinogenic effects, are believed to have a threshold, that is, a dose below which adverse health effects will not occur. As a result, health-based guidelines such as the MRL are derived, usually from animal toxicology experiments (if no human data is available), from a dose at which a no observed adverse effect level (NOAEL), is observed. The NOAEL is modified with an uncertainty (or safety) factor, which reflects the degree of uncertainty that exists when experimental animal data are extrapolated to the human population and also accounts for human variability.

ATSDR's chronic oral MRL for arsenic is based on a study conducted in Taiwan where a large number of farmers were exposed to high levels of naturally occurring arsenic in well water [5]. In this study, the incidence of Blackfoot Disease and dermal lesions (hyperkeratosis and hyperpigmentation) was investigated. In cases of low-level chronic arsenic exposure (usually from water), these skin lesions appear to be the most sensitive indication of an adverse health effect. A control group used in the study showed NOAEL effects at 0.0008 milligrams per kilogram per day (mg/kg/day). In this study, the lowest observable adverse health effects level (LOAEL) was determined to be 0.014 mg/kg/day, where hyperpigmentation and kerotosis of the skin were observed. When comparing the highest arsenic level that residents are ingesting, the highest exposure dose (child: 0.002 mg/kg/day) is at least 7 times lower than the LOAEL. Therefore, it is not likely that consumption of known levels of arsenic from drinking water wells in these south Georgia counties will lead to hyperpigmentation and kerotosis of the skin.

Cancer Health Effects

The EPA classifies inorganic arsenic as a human carcinogen based on sufficient evidence from human data. Increased mortality from multiple internal organ cancers (liver, lung, and bladder) and an increased incidence of skin cancer were observed in populations consuming drinking water high in inorganic arsenic [5]. Exposure to a cancer-causing chemical, even at low concentrations, is assumed to be associated with some increased risk for evaluation purposes. The estimated risk for developing cancer from exposure to the highest level of arsenic found was calculated by multiplying the exposure dose by EPA's chemical-specific cancer slope factors (CSFs) available at *www.epa.gov/iris*. The exposure does is calculated based on default values of:

- Intake rate of 2 liters/day for adults, and 1 liter/day for children;
- average body weight for adults is 70 kilograms and children,16 kilograms;
- frequency of exposure, exposure duration, and time of exposure. The exposure factor used for the purpose of this analysis was one. This is the most conservative exposure factor assuming exposure is occurring 24 hours per day, 7 days per week.

The theoretical risk[5] for developing cancer in an adult from a lifetime of exposure to the highest level of arsenic found (34.8 ppb) is 1.5×10^{-3} (1.5 excess cancers in 1,000 people consuming the same water).

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[4] The Minimal Risk Level used is a chronic oral MRL based on exposures greater than 365 days and is expressed in mg/kg/day.

[5] Based on EPA's cancer slope factor [Arsenic: 1.5 $(mg/kg/day)^{-1}$] for adults only. This is a lifetime cancer risk associated with arsenic exposure at the highest concentration found over a 70 year period.

Therefore, DPH concludes the persons exposed to the highest levels of arsenic found (34.8 ppb) in a private well have an increased risk for developing cancer related to this chemical over a lifetime of consuming this drinking water.

The National Research Council[6] (NRC) published a report in 2001 about arsenic in drinking water. This report concludes that the science is "sound and sufficient" on the carcinogenic effects of arsenic in humans to calculate theoretical estimates of cancer risk. According to the NRC report, exposure to 10 ppb of arsenic in drinking water for a lifetime would result in a maximum of 10 to 20 additional cancers per 10,000 exposed individuals. From a risk assessment perspective, this represents additional risk. According to EPA, the theoretical maximum-likelihood estimates of excess lifetime cancer risk are within a range of 1 in 10,000 to 1 in 1,000,000 for a given contaminant [6]. It should be noted that this is not a legislative mandate.

Pets

Several residents reported sick pets and pets that died, and expressed concern about their pets' exposure to arsenic in drinking water. In response, DPH distributed a fact sheet, Elevated Levels of Arsenic in South Georgia Wells (Appendix C) to the medical community (including veterinarians) in six counties: Thomas, Lowndes, Colquitt, Decatur, Grady, and Brooks. Different species of pets may have different sensitivities to arsenic in drinking water. Symptoms of arsenic poisoning in a pet include vomiting and diarrhea (sometimes containing bright red blood), pain in the stomach or abdominal regions (may cry in pain when you pick it up or touch its belly), and liver and kidney failure. Residents with concerns about their pets' potential exposure to arsenic can substitute a portion of the pet's water with bottled water, install a point-of-use water filtrations system, and consult with a veterinarian for evaluation and testing. To prevent arsenic exposure in pets, they should be given drinking water that conforms to the same standards/guidelines set for humans.

HEALTH OUTCOME DATA

Cancer Data Analyses

Studies of people in parts of Southeast Asia and South America with high levels of arsenic in their drinking water have found higher risks of cancers of the bladder, kidney, lung, skin, and, less consistently, colon and liver [5]. In most of these studies, the levels of arsenic in the water were many times higher than those typically seen in Thomas County. There have not been as many studies looking at arsenic exposure and cancer in the United States. This is largely because the studies that have been done have generally not found a strong link between cancer and the lower levels of arsenic exposure typically seen in the United States, even where arsenic levels are highest, and much higher than those in Thomas County and south Georgia.

<u>Methods</u>
Cancer has been a reportable disease in Georgia since 1995. Facilities such as hospitals, independent pathology laboratories; independent treatment facilities, and private physicians are required to report cancer within 6 months of the date of diagnosis. Since 2000, the DPH, Georgia Comprehensive Cancer Registry (GCCR) has been receiving complete and accurate cancer data. In Georgia, GCCR collects,

[6] The National Research Council (NRC) is part of the National Academy of Sciences, a non-profit organization whose members serve pro bono as "advisers to the nation on science, engineering, and medicine" [www.nationalacademies.org/nrc].

maintains, analyzes, and publishes cancer mortality and morbidity data and responds to residents' concerns and inquiries about cancer

Cancers may take a long time to develop. Latency (the time from exposure to the development of the cancer) can be anywhere from a few months to 40 years or more. It is thought that most cancers have a latency of at least 20 years. In addition, the latency for most substances and exposures is not known, so it is difficult for cancer cluster researchers to know how far back to look for a cause. Also, it is difficult to prove or even identify exposures that occurred many years earlier.

For this report, GCCR staff analyzed Georgia cancer incidence data from 2005 to 2009 (most recent complete data available).Analyses covered the state as a whole, then Thomas County individually, then by Thomasville zip code (Appendix E). Zip code areas are the smallest geographic units for which data are available. The residents who initially contacted DPH with health concerns reside in the zip code for Thomasville, which also has the highest reported arsenic level and the largest population in Thomas County.

Results

Summary of cancer incidence data from 2005 to 2009:

- An analysis of cancer data for the Thomasville zip code showed no elevated rates or number of cancer cases.
- The overall cancer incidence rate in Thomas County was significantly higher than the rate for Georgia as a whole.
- The overall cancer incidence rate for males in Thomas County was significantly higher than the rate for Georgia males
- The lung cancer incidence rate was significantly higher for males in Thomas County than for Georgia males as a whole.
- The kidney and renal pelvis cancer incidence rate was significantly higher for females in Thomas County than for Georgia females.
- The colorectal cancer incidence rate was significantly higher for males in Thomas County than for Georgia males as a whole.
- The uterine cancer incidence rate was significantly higher for females in Thomas County than for Georgia females.

Because cancer rates for several types of cancer were elevated for Thomas County, DPH mapped cancer mortality data for Thomas, Lowndes, Colquitt, Decatur, Grady, and Brooks Counties for years complete data were available (1994-2008) for all cancer sites, and for specific arsenic-related cancers lung cancer and bladder cancer (Figures 2 - 4). Lung cancer may be elevated in several of these counties, but additional data and analyses are required beyond the scope of this document.

Figure 2. Cancer mortality rates, all cancer sites
Georgia, 1994-2008 *

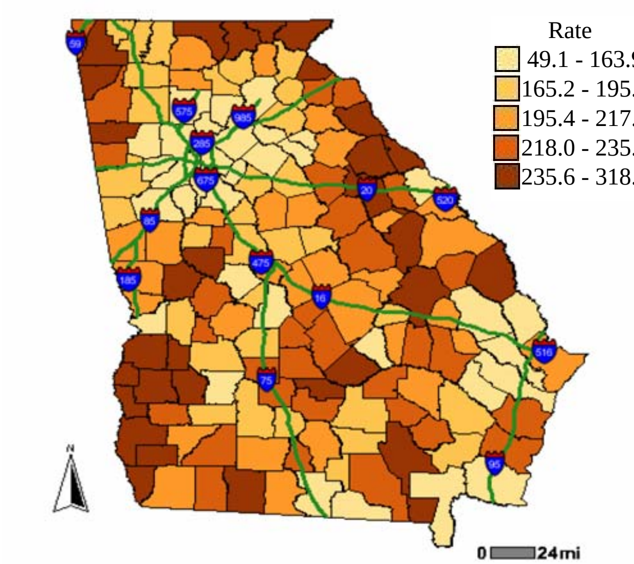


Figure 3. Cancer mortality rates, lung cancer
Georgia, 1994-2008 *

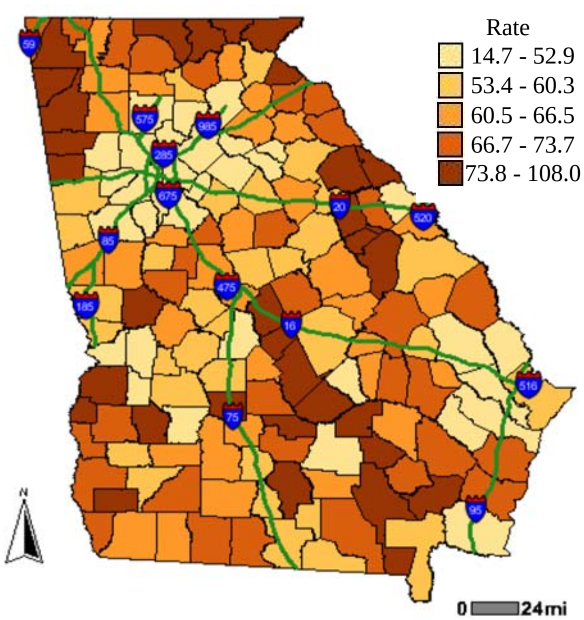
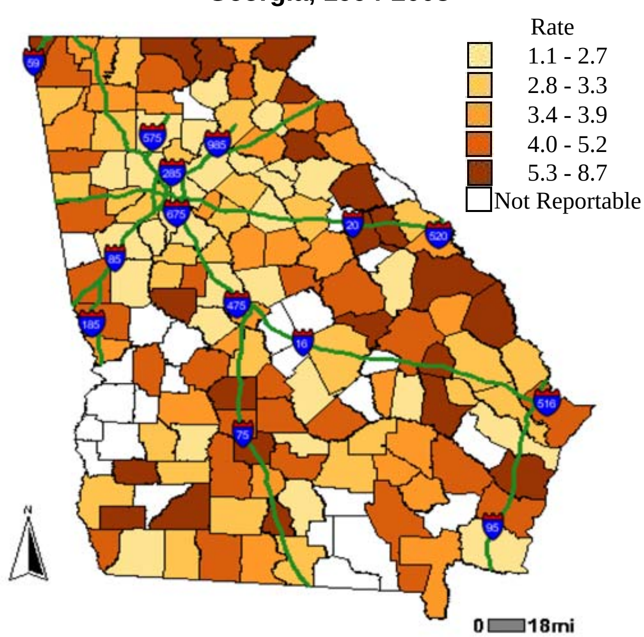


Figure 4. Cancer mortality rates, bladder cancer
Georgia, 1994-2008 *



*** Source:**

Georgia Department of Public Health
OASIS Mapping Tool www.oasis.state.ga.us
Office of Health Indicators for Planning (OHIP)

Map created: February, 2013.
Note: This is a color map.
Data Classification Method: Quantities.

Noncancer Data Analyses

DPH offers the Online Analytical Statistical Information System (OASIS) on the agency's website. OASIS is a repository and suite of interactive tools used to access state public health standardized health data. OASIS and the repository are designed, built and maintained by the DPH Office of Health Information and Policy (*http://oasis.state.ga.us*).

Evaluating noncancer health outcomes related to arsenic exposure in well water in south Georgia is difficult because symptoms and diseases associated with arsenic exposure (nausea and vomiting, decreased production of red and white blood cells, damage to blood vessels, "pins and needles" in hands and feet, skin changes, etc.) are not "reportable diseases" . Only certain diseases, mostly contagious and capable of resulting in epidemics (i.e.; hepatitis, meningitis, tuberculosis) are reportable, meaning diagnostic and health outcome data is collected. DPH evaluated the OASIS subcategories "kidney disease" and "all other chronic lower respiratory diseases" in an attempt to identify any trends in applicable health outcomes for Thomas, Lowndes, Colquitt, Decatur, Grady, and Brooks Counties. DPH evaluated the following OASIS measures/indicators:

- Mortality and hospital emergency room visit rates for kidney and respiratory diseases
- Hospital discharge rates for kidney and respiratory diseases

Methods

In this report, DPH first evaluated these applicable health outcome data available on OASIS for Thomas County as well as the South and Southwest Public Health Districts for the five-year period, 2006-2010. For these years, analyses were conducted for the state as a whole, then individually for the following counties: Thomas, Lowndes, Colquitt, Decatur, Grady, and Brooks (Appendix F). For counties with 5-year total incidence rates that exceeded the state total rate, we measured the same data but expanded the time interval to ten years (most recent years complete data are available); 2001-2010 for discharges and deaths, and 2002-2010 for hospital emergency room visits (Appendix F).

Results

Summary of noncancer health outcome rates during the 5- and 10- year periods 2006-2010 and 2001-2010 (2002-2010):

- Some counties had rates higher than those of the state for each measure and cause investigated.
- Some counties had rates higher than those of the state for each measure and cause investigated.
- Of the six counties evaluated, Thomas County was the only county in which hospital discharge rates from chronic respiratory diseases were lower than those of the state.
- Thomas County's mortality rate for kidney diseases was equal to the state mortality rate for kidney diseases over the period 2006-2010. However, the rate for Thomas County during 2001-2010 was lower than that of Georgia as a whole.
- During the period 2006-2010, hospital emergency room visits and mortality rates resulting from chronic respiratory diseases were higher in Thomas County than the state. However, these rates for Thomas County during 2001-2010 (2002-2010) were lower than that of Georgia.

Note: These data are not representative of all the cases of these conditions, only those severe enough to result in hospital emergency room visits, hospitalizations and deaths.

Tables 1-16 in Appendix F summarize the county data we evaluated for applicable noncancer health outcomes measures;indicators, compared to the state rates. Although a county rate may exceed the state rate, this does not mean that the difference is statistically significant. In addition, if we look at all counties in Georgia, there are no apparent trends for these health measures/indicators in Thomas County or other south and southwest Georgia counties potentially impacted by arsenic contamination.

Conclusions

DPH concludes that:

1. The arsenic found in private well water in Thomas County is naturally occurring.
2. Arsenic is not easily absorbed by the skin, and does not "stick" easily to hard surfaces (such as dishes) or clothing, so cleaning, laundering, brushing teeth, and bathing are not considered routes of exposure.
3. If residents have health concerns, they can consult with a health care professional for medical testing to determine if exposure to arsenic is occurring or has occurred. There are tests available to measure arsenic in blood, urine, hair, and fingernails.
4. People who consume water over a lifetime (70 years) from private wells with the highest level of arsenic found in Thomas County may have an increased risk for developing cancer related to this exposure.
5. Several cancer incidence rates were elevated for Thomas County; however, there are no cancer cases that can be attributed to arsenic exposure.
6. Noncancer symptoms and disease from consuming water contaminated with arsenic at levels found in Thomas County are not expected to occur because the estimated exposure doses are many times below doses shown to have noncancer adverse health outcomes in human health studies.
7. If residents are concerned about their pet's current arsenic exposure, they can consult with a veterinarian for evaluation and testing.

Recommendations

- Residents concerned about human and pet exposure to arsenic in well water should consider using bottled water and other retail products (e.g., low sugar fruit juice) for a portion of or for all of their consumption. To prevent arsenic exposure in pets, they should be given drinking water that conforms to the same standards/guidelines set for humans.
- Install point of use and point source household filters specific to drinking water treatment to reduce arsenic concentrations.
- When the arsenic level in well water is greater than the Maximum Contaminant Level {MCL=10 parts per billion), the well owner should re-test to confirm the result before obtaining a treatment system. When re-testing for arsenic, also test the pH, phosphate, silica, hardness, iron, manganese and sulfate levels. The pH, phosphate and silica levels will help water treatment professionals estimate the life of arsenic treatment media, and the hardness, and iron, manganese and sulfate levels will determine whether a pre-treatment step is necessary.
- The frequency of water quality testing in water supply wells located in high risk areas (Gulf Trough) throughout south Georgia should be increased to ensure fluctuations of arsenic inside associated well fields do not periodically exceed the MCL.

Sincerely,

Jane M. Perry

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5. Agency for Toxic Substances and Disease Registry, *Toxicological Profile for Arsenic*. August 2007.

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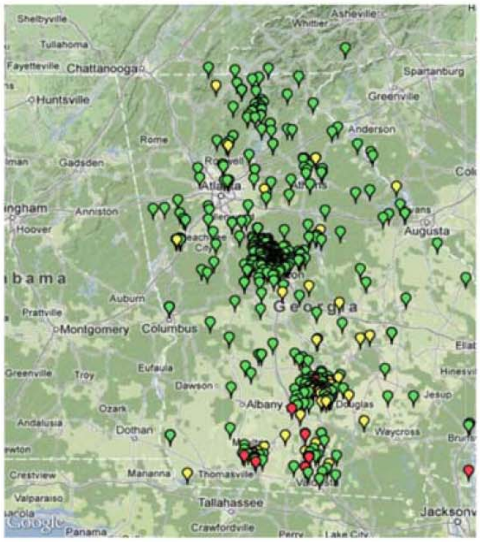
APPENDIX A. ARSENIC IN PRIVATE WELL WATER
Georgia and Thomas County, 2012

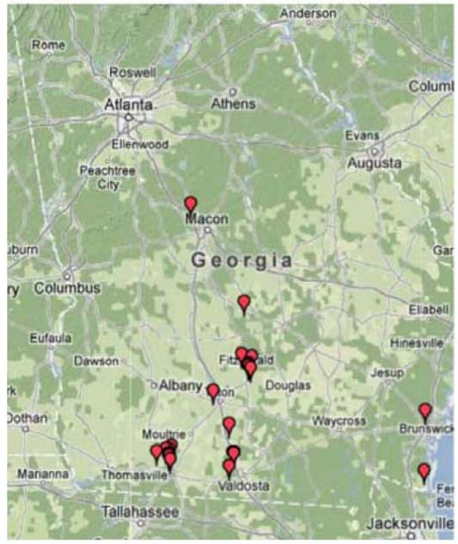
(Source: University of Georgia, *http://aesl.ces.uga.edu/water/asu.html.* Retrieved October 1, 2012.)

Private Wells

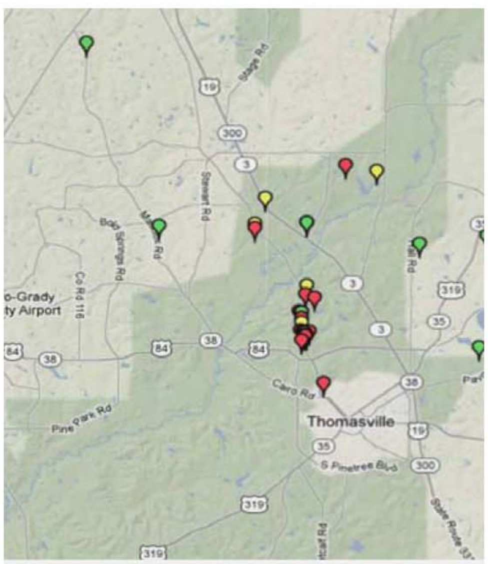
SAMPLED | **ABOVE MCL**

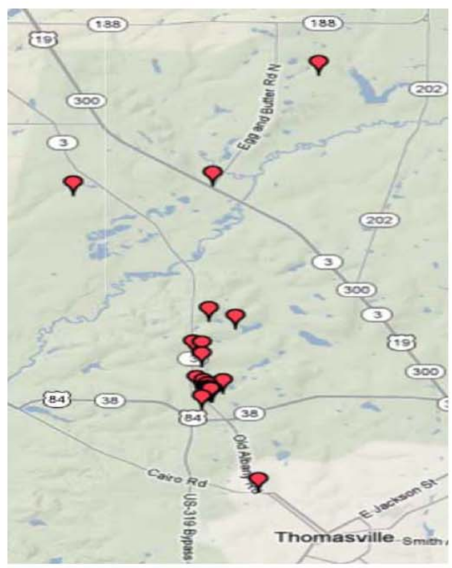
STATE WIDE





THOMAS COUNTY





APPENDIX B. FACT SHEET FOR RESIDENTS

Georgia Department of Public Health

Georgia Environmental Health
404-657-6534

FACT SHEET

NATURALLY-OCCURRING ARSENIC IN PRIVATE WELL WATER

Thomas County, Georgia

Naturally-occurring arsenic does not affect the taste and appearance of your water, but it can affect your health. Test your well water routinely to ensure the safety of your drinking water.

REPORT HEALTH CONCERNS ABOUT ARSENIC IN WELL WATER TO THE DEPARTMENT OF PUBLIC HEALTH: 404-657-6534.

What is arsenic?

Arsenic is an element that occurs naturally in rocks and soil. Arsenic gets into well water through natural erosion. When underground water flows over rocks and soil that contain arsenic, the arsenic slowly dissolves into the water. As a result, some private water wells in Georgia may exceed the federal regulatory standard for arsenic in public water supplies. Arsenic occurs in bedrock and shallow wells and the amount of arsenic in well water will vary greatly from place to place. Testing is the only way to determine if water contains arsenic.

What are the Health Effects of Arsenic Exposure?

People are most often exposed to arsenic by eating food and drinking water that contain arsenic. Arsenic in your drinking water can get into your body when you drink the water or use it to cook or prepare your food. Arsenic does not easily get into your body through your skin, so showering and bathing are not a problem. You cannot breathe in the arsenic that is in your water.

Exposure to high concentrations of arsenic in drinking water has been linked to cancer, and cardiovascular and respiratory problems. Studies conducted in other countries found some people who repeatedly, and over many years, drank water containing arsenic at levels ten times above the federal drinking water standard developed several kinds of cancer (lung, liver, skin, kidney, and prostate) and had darkening skin, thickening of the skin on the palms of their hands and soles of their feet, and many small warts and other skin abnormalities.

A few studies found no harmful effects in persons in the United States who throughout their lifetimes drank water containing arsenic at levels five times above the drinking water standard. Even though harmful health effects were not found in persons who drank water containing elevated arsenic levels, reducing exposure to arsenic can reduce the risk of harmful health effects. The Georgia Department of Public Health recommends that people concerned about arsenic exposure drink bottled water, and install a point-of-use or whole house filter system. If residents are concerned about current arsenic exposure, they can consult with a health care professional for medical testing.

Is Arsenic in Well Water Regulated in Georgia?

Under the Safe Drinking Water Act, the U.S. Environmental Protection Agency establishes maximum contaminant levels (MCLs) for contaminants in public drinking water supplies. MCLs are below levels at which health effects have been observed. Therefore, they are assumed to be protective of public health. The MCL for arsenic is 10 μg/l (micrograms per liter) or 10 ppb (parts per billion) in drinking water.

Although private water wells are not subject to the same regulatory standards as those set for public drinking water supplies, it is recommended for health purposes that private well owners use these standards to guide their water treatment decisions.

Should I Test My Well Water For Arsenic?

Several private water wells in Thomas County have been tested and results show elevated levels of arsenic in some wells. The arsenic is naturally-occurring and coincides with a geological phenomenon known as the 'Gulf Trough' located in the region. The University of Georgia Cooperative Extension and Thomas County Code Enforcement sampled approximately 20 wells and the results ranged from none detected to 34.8 ppb. The Georgia Department of Public Health is working with residents and local officials to investigate and address health concerns. However, because the arsenic is naturally occurring, residents are responsible for the water quality of their well.

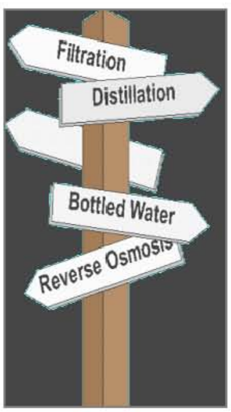
To have your water tested, contact your county health department, county cooperative extension office or a certified private laboratory. It is essential to test all new water wells and all wells for toxic chemicals, including arsenic, every three years. In most areas, the cost of testing a sample of water for arsenic usually ranges from $20 to $40. Because the amount of arsenic in well water can vary throughout the year, you should test more than once, at different times of the year. If arsenic is found, a filtration or water treatment system can be installed.

How do I Remove Arsenic from my Well Water?

While exposure to elevated levels of arsenic in drinking water for a short period of time is not an immediate health concern, arsenic may pose a health risk when the water is used for drinking and cooking over many years.

Arsenic can be found in water in two forms: **inorganic** and **organic**. Granular activated carbon **ca**rtridges will only remove inorganic arsenic, and reverse osmosis membranes will remove both forms. However, arsenic removal is not as simple as removing some other common contaminants. To evaluate your options before installing an arsenic removal system, please visit NSF International's* list of approved methods for removing arsenic:

www.nsf.org/certified/dwtu/Listings.asp?ProductFunction=053%7CArsenic+%28P.



Removing arsenic from water requires special adsorption media. Granular ferric oxide, titanium and hybrid media that contain iron-impregnated resin are all highly effective, but there are differences in the length of time before the filter media needs to be replaced. The following recommendations regarding filtration to remove arsenic from drinking water are from the University of Georgia Cooperative Extension:

- If you have tested your water and the arsenic level is greater than 10 parts per billion, you should re-test to confirm the result before installing a home filtration or treatment system.
- When re-testing for arsenic, also test pH, and for the levels of phosphate, silica, hardness, iron, manganese and sulfate levels. The pH, phosphate and silica levels will help your water treatment professional estimate the life of arsenic treatment media, and the hardness, iron, manganese and sulfate levels will determine whether a pre-treatment step is necessary

Sources: University of Georgia Cooperative Extension, "Arsenic and Uranium in Georgia Wells"; http://aesl.ces.uga.edu/water/asu.html.
** NSF (National Sanitation Foundation) International is an independent, not-for-profit organization that provides standards development, product certification, auditing, education and risk management for public health and the environment; www.nsf.org.*

FOR MORE INFORMATION

Georgia Department of Public Health
Environmental Health Branch
Chemical Hazards Program
(404) 657-6534
www.health.state.ga.us/programs/hazards

Agricultural and Environmental Services Laboratories
University of Georgia
Cooperative Extension
(706) 542-5350
http://aesl.ces.uga.edu

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APPENDIX C. FACT SHEET FOR MEDICAL COMMUNITY

ELEVATED LEVELS OF ARSENIC IN SOME PRIVATE WELLS

REPORT HEALTH CONCERNS ABOUT ARSENIC IN WELL WATER TO THE DEPARTMENT OF PUBLIC HEALTH: 404-657-6534

- The Georgia Department of Public Health (DPH) has reviewed private well water sampling results showing elevated levels of arsenic in several wells in Ben Hill, Brooks, Colquitt, Decatur, Grady, Irwin, Lowndes, and Thomas Counties.
- It has been determined that the arsenic is naturally occurring.
- The city drinking water systems serving these communities do NOT contain elevated levels of arsenic.
- Under the Safe Drinking Water Act, the U.S. Environmental Protection Agency establishes maximum contaminant levels (MCLs) for contaminants in public drinking water supplies. The MCL for arsenic is 10 μg/l (micrograms per liter) or 10 ppb (parts per billion) in drinking water.
- Although private water wells are not subject to the same regulatory standards as those set for public drinking water supplies, it is recommended for health purposes that private well owners use these standards to guide their water treatment decisions.

What is arsenic?

Arsenic is an element that occurs naturally in rocks and soil and gets into well water through natural erosion. As a result, some private water wells in Georgia may exceed the federal regulatory standard for arsenic in public water supplies. Arsenic occurs in both bedrock and shallow wells and the amount of arsenic in well water will vary greatly over time, seasons, and locations. Regular testing is the only way to determine if water contains arsenic at levels of concern.

Potential Health Effects of Arsenic Exposure

Acute health effects include stomach pain, nausea, vomiting and diarrhea, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands and feet. **Long-term health effects** include darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso; and disorders of the heart, kidney, lung, skin, reproductive, immune, and nervous systems. Arsenic exposure is a risk factor for bladder, skin, lung, liver, kidney and prostate cancers.

Recommendations:

1. DPH recommends that residents concerned with exposure to arsenic drink bottled water and/or install a point-of-use or whole house filtration system.
2. If residents are concerned about current arsenic exposure, they can consult with a health care professional for medical testing. If elevated levels of inorganic arsenic are found in urine, they can contact the Chemical Hazards Program, Georgia Department of Public Health, at (404) 657-6534.

Resources for Health Care Providers

Case Studies in Environmental Medicine: Arsenic
www.atsdr.cdc.gov/csem/arsenic/docs/arsenic.pdf
Information on exposure routes, physiological effects and clinical evaluation (CME/CNE credits available).

Emory University Pediatric Environmental Health Specialty Unit (PEHSU)
www.pediatrics.emory.edu/centers/pehsu
Telephone consultation on health risks from environmental exposures in children.

Medscape Reference
http://emedicine.medscape.com/article/812953-overview
Arsenic toxicity in emergency medicine.

Contact Information

DPH
Georgia Department of Public Health

Jane M. Perry, Director
Chemical Hazards Program
Georgia Department of Public Health
2 Peachtree Street NW, 13th Floor
Atlanta, GA 30303-3142

Phone: 404.657.6534
Fax 404.657.6533
jmperry@dhr.state.ga.us

APPENDIX D: EXPLANATION OF TOXICOLOGIC EVALUATION

Step 1--The Screening Process

In order to evaluate the available data, DPH used comparison values (CVs) to determine which chemicals to examine more closely. CVs are contaminant concentrations found in a specific environmental media (for example: air, soil, or water) and are used to select contaminants for further evaluation. CVs incorporate assumptions of daily exposure to the chemical and a standard amount of air, soil, or water that someone may inhale or ingest each day. CVs are generated to be conservative and non-site specific. The CV is used as a screening level during the health consultation process where substances found in amounts greater than their CVs might be selected for further evaluation. CVs are not intended to be environmental clean-up levels or to indicate that health effects occur at concentrations that exceed these values.

CVs can be based on either carcinogenic (cancer-causing) or non-carcinogenic effects. Cancer-based CVs are calculated from the U.S. Environmental Protection Agency's (EPA) oral cancer slope factors for ingestion exposure, or inhalation risk units for inhalation exposure. Non-cancer CVs are calculated from ATSDR's minimal risk levels, EPA's reference doses, or EPA's reference concentrations for ingestion and inhalation exposure. When a cancer and non-cancer CV exist for the same chemical, the lower of these values is used as a conservative measure. The chemical and media-specific CVs used in the preparation of this health consultation are listed below:

A **Maximum Contaminant Level (MCL)** is a standard set by the EPA for the legal threshold limit on the amount of a substance that is allowed in public water systems under the Safe Drinking Water Act.

An **Environmental Media Evaluation Guide (EMEG)** is an estimated comparison concentration for exposure that is unlikely to cause adverse health effects, as determined by ATSDR from its toxicological profiles for a specific chemical.

Step 2--Evaluation of Public Health Implications

The next step in the evaluation process is to take those contaminants that are above their respective CVs and further identify which chemicals and exposure situations are likely to be a health hazard. Separate child and adult exposure doses (or the amount of a contaminant that gets into a person's body) are calculated for site-specific scenarios, using assumptions regarding an individual's likelihood of accessing the site and contacting contamination. A brief explanation of the calculation of estimated exposure doses used in this health consultation is presented below. Calculated doses are reported in units of milligrams per kilogram per day (mg/kg/day).

Ingestion of contaminants present in drinking water

Exposure doses for ingestion of contaminants present in drinking water were calculated using the highest detected concentration of a contaminant in micrograms per liter (ug/L [ug/L = ppb]). The following equation is used to estimate the exposure doses resulting from ingestion of contaminated drinking water:

$$ED_w = \frac{C \times IR \times EF}{BW}$$

$$\frac{0.035 \text{ mg/L} * 2\text{L/day} *1}{70 \text{ kg}} = \mathbf{0.001\ mg/kg/day}$$

$$\frac{0.035 \text{ mg/L} * 1\text{L/day} *1 = 0.001 \text{ mg/kg/day}}{16 \text{ kg}} = \mathbf{0.002\ mg/kg/day}$$

where;

ED_w = exposure dose from drinking water (mg/kg/day)
C = contaminant concentration (mg/L)
IR = intake rate of contaminated medium (based on default values of 2 L/day for adults, and 1 L/day for children).

EF = exposure factor (based on frequency of exposure, exposure duration, and time of exposure). The exposure factor used for the purpose of this analysis was one. This is the most conservative exposure factor assuming exposure is occurring 24 hours per day, 7 days per week.

BW = body weight (based on average rates for adults: 70 kg; and children: 16 kg)

Non-cancer Health Risks

The doses calculated for exposure to individual chemicals are then compared to an established health guideline, such as an ATSDR minimal risk level (MRL) or an EPA reference dose (RfD), in order to assess whether adverse health impacts from exposure are expected. Health guidelines are chemical-specific values that are based on available scientific literature and are considered protective of human health. Non-carcinogenic effects, unlike carcinogenic effects, are believed to have a threshold, that is, a dose below which adverse health effects will not occur. As a result, the current practice to derive health guidelines is to identify, usually from animal toxicology experiments, a no observed adverse effect level (NOAEL), which indicates that no effects are observed at a particular exposure level. This is the experimental exposure level in animals (and sometimes humans) at which no adverse toxic effect is observed. The known toxicological values are doses derived from human and animal studies that are summarized in ATSDR's *Toxicological Profiles (www.atsdr.cdc.gov/toxpro2.html).* The NOAEL is modified with an uncertainty (or safety) factor, which reflects the degree of uncertainty that exists when experimental animal data are extrapolated to the human population. The magnitude of the uncertainty factor considers various factors such as sensitive subpopulations (e.g., children, pregnant women, the elderly), extrapolation from animals to humans, and the completeness of the available data. Thus, exposure doses at or below the established health guideline are not expected to cause adverse health effects because these values are much lower (and more human health protective) than doses, which do not cause adverse health effects in laboratory animal studies.

For non-cancer health effects, the following health guidelines were used in this health consultation:

Minimal Risk Levels (MRLs) are developed by ATSDR for contaminants commonly found at hazardous waste sites. The MRL is developed for ingestion and inhalation exposure, and for lengths of exposures: acute (less than 14 days); intermediate (between 15-364 days), and chronic (365 days or greater). ATSDR has not developed MRLs for dermal exposure (absorption through skin).

If the estimated exposure dose to an individual is less than the health guideline value, the exposure is unlikely to result in non-cancer health effects. If the calculated exposure dose is greater than the health guideline, the exposure dose is compared to known toxicological values for the particular chemical and is discussed in more detail in the text of the health consultation. A direct comparison of site-specific exposures and doses to study-derived exposures and doses found to cause adverse health effects is the basis for deciding whether health effects are likely to occur.

It is important to consider that the methodology used to develop health guidelines does not provide any information on the presence, absence, or level of cancer risk. Therefore, a separate cancer risk evaluation is necessary for potentially cancer-causing contaminants detected at this site.

Cancer Risks

Exposure to a cancer-causing chemical, even at low concentrations, is assumed to be associated with some increased risk for evaluation purposes. The estimated risk for developing cancer from exposure to contaminants associated with the site was calculated by multiplying the site-specific doses by EPA's chemical-specific cancer slope factors (CSFs) available at *www.epa.gov/iris*. This calculation estimates a theoretical excess cancer risk expressed as a proportion of the population that may be affected by a carcinogen during a lifetime of exposure. For example, an estimated risk of 1×10^{-6} predicts the probability of one additional cancer over background in a population of 1 million. An increased lifetime cancer risk is not a specified estimate of expected cancers. Rather, it is an estimate of the increase in the probability that a person may develop cancer sometime in his or her lifetime following exposure to a particular contaminant under specific exposure scenarios.

Because of conservative models used to derive CSFs, using this approach provides a theoretical estimate of risk; the true or actual risk is unknown and could be as low as zero. Numerical risk estimates are generated using mathematical models applied to epidemiologic or experimental data for carcinogenic effects. The mathematical models extrapolate from higher experimental doses to lower experimental doses. Often, the experimental data represent exposures to chemicals at concentrations orders of magnitude higher than concentrations found in the environment. In addition, these models often assume that there are no thresholds to carcinogenic effects--a single molecule of a carcinogen is assumed to be able to cause cancer. The doses associated with these estimated hypothetical risks might be orders of magnitude lower that doses reported in toxicology literature to cause carcinogenic effects. As such, a low cancer risk estimate of 1×10^{-6} and below may indicate that the toxicology literature supports a finding that no excess cancer risk is likely. A cancer risk estimate greater than 1×10^{-6}, however, indicates that a careful review of toxicology literature before making conclusions about cancer risks is in order.

APPENDIX E-1. CANCER INCIDENCE DATA

(Source: Georgia Comprehensive Cancer Registry, Georgia Department of Public Health, 2012.)

Table 1. Age-Adjusted Cancer Incidence Rates for the State of Georgia, 2005-2009

	Total		Males		Females	
Site	Cases	Rate	Cases	Rate	Cases	Rate
All Sites	202483	467.5	107113	570.0	95361	397.4
Oral Cavity	4999	11.1	3557	17.3	1442	6.0
Esophagus	2005	4.6	1544	8.0	461	1.9
Stomach	2768	6.6	1644	9.1	1124	4.8
Colon and Rectum	19250	45.0	9988	53.4	9262	38.8
Liver	2378	5.3	1786	8.8	592	2.5
Pancreas	4850	11.7	2436	13.5	2414	10.3
Larynx	2029	4.5	1687	8.5	342	1.4
Lung and Bronchus	29932	71.7	17030	95.6	12900	54.8
Bone and Joints	408	0.9	220	1.0	188	0.8
Melanoma	9351	21.1	5452	28.5	3899	16.1
Breast	--	--	--	--	29084	119.8
Uterine Cervix	--	--	--	--	1964	8.2
Uterine Corpus	--	--	--	--	4533	18.4
Ovary	--	--	--	--	3078	12.8
Prostate	--	--	32303	167.7	--	--
Testis	--	--	925	3.9	--	--
Kidney and Renal Pelvis	6454	14.7	3951	20.1	2503	10.4
Bladder (Incl in situ)	7351	18.1	5533	33.0	1818	7.8
Brain and Other Nervous System	2823	6.3	1535	7.4	1287	5.4
Thyroid	4502	9.6	1024	4.7	3478	14.3
Hodgkin Lymphoma	1234	2.6	679	3.0	555	2.3
Non-Hodgkin Lymphoma	7468	17.5	4092	21.6	3376	14.2
Multiple Myeloma	2582	6.1	1403	7.7	1179	5.0
Leukemias	4874	11.4	2674	14.6	2199	9.2

Average annual rate per 100,000, age-adjusted to the 2000 US standard population.

Table 2. Age-Adjusted Cancer Incidence Rates for Thomas County, Georgia, 2005-2009

Site	Total		Males		Females	
	Cases	Rate	Cases	Rate	Cases	Rate
All Sites	1303	497.3	687	632.4	616	414.6
Oral Cavity	43	16.5	24	21.6	19	~
Esophagus	20	7.8	9	~	11	~
Stomach	16	~	10	~	6	~
Colon and Rectum	129	47.6	66	60.0	63	39.1
Liver	13	~	8	~	5	~
Pancreas	29	10.7	15	~	14	~
Larynx	9	~	***	~	<5	~
Lung and Bronchus	226	85.2	138	125.6	88	56.5
Bone and Joints	<5	~	<5	~	<5	~
Melanoma	73	29.5	39	36.3	34	26.1
Breast	--	--	--	--	168	114.3
Uterine Cervix	--	--	--	--	7	~
Uterine Corpus	--	--	--	--	40	27.0
Ovary	--	--	--	--	16	~
Prostate	--	--	188	172.1	--	--
Testis	--	--	9	~	--	--
Kidney and Renal Pelvis	58	22.5	28	25.7	30	19.9
Bladder (Incl in situ)	35	13.2	27	26.9	8	~
Brain and Other Nervous System	23	9.6	14	~	9	~
Thyroid	15	~	<5	~	***	~
Hodgkin Lymphoma	<5	~	<5	~	<5	~
Non-Hodgkin Lymphoma	47	18.3	28	25.6	19	~
Multiple Myeloma	8	~	<5	~	<5	~
Leukemias	27	10.7	17	~	10	~

Average annual rate per 100,000, age-adjusted to the 2000 US standard population.
Rates highlighted in yellow are significantly lower than the state rate (p<.05).
Rates highlighted in orange are significantly higher than the state rate (p<.05).

Table 3. Age-Adjusted Cancer Incidence Rates for Zip Code 31792, Georgia, 2005-2009

Site	Total		Males		Females	
	Cases	Rate	Cases	Rate	Cases	Rate
All Sites	636	454.0	320	560.8	316	394.9
Oral Cavity	20	14.9	11	~	9	~
Esophagus	13	~	6	~	7	~
Stomach	11	~	5	~	6	~
Colon and Rectum	66	45.0	29	49.7	37	42.1
Liver	9	~	***	~	<5	~
Pancreas	16	~	9	~	7	~
Larynx	5	~	<5	~	<5	~
Lung and Bronchus	114	80.9	70	120.1	44	52.9
Bone and Joints	<5	~	<5	~	<5	~
Melanoma	33	24.8	15	~	18	~
Breast	--	--	--	--	89	113.9
Uterine Cervix	--	--	--	--	<5	~
Uterine Corpus	--	--	--	--	18	~
Ovary	--	--	--	--	11	~
Prostate	--	--	89	155.1	--	--
Testis	--	--	<5	~	--	--
Kidney and Renal Pelvis	29	21.6	16	~	13	~
Bladder (Incl in situ)	14	~	***	~	<5	~
Brain and Other Nervous System	8	~	<5	~	<5	~
Thyroid	6	~	<5	~	<5	~
Hodgkin Lymphoma	<5	~	<5	~	<5	~
Non-Hodgkin Lymphoma	23	17.4	13	~	10	~
Multiple Myeloma	<5	~	<5	~	<5	~
Leukemias	8	~	<5	~	<5	~

Average annual rate per 100,000, age-adjusted to the 2000 US standard population.

APPENDIX E-2. THOMAS COUNTY CANCER INCIDENCE DATA SUMMARY 2005-2009

All Cancer Sites

- 1303 new cancer cases were diagnosed in Thomas County during 2005 to 2009, an average of 261 new cases per year.
- It is expected that about 137 males and 123 females will be diagnosed with cancer every year in Thomas County.
- The overall age-adjusted cancer incidence rate in Thomas County is 497.3 per 100,000 population. This is significantly higher than the rate for Georgia (467.5 per 100,000) as a whole.
- Males are 53% more likely than females to be diagnosed with cancer in Thomas County.

Males

- The overall age-adjusted cancer incidence rate for males in Thomas County is 632.4 per 100,000 population. This is significantly higher than the rate for Georgia males (570.0 per 100,000).
- Prostate, lung, and colorectal are the top cancer sites among males in both Thomas County and the State of Georgia as a whole.
- The age-adjusted prostate cancer incidence rate is higher for males in Thomas County (172.1 per 100,000) than for Georgia males (167.7 per 100,000), but this difference is not statistically significant.
- The age-adjusted lung cancer incidence rate is significantly higher for males in Thomas County (125.6 per 100,000) than for Georgia males (95.6 per 100,000).
- The age-adjusted colorectal cancer incidence rate is higher for males in Thomas County (60.0 per 100,000) than for Georgia males (53.4 per 100,000), but this difference is not statistically significant.

Females

- The overall age-adjusted cancer incidence rate for females in Thomas County is 414.6 per 100,000 population. This is higher than the rate for Georgia females (397.4 per 100,000), but this difference is not statistically significant.
- Breast, lung and colorectal are the top cancer sites among females in both Thomas County and the State of Georgia as a whole.
- The age-adjusted breast cancer incidence rate is lower for females in Thomas County (114.3 per 100,000) than for Georgia females (119.8 per 100,000), but this difference is not statistically significant.
- The age-adjusted lung cancer incidence rate is higher for females in Thomas County (56.5 per 100,000) than for Georgia females (54.8 per 100,000), but this difference is not statistically significant.
- The age-adjusted colorectal cancer incidence rate for females in Thomas County (39.1 per 100,000) is similar to that for Georgia females (38.8 per 100,000).
- The age-adjusted uterine corpus cancer incidence rate is significantly higher for females in Thomas County (27.0 per 100,000 than for Georgia females (18.4 per 100,000).
- The age-adjusted melanoma incidence rate is significantly higher for females in Thomas County (26.1 per 100,000 than for Georgia females (16.1 per 100,000).
- The age-adjusted kidney cancer incidence rate is significantly higher for females in Thomas County (19.9 per 100,000 than for Georgia females (10.4 per 100,000).

APPENDIX F. MORBIDITY AND MORTALITY DATA

Thomas, Lowndes, Colquitt, Decatur, Grady, and Brooks Counties compared to Georgia as a whole, 2001-2010

(Source: Georgia Department of Public Health, 2012.)

Note: Only counties with rates higher than or equal to that of the state as a whole for that period are shown in each table. DPH first evaluated health outcome data for the five-year period, 2006-2010. For counties with 5-year total incidence rates exceeded the state total rates, we measured the same data but expanded the time interval to 2001-2010 for discharges and deaths, and 2002-2010 for emergency hospital visits (years complete data are available).

Table 1. Total Age-Adjusted Hospital Discharge Rate for Kidney Diseases, 2006-2010 (per 100,000)

	Total Discharge Rate
Brooks	151.5
Lowndes	178.6
Colquitt	156
Georgia	128.7

Table 2. Total Age-Adjusted Hospital Discharge Rate for Kidney Diseases, 2001-2010 (per 100,000)

	Total Discharge Rate
Lowndes	140.6
Georgia	128.7

Table 3. Total Age-Adjusted Hospital Discharge Rate for Kidney Infections, 2006-2010 (per 100,000)

	Total Discharge Rate
Brooks	67
Lowndes	45.5
Colquitt	38.3
Decatur	74.4
Georgia	33.5

Table 4. Total Age-Adjusted Hospital Discharge Rate for Kidney Infections, 2001-2010 (per 100,000)

	Total Discharge Rate
Brooks	89.2
Lowndes	48.9
Colquitt	51
Decatur	76.9
Georgia	37

Table 5. Total Age-Adjusted Hospital Discharge Rate for Chronic Respiratory Diseases, 2006-2010 (per 100,000)

	Total Discharge Rate
Brooks	7.8
Lowndes	9.7
Colquitt	11
Decatur	8.1
Grady	13
Georgia	7.1

Table 6. Total Age-Adjusted Hospital Discharge Rate for Chronic Respiratory Diseases, 2001-2010 (per 100,000)

	Total Discharge Rate
Brooks	10.8
Lowndes	15.2
Colquitt	12.2
Decatur	11.8
Grady	13.7
Georgia	9.2

Table 7. Total Age-Adjusted Mortality Rate for Kidney Diseases, 2006-2010 (per 100,000)

	Total
	Death Rate
Brooks	29.3
Lowndes	25.2
Colquitt	22.1
Decatur	40.3
Grady	26.6
Thomas	20.9
Georgia	20.9

Table 8. Total Age-Adjusted Mortality Rate for Kidney Diseases, 2001-2010 (per 100,000)

	Total
	Death Rate
Brooks	32.8
Lowndes	27
Colquitt	21.9
Decatur	36.7
Grady	28
Georgia	20.9

Table 9. Total Age-Adjusted Mortality Rate for Chronic Respiratory Diseases, 2006-2010 (per 100,000)

	Total
	Death Rate
Lowndes	43.8
Colquitt	61.8
Decatur	40.8
Grady	42.1
Thomas	40.7
Georgia	38.9

Table 10. Total Age-Adjusted Mortality Rate for Chronic Respiratory Diseases, 2001-2010 (per 100,000)

	Total
	Death Rate
Lowndes	43.9
Colquitt	49.5
Grady	40.3
Georgia	38.9

Table 11. Total Age-Adjusted Hospital Emergency Visit Rate for Kidney Disease, 2006-2010 (per 100,000)

	Total
	ER Visit Rate
Colquitt	33.5
Decatur	18.8
Georgia	15.3

Table 12. Total Age-Adjusted Hospital Emergency Visit Rate for Kidney Disease, 2002-2010 (per 100,000)

	Total
	ER Visit Rate
Colquitt	28.6
Decatur	17.1
Georgia	12.5

Table 13. Total Age-Adjusted Hospital Emergency Visit Rate for Kidney Infections, 2006-2010 (per 100,000)

	Total ER Visit Rate
Brooks	144.4
Decatur	94.8
Georgia	86.8

Table 14. Total Age-Adjusted Hospital Emergency Visit Rate for Kidney Infections, 2002-2010 (per 100,000)

	Total ER Visit Rate
Brooks	133.4
Decatur	82.9
Georgia	82.2

Table 15. Total Age-Adjusted Hospital Emergency Visit Rate for Chronic Respiratory Diseases, 2006-2010 (per 100,000)

	Total ER Visit Rate
Brooks	54.1
Lowndes	49.5
Colquitt	112.7
Grady	34.4
Thomas	27.5
Georgia	26

Table 16. Total Age-Adjusted Hospital Emergency Visit Rate for Chronic Respiratory Diseases, 2002-2010 (per 100,000)

	Total ER Visit Rate
Brooks	50.2
Lowndes	47.7
Colquitt	103.2
Grady	29.6
Georgia	25.7