

# Health Consultation

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STROTHER CREEK

REYNOLDS COUNTY, MISSOURI

**Prepared by the  
Missouri Department of Health and Senior Services**

JUNE 2, 2010

Prepared under a Cooperative Agreement with the  
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Agency for Toxic Substances and Disease Registry  
Division of Health Assessment and Consultation  
Atlanta, Georgia 30333

## **Health Consultation: A Note of Explanation**

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners 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 or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

STROTHER CREEK

REYNOLDS COUNTY, MISSOURI

Prepared by:

Missouri Department of Health and Senior Services  
Division of Community and Public Health  
Section for Disease Control and Environmental Epidemiology  
Bureau of Environmental Epidemiology  
Under a Cooperative Agreement with the  
Agency for Toxic Substances and Disease Registry

## *SUMMARY*

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**INTRODUCTION** The top priority for the Missouri Department of Health and Senior Services (DHSS), in cooperation with the federal Agency for Toxic Substances and Disease Registry (ATSDR), in evaluating the public health impact of contaminants in the sediment and water of Strother Creek is to provide users of the Ozark Trail with the best information possible to safeguard their health.

Strother Creek runs along the border of Iron and Reynolds counties and crosses a portion of the Ozark Trail called Middle Fork. Upstream from where Strother Creek crosses the Middle Fork trail, there is a large tailings pond that has been formed by an active lead mine known as the Buick Mine. For several years, the Missouri Department of Natural Resources (DNR) has been monitoring the water and sediment in Strother Creek downstream of the Buick Mine tailings pond to determine if there has been any significant release of lead contaminated water or waste materials.

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**CONCLUSIONS** DHSS has reached one important conclusion in this health assessment:

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Conclusion 1  
*Soil* DHSS concludes that ingesting (swallowing), inhaling (breathing), and/or touching lead contaminated sediment or water at Strother Creek is not expected to harm trail users' health. This conclusion applies to past and present exposures to lead at this site.

Basis for Decision  
*Soil* Samples collected by DNR at Strother Creek have shown several mining-related contaminants in water and sediment. However, a trail user is not expected to visit this portion of the trail more than a few times per year. In addition, the amount of time spent at Strother Creek while using the trail is minimal. Therefore, trail users are not exposed to enough contaminants to pose a health risk.

## STATEMENT OF ISSUES

The Missouri Department of Health and Senior Services (DHSS), in cooperation with the federal Agency for Toxic Substances and Disease Registry (ATSDR), has completed this health consultation at the request of the Ozark Trail Association (OTA). This health consultation addresses whether there are health risks to users of the Ozark Trail that can be attributed to metal contaminants in the sediment and water of Strother Creek. The data that will be used for this health consultation is taken from sediment and water samples collected by the Missouri Department of Natural Resources (DNR) from Strother Creek near the Ozark Trail.

## BACKGROUND

### Site Description and History

#### *Lead Mining in Missouri*

Missouri has a rich history of lead mining dating back to the 1700s. In fact, throughout most of its history, Missouri has been the top producer of lead in the country. Mining began along the Meramec River and in the St. Francois Mountains in the southeast part of the state, and then expanded throughout the southern half of the state as new lead deposits were discovered. Lead mining is still occurring today in Iron and Reynolds counties in an area called the “New Lead Belt.”

During the lead mining and milling processes, large quantities of lead-containing waste products, called tailings, are generated and deposited on the surface. Dams are constructed to contain the tailings and form tailings ponds. Since not all of the lead can be extracted from mined rock, the waste materials in a tailings pond will contain some amount of lead. The concentration of lead in the waste materials depends on the efficiency of the extraction process.

#### *The Ozark Trail*

Thirteen trail sections in Missouri currently make up the over 300 miles of trails called the Ozark Trail. These trail sections lay between St. Louis and the Mark Twain National Forest in Ozark County near West Plains. (1)

Two groups currently working to complete the Ozark Trail are called Ozark Trail Council (OTC) and the OTA. The OTC establishes guidelines for construction, maintenance and mapping of the Ozark Trail as well as promoting the Ozark Trail. (1)

The OTA is a volunteer group that works with Ozark Trail land managers to build new trail and repair and maintain existing trail. Through the OTA, individuals and groups can also volunteer to maintain a portion of the Ozark Trail by joining OTA's "Adopt-A-Trail Program." These volunteers visit their portion of the trail at least three times per year to pick up litter, sticks and rocks on the trail, replace signs and report vandalism and other hazards found on the trail. The Middle Fork section of the Ozark Trail is a 25 mile long trail located in Iron and Reynolds counties. This trail crosses many Ozark streams including Strother Creek. (1)

### *Strother Creek*

Strother Creek runs along the border of Iron and Reynolds counties. Upstream from where the Middle Fork trail crosses Strother Creek, there is a large tailings pond that has been formed by an active lead mine known as the Buick Mine. The nearest designated parking area to Strother Creek shown on OTA's maps is located at Oates, Missouri, which is 3.7 miles from Strother Creek when following the trail. (1)

### *Site Investigation*

For several years, DNR has been monitoring the water and sediment in Strother Creek downstream of the Buick Mine tailings pond to determine if there has been any significant release of lead contaminated water or waste materials.

Data generated from water samples taken by DNR in Strother Creek from 2002 to 2005 show concentrations of lead in the water ranging from 0.5 micrograms per liter ( $\mu\text{g/L}$ ) to 22.1  $\mu\text{g/L}$  (see Table 1 in Appendix A). The water sample collected in 2005 was the only water sample that exceeded EPA's action level of 15  $\mu\text{g/L}$  for lead in drinking water. Cadmium, copper, nickel and zinc were also tested for, but the concentrations of these contaminants did not exceed CVs.

DNR collected two sediment samples below the tailings pond near the Middle Fork trail in 2004 and again in 2006. The lead concentration in these samples ranged from 827 parts per million (ppm) to 1,980 ppm. Other contaminants found in these samples included arsenic with an average of 71 ppm, cobalt with an average of 939 ppm and manganese with an average of 3,900 ppm (see Table 2 in Appendix A). Background concentrations for soil given by U.S. Geological Survey (USGS) PLUTO database in 2005 for Iron County and Reynolds County is 53 ppm for lead, 12 ppm for arsenic and 13 ppm for cobalt (2). Background soil concentrations were not available in PLUTO for manganese.

## **DISCUSSION**

Comparison values (CVs) have been used to evaluate most of the data provided by DNR's sampling events. CVs have been developed by ATSDR and U.S. Environmental

Protection Agency (EPA) that are media-specific concentrations used by health assessors to select environmental contaminants of concern. Contaminant concentrations that are less than CVs are unlikely to pose a health threat. Contaminant concentrations above CVs do not necessarily indicate that a health threat is present, but that further evaluation of the chemical and pathways is needed. CVs are usually developed for chronic (more than 365 days) exposure, intermediate (14 day to 365 days) exposure and acute (less than 14 days) exposure. ATSDR and EPA have not developed a CV for lead. Instead, EPA has developed standard cleanup values of 400 ppm and 1,200 ppm of lead that they use when evaluating soil in residential yards. We identified 1,200 ppm of lead as the appropriate CV for lead at this site. See Lead Values for Soil under the Toxicological Evaluation section in Appendix B for an explanation of the lead values used. All CVs for this evaluation can be found in Appendix A.

Some of the sediment data provided by DNR's sampling events were above CVs. However, contaminant concentrations that exceed CVs do not necessarily indicate that a health threat is present, but that further evaluation of the chemical, exposure duration, and exposure pathway is needed. Similarly, some of the water and sediment data are above EPA's action levels for lead in a residential exposure scenario, but residential exposures are not occurring here. The exposure pathway of concern for individuals using the Ozark Trail at the Strother Creek location is through ingestion (swallowing) of contaminated water or sediment. Other potential exposure pathways, such as inhalation (breathing) or dermal contact (touching) are expected to be of less concern.

John Roth, President of the OTA, reports that individuals typically do not visit this portion of the trail more than five times a year. This area would not easily allow camping and there is not enough water typically to allow swimming. There is, however, enough water at this area to fill a water bottle and get wet. One water sample collected from Strother Creek was greater than the EPA's drinking water action level of 15 µg/L for lead. However, the average concentration of lead from all the results provided by DNR was 6.2 µg/L, which is well below the action level. CVs for drinking water are typically developed assuming residential exposure where an individual is drinking a certain amount of this water, often two liters for an adult or one liter for a child, per day for a long period of time. The amount of exposure to the water at this site would be much less.

Drinking any surface water in Missouri without properly treating the water first may cause adverse health effects. This is due to the possibility of organisms, such as *Escherichia coli* (*E. coli*), *Giardia*, *Cryptosporidium* (commonly known as Crypto), hepatitis A and cyanobacteria (also called blue-green algae), existing in the surface water that may cause serious illness. (3) These organisms present an immediate health threat to individuals drinking untreated surface water.

Sediment samples showed arsenic, cobalt, lead and manganese concentrations exceeding available CVs for children and background concentrations for soil. However, further evaluation of the CVs, exposure duration and exposure pathways are needed. The concentrations of these contaminants were all below CVs for adults. The CVs for children that were used for arsenic, cobalt and manganese are for intermediate exposures

(14 day to 365 days) or chronic exposures (more than 365 days), but individuals are not expected to visit this location more than five days per year. The closest designated parking area to Strother Creek shown on the OTA Web site is 3.7 miles away when following the trail (1). The distance from the parking lot is expected to limit the number of visits made by young children and minimize the amount of higher-exposure activities like cooking and camping.

In addition, the CVs for arsenic, cobalt, lead and manganese that most closely match exposure to sediment are CVs that are used for soil at a residential property. However, DNR's samples were composed of sediment existing under water. Exposure to sediment is expected to occur differently and for a much shorter time period than for soil in a residential yard.

Samples taken by DNR at Strother Creek shows elevated concentrations of arsenic, cobalt, lead and manganese in the sediment. However, for the reasons described above, use of this trail is not expected to cause adverse health effects as a result of exposure to arsenic, cobalt, lead and manganese in the sediment.

## **TOXICOLOGICAL EVALUATION**

### **Introduction**

This site is not expected to cause adverse health effects as a result of lead. However, lead mining has and is occurring in this area. Because lead is prevalent in this area, the health effects of exposure to lead are discussed in Appendix B. A discussion of non-cancerous health effects and the possibility of the contaminants causing cancer are evaluated in this section as well.

### **Children's Health**

DHSS, along with ATSDR, realize that children are not small adults. Because their bodies are still developing and their behaviors are different, their susceptibility and exposure may be different than adults. Because of this, DHSS has evaluated the health implications for children who may be exposed to lead.

In general, children are more likely than adults to become exposed to contaminants in soil or water. In their daily activities, children have a tendency to have frequent hand-to-mouth contact and introduce non-food items into their mouths. Because children are smaller and their bodies typically absorb more of the contaminants, it usually takes less of a contaminant to cause adverse health effects in children than adults.

The health effects lead has on children is discussed in Appendix B.

## POTENTIAL TRAIL USER CONCERNS

The users of the Ozark Trail may reside throughout Missouri and beyond. Therefore, the ability to discuss their concerns is limited. Below are some anticipated questions individuals may have.

Is it OK to wade through the water in Strother Creek? Yes.

Is it OK to lay or swim in the water? Yes. When swimming in water, it is possible to accidentally swallow some water. This would not expose you to a significant amount of contaminants. However, if you do swallow creek water, it is possible that you would be exposed to an organism that could cause you adverse health effects. This would be the same as most other streams in Missouri.

Is it OK to wash my hands off in Strother Creek?

Yes. The amount of contaminants you would be exposed to when washing your hands would be negligible. Again, if you put your hands in your mouth after placing your hands in the creek water, it is possible to contract an organism that could cause illness. You should consider using a hand sanitizer before eating, drinking or smoking if your hands have been in contact with creek water.

Is it OK to drink water from Strother Creek?

Not without properly treating the water first. This is due to the possibility of organisms existing in the water that may cause adverse health effects. This would be the same as most other streams in Missouri.

Is it OK to sit on the bank of Strother Creek?

Yes. If your hands get dirty, it would be best to wash your hands before eating.

What do I do if I get mud on my shoes and/or clothes? Or if I get sediment in my shoes?

You want to avoid bring the contaminated soil into your home where you and/or others can be exposed to it on a more frequent bases. Try to wash as much of the mud or sediment off in Strother Creek as possible. Remove the shoes and clothing with mud on them before bringing them into your home. To be extra cautious, you can wash the shoes and clothing separately from your other laundry.

How can I tell if I've been exposed to lead?

The easiest way to know if you have been exposed to lead or not is to have your blood tested for lead. Your physician should be able to do this for you.

## CONCLUSION

Samples collected by DNR at Strother Creek have shown several contaminants in water and sediment with some contaminants exceeding CVs for intermediate or chronic exposures. However, a trail user is not expected to visit this portion of the trail more than five times per year. This exposure duration is much lower than what is used to develop CVs for intermediate or chronic exposures. Because of this, DHSS concludes that use of this trail is not expected to harm people's health as a result of exposure to contaminants detected in the water and sediment.

## RECOMMENDATIONS

1. Individuals should not drink this or any surface water in Missouri without properly treating the water first. This is due to the possibility of organisms, such as *Escherichia coli* (*E. coli*), *Giardia*, *Cryptosporidium* (commonly known as Crypto), hepatitis A and cyanobacteria (also called blue-green algae), existing in the surface water that may cause serious illness.
2. To keep exposure times to a minimum, DHSS recommends not developing facilities on the Middle Fork Trail near Strother Creek.
3. DHSS recommends blood lead testing for pregnant women and yearly testing for children under the age of 72 months to determine if they have been exposed to lead.

## PUBLIC HEALTH ACTION PLAN

This Public Health Action Plan (PHAP) for Strother Creek contains an explanation of the actions to be taken by the Missouri Department of Health and Senior Services (DHSS), the Agency for Toxic Substances and Disease Registry (ATSDR) and other stakeholders. The purpose of the PHAP is to ensure that this public health consultation not only identifies public health hazards, but provides an action plan to mitigate and prevent adverse human health effects resulting from past, present and future exposures to hazardous substances at or near the site. Below is a list of commitments of public health actions to be implemented by DHSS, ATSDR or other stakeholders at the site:

1. DHSS/ATSDR will provide educational materials and training to individuals using the Ozark Trail when requested.
2. DHSS/ATSDR will work with the OTA to address any health concerns and questions as they arise.

## CERTIFICATION

The Missouri Department of Health and Senior Services (DHSS) prepared this Strother Creek Health Consultation under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with the approved methodologies and procedures existing at the time the health consultation were initiated. The Cooperative Agreement partner completed editorial review.



Technical Project Officer, CAT, CAPEB, DHAC

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



Team Lead, CAT, CAPEB, DHAC, ATSDR

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## APPENDIX A

**Table 1: Strother Creek Water Sampling Results**

ID #	Collection Year	Cadmium (µg/L)	Copper (µg/L)	Nickel (µg/L)	Lead (µg/L)	Zinc (µg/L)
1	2002	0.5	4.99	Not Tested	2.94	139
2	2003	0.5	4.99	Not Tested	8.27	4.6
3	2003	0.125	2.499	31.9	1.32	40.7
4	2003	0.125	2.499	56.1	4.64	72.9
5	2004	0.125	2.499	47.3	0.499	69.9
6	2004	0.125	1.28	34	0.57	36
7	2004	0.125	2.499	72	9.55	233
8	2005	0.69	2.499	73.6	22.1	386
Average of Samples		0.29	2.97	52.48	6.24	122.76
Maximum Sample		0.69	4.99	73.6	22.1	386
Comparison Value(s)		5	1,300	200/700	15	3,000/10,000
Source of Comparison Value(s)		MCL	EPA action level	ATSDR Intermediate Child/Adult	EPA action level	ATSDR Intermediate Child/Adult

µg/L = micrograms per liter

ATSDR = Agency for Toxic Substances and Disease Registry

EPA = U.S. Environmental Protection Agency

MCL = EPA's Maximum Contaminant Levels

intermediate = 14 day to 365 days of exposure

**Table 2: Strother Creek Sediment Sampling Results**

ID #	Collection Date	Arsenic (ppm)	Cobalt (ppm)	Lead (ppm)	Manganese (ppm)
1	August 2004	Not Tested	719	827	4,280
2	October 2004	58.6	1,200	1,480	6,860
3	February 2006	59.3	718	1,080	1,660
4	February 2006	95	1,120	1,980	2,800
Average of Samples		71	939	1,342	3,900
Background Concentrations for Iron and Reynolds Counties		12	13	53	NA
Comparison Value(s)		20/200	500/7,000	1,200	3,000/40,000
Source of Comparison Value(s)		ATSDR Chronic Child/Adult	ATSDR Intermediate Child/Adult	EPA Time-Critical Removal Action	ATSDR Intermediate Child/Adult

ppm = parts per million

ATSDR = Agency for Toxic Substances and Disease Registry

EPA = U.S. Environmental Protection Agency

chronic = more than 365 days of exposure

intermediate = 14 day to 365 days of exposure

NA = not available

Background concentrations for soil were taken from the U.S. Geological Survey (USGS) PLUTO 2005 database.

## APPENDIX B

### TOXICOLOGICAL EVALUATION

#### Introduction

This site is not expected to cause adverse health effects as a result of lead. However, lead mining has and is occurring in this area. Because lead is prevalent in this area, this section will discuss the health effects of exposure to lead. A discussion of non-cancerous health effects and the possibility of the contaminants causing cancer are evaluated in this section as well.

#### Lead

Lead is a naturally occurring metal found in the earth's crust (4). It has no characteristic taste or smell (4). It is mined and processed for use in various industries. Lead is used in some types of batteries, ammunition, ceramic glazes, medical equipment, scientific equipment and military equipment (4). At one time, lead was used as an additive in gasoline and in paint. Lead from gasoline was released into the air in automotive exhaust and deposited along roadways (4). Houses built before 1978 may contain lead based paint. Lead in the soils in the inner cities is often attributable to lead based paint and leaded gasoline (4).

Lead has no nutritional benefits for humans. Exposure to lead can occur by inhalation or ingestion. Lead is not readily absorbed through the skin, so dermal contact is not an important route of exposure. Lead has the greatest effect on the nervous system, especially in children. Pregnant women can experience complications with their pregnancy ranging from low birth rate to miscarriage if exposed to high concentrations of lead. (4)

#### *Lead Value for Soil*

Exposure to lead in soil is evaluated by using a biological model that predicts a blood lead concentration that would result from exposure to environmental lead contamination. The modeled blood lead concentration is then compared to the level of concern for blood lead concentrations in children as recommended by the CDC (CDC, 2005). CDC's current blood lead level of concern is 10 µg/dL. Using this model, EPA has established a standard cleanup value of 400 ppm for lead in soil using the default parameters in this model (5). The default parameters in the model include many estimated values such as estimated soil ingestion and time spent outdoors.

In addition to the standard cleanup value, EPA typically develops another lead concentration for large sites to prioritize which residential yards need to be remediated first. Residential yards with concentrations above this value are called time-critical yards. For many sites in Missouri, EPA has set 1,200 ppm as the Time-Critical Removal Action level.

The default parameters used in the model may not take into consideration all of an individual's exposure to lead. An individual can be exposed to lead through many sources such as drinking water, lead paint and other items containing lead including certain toys, jewelry, herbal remedies, Mexican candies, water hoses and others.

### *Cancer*

While the EPA considers lead to be a probable human carcinogen and the National Toxicity Program (NTP) has determined that lead and lead compounds are reasonably anticipated to be human carcinogens, there have been no studies linking residential ingestion of lead contaminated soil or drinking water with an increase cancer risk (4). Although the American Cancer Society estimates less than half of men and slightly more than a third of women in the United States will develop some form of cancer in their lifetime, the primary health concern for lead in Strother Creek is not cancer; instead, the primary concern from exposure to lead in Strother Creek is the effects lead has on the nervous system, especially on children less than 72 months of age (6, 7).

### **Children's Health**

DHSS, along with ATSDR, realize that children are not small adults. Because their bodies are still developing and their behaviors are different, their susceptibility and exposure may be different than adults. Because of this, DHSS has evaluated the health implications for children who may be exposed to lead.

In general, children are more likely than adults to become exposed to contaminants in soil or water. In their daily activities, children have a tendency to have frequent hand-to-mouth contact and introduce non-food items into their mouths. Because children are smaller and their bodies typically absorb more of the contaminants, it usually takes less of a contaminant to cause adverse health effects in children than adults.

Studies have shown that there is a definite correlation between concentrations of lead in soils and blood lead levels in children. In general, blood lead levels increase as the lead concentrations in soil and dust increase. As blood lead levels increase, the likelihood of adverse health effects also increases. (4)

Children are more susceptible to lead poisoning than adults, and children are also more likely to be exposed to lead contaminated materials. Infants and young children can swallow and breathe lead contaminated dirt, dust or sand while they play on the floor or ground. They can also be exposed to lead through breast milk if the mother has elevated levels of lead in her system. Also, compared to adults, a larger proportion of the amount

of lead swallowed will enter the blood in children (4). While about 99 percent of the amount of lead taken into the body of an adult will leave as waste within a few weeks, only about 32 percent of lead taken into the body of a child will leave as waste (4). All of these factors result in children being more affected by lead than adults when they have similar lead concentrations in their environment.

When children are exposed to lead contaminated materials, a variety of adverse health effects can occur depending on the amount of lead to which they are exposed and the duration of exposure. These effects include learning disabilities, slowed growth, hyperactivity, impaired hearing and at very high exposure levels, even brain damage (4). Lead has the greatest effect on the nervous system, especially in children. In children, low levels of lead can cause weakness in fingers, wrists or ankles. Unborn children can also be exposed to lead through their mothers and are at risk of premature births, low birth weight, decreased mental ability, learning difficulties and reduced growth as young children (4).

Yearly blood lead testing before a child is 72 months old is key in determining if the child has been exposed to lead. Eliminating exposure pathways by controlling contamination sources, practicing good personal hygiene and eating a proper diet high in calcium can reduce the risk of lead poisoning in children.