

# Health Consultation

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HERCULANEUM LEAD SMELTER (DOE RUN COMPANY)  
(a/k/a HERCULANEUM LEAD SMELTER SITE)

HERCULANEUM, JEFFERSON COUNTY, MISSOURI

EPA FACILITY ID: MOD006266373

OCTOBER 22, 2002

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service  
Agency for Toxic Substances and Disease Registry  
Division of Health Assessment and Consultation  
Atlanta, Georgia 30333

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

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

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

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## HEALTH CONSULTATION

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Prepared by:

Exposure Investigation and Consultation Branch  
Division of Health Assessment and Consultation  
Agency for Toxic Substances and Disease Registry

## **Background**

The Herculaneum lead smelter is an active facility that has been operating since 1892. The Doe Run Company currently owns and operates the smelter. The facility is located along the Mississippi River at 881 Main Street in Herculaneum, Missouri. A lead ore concentrate, consisting of 80 percent lead sulfide, is processed at the smelter [1].

The first step in the smelting process is to mix the ore with fluxes and recycled lead-containing materials, such as baghouse fume, to form the sinter feed mix. This mixture is then tumbled to form pellets that are fed into the sinter machine. The pellets are heated by gas burners to form lead sinter. Hot gaseous combustion products released during this process include sulfur dioxide, which is collected and used to produce sulfuric acid at the facility.

Residents living near the smelter have reported that they occasionally smell sulfur in the air, and that air emissions from the smelter have damaged paint on their cars [1]. In response to these complaints, the Missouri Department of Health and Senior Services (MDHSS) asked ATSDR to review the available data and information and determine if sulfur dioxide emissions from the facility pose a public health hazard. In addition, MDHSS asked ATSDR if current ambient air monitoring for sulfur dioxide is adequate to characterize sulfur dioxide emissions from the facility.

## **Ambient Air Monitoring**

### *Ambient air monitoring stations*

The Missouri Department of Natural Resources (MDNR) provided ATSDR with air monitoring data for sulfur dioxide from three ambient air monitoring stations in the Herculaneum area. The monitoring station at Dunklin High School is located less than ½-mile north of the smelter. This station monitored sulfur dioxide from at least 1993 to 2001. A second sulfur dioxide monitoring station was located on Crystal Road in the town of Festus, about ½-mile southwest of Herculaneum. A third air monitoring station is located near Joachim Creek about ½-mile northwest of the smelter. This station has been monitoring for sulfur dioxide since the summer of 2001.

MDNR chose the location for the Joachim Creek station based on the results of air modeling of sulfur dioxide emissions from the stack at the Doe Run smelter. The station is located near areas where the air dispersion model predicted that high 3-hour and 24-hour concentrations of sulfur dioxide might occur. MDNR could not obtain access to the optimal sampling location on a bluff, so the station was sited on private property below the bluff. When the Joachim Creek station began operating in 2001, monitoring for sulfur dioxide at the other two stations was stopped.

ATSDR also reviewed air sulfur dioxide monitoring data for 2000-2001 provided by the Doe Run Company. Doe Run monitors ambient air sulfur dioxide concentrations at five monitoring stations in Herculaneum. (A sixth air monitoring station next to the MDNR Joachim Creek station was added in May 2001.)

### *Ambient air standards for sulfur dioxide*

The U.S. Environmental Protection Agency (EPA) promulgated the National Ambient Air Quality Standards (NAAQS) to protect human health and welfare from hazardous air pollutants. For sulfur dioxide, the EPA has established a primary NAAQS of 0.14 parts per million (ppm) for a 24-hour average air concentration and 0.03 ppm for a 1-year average air concentration. These standards, which were established to protect human health, are not to be exceeded more than once per year.

The EPA has also promulgated a secondary NAAQS for sulfur dioxide to protect human welfare. The secondary NAAQS for sulfur dioxide is 0.5 ppm over a 3-hour period. This standard was established to prevent impacts on welfare such as “damage to vegetation by sulfur dioxide resulting in economic losses in commercial crops, aesthetic damage to cultivated trees, shrubs, and other ornamentals, and reductions in productivity, species richness, and diversity in natural ecosystems” [2].

People with asthma are particularly susceptible to adverse health effects from acute inhalation exposures to sulfur dioxide. The populations most likely to be affected by ambient air pollution with sulfur dioxide are mild and moderate asthmatic children, adolescents, and adults who are physically active outdoors. To protect asthmatics against such effects, the EPA has considered establishing a short-term (e.g., 5-minute) ambient air standard for sulfur dioxide [3]. However, no such standard is currently in effect.

## **Discussion**

### *Compliance with NAAQS*

The MDNR provided ATSDR with summary air monitoring data for sulfur dioxide from the air monitoring stations at Dunklin High School (1997 - 2001), Joachim Creek (2001), and Festus (1998-2001). MDNR also provided ATSDR with comprehensive hourly air monitoring data for the three stations for 2001. Additional air monitoring data for these stations on the MDNR internet site were also examined [4].

The MDNR monitoring station closest to the Doe Run smelter is the station at Dunklin High School. An examination of the hourly monitoring data for Dunklin High School indicated that the sulfur dioxide concentrations tended to be higher in the afternoon than during the rest of the day, particularly in the summer months. This trend may be related to changes in the direction of wind flow as the ground heats up during the day.

The historical MDNR data for the monitoring station at Dunklin High School indicate that the concentrations of sulfur dioxide in ambient air decreased over the time period 1993-2001. In 1997, Doe Run built a 550-foot stack to replace an older, 350-foot stack. In addition, Doe Run reported that in the past five years they have upgraded and repaired their sulfur dioxide collection system and control equipment. These improvements have likely contributed to the observed decrease in sulfur dioxide concentrations that have been detected at the ambient air monitoring stations.

None of the reported air concentrations of sulfur dioxide from MDNR monitoring stations from 1993-2001 exceeded the applicable NAAQS. In addition, none of the monitoring data from the six Doe Run monitoring stations exceeded the NAAQS. Therefore, the ambient air monitoring data do not provide evidence that residents of Herculaneum have been exposed to sulfur dioxide at concentrations in excess of existing regulatory standards.

*Shorter-term ambient air sulfur dioxide concentrations*

The NAAQS apply to time-weighted average intervals of 3-hours, 24-hours and 1 year. It is possible that short-term peaks of higher sulfur dioxide concentrations could occur, even though regulatory standards for longer time intervals are not exceeded. Such excursions could result from fugitive emissions from the facility or from smelter stack emissions.

ATSDR reviewed the hourly air monitoring data for the MDNR monitoring stations closest to the Doe Run Smelter for 2001, the most recent year for which data were available. Monitoring data for time intervals shorter than 1-hour were not available. The summary data for these stations are as follows:

Sulfur Dioxide Concentration (ppm)			
<u>MDNR Station</u>	<u>Annual Average 1-hour</u>	<u>Maximum 1-hour</u>	<u>Maximum 3-hour</u>
Herculaneum High School	0.002	0.097	0.047
Joachim	0.004	0.226	0.108
Festus (Crystal Road)	0.004	0.233	0.170

Monitoring data from the Doe Run monitoring stations for 2001 are summarized in the following table.

Sulfur Dioxide Concentration (ppm)

<u>Doe Run Station</u>	<u>Annual Average 1-hour</u>	<u>Maximum 1-hour</u>	<u>Maximum 3-hour</u>
Herculaneum High School	0.011	0.152	0.101
Crystal Heights	0.007	0.135	0.099
Joachim	0.010	0.368*	0.278*
Ursuline	0.008	0.198	0.136
Golf Course	0.012	0.210	0.106
North	0.009	0.178	0.110

(\*) These values are suspect because the MDNR monitor at the same location measured 0.001 ppm sulfur dioxide for the same time interval.

There is currently no NAAQS for 1-hour concentrations of sulfur dioxide. However, the sensitivity of asthmatics has prompted the EPA to consider establishing an Intervention Level Program (ILP), which would allow States, tribes, and local governments to address short-term elevations in sulfur dioxide levels [5]. Included in the ILP is a proposal to establish a concern level of 0.6 ppm for a 5-minute average sulfur dioxide concentration, and an endangerment level of 2.0 ppm for a 5-minute average [3, 5]. To date, this program has not been enacted. All of the hourly sulfur dioxide air concentrations detected at the MDNR and Doe Run monitoring stations in 2001 were less than ambient air standards that have been proposed by the EPA.

*Odors and damage reports*

Residents of Herculaneum occasionally report smelling sulfur odors. The odor threshold for sulfur dioxide varies among people from 0.1 to 4.8 ppm [6]. Sulfur dioxide concentrations within this range have been detected at monitoring stations operated by MDNR and Doe Run. Therefore, reports of sulfur or sulfur dioxide odors can be corroborated by air monitoring data.

Residents of Herculaneum have reported damage to the paint on their cars and to rain gutters that they attribute to “acid emissions” from the plant. These reports of damage might have been related to spills of sulfuric acid during acid loading operations, leaks in sulfur dioxide transfer lines within the facility, or stack emissions. No monitoring data are available to document such “acid emission” events.

ATSDR reviewed Missouri's Environmental Emergency Response complaints for Herculaneum for the time period 1994-2002. No specific reports of "acid" damage were reported during this time period, although there continue to be reports of nuisance odors and sulfur-like odors from the facility.

*Health impact of sulfur dioxide exposures*

In healthy individuals, exposures to sulfur dioxide concentrations of 1-5 ppm have been associated with increases in airway resistance. Asthmatic individuals are more sensitive to sulfur dioxide and may experience symptoms after being exposed to sulfur dioxide at concentrations that have no effect on normal individuals.

Experimental studies have shown that some asthmatics who are briefly exposed (2 to 10 minutes) to sulfur dioxide at concentrations of 0.5 to 1.0 ppm while exercising may experience bronchoconstriction, wheezing, chest tightness, and shortness of breath. These symptoms are relatively transient, and lung function typically returns to normal within an hour of exposure [7]. In very sensitive asthmatic subjects, slight increases in airway resistance have been observed after inhalation of even lower concentrations of sulfur dioxide.

The maximum 1-hour ambient air concentration of sulfur dioxide detected during recent monitoring (2001) were generally 0.2 ppm or less. These concentrations are less than existing or proposed ambient air standards and would not be expected to cause significant adverse health effects in residents.

Doe Run reported that they continuously monitor sulfur dioxide at five ambient air monitoring stations around the town. If ambient air sulfur dioxide concentrations in excess of 0.25 ppm are detected, they evaluate the situation and determine if a reduction in the production rate is indicated. However, the existing air monitoring stations are sited to monitor emissions from the smelter stack. Fugitive sulfur dioxide emissions, if they occur, may not be detected at these stations. Therefore, it cannot be determined if fugitive emissions are a source of elevated sulfur dioxide exposures in the immediate vicinity of the facility.

## **Conclusions**

- (1) Ambient air monitoring data have not indicated any violations of the National Ambient Air Quality Standards (NAAQS) for sulfur dioxide in Herculaneum (1993-2001).
- (2) Based on recent monitoring data, the concentrations of sulfur dioxide detected in ambient air pose no apparent public health hazard. This characterization is subject to change if future monitoring in the immediate vicinity of the facility detects sulfur dioxide in potential fugitive emissions at concentrations of health concern.
- (3) Sulfur dioxide monitoring stations currently being operated by MDNR and Doe Run are sited in locations to monitor stack emissions. Monitors at these locations may not detect fugitive sulfur dioxide emissions from the plant, if they occur.

## **Recommendations**

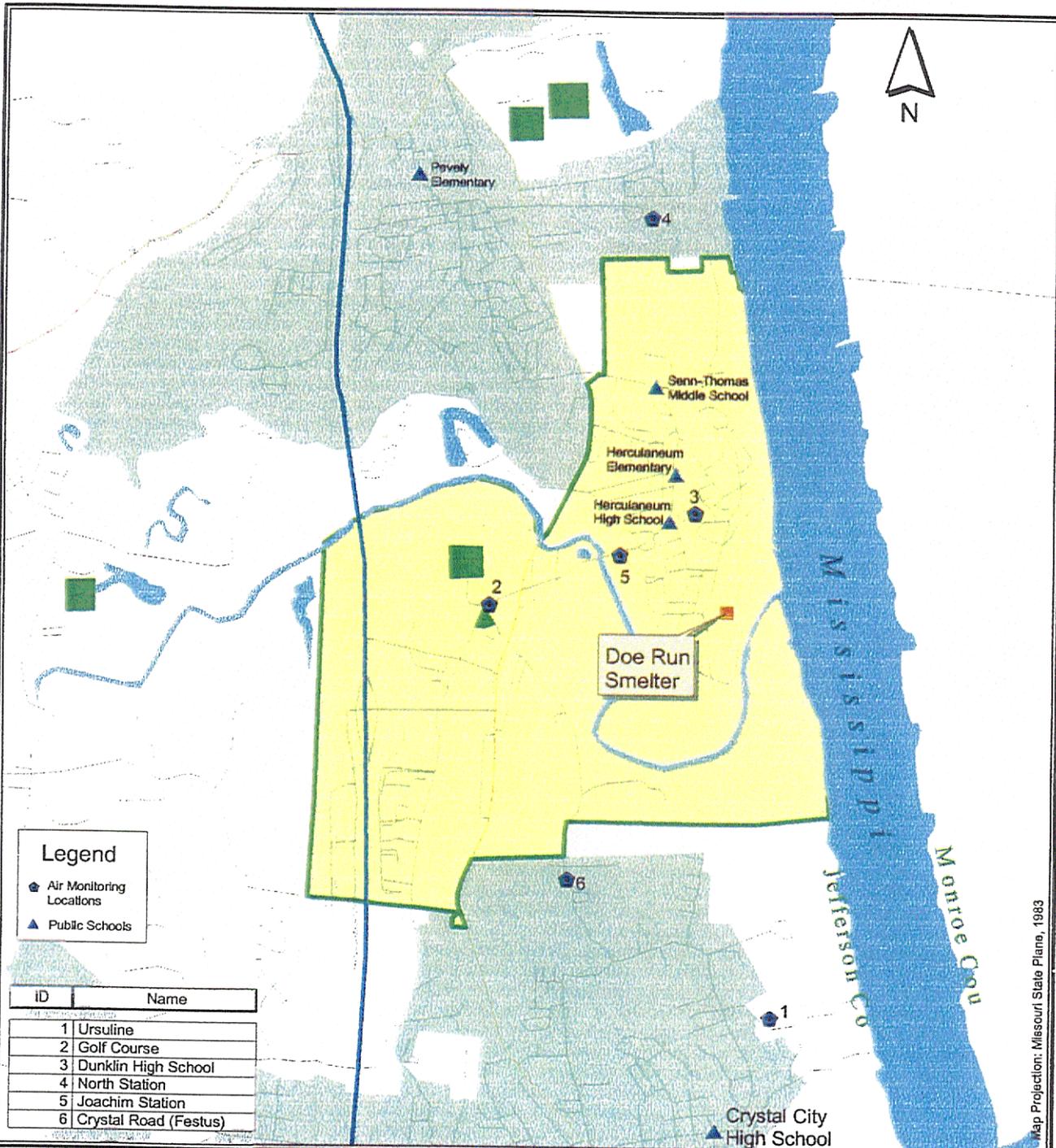
- (1) The Doe Run Company should continue to upgrade and maintain in good repair its sulfur dioxide control equipment. Regulatory agencies should continue to work with the Doe Run Company to ensure that sulfur dioxide emissions from the plant are minimized and in compliance with all regulatory standards.
- (2) Regulatory agencies should consider siting a sulfur dioxide monitor near the plant to monitor for potential fugitive emissions.

Report prepared by:

Kenneth G. Orloff, Ph.D, DABT  
Senior Toxicologist

## References

- (1) Missouri Department of Natural Resources; Preliminary Assessment Report: Herculaneum Lead Smelter Site; March 30, 1999.
- (2) U. S. Environmental Protection Agency; Review of the National Ambient Air Quality Standards for Sulfur Oxides: Assessment of Scientific and Technical Information; page 126; EPA-450/5-82-007; November 1982.
- (3) U. S. Environmental Protection Agency; National Ambient Air Quality Standards for Sulfur Oxides (Sulfur Dioxide); Availability of Information; Federal Register Vol. 66, No. 6; pages 1665-1668; January 9, 2001.
- (4) Missouri Department of Natural Resources; Environmental Services Program; <http://www.dnr.state.mo.us/alpd/esp/aqm/herc.htm>
- (5) U. S. Environmental Protection Agency; Proposed Implementation Requirements for Reduction of Sulfur Oxide (Sulfur Dioxide) Emissions; Proposed Rule. Federal Register Vol. 62, No. 1; pages 210-222; January 2, 1997.
- (6) Hazardous Substances Data Base (on-line data base); National Library of Medicine <http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB> 2002.
- (7) U. S. Environmental Protection Agency; National Ambient Air Quality Standards for Sulfur Oxides (Sulfur Dioxide); Final Decision; Federal Register Vol. 61, No. 100; pages 25566-25580; May 22, 1996.



**Legend**

- Air Monitoring Locations
- Public Schools

ID	Name
1	Ursuline
2	Golf Course
3	Dunklin High School
4	North Station
5	Joachim Station
6	Crystal Road (Festus)

Map Projection: Missouri State Plane, 1983

# Sulfur Dioxide Ambient Air Monitoring Stations

Herculaneum, Missouri  
 CERCLIS NO MOD006266373

## VICINITY MAP



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