

# **Health Consultation**

## **Review of Environmental Data in Air, Drinking Water and Soil**

**Sierra Vista, Cochise County, Arizona**

**Prepared by**

**Arizona Department of Health Services  
Office of Environmental Health  
Environmental Health Consultation Services**

**under cooperative agreement with the  
Agency for Toxic Substances and Disease Registry**

## **Introduction**

The Arizona Department of Health Services Cancer Registry has identified 7 cases of childhood leukemia in the Sierra Vista, Arizona area since 1995. Five of the childhood leukemia cases were identified as a class of lymphoid leukemia and 2 of the cases were a class of myeloid leukemia. Based on random variation, a total of 6 or fewer cases of leukemia would have been expected over those seven years. An analysis of the data suggests that the number of cases is statistically elevated for the time period 1995 to 2001.

The objective of this report is to determine whether there are any documented environmental exposures from drinking water, ambient air or waste sites that may have placed residents of the Sierra Vista, Arizona area at greater risk of developing childhood leukemia.

This report specifically analyzes the available data from drinking water, air and waste areas to determine whether any environmental exposure may be responsible for placing residents of the Sierra Vista area at a greater risk of developing leukemia. The report focuses on chemicals that are known to cause human cancers including leukemia. The most frequently cited environmental causes of leukemia are large doses of radiation and exposure to benzene. Exposure to arsenic is also examined since it can cause other kinds of human cancers.

## **Epidemiological Data Review**

In the summer of 2001, staff from the University of Arizona hematology clinic reported to the Arizona Department of Health Services Cancer Registry that parents of children diagnosed with leukemia in Sierra Vista suspected that there may be an elevated rate of leukemia in the Sierra Vista area. In response to this report, the Arizona Cancer Registry counted all reported cases of leukemia diagnosed in the Sierra Vista area from 1995 to date in 2001. The leukemia rate in Sierra Vista was compared to the state rate.

Statewide, there were 167 cases of leukemia reported among children age 0-14 from 1995 to 1998 (see Table 1). The statewide age-specific rate for that time period is 4.0 cases per 100,000 children-years.

From 1995 through 2001 there were 7 cases of leukemia reported in Sierra Vista. This calculates to an age-specific rate of 8.8 cases per 100,000 children-years. The statewide rate was used to project an upper limit of 6 “expected” cases in Sierra Vista. These data suggest that the number of cases from Sierra Vista is marginally statistically significant, meaning that the number of cases of leukemia from 1995 to 2001 is higher than expected when compared to the latest available state rate (1995 – 1998). This conclusion is based on the assumption that the statewide rate for 1999 to 2001 will remain consistent with the rate for 1995 - 1998. When complete statewide data become available, the Arizona Cancer Registry will compare the rates of Sierra Vista and Arizona using identical time frames.

**Table 1. Child leukemia cases and rate (per 100,000 children), reported to the Arizona Cancer Registry as of September 2002**

Diagnosis Year	Sierra Vista area			Arizona		
	Count	Child population age 0-14	Rate <sup>b</sup>	Count	Child population age 0-14	Rate
1995	0	11569	--	47	997724	4.71
1996	0	11603	--	38	1030005	3.69
1997	1	11310	--	38	1045282	3.63
1998	1	11090	--	44	1086261	4.05
1999 <sup>a</sup>	1	X	--	50 <sup>a</sup>	1125177	4.44 <sup>a</sup>
2000 <sup>a</sup>	1	11351	--	56 <sup>a</sup>	1150466	4.86 <sup>a</sup>
2001 <sup>a</sup>	3	X	--	52 <sup>a</sup>	n.a.	n.a.
2002 <sup>a</sup>	n.a.	n.a.	--	1 <sup>a</sup>	n.a.	n.a.

<sup>a</sup> Arizona statewide data for these years is not complete. Additional cases may be found when ACR staff review records at pathology laboratories.

<sup>b</sup> Rates calculated on fewer than 5 events are too unstable to show individually.

n.a. = Not Available

X = The average value of 11384 children was used for these cells in calculating the combined rate for 1995-2001.

Five of the seven cases were lymphoid leukemias; two were myeloid leukemias. The small number of cases in this area, even when looking at the 7-year period, severely limits the ability to detect patterns or draw definitive conclusions.

Review of the case's and parent's residences for 4 of the cases, for whom parents provided residential history forms, shows no obvious clustering within a neighborhood. Rather, the residences are scattered among several neighborhoods. Addition of the addresses at diagnosis of the 3 remaining case children does not reveal neighborhood clustering. Three of the seven cases had Fort Huachuca addresses at diagnosis; four had other addresses in the Sierra Vista area.

## **Environmental Data Review**

### **Drinking Water Quality**

The Arizona Department of Environmental Quality administers an environmental program to ensure that all drinking water systems in Arizona comply with the federal Safe Drinking Water Act. The federal act requires that water systems regularly test for a number of drinking water contaminants. All water systems must comply with the maximum contaminant levels established by the United States Environmental Protection Agency. All 26 public drinking water systems in the Sierra Vista area have been in compliance with the federal drinking water chemical standards since 1989. There have been no detections of industrial solvents or gasoline components.

### *Radiochemicals*

Water can contain naturally occurring radioactive materials that have dissolved from soil and rocks. If groundwater is used as a primary drinking water source it is possible that radiological contaminants could be present in drinking water. Most radiological contaminants in groundwater decay when the nucleus of the chemical emits a subatomic particle called an alpha particle. The radiation from this process can be measured and reported as Gross Alpha Radioactivity. Some radioactive materials decay by emission of beta particles, gamma rays or photons, but they usually have an associated alpha particle emission as well. A measure of Gross Alpha Radioactivity is a good screening tool for measuring the amount of radiochemicals in drinking water for these reasons.

The USEPA has established a Maximum Contaminant Level (MCL) for Gross Alpha Radioactivity in water of 15 pico Curies per liter of water (pCi/L). The MCL for the radium species part of the Gross Alpha Radioactivity is 5 pCi/L. Likewise, the Agency for Toxic Substances and Disease Registry Minimal Risk Level is 5 pCi/L.

Table 2 displays the Average Gross Alpha Radioactivity Levels for the public water systems in the Sierra Vista Area from 1989 to 2002.

**Table 2. Gross Alpha Radioactivity in Sierra Vista Area Water Systems<sup>3</sup>**

<b>Water System</b>	<b>Average Gross Alpha Readings</b> (pCi/L)	<b>Above Minimal Risk Level?</b> (5 pCi/L)
Antelope Run	2.2	No
Arizona Water, Village Mead	1.5	No
Bella Vista Water Co.	2.1	No
Bella Vista, Nicksville	2.4	No
Bella Vista, Rail Oaks	4.4	No
Bella Vista, Welch	3.9	No
Cloud Nine Water Co.	2.5	No
Cochise Water Co.	3.3	No
Desert Winds Mobile Home Park	1.1	No
East Slope Water Co.	2.3	No
Huachuca City	2.0	No
Indiana Water Co.	3.2	No
Mustang Water Co.	3.6	No
Pueblo del Sol Water Co.	2.8	No
Sierra Sunset Water Co.	3.4	No
Sierra Vista Mobile Home Village	1.4	No
Southland Utilities, Golden Acres	1.3	No
Sunrise Mobile Home Park	1.8	No
US Army, Fort Huachuca	2.6	No
Whetstone Water Assoc.	2.3	No

The measured Gross Alpha Radioactivity Levels in the water systems in the area are less than the Minimum Risk Levels and USEPA Maximum Contaminant Levels, suggesting that radiochemicals in drinking water in the Sierra Vista area do not represent a health threat. Lifetime exposure to the level of radioactivity in the water in Sierra Vista represents an additional cancer risk of three in one hundred thousand, suggesting that radiochemicals in the water are not the cause of the additional cases of leukemia found in Sierra Vista.<sup>4</sup>

*Arsenic*

Arsenic is a naturally occurring metal in soils, commonly found in combination with other metals such as copper. Exposure to elevated levels in drinking water has been found to cause an increased chance of developing skin cancer, and to a lesser extent bladder and stomach cancer. While exposure to arsenic has not been associated with the development of leukemia, we reviewed the drinking water data from the Sierra Vista area for arsenic levels because it can cause cancer in humans.

Recent toxicological studies have linked elevated arsenic concentrations with increased incidents of heart disease, diabetes, and reproductive disorders, as well as the more commonly known skin cancers and hyperpigmentation effects. Based upon the recommendations of the United States Environmental Protection Agency advisory panels, the drinking water standard or Maximum Contaminant Level has been lowered to 10 ug/L. Full implementation of the new standard is scheduled for 2006. The Minimal Risk Level for arsenic is equal to the new federal drinking water standard of 10 ug/L.

**Table 3. Arsenic Levels in Sierra Vista Area Water Systems<sup>3</sup>**

<b>Water System</b>	<b>Frequency of Detection</b>	<b>Average Detected Level</b> <small>Micrograms per liter (ug/L)</small>	<b>Average Arsenic Level Above Minimal Risk Level?</b>	<b>Average Arsenic Level Above MCL?</b>
Antelope Run	0/9	--	No	No
Arizona Water, Village Mead	0/24	--	No	No
Bella Vista Water Co.	11/79	3	No	No
Bella Vista, Nicksville	0/20	--	No	No
Bella Vista, Rail Oaks	0/5	--	No	No
Bella Vista, Welch	1/13	3	No	No
Cloud Nine Water Co.	1/3	2	No	No
Cochise Water Co.	0/7	--	No	No
Coronado Memorial	0/2	--	No	No
Dairy Queen	0/2	--	No	No
Desert Winds Mobile Home Park	0/4	--	No	No
East Slope Water Co.	0/15	--	No	No
Huachuca City	6/15	3	No	No
Indiana Water Co.	2/16	2	No	No
Jimbo's Beach Shack	0/1	--	No	No
Mesquite Tree	0/2	--	No	No
Mustang Water Co.	3/4	6	No	No
Pueblo del Sol Water Co.	0/10	--	No	No
Sierra Sunset Water Co.	2/3	4	No	No
Sierra Vista M. H. Park	0/3	--	No	No
Southland Utilities, Golden Acres	0/9	--	No	No
Sunrise Mobile Home Park	0/2	--	No	No
US Army, Fort Huachuca	15/40	8	No	No
Whetstone Water Association	0/9	--	No	No

The average arsenic levels in the Sierra Vista area water systems are lower than Minimum Risk Levels and the new federal drinking water standard, suggesting that arsenic in drinking water in the area does not represent a health threat. Lifetime exposure to the level of arsenic in the water in Sierra Vista represents an additional cancer risk of five in one hundred thousand, suggesting that arsenic in the water is not the cause of the additional cases of leukemia found in Sierra Vista.<sup>4</sup>

*Benzene*

Exposure to high levels of benzene can cause various kinds of cancers including leukemia. Specifically, benzene exposure has been associated with the development of leukemia. For this reason, we reviewed water system data from the Sierra Vista area to determine whether benzene has been found in water in the area.

Table 4 displays the summary data for all of the samples taken in the public water systems in the Sierra Vista area. The data indicate that benzene has never been detected in drinking water.

**Table 4. Benzene Presence and Levels in Sierra Vista Area Water Systems<sup>3</sup>**

Water System	Frequency of Benzene Detection	Maximum Detected Level	Above Minimal Risk Level?
All 26 Sierra Vista Water Systems (1989-2002)	0/493	--	No

Benzene has never been detected in any of the public drinking water sources in the Sierra Vista area, suggesting that benzene is not a health threat in drinking water.

**Air Quality**

The Arizona Department of Environmental Quality Air Quality Assessment Section monitors for compliance with National Ambient Air Quality Standards pollutants in air quality non-attainment areas and special-purpose monitoring for air toxics, ozone precursors, visibility, and meteorological data.

Sierra Vista area is in attainment with all federal air quality standards. As a result, there is no active sampling program in the area, and quantitative air quality data are not available. However, a qualitative estimate of air quality in the area can be developed using the Arizona Department of Environmental Quality emissions inventory for the Sierra Vista area.

*Air Quality Emission Inventory*

Stationary sources of air pollution need an air quality permit from the Arizona Department of

Environmental Quality if the process or equipment causes or has the potential to cause air pollution. Any facility that is classified by the Arizona Department of Environmental Quality as having the *potential to emit* must have a permit. The *potential to emit* classification is based on the facility's maximum air pollution emission. Smaller facilities such as gasoline service stations usually emit very small amounts of air pollutants and are not classified as having the *potential to emit*.

There are 10 facilities that meet the *potential to emit* requirements in the Sierra Vista area. All of the facilities are low emission facilities. Table 5 displays the emission inventory for the Sierra Vista area.

**Table 5. Emission Inventory for the Sierra Vista Area<sup>5</sup>**

<b>Facility</b>	<b>Particulate Matter Emissions</b> (lbs./day)	<b>Volatile Organic Compounds</b> (lbs./day)	<b>Hazardous Air Pollutants</b> (lbs./day)
<b>Concrete and Block Manufacturing</b>			
Huachuca Concrete Plant	--	--	--
San Pedro Valley Redi-mix	--	--	--
Sierra Ready Mix	--	--	6.2
Young Block Company	36	9	--
<b>Dry Cleaning Services</b>			
Bonanza Dry Cleaners	--	--	--
Lloyd's Dry Cleaning	--	--	--
One Hour Martinizing	--	--	--
<b>Funeral Services</b>			
Foothills Memorial	0.25	0.2	--
Hatfield Funeral Home	--	--	--
<b>Miscellaneous</b>			
Sierra Vista School District	--	--	--

-- No emissions over the *potential to emit* threshold

The largest stationary source of air pollutants in the area is the Young Block Company, which is a local manufacturer of concrete blocks. The emissions from the facility are typical of many concrete block manufacturers. The facility is classified as a low emitter because of the low level of pollutants emitted by the facility. All other facilities in the area emit very low levels of airborne contaminants.

### *Vehicular Sources*

There are many non-point sources of air pollutions such as automobiles and trucks that can affect air quality. Emissions from vehicular traffic in the Sierra Vista area are relatively small since Sierra Vista has a relatively small population (approximately 39,000) and because it is not located in a large urban area. Vehicular traffic does not appear to be significantly affecting air quality in Sierra Vista.

### *Aviation Sources*

Fort Huachuca has an active airfield called the Libby Army Airfield. The runway at Libby Army Airfield is shared with the Sierra Vista Municipal Airport. There are 85 aircraft based at the facility. Approximately half of the aircraft are single engine airplanes. Twenty-eight of the 85 airplanes are military aircraft. The average airport operation activity is approximately 300 flights per day. Approximately 75% of the daily flights are conducted by the military, with the remaining flights spread among local, transient, and commercial aviation.

Aviation fuel (Avgas and Jet A) is commercially available at the Sierra Vista Municipal Airport. The fuel is stored in underground fuel storage tanks that have proper safety and vapor prevention devices. In addition, Fort Huachuca stores jet aviation fuel (JP 8) in underground storage facilities at Libby Army Airfield. All of the aviation fuel used at Libby Air Field is delivered by truck and dispensed according to the current industry standard methods.

During aviation emergencies is it occasionally necessary for aircraft to discharge fuel in order to avoid the potential for fire during emergency landings. There is less than 1 event per year when discharging fuel is necessary, suggesting that the discharge of aviation fuel does not adversely impact air quality in the Sierra Vista area.

### **Soil**

Fort Huachuca is an Army post near Sierra Vista that has been in continuous operation since its establishment in 1877. There are 4 hazardous waste sites and 18 former underground storage tanks that have leaked into soil or groundwater. In addition, there are 20 sites at the Fort that the Arizona Department of Environmental Quality classifies as solid waste sites. The principal contaminants at the various sites are petroleum hydrocarbons.

In general, contaminated soils at the Fort Huachuca are inaccessible to the public because the soils were in a protected area and away from off site residences. Fort workers may have contacted low-levels of contaminated soil during their routine work, but exposure, if any, probably occurred infrequently and for only short periods of time. No current or future exposures are likely to occur because of successful cleanups at the airfield and because of institutional controls preventing contact with on site contaminants.

## **Discussion**

### *Drinking Water*

All of the 26 drinking water systems in the Sierra Vista area have been in compliance with the drinking water standards since 1989. There have been no detections of industrial solvents or gasoline components (including benzene) in drinking water, and the levels of arsenic and radiochemicals are below levels of concern, suggesting the drinking water in the Sierra Vista area does not represent a health threat.

Total lifetime exposure to arsenic and radioactivity in the water in Sierra Vista represents an additional lifetime cancer risk of eight in one hundred thousand. This risk level represents a population risk of approximately one additional cancer in Sierra Vista every 70 years, suggesting that radiochemicals and arsenic in the water are not the cause of the additional cases of leukemia found in Sierra Vista.

### *Ambient Air*

There are 10 facilities that meet the *potential to emit* requirements in the Sierra Vista area. All of the facilities are minor sources of air pollution. The largest stationary source is a local manufacturer of concrete blocks. The emissions from the facility are typical of many concrete block manufacturers with low levels of particulate matter and vapors. All other facilities in the area emit very low levels of airborne contaminants. There are no permitted stationary sources of air pollution in the Sierra Vista area that adversely impact air quality in the area.

Air pollution sources from vehicular traffic are limited because of the relatively small population in the Sierra Vista area. Pollutant sources from the Sierra Vista Municipal Airport and Libby Army Airfield are limited because the airfield handles mainly small aircraft and because of the low number of flights that occur.

### *Fort Huachuca Soil Contamination*

Contaminated soils at the Fort Huachuca are inaccessible to the public because the soils were in a protected area and away from off site residences. Fort workers might have contacted low-levels of contaminated soil during their routine work, but exposure, if any, probably occurred infrequently and for only short periods of time. No current or future exposures are likely to occur because of successful cleanups at the airfield and because of institutional controls preventing contact with on site contaminants.

## **Child Health Initiative**

The purpose of this report is to determine whether any environmental exposure might be responsible for the higher than expected number of childhood leukemia cases between 1995 and 2001 in Sierra Vista. The report focuses on chemicals that are known to cause human cancers including leukemia in children.

The exposure doses and toxicity values used to evaluate exposure and environmental risk

account for the unique vulnerabilities of infants and children that demand special emphasis in communities faced with environmental contamination. The approaches used are important because children's developing body systems can sustain permanent damage if toxic exposures occur during critical growth stages.

## **Conclusion**

No common environmental exposure from drinking water, ambient air or waste sites were identified that might have placed residents of the Sierra Vista area at greater risk of developing leukemia.

## **Recommendations**

No recommendations at this time.

## **Preparers of the Report**

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## **References**

1. Arizona Department of Health Services. 2002. Memorandum from Tim Flood M.D. Arizona Cancer Registry. August 8, 2001.
2. Personal Communication with Tim Flood M.D. Arizona Department of Health Services. Arizona Cancer Registry. February 28, 2002.
3. Arizona Department of Environmental Quality. 2002. Drinking Water Inventory Report for Sierra Vista, AZ Water Systems. February 2002.
4. United States Environmental Protection Agency. 2000. Health Effects Assessment Summary Tables. Table 3 Cancer Potency Factors for Radium and Arsenic. EPA-540-R-00-036. July 2000.
5. Arizona Department of Environmental Quality. 2002. Air Quality Emissions Inventory for Sierra Vista for 2001. Latha Toopal. June 2002.