

HEALTH CONSULTATION

PERHAM ARSENIC SITE

PERHAM, OTTERTAIL COUNTY, MINNESOTA

CERCLIS NO. MND980609572

February 1999

Prepared By:

The Minnesota Department of Health
in Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

INTRODUCTION

A public health assessment, prepared by the Agency for Toxic Substances and Disease Registry (ATSDR), for the Perham Arsenic site (the site) was released in April 1989 (1), followed by a site review and update in September, 1993 (6). Since that time, additional groundwater monitoring data for the site has been collected, and a groundwater remediation system is now installed and operating. This health consultation will briefly review information contained in the 1989 public health assessment and 1993 update document with an assessment of new and pertinent information to reflect current site conditions and recommendations.

BACKGROUND AND STATEMENT OF ISSUES

The information presented in this health consultation was gathered from files maintained by the Minnesota Pollution Control Agency (MPCA). Additional information was gathered through a site visit and from discussions with MPCA and the U.S. Environmental Protection Agency (EPA) staff familiar with the site.

The site is in the City of Perham, Ottertail County, in east-central Minnesota. It is approximately 1/2 mile south of downtown Perham at the East Ottertail County Fairgrounds and is on the Federal Superfund list. The site consists of arsenic contaminated soils in a small area on the southern edge of the fairgrounds and contaminated groundwater that extends east and south from the area of soil contamination.

Historically, arsenic bait used for agricultural pest control was handled and stored at the fairgrounds property. Following termination of a Department of Agriculture grasshopper-baiting program for which the arsenic was provided, mixed bait and technical grade arsenic were buried near a cattle shed in the southeast corner of the fairgrounds. The arsenic material (lead arsenate and possibly unused arsenic bait) was buried sometime in the 1940s in a shallow (3 to 6 feet deep) pit.

In May 1972, the Hammers Construction Company built an office and warehouse structure, located immediately south of the arsenic disposal pit, and began operating a new well (figure 1). Thirteen employees were exposed to arsenic contaminated drinking water through use of this 31 foot deep well. Five employees developed gastrointestinal symptoms in May but were not aware of the contamination. In July, two employees developed neurological symptoms, were hospitalized and received dimercaprol treatment for severe neuropathy. Eight of the remaining exposed individuals had scalp-hair arsenic determinations and five showed elevated levels of arsenic. Following the hair determinations, a third exposed individual also was treated with dimercaprol for symptoms of neuropathy. The biological sample results and details of the poisoning event were documented by Edward J. Feinglass, M.D. in an article of the New England Journal of Medicine, April 19, 1973 (5).

Investigation of the site was prompted by the poisoning incident. Testing of the company's well measured up to 11,800 micrograms of arsenic per liter of water (Fg/l)--a concentration that is also referred to as parts per billion. The well was removed from service and municipal water was provided to the company.

Soil around the pit area was sampled in the Fall of 1972 by the Minnesota Department of Agriculture. Heavy soil contamination was found to be limited to the pit area where the highest level of arsenic was found. Up to 12,600 milligrams of arsenic per kilogram of soil (mg/kg) was measured. In 1980, EPA investigators found high levels of arsenic dissolved in groundwater east of the disposal area. In 1982, the City of Perham capped the disposal area with clay and an impermeable membrane.

In 1984, the MPCA, contracted with Twin City Testing (TCT), to define the extent of soil and groundwater contamination. This remedial investigation (RI) revealed that arsenic levels in groundwater ranged from non-detectable to a maximum of 2,100 Fg/l. The highest levels of arsenic in groundwater were found just north of the Hammers' building. In 1985, soil material containing greater than 500 mg/kg arsenic was excavated by an MPCA contractor and placed in a licensed hazardous waste disposal facility off-site. Clean soil was used to fill the area of excavation and a clay/membrane cap was replaced over the area.

Because of the persistence of groundwater contamination over time, the MPCA contracted with Barr Engineering (Barr) to perform a limited Remedial Investigation and Feasibility Study in 1989 (2). The responsibility for the site as lead agency was assumed by the U.S. Environmental Protection Agency (EPA) in 1991 and the implementation of portions of the study were turned over to another consulting firm, Metcalf and Eddy. Twenty five additional monitoring wells were installed as part of the "Final Feasibility Study for the Perham Arsenic Burial Site" dated February, 1994 (7). Arsenic above the MCL (50 Fg/l) was identified in 9 of 34 total wells sampled in May 1993. The plume was estimated to be about 600 feet long and 400 feet wide, with the maximum concentrations above 500 Fg/l in an area about 300 feet long and 100 feet wide. There are three general types of monitoring wells at the site; those at the water table (about 20 feet in depth), those about 40 feet in depth, and others roughly 60 feet deep. Arsenic concentrations have been found to increase with depth in groundwater as distance increases down-gradient (east) from the site.

Sampling in 1992 showed that the nearest residential well, located approximately 600 ft. south of the pit area, had 6-8 Fg/l of arsenic. An adjacent turkey barn well had < 2 Fg/l. Data from sampling residential wells in the site vicinity by MDH before 1984 did not show measurable levels of arsenic. No previously unidentified private drinking water wells were found by Barr Engineering within one mile down-gradient of the site in records maintained by the Minnesota Geologic Survey (2). Two wells were located at greater than 4,000 feet to the east-northeast of the site--these were considered to be irrigation or supply wells rather than drinking water wells.

In 1994, a decision was made to permanently remedy the groundwater contamination. The US EPA

Record of Decision (ROD) for the Perham Arsenic Burial site, signed on March 31, 1994 stipulated institutional controls, installation of groundwater recovery wells and an activated alumina adsorption treatment system, discharge of treated water via an on-site infiltration gallery, and municipal hook-up for the nearest residence (4). The nearest residence located south of the site was connected to city water and the well was permanently sealed in late 1994 (3). Hammers Construction Company well was also permanently sealed. The last sample taken from Hammers' well in May, 1993 found 1,170 Fg/l arsenic. The turkey barn well has not been sealed. A sample from that well taken in June 1995 found no detectable level of arsenic (8).

On a regional scale, groundwater in the Perham area moves in an east-southeasterly direction and ultimately discharges into the Otter Tail River, located roughly two miles from the site. The most recent monitoring data (October 1995) available for the area around the pit shows the plume of arsenic continues to extend in a similar direction. The contamination is generally known to extend as far east as 500 to 600 feet from the source (pit) area. Arsenic levels in 50-60 ft. deep wells have shown the highest concentrations at 1,480 Fg/l (monitoring point TCT-3A) and 840 Fg/l (monitoring point TCT-5A). Arsenic has not been detected in groundwater sampled from other monitoring wells in the apparent down-gradient location from these wells.

The City of Perham now has 4 municipal wells, none of which are impacted by the site: 2 are located ½ mile west and up-gradient of the site, and 2 are ¾ mile north and side-gradient.

On August 6, 1997 Rita Messing, Jean Small-Johnson, Mark Staba and Richard Soule of the MDH visited the site and the surrounding area. The following observations were made:

P The former disposal pit area is now paved, accessible from the street and is used for parking for tenants of the Hammers Construction building. There are windows and a door on the north side of the building facing the pit's location which serves as an entrance from the parking lot. A fence on the east side of the parking area prevents vehicle access to the fairgrounds.

P The yard around the Hammers facility is also partially fenced but accessible from a gate in the back and along the entry drive in the front. The ground surface in the rear of the Hammers' yard is bare soil where vehicles are parked and construction materials and equipment are stored.

P The fairgrounds are also fenced with entrance gates on the other side from the former arsenic disposal area. At the time of the site visit, a ballfield next to the fairgrounds was in use. Numerous monitoring wells are located on the fairgrounds property east of the pit area.

P The areas around the fairgrounds are used for both commercial and residential purposes. A mix of newer and older homes is located north and west of the fairgrounds. A single home and the turkey barn are located approximately 600 feet south of the former arsenic pit area. The turkey barn was not in use at the time of the visit but it appeared to have been used during the recent county fair. A water line from the adjacent home appeared to be providing water to the barn.

PA well driller under contract to the EPA was on the site at the time of the visit conducting soil borings for installation of additional monitoring wells and extraction wells as part of the EPA's groundwater remediation project, which was in the early stages of installation at that time (9).

A meeting with the city manager, Bob Louiseau, indicated that city residents have been kept well informed about activities at the site and there is a very low level of concern about health risks. The residents are very supportive of the planned remedy and the city is working cooperatively with the EPA.

MDH staff visited the newspaper office and the Perham library to review historical files in an attempt to identify any further documentation or reports concerning the health status of the 13 individuals who were exposed to the contamination in 1972. No additional information or new reports were found.

DISCUSSION

The excavation of the buried arsenic and capping of the associated contaminated soil material did not reduce the existing groundwater contamination as was expected and monitoring results do not indicate a decrease in arsenic levels. In the "Preliminary Remedial Design Report for the Perham Arsenic Burial Site" prepared by Weston, Inc. for EPA dated June, 1996, it was stated that the groundwater plume has moved down-gradient from the original disposal pit in a slug (as evidenced by lower concentrations directly under the pit, and higher ones down-gradient).

There is no human exposure to this plume of groundwater contamination at the present time. The main public health concern is the potential for future exposure. Arsenic is a known human carcinogen, and causes non-cancer health effects in many organ systems of the body. Without institutional control and/or remediation of the contamination, the possibility exists that development of land east of the site and installation of drinking water wells into the plume as it moves towards the Ottetail River could expose people to dangerous levels of arsenic. The EPA and MPCA have determined that the potential health risk is unacceptable and high enough to warrant remediation.

In the spring of 1998, the EPA completed the installation of a groundwater extraction and treatment system to permanently remedy the groundwater contamination (figure 1). The groundwater is being extracted by 4 wells located along the plume at an extraction rate of 100 gallons per minute. The current clean-up goal is the Maximum Contaminant Level (MCL); 50 Fg/l arsenic. The MCL is the EPA standard for public water supplies. The infiltration gallery is located up- and side-gradient of the plume and is designed to handle up to 250 gallons per minute of discharge. The discharge limit has been set at 10 Fg/l arsenic, consistent with available data measuring background levels of arsenic in the area.

On December 1, 1998, the EPA conducted a final inspection of the treatment system. EPA's project manager, Tom Bloom, reported that 400 ppb of arsenic was measured in the extracted water prior to

filtering (3). After the initial filter, arsenic concentrations were non-detectable (<1 ppb). The EPA will be leasing a portion of Hammers' building for 6 years to house the remediation equipment. EPA expects to reach clean-up goals within 6 years of operation.

The MPCA plans to submit an application to the MDH for a special well construction advisory area at the site as an institutional control until the plume has been reduced to safe levels. This control is a systematic mechanism that requires well drillers to inquire with MDH before drilling in the advisory area. This advisory is intended to prevent the installation of any new drinking water wells in the area of the plume and to control changes in groundwater flow that might be caused by irrigation wells in the area. This control provides a necessary safeguard until the plume can be cleaned to acceptable levels. Its utility may be limited somewhat by a lack of compliance by drillers and private well installations.

As part of the "Final Feasibility Study for the Perham Arsenic Burial site" dated February, 1994 (prepared by Metcalf and Eddy, Inc. for EPA) soil borings showed arsenic levels between 0.6 and 11.1 ppm (7). Ambient background levels for arsenic were estimated to be between 0.5 and 23 ppm. The MPCA soil reference value (SRV) for direct contact exposure pathways under residential settings is 12 ppm arsenic. The SRV corresponds to an excess cancer risk of 1×10^{-5} . For these reasons, soil contamination is not addressed as part of the ongoing site remediation.

Because lead is a constituent of the lead arsenate buried at the site, groundwater samples were also analyzed for lead in the October 1995 sampling. Lead was detected in two shallow monitoring wells but did not exceed the EPA action level of 15 ug/l in any of the shallow or deep aquifer wells. Based on these results, treatment of lead was not required.

Although the MDH makes no assessment of the feasibility of completing treatment of the contaminated plume within the expected six year time period, the issue remains of whether the clean-up standard of 50 ug/l (the current MCL) is adequate for the protection of public health, particularly considering that this standard is under review and may be lowered in the future to 20 ug/l or less. There is growing concern about long-term exposure to low levels of arsenic commonly found in drinking water. The MDH has not promulgated a Health Risk Level (HRL) for arsenic in groundwater. However, we believe that current information supports a health-based value for arsenic substantially lower than the current MCL. The EPA may need to address this concern with an amendment to the Perham Site Record of Decision (ROD), lowering the clean-up standard at the site if necessary.

The 1993 SRU recommended that the protective cover over the pit area must remain undisturbed and protected. The paving of a parking lot over the capped pit was approved by the EPA and should provide added protection assuming the paving is maintained and fully covers any contaminated soils. Soil borings taken under the pit area and through the floor in Mr. Hammer's building found no arsenic residuals (3). The parking lot area is partially owned by the city and it is unclear what, if any, restrictions have been placed on future uses of the property.

The community strongly supports the final remediation of the groundwater contamination at this site. The remedy provides a sense of relief to residents who have lived with the site's long history. Perham residents and officials were actively involved in the passage of the Minnesota Environmental Response and Liability Act (MERLA) in 1983. The 1984 excavation of arsenic contaminated soil in Perham was one of the earliest projects funded under MERLA in Minnesota.

This site is also one of the very few where actual human harm has been documented as a result of exposure to contamination. Thirteen people were exposed and at least three individuals were severely injured in 1972. Reports based on personal communications with the Hammers family indicate that three individuals may have suffered permanent neurological disability. In 1983, one victim of the poisoning testified at a State legislative committee hearing on the passage of MERLA that "Of the thirteen personnel (exposed) one is 100% disabled and two are 50% disabled".

No follow-up investigation of the exposed individuals has been conducted to confirm that permanent neurological disability resulted from arsenic exposures at this site. Dr. Feinglass suggests in his case report that "perhaps the consequences of chronic arsenic poisoning were avoided in the majority of our cases because of the very high concentrations in the well water bringing early attention to the problem". A follow-up investigation is needed to identify and document any chronic neurological health effects which may be attributable to the 1972 poisoning. The investigation would provide a public health benefit by alerting public health and medical professionals to the potential for permanent neurological effects from similar incidents of acute or sub-chronic arsenic exposure.

Agency for Toxic Substance and Disease Registry (ATSDR) Child Health Initiative

Although no children were exposed to arsenic contamination at this site, children will be given special consideration for protection from future risks. ATSDR's Child Health Initiative recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contamination of their water, soil, air, or food. Children are at greater risk than adults from certain kinds of exposures to hazardous substances like DCA. Children are smaller, resulting in higher doses of chemical exposure per body weight and their developing body systems can sustain permanent damage if toxic exposures occur during critical growth stages. In addition, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care. Such factors need to be considered during decisions regarding the complete remediation of this groundwater plume.

CONCLUSIONS

Currently, there is no public health hazard at the Perham arsenic site because no one is exposed to the contaminated groundwater. The nearest residential wells in the area have been sampled and are now connected to the municipal supply so that no exposure to the community is occurring presently. The EPA has done extensive monitoring of the groundwater and soil contamination to better define the

location and movement of the plume. Despite the excavation and capping of the burial pit, groundwater contamination persists at levels which could pose a future public health hazard if impacted groundwater is used for potable purposes. A groundwater remediation system has been designed and installed by the EPA. Extraction and treatment of the groundwater began in 1998 and will continue for 6 years or until clean-up levels have been reached. This remediation is expected to minimize the threat of future exposure to the arsenic plume. Residual soil contamination under the Hammers' building and in the pit area was not found in recent sampling and direct contact with the soil is not a health concern at this time. Residents of Perham are informed about the risks from the contamination and support the remediation.

The long-term health consequences of past exposure to arsenic at the Perham site have not been documented despite reports from residents that permanent neurological damage has occurred.

RECOMMENDATIONS

Maintain the asphalt cover over the pit area in good condition. Obtain approval of the EPA prior to construction and digging activities in the pit area. Inform owners of the property of the potential for soil contamination.

MDH will regularly monitor the progress of the remediation of the groundwater contamination. A review of the 50 Fg/l clean-up standard is also recommended when the arsenic MCL is lowered or as new health data becomes available.

Until the arsenic concentrations in the plume have been reduced to safe levels, implement a well advisory area to prohibit new wells for potable purposes from being installed into contaminated groundwater.

MDH will investigate the feasibility of conducting a comprehensive case review to describe any permanent neurological effects that may have occurred as a result of sub-chronic exposure to high levels of arsenic in drinking water for thirteen individuals exposed at this site in 1972.

Preparers of the health consultation:

Jean Small-Johnson, Ph.D.
Epidemiologist
Minnesota Department of Health

Richard Soule, M.S.
Hydrogeologist
Minnesota Department of Health

CERTIFICATION

The Perham Arsenic Health Consultation was prepared by the Minnesota Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun.

Technical Project Officer, SPS, SSAB, DHAC, ATSDR

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

Chief, SPS, SSAB, DHAC, ATSDR

REFERENCES

1. ATSDR, 1989. Health Assessment for the Perham Arsenic National Priorities List (NPL) Site: Perham, Minnesota Cerclis No. MND980609572.
2. Barr Engineering Corporation, 1990. Remedial Investigation/Feasibility Study Support Document.
3. EPA, September 1997 and December 1998, Personal Communication.
4. EPA Record of Decision for Perham Arsenic Burial Site, March 31, 1994.
5. Feinglass, E., 1973. Arsenic Intoxication From Well Water in the United States. New England Journal of Medicine, Vol. 288, no. 16, pp.828-830.
6. MDH, 1993. Site Review and Update for Perham Arsenic Site.
7. Metcalf and Eddy, Inc., 1994. Final Feasibility Study for the Perham Arsenic Burial Site.
8. Roy F. Weston, Inc., 1995. Groundwater Sampling Memorandum (Round 2 - October 1995) Perham Arsenic Burial Site, Perham Minnesota.
9. Roy F. Weston, Inc., 1996. Preliminary Remedial Design Report for the Perham Arsenic Burial Site.