# Public Health Assessment

## Circle Smelting Corporation

## Beckemeyer, Clinton County, Illinois

## EPA Facility ID# ILD050231976

Prepared by

Illinois Department of Public Health
under cooperative agreement with the
Agency for Toxic Substances and Disease Registry

## Table of Contents

## Summary

The Circle Smelting site in Beckemeyer, Illinois initially produced zinc from ore as a primary zinc smelter, and later recycled zinc and aluminum scrap as a secondary zinc and aluminum smelter. It ceased operations in the fall of 1994. Site-related contamination may pose a public health hazard because of long-term exposure to inorganic contaminants found in the soil, sediments, surface water and groundwater. Past emissions also included releases to the air and deposition off the site. Residential yards, creek sediments, and on-site groundwater are contaminated with metals, including cadmium, chromium, lead, nickel, and zinc. Because the community is so close to the site, residential yards may have accumulated contaminants from former plant operations or from wastes used as backfill for yards, alleys and sidewalks.

In 1992, the Illinois Environmental Protection Agency presented this site to the U.S. Environmental Protection Agency for remediation. In the spring of 1993, the Agency for Toxic Substances and Disease Registry asked the Illinois Department of Public Health (IDPH) to evaluate the need for a time-critical cleanup of the site. IDPH wrote a health consultation in May 1993 and offered blood lead screening to area residents. IDPH did not find an increased prevalence of elevated lead levels in the blood samples from residents, and did not recommend an emergency site cleanup. IDPH has provided citizen and health professional education to attempt to reduce exposure to contaminants. IDPH issued another health consultation in February 1994 to address exposures from digging in Beckemeyer during the installation of new water lines.

Chemicals migrating from the site may contaminate soil, sediment, and surface water on surrounding properties. Beckemeyer residents and former workers may have been exposed to metals by inhalation or ingestion. In the early 1980s, the U.S. Occupational Safety and Health Administration (OSHA) cited this plant for excessive heavy metal exposures to workers. During early primary smelting operations, regular exposures to air emissions could have occurred.

Residential properties are generally well covered with vegetation and well maintained, so exposure to soil is reduced. Because of the efforts of site owners and environmental regulators, site conditions have continued to improve and the current exposure risks have been minimized. Cleanup of the site and residential soil sampling is progressing.

## Background

In cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR), the Illinois Department of Public Health (IDPH) will evaluate the public health significance of the Circle Smelting Corporation site and will recommend further actions to reduce or prevent possible adverse health effects in exposed persons. ATSDR is authorized by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or "Superfund") to conduct health assessments at hazardous waste sites.

The Circle Smelting site is on the Superfund Accelerated Cleanup Model list in Illinois. The U.S. Environmental Protection Agency (USEPA) is the lead agency tracking the clean-up activities. The site owners are funding the costs of the remedial actions.

### Site Description

Circle Smelting is in Beckemeyer, Illinois in central Clinton County (Attachment 1). Beckemeyer has a population of about 1,000 and is primarily residential with a few small businesses. The community has a park, public schools and a parochial school. The county seat, Carlyle, is about 3 miles east of the site. Carlyle is on the southern shore of Carlyle Lake, a reservoir that is the source of drinking water for the village of Beckemeyer.

The Circle Smelting facility was initially built around 1904. This location was likely selected for a smelter because of the abundance of coal and ready access to rail lines. In early 1982, the state water and geological surveys described the site as being geologically appropriate for the storage of solid wastes (ISGS, 1982). Today, the parent company is the American Smelting and Refining Company (ASARCO). The 41-acre site is on the east side of Beckemeyer, along old Highway 50 (Attachment 2). Properties along First Street share the southern fence line near the former operations area and are the homes closest to the site. According to the owners (ASARCO, 1995), 11 properties make up this area and ASARCO purchased eight of them in 1995.

The topography of the Beckemeyer area slopes northward. The eastern and western drainage ditches on the site flow northward under old Route 50 to an unnamed creek (Attachment 2). This creek is a tributary of Beaver Creek, which connects with Shoal Creek, and joins the Kaskaskia River. Carlyle Lake is a manmade impoundment of the Kaskaskia River about 5 miles east of the site, and is used for drinking water, recreation, boating, fishing, and swimming.

### Operations History

Several metal smelting operations have existed at this site, with up to seven metal-processing roasters operating at one time. Peak production pre-dated many environmental and worker safety regulations. Primary zinc smelting with coal and coke began about 1904, and secondary zinc smelting started around 1920. In 1992, about 20 people worked at the secondary zinc and aluminum smelter. Operations continued through late 1994 (ASARCO, 1995).

The facility produced zinc metal, zinc compounds, fertilizer additives, and animal feed additives. Zinc ores were shipped by rail to Beckemeyer from other states, primarily from Missouri. Some substances associated with plant operations were aluminum, lead, zinc, zinc oxides, magnesium oxide, copper oxide, borates, and iron compounds. Because coal and coke were used as a source of fuel, a large amount of cinders and clinkers were generated. This waste was deposited on-site or transported off the site and reportedly used for backfill, as underlayment for concrete and on roads throughout the county. Several metals have been identified in the waste materials.

**Regulatory History**

The U.S. Occupational Safety and Health Administration (OSHA) investigated the operations at this facility in the late 1970s and early 1980s. OSHA fined the company in the early 1980s for workplace exposure violations. According to the plant manager, alterations in operations and procedures reduced worker exposure following the OSHA citations. Personal air monitors were placed on workers and other sampling was conducted.

In July 1986, a fire occurred at the smelter. After the fire, the Illinois Environmental Protection Agency (Illinois EPA) sampled nearby yards and dust in one home. In soil, the highest lead concentration found samples was 990 milligrams per kilogram (mg/kg). Lead measured in the dust sample was 1,500 mg/kg. The highest soil cadmium level around the plant was 19.6 mg/kg. The environmental contamination was attributed to smelter operations, not the fire.

IDPH collected blood samples from 20 persons living near the plant (Table 1). The results of the blood lead and erythrocyte protoporphyrin (EP) tests were not high enough to warrant any health actions under 1986 guidelines. The site owners agreed to clean up some debris after negotiations with Illinois EPA.

In 1987, Illinois EPA began operating an air monitoring station for particulate emissions and began a preliminary assessment of the site. In 1988, Illinois EPA conducted a site inspection and sampled on-site soil, wastes, and sediment. In March 1992, Illinois EPA completed an expanded site inspection, that was submitted to USEPA Region 5. ATSDR contacted IDPH in April 1993 for an opinion about the necessity for an immediate clean-up action (ATSDR, 1993). IDPH wrote a health consultation evaluating potential exposures to the community and recommended blood lead testing of area residents (IDPH, 1993).

In the fall of 1993, with the cooperation of community leaders and the local hospital staff, IDPH collected blood samples from 248 area residents. The results did not suggest any immediate health risks from lead exposures (Table 2). In 1994, IDPH again consulted with ATSDR about workers installing new drinking water lines in the community (IDPH, 1994). IDPH made recommendations regarding worker protection and training, and dust control measures.

USEPA nominated the site for the Superfund Accelerated Cleanup Model (SACM), which provides greater flexibility to clean up National Priorities List (NPL)-caliber sites more efficiently (USEPA, 1996). Off-site soil sampling began in April 1999 and was completed in the spring of 2000. Properties sampled included residential yards, gardens, unpaved driveways, public areas, commercial properties and vacant lots. The highest level of lead detected in any laboratory sample analyzed during the 1999-2000 sampling was 65,930 mg/kg.

Contractors hired by the site owners continue with remediation efforts. The response action selected for the site includes excavation of soil, wastes, and sediments from off-site areas, and placement of the excavated materials in a designated on-site area to be capped (USEPA, 1996).

**Site Visits**

Since the fall of 1992, IDPH staff have visited the site several times. The most recent visit was on June 20, 2001 and the following site features were observed:

- The main operations area consists of several large metal buildings. The site manager indicated that the site once contained a lake filled with process water. Today, little standing water exists on the site.

- Demolition activities have been occurring regularly for several years. During a June 1999 site visit, a brick building on the site was being demolished.

- Site access to the former operations area is restricted by a 6-foot-tall cyclone fence topped with barbed wire. Before the installation of the fence, the site had several access points.

- A rail line that bisects the community delineated the southern boundary. The homes closest to the site are south of the rail lines. Several rail spurs provided access to the site for trains to load and unload.

- A drainage ditch was between the northern site fence line and old Route 50. This area drains under the road and into a wetland area.

- A large part of the site has been covered with waste cinders and clinkers from former operations. Smelting waste excavated from the 1994 water line installation was stored in a building on the site.

- Trucks regularly access the site. A portion of the property is being used by a commercial trucking firm and gravel has been added for roads used by the trucks.

**Demographics, Land Use, and Natural Resource Use**

Clinton County is rural and sparsely populated (total population 34,000) with farming as the main industry. Most residents of Beckemeyer live within 3 miles of the site. The site drains to the north under Route 50 into a privately-owned wetland area that leads to Beaver Creek west of

Beckemeyer. The homes closest to the site share the site's southern fence line. A public elementary school is located southwest of the site. Over the years, Circle Smelting has purchased some nearby properties south of the site. The land east of the site is used for farm crops. A sawmill and a scrap metal yard are adjacent to the site. Today, part of the site has been paved and is used as a truck staging facility.

Drinking water in Beckemeyer is obtained by pipeline from Lake Carlyle, about 5 miles northeast of the site. New water mains, service lines, meters, and a water tower were constructed in the 1990s. Before this water system was installed, the residents used private wells and complained about aesthetically poor drinking water.

## Discussion

### Environmental Contamination

IDPH compared environmental sampling results with the appropriate comparison values developed by ATSDR (Attachment 3). Comparison values are used to select contaminants for further evaluation. Chemicals found at levels greater than comparison values or those for which no comparison exists were selected for further evaluation and are presented in Tables 3-5. The contaminants of interest at the site are metals.

Because metals occur naturally in the environment, comparison to background levels typically found in Illinois is helpful in determining whether the levels of metals are typical or elevated. Background levels of metals (Illinois EPA, 1994) have been included in Tables 3-5. In addition, the Illinois State Water Survey and the ISGS collected background samples and reported the results in 1992. The background samples were taken from an area 1.5 miles southwest of the site near Breese, Illinois. The range of metals in these background samples were: 20-50 mg/kg zinc; <0.02-0.2 mg/kg cadmium; 5-20 mg/kg copper; and 7-20 mg/kg lead. Little variation was present between surface and subsurface samples.

In 1988, on-site soil, wastes and sediments were analyzed for pesticides and other organic compounds. None of these chemicals were found at levels that exceeded comparison values.

### A. On-site Soil

Raw materials, byproducts and wastes historically used or produced at the site were often stored or spread directly on the ground. Soil in the main operations area may contain tailings, spent ores, cinders, coke, scrap metals, and smelting wastes. ISGS noted no significant lateral migration of zinc, copper, cadmium, and lead in the early 1980s (ISWS/ISGS, 1982). Of the four metals, zinc is probably the most mobile. Most of the 41 acres have had cinders spread over the surface. At some points, the fill is 15 feet thick. Smelter waste was used to fill a small lake formerly on the site. Solid waste has also been deposited along the western drainage ditch and on the eastern portion of the site.

**B. On-site Sediments and Surface Water**

Ditches near the east and west borders of the site were designed to drain the property. When conditions provide enough water, they flow to the north and connect to an unnamed stream north of Highway 50. Results of the analyses from sediment samples collected from these ditches are included with the information from on-site soils and wastes in Table 3.

No data were available for on-site surface water. No permanent standing water currently exists on the site except for the drainage ditches. The western ditch holds more water that the eastern ditch.

**C. On-site Groundwater**

A shallow aquifer at the site is about 1 to 3 feet thick and occurs at depths from 6 to 10 feet. The general direction of groundwater movement is to the northwest, which is similar to the surface drainage patterns. The slope of the site and the presence of drainage ditches reduces the likelihood of metals leaching into soils and underlying groundwater. Groundwater studies have found that the regional soils are suited for retaining metals (ISWS/ISGS, 1982).

Twenty-eight monitoring wells have been installed at the site. Zinc concentrations in deeper groundwater samples contained less than 0.5 milligrams of zinc per liter (mg/L). Samples from the shallow wells ranged from 0.66 to 45.5 mg/L of zinc. Groundwater is not included in the current clean-up activities, but may be included in future remedial investigations.

**D. Off-site Contamination Migration**

Known and potential movement of contaminants from the site include:

- air emissions during operation and from the 1986 fire,
- use of waste for sidewalks, railroad beds, fill, driveways, and fertilizer,
- surface water runoff,
- wind erosion of waste and bare soil,
- tracking of soils from heavy equipment during site operations,
- digging of contaminated soils and waste during installation of water lines, and
- contaminated dust and debris carried into workers vehicles and homes.

**E. Residential Soil and Use of Waste Material**

USEPA staff has recorded anecdotal accounts from Beckemeyer residents about the use of site-related materials in the community. Waste generated by smelting operations may have been used for fill for sidewalks and alleys. Rail lines and roads may have been constructed with waste materials from the smelter. As a good neighbor policy, the site operators historically allowed residents to use site wastes for fill and other uses. Many residents do not know if site wastes have been used on their properties.

In 1993, during the installation of the present water system, metal-rich soils and fill from areas where new water lines were installed were sampled. The wastes containing elevated levels of lead were taken to a large storage building on the site.

In the mid-1990s, field instruments were used to screen public and private properties throughout the community to determine the location of elevated lead levels in soil. Collection of soil samples for laboratory analysis began on off-site properties surrounding the site in April 1999 and field work was completed in spring 2000. The results of this sampling were provided to IDPH in December 2000 (ASARCO, 2000).

The types of properties in the most recent soil sampling event included residential properties (front and back yards, gardens, and unpaved drives), public areas, commercial properties, vacant lots, and right-of-ways. Some commercial areas with paved areas and residences where access agreements were not granted were not included.

Including screening and duplicate samples, more than 10,000 results were obtained from 549 properties. Each property was inspected and screened with a field instrument to map the areas where smelter materials were present. Visible evidence included cinders, slag, retort or smelter brick, gray or black color, and stressed vegetation areas. Residents and owners were interviewed regarding property history and management activities.

Composite samples were collected from the front yard, back yard, garden area, and driveway of each home. Areas found to have composite soil lead levels greater than 500 mg/kg were included in clean-up actions. A total of 370 properties are candidates for remediation including 246 residences, 6 public areas, 10 commercial properties, 28 vacant lots, and 80 right-of-ways. Cleanup began during the summer of 2001. Currently, about 70 percent of the properties have been remediated. USEPA is currently removing contaminated soils on village property.

### F. Wetland Area Soil and Sediments

Part of the main operations area once contained a small, shallow lake. Over time, waste material was used to fill low-lying areas on the site. Two ditches on the site collect the runoff from the mounded wastes. The ditches drain northward under the highway into privately-owned wetlands. According to ISGS records, the wetlands north of the site had high levels of zinc (Table 5).

### G. Off-site Air

During most of the operations at this site, air pollution controls and regulations did not exist. Air emissions may have deposited contaminants over the west side of town, and perhaps agricultural fields to the north and east. While the plant operated, bag houses were used to collect particles and this fine material was recycled into the smelting process. Following the 1986 fire, Illinois EPA collected 62 outdoor air samples at ground level at residential properties from March 22, 1987 through May 27, 1988. No ambient air quality standards were exceeded during this sampling period. In 1993, Circle Smelting reported 11,100 pounds of zinc released to the air on the Toxic Release Inventory. During periods of high winds, dust from the on-site wastes may blow onto nearby properties and into nearby residences.

### H. Quality Assurance and Quality Control

IDPH assumes adequate quality assurance/quality control measures were followed for chain-of-custody of samples, laboratory procedures, and data reporting. The analyses and conclusions in this health assessment are valid only if the referenced information is complete and reliable.

### I. Physical Hazards

The site is no longer in operation and physical hazards have been reduced. Access to the site has been restricted with a fence and barbed wire. Previously, trespassers could readily access the site.

## Exposure Assessment

IDPH evaluated the environmental conditions of the site to determine whether workers or residents living near the site have been, are being, or may be exposed to hazardous chemicals. IDPH evaluated this information for the five parts of an exposure pathway. These five parts include a contaminant source, an environmental transport pathway (e.g., groundwater), a point of potential exposure (e.g., a private well), a route of exposure (e.g., ingestion of contaminated groundwater), and a receptor population or people who may be exposed.

If all five components for a particular exposure pathway exist, then it is considered complete. This suggests past, present and/or future exposure to contaminants. A potential exposure pathway has one or more components currently missing, but which could have occurred in the past or occur in the future. An exposure pathway can be eliminated only if at least one component is missing and will never be present. Discussion of completed and potential exposure pathways follow and are shown in Tables 6 and 7.

### A. Completed Exposure Pathways

Exposures to air emissions, wastes, and contaminated soils occurred to former smelter workers. Exposure of any current workers on the site would be low since operations have ceased. Trespassers may also have been exposed in the past.

Residential areas have been affected by waste and contaminated soils transported for fill. Past air emissions and windborne particles have deposited residues onto off-site surfaces including yards, streets, sidewalks, patios, and drives. Surface contamination can be tracked into homes. Through the years, drip-lines around homes may have accumulated airborne contaminants as rain washed residues from roofs. Residents of all ages have likely contacted site-related contamination.

**B. Potential Exposure Pathways**

Workers' families may have been exposed to metals in dust transported home on the clothes of former workers where it may have been inhaled or ingested. The site may potentially affect shallow private wells in the area, but on-site groundwater monitoring has not shown contamination at levels that would be expected to cause adverse health effects.

High levels of zinc are especially harmful to plants. Area residents may be consuming garden vegetables grown in soils containing elevated levels of metals. Ditches on the site have sediment contamination and discharge into local wetlands and creeks. Recreational users of the wetlands and downstream areas may be potentially exposed.

## Toxicological Evaluation

IDPH estimated exposure to metals in residential surface soil based on two exposure scenarios. The first was for a 16-kg child contacting and ingesting 200 milligrams of soil daily while playing in a yard six days per week, 10 months per year for 16 years. The second was for an adult contacting and ingesting 100 milligrams of soil daily while in a yard six days per week, 10 months per year, for 40 years.

Workers on the site were assumed to wear the appropriate personal protective equipment when working with waste material or contaminated soil. Trespassers were assumed to be youths or adults contacting and ingesting 100 milligrams of soil daily while trespassing onto the site 12 days per year. Recreational users of the wetlands were assumed to be persons contacting and ingesting 100 milligrams of sediments 12 times per year.

IDPH compared the estimated doses to minimal risk levels (MRLs) developed by ATSDR for chemicals commonly found at hazardous waste sites. An MRL is an estimate of the daily exposure to a contaminant below which noncancerous, adverse health effects are unlikely to occur. When an MRL was not available, IDPH used the USEPA reference dose (RfD). RfDs are used for long-term exposure, but may not be protective of hypersensitive individuals. Based on our exposure scenarios, antimony, arsenic, cadmium, and nickel would not be expected to cause adverse health effects. Adverse health effects that could occur based on our exposure scenarios are discussed for copper, lead and zinc.

**A. Copper**

The average level of copper in Illinois soil is 28.9 mg/kg, and an area background sample contained 16.2 mg/kg of copper. The most concentrated site-related samples greatly exceeded these typical levels. The highest copper concentration found on the site was 12,200 mg/kg and the highest found off the site was 7,300 mg/kg. Based on our exposure scenarios, no adverse health effects would be expected in adults from exposure to copper. Children exposed to the highest level of copper detected may experience adverse gastrointestinal effects (ATSDR, 2003). Based on average levels of copper, no adverse health effects would be expected.

B. Lead

ATSDR has no health guidelines for lead. Lead levels detected on and off the site are greater than levels that USEPA has used as a cleanup level for industrial areas. We do not know what levels in the environment can increase blood lead levels in people upon exposure. Changes in the blood have been seen at 0.02 milligrams per kilogram day (mg/kg-day) (ATSDR, 1999).

Lead in residential soils was greater than 500 mg/kg, which USEPA is using as a clean-up level in Beckemeyer for residential soil. The highest level of lead detected in samples from the site was 65,930 mg/kg. The highest residential sample was 50,000 mg/kg, and the greatest wetland sample was 7,162 mg/kg. Background lead levels in Illinois are about 70 mg/kg.

The type of lead present in the soil, air, and dust is important because some compounds of lead are more readily absorbed by the body than others; however, these analyses were not completed during the sampling events reviewed. No one had an elevated blood lead level when IDPH tested area volunteers. Based on the results of the blood lead testing, no heath effects would be expected from the lead exposure; however, not every person was tested and therefore some exposed persons may not have been identified.

Children exposed to lead before they are born and young children exposed to lead can exhibit decreased IQ (Intelligence Quotient) and may exhibit behavioral problems. Lead is stored in the bone. Women who were exposed to lead in the past can pass lead to their unborn child when lead stores are released from the bones to the blood stream and cross the placenta (ATSDR, 1999).

**C. Zinc**

Based on our exposure scenarios, no adverse health effects would be expected from exposure to zinc. Although zinc is an essential nutrient, exposure to high levels of zinc can cause adverse health effects including breathing difficulties and a sickness called metal fume fever. In the past, workers may have been exposed by breathing high levels of zinc in the work place.

## Health Outcome Data

IDPH first conducted blood sampling in Beckemeyer in 1986 after a fire at the plant. Twenty persons from the community volunteered for blood lead testing (Table 1). Fingerstick tests were performed on the younger children and venipunctures on older children and adults. Both of these assays are sensitive, reliable, and well established; however, erythrocyte protoporphyrin concentration is more proportional to blood lead over the range of 30–80 µg/dL and less reliable at lower levels. The EP concentration is useful for assessing lead exposure over the past 3 to 4 months. No elevated blood leads were noted at that time. IDPH provided information on how to reduce exposure to the existing environmental contamination.

In 1993, IDPH held a clinic at the Beckemeyer Grade School on the evenings of September 28 and 30. Interested residents were interviewed, blood samples were collected by venipuncture and were analyzed for lead. The overall participation rate was 23% using U.S. Census data. Each participant received a written report with individual results. Of the 248 persons tested, only one child had an elevated level of blood lead (Table 2). A blood test can tell if a person has been recently exposed to lead. The September 1993 blood tests would have detected recent summertime exposure. Exposure and blood lead levels can vary over time. Because lead can be stored in the body for long periods, past exposures cannot be accurately evaluated with a blood test. Each participant received a written report with individual results. Although a limited number of children have been tested, results do not indicate that these children are lead poisoned, but their blood lead levels are somewhat higher than the U.S. average.

## Community Health Concerns

In the past, citizens of Beckemeyer have been concerned about air emissions frequently observed during normal operations as well as during a 1986 fire on the site. Several families were evacuated from their homes as a precaution. Plant operations ceased in October 1994.

Some individuals living near the waste site have been concerned about the potential adverse health effects from metal contamination in and around their homes. At one time, several families with young children lived close to the smelter. One family related that their children appeared to have neurological disorders. A resident with a history of an allergy to metals feels that environmental metal contamination exacerbates recurring symptoms.

Most questions raised during community meetings were not related to health risks, but to economic concerns. Some developers and residents worried that the site-related activities may reduce real estate values. Many residents objected to the additional costs and delays that occurred during the water line replacement project planned before USEPA investigated the site.

**Question:** Did the site require an emergency cleanup?

**Answer:** IDPH arranged for blood sampling of interested individuals in September 1993. Of 248 volunteers, only one child had an elevated blood lead level. Our sampling did not suggest that current lead exposures were an immediate health threat in Beckemeyer. IDPH did not recommend an emergency cleanup based on this investigation and provided this information to the regulatory agencies.

**Question:** If the smelter did not harm us when it was in operation, how can it hurt us now?

**Response:** Although the smelter is no longer in operation, environmental sampling suggests that considerable lead contamination exists in the surface soil of Beckemeyer. Exposure to elevated levels of lead can adversely affect the developing central nervous system in young children.

**Question:** Doesn't the number of Beckemeyer senior citizens show that lead exposure from the smelter has not created a health problem?

**Response:** Beckemeyer does have more seniors than young adults; however, this may be related to a migration of younger people to other job markets. Lead is lethal only in very large doses and it is highly unlikely that an individual would die prematurely due to environmental exposures from current conditions. Some developers and residents worried that the site-related activities may reduce real estate values. Many residents objected to the additional costs and delays that occurred during the water line replacement project planned before USEPA investigated the site.

This public health assessment was made available for public comment from October 16 to November 27, 2002. No public comments were received.

## Child Health Considerations

ATSDR recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contamination of their environment. Children are at greater risk than adults from certain kinds of exposures to hazardous substances emitted from sites. They are more likely to be exposed because they play outdoors and they often bring food into contaminated areas. They are shorter than adults, which means they can breathe in any dusts close to the ground. Children are also smaller, resulting in higher doses of chemical exposure per body weight. The developing body systems of children make them more sensitive to exposures that occur during critical growth stages. Also, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care.

IDPH evaluated the likelihood of residents living near the site to be exposed to lead at levels that could cause adverse health effects. Children were likely exposed to higher levels of chemicals in the past than they are at present. Lead in soil is a source of exposure for area children; however, in the future, exposures should decrease as remediation and educational efforts continue.

## Conclusions

Based on the environmental data, IDPH concludes that the Circle Smelting site poses a **public health hazard**. Environmental data show that persons may be exposed to elevated levels of contaminants; however, biological sampling did not show increased levels of lead in blood collected in 1993. The chemicals of interest include metals known to cause adverse health effects. Exposure to these metals has been reduced by the efforts of the site owners, state and federal environmental agencies, and area residents. Since metals do not degrade, efforts should continue to reduce exposures to site-related chemicals. Clean-up activities are continuing. Groundwater investigations are not included in the current efforts, but may occur in the future.

## Recommendations and Public Health Actions

IDPH recommends that the site owners maintain the site fencing to prevent direct contact with wastes, and institute procedures to suppress dust migration during on-site clean-up activities. This is part of the clean-up plan.

IDPH has reviewed the results of residential soil sampling and given residents information about the results of this sampling. IDPH has provided residents with information about reducing exposure to environmental contamination.

## Preparers of Report

**Preparer**
Catherine Copley
Environmental Toxicologist
Illinois Department of Public Health

**Reviewers**
Ken Runkle
Jennifer Davis
Environmental Toxicologists
Illinois Department of Public Health

**ATSDR Regional Representative**
Mark Johnson
Regional Operations
Office of the Assistant Administrator

**ATSDR Technical Project Officers**
Allen Robison
Division of Health Assessment and Consultation

Steve Inserra
Division of Health Studies

Sylvia Allen-Lewis
Division of Health Education and Promotion

## References

Agency for Toxic Substances and Disease Registry. Comparison Values (Second Quarter of 1999). Atlanta: US Department of Health and Human Services; 1999.

Agency for Toxic Substances and Disease Registry. Toxicological Profile for Copper. Atlanta: US Department of Health and Human Services; 2003.

Agency for Toxic Substances and Disease Registry. Toxicological Profile for Lead. Atlanta: US Department of Health and Human Services; 1999.

Agency for Toxic Substances and Disease Registry. Memorandum: Request for Evaluation of Data Provided by EPA to Determine if Sufficient Pubic Health Risk Exists to Conduct an Immediate Removal at the Circle Smelting Site in Beckemeyer Illinois. From Manna M. Muroya, ATSDR, to Tom Long, IDPH Toxicology Section Chief. April 30, 1993.

Agency for Toxic Substances and Disease Registry. Public Health Assessment Guidance Manual. Atlanta: US Department of Health and Human Services; March 1992.

ASARCO. Soil Sampling Results for the Circle Smelting Site, Beckemeyer, Illinois. Prepared by Hydrometrics, Inc. A summary of the 0-24 inch soil profiles analyzed using XRF (Spectrace 500) technology; November 1995.

Illinois Department of Public Health. Mark Flotow, personal communication discussion of 1990 U.S. Census information. June 1994.

Illinois Department of Public Health. Press release of the results of blood lead testing of Beckemeyer residents. March 11, 1994.

Illinois Department of Public Health. Health Consultation: Circle Smelting, Beckemeyer, Clinton County, Illinois, SACM Site, IDPH case #408268601H. February 28, 1994.

Illinois Department of Public Health. Health Consultation: Circle Smelting, Beckemeyer, Clinton County, Illinois, SACM Site, IDPH case #408268601H. May 12, 1993.

Illinois Department of Public Health. Tom Long summarizing 1987 blood lead testing from Circle Smelting. May 6, 1987.

Illinois Environmental Protection Agency. Division of Land File Search. Circle Smelting Corporation. June 1, 1992.

Illinois Environmental Protection Agency. CERCLA Expanded Site Inspection Report (Draft); 1992.

Illinois Environmental Protection Agency. Superfund Accelerated Cleanup Model (SACM) for Circle Smelting (Draft). Springfield, Illinois; 1993.

Illinois Environmental Protection Agency. A Summary of Selected Background Conditions for Inorganics in Soil. Office of Chemical Safety. August 1994.

Illinois State Water Survey and Illinois State Geological Survey. Retention of Zinc, Cadmium, Copper, and Lead by Geologic Materials. J.P. Gibb and K. Cartwright of the Illinois Department of Energy and Natural Resources, 1992.

Southwestern Illinois Metropolitan and Regional Planning Commission. Regional Atlas. April 1, 1978.

U.S. Department of the Interior Geological Survey. Beckemeyer Quadrangle, Illinois. Clinton County. 7.5 Minute Topographic Series, 1969.

U.S. Environmental Protection Agency. Enforcement Action Memorandum: Request for a Non-Time-Critical Removal Action at the Circle Smelting Site, Village of Beckemeyer, Clinton County, Illinois (Site ID#WJ). USEPA, Region 5, Chicago, 1996.

U.S. Environmental Protection Agency. Toxic Chemical Release Inventory. National Library of Medicine's TOXNET database search; 1996.

U.S. Environmental Protection Agency. Circle Smelting Corporation Site Risk Evaluation Addendum for Residential and Industrial Areas. Prepared by Patricia Van Leeuwen, USEPA Toxicologist, Region V. November 1, 1995.

U.S. Environmental Protection Agency. Sampling Protocols Circle Smelting Corporation Site (for Risk Evaluation Addendum to EE/CA). March 23, 1995.

U.S. Environmental Protection Agency. Engineering Evaluation and Cost Analysis - Circle Smelting Corporation Site, Beckemeyer, Illinois. WA No. 68-5LWJ/Contract No. 68-W8-0040. Prepared by CH2M Hill for USEPA Region V in Chicago, Illinois; 1995.

## Certification

This Circle Smelting public health assessment was prepared by the Illinois Department of Public 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.

W. Allen Robison
Technical Project Officer
Superfund Site Assessment Branch (SAAB)
Division of Health Assessment and Consultation (DAC)
ATSDR

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

Roberta Erlwein
Chief, State Programs Section
SSAB, DHAC, ATSDR

# Tables

**Table 1. Results of IDPH March 1987 Beckemeyer Blood Lead and EP* Screening.**

| Participant Age Range | Blood Lead Levels (mcg%) | | |
|---|---|---|---|
| | Blood Lead or EP Ranges | Mean | Median |
| 0-5 (n=3) | EP = 18, 24, 26 | 22.7 | 24 |
| 6-12 (n=5) | 6, 9, 10, 14, 15 | 10.8 | 10 |
| 13-19 (n=3) | 7, 7, 8 | 7.3 | 7 |
| 20-29 (n=4) | 5, 7, 12, 22 | 11.5 | 9.5 |
| 30-39 (n=3) | 5, 9, 12 | 8.7 | 9 |
| 40-53 (n=2) | 7, 11 | 9.0 | 9.0 |
| Total** | EP = 18-26<br>Lead = 5-22 | EP = 22.7<br>Lead = 166/17 = 9.8 | EP = 24<br>Lead = 9.0 |

* = Erythrocyte Protoporphyrin performed on finger sticks from young children.
** = Most common lead value for all the participants (mode) was 7 mcg% (n=3).

**Table 2. Results of IDPH September 1993 Beckemeyer Area Blood Lead Screening. Detection Limit is 2.0 micrograms/deciliter (µg/dL).**

| Participant Age Range | # Individuals | | Rate of Participation | Blood Lead Levels (µg/dL) | | |
|---|---|---|---|---|---|---|
| | 1990 U.S. Census Bureau data | 1993 Screen | | Blood Lead Ranges | Mean ND=1.9* | Median |
| 0-5 | 96 | 24 | 25% | ND-17.4 | 4.9 | 3.9 |
| 6-9 | 77 | 36 | 47% | ND-6.6 | 3.2 | 3.1 |
| 10-13 | 77 | 36 | 47% | ND-6.7 | 2.9 | 2.5 |
| 14-19 | 162 | 16 | 10% | ND-5.4 | 2.5 | 1.9 |
| 20-29 | 150 | 27 | 18% | ND-11.2 | 3.0 | 2.2 |
| 30-39 | 151 | 47 | 31% | ND-11.8 | 3.6 | 3.0 |
| 40-49 | 106 | 24 | 23% | ND-5.8 | 3.1 | 2.9 |
| 50-59 | 95 | 19 | 20% | ND-10.5 | 5.0 | 4.8 |
| 60-69 | 109 | 12 | 11% | ND-6.9 | 4.5 | 4.3 |
| 70+ | 124 | 7 | 6% | 3.4-12.9 | 7.0 | 6.7 |
| Total | 1070 | 248 | 23% | ND-17.4 | 3.6 | 3.1 |

* = results below the detection limit were included as 1.9 µg/dL

**Table 3. Chemicals of Interest in Circle Smelting On-site Waste Materials, Soil and Sediment in milligrams per kilogram (mg/kg).**

| Chemical | 7-11-86 n=1 | 7-26-88 n=5 (average) | 3-1-92 n=1 | 3-29-93 n=12 (average) | Background Concentrations | | ATSDR Soil Comparison Values | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | State Range (average) | Breese 3-1-92 X101 X102 | Child | Adult | Source |
| Arsenic | NA | 0.31-31 (16) | 20 | NA | 1.1-24 (7.4) | 6.6 9.1 | 0.5 20 | 200 | CREG CEMEG |
| Cadmium | 8 | 0.97-54 (19.4) | 22 | 2.5-127.7 (43.4) | <2.5-8.2 (1.3) | ND ND | 10 | 100 | CEMEG |
| Copper | NA | 160-5,800 (2,710) | 3,800 | 123-12,200 (5,115) | <2.93-156 (28.9) | 10.1 16.2 | none | none | |
| Lead | 2525 | 300-9,370 (4,892) | 9,370 | 239-19,348 (7,789) | 4.7-647 (71.1) | 24.5 67.0 | none | none | |
| Nickel | NA | 74-3,200 (1,191) | 1,000 | NA | <3.1-135 (20.9) | 11.9 15.6 | 1,000 | 10,000 | RMEG |
| Zinc | NA | 6,600-72,000 (37,020) | 61,000 | 6,144-591,437 (144,416) | 23-798 (137.9) | 55.3 89.9 | 20,000 | 200,000 | CEMEG |

NA = not analyzed
U = estimated value
n = number of samples

**Table 4. Chemicals of Interest in Beckemeyer Off-site Residential Waste Materials and Soil in milligrams per kilogram (mg/kg).**

| Chemical | 7-21-86 n=3 | 9-25-86 n=10 (average) | 7-26-88 | 3-1-92 (average) | 1-11-93 n=2 | 5-17-93 n=10 (average) | 7-30-93 n=2 (average) | 10-4-93 n=25 (average) | Background Concentrations | | ATSDR Soil Comparison Value | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | State Range (Means) | Breese 3-1-92 X101 X102 | Child | Adult | Source |
| Antimony | NA | NA | 8U-9.1U | 3.3-52.2<br>(28.4) | NA | NA | NA | NA | 0.24-8<br>(4.2) | ND<br>3.3 | 20 | 300 | RMEG |
| Arsenic | NA | NA | 1.5-9.6 | 6.2-38<br>(14.3) | NA | NA | 11.8-12.1 | NA | 1.1-24<br>(7.4) | 6.6<br>9.1 | 0.5<br>20 | <br>200 | CREG<br>CEMEG |
| Cadmium | NA | ND-16.4 | 1U-4.9 | 0.6-4.8<br>(1.8) | 11 | 0.4-1.8<br>(0.7) | ND-2.1 | NA | <2.5-8.2<br>(1.3) | ND<br>ND | 10 | 100 | CEMEG |
| Copper | NA | NA | 71-880 | 16-3,600<br>(431) | 1,000-<br>7,300 | 12.7-418<br>(100.5) | 56-200 | NA | <2.93-156<br>(28.9) | 10.1<br>16.2 | none | none | |
| Lead | 140-1,500 | 60.6-770 | 940-1,600 | 61-14,000<br>(1,573) | 7,100-<br>50,000 | 32.5-600<br>(245) | 300-1,160 | ND-4,350<br>(493.3) | 4.7-64<br>(71.1) | 24.5<br>67.0 | none | none | |
| Nickel | NA | 249 | 35-450 | 25.8-2,020<br>(155) | 65-130 | 10.8-140<br>(41.3) | NA | NA | <3.1-135<br>(20.9) | 11.9<br>15.6 | 1000 | 10,000 | RMEG |
| Zinc | 2,200-17,000 | 990-18,500<br>(7,117) | 640-11,000 | 614-24,200<br>(3,941) | 57,000-<br>71,000 | 66.1-1,990<br>(793.2) | 691-1,970<br>(681.8) | NA | 23-798<br>(137.9) | 55.3<br>89.9 | 20,000 | 200,000 | CEMEG |

NA = not analyzed; U = estimated value; n = number of samples

**Table 5. Chemicals of Interest in Beckemeyer Wetlands (non-residential) Soil and Sediments in milligrams per kilogram (mg/kg).**

| Chemical | 9-25-86 n=6 (average) | 7-26-88 n=1 | 3-1-92 n=9 (average) | 1-11-93 n=8 (average) | 5-17-93 n=31 (average) | 7-30-93 n=2 | Background Concentrations | | ATSDR Soil Comparison Value | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | State Range (Means) | Breese 3-1-93 X101 X102 | Child | Adult | Source |
| Antimony | ND-16.8 | 7.9U | 10.6 | NA | 1.7-82.9 (10.7) | NA | 0.24-8 (4.2) | ND 3.3 | 20 | 300 | RMEG |
| Arsenic | 6.56-6.93 | 0.28 | 4.1-56.4 | NA | 4.2-45.5 (11.3) | 8.34-15.6 | 1.1-24 (7.4) | 6.6 9.1 | 0.5 20 | 200 | CREG CEMEG |
| Cadmium | ND-19.6 | 4.7 | 0.7-16 | 2U-10 | 0.51-52.6 (5.0) | ND-1.73 | <2.5-8.2 (1.3) | ND ND | 10 | 100 | CEMEG |
| Copper | 93.2-636 | 180 | 7.8-3,600 (857) | 38-2,400 (453) | 8.6-3,334 (325.7) | 86.6-603 | <2.93-156 (28.9) | 10.1 16.2 | none | none | |
| Lead | 180-1,010 (431.5) | 550 | 13.3-6,100 (1,698) | 37-4,100 (742) | 30-7,162 (788) | 135-1,390 | 4.7-647 (71.1) | 24.5 67.0 | none | none | |
| Nickel | 37.6-564 | 180 | 9.1-1,570 (397) | 12-960 (170) | 10-1,500 (307) | NA | <3.1-135 (20.9) | 11.9 15.6 | 1,000 | 10,000 | RMEG |
| Zinc | 895-29,500 | 58,000 | 52.5-42,000 (10,066) | 170-20,000 (3,759) | 10-16,700 (3,423) | 1,370-2,720 | 23-798 (137.9) | 55.3 89.9 | 20,000 | 200,000 | CEMEG |

NA = not analyzed ; U = estimated value; n = number of samples

**Table 6. Circle Smelting Completed Exposure Pathways.**

| PATHWAY NAME | EXPOSURE PATHWAY ELEMENTS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Source** | **Media** | **Exposure point** | **Exposure route** | **Receptors** | **Time** | **Activities** | **Estimated Number Exposed** | **Chemicals** |
| On-site Waste | Smelter | Waste<br>Soil | On-site surface | Ingestion<br>Inhalation | Workers<br>Trespassers | Past<br>Present | Working with waste material | 25 | Metals |
| On-site Air | Smelter | Air | On-site air | Inhalation | Workers<br>Trespassers | Past | Breathing | 25 | Metals |
| Residential Soil and Fill | Smelter | Soil<br>Solid waste | Residential soil<br>Sidewalks<br>Alleys | Ingestion<br>Inhalation | Residents | Past<br>Present | Playing<br>Gardening<br>Digging | 1,000 | Metals |
| Off-site Air | Smelter | Air | Off-site air | Inhalation | Residents | Past | Outdoor activities | 1,000 | Metals |

**Table 7. Circle Smelting Potential Exposure Pathways**

| PATHWAY NAME | EXPOSURE PATHWAY ELEMENTS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Source** | **Medium** | **Exposure point** | **Exposure route** | **Receptors** | **Time** | **Activities** | **Estimated number exposed** | **Chemicals** |
| Residential dust | Smelter | Dust | Worker cars and homes | Ingestion Inhalation | Workers and their families | Past Present | Residing | 100 | Metals |
| Surface water | Smelter | Surface water | Creeks | Ingestion | Recreational users | Past Present Future | Wading Recreation | 10 | Metals |
| Groundwater | Smelter | Groundwater | Private wells | Ingestion | Private well users | Past Present Future | Drinking Cooking | 0 | Metals |
| Biota | Smelter | Plants | Gardens | Ingestion | Gardeners | Past Present Future | Eating | 25 | Metals |

# Attachments

Attachment 3

**Comparison Values Used In Screening Contaminants For Further Evaluation**

Environmental Media Evaluation Guides (EMEGs) are developed for chemicals based on their toxicity, frequency of occurrence at National Priority List (NPL) sites, and potential for human exposure. They are derived to protect the most sensitive populations and are not action levels, but rather comparison values. They do not consider carcinogenic effects, chemical interactions, multiple route exposure, or other media-specific routes of exposure, and are very conservative concentration values designed to protect sensitive members of the population.

Reference Dose Media Evaluation Guides (RMEGs) are another type of comparison value derived to protect the most sensitive populations. They do not consider carcinogenic effects, chemical interactions, multiple route exposure, or other media-specific routes of exposure, and are very conservative concentration values designed to protect sensitive members of the population.

Cancer Risk Evaluation Guides (CREGs) are estimated contaminant concentrations based on a probability of one excess cancer in a million persons exposed to a chemical over a lifetime. These are also very conservative values designed to protect sensitive members of the population.

Maximum Contaminant Levels (MCLs) have been established by USEPA for public water supplies to reduce the chances of adverse health effects from contaminated drinking water. These standards are well below levels for which health effects have been observed and take into account the financial feasibility of achieving specific contaminant levels. These are enforceable limits that public water supplies must meet.

Lifetime Health Advisories for drinking water (LTHAs) have been established by USEPA for drinking water and are the concentration of a chemical in drinking water that is not expected to cause any adverse non-carcinogenic effects over a lifetime of exposure. These are conservative values that incorporate a margin of safety.