Superior Arizona Related
Health Assessments and Remediation
Chronology and Synopsis
September 14, 2016

This is a synopsis of the available health related and environmental remediation studies, summaries and documents found and related to current and historic mining activity in and around the Superior Arizona area. This is produced on behalf of the Community Working Group of Superior and for the information of area residents. This synopsis will be updated as any additional, credible data on this issue comes to light.

All original documents and studies are available for expanded review at SuperiorAZCWG.org

- 1977 -- The first research was obtained through the Arizona Department of Health Services (ADHS) related to general health issues in and around mining communities in Arizona.

A study was conducted in 1977 prompted by reports of increased lead and arsenic levels found in children living near smelters in El Paso, Texas, Kellogg, Idaho and Tacoma, Washington.

A nationwide survey was conducted for heavy metal absorption in children living near primary copper, lead and zinc smelters in 19 communities in the U.S. These included the copper smelter towns of Ajo, Douglas, Hayden, Miami, Morenci and San Manuel in Arizona.

Door to door interviews were conducted and samples were obtained of blood, hair or urine.

Results generally found significantly higher hair and urine arsenic levels in children living in copper smelter towns. Blood lead levels found no consistent trend. In Ajo, Arizona where high arsenic levels occurred in drinking water at the time, urinary arsenic levels were higher.

Levels seemed to be influenced by residences proximity to the smelter, the actual numbers of people living near smelters, stack
height and the quantity and characteristics of the ore being processed.

- **1990** -- ADHS issued a report on a mortality study conducted for Gila Basin Smelter Towns, including Hayden, Globe, Miami, Winkelman, Kearney and Superior, from 1979 – 1988. The study was prompted by an earlier EPA report indicating elevated lung cancer risks for residents exposed to smelter emissions in the Hayden area.

ADHS analyzed Arizona death certificates comparing lung cancer deaths in these communities to rates in metropolitan areas.

The study concludes:

‘The lung cancer mortality rate in the over-age-60 age group was elevated in Gila Basin smelter towns during the 1979-1988 time period. The cause of the elevation remains to be explained.

Data is lacking concerning the prevalence of cigarette smoking, and the levels of exposure to arsenic or other potential carcinogens. Such information is essential before drawing any conclusion about the role of the smelters in the cause of the excess lung cancer rates.’

- **1993** -- ADHS provided an article published in the American Journal of Epidemiology that pertained to an *Assessment of Blood Lead levels (BLL) in Children Living in a Historic Mining and Smelting Community.*

That study focused only on Leadville, Colorado and found elevated blood lead levels in children from a variety of sources, including smelting, mine tailings, and natural mineralization, as opposed to just smelting or mining alone. The study, however, did conclude that elevated BLLs found in children were similar to results from 16 other smelting communities and above those found in 15 mining communities without smelters.

- **1996** -- ADHS published the results of a study on childhood blood lead levels in 50 smelter towns in Arizona conducted in 1994. The
study was designed to compare childhood blood lead level rates in 50 Arizona smelter towns with rates in the State of Arizona and the U.S. Some studies showed that children living near smelters can have increased exposure and higher blood and body lead levels.

Of 31 zip code areas studied, eight were found to have elevated blood lead levels. Four of these were zip codes in which smelters were, or had been, located and operating.

The report states, however, that because of the extremely small sample size and the difficulty of obtaining quantifiable data, the information...’is considered highly unrepresentative of the childhood population. Such low SRs {screening ratios} can result in EBLL {elevated blood lead level} prevalence rates that can be very misleading and should not be considered truly representative of the childhood population in the smelter towns.’

The report concludes:

‘Because of the lack of adequate health and soil data no conclusions can be made as to what effects the presence of these smelters has had on the prevalence of childhood lead poisoning in the respective surrounding communities. Statistical analysis in this study only demonstrates whether the blood levels for children, ages 1-5 and 6-11, were higher when compared to national and state data. No causal relationship can be drawn from these findings. Since an elevated blood lead level can have several potential causes, it is an incorrect assumption to suppose that an elevated blood lead level is caused from exposure to smelter emissions or waste related soil or dust.’

- 1998 – Experts from the University of Pittsburgh, University of Arizona, Esmen Research and Engineering in Oklahoma City, and the Arizona Department of Health Services published the results of an investigative study in the Archives of Environmental Health. The study was designed to investigate factors related to lung cancer mortality in the four Arizona copper-smelter towns of Ajo, Clifton-Morenci, Douglas and San Manuel.
In brief, the study summary states:

The results of this study provide little evidence of a positive association between lung cancer risk and any of the indices of residential exposure to smelter emissions considered. However, the study did reveal a statistically significant positive association between lung cancer and employment in copper mines and/or smelters.

- **1999** – The results of a Hayden-Winkelman Arsenic and Lead Survey was released from the University of Arizona. The survey concludes:
  14 children tested in Hayden and Winkelman had blood lead concentrations below the CDC intervention level of 10 µg/dl, with an average blood lead concentration of 3.6 µg/dl. No evidence of excessive environmental lead exposure was found in the study participants.

  The average urinary total arsenic concentration in Hayden and Winkelman was 13.7 µg/l. Five (2%) of 224 individuals tested in Hayden and Winkelman had inorganic urinary arsenic concentrations exceeding our action level of 30 µg/l. The maximum concentration measured was 47 µg/l. The possible adverse effects of such levels are not known. We have recommended that these five individuals have their urine retested. If the levels are still high, then interventions should be considered to reduce their arsenic exposure. Given the recent renovation activities in these three households, exposure to house dust may have been a contributing factor.

- **2009** – Risk Assessment.

A site-specific human health risk assessment was conducted in 2007 and 2008 to address the potential that exposure to metals in soil might result in adverse health effects to children and adults living in the Northwest Study Area in the Town of Superior next to the West Plant Site.

The 45 acre Study Area included residences, two businesses, two
churches, the Town of Superior’s police station, vehicle maintenance facility, the School District’s bus maintenance facility, an Arizona Department of Transportation district office, and several vacant properties.

The “Phase IV Risk Assessment” was conducted by Brown and Caldwell and Exponent for BHP Copper Inc. in cooperation with the Arizona Department of Environmental Quality’s (ADEQ).

**Background**

A tailings release in 1993 caused tailings to flow from the West Plant Site into an adjacent residential area.

Following the release, the Magma Mining Company, owner of the site, removed visible tailings from the residential area and capped the tailings that were stored on site to prevent future releases. The boundaries of the Study Area were selected to encompass the area where tailings were removed in 1993, as well as areas upstream and downstream of the tailings release.

Collection and analysis of 283 soil samples from the area was conducted by BHP Copper in 2004 because of an ADEQ report indicating that elevated arsenic and copper levels had been detected in a residential area.

A draft risk assessment conducted in 2004 indicated that the cancer risk associated with the arsenic that had been detected in soil within the Study Area were within the acceptable range of state and federal regulations.

BHP Copper volunteered to collect more soil samples and conduct a more detailed risk assessment on a property-by-property basis. The work plan for the Phase IV Sampling was approved by ADEQ in 2007.

**Phase IV Sampling**

BHP obtained access to 118 properties in the Study Area for sampling. A total of 343 composite samples of surface soil were collected in the Study Area and 73 surface and subsurface samples
were collected from 27 boring locations.

All samples were analyzed for arsenic and some were analyzed for copper, lead, and manganese. Arsenic was detected at or above its residential Soil Remediation Levels (SRL) in most of the samples; lead was detected at or above its residential SRL in 7 samples; copper was detected at or above its residential SRL in 5 samples; and manganese was detected at or above its residential SRL in 2 of the samples.

**Risk Assessment**

Although residential SRLs are health-based concentrations considered safe for a lifetime of exposure by children and adults, concentrations above the SRLs does not necessarily indicate a concern for human health. Rather, the presence of concentrations above the SRLs indicates that more study is warranted. Accordingly, arsenic, copper, lead, and manganese were considered chemicals of potential concern (COPCs) and were evaluated.

Site-specific risk calculations were performed that addressed all required site-specific factors and utilized conservative assumptions suggested by ADEQ's contract toxicologist. The risk assessment indicated that that the cancer risks for all properties were within the allowable risk range set forth in state and federal regulations and that the allowable non-cancer risk was met for all but two properties.

Arizona standards require soil to be excavated or remediated to background or other specific levels determined by Arizona law. BHP Copper agreed to excavate copper, lead, and manganese to the pre-determined, residential SRLs, and to excavate arsenic to a site-specific remediation standard.

- **2012 – Arsenic Biomonitoring**

  BHP Copper contracted with ENVIRON International Corporation (ENVIRON) to conduct an arsenic biomonitoring study of residents in the Northwest Study Area (NSA). In developing a plan
with BHP Copper for cleanup in the NSA, the Arizona Department of Environmental Quality (ADEQ) required a two phase arsenic biomonitoring program to be offered to the community as a condition to using a specific target risk goal in developing soil remediation levels for the NSA.

A human health risk assessment found that arsenic levels in the study area were not expected to contribute significantly to natural background arsenic exposures from food and drinking water. ADEQ wanted to confirm the minimal risk presented by the study area soils through this program. The arsenic biomonitoring program was paid for by BHP Copper with oversight by the ADEQ. Participation in the program by residents was voluntary.

Samplings occurred in the summer of 2011 and in August 2012.

**Overview of the Arsenic Biomonitoring Study**

Arsenic is naturally present in most foods and in drinking water, and is found in the environment from many sources. Human exposures come from drinking water, food and inhalation. Fish and seafood have the highest concentrations but most arsenic is present as nontoxic organic forms.

Biomonitoring is the measurement of a chemical or its metabolites in body tissues and fluids. Urinary arsenic testing was the focus of biomonitoring offered to the community.

Eight people in the NSA participated in the Summer 2012 urinary arsenic biomonitoring study and completed the exposure survey.

For these eight individuals, total urinary arsenic was reported above the detection limit in six samples. The range of total and speciated urinary arsenic concentrations reported are well within levels considered normal by the Agency for Toxic Substances and Disease Registry and consistent with average concentrations determined for Arizona residents based on Arizona Department of Health Services involvement in other biomonitoring programs.

These findings are consistent with the site-specific human health risk assessment that found that arsenic levels in the study area
are not expected to contribute significantly to natural background arsenic exposures from food and drinking water and provide further assurance of the minimal risk presented by the study area soils in the vicinity of NSA residents.

- **2013 – Remediation Summary**

  During 2011 and 2012, BHP Copper conducted voluntary soil remediation activities on 77 properties within the Northwest Study Area (NSA) in Superior. The effectiveness of the remediation was positively confirmed by comparing the results of confirmation soil sampling to soil remediation levels that the Arizona Department of Environmental Quality (ADEQ) approved for the NSA site.

  BHP Copper also completed soil sampling on 6 properties not previously accessible. These properties met ADEQ's approved soil remediation levels without requiring remediation. BHP submitted information to ADEQ regarding 40 other properties that were in compliance with soil remediation levels. ADEQ determined that no further action was needed for those 40 properties.

  Based on the information presented in the Completion Report and the property-specific Summary Reports submitted, compliance with soil remediation levels was demonstrated for all 83 properties addressed by the Completion Report, and no further action was necessary.

- **2013 --** The *Community Working Group (CWG) of Superior* was formed in June to consider the array of issues, benefits and consequence of the proposed Resolution Copper Project.

- **2014 --** In the first quarter, the facilitators of the group became aware of a letter that had been sent to the Agency for Toxic Substances and Disease Registry (ATSDR) by an unknown person or persons requesting a public health assessment.
The facilitators obtained a copy of the redacted letter, which appeared to have been signed in January 2011, and provided it to the CWG. The letter requested a health assessment and alleged a wide variety of health problems currently experienced by Superior residents and also listed the existence of a wide variety of environmental contaminants and toxics. The facilitators were told that the issue had been assigned by ATSDR to the Arizona Department of Health Services (ADHS) who accepted the assignment for further action and investigation in 2013.

- **2013** – ADHS met with the petitioner, Resolution Copper, BHP, and ADEQ to gather available information and gain a better understanding of the issues.
- **2014** - ADHS reviewed the available data and entered into technical discussions with ADEQ and Resolution Copper regarding methods to estimate the bioavailability of site-related arsenic.
- **2014** – In response to the petitioner, ADHS reviewed public drinking water reports to determine if there were any health related issues and published a health consultation (available: [http://azdhs.gov/documents/preparedness/epidemiology-disease-control/environmental-toxicology/hc-az-water-company-091714.pdf](http://azdhs.gov/documents/preparedness/epidemiology-disease-control/environmental-toxicology/hc-az-water-company-091714.pdf)). Community members were also concerned with potential air or soil exposures. However, data was not available in the geographical location of interest to the petitioner.

- **2014** -- By invitation of the Group, on May 21, ADHS presented a synopsis of their planned ‘health consultation’ in Superior at a meeting of the CWG.

The presentation included an overall explanation of the process, risk assessment and the various authorities involved. In addition, it also presented the results of previous blood lead testing in Superior between 2003 and 2012 with children 0-6 years of age, and children older than 6 years of age.

Results of previous tests did not indicate abnormally high blood lead levels in children tested. Statistical evidence of previous
cancer cases was also presented for the Superior/Kearny Community Health Analysis Area (CHAA) and results of those data for bladder, kidney and lung cancer cases indicated rates commensurate with or below rates throughout Arizona.

- **2015** – ADHS placed ads in the local paper and coordinated with the Superior Clinic and the local elementary school to post signs around town to advertise an open house public meeting. ADHS offered blood lead tests (focused on children and pregnant women) and urine arsenic tests (for individuals using private wells) to Superior residents. However, no one from the community attended the meeting. ADHS met with HeadStart and local school teachers, advertised the testing event around town with posters, newspaper advertisements, and newspaper articles. ADHS spoke about the opportunity at a Superior Town Hall, and also made arrangements with the local elementary school to set up an informational table during the school’s parent-teacher conferences. Fifty-three people signed up, and 22 people showed up at the clinic to participate. 13 of the participants were children under 18 years of age. All results were less than the lab’s reporting limit of 3 ug/dL. CDC’s reference value is 5 ug/dL. No participants had a private well, and therefore none were eligible for urine arsenic tests.

- **2015** -- ADHS issued a letter stating:

  ‘2 months ago the Agency for Toxic Substances and disease registry offered blood lead tests to residents of Hayden and Winkelman, AZ in a community sampling event. At one of the meetings the Mayor and Town Manager of Superior heard of the activities and asked ADHS if there was a way of doing something similar in Superior. We have left over supplies to draw blood for a blood lead test, and our state public health laboratory has agreed to run up to 50 tests free of charge for Superior residents. All residents 0-6 years of age and pregnant women are welcome to participate.'
Residents who own a private well may also have the opportunity to have private well water and urine samples analyzed for heavy metals through ADHS’ biomonitoring project. All residents 6 years of age and older are allowed to participate. This project is part of a 4 state consortium (with Utah, Colorado, and New Mexico), and summary statistics will be shared with them, and with the CDC, but individual results will be kept confidential.

ADHS organized testing to be held at the Superior Clinic on August 7th and 8th from 9am to 4pm. Residents can come and have their blood drawn by the phlebotomists provided by Superior Clinic/Cobra Valley and leave their urine specimens. All results will be reported to the individuals, and kept confidential. Summary statistics may be shared.’

- **2015 --** On August 7th and 8th ADHS blood lead and urine arsenic testing was provided free of charge at Superior Clinic.

- **2015 --** On September 30, ADHS Director Dr. Cara Christ posted the following synopsis of the results to her online blog:

> ‘Every year our Environmental Toxicology program responds to environmental health concerns and provides communities with epidemiologic and toxicological health assessments. Recently a community member from the town of Superior brought up concerns that contamination from past mining activities could be affecting the health of residents. Superior is a small mining town with a population of about 3,000, located approximately 60 miles east of Phoenix.

Our environmental health team visited Superior, conducted a drive-by survey, toured the mine, and met with residents, the mine and Arizona Department of Environmental Quality to better understand the community. A health consultation was conducted based on annual water quality reports. No public health concerns were identified from this health consultation.
Another concern was that people in the community might have come into contact with lead present in waste piles (tailings) from smelting processes. This past summer, in partnership with the Superior Clinic, free blood lead screening was offered to the residents. Public meetings were held at the local school and at the Superior Town Hall to provide information. We advertised around town with posters, newspaper advertisements and articles in the local paper.

Fifty-three people signed-up for free blood testing, and 22 people, including 13 children, showed up at the clinic for testing. All blood lead levels came back below the CDC’s reference value of five micrograms/deciliter, showing that none of the community members tested were experiencing lead poisoning. Participants received a letter about their results and health education materials.

This work demonstrates the ability of ADHS to partner with communities, businesses, and other agencies to address health concerns and provide information about how communities can take action on their environmental health problems, and improve their health and quality of life.'