

LETTER HEALTH CONSULTATION

EVALUATION OF AMBIENT AIR MONITORING DATA
IN GLASGOW BOROUGH
BEAVER COUNTY, PENNSYLVANIA

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Prepared by:



Pennsylvania Department of Health
Division of Environmental Health Epidemiology

Health Consultation: A Disclaimer

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The conclusions and recommendations presented in this health consultation document are based on an analysis of the environmental sampling data and information made available to the PADOH within a limited time frame. The availability of additional sampling data, new information and/or changes in site conditions could affect the conclusions and recommendations presented in this document. PADOH will consider reviewing additional future data related to the site, if made available and deemed appropriate.



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Re: Review of Ambient Air Toxics Project Summary, Glasgow Borough, Beaver County, PA

On May 26, 2016 the Pennsylvania Department of Environmental Protection (DEP) requested the Pennsylvania Department of Health (DOH) evaluate potential health impacts from metals measured in residential community air in Glasgow Borough, Beaver County, PA. The DEP provided the DOH a copy of the Ambient Air Toxics Project Summary report (dated May 9, 2016) for evaluation. The report contained the data analysis summary in Table 1 (Data collection and sample result summary for TSP sampler 35IQ) and Table 2 (Data collection and sample summary for PM₁₀ sampler 35IP).

According to the report, in the summer of 2014, residents of the Glasgow Borough contacted the U.S. Environmental Protection Agency (EPA) Region III Air Protection Division in Philadelphia about the potential adverse impacts of toxic metals emitted from the S.H. Bell Company's East Liverpool Terminal and nearby metals processing facilities in East Liverpool, Ohio and Midland, PA. The S.H. Bell East Terminal is bisected by the PA/OH border lying partially in the Glasgow Borough, PA and partially in the City of East Liverpool, OH.

In response to the community's concerns, the EPA Region III contacted the DEP. Due to the concerns raised by the community, DEP's Air Quality Monitoring Division (AQM) initiated an ambient air monitoring project to screen for potential impacts due to ambient concentrations of eight toxic metals. The DEP started the sampling on October 26, 2014 and continued every six days through July 5, 2015.

The report further states that in the fall of 2014, the DEP installed two particulate samplers in the Borough to determine the ambient air toxic metals concentrations over time. According to DEP the samplers were located in the downwind direction of the S. H. Bell facility. The samplers included a total suspended particulate (TSP) sampler and a PM₁₀ particulate sampler. The two samplers collected 24 hour time weighted average samples every six days using quartz filters suited for measuring metals in ambient air. The samples were analyzed by the DEP laboratory. The analyses included particulate weight and concentrations of metals including arsenic, beryllium, cadmium, chromium, lead, manganese, nickel and zinc.

For the DOH to evaluate public health implications associated with exposure to toxic metals in the air, it is appropriate to use ambient airborne particulate matter with aerodynamic diameters of 10 microns or less (PM₁₀). This represents inhalable particles capable of penetrating the thoracic region of the respiratory tract. Metal concentrations of PM₁₀ are more reliable for health based screening because they better represent inhalable particles into the lungs. Also, health protection values established by the EPA as well as by the Agency for Toxic Substances and Disease Registry (ATSDR), are based on the respirable fraction of metals containing particles (less than 10 microns in aerodynamic diameter). In general, particulates greater than 10 microns in diameter are not inhaled into the lungs. Therefore, they do not pose a significant threat to the public health from air exposure pathway. Some portion of the total suspended particulates are too large to enter the human respiratory tract. Therefore, total suspended particulate is not a valid indicator of health related exposure and was not used for health effects evaluation in this document.

Evaluation of Environmental data:

To determine whether the metals detected in the ambient air (PM₁₀) pose a health threat, the DOH screened the concentrations of metals detected against health based comparison values (CVs) such as ATSDR Minimum Risk Levels (MRLs), EPA Reference Concentrations (RfCs), Cancer Risk Evaluation Guides (CREGs) etc. Also, the DOH reviewed scientific literature that documents health effects caused by exposure to these metals. Those concentrations of metals which exceeded the CVs during the sampling period as well as the cancer risk estimates calculated on the measured concentrations are presented in Table A:

Table A
Metals that exceeded CVs during the sampling period (October 2014 –July 2015) and cancer risk estimates:

Metals	Mean Concentration $\mu\text{g}/\text{m}^3$	95% UCL $\mu\text{g}/\text{m}^3$	EPA Inhalation unit risk	CV $\mu\text{g}/\text{m}^3$	Agency Guidelines	Estimated 95% UCL cancer risk (ED-30 yrs.)
Arsenic	0.002	0.003	4.3E-03	0.00023 (C) 0.015 (NC)	ATSDR CREG Cal EPA	5.5E-06
Cadmium	0.0005	0.0006	1.8E-03	0.00056 (C) 0.01 (NC)	ATSDR CREG ATSDR C-MRL	4.6E-07
Chromium VI	0.0010	0.0012	1.2E-02	0.00008 (C) 0.005 (NC)	ATSDR CREG ATSDR C-MRL	6.1E-06
Manganese	0.1452	0.21		0.3 (NC) 0.05 (NC)	ATSDR C-MRL EPA RfC	N/A

Total Risk: 1.2E-05

95% UCL = 95% of upper confidence limit of the mean

$\mu\text{g}/\text{m}^3$ = microgram per cubic meter

Ca EPA = California Environmental Protection Agency

NC = Non-cancer

C = Cancer

CV = Health based comparison value

RfC = USEPA Reference Concentration

CREG = ATSDR Cancer Risk Evaluation Guide

C-MRL = ATSDR Chronic Minimum Risk Level

ED = Exposure duration – 30 years national upper bound time (90th percentile) at one residence

NA = Not applicable

Health effects evaluation:

a) Cancer risk evaluation:

The U.S. Department of Health and Human Services has classified cadmium, chromium VI and arsenic as human carcinogens. Manganese is not considered a carcinogen. The ATSDR has developed CREGs which represent the concentration of a chemical in a media that if an individual is exposed to, would result in one additional case of cancer per 1,000,000 people. The detected concentration levels (concentration as the 95% upper confidence limit (UCL) of the mean concentration for chemicals) of the three metals at

this site exceeded ATSDR's CREG for arsenic ($0.00023 \mu\text{g}/\text{m}^3$), cadmium ($0.00056 \mu\text{g}/\text{m}^3$) and chromium VI ($0.00008 \mu\text{g}/\text{m}^3$). For these carcinogens, the DOH expressed inhalation toxicity measurements as inhalation unit risk (IUR) in units of risk per $\mu\text{g}/\text{m}^3$. The DOH used IURs from EPA's Integrated Risk Information System (IRIS). The cancer risk for each metal was derived (based on exposure over 30 years) by multiplying exposure concentration (mean; 95% UCL) by the IUR. We summed cancer risks for individual metals to estimate the cumulative cancer risk. Cancer risk estimates were calculated based on measured ambient air metal concentration (as presented in Table A). The cumulative estimated cancer risk from exposure to arsenic, chromium VI, and cadmium is $1.2\text{E}-05$. This falls within EPA's target cancer risk range of $1.0\text{E}-06$ to $1.0\text{E}-04$ or between risk of 1 additional case of cancer per 1,000,000 people and risk of 1 additional case of cancer per 10,000 people. Also, it is not unusual for cumulative risk for chemicals in ambient air to pose a cancer risk higher than the increased risk of one in one million people developing cancer. Furthermore, the detected concentration levels of arsenic, cadmium, and chromium VI at this site were within the detected concentration range levels in ambient air in the US.

b) Non-cancer health effects evaluation:

Only the level of manganese at $0.21 \mu\text{g}/\text{m}^3$ (mean; 95% UCL) exceeded EPA's RfC of $0.05 \mu\text{g}/\text{m}^3$ but below ATSDR's cMRL of $0.3 \mu\text{g}/\text{m}^3$.

Manganese is found in the air, dust, soil, water and food and is an essential dietary element. It can elicit a variety of toxic effects upon prolonged exposure to high levels either by inhalation or orally. However, as a route of manganese exposure, the respiratory tract is the most important portal of entry. High inhalation exposure to manganese particles in dust/or fumes in the work place is a known risk of deteriorating psychiatric health, declining cognitive ability and movement disorders similar to Parkinson's disease (*Bowler et al, 2007 a and b; Fieldman, 1999*).

The MRL and RfC are based on an occupational study of workers exposed through work at a manganese battery factory and unexposed control subjects (*Roel et al, 1992*). Based on this epidemiological study the RfC of $0.05 \mu\text{g}/\text{m}^3$ for inhalation exposure was calculated from a human lowest observed adverse effect level (LOAEL) of $50 \mu\text{g}/\text{m}^3$ ($0.05 \text{mg}/\text{m}^3$) for impairment of neurobehavioral function. The study population was occupationally exposed to airborne manganese dust at an average concentration of $0.215 \text{mg}/\text{m}^3$ and $0.948 \text{mg}/\text{m}^3$ in respirable and total dust respectively, for 0.2 to 17.7 years with a median duration of 5.3 years. Neurological examinations, psychomotor tests, lung function tests etc., were used to determine the possible effects of exposure. A safety factor of 1,000 was applied to derive the RfC of $0.05 \mu\text{g}/\text{m}^3$. The EPA's RfC has not been updated since its original 1993 publication. Recently, California adopted a final manganese chronic Reference Exposure Level (REL) of $0.09 \mu\text{g}/\text{m}^3$.

The ATSDR in 2012 established a chronic MRL of $0.3 \mu\text{g}/\text{m}^3$ using the same study (*Roel et al, 1992*) that was used by EPA to derive the RfC. From this study the ATSDR used incidence data for abnormal eye-hand coordination scores in workers exposed to

respirable manganese. Using a bench mark dose (BMD) analysis of eye-hand coordination scores, the exposure concentration associated with a 10% response was determined to be 142 $\mu\text{g}/\text{m}^3$. This number was divided by 100. A factor of 10 was used to account for human variability (including the possibly enhanced susceptibility of the elderly, infants and children with chronic liver disease, of parenteral nutrition, and females and individuals with iron deficiency). Another factor of 10 was used for limitations/uncertainties in the database (including lack of epidemiological data for humans chronically exposed to soluble forms of manganese and the concern that general population may be more exposed to soluble forms of manganese than most of the manganese exposed workers in the principal and supporting studies). Also, BMD was adjusted for continuous exposures instead of occupational exposures.

The detected level for manganese is below the ATSDR's chronic MRL but four times higher than the EPA's RfC. A recent study found evidence for an association of long term chronic environmental manganese exposure (range from 0.01 to 6.32 $\mu\text{g}/\text{m}^3$) with impairment in motor function (*Bowler et al 2016*). There are significant uncertainties in the scientific literature regarding the effects of chronic low level airborne manganese exposure in the general population. Most of the epidemiological studies of manganese exposure in humans are from occupational settings which may or may not reflect what is going on in community settings. Therefore, exposure to manganese at the concentrations detected may cause harm to public health.

Limitations:

The air sampling was conducted for about nine months. However, to account for seasonal variation in ambient air, at least one year of data is important for estimating annual mean concentration (95% UCL) of pollutants. However, for the purpose of preliminary health evaluation, the data can provide information regarding the pollutant levels in the ambient air to determine the potential health effects. People who live closer to the source are expected to be exposed to higher levels of pollutants. The samplers might not have been placed in close proximity to areas where most residents live (receptor population) and the results of the air sampling may not reflect worst case exposure conditions. Also, the TSP sampler collects all particulates, including large particles that are not respirable. Therefore, the TSP sampling data is not ideal for health evaluation purposes. This health consultation is limited to chemicals that were monitored in the ambient air.

Conclusions:

- Based on the preliminary test results of the ambient air, long term (chronic) exposure to manganese at the detected concentrations has the potential to harm people's health.
- Of the metals tested, manganese was the only metal identified which warrants additional testing and evaluation.

Recommendation:

- The DOH recommends that DEP conduct further ambient air measurements of manganese from the site in order to better characterize human exposure.

The DOH appreciates the opportunity to work with your Agency in evaluating the environmental air sampling data for this site in order to reduce exposures to toxic chemicals. The DOH remains available for further consultation on this site. If you have any questions or concerns, please feel free to contact us.

Sincerely,



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