East Liverpool Ohio Air Quality Study 2008

Division of Air Pollution Control
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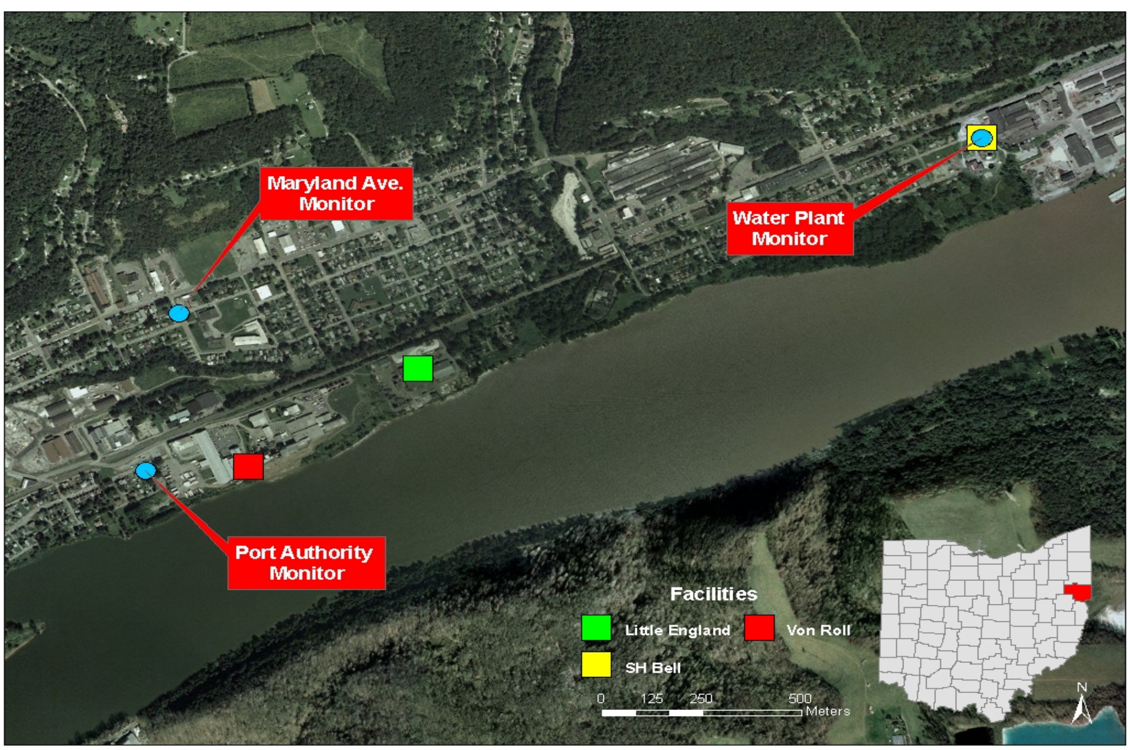
EXECUTIVE SUMMARY

The Ohio EPA, Division of Air Pollution Control (DAPC) has completed an urban air toxic study of East Liverpool, Ohio. This study contains the initial results for an ongoing investigation of outdoor (ambient) air near a potential source of heavy metal compounds. The primary objective of this study is to determine if residents of the East Liverpool area are being exposed to airborne concentrations of pollutants that may pose unacceptable risks to health. Initial sampling in this area was conducted by both Ohio EPA and U.S. EPA at several locations from 1999 - 2000. Information regarding this sampling is published in a U.S. EPA report entitled: "A Final Report on Environmental Monitoring in the Vicinity of Von Roll WTI Incinerator Facility, East Liverpool, Ohio, May 23, 2003."

Subsequent to the sampling events documented in the U.S. EPA final report, Ohio EPA continued to monitor for heavy metals in East Liverpool. An investigation is also being conducted to identify all potential sources of heavy metals in the area. Ohio EPA collected ambient air monitoring data at three East Liverpool locations from March 2000 through December 2007 (excluding the year 2002).

Figure 1 shows the location of the three Ohio EPA ambient monitoring sites in East Liverpool. Air sampling for heavy metals was conducted using a high volume total suspended particulate (TSP) sampler, with 24-hour samples collected once every six days. Each group of filter samples was analyzed for the following metals: arsenic, beryllium, cadmium, chromium, lead, nickel, manganese, and zinc.

Figure 1, East Liverpool Monitoring Locations for Heavy Metals



Air Toxic Risk Summary

In this study, the risk assessment focuses on direct inhalation of contaminants measured in outdoor air at three locations in East Liverpool between March 2000 and September 2007. This process uses U. S. EPA methods to estimate both the cancer and non-cancer health effects that individuals or populations may experience as a result of prolonged (long-term) exposure to the toxic compounds. In an air pollution risk assessment, exposure is assumed to be constant inhalation (24 hours per day; 365 days per year; for 30-70 years) at the measured concentrations of air pollutants. This estimate centers on the additional lifetime risk predicted from the exposure being analyzed, beyond that due to any other factors, and utilizes potency factors that U.S. EPA considers to be plausible upper-bounds (i.e., actual risk may be lower, but sensitive populations and children may be at a higher risk).

Cancer risk is expressed as a probability usually represented in scientific notation as a negative exponent of 10. For example, an additional lifetime risk of contracting cancer of 1 chance in one million (or one additional person in 1,000,000 people) is written as $1x10^{-6}$ or 1.0 E-6. U.S. EPA has established a range of "acceptable" health risk values for carcinogens (cancer) compounds between one in 1,000,000 (1×10^{-06}) and one in 10,000 (1×10^{-04}) based on feasible risk reduction strategies. While it is not always possible or feasible to remove all traces of a chemical released into the environment, Ohio EPA generally takes action to reduce the health risks associated with exposure to air pollutants that exceed the 1×10^{-4} risk level.

Non-cancer risks are evaluated by estimating the ratio of the individually measured concentrations to the no-effect level known as the Hazard Quotient (HQ). The Hazard Quotients (HQs) can be added together to yield a total estimate of non-carcinogenic risk known as the Hazard Index (HI). Concentrations below these “no-effect” levels are generally regarded as "safe." Any individual non-cancer chemical that is above 100% (1.0) of the HQ is considered unacceptable and merits further investigation.

Based on all of the compounds measured; only manganese and chromium exhibit long-term average ambient air concentrations above the level at which Ohio EPA considers protective of public health. The air monitoring and risk assessment results are the subject of this air quality report.

The total cancer and non-cancer risk (HI) for each of the East Liverpool locations are summarized in **Table 1** below. The chronic (long-term) carcinogenic risk in the immediate area of the St. Georges St. and Maryland Ave. monitor are in the 10^{-5} risk range while the chronic (long-term) carcinogenic risk for the Michigan Ave air monitor is more than two times the 10^{-4} risk level. For every location, chromium is the chemical of concern that drives the cancer risk. The average chromium concentrations measured for the Michigan Ave. monitor contributes to more than 90% of the total estimates for cancer risk.

When the non-cancer risk estimates are calculated for each of the monitoring locations, long-term non-carcinogenic risk in the immediate area of the Maryland Ave. and Port Authority air monitors exceeds the “no health-effects level” by more than 5 and 8 times respectively. The long-term non-carcinogenic risk in the immediate area of the Water Plant (Michigan Ave.) monitor is more than 34 times the non-cancer “no health-effects level”. For each of the East Liverpool locations, it is important to note that manganese is the major chemical of concern that contributes to more than 95% of the total non-cancer risk.

Cancer and non-cancer risk estimates for chromium and manganese measured at each monitoring location are listed below in **Tables 2A** and **2B.** Note that health studies indicate that exposure to manganese results only in non-cancer health impacts. Therefore, **Table 2B** contains only non-cancer risk estimates for manganese. Risk estimates for the other compounds measured are discussed in the body of this report.

Table 1. Total Cancer and Non-Cancer Risk Summary-East Liverpool, Ohio.

Based on the average of the data collected from March 2000 through September 2007 (excluding 2002)

Site Location	Total Non-Cancer Risk (HI)	Total Cancer Risk
Maryland Ave.	5.14	7.31×10^{-5}
Port Authority	8.64	7.96×10^{-5}
Water Plant	34.54	2.47×10^{-4}

Table 2A Chromium Risk Estimates- East Liverpool, Ohio

Based on the average of the data collected from March 2000 through September 2007 (excluding 2002)

Site Location	Average 2000-2007	Non-Cancer Risk (HI)	Cancer Risk
	µg/m³		
Maryland Ave.	0.005	0.05	5.03×10^{-5}
Port Authority	0.006	0.07	6.50×10^{-5}
Water Plant	0.020	0.19	2.29×10^{-4}

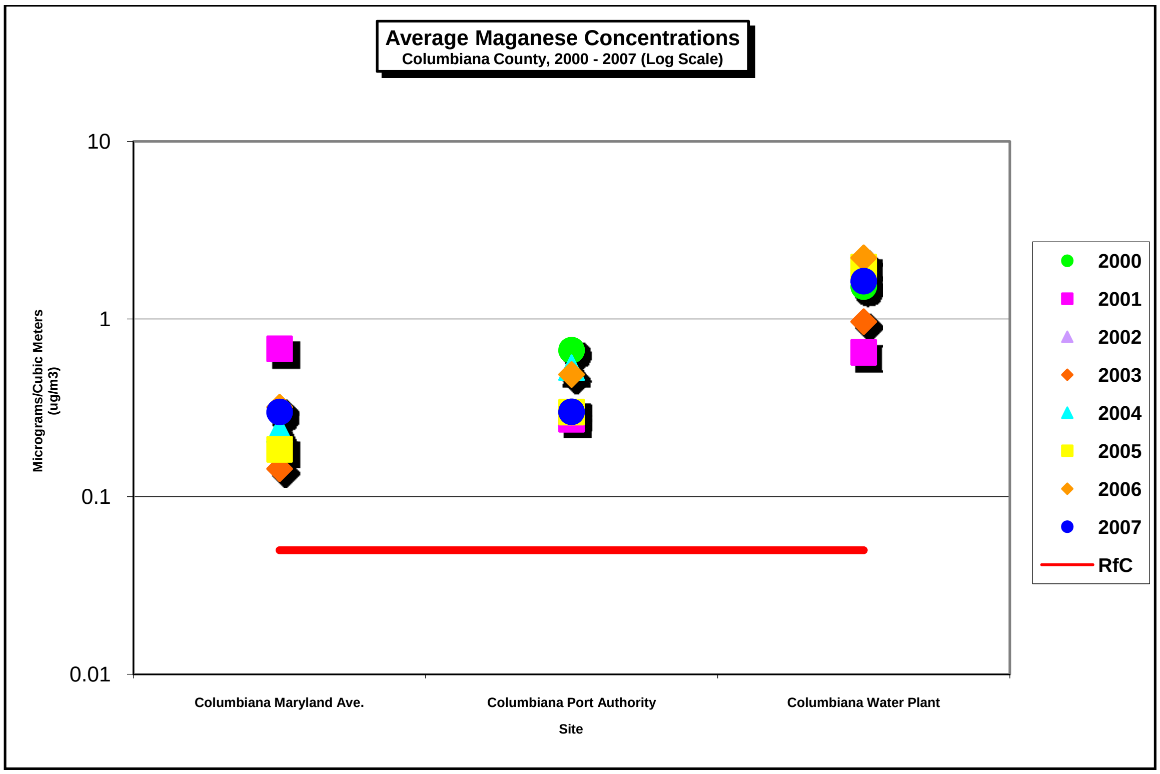
Table 2B. Manganese Risk Estimates- East Liverpool, Ohio

(Based on the average of the data collected from March 2000 through September 2007)

Site Location	Average Concentration 2000-2007	Non-Cancer Risk (HI)
	µg/m³	
Maryland Ave.	0.25	5.06
Port Authority	0.42	8.54
Water Plant	1.71	34.29

Figure 2 compares the annual average manganese concentrations for the three East Liverpool monitoring sites with the U.S. EPA manganese reference concentration (RfC) using a logarithmic scale. This U.S. EPA reference concentration of 0.05 µg/m³ is used to estimate the "no health effect" level. It is important to note that the graph shows that the average concentrations of manganese for each of the sites are significantly above the level at which Ohio EPA takes action to mitigate potential health impacts to the public. In addition, the average concentrations of manganese measured at the Michigan Ave., Water Plant is probably the highest average concentration monitored anywhere in the United States. Therefore, Ohio EPA is taking action to investigate and reduce potential air pollution sources for this area.

Figure 2. Annual Average Manganese Concentrations, East Liverpool Ohio



Introduction

The Ohio EPA, Division of Air Pollution Control (DAPC) has completed an urban air toxic monitoring study for the East Liverpool, Ohio area. This study contains the initial results of an ongoing investigation of the ambient air health impacts near a potentially large source of particulate heavy metal compounds. This study is the responsibility of the Air Toxics Unit (ATU) of the Division of Air Pollution Control of the Ohio EPA.

Initial sampling in East Liverpool, Ohio was conducted by both Ohio EPA and U.S. EPA at several locations from 1999 - 2000. This sampling was conducted as part of an investigation for a high profile facility located in the area. Ohio EPA sampled for heavy metals, and U.S. EPA sampled for heavy metals, PAHs, dioxins, VOCs and particulate matter. The results from the U.S. EPA study are published in a U.S. EPA report entitled: "A Final Report on Environmental Monitoring in the Vicinity of Von Roll WTI Incinerator Facility, East Liverpool, Ohio, May 23, 2003".

For Ohio EPA's subsequent study (the subject of this report), ambient air monitoring data was collected at three locations in the East Liverpool area. The long-term average air concentrations for some of the pollutants measured are above the level at which Ohio EPA considers protective of public health. Based on all of the compounds measured, both manganese and chromium exhibit long-term average air concentrations above the level at which Ohio EPA considers protective of public health. The air monitoring data and the toxicological interpretation of the data are the subject of this air quality report.

Air Monitoring Locations

Air sampling monitors were sited at three East Liverpool locations in order to measure the amount of metals in the ambient air for the area. The locations of the monitors are shown above in **Figure 1** and discussed below. Photographs of the monitors are also shown in Appendix B of this report.

Maryland Ave. (Air Quality System # 39-029-0022)

The Maryland Ave. site contains two TSP monitors on the roof of the East Liverpool School Administration Building at 500 Maryland Ave. This site is located in both a residential and industrial/commercial area.

Port Authority (Air Quality System # 39-029-0019)

Sampler number two is located on a deck along the south side of the Port Authority building at 1250 St. George St. The area consists of both residential and industrial properties.

Water Plant (Air Quality System # 39-029-0020)

The third monitor is sited at the East Liverpool Water Plant at 2220 Michigan Ave. adjacent to the S.H. Bell Stateline facility. This area also contains both residential and industrial properties.

Methods

Heavy Metals Sampling and Analysis

This study consists of ambient air sampling for heavy metals through the use of particulate air pollution sampling devices. These are defined as metals that are generally found in the solid / particulate state at normal temperatures. Sampling for heavy metals is conducted using a high volume total suspended particulate (TSP) sampler. With this sampler, particulate matter in the air is collected on a pre-weighed glass fiber filter. Sampling is done intermittently with 24-hour samples collected once every six days, although at times different schedules are used. The operating procedures can be found in the *Code of Federal Regulations, 40 CFR, Part 50, Appendix B - Reference Method for Determination of Suspended Particulate Matter in the Atmosphere. 40 CFR Part 50, Appendix G* is used for lead.

Filters collected at each site are generally analyzed as a monthly composite. All DAPC air filter samples are analyzed by the Ohio EPA's Division of Environmental Services (DES), laboratory. Each group of filter samples was analyzed for the following metals: arsenic, beryllium, cadmium, chromium, lead, nickel, manganese, and zinc. The filters are first processed using Ohio EPA Method 400.2. The acid-extracted samples are analyzed manually or automatically via an autosampler by an Inductively Coupled Plasma (ICP) Emission Spectrometer, as defined in Ohio EPA Method 401.1. The ICP instrument measures element – emitted light by optical spectrometry. Samples are nebulized into an aerosol and transported to the plasma by nebulizer argon flow. The first function of the high temperature plasma is to remove the solvent from, or desoluate, the aerosol, usually leaving the sample as microscopic salt particles. The next steps involve decomposing the salt particles into a gas of individual molecules (vaporization) that are then dissociated into atoms (atomization). The next plasma functions are Excitation and Ionization. The light emitted by the excited atoms and ions in the plasma is measured to obtain concentration information about the sample.

As part of this study each group of filters samples was also analyzed for mercury by an Automated Cold Vapor Method, Ohio EPA Method 438.1. Total mercury is determined through the conversion of organic and inorganic mercury to mercury vapor via, first, ion oxidation and then reduction. The mercury concentration is determined by measuring the observed absorbance of the vapor in a carrier gas as it passes through one path of a double path cell and then comparing it to the absorbance of the carrier gas alone as it passes through the second pathway.

Compound measurements below the detection limit are calculated as follows. The detection limit is the lowest measurement the procedure can accurately quantify as a true measurement of the ambient air concentration. If a compound was detected once or more during the sampling period, the arithmetic mean (average) contains a value for any non-detect measurement(s) of one / half (½) the detection limit. Other options for handling values below the detection limit are available, such as using the detection limit itself, or using a value of zero for the measurement result. Using the value one half the detection limit is common U.S. EPA practice because a value of zero may underestimate the true air concentration, while a value equal to of the detection limit itself may over-estimate the true air concentration.

Results & Discussion

In this study, the ambient air concentrations and risk estimates from potential exposure to heavy metals are reported. **Appendix A** (located at the end of this report) lists the results for samples collected at three locations from March 2000 through December 2007 (excluding the year 2002). The table lists the compound names and the measured concentrations for each sample collection date. All units are in micrograms per cubic meter of air volume ($\mu g/m^3$).

The data generated by this study represents the measured concentrations for airborne metals sampled in the general area of East Liverpool. Ambient air monitoring results are evaluated by an inhalation risk assessment. This process uses current available toxicological information as a basis for estimating the health effects that individuals or populations may experience as a result of prolonged exposure to the measured substances.

Ohio EPA generally follows the risk assessment guidelines provided by the U.S. EPA. Risk-based screening levels are based upon U.S. EPA's Integrated Risk Information System (IRIS) unit risk factors for carcinogens and reference concentrations [RfCs] for non-carcinogenic effects. A risk assessment produces a numerical prediction of the probability of an adverse health effect, such as carcinogenicity and / or systematic toxicity that may occur as a result of (chronic) long-term exposure to air pollutants.

In an air pollution risk assessment, exposure is assumed to be constant inhalation (24 hours per day; 365 days per year; for 30-70 years) to the average of the measured concentrations of air pollutants. These exposure assumptions are conservative in general, to ensure that the actual risks will be no greater than the estimated risk. In fact, the actual risks will most likely be less than those estimated by the risk assessment process, but sensitive populations and children may be at a higher risk. The average exposure concentration is calculated from the total collected samples, including periods of higher and lower concentrations. For this study, measurements were taken approximately four times per month for over a five year period. Currently, there is no reason to suspect that the data collected do not represent the ambient air concentrations at or around the locations of the air sampling devices.

Toxicity of the Chemicals of Concern

The following health effects information is a brief summary of data collected from the U.S. EPA's IRIS database and the Technology Transfer Network Air Toxics hazard summaries. The Agency for Toxics Substances and Disease Registry (ATSDR - part of the national Center for Disease Control [CDC]) also supplies information concerning the potential health effects caused by toxic air pollutants. Ohio EPA risk assessment procedures follow guidelines provided by U.S. EPA (Risk Assessment Guidance for Superfund - Volume 1 - Human Health, December 1989) and the recently revised U.S. EPA Air Toxics Risk Assessment Library (Volumes 1-3, 2005).

MANGANESE

Chronic (long-term) exposure to high levels of manganese by inhalation in humans may result in central nervous system (CNS) effects. Visual reaction time, hand steadiness, and eye-hand coordination were affected in chronically-exposed workers. A syndrome named "manganism" may result from chronic exposure to higher levels. Manganism is characterized by feelings of weakness and lethargy, tremors, a mask-like face, and psychological disturbances. Respiratory effects have also been noted in workers chronically exposed by inhalation.

CHROMIUM

Chromium exists in multiple valence states. Of all possible valences, trivalent (+3) (chromium III), and hexavalent (+6) (chromium VI) are the most relevant in the environmental setting. Natural ores of chromium +3 are the most common natural form, while most sources of chromium VI are man-made and often associated with electroplating and metal finishing, leather tanning, and textile production. It was also used as a corrosion inhibitor and can be a component of fly ash. Without specific data as to the form of the collected chromium compound, as it is customary to treat all chromium data as chromium VI due to its greater toxicity and carcinogenicity. This assumption, while protective, may greatly overestimate the potential risk.

Chronic inhalation of chromium VI results in irritation of the respiratory tract and can result in asthma or other signs of respiratory distress with measurable decrease of respiratory function. In addition to the non-cancer effects of chromium VI inhalation, a number of studies have linked inhalation of chromium VI to lung cancer in humans. Studies of the toxic effects of chronic ingestion of chromium VI are not conclusive, but acute effects following ingestion of moderate doses (0.56 milligram per kilogram per day [mg/kg-d]) are associated with oral ulceration, diarrhea, abdominal pain, indigestion, vomiting, and blood system damage.

It is also important to clarify that during the ambient air monitoring performed by Ohio EPA, no concentrations collected by the 24-hour samples exceeded the acute (short-term) health-based exposure levels normally associated with the health effects cited above. The data analyzed here is being used for the chronic (long-term) exposure estimations for health effects caused by 30-70 years of breathing these toxic chemicals.

Risk Summary/Acceptable Risk

Risk is analyzed in two phases: carcinogenic (cancer) and non-carcinogenic (non-cancer) risk. Carcinogenic risk assumes no safe exposure limit, and all exposure increases the possibility of a health effect. Non-cancer health risk evaluation includes a presumed exposure level below which there is no appreciable health risk.

Toxic (harmful) effects from carcinogenic and non-carcinogenic compounds are determined by using Unit Risk Factors (URFs) for carcinogenic compounds and Reference Dose / Reference Concentrations (RfCs) for non-carcinogenic compounds. Current toxicity information is obtained from U.S. EPA's IRIS database. URFs and RfCs listed as of January 2008 are used in these calculations.

Carcinogenic Risk

The following chemicals are considered cancer causing compounds: arsenic, beryllium, cadmium, chromium and nickel. The cancer URF is a toxic potency value that defines quantitatively the relationship between dose and response. Multiplying the URF by the long-term average daily dose (average ambient air concentration) will produce the probability of developing a cancer as a result of toxic exposure. This is defined as the excess lifetime cancer risk - the extra risk added to an individual's lifetime risk by the additional exposure to the toxic air pollutant. The result is expressed numerically as a probability, for example, one in 1,000,000 (which equals 1×10^{-6}, or 1.0 E-06).

The current method of estimating the total health effects risk from exposure to mixtures of carcinogenic compounds consists of adding individual risk numbers to approximate the total risk. This summation is based upon the principle that the addition of each risk produces a combined total risk estimate. This is the method currently recommended by the U.S. EPA, although exposure to combinations of carcinogens may cause greater or lesser risk than can be explained by merely the summation of the individual exposure risks.

Non-carcinogenic Risk

Chemicals monitored that are considered to have health impacts other than cancer include: beryllium, chromium, manganese, mercury and nickel. The non-cancer, long-term (chronic) RfCs are estimates of daily exposure levels for which people, including sensitive subpopulations, may be exposed constantly for long periods without an appreciable risk of adverse health effects (essentially a no-risk exposure scenario). Safety factors are especially developed to be protective for long-term exposures. Non-carcinogenic risks are individually evaluated by the use of a Hazard Quotient (HQ), which is the ratio of the average ambient air concentration compared to the RfC for each compound (the measured concentration is divided by the RfC and expressed as a percentage).

If the HQ exceeds 1.0 (100% of the RfC) for any individual compound, there may be potential health effect(s) as a result of exposure to the compound, although the potential may be proportionally small for slight increases over an HQ of 1.0. As a matter or policy however, an HQ over 100% (1.0) may initiate further investigation by Ohio EPA.

To evaluate combined (total) non-carcinogenic adverse health effects, the total risk is described by the use of the Hazard Index (HI). The HI is the summation of the individual HQs for all the compounds in the mixture of toxic air pollutants. If the totaled HI exceeds 100% for the mixture of compounds, there may be increased probability for health effects as a result of exposure to the group of compounds. As such, a HI over 100% (1.0) initiates further investigation by Ohio EPA.

Acceptable Risk

A range of "acceptable" health risk values for carcinogens has been defined by U.S. EPA and implemented by Ohio EPA in the examination of toxic air pollutants in the State. Historically, acceptability ranges from a target goal of one in 1,000,000 (1×10^{-06}) for regulation of certain source categories of individual toxic air pollutants, to some source categories routinely operating in the one in 100,000 (1×10^{-05}) range. For non-carcinogenic estimation of Hazard Indexes, a calculated HI below 1.0 (100%) is generally regarded as a "safe" level of exposure.

To put risk in perspective, most large urban areas in the United States exhibit aggregate or total carcinogenic risks in the 10^{-05} to 10^{-06} range. The totaled HQ for some of these areas may exceed a value of 100% (1.0). While it is common for industrial or light industrial areas to have risks greater than those, some smaller suburban and rural areas have combined carcinogenic risks in the 10^{-06} to 10^{-08} range. Areas of higher risk characteristically may also contain large volumes of automobile traffic. While workers in such areas routinely are exposed only during working hours, and return to residential areas of decreased exposure concentrations during non-working hours, individuals living in these areas may be constantly exposed to these higher levels of pollutants. While it is certainly desirable to have these aggregate risks minimized to the lowest possible level, a no-risk scenario is impossible to achieve in an industrial area.

Within the above framework describing acceptable risk, the non-acceptable risk level defined for an individual carcinogenic compound in ambient air is 1.0×10^{-4} (one in 10,000) or greater. Any individual non-cancer HQ above 100% (1.0) is considered potentially unacceptable (although non-cancer risk unacceptability is not so clearly defined) [U.S. EPA Risk Assessment Guidelines 1989 & 2005]. The evaluation of appropriate risk takes into consideration the exposure and duration of the populations affected. Dedicated industrial areas could accept more risk than a residential area (or an area with more susceptible populations such as children, the elderly, or persons with respiratory impairments).

Tables 3-5 (below) contain the average ambient air concentrations and corresponding carcinogenic and non-carcinogenic risks calculated for each of the East Liverpool monitoring locations. Risk estimates are based on all the samples collected from March 2000 through September 2007 (excluding the year 2002). The tables also contain the total number of samples analyzed to date as well as the maximum and minimum concentration detected for the entire sampling period.

Maryland Ave. & Port Authority Sites

The data for the Maryland Ave. and Port Authority monitors indicate that the total carcinogenic risks is in the 10^{-5} risk range and the Hazard Indexes (HI) for the area are above 100% (1.0). More significantly, however, is the fact that the cancer risk is driven by chromium compounds and the non-cancer risk is driven by manganese. Both the individually measured average concentrations and corresponding estimates for total chronic (long-term) risk are well above the levels at which Ohio EPA takes action to mitigate potential health impacts to the public.

Table 3: Summary of Health Effects Risk for East Liverpool, Ohio 2007

EAST LIVERPOOL HEAVY METALS DATA				2001 - September 2007 *		
500 Maryland Ave.						
AQS: 39-029-0022						
Columbiana	- designated	Parameters				
Compounds	**Average (2001-2007)**	**Non- caner HI**	**Cancer RISK**	**Maximum**	**Minimum**	**Count**
	µg/m³			µg/m³	µg/m³	
Arsenic	0.00453		1.95E-05	0.15000	0.00073	59
Beryllium	0.00004	0.00	1.07E-07	0.00014	0.00002	53
Cadmium	0.00108		1.95E-06	0.00460	0.00025	59
Chromium	0.00503	0.05	5.03E-05	0.03100	0.00145	41
Lead	0.01570			0.08100	0.00420	57
Zinc	0.10151			0.49000	0.02500	59
Manganese	0.25310	5.06		1.00000	0.01900	59
Mercury	0.00006	0.00		0.00076	0.00001	56
Nickel	0.00542	0.03	1.30E-06	0.02500	0.00520	12
Total		**5.14**	**7.31E-05**			

Table 4: Summary of Health Effects Risk for East Liverpool, Ohio 2007

EAST LIVERPOOL HEAVY METALS DATA
Port Authority 2000 - September 2007 *
1250 St. George St.:
AQS: 39-029-0019
Columbiana County Parameters units -- µg/m³

Compounds	Average (2000-2007)	**Non-caner** HI	**Cancer** RISK	Maximum	Minimum	Count
	µg/m³					
Arsenic	0.00254		1.09E-05	0.00940	0.00062	68
Beryllium	0.00013	0.01	3.14E-07	0.00043	0.00002	66
Cadmium	0.00110		1.99E-06	0.00480	0.00023	68
Chromium	0.00650	0.07	6.50E-05	0.04300	0.00195	52
Lead	0.01736			0.07600	0.00390	66
Zinc	0.12419			0.54000	0.02800	68
Manganese	0.42694	8.54		1.90000	0.03000	68
Mercury	0.00011	0.00		0.00200	0.00001	66
Nickel	0.00577	0.03	1.38E-06	0.02400	0.00330	23
Total		**8.64**	**7.96E-05**			

Water Plant Site

For the Water Plant monitor, **Table 5** (below) lists the average ambient air concentrations and corresponding carcinogenic and non-carcinogenic risks for all the samples analyzed to date. The table shows that the total carcinogenic risk is greater than $1x\ 10^{-4}$ and the Hazard Index (HI) for the area is well above 100% (1.0). Again, chromium compounds account for the majority of the cancer risk and the non-cancer risk is primarily driven by the manganese ambient air levels. The individual Hazard Quotient for manganese is 3,500% (34.54) of the “no health effects” level. Based on a review of the air monitoring data contained in U.S. EPA AirData database, the manganese concentrations measured for the Michigan Ave. sampler represent the highest average concentration detected by any State.

Table 5: Summary of Health Effects Risk for East Liverpool, Ohio 2007

EAST LIVERPOOL HEAVY METALS DATA 2000 - September 2007*
Water Plant
2220 Michigan Ave.
AQS: 39-029-0019
Columbiana

Compounds	Average (2000-2007)	HI	Cancer RISK	Maximum	Minimum	Count
	µg/m³			µg/m³	µg/m³	
arsenic	0.00		1.30E-05	0.02	0.00	69
beryllium	0.00	0.00	1.65E-07	0.00	0.00	53
cadmium	0.00		1.94E-06	0.01	0.00	69
chromium	0.02	0.19	2.29E-04	0.09	0.00	67
lead	0.02			0.07	0.00	67
zinc	0.11			0.72	0.02	69
manganese	1.71	34.29		6.80	0.16	69
mercury	0.00	0.00		0.00	0.00	67
nickel	0.01	0.05	2.53E-06	0.09	0.00	56
Total		**34.54**	**2.47E-04**			

Risk Summary/ Conclusions

This study evaluates the likelihood that pollution from heavy metals will cause adverse effects on human health in East Liverpool, Ohio. Risk assessment provides quantitative and qualitative estimates of long-term risk posed to human health through exposure to target air pollutants.

Ohio EPA has documented unacceptably high concentrations of airborne manganese and chromium for the East Liverpool area. Within the above framework for describing acceptable risk, Ohio EPA generally takes action to reduce health risks associated with exposure to air pollutants that exceed the 1x 10^{-4} cancer risk level. Action is also taken to reduce any individual non-cancer risk above 100% (1.0).

Currently, both the long-term carcinogenic and non-carcinogenic risks associated with the ambient air measurements evaluated for East Liverpool are above the acceptable or “safe” levels determined by Ohio EPA to be protective of public health. Ohio EPA will continue to conduct air monitoring to evaluate changes that result from activities associated with the Agency’s efforts to reduce the levels of metals released in East Liverpool, Ohio.

For more information:

Risk Assessment Questions

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Ambient Monitoring & Laboratory Analysis Questions

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Appendix A

East Liverpool Heavy Metals Data 2000-2007

Maryland Ave Samplers
500 Maryland Ave.

EAST LIVERPOOL HEAVY METALS DATA			2001 - September 2007 *		
500 Maryland Ave.					
	units -- µg/m³				
Columbiana	designated	Parameters			

*bold numbers are 1/2 of detection limit

2001									
MONTH	beryllium	chromium	lead	manganese	nickel	zinc	arsenic	cadmium	mercury
JANUARY	na	na	na	na	na	na	na	na	na
FEBRUARY	na	na	na	na	na	na	na	na	na
MARCH	na	na	na	na	na	na	na	na	na
APRIL	na	na	na	na	na	na	na	na	na
MAY	na	na	na	na	na	na	na	na	na
JUNE	na	na	na	na	na	na	na	na	na
JULY	na	na	na	na	na	na	na	na	na
AUGUST	na	na	na	na	na	na	na	na	na
SEPTEMBER	na	na	na	na	na	na	na	na	na
OCTOBER	na	na	na	na	na	na	na	na	na
NOVEMBER	0.00013	0.03100	0.02500	0.86000	0.02500	0.04300	0.00280	0.00039	na
DECEMBER	0.00005	0.02600	0.01100	0.50000	0.01000	0.04600	0.00180	0.00050	na
2003	**beryllium**	**chromium**	**lead**	**manganese**	**nickel**	**zinc**	**arsenic**	**cadmium**	**mercury**
JANUARY	0.00003	0.00170	0.00600	0.03000	**0.02300**	0.03400	0.00100	0.00054	0.00004
FEBRUARY	0.00005	0.00160	0.01100	0.09900	**0.02150**	0.09800	0.00200	0.00075	0.00005
MARCH	0.00010	0.00440	0.01000	0.16000	**0.02800**	0.08600	0.00230	0.00063	0.00006
APRIL	0.00014	0.00390	0.08100	0.10000	**0.02500**	0.07800	0.00600	0.00087	0.00005
MAY	0.00006	0.00410	0.01700	0.05300	**0.02550**	0.12000	0.00200	0.00099	0.00007
JUNE	0.00004	0.00165	0.01300	0.05700	**0.02200**	0.03300	0.00140	0.00086	0.00004
JULY	0.00003	0.00510	0.01200	0.07200	**0.02200**	0.07600	0.00220	0.00075	0.00004
AUGUST	0.00003	0.00145	0.01400	0.14000	**0.01950**	0.11000	0.00130	0.00098	0.00001
SEPTEMBER	0.00004	0.00530	0.01400	0.44000	**0.02150**	0.11000	0.00180	0.00160	0.00005
OCTOBER	0.00003	0.00480	0.01500	0.14000	**0.02250**	0.05400	0.00340	0.00066	0.00004
NOVEMBER	0.00003	0.00510	0.02000	0.06400	**0.02200**	0.17000	0.00190	0.00140	0.00005
DECEMBER	0.00003	0.00800	0.01700	0.37000	**0.02150**	0.13000	0.00120	0.00180	0.00005
2004	**beryllium**	**chromium**	**lead**	**manganese**	**nickel**	**zinc**	**arsenic**	**cadmium**	**mercury**
JANUARY	**0.00002**	**0.00260**	**0.00345**	0.01900	**0.00345**	0.03800	0.00073	0.00100	0.00003
FEBRUARY	0.00004	0.00450	0.01100	0.45000	**0.00220**	0.09300	0.00140	0.00240	0.00005
MARCH	0.00006	0.00380	0.01300	0.35000	**0.00215**	0.07800	0.00170	0.00060	0.00006
APRIL	0.00008	0.00460	0.01500	0.12000	**0.00245**	0.03900	0.00160	0.00028	0.00004
MAY	0.00004	**0.00195**	0.03000	0.19000	**0.00260**	0.03700	0.00520	0.00041	0.00007
JUNE	0.00004	**0.00200**	0.00910	0.18000	**0.00270**	0.02900	0.00120	0.00033	0.00008
JULY	0.00004	0.00550	0.00990	0.25000	**0.00265**	0.06200	0.00180	0.00059	0.00005
AUGUST	0.00003	**0.00155**	0.00420	0.25000	**0.00210**	0.02500	0.00120	0.00028	0.00004
SEPTEMBER	0.00003	**0.00185**	0.00700	0.19000	**0.00250**	0.04600	0.00160	0.00049	0.00004
OCTOBER	0.00007	0.00850	0.01300	0.50000	**0.00240**	0.10000	0.00300	0.00140	0.00006
NOVEMBER	0.00004	0.00600	0.00800	0.30000	**0.00230**	0.05400	0.00210	0.00070	0.00005
DECEMBER	**0.00001**	**0.00215**	0.00850	0.06100	**0.00285**	0.06200	0.00110	0.00097	0.00003

2005	beryllium	chromium	lead	manganese	nickel	zinc	arsenic	cadmium	mercury
JANUARY	**0.00001**	**0.00205**	0.01600	0.07400	**0.00275**	0.24000	0.00120	0.00130	0.00005
FEBRUARY	0.00004	0.00440	0.01800	0.18000	**0.00295**	0.18000	0.00140	0.00250	0.00005
MARCH	0.00007	0.00600	0.00850	0.21000	**0.00240**	0.09500	0.00140	0.00093	0.00004
APRIL	0.00007	0.00660	0.01700	0.18000	**0.00250**	0.20000	0.00240	0.00130	0.00006
MAY	0.00004	**0.00235**	0.00980	0.06400	**0.00315**	0.03900	0.00300	0.00052	0.00011
JUNE	0.00007	0.00750	0.01000	0.50000	**0.00280**	0.05100	0.00280	0.00059	0.00004
JULY	0.00006	**0.00260**	0.01500	0.09800	**0.00345**	0.11000	0.00230	0.00084	0.00004
AUGUST	0.00004	0.00490	0.00750	0.14000	**0.00280**	0.03800	0.00160	0.00033	0.00003
SEPTEMBER	0.00008	0.00780	0.01400	0.33000	**0.00270**	0.11000	0.00260	0.00100	0.00003
OCTOBER	0.00002	**0.00160**	0.01400	0.18000	**0.00215**	0.07200	0.00130	0.00072	0.00004
NOVEMBER	0.00003	**0.00185**	0.00520	0.04200	**0.00245**	0.05600	0.00088	0.00058	0.00003
DECEMBER	**0.00001**	**0.00180**	0.00520	0.22000	**0.00240**	0.04000	0.00110	0.00051	0.00003
2006	**beryllium**	**chromium**	**lead**	**manganese**	**nickel**	**zinc**	**arsenic**	**cadmium**	**mercury**
JANUARY	**0.00001**	**0.00185**	0.04300	0.28000	**0.00250**	0.34000	0.00180	0.00340	0.00005
FEBRUARY	0.00004	0.00480	0.01100	0.32000	**0.00240**	0.08100	0.00170	0.00057	0.00004
MARCH	0.00005	0.00690	0.04700	0.95000	**0.00320**	0.23000	0.00320	0.00460	0.00008
APRIL	0.00005	**0.00250**	0.00910	0.29000	**0.00330**	0.07900	0.00160	0.00075	0.00004
MAY	0.00003	**0.00205**	0.00610	0.16000	**0.00275**	0.03500	0.00200	0.00033	0.00003
JUNE	0.00005	0.00660	0.01400	0.54000	**0.00275**	0.04400	0.00160	0.00038	0.00008
JULY	0.00004	0.00480	0.01200	0.35000	**0.00285**	0.03800	0.00250	0.00037	**0.00000**
AUGUST	0.00005	0.00530	0.00830	0.22000	**0.00350**	0.04400	0.00150	0.00039	0.00003
SEPTEMBER	0.00003	**0.00195**	**0.00260**	0.29000	**0.00260**	0.02600	0.00110	0.00044	0.00009
OCTOBER	0.00004	**0.00185**	0.00890	0.14000	**0.00250**	0.06500	0.00360	0.00049	0.00005
NOVEMBER	0.00004	0.00710	0.04200	0.25000	0.00660	0.46000	0.00320	0.00280	0.00005
DECEMBER	**0.00001**	**0.00155**	0.01200	0.04800	**0.00205**	0.15000	0.15000	0.00110	0.00004
2007	**beryllium**	**chromium**	**lead**	**manganese**	**nickel**	**zinc**	**arsenic**	**cadmium**	**mercury**
JANUARY	0.00003	0.00460	0.00780	0.03200	0.00610	0.03100	0.00095	0.00025	0.00003
FEBRUARY	0.00003	0.00430	0.00580	0.03300	0.00580	0.04100	0.00160	0.00072	0.00005
MARCH	0.00006	0.00560	0.04500	0.24000	0.00520	0.49000	0.00230	0.00370	0.00010
APRIL	0.00003	0.00420	0.00540	0.07700	0.00560	0.04400	0.00085	0.00035	0.00004
MAY	0.00010	0.01200	0.03100	0.30000	0.00570	0.29000	0.00230	0.00260	0.00004
JUNE	0.00004	0.00460	0.01100	0.15000	0.00560	0.04000	0.00180	0.00058	0.00003
JULY	0.00003	0.00550	0.02300	0.57000	0.00590	0.11000	0.00220	0.00370	0.00005
AUGUST	0.00003	0.00490	0.02400	1.00000	0.00580	0.20000	0.00300	0.00089	0.00003
SEPTEMBER	0.00004	0.00520	0.01900	0.53000	0.00700	0.06900	0.00300	0.00230	0.00076
OCTOBER	na	na	na	na	na	na	na	na	na
NOVEMBER	na	na	na	na	na	na	na	na	na
DECEMBER	na	na	na	na	na	na	na	na	na

Port Authority
1250 St. George St.

*bold numbers are 1/2 of detection limit

EAST LIVERPOOL HEAVY METALS DATA 2000 - September 2007 *									
Port Authority									
1250 St. George St.	units -- µg/m³								
Columbiana County									
2000	**beryllium**	**chromium**	**lead**	**manganese**	**nickel**	**zinc**	**arsenic**	**cadmium**	**mercury**
JANUARY	na	na	na	na	na	na	na	na	na
FEBRUARY	na	na	na	na	na	na	na	na	na
MARCH	na	na	na	na	na	na	na	na	na
APRIL	0.00029	0.00550	0.01800	0.27000	0.00740	0.10000	0.00370	0.00082	0.00022
MAY	0.00024	0.00460	0.01300	0.17000	0.00620	0.07700	0.00190	0.00091	0.00009
JUNE	0.00017	0.00510	0.01100	0.64000	0.00570	0.05900	0.00300	0.00045	0.00019
JULY	0.00013	0.01000	0.01500	0.33000	0.00690	0.04100	0.00940	0.00034	0.00014
AUGUST	0.00010	0.02140	0.01680	1.74000	0.01180	0.08640	0.00253	0.00177	0.00012
SEPTEMBER	0.00010	0.00496	0.02050	0.53100	0.00522	0.05680	0.00257	0.00141	0.00006
OCTOBER	0.00028	0.00510	0.01800	0.30000	0.00580	0.04800	0.00490	0.00055	0.00042
NOVEMBER	0.00011	0.01100	0.01400	1.10000	0.00630	0.06700	0.00280	0.00054	0.00037
DECEMBER	0.00003	0.04300	0.02300	0.94000	0.01300	0.04400	0.00320	0.00088	0.00200
2001	**beryllium**	**chromium**	**lead**	**manganese**	**nickel**	**zinc**	**arsenic**	**cadmium**	**mercury**
JANUARY	na	na	na	na	na	na	na	na	na
FEBRUARY	na	na	na	na	na	na	na	na	na
MARCH	na	na	na	na	na	na	na	na	na
APRIL	na	na	na	na	na	na	na	na	na
MAY	na	na	na	na	na	na	na	na	na
JUNE	na	na	na	na	na	na	na	na	na
JULY	na	na	na	na	na	na	na	na	na
AUGUST	na	na	na	na	na	na	na	na	na
SEPTEMBER	na	na	na	na	na	na	na	na	na
OCTOBER	na	na	na	na	na	na	na	na	na
NOVEMBER	0.00012	0.01800	0.02400	0.04600	0.02400	0.02800	0.00120	0.00032	na
DECEMBER	0.00005	0.02700	0.01100	0.50000	0.00970	0.06400	0.00200	0.00059	na
2003	**beryllium**	**chromium**	**lead**	**manganese**	**nickel**	**zinc**	**arsenic**	**cadmium**	**mercury**
JANUARY	0.00004	**0.00325**	**0.00430**	0.03000	**0.04300**	0.08700	0.00093	0.00044	0.00006
FEBRUARY	0.00006	**0.00330**	0.01300	0.25000	**0.04400**	0.24000	0.00250	0.00058	0.00006
MARCH	0.00015	0.00195	0.00920	0.22000	**0.02600**	0.08900	0.00200	0.00055	0.00006
APRIL	0.00024	0.00490	0.03000	0.16000	**0.02550**	0.06200	0.00320	0.00480	0.00005
MAY	0.00010	**0.00210**	0.01300	0.05800	**0.02850**	0.15000	0.00230	0.00091	0.00008
JUNE	0.00012	**0.00220**	0.01700	0.08100	**0.02950**	0.16000	0.00250	0.00050	0.00007
JULY	0.00010	**0.00225**	0.02100	0.08600	**0.03000**	0.29000	0.00360	0.00094	0.00006
AUGUST	0.00009	**0.00190**	0.02200	0.17000	**0.02550**	0.31000	0.00230	0.00110	0.00008
SEPTEMBER	0.00006	0.00610	0.01900	0.32000	**0.03000**	0.26000	0.00220	0.00130	0.00014
OCTOBER	0.00005	0.00580	0.01700	0.16000	**0.02650**	0.13000	0.00450	0.00068	0.00004
NOVEMBER	0.00004	0.00780	0.02700	0.16000	**0.02650**	0.34000	0.00320	0.00200	0.00006
DECEMBER	0.00003	0.01300	0.02600	1.90000	**0.02600**	0.25000	0.00250	0.00280	0.00007

2004	beryllium	chromium	lead	manganese	nickel	zinc	arsenic	cadmium	mercury
JANUARY	0.00003	**0.00180**	**0.00240**	0.04000	**0.00240**	0.06600	0.00062	0.00045	0.00006
FEBRUARY	0.00006	0.00530	0.00790	0.43000	**0.00245**	0.11000	0.00160	0.00180	0.00005
MARCH	0.00005	0.00430	0.01400	0.61000	**0.00255**	0.07400	0.00230	0.00056	0.00007
APRIL	0.00016	**0.00260**	0.01300	0.26000	**0.00345**	0.04300	0.00190	0.00036	0.00006
MAY	0.00008	**0.00215**	0.02200	0.35000	**0.00285**	0.05200	0.00520	0.00037	0.00007
JUNE	0.00013	**0.02200**	0.07600	1.40000	**0.02900**	0.30000	0.00240	0.00033	0.00012
JULY	0.00032	0.00580	0.01100	0.55000	**0.00310**	0.06600	0.00560	0.00069	0.00009
AUGUST	0.00009	**0.00135**	0.00620	0.28000	**0.00180**	0.03400	0.00260	0.00039	0.00006
SEPTEMBER	0.00019	**0.00195**	0.00920	0.14000	**0.00260**	0.03200	0.00210	0.00065	0.00010
OCTOBER	0.00017	0.00790	0.01400	0.80000	**0.00250**	0.11000	0.00350	0.00097	0.00009
NOVEMBER	0.00006	0.00910	0.01200	0.99000	**0.00195**	0.06900	0.00400	0.00100	0.00004
DECEMBER	0.00003	0.00450	0.00970	0.55000	**0.00190**	0.05500	0.00110	0.00094	0.00004
2005	**beryllium**	**chromium**	**lead**	**manganese**	**nickel**	**zinc**	**arsenic**	**cadmium**	**mercury**
JANUARY	**0.00001**	0.00420	0.01100	0.35000	**0.00180**	0.10000	0.00130	0.00090	0.00004
FEBRUARY	0.00003	0.00470	0.02200	0.26000	**0.00190**	0.24000	0.00160	0.00300	0.00005
MARCH	0.00009	0.00620	0.01200	0.73000	**0.00195**	0.09800	0.00180	0.00100	0.00004
APRIL	0.00018	0.00620	0.01900	0.22000	**0.00250**	0.27000	0.00110	0.00170	0.00008
MAY	0.00021	0.00630	0.01400	0.18000	**0.00200**	0.05800	0.00420	0.00067	0.00007
JUNE	0.00033	0.00750	0.01200	0.71000	**0.00220**	0.06000	0.00400	0.00068	0.00008
JULY	0.00035	0.00700	0.01900	0.29000	**0.00220**	0.15000	0.00260	0.00100	0.00004
AUGUST	0.00024	0.00430	0.01100	0.21000	**0.00220**	0.04500	0.00200	0.00037	0.00006
SEPTEMBER	0.00016	0.00540	0.01500	0.24000	**0.00215**	0.12000	0.00210	0.00100	0.00005
OCTOBER	0.00011	0.00310	0.01300	0.22000	**0.00170**	0.07500	0.00140	0.00077	0.00006
NOVEMBER	0.00012	**0.00185**	0.00920	0.09100	**0.00245**	0.09000	0.00150	0.00077	0.00003
DECEMBER	**0.00001**	**0.00145**	0.00460	0.11000	**0.00190**	0.05200	0.00100	0.00040	0.00003
2006	**beryllium**	**chromium**	**lead**	**manganese**	**nickel**	**zinc**	**arsenic**	**cadmium**	**mercury**
JANUARY	0.00003	0.00390	0.05000	0.50000	**0.00200**	0.39000	0.00200	0.00380	0.00005
FEBRUARY	0.00006	0.00720	0.01200	1.70000	0.00530	0.11000	0.00270	0.00091	0.00004
MARCH	0.00015	0.00530	0.00400	0.39000	**0.00200**	0.18000	0.00210	0.00390	0.00008
APRIL	0.00024	0.00680	0.05500	0.82000	0.00590	0.20000	0.00240	0.00240	0.00006
MAY	0.00011	**0.00160**	0.00960	0.12000	**0.00210**	0.04600	0.00250	0.00050	0.00005
JUNE	0.00032	0.00610	0.01400	0.35000	**0.00260**	0.05000	0.00180	0.00050	0.00010
JULY	0.00043	0.00650	0.01600	0.50000	**0.00360**	0.05900	0.00300	0.00054	0.00008
AUGUST	0.00027	0.00500	0.01100	0.41000	**0.00210**	0.06400	0.00200	0.00059	0.00001
SEPTEMBER	0.00024	0.00470	0.00610	0.60000	**0.00200**	0.03400	0.00160	0.00068	0.00013
OCTOBER	0.00009	**0.00145**	0.01100	0.11000	**0.00190**	0.06900	0.00320	0.00053	0.00008
NOVEMBER	0.00005	0.00820	0.04400	0.30000	0.00910	0.54000	0.00290	0.00330	0.00006
DECEMBER	0.00003	0.00270	0.01100	0.05800	**0.00160**	0.16000	0.00130	0.00093	0.00003
2007	**beryllium**	**chromium**	**lead**	**manganese**	**nickel**	**zinc**	**arsenic**	**cadmium**	**mercury**
JANUARY	0.00002	0.00280	0.00390	0.06500	0.00370	0.02900	0.00100	0.00023	0.00003
FEBRUARY	0.00003	0.00480	0.00640	0.03600	0.00640	0.05600	0.00120	0.00049	0.00005
MARCH	0.00006	0.00480	0.03500	0.27000	0.00330	0.36000	0.00200	0.0027	0.00009
APRIL	0.00008	0.00360	0.00660	0.18000	0.00410	0.04700	0.00110	0.00052	0.00004
MAY	0.00030	0.01200	0.03600	0.51000	0.00570	0.30000	0.00320	0.0027	0.00003
JUNE	0.00010	0.00350	0.01300	0.16000	0.00410	0.03800	0.00230	0.00066	0.00007
JULY	0.00016	0.00580	0.01300	0.69000	0.00690	0.05000	0.00250	0.00059	0.00006
AUGUST	0.00010	0.00350	0.03400	0.50000	0.00410	0.19000	0.00240	0.00082	0.00003
SEPTEMBER	0.00014	0.00460	0.02700	0.59000	0.00400	0.06500	0.00290	0.00180	0.00009

Water Plant

2220 Michigan Ave.

*bold numbers are 1/2 of detection limit

EAST LIVERPOOL HEAVY METALS DATA			2000 - September 2007 *						
Water Plant									
2220 Michigan Ave.	units -- µg/m³								
- designate	Parameters								
Columbiana County									
2000	**beryllium**	**chromium**	**lead**	**manganese**	**nickel**	**zinc**	**arsenic**	**cadmium**	**mercury**
JANUARY	na	na	na	na	na	na	na	na	na
FEBRUARY	na	na	na	na	na	na	na	na	na
MARCH	0.00014	0.00820	0.01300	1.30000	0.00760	0.06200	0.00160	0.00056	0.00039
APRIL	0.00005	0.01000	0.02400	2.50000	0.01000	0.11000	0.00360	0.00078	0.00032
MAY	0.00003	0.00480	0.01600	0.66000	0.00580	0.09200	0.00260	0.00054	0.00021
JUNE	0.00007	0.01500	0.01500	1.80000	0.01400	0.05800	0.00560	0.00078	0.00011
JULY	0.00008	0.08700	0.05100	2.30000	0.02700	0.11000	0.00710	0.00081	0.00016
AUGUST	0.00012	0.00796	0.01390	1.87000	0.00514	0.07180	0.00375	0.00144	0.00008
SEPTEMBER	0.00007	0.00626	0.01020	0.31700	0.00511	0.06260	0.00134	0.00055	0.00006
OCTOBER	0.00010	0.00770	0.01900	1.20000	0.00840	0.05600	0.00310	0.00075	0.00075
NOVEMBER	0.00007	0.01900	0.02500	3.00000	0.01600	0.17000	0.00470	0.00120	0.00056
DECEMBER	0.00010	0.00390	0.01700	0.33000	0.00520	0.08900	0.00330	0.00052	0.00033
2001	**beryllium**	**chromium**	**lead**	**manganese**	**nickel**	**zinc**	**arsenic**	**cadmium**	**mercury**
JANUARY	na	na	na	na	na	na	na	na	na
FEBRUARY	na	na	na	na	na	na	na	na	na
MARCH	na	na	na	na	na	na	na	na	na
APRIL	na	na	na	na	na	na	na	na	na
MAY	na	na	na	na	na	na	na	na	na
JUNE	na	na	na	na	na	na	na	na	na
JULY	na	na	na	na	na	na	na	na	na
AUGUST	na	na	na	na	na	na	na	na	na
SEPTEMBER	na	na	na	na	na	na	na	na	na
OCTOBER	na	na	na	na	na	na	na	na	na
NOVEMBER	0.00130	0.02400	0.03100	0.92000	0.02600	0.12000	0.00330	0.00150	na
DECEMBER	0.00052	0.02300	0.01600	0.38000	0.01000	0.06800	0.00160	0.00066	na
2003	**beryllium**	**chromium**	**lead**	**manganese**	**nickel**	**zinc**	**arsenic**	**cadmium**	**mercury**
JANUARY	0.00003	0.01800	0.00550	0.21000	**0.00265**	0.04100	0.00170	0.00033	0.00006
FEBRUARY	0.00005	0.02700	0.01500	1.10000	**0.00225**	0.13000	0.00190	0.00088	0.00006
MARCH	0.00006	0.00800	0.01700	0.90000	**0.00375**	0.21000	0.00240	0.00110	0.00011
APRIL	0.00006	0.05600	0.01200	0.74000	0.03100	0.04500	0.00200	0.00047	0.00008
MAY	0.00010	0.02000	0.02200	0.75000	0.01600	0.16000	0.00270	0.00091	0.00010
JUNE	**0.00001**	**0.00140**	**0.00185**	0.16000	**0.00185**	0.01800	0.00150	0.00021	0.00007
JULY	**0.00001**	0.00860	0.00860	0.24000	0.00590	0.06300	0.00220	0.00062	0.00008
AUGUST	0.00010	0.00520	0.01200	1.80000	0.00560	0.12000	0.00160	0.00097	0.00010
SEPTEMBER	0.00005	0.04000	0.01900	1.60000	0.00900	0.14000	0.00210	0.00140	0.00009
OCTOBER	0.00006	0.05800	0.02100	0.83000	0.01200	0.09700	0.00260	0.00090	0.00006
NOVEMBER	0.00006	0.03600	0.03300	1.70000	0.00770	0.27000	0.00250	0.00220	0.00007

2004	**beryllium**	**chromium**	**lead**	**manganese**	**nickel**	**zinc**	**arsenic**	**cadmium**	**mercury**
JANUARY	**0.00001**	0.00450	**0.00205**	0.46000	**0.00205**	0.01800	0.00068	0.00029	0.00006
FEBRUARY	0.00004	0.01700	0.03100	2.80000	0.01000	0.08200	0.00160	0.00120	0.00010
MARCH	0.00007	0.02900	0.01600	2.80000	0.01800	0.10000	0.00390	0.00062	0.00009
APRIL	**0.00001**	0.00450	0.01100	0.64000	0.00850	0.03300	0.00180	0.00028	0.00007
MAY	**0.00001**	0.01100	0.02900	1.40000	0.00640	0.03500	0.00280	0.00034	0.00010
JUNE	**0.00001**	0.00470	0.01700	2.90000	0.00530	0.02800	0.00220	0.00027	0.00010
JULY	**0.00001**	0.01600	0.01100	2.40000	**0.00225**	0.06100	0.00400	0.00058	0.00009
AUGUST	**0.00001**	0.01000	0.00510	3.60000	**0.00180**	0.02100	0.00150	0.00024	0.00006
SEPTEMBER	0.00002	0.01600	0.00910	0.81000	0.00960	0.06900	0.00210	0.00069	0.00007
OCTOBER	0.00022	0.03600	0.02000	3.00000	0.01100	0.13000	0.00840	0.00110	0.00010
NOVEMBER	0.00004	0.05400	0.02900	3.90000	0.02000	0.06800	0.02000	0.00083	0.00006
DECEMBER	**0.00001**	0.04200	0.00690	0.80000	0.00500	0.04800	0.00160	0.00075	0.00010
2005	**beryllium**	**chromium**	**lead**	**manganese**	**nickel**	**zinc**	**arsenic**	**cadmium**	**mercury**
JANUARY	0.00002	0.02700	0.00940	1.60000	0.00790	0.10000	0.00190	0.00084	0.00007
FEBRUARY	0.00002	0.01500	0.03100	2.80000	0.00570	0.22000	0.00380	0.00280	0.00007
MARCH	0.00004	0.01500	0.01700	3.20000	0.00910	0.09800	0.00220	0.00100	0.00007
APRIL	0.00004	0.01400	0.01700	0.99000	0.00460	0.21000	0.00300	0.00140	0.00006
MAY	0.00002	0.01100	0.01000	0.64000	0.00570	0.05800	0.00250	0.00048	0.00012
JUNE	0.00008	0.02400	0.01800	4.20000	0.00930	0.08500	0.00500	0.00058	0.00011
JULY	0.00003	0.02000	0.01400	1.30000	**0.00235**	0.12000	0.00330	0.00064	0.00004
AUGUST	**0.00001**	0.00730	0.00580	0.97000	**0.00290**	0.03500	0.00170	0.00028	0.00006
SEPTEMBER	0.00003	0.02000	0.01900	1.70000	0.00660	0.12000	0.00260	0.00100	0.00005
OCTOBER	0.00002	0.01110	0.01800	4.40000	0.00890	0.10000	0.00220	0.00099	0.00007
NOVEMBER	**0.00001**	0.00540	0.01300	0.29000	**0.00205**	0.08400	0.00150	0.00076	0.00003
DECEMBER	**0.00001**	0.00700	0.00560	1.50000	**0.00195**	0.04800	0.00170	0.00046	0.00007
2006	**beryllium**	**chromium**	**lead**	**manganese**	**nickel**	**zinc**	**arsenic**	**cadmium**	**mercury**
JANUARY	0.00002	0.01800	0.06700	4.60000	0.00880	0.52000	0.00490	0.00540	0.00006
FEBRUARY	0.00004	0.02700	0.01400	6.40000	0.00820	0.14000	0.00370	0.00120	0.00004
MARCH	0.00002	0.01200	0.03400	2.80000	0.02200	0.16000	0.00250	0.00300	0.00008
APRIL	0.00003	0.01900	0.02500	3.20000	0.08800	0.19000	0.00450	0.00180	0.00007
MAY	**0.00002**	**0.00230**	0.01200	0.57000	0.01500	0.04900	0.00280	0.00052	0.00004
JUNE	**0.00001**	0.00760	0.00930	0.80000	**0.00245**	0.04400	0.00130	0.00064	0.00006
JULY	**0.00001**	0.00540	0.01000	1.30000	**0.00255**	0.04100	0.00260	0.00056	0.00003
AUGUST	0.00003	0.01600	0.00820	2.00000	0.00690	0.08800	0.00190	0.00078	0.00002
SEPTEMBER	0.00012	0.02100	0.00750	1.60000	0.02900	0.04200	0.00170	0.00078	0.00007
OCTOBER	0.00002	0.00600	0.01400	0.42000	0.01900	0.07000	0.00170	0.00086	0.00006
NOVEMBER	0.00004	0.03400	0.05100	1.30000	0.01500	0.72000	0.00300	0.00400	0.00006
DECEMBER	**0.00001**	0.02600	0.01500	1.60000	0.00470	0.19000	0.00250	0.00130	0.00005
2007	**beryllium**	**chromium**	**lead**	**manganese**	**nickel**	**zinc**	**arsenic**	**cadmium**	**mercury**
JANUARY	0.00002	0.00580	0.00580	0.48000	0.00440	0.02800	0.00110	0.00038	0.00005
FEBRUARY	0.00002	0.01500	0.00490	0.28000	0.00490	0.03000	0.00110	0.00029	0.00004
MARCH	0.00004	0.02300	0.03400	1.60000	0.00790	0.30000	0.00290	0.00360	0.00009
APRIL	0.00004	0.02500	0.01400	0.73000	0.00790	0.06700	0.00290	0.00054	0.00007
MAY	0.00004	0.02400	0.02200	1.20000	0.00700	0.24000	0.00210	0.00200	0.00006
JUNE	0.00002	0.01900	0.01000	0.72000	0.00480	0.04000	0.00210	0.00051	0.00006
JULY	0.00003	0.02000	0.01900	6.80000	0.04000	0.12000	0.00900	0.00310	0.00006
AUGUST	0.00004	0.01100	0.01600	1.30000	0.00970	0.18000	0.00280	0.00094	0.00003
SEPTEMBER	0.00003	0.00930	0.03200	1.30000	0.00490	0.06300	0.00380	0.00120	0.00008
OCTOBER	na	na	na	na	na	na	na	na	na
NOVEMBER	na	na	na	na	na	na	na	na	na
DECEMBER	na	na	na	na	na	na	na	na	na

Appendix B

East Liverpool Monitoring Locations 2000-2007

Port Authority
1250 St. George St.

Maryland Ave Samplers
500 Maryland Ave.

Water Plant
2220 Michigan Ave.