Letter Health Consultation

ROCKY MOUNTAIN STEEL MILLS

PUEBLO, COLORADO

Prepared by the
Colorado Department of Health and Environment

MARCH 3, 2010

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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LETTER HEALTH CONSULTATION

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TO: GORDON PIERCE (PROGRAM MANAGER, AIR POLLUTION CONTROL DIVISION)

FROM: SHANNON ROSSITER, MPH (CCPEHA/DCEED/CDPHE)

SUBJECT: EVALUATION OF AMBIENT AIR QUALITY NEAR ROCKY MOUNTAIN STEEL MILLS

DATE: 02/22/2010

CC: RAJ GOYAL, PHD (CCPEHA/DCEED/CDPHE)

The Air Pollution Control Division (APCD) of the Colorado Department of Health and Environment (CDPHE) requested assistance from the Colorado Cooperative Program for Environmental Health Assessments (CCPEHA) to evaluate the potential health hazards with respect to current and future ambient air quality near the Rocky Mountain Steel Mills. The purpose of this evaluation is to determine if there are any present or future potential health impacts to nearby residents resulting from inhalation of air emissions of metals from Rocky Mountain Steel Mills, and recommend actions to reduce exposure, if necessary.

The 24-hour particulate samples considered in this health consultation were total suspended particulate (TSP) matter filters collected and analyzed for metals on an every 6th day basis. No data are available for PM_{10} respirable size particles. Nonetheless, the evaluation of the potential for health effects is being conducted with the available TSP data, which is a conservative (worst-case) exposure assumption resulting in the over-estimation of risk.

Evraz, or Rocky Mountain Steel Mills (RMSM), operates a steel mini-mill at 1612 E Abriendo Ave, Pueblo, CO (Figure 1). Plant operations include melting steel scrap with additives to produce molten steel, and producing forms such as rails[1.] These additives include carbon (from coal), limestone, other fluxing agents, and oxygen. Other materials may be used in the steel melting process as required to meet quality specifications. The melting operation is a batch process, and the

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1 Air Resource Specialists, Inc. (2009). *Data Transmittal Report for the Rocky Mountain Steel Mills PSD Air Monitoring Program. March1, 2009- May 31, 2009.*

type of steel produced varies depending on the intended use. Over 150 grades of steel are made at the RMSM facility [2].

Prior to March 2006, RMSM modified their two-electric arc furnace steel melting operation to a single modern furnace with a dual fabric filter control system (4th hole and canopy controls). This was designed to be New Source Performance Standards (NSPS) compliant. In addition, refinements in the operation of the new Electric Arc Furnace (EAF) will potentially allow the facility to achieve a greater production rate than was originally anticipated, with production approaching 1,350,000 tons per year. This health consultation will consider data collected before and after the installation of this new EAF separately in order to evaluate the impact of these controls on residents who live within ¼ mile of the facility.

Discussion

The data used for this health consultation were collected by Air Resource Specialists, Inc., who was contracted by the RMSM to conduct a gaseous, particulate, and meteorological monitoring program for one monitoring station on the north end of the RMSM facility (Figure 2). The Rocky Mountain Steel Mill Site 1 was located on the northern boundary of the plant, immediately to the south of Northern Avenue. The purpose of the site was to capture pollutant impacts that will travel northward from the plant, into a nearby residential area. Although the wind rose (Figure 3) shows that the predominant winds run from the northwest and west-northwest towards the east-southeast, the wind rose indicates that at various times, pollutant emissions from the site may travel in almost any direction. The steel mill site is located in the center of a large metropolitan area (Figure 4), so public exposure to the measured metals concentrations does occur. It is believed that, due to the proximity of operations to the northern border, the Site 1 concentrations measured likely represent the maximum level of public exposure.

The meteorological and gaseous pollutant variables were monitored continuously. The 24-hour particulate samples considered in this health consultation were total suspended particulate matter filters collected and analyzed for metals on an every 6th day basis[3]. As mentioned above, no data are available for PM_{10} respirable size particles. In addition, criteria pollutants,

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2 BURNS & McDONNELL ENGINEERING COMPANY, INC. (2008). *Amended Application for Rocky Mountain Steel Mills,* December 20, 2007.

3 Air Resource Specialists, Inc. (2009). *Data Transmittal Report for the Rocky Mountain Steel Mills PSD Air Monitoring Program. March1, 2009- May 31, 2009.*

that are subject to National Air Quality Standards (NAQQS), are being monitored under the oversight of CDPHE's Air Pollution Control Division.

For chromium and manganese, sampling occurred from September 2002 through February 2009. All other metals sampled during the same time frame, except for a gap in sampling between December 2003 and March 2006. During this gap, the time between pre and post-construction air monitoring periods, only chromium and manganese sampling was required. A summary of the data collected is provided in Table 1. The data were divided into two parts: (1) the exposure period from September 2002 through February 2006 when limited emission controls were installed; and (2) the exposure period from March 2006 to February 2009 when the new emission control technology was installed (i.e., the Electric Arc Furnace). It should be noted that peak concentrations of manganese (>1.0 $\mu g/m^3$) were observed only 6 times over the entire data collection period from 2002 to 2009.

For the evaluation of potential health effects, the maximum value was compared with health based environmental guidelines or Comparison Values (CVs) to select contaminants of potential concern (COPCs). Exposures to contaminants below the health risk-based environmental guidelines are not expected to result in adverse or harmful health effects and thus are not evaluated further. As shown in Table 2, arsenic, chromium, cadmium, manganese and nickel were selected as COPCs for the period from September 2002 through February 2006, and arsenic, chromium, cadmium, beryllium, manganese and nickel were selected as COPCs for the exposure period from March 2006 to February 2009. For estimating the inhalation exposure of residents, it was assumed that residents inhale contaminated air 24 hours per day, 365 days per year for 30 years (6 years as a child and 24 years as an adult). The exposure point concentration (95% Upper Confidence Limit on the mean) was calculated using the EPA's method (Pro UCL 4.0).

For chromium, the estimated theoretical cancer risks range from 1.2E-04 (through 2/06) to 2.14E-04 (after 3/06) (Table 3). These theoretical cancer risks are above the US Environmental Protection Agency's (EPA's) acceptable risk range of 1 in a million to 100 in a million (1E-06 to 1E-04). Chromium is evaluated as total chromium; the 1:6 ratio of chromium VI: chromium III is based on the ratio used in the derivation of EPA's inhalation cancer slope factor.[4] The Department of Health and Human Services (DHHS), the International Agency for Reseach on Cancer (IARC), and the EPA have determined that chromium (VI) compounds are known human carcinogens. In workers, inhalation of chromium (VI) has been shown to cause lung cancer. In addition, chromium (VI) also

4 US Environmental Protection Agency-Integrated Risk Information System (1998). Chromium VI. Available at http://www.epa.gov/ncea/iris/subst/0144.htm, last accessed February 2010.

causes lung cancer in animals. An increase in stomach tumors was observed in humans and animals exposed to chromium (VI) in drinking water[5].

The theoretical cancer risks for arsenic, cadmium, nickel, and beryllium are either below or at the low end of the EPA's acceptable risk range of 1 in a million to 100 in a million (Table 3). The estimated theoretical cancer risks for cadmium range from 1.62E-06 (through 02/06) to 1.82E-06 (after 03/06). Estimated theoretical cancer risks for arsenic range from 3.66E-05 (through 02/06) to 1.0E-05 (after 03/06). The estimated theoretical cancer risks for nickel range from 9.33E-07 (through 02/06) to 1.19E-06 (after 03/06). Theoretical cancer risks for beryllium are below 1 in a million (1E-06) for the March 2006 through February 2009 time period, the only period in which it was monitored. These conservative risk estimates, based on the TSP data, indicate that inhalation of arsenic, cadmium, nickel, and beryllium is associated with a low to very low increased risk of developing cancer.

Finally, the cumulative theoretical estimated cancer risk for chromium, arsenic, nickel, beryllium (after monitoring started in 3/06), and cadmium combined is above EPA's acceptable risk range (Table 3). In the period through February 2006, the theoretical cumulative cancer risk is 1.59E-04, and it is 2.27E-04 after March 2006. It should be noted that the risks attributable to chromium are largely driving this cumulative cancer risk. The chromium risk assessment is complicated by the fact that the current air monitoring method cannot distinguish between Cr (VI) a carcinogen, and Cr (III), a noncarcinogen.

For manganese, the estimated noncancer hazards are above the level of health concern or "safe levels" (i.e. Hazard quotient well above 1.0) for both time periods. It is important to note that the estimated noncancer hazards are higher in the time period beginning in March 2006, after the installation of new control technologies (Table 1). However, the highest exposure point concentration of 0.38 $\mu g/m^3$ for manganese is well below the Lowest Observed Adverse Effect Levels (LOAEL) of 50 $\mu g/m^3$ and the No-Observed Adverse Effect-Level (NOAEL) of 150 $\mu g/m^3$ observed in human occupational studies used for deriving EPA's Reference Concentration for manganese. It should be noted that these effect levels were observed in occupational studies, and are not relevant for residential exposures.

Manganese is used principally in steel production to improve hardness, stiffness, and strength. Manganese is an essential nutrient, and eating a small amount of it each day is important to stay healthy. Manganese is also a naturally occurring metal in rocks. The most common health problems in workers exposed to high levels of manganese involve the nervous system. These health effects include behavioral changes and other nervous system effects, which include movements

5 Agency for Toxic Substances and Disease Registry (2008). *ToxFAQs for Chromium.* Available on the internet at: http://www.atsdr.cdc.gov/tfacts7.html#bookmark05, last accessed November 2009.

that may become slow and clumsy. This combination of symptoms when sufficiently severe is referred to as "manganism". Other less severe nervous system effects such as slowed hand movements have been observed in some workers exposed to lower concentrations in the work place.[6]

Conservative risk estimates, based on the TSP data, indicate that inhalation of arsenic, cadmium, nickel, and beryllium is not associated with significant non-cancer health effects because the maximum detected concentrations for these metals are below the ATSDR and/or EPA health guidelines.

Limitations

Quantitative evaluation of the risks to humans from environmental contamination is frequently limited by uncertainty (lack of knowledge) regarding a number of important exposure and toxicity factors. Some of the major uncertainties are briefly noted below.

- The 24-hour particulate samples considered in this health consultation were total suspended particulate matter filters collected and analyzed for metals on an every 6th day basis. No data are available for PM_{10} respirable size particles. This type of data is likely to result in the overestimation of risk. Furthermore, this data limits our ability to evaluate the effectiveness of new technologies as the elevated risks in the time period after the installation of the new EAF may be an artifact of the sampling, and not a true indication of increased risk.
- The fact that the monitoring location may detect emissions from sources other than Rocky Mountain Steel.
- The inability to realistically and continuously monitor ambient air at all places of interest and in the breathing zone of the exposed population.
- Potential health impacts associated with contaminant concentrations at these locations could over estimate the true risk since they may not reflect the actual long-term residential exposure concentration. Additionally, they could underestimate the true risk to people living near sources of high concentrations of contaminant emissions.
- Short-term acute and intermediate exposures to manganese cannot be evaluated because no health guidelines are available.
- The chromium cancer risk assessment is complicated by the fact that the concentration of hexavalent chromium (Cr VI), versus the less-toxic trivalent chromium (Cr III), is unknown. The Total Suspended Particulate matter sampler measures only total chromium (Cr VI plus Cr III), in ambient air, and no other facility or process data is available to help

6 Agency for Toxic Substances and Disease Registry (2008). *ToxFAQs for Manganese.* Available on the internet at: http://www.atsdr.cdc.gov/tfacts151.html, last accessed November 2009.

determine the relative concentrations of Cr VI and Cr III. Thus, cancer risk estimates for chromium may be over- or under-estimated, based on the assumption of a 1:6 ratio of chromium VI: chromium III.

Conclusions

Based on the review of the available ambient air data, CCPEHA and ATSDR conclude that currently it cannot be determined if breathing ambient air near RMSM is expected to harm people's health during both time periods considered here. The reason for this decision is that the data collected on site did not include data for respirable size particles (PM_{10}). Nonetheless, the conservative estimates of cancer risk and noncancer hazards, based on the total suspended particulate data, suggest the possibility of adverse health effects, indicating the need for more air monitoring and collection of PM_{10} data.

Recommendations

The following recommendations should be implemented in order to appropriately estimate public health hazards:

- RMSM should continue on-site monitoring by collecting respirable size PM_{10} data.
- Source sampling should be performed to attempt to address the issue of attribution.

Public health action plan

- Continue on-site monitoring with the collection of PM_{10} data.
- CCPEHA will evaluate any new PM_{10} data upon request.

Tables and Figures

Figure 1. Map Outlining Approximate Location of Rocky Mountain Steel Mills[7]

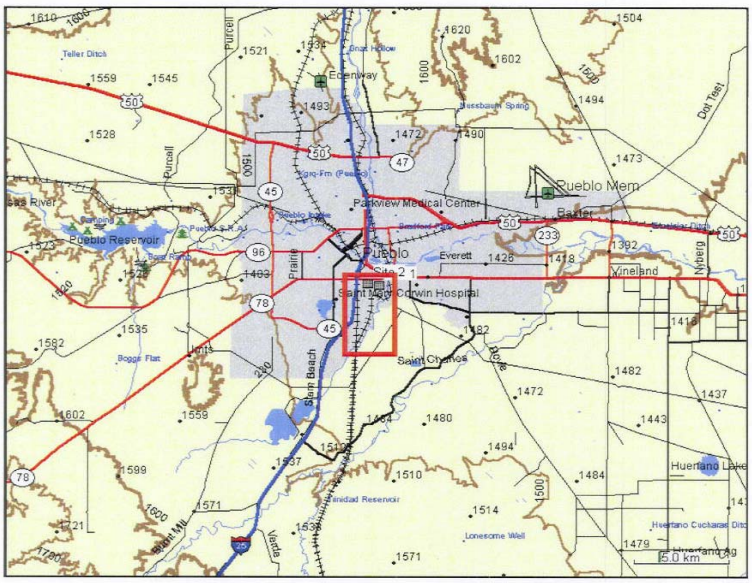

Figure 1-1. Project area in the southeast portion of Pueblo.

7 Air Resource Specialists, Inc. (2009). *Data Transmittal Report for the Rocky Mountain Steel Mills PSD Air Monitoring Program. March1, 2009- May 31, 2009.*

Figure 2. Map Outlining the Project Area and the Position of the Monitoring Site [8]

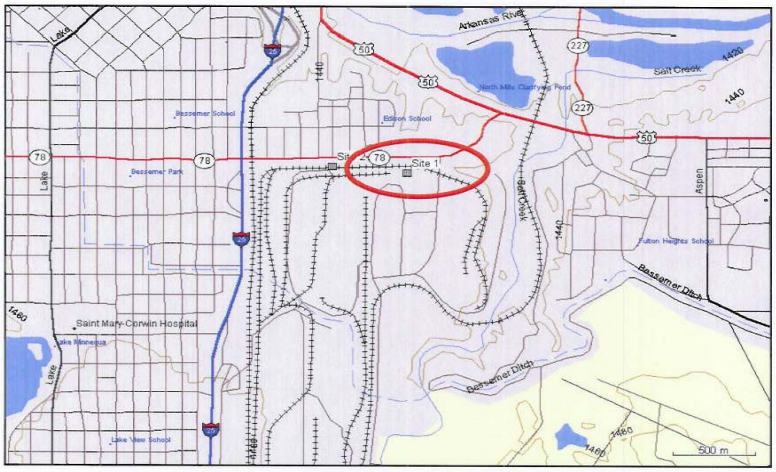

Figure 1-2. Project area showing the positions of monitoring Site 1.

8 Air Resource Specialists, Inc. (2009). *Data Transmittal Report for the Rocky Mountain Steel Mills PSD Air Monitoring Program. March1, 2009- May 31, 2009.*

Figure 3. Wind Rose showing Wind direction in the vicinity of Rocky Mountain Still Mills. Source: Data Transmittal Report for the Rocky Mountain Steel Mills PSD Air Monitoring Program, September - November 2009. Air Resource Specialists, Inc.

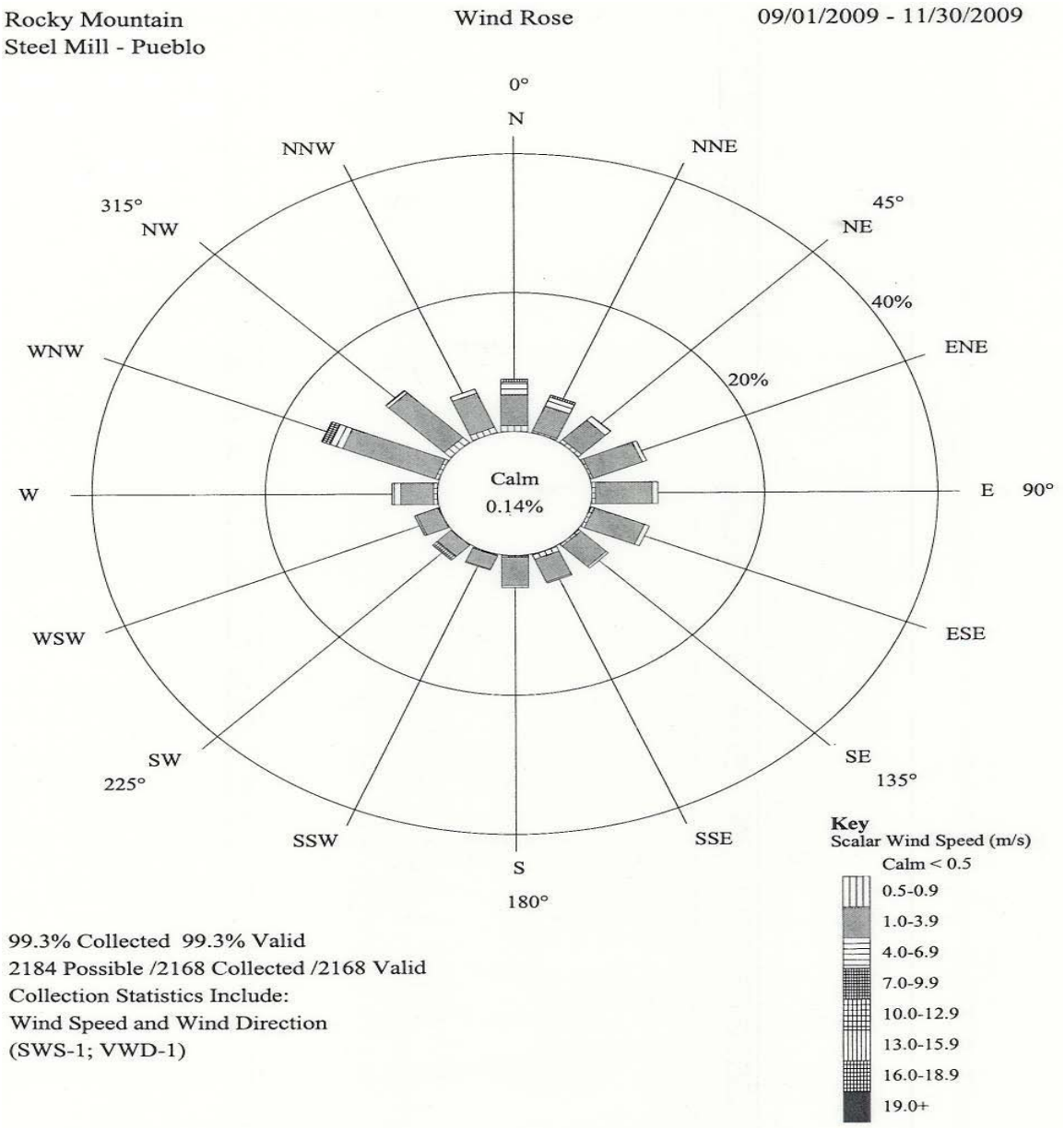

Figure 4. Google Earth Photograph of northern section of Rocky Mountain Steel Mills, showing surrounding residential and industrial land use.

Source: Google Earth, accessed February 10, 2010.

Table 1. Summary of Residential Air Data Collected at Rocky Mountain Steel Mills

Timeframe	Contaminant	Number of Samples	Minimum ($\mu g/m^3$)	Maximum ($\mu g/m^3$)	Mean ($\mu g/m^3$)	95% UCL ($\mu g/m^3$)
September 2002 – February 2006						
	Chromium	275	0.001	0.063	0.0152	0.018
	Manganese	275	0.009	1.011	0.227	0.245
	Nickel	149	0.001	0.041	0.0053	0.0070
	Arsenic	149	0.01	0.02	0.0144	0.015
	Cadmium	149	0.001	0.003	0.00152	0.0016
March 2006 – February 2009						
	Chromium	180	0.0014	0.106	0.0297	0.032
	Manganese	180	0.0549	1.477	0.355	0.384
	Nickel	180	0.0015	0.037	0.0082	0.0089
	Arsenic	55	0.001	0.0146	0.0029	0.0042
	Cadmium	180	.00016	0.0068	0.0017	0.0018
	Beryllium	176	0	.0009	.00019	0.00025

Note:

- $\mu g/m^3$ = Micrograms per Cubic Meter of Air
- UCL = Upper Confidence Limit
- Beryllium monitoring was not required prior to March 2006
- Significant figures in the tables are determined by the sample detection limits, which improved (got lower) over time.

Table 2. Selection of Chemicals of Potential Concern (COPCs) in Residential Air at Rocky Mountain Steel Mills

Compound	Max Value (09/2002 – 02/2006) (µg/m^3)	Max Value (03/2006 – 02/2009) (µg/m^3)	ATSDR Comparison Value Chronic CREG/EMEG (µg/m^3)	EPA Regional Screening Level (µg/m^3)	Selected COPCs (09/2002 – 02/2006)	Selected COPCs (03/2006 – 02/2009)
Chromium	0.063	0.106	N/A	0.000029	Y	Y
Manganese	1.011	1.477	0.04	0.052	Y	Y
Nickel	0.041	0.037	0.09	0.01	Y	Y
Arsenic	0.02	0.0146	0.0002	0.00057	Y	Y
Cadmium	0.003	0.0068	0.0006	0.0014	Y	Y
Beryllium	NA	.0009	0.0004	0.001	N	Y

Note:

- µg/m^3 = Micrograms per Cubic Meter of Air
- CREG = Cancer Risk Evaluation Guide
- EMEG = Environmental Media Evaluation Guide
- COPC = Contaminant of Potential Concern
- The Regional Screening Level is based on EPA methodology. Available at http://www.epa.gov/reg3hwmd/risk/human/rbconcentration_table/Generic_Tables/index.htm

Table 3. Theoretical Cancer Risks and Noncancer Hazards Using Risk-Based Concentrations in Outdoor Air

Timeframe	Contaminant	EPC (µg/m^3)	Cancer Risk	Noncancer HQ
September 2002 – February 2006				
	Chromium (as total chromium)	0.018	1.2E-04	N/A
	Manganese	0.245	N/A	4.9
	Nickel (as refinery dust)	0.0070	9.33E-07	0.08
	Arsenic	0.015	3.66E-05	1.00
	Cadmium	0.0016	1.62E-06	0.15
	Cumulative Cancer Risk		1.59E-04	
Timeframe	**Contaminant**	**EPC (µg/m^3)**	**Cancer Risk**	**Noncancer HQ**
March 2006 – February 2009				
	Chromium (as total chromium)	0.032	2.14E-04	N/A
	Manganese	0.384		7.68
	Nickel (as refinery dust)	0.0089	1.19E-06	0.10
	Arsenic	0.0042	1.0E-05	0.28
	Cadmium	0.0018	1.82E-06	0.18
	Beryllium	.00025	3.33E-07	0.01
	Cumulative Cancer Risk		2.27E-04	

Note:

- µg/m^3 = Micrograms per Cubic Meter of Air
- EPC = Exposure Point Concentration (the 95% UCL)
- HQ = Hazard Quotient; here the noncancer hazard quotient was calculated by dividing the EPC with the health based guideline
  - Chromium (N/A) = no health guideline available
  - Manganese = EPA reference concentration of 0.05 µg/m^3
  - Nickel = ATSDR MRL of 0.09 µg/m^3
  - Arsenic = EPA reference concentration of 0.015 µg/m^3
  - Cadmium = EPA reference concentration of 0.01 µg/m^3
  - Beryllium = EPA reference concentration of 0.02 µg/m^3
- No health guideline was available for total chromium
- Theoretical Cancer Risk was calculated by estimating exposure dose for 30 years (age adjusted for child (6 years) and adult (24 years) and EPA's cancer slope factors for all metals:
  - Body weight (child = 15 kg: adult = 70 kg
  - Exposure duration child = 6 years; adult = 24 years
  - Exposure time = 24 hours/day
  - Exposure frequency = 365 days/year
  - Inhalation rate child= 12 m3/day; adult = 20 m3/day
  - Averaging time = 70 years
- Beryllium was not monitored prior to March 2006
- Manganese is not a carcinogen, so no cancer risk is calculated

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CERTIFICATION

This Letter Health Consultation was prepared by the Colorado Department of Public Health and Environment 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. Editorial review was completed by the Cooperative Agreement partner.

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

Alan Yarbrough
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CAT, CAPEB, DHAC, ATSDR