

Assessing the Public Health Implications of the Criteria (NAAQS) Air Pollutants and Hydrogen Sulfide

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U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Report Release Timeline

Spring 2012

- **HC 1: Assess the Adequacy of the Ambient Air Monitoring Database to Assess the Potential for Health Effects**

Fall 2012

- **HC 2: Assess the Public Health Implications of Exposure to Criteria Air Pollutants and Hydrogen Sulfide**

Spring/
Summer 2013

- **HC 3: Assess Exposures to Organic Compounds (VOC) and Inorganic Pollutants in Air**
- **HC 4: Review and Analyze Organic Compounds (VOC) and Inorganic Pollutants in Media Other than Air**
- **HC 5: Evaluate Health Outcome Data for the Midlothian Area**
- **HC 6: Evaluate Reported Animal Health Problems in the Midlothian Area**

HC 1: Assessing the Adequacy of the Ambient Air Monitoring Database for Evaluating Community Health Concerns

□ **Answers community questions**

- Are the air monitors in the right place?
- Are there “hot spots” in the community?
- Has monitoring been conducted for the right chemicals?
- Does monitoring every 6th day for 24 hours give adequate information?

□ **Status**

- Addressing public comments
- Preparing for peer review
- Expect final report late Spring 2013

HC 2: Assessing the Public Health Implications of the Criteria (NAAQS) Air Pollutants and Hydrogen Sulfide

❑ Human health issues

- Are harmful effects possible from past, current or possibly future exposures to NAAQS air pollutants and hydrogen sulfide?

❑ Based on conclusion(s)

- Make recommendations to prevent, reduce, or further characterize exposures
- Plan public health actions

HC 2: Overall ATSDR Conclusions

- ❑ Sulfur dioxide, lead, and long-term exposures to PM_{2.5} may have caused harmful effects in the past**
- ❑ Ozone and short-term exposures to PM_{2.5} may have caused harmful effects in both the past and present**
- ❑ Carbon monoxide, nitrogen dioxide, and hydrogen sulfide are not expected to cause harmful effects in the past or present**
- ❑ Due to a lack of data and information, ATSDR is uncertain about exposures to sulfur dioxide and PM_{2.5} downwind of Ash Grove and Holcim**
- ❑ Mostly below EPA standards in place at the time of sampling**

How did ATSDR reach conclusions?

- ❑ **Considered findings from HC 1**
- ❑ **Evaluated selected contaminants of concern**
- ❑ **Public health implication**
- ❑ **Community health concerns**
- ❑ **Determined recommendations and next steps**

Selecting Air Contaminants of Concern

- ❑ **Compared measured and estimated air levels to**
 - Health-based standards or guidelines
 - ATSDR, EPA, WHO, or TCEQ

- ❑ **Health comparison values designed to protect sensitive persons**
 - Persons with asthma
 - Children
 - Elderly

- ❑ **Evaluated public health implications for all contaminants of concern**

Evaluation of Carbon Monoxide Exposures

❑ Sources

- Incomplete burning of fuels
- Primary industrial sources
 - Holcim
 - Gerdau
 - TXI
 - Ash Grove

❑ Overall emissions decreased since 2008

❑ No air monitoring for carbon monoxide

❑ Air modeling used “worst case” conditions

- Used highest annual facility emissions
- Assumed highest emissions occurred at same time

Evaluation of Carbon Monoxide Exposures (cont.)

	Estimated Carbon Monoxide Level	EPA Standard/ WHO Guideline	How Much Below Standard or Guideline
1-Hour	0.85 ppm	35 ppm/26 ppm	30-41 times
8-Hour	0.55 ppm	9 ppm/9 ppm	16 times

- ❑ **1-hour estimated carbon monoxide levels below**
 - Background for Dallas-Fort Worth area (3 ppm)
 - Exposure to vehicle exhaust while driving (9-25 ppm)
- ❑ **No ATSDR Minimal Risk Level**
 - Estimated worst-case levels at low end of effect range (0.5-10 ppm)
- ❑ **Carbon monoxide released from four facilities is not contaminant of concern**

Evaluation of Nitrogen Dioxide Exposures

❑ Sources

- Combustion-related sources (mostly from mobile or industrial sources)

❑ Primary industrial sources in Midlothian

- Cement manufacturing facilities
- Minor contribution by Gerdau

❑ Overall emissions decreased since 2008

❑ Reliable continuous air monitoring data for 2000-2011

Evaluation of Nitrogen Dioxide Exposures (cont.)

	Range of Nitrogen Dioxide Levels	EPA Standard/ WHO Guideline	How Much Below Lowest Standard or Guideline
1-Hour	46.0-78.6 ppb	100 ppb/106 ppb	1.3- 2.2 times
Annual	4.5-10.9 ppb	53 ppb/21 ppb	2-5 times

- ❑ **Data available for several years when emissions were higher (2000-2008)**
- ❑ **No data downwind of Holcim and Ash Grove**
 - Cement Valley air data reasonable indicator of area exposures
- ❑ **Nitrogen dioxide released from facilities not contaminant of concern for years with available monitoring data**

Evaluation of Hydrogen Sulfide Exposures

❑ Sources

- Many natural and man-made sources
- Primary sources
 - Sewage treatment plants, pulp and paper, petroleum and food processing plants

❑ Cement and steel manufacturing facilities not considered major sources

❑ No reliable emissions data

❑ Reliable continuous monitoring data for 2000-2011

- Cedar Drive data or data for 1997-1999 not used due to quality issues

Evaluation of Hydrogen Sulfide Exposures (cont.)

	Range of Hydrogen Sulfide Levels	Standard or Guideline	How Much Below Lowest Standard or Guideline
1-Hour	2.7-10.1 ppb	70 ppb ATSDR 80 ppb TCEQ 106 ppb WHO	6.9- 26 times
Annual	0.13-0.6 ppb	1.4 ppb EPA	2.3-10.1 times

- ❑ **No downwind data from Holcim and Ash Grove**
 - Air data from Cement Valley reasonable indicator of area exposures
- ❑ **Hydrogen sulfide not contaminant of concern**

Evaluation of Sulfur Dioxide Exposures

❑ Sources

- Burning sulfur-containing fuels
- Metal smelting and other industrial processes
 - Cement and steel mills

❑ Primary industrial sources in Midlothian

- Cement manufacturing facilities major sources (about 98%)
- Gerdau contributes much less

❑ In general, emissions reduced since 2008

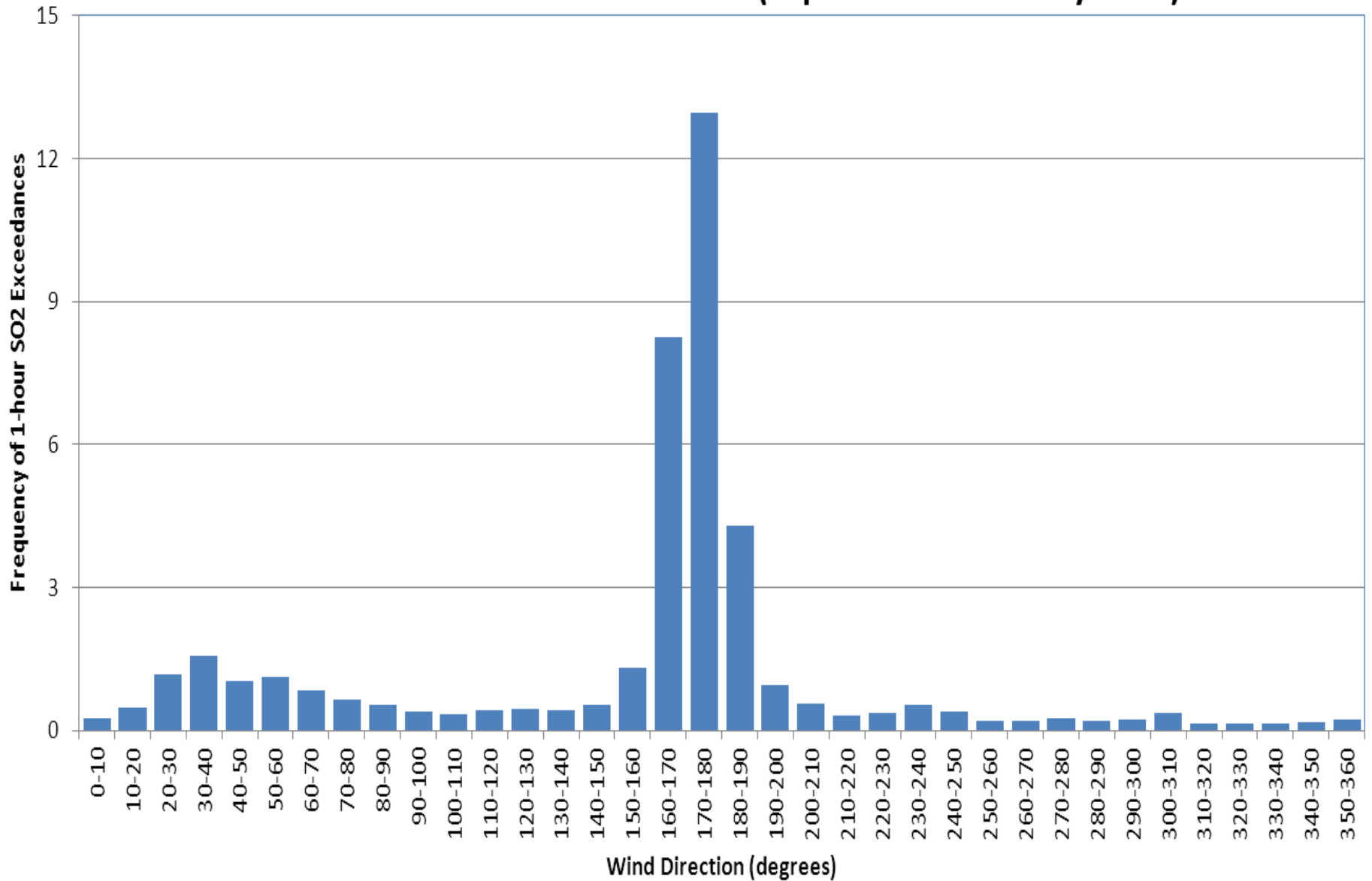
❑ Reliable continuous monitoring data for 1997-2011

Evaluation of Sulfur Dioxide Exposures (cont.)

Monitor	Timeframe	Number of Detections Above Current EPA 1-Hour Standard (75 ppb)
Old Fort Worth Road	1997-early 2008	312
Wyatt Road	2005-early 2006	6
Midlothian Tower	1997-2005	24
All Monitors	Since late 2008	0

- ❑ **All data show compliance with previous EPA standard (in place before 1-hour standard adopted in 2010)**
- ❑ **Before 2009, current standard exceeded often in Cement Valley**
- ❑ **No data downwind of Holcim and Ash Grove**
- ❑ **Sulfur dioxide is a past and possible current contaminant of concern**

Figure 9: Frequency of Sulfur Dioxide Exceedances by Wind Direction at the Old Fort Worth Road Monitor (September 1997- May 2009)



Sulfur Dioxide Health Evaluation

- ❑ **Primary concern**
 - Cement Valley
 - East and south of TXI fence line
- ❑ **Concern for sensitive populations (children, elderly, and asthmatics)**
- ❑ **Used 5-minute peak sulfur dioxide air data**
- ❑ **Based evaluation on human health studies**
- ❑ **Real-world conditions (colder and dryer air) may cause effects at lower levels**

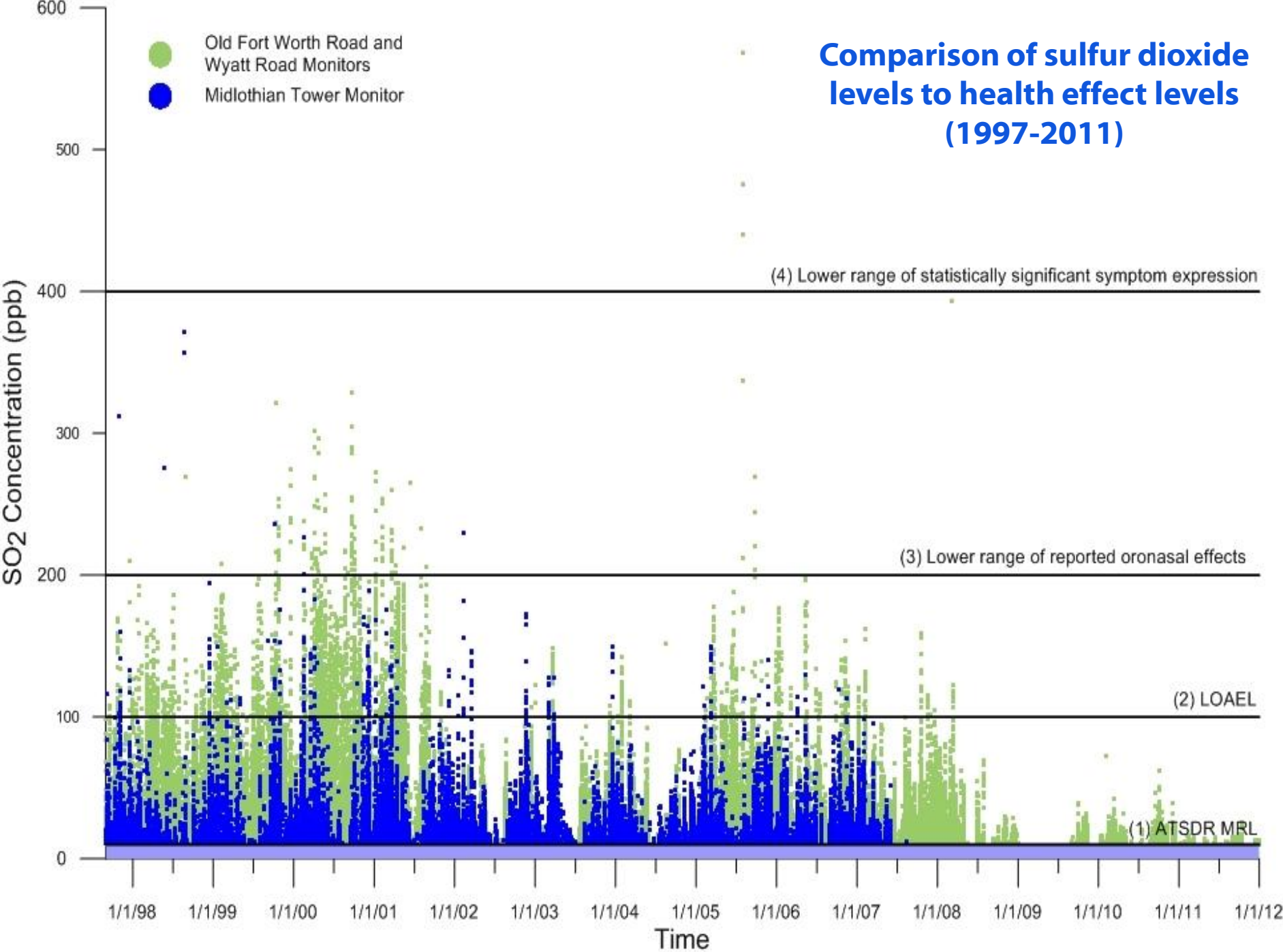
Sulfur Dioxide Health Evaluation

Public Health Implications

- ❑ **Exposures greater than 400 ppb**
 - Can cause symptoms of coughing, wheezing, or chest tightness in sensitive persons
- ❑ **Exposures between 200-400 ppb**
 - May not experience symptoms
- ❑ **Exposures between 100-200 ppb**
 - Effects in mild to moderate asthmatics seen in clinical studies as low as 100 ppb but somewhat uncertain
- ❑ **ATSDR Minimal Risk Level of 10 ppb**

Comparison of sulfur dioxide levels to health effect levels (1997-2011)

- Old Fort Worth Road and Wyatt Road Monitors
- Midlothian Tower Monitor



Evaluation of Ozone Exposures

- ❑ **Common gas in urban air (highest in summer afternoons)**
- ❑ **Sources**
 - Not directly released but formed from combination of NOX and VOCs from many industrial and motor vehicle sources plus sunlight
- ❑ **Regional air pollutant**
 - Not directly related to emissions from Midlothian
 - Emissions do contribute to ozone formation
- ❑ **Ellis County part of 11-counties in DFW area that are in non-attainment for past 20 years**
- ❑ **Reliable monitoring data from 1997-2011 for Old Fort Worth Road and Midlothian Tower**

Evaluation of Ozone Exposures (cont.)

Monitor	Timeframe	Maximum Value	Number of Detections Above Current EPA 8-Hour Standard (75 ppb)
Midlothian Tower	1997-2007	120 ppb	236
Old Fort Worth Road	2006-2011	96 ppb	

- ❑ **Levels at Midlothian Tower and Old Fort Worth Road indicative of exposures to all Midlothian residents**
- ❑ **ATSDR concludes ozone is contaminant of concern**

Ozone Health Evaluation Public Health Implications

- ❑ **Most levels detected are of concern for sensitive individuals**
- ❑ **Ozone can**
 - Reduce lung function
 - Increase respiratory symptoms (aggravate asthma)
 - Increase breathing discomfort
- ❑ **Recent information shows association with other outcomes such as risk for cardiovascular event**
- ❑ **Rarely, levels above 100 ppb may result in harmful effects in general public**

Evaluation of Particulate Matter (PM) Exposures

- ❑ **Tiny particles or droplets in air**
- ❑ **Many sources**
 - Wind-blown dust
 - Man-made sources
 - Smallest particles from combustion
- ❑ **Local and regional air pollutant**
 - Directly related to emissions from Midlothian
 - Other local and regional sources contribute
- ❑ **Monitoring and standards changed through the years (TSP to PM₁₀ to PM_{2.5})**
- ❑ **1981-2011: monitoring data from various locations**

Evaluation of Particulate Matter (PM) Exposures (cont.)

- ❑ **1981-1984: TSP data not used in exposure evaluation**
- ❑ **1991-2004: PM₁₀ monitored at 10 locations**
 - Data quality good
- ❑ **2000-2011: PM_{2.5} monitored at four locations**
 - Data quality generally good
 - May be negative bias with continuous monitors

Evaluation of PM₁₀ Exposures

Annual Average PM ₁₀ (µg/m ³)—1996 to 1998			
Monitor	1996	1997	1998
Gerdau Ameristeel	50.8	48.1	50.2
Old Fort Worth Road	20.9	19.9	24.9
Midlothian Tower	22.0	21.4	26.0
Tayman Drive Treatment Plant	21.9	No data	No data

- ❑ **1987-2006 : Former EPA annual average PM₁₀ standard (averaged over 3 years) was 50 µg/m³**
- ❑ **1996-1998: Annual average PM₁₀ levels at Gerdau Ameristeel monitor did not exceed former EPA standard**
- ❑ **1991-2004: No 24-hour PM₁₀ levels above EPA standard of 150 µg/m³**
- ❑ **ATSDR will further evaluate annual average PM₁₀ levels at Gerdau Ameristeel monitor as indicator of past long-term PM_{2.5} exposures**

Evaluation of PM_{2.5} Exposures

Annual Average PM_{2.5} (µg/m³)—2000-2011
(Current Standard = 15 µg/m³ since 1997)

Monitor	Time Period	Range	Above Proposed EPA Standard Range (12-13 µg/m ³)?
CAMS 302-Wyatt Road	2001-2005	10.2-11.9	No
Old Fort Worth Road	2006-2011	9.2-11.8	No
Gerdau Ameristeel	1996-1998	22.6-26.4 (est)	Yes, also above current EPA standard
Midlothian Tower	2000-2006	10.0-12.4	No
Holcim	2006-2009	10.2-11.8	No, but levels uncertain

- ❑ **All levels, except possibly at Gerdau Ameristeel, likely below current EPA standard**
- ❑ **No PM_{2.5} data downwind of Ash Grove (Holcim data uncertain)**
- ❑ **Levels downwind of TXI and Gerdau dropped after 2008**
- ❑ **24-hour standard not exceeded**
 - EPA Air Quality Index indicates problem days
 - Further evaluated

PM_{2.5} Health Evaluation

Public Health Implications

- ❑ Heart and lung harmful effects associated with short- and long-term exposures to PM_{2.5}**
- ❑ Sensitive groups**
 - Infants
 - Persons over 65
 - Persons with pre-existing lung or heart disease (asthma and COPD)
- ❑ Studies show long-term effects possible in 11-15 µg/m³ range, especially to sensitive persons**
- ❑ Based on EPA's air quality index, infrequent exposure to elevated short-term levels could result in harmful lung or heart effects in sensitive persons**

Evaluation of Lead Exposures

❑ Sources

- Emitted from many man-made sources
 - Steel foundries (Gerdau Ameristeel)
 - Cement plants considered minor contributor

❑ **Gerdau Ameristeel emits about 80% of the lead**

- Past Gerdau lead emissions higher

❑ **Lead in air measured for over 30 years at 16 different locations**

❑ **Current EPA standard 1/10th former standard**

Evaluation of Lead Exposures (cont.)

□ 1980's

- City Hall monitor not good indicator of emissions from cement and steel facilities
- Likely from mobile sources

□ 1990's

- Levels at Gerdau
 - Below former standard of $1.5 \mu\text{g}/\text{m}^3$ (in place 1978-2008)
 - Above current standard of $0.15 \mu\text{g}/\text{m}^3$ (in place since 2008)

□ 2000's

- No levels above current standard

Evaluation of Lead Exposures (cont.)

Monitor	Timeframe	Highest Quarterly Average ($\mu\text{g}/\text{m}^3$)	Current EPA Standard
Gerdau Ameristeel	1993-1998	0.443	0.15 $\mu\text{g}/\text{m}^3$

- ❑ Annual average values ranged from 0.176-0.251 $\mu\text{g}/\text{m}^3$
- ❑ Levels below former standard of 1.5 $\mu\text{g}/\text{m}^3$ (in place 1978-2008)
- ❑ ATSDR concludes lead is a past contaminant of concern

Lead Health Evaluation Public Health Implications

- ❑ Current EPA standard developed to protect against 1-2 point IQ drop in young children**
- ❑ Evaluated using former CDC childhood blood lead level of concern (10 µg/dL) and new reference value (5 µg/dL)**
- ❑ Model did not predict problem at former CDC level but did indicate possible concern using new value**
- ❑ Past air exposures (1993-1998) in localized area of Cement Valley may have resulted in 1-2 point IQ drop**
- ❑ Uncertainty in findings**
- ❑ Lead levels in Cement Valley dropped since early 2000s**

Mixtures Health Evaluation

Public Health Implications

- ❑ **Single air pollutant exposures compared to real-world multiple air pollutant exposures**
- ❑ **Many data gaps in knowledge of mixtures**
- ❑ **Focus on co-exposures to SO₂, ozone and PM_{2.5}**
- ❑ **Past exposures greatest concern**
 - In late afternoon/early evening
 - From late spring to early fall
- ❑ **Greatest co-exposure concern for Cement Valley residents in past**

Mixtures Health Evaluation Public Health Implications

- ❑ **Population of greatest concern for mixture effects is sensitive persons especially while exercising**
- ❑ **Not enough scientific information to allow for definitive evaluation**
 - **Mixtures conclusion based on ATSDR's best professional judgment**
- ❑ **ATSDR believes effects not likely to be greater than those discussed for individual air pollutants**
- ❑ **Mixtures exposures could increase number of affected sensitive persons due to increased sensitivity at lower sulfur dioxide levels**

Community Health Concerns Evaluation

- ❑ **Evaluated community health concerns related to air pollutant exposures**

- ❑ **Concerns**
 - Protectiveness of regulatory health-based screening guidelines
 - Health effects of mixtures
 - Impact on pregnant women, infants, children, elderly, and immune-suppressed
 - Confounding circumstances such as Ellis County being an EPA non-attainment area for ozone

Community Health Concerns Evaluation (cont.)

□ Concerns

- Health effects of air quality
 - Are there air quality issues in Midlothian?
- Strong smell in air
 - Rotten egg odor around sunset
- Transportation contributions to air quality problems
- Need to address cement kiln dust
 - Cars dusty all the time (thick, white dust)
- Concern for specific health effects
 - Allergies
 - Autoimmune disease
 - Cancer
 - Respiratory disease
 - Sinus problems

Sulfur Dioxide Exposures

□ Conclusions

- 1997-late 2008: Breathing air contaminated with sulfur dioxide for short periods could have harmed the health of sensitive persons
- 1997-late 2008: Sulfur dioxide concentrations in air were below levels expected to harm the health of general population
- Since late 2008 reductions in sulfur dioxide in Cement Valley have occurred
 - Exposures are **not** expected to be harmful to sensitive persons or general public
- Due to lack of data, ATSDR cannot determine if harmful exposures to sulfur dioxide occurred downwind of Holcim and Ash Grove facilities

□ Recommendations

- TCEQ should consider
 - Evaluating and reducing future potential sulfur dioxide emission from TXI to prevent harmful exposures
 - Conducting ambient air monitoring downwind of Ash Grove and Holcim and take action if needed to reduce exposures

Fine Particulate Matter (PM_{2.5}) Exposures

□ Conclusions

- Local and regional air quality issue
- Breathing air contaminated with PM_{2.5} downwind of TXI and Gerdau Ameristeel for 1 year or more is **not likely** to have harmed people's health
 - Except for localized area just north of the Gerdau Ameristeel fence line 1996-1998
- Although relatively infrequent, short-term elevations of PM_{2.5}, based on AQI, could result in harmful cardiopulmonary effects, especially in sensitive persons
- ATSDR is uncertain whether harmful exposures have been occurring downwind of Ash Grove and Holcim

□ Recommendations

- Evaluate and reduce, as needed, particulate matter exposures

Ozone Exposures

□ Conclusions

- Many ozone levels detected since monitoring began in 1997 indicate that sensitive persons have increased likelihood of experiencing harmful respiratory effects
 - Respiratory symptoms
 - Breathing discomfort
- Active children and adults and people with respiratory diseases at greater risk
- General population **not** expected to experience harmful effects from ozone exposure except on rare occasions when ozone levels reach around 100 ppb or more

Mixtures Exposures

□ Conclusions

- Sufficient information to warrant concern for sensitive persons exposed to multiple air pollutants
 - 1997-late 2008: When sulfur dioxide levels were higher
 - When breathing at higher rates (e.g., while exercising)
- Severity of health effects from a mixture exposure **not** likely to exceed those for sulfur dioxide, PM_{2.5}, or ozone exposure alone
- For past sulfur dioxide exposures, more sensitive persons may have been affected because of possible combined exposure to sulfur dioxide and ozone, PM_{2.5}, or both

□ Recommendations

- TCEQ should consider
 - Evaluating and reducing current PM_{2.5} and sulfur dioxide exposures from local and regional sources, as needed
 - Continuing efforts to reduce regional ozone exposures

Lead Exposures

❑ Conclusions

- 1993-1998: Exposures to lead in air just north of the Gerdau Ameristeel fence line could have harmed the health of children who lived or frequently played there
- Estimated health effect would have been a slight lowering of IQ levels (1-2 points) for some children living there
 - Since 1998, air lead levels in Cement Valley have dropped below EPA standard
- Monitoring data do **not** indicate lead levels in air, related to Gerdau Ameristeel, exceeded EPA's current standard in other areas of Midlothian

❑ Further evaluation planned

Carbon Monoxide, Nitrogen Dioxide, and Hydrogen Sulfide Exposures

□ Conclusions

- ATSDR does **not** expect harmful effects from current or past exposures
- Levels are below health-protective comparison values developed by EPA, WHO, or ATSDR

Public Health Actions

- ❑ **ATSDR and Texas Department of State Health Services**
 - Distribute health education material related to sulfur dioxide, PM_{2.5}, and ozone exposures
 - Susceptible and potentially susceptible populations
 - Information on health effects and ways to minimize harmful exposures to air pollution
 - Provide educational material to health professionals on air pollution and patient health

Public Health Actions (cont.)

- ❑ **ATSDR and Texas Department of State Health Services**
 - Work with TCEQ
 - Address health consultation recommendations
 - Evaluate additional recommendation-related data that become available
 - Issue two Health Consultations that further evaluate cement kiln dust
 - Evaluate chemical makeup of cement kiln dust and whether those pose health hazard via dust inhalation
 - Consider extent to which cement kiln dust has contaminated soils and water ways through atmospheric deposition

Questions

For more information please contact Agency for Toxic Substances and Disease Registry

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.



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