Health Consultation

Midlothian Area Air Quality, Part 1:
Volatile Organic Compounds & Metals
Midlothian, Ellis County, Texas

Executive Summary

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Prepared by

Texas Department of State Health Services
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

Executive Summary

Residents of Midlothian, Texas, petitioned the Agency for Toxic Substances and Disease Registry (ATSDR) and the Texas Department of State Health Services (DSHS) to more fully characterize the emissions from multiple large industries in the area and evaluate potential health risks resulting from individual and aggregate chemical exposures.

In this initial health consultation we primarily address the various air contaminants identified from ambient air samples collected by the Texas Commission on Environmental Quality (TCEQ) in the Midlothian area (usually every 6 days) from May 1981 through March 2005. The 227 contaminants that we reviewed in this report include 119 volatile organic compounds (VOCs) and 108 metals and other inorganic substances present in particulate matter.

The ambient air data that were collected on an hourly basis for sulfur dioxide, hydrogen sulfide, nitric oxide, nitrogen dioxide, nitrogen oxides, ozone, and particulates under the U.S. Environmental Protection Agency's (EPA's) National Ambient Air Quality Standards (NAAQS) are being evaluated and will presented in a separate health consultation.

Response to Petitioner and Community Health Concerns

The 4 different lists (A, B, C, & D) of petitioner and community concerns are given in Appendix B. Each list contains from 4 to 8 individual (numbered) concerns. Responses to one or more of these concerns are addressed in the paragraphs below (identified by the list letter and concern number, e.g. C.3. refers to list C, concern number 3).

A.1. While it is true that "all the chemicals being released from cement kilns and steel mills have not been fully identified," this health consultation has evaluated 237 individual contaminants including 119 VOCs and 108 metals and other inorganic substances.

A.2. It is also true that "All the chemicals currently being incinerated and released have not been tested for carcinogenicity and endocrine disrupting potential." However, based on historical reviews of cancer incidence and/or mortality rates in Midlothian and Ellis County, no individual or aggregate cancer rates were significantly elevated with respect to the rest of the state.

A.4., C.3., & D.3. The community was concerned about the health effects of dioxins, metals, and mixtures of compounds. Air data for dioxins are not routinely collected in Texas; therefore it was not possible to evaluate the potential adverse health effects associated with these compounds. We evaluated available VOCs and metals air contaminant data with respect to its potential for causing adverse health effects in humans due to acute, intermediate, and/or chronic exposures. Only manganese exceeded its health based screening value for chronic inhalation exposures. However, based upon a review of the toxicological data, we would not expect to see adverse health effects due to either long-term or short-term exposure to manganese. Mixtures of compounds also were evaluated in this consultation. Long-term aggregate exposures to air contaminants in Midlothian are not expected to result in adverse non-cancer or cancer health effects.

A.5., A.7., & C.1. In this health consultation, DSHS has analyzed each and every individual air sampling result collected from all TCEQ sampling locations in the Midlothian area and has not relied on any TCEQ-summarized data. Also, DSHS has not relied on any of the TCEQ's effects screening levels (ESLs) for determining potential health risks associated with exposures to airborne contaminants in Midlothian.

A.6. & D.4. The community was concerned that the potential for adverse health effects may be underestimated due to averaging of contaminant data over time. The initial screening of the air data involved comparing the maximum concentration for each contaminant to its most conservative health-based screening value. Contaminants whose maximum concentrations exceeded the most conservative health-based screening value were evaluated for acute, intermediate, and long-term exposures. None of the compounds examined (with the exception of benzene) had a single 24-hour measurement that exceeded its acute exposure guideline. The acute inhalation MRL for benzene was exceeded 3 isolated times in 13 years. Consequently, after reviewing all of the available data (which includes 94,932 individual 24-hour measurements), we find no evidence to suggest that adverse health effects would be anticipated as a result of any of the short-term or peak exposures to VOCs or Metals. The potential for adverse health effects due to exposure to EPA's NAAQS compounds will be evaluated in a future health consultation.

A.8., B.4., C.4., & D.1. The community was concerned about asthma, allergies, immune system deficiencies, and other health problems in adults as well as children. Data for these health problems are not routinely collected in Texas. Therefore, we were not able to systematically assess whether the levels of these conditions in Midlothian are different than in other areas of the state.

B.1., B.2., & D.2. Over the years, the Texas Cancer Registry and Texas Birth Defects Registry have conducted incidence, mortality, and prevalence investigations to determine if cancer and birth defect rates were higher or lower in the Midlothian area compared to the rest of the state (Appendix D). No statistically significant elevations of specific or total cancers were found. The prevalences for a few birth defects were higher than expected and for a few other birth defects were lower than expected based on state rates. These higher prevalence rates were not unique to Midlothian/Ellis County but were also observed throughout Health Service Region 3 (which includes 18 other counties primarily north and west of Ellis County). Because of the numerous factors involved, it is not possible to determine if these increases are due to environmental exposures or differences in reporting practices in this region compared with the rest of the state. Furthermore, it should be noted that only 3 of the 99 compounds with health based comparison values (i.e., ethylbenzene, 2-butanone, and methyl isobutyl ketone) listed "developmental effects" as the critical effect (i.e., the first observable physiological or adverse health effect occurring at the lowest exposure dose known to produce any effect at all). Hazard quotients for those 3 compounds were 0.000352, 0.0000653, and 0.00000793 respectively, levels that are far below levels that might be expected to result in an increased risk for birth defects.

B.3. It has been suggested that the Down syndrome cluster reported in Ellis, Hood, and Somervell Counties in 1991-1994 may have been related to a cesium-137 source melt that occurred at Chaparral Steel on September 16, 1993. This might seem plausible in

that one of the risk factors for Down syndrome is exposure of the mother or the father to excessive radiation prior to conception of the child. However, the time line is not right for this to have been a possibility, because the non-disjunction of chromosome 21 that results in the manifestations of Down syndrome would have had to have occurred **prior** to the date of the cesium-137 source melt for 15 out of 18 of the reported Down syndrome cases (based on the estimated date of conception for each of the children with Down syndrome). Also, analysis of the wind rose patterns for Midlothian during a similar time period to the cluster (i.e., 1992-94), revealed that the wind would have been blowing in the direction of one of the Down syndrome cases for less than 2% of the time during the 3-year period. Although the precise wind direction on the exact day of the source melt in not known, the predominant winds are out of the SSE during September, which would have been blowing toward none of the three Down syndrome cases whose estimated date of conception was after the cesium-137 source melt (two of these cases were from Granbury, which is approximately 44 miles west of Midlothian, and the other was from Palmer which is 21 miles ESE of Midlothian). And finally, although the exact quantity of radiation released is unknown, modeling of this release as though the entire source (approximately 89 millicuries of cesium-137) was vaporized and released into the air (and not caught in baghouse dust as most of it was), indicates that the additional radiation would not have been detectable above background radiation levels.

C.2. This concern turned out to be unfounded, in that all three CAMS monitoring locations have collected air sampling data on 97-99 of the 119 different VOCs, amounting to 60,396 individual contaminant measurements. The CAMS-94 location collected air sampling data on 52 metals or other inorganics present in $PM_{2.5}$ particulate matter amounting to 8,164 individual contaminant measurements, and the CAMS-302 location collected air sampling data on 24 metals or other inorganics present in PM_{10} particulate matter, amounting to 4,344 individual contaminant measurements. Only the CAMS-52 location collected no air samples for metals or other inorganics present in particulate matter. The confusion may have arisen because the CAM sites only collect data for the NAAQS compounds on a continuous basis (i.e., 24 one-hour-average levels per day). The other contaminants (VOCs and metals) are collected noncontinuously as one 24-hour-average level collected once every 6 days.

C.4. & D.5. Health problems reported in domesticated animals and livestock were shared with veterinarians at Texas A&M University. While DSHS does not have animal-species-specific health-based comparison values to evaluate the risks for health effects in animals, many of the health-based comparison values used in our evaluation of human exposures are derived from animal studies and consequently, we would expect these human HAC values to be equally conservative in protecting animal health for most common domestic and farm animals.

Past DSHS Health Data Reviews

This health consultation summarizes a number of previously published investigations by the DSHS Cancer Registry and the DSHS Birth Defects Registry into cancer incidence, cancer mortality, and birth defect prevalence rates in Midlothian, Ellis County, and Health Service Region 3 compared with Texas (see Appendix D).

The DSHS Cancer Registry has conducted 4 cancer incidence and/or mortality investigations for Midlothian and/or Ellis County from November 1995 through May 2005. Prostate cancer mortality rates were significantly lower in Midlothian compared with Texas and prostate cancer incidence rates were significantly lower in Venus compared with Texas. None of the Midlothian or Ellis County cancer rates (including leukemia, colon, pancreas, lung, trachea, prostate, breast, brain, liver, bladder, uterus, non-Hodgkin's lymphoma, larynx, total childhood cancers, and total cancers) were reported to be significantly higher than the state as a whole.

Maternal age- and race/ethnicity-adjusted prevalence rates for total birth defects and for hypospadias/epispadias in Midlothian were significantly elevated with respect to Texas. Similarly adjusted prevalence rates for total birth defects and for craniosynostosis were significantly elevated in Ellis County with respect to Texas. Similarly adjusted prevalence rates for total birth defects, craniosynostosis, microcephaly, hypospadias/epispadias, and obstructive genitourinary defects were significantly elevated in Health Service Region 3 with respect to Texas. Similarly adjusted prevalence rates for pyloric stenosis were significantly lower in Health Service Region 3 than in Texas as a whole.

General Findings

1. One hundred thirteen contaminants (47 VOCs and 66 metals or other inorganic compounds) had no levels exceeding the most conservative HAC value (or had no reported levels above the detection limit). No known health effects are associated with exposure to these contaminants at the concentrations measured in Midlothian; therefore, exposure to these contaminants would not be expected to result in adverse health effects.
2. Health based screening values were not available for 87 contaminants (59 VOCs and 28 metals or other inorganic compounds). Additional information is needed to determine the public health significance of these contaminants.
3. Thirteen VOCs had one or more measured level above the most protective health-based screening value. Three of the VOCs (1,1,2-trimethylbenzene; 1,3,5-trimethylbenzene; and m- and p- xylene) had one or more level above the most conservative contaminant-specific <u>non-cancer</u> screening value. Ten of the VOCs (benzene; 1,3-butadiene; carbon tetrachloride; chloroform; 1,2,-dibromoethane; 1,2-dichloroethane; methylene chloride; 1,1,2,2-tetrachloroethane; 1,1,2-trichloroethane; and vinyl chloride) had one or more level above the most conservative contaminant-specific <u>cancer</u> screening value.
4. Fourteen metals or other inorganic compounds had one or more measured level above the most protective health-based screening value. Four of the metals or other inorganic compounds [chlorine ($PM_{2.5}$), lead (TSP), manganese (TSP), and manganese (PM_{10})] had one or more level above the most conservative contaminant-specific <u>non-cancer</u> screening value. Ten metals [arsenic (PM_{10}), arsenic $PM_{2.5}$), arsenic (TSP), beryllium (PM_{10}), cadmium (PM_{10}), cadmium ($PM_{2.5}$), cadmium (TSP), chromium (PM_{10}), chromium ($PM_{2.5}$), and chromium (TSP)] had one or more level above the most conservative contaminant-specific <u>cancer</u> screening value.

Background Comparisons

1. Five out of 47 VOCs and 11 out of 66 metals or other inorganics that were below health-based screening levels nevertheless slightly exceeded average background levels (levels obtained from other areas in Texas and/or the US).
2. Sixteen out of 59 VOCs and 2 out of 28 metals or other inorganic compounds for which HAC values were not available had average levels slightly above average background.
3. All 13 VOCs having one or more level exceeding its minimum HAC value nevertheless had average levels that were below average background.
4. Seven out of 14 metals having one or more level exceeding its minimum HAC value [arsenic (PM_{10}), beryllium (PM_{10}), cadmium (PM_{10}), chromium (PM_{10}), lead (TSP), manganese (TSP), and manganese (PM_{10})] had average levels that also were above average background.

Individual Contaminants – Non-Cancer Health Effects Evaluation

Using reasonable maximum exposure scenarios, only manganese (both as PM_{10} and as TSP) exceeded ATSDR's chronic inhalation MRL by a small margin. After an in-depth review of the toxicological information and the uncertainty factors used in deriving the chronic inhalation MRL, we concluded that it is highly unlikely that the manganese levels seen in Midlothian would result in any observable adverse health effects, even after long-term exposure.

Individual Contaminants – Cancer Health Effects Evaluation

Exposures Prior to 1982:

Based on ambient air samples collected prior to calendar year 1982, the estimated excess lifetime cancer risks associated with reasonable maximal exposure to arsenic (TSP), cadmium (TSP), and chromium (TSP) ranged from 5.38×10^{-5} (a total of 1 excess cancer in 18,597 people exposed for 70 years) to 9.30×10^{-5} (a total of 1 excess cancer in 10,748 people exposed for 70 years). If these exposures were to continue for 70 years, they would pose a low increased lifetime risk for cancer and would not be expected to result in measurable harmful health effects. Past exposures to these compounds (prior to 1982) therefore posed "no apparent public health hazard."

Exposures 1993 through 2005:

1. The estimated lifetime cancer risks associated with reasonable maximal exposure to arsenic (PM_{10}), chromium (PM_{10}), and chromium ($PM_{2.5}$) ranged from 1.68×10^{-5} (a total of 1 excess cancer in 59,689 people exposed for 70 years) to 6.8×10^{-5} (a total of 1 excess cancer in 14,714 people exposed for 70 years). Based on available information, we have concluded that exposures to these contaminants pose a low increased lifetime risk for cancer and would not be expected to result in measurable harmful health effects.
2. The estimated lifetime cancer risks associated with reasonable maximal exposure to benzene, carbon tetrachloride, 1,2-dibromoethane, arsenic ($PM_{2.5}$), beryllium (PM_{10}), cadmium (PM_{10}), and cadmium ($PM_{2.5}$) ranged from 1.2×10^{-6} (a total of 1

excess cancer in 833,333 people exposed for 70 years) to 9.66×10^{-6} (a total of 1 excess cancer in 103,548 people exposed for 70 years). Based on available information we have concluded that exposures to these contaminants pose no apparent increased lifetime risk for cancer and would not be expected to result in measurable harmful health effects.

3. The estimated lifetime cancer risks associated with reasonable maximal exposure to 1,3-butadiene, chloroform, 1,2-dichloroethane, methylene chloride, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, and vinyl chloride ranged from 5.06×10^{-8} (a total of 1 excess cancer in 19,751,644 people exposed for 70 years) to 8.47×10^{-7} (a total of 1 excess cancer in 1,180,057 people exposed for 70 years). Based on available information we have concluded that exposures to these contaminants pose no increased lifetime risk for cancer and would not be expected to result in measurable harmful health effects.

Aggregate Exposures – Non-Cancer Health Effects

Only one critical non-cancer effect had a HI greater than or equal to 1.0 – the HI for CNS/neurological effects. Although several compounds contributed to CNS/neurological effects, manganese (PM_{10}) contributed 96% of this result. The toxicological basis for the health-based criteria for manganese is based on a no-effects level that is over 2,100 times lower that the estimated reasonable maximal exposure estimates used in this analysis. Based on available information, long-term aggregate exposures to air contaminants in Midlothian would not be likely to result in CNS/neurological effects, either under current or anticipated future conditions.

Aggregate Exposures – Cancer Health Effects

Total cancers had a cumulative risk for aggregate exposures that exceeded 1×10^{-4} (i.e., exceeded a total of 1 excess cancer in 10,000 people exposed for 70 years). However, this cancer risk estimate is based on the assumption that all chromium (PM_{10}) present in the air is chromium(VI), an assumption that is inconsistent with information obtained from other areas of the state. Additional sampling is needed to determine the specific proportions of the major chromium oxidation states and to further refine the total cancer risk estimate.

Overall Conclusions

We found that the majority of the risks associated with exposure to the chemicals analyzed in this health consultation were low. However, we are classifying this site as an Indeterminate Public Health Hazard because further information is needed to fully characterize the extent of the public health hazard posed by air contaminants in Midlothian. This classification is based on the following facts:

1. Sixteen out of 59 VOCs and 2 out of 28 metals or other inorganic compounds for which health-based screening values were not available had average levels above average background (levels obtained from other areas in Texas and/or the U.S.). Additional information is needed to determine the public health significance of these contaminants.

2. While individual contaminants produced, at most, a low increased lifetime risk for cancer and no apparent public health hazard, under the aggregate exposure scenario, total excess lifetime cancer risk for all cancers combined could be interpreted as posing a public health hazard. However, this conclusion is based on the assumption that all the chromium detected in the air is of the most toxic form [i.e., chromium(VI)], an assumption that is inconsistent with information obtained from other areas of the state. The relative proportions of chromium(III) and chromium(VI) will need to be determined in order to accurately define the risk estimate for total cancer (all sites combined).
3. While this health consultation reviewed the majority of the contaminants measured in Midlothian air (119 VOCs and 108 metals and other inorganics), EPA's NAAQS compounds still need to be evaluated in a future consultation.
4. There are data gaps both in sampling locations and parameters of interest. No air data for the analysis of VOCs were collected prior to 1993. Air data for the analysis of metals and other inorganic compounds were collected at only one location from 1981 through 1984. No air data for these contaminants were collected prior to 1981 and none were collected between 1985 and 1992. For the time periods when air data does exist, data were collected from a limited number of monitoring stations and may not reflect conditions throughout the community. However, since the major monitoring locations were relatively close to one or more of the primary emission sources, we do not anticipate that air pollutant levels for much of the city would be too much higher than those observed.

Recommendations

We have made the following recommendations in response to these findings:

1. As resources allow, research the toxicology literature for contaminants measured in Midlothian air for which health-based screening values were not available, and determine the potential public health impact of exposures to these substances.
2. Collect additional ambient air samples from previously sampled locations to determine the specific distribution of chromium species and to refine the risk estimates for this contaminant.
3. Evaluate the levels of EPA's NAAQS compounds in the continuous air monitoring data.

Where possible identify and fill data gaps with additional data from TCEQ to identify any additional air contaminants that might need evaluation and/or sampling.

Actions Completed

1. Historically, the TCEQ has collected a vast amount of environmental data in Midlothian, Texas, including air monitoring samples, soil samples, vegetation samples, and others dating back to the early 1980's.
2. Earlier data were analyzed by the TCEQ using EPA methodology and TCEQ's screening levels [4, 10].

3. DSHS staff reviewed summarized monitoring data (1993 through 1995), attended numerous meetings with TCEQ staff and area residents, and distributed questionnaires to see if there were consistent reports of odors, or signs or symptoms of illnesses that might be related to environmental pollution.
4. The Texas Cancer Registry analyzed cancer morbidity and mortality data for Midlothian and Ellis County, looking for any significant increases in cancer rates in this area over the period 1993 through 2002.
5. The Texas Birth Defects Registry analyzed birth defect data for Midlothian, Ellis County, and Health Service Region 3, looking for any significant birth defect elevations during the period 1999 through 2003.
6. DSHS staff conducted site visits in 2005 to determine community concerns, as well as to gather information about the major industries in town. Data from the door-to-door survey (conducted in December 2005) and from mailers which were distributed to ascertain public health concerns were compiled and evaluated to determine additional community health concerns. These concerns were addressed in the "Response to Community Health Concerns" section of this document.
7. DSHS staff obtained detailed (not summarized) TCEQ air monitoring data from 1981 through 1984 and from January 1993 through March 2005 in an electronic format and created a database of monitoring results. With the completion of this health consultation, DSHS has analyzed this data for VOCs and metals or other inorganic compounds and compared these data to health-based screening levels published by ATSDR and EPA. A conservative exposure scenario was generated, and carcinogenic and non-carcinogenic risk estimates were calculated, assuming 70-year lifetime and/or chronic exposures at the reasonable maximal exposure levels seen in the Midlothian area.

Actions Under Way

Currently, DSHS staff are analyzing the hourly NAAQS data (sulfur dioxide, hydrogen sulfide, nitric oxide, nitrogen dioxide, nitrogen oxides, ozone, and particulates) and preparing a health consultation to address these compounds.

Actions Planned

1. DSHS and ATSDR will make this health consultation available to the public, local industries, the local government, and state and federal health/environmental agencies.
2. DSHS and ATSDR will continue to address the community's health concerns relating to air quality.
3. DSHS will discuss with ATSDR the possibility of researching the toxicology literature for contaminants measured in Midlothian air that were at levels above background and for which health-based screening values were not available.
4. DSHS will discuss with TCEQ the potential for determining the specific distribution of chromium species in Midlothian air.

5. DSHS will discuss with TCEQ the potential for identifying and filling data gaps and identifying any additional air contaminants that might need evaluation and/or sampling
6. DSHS will complete the analysis of the hourly NAAQS data.