October 25, 1995
AS-71

Critical Evaluation of the Potential Impact of Emissions From Midlothian Industries: A Summary Report

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Office of Air Quality/Toxicology and Risk Assessment Section
TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Critical Evaluation of the Potential Impact of Emissions From Midlothian Industries: A Summary Report

Prepared by
Toxicology and Risk Assessment Section
Office of Air Quality

AS-71
October 25, 1995

TNRCC

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EXECUTIVE SUMMARY

Midlothian, a community 30 miles to the south of the Dallas-Fort Worth metropolitan area, is home to 3 of the 11 cement companies and 1 of the 6 secondary steel mills in Texas. The use of waste-derived fuel by two of the cement companies has been the focus of intense public attention and has resulted in detailed regulatory scrutiny of the major industrial operations in Midlothian.

The cement manufacturing process involves mixing and heating limestone, clay and shale to produce clinker, which in turn is mixed with gypsum to form cement. The production of clinker is an extremely energy intensive process, largely due to the extremely high temperatures needed to bring about the reactions necessary to produce the clinker from the raw materials. These high temperatures, in conjunction with the relatively long residence time in the kilns, results in highly efficient combustion and destruction of organic compounds. Historically, cement kilns in Texas have used fossil fuels including coal, petroleum coke, and natural gas to meet their energy requirements. In the mid-1980's, North Texas Cement Company (NTCC) and Texas Industries (TXI) began using waste-derived fuel as a supplemental fuel. North Texas Cement Company burned waste-derived fuel from 1986 to April 1991, while TXI began using waste-derived fuel in 1987 and continues to the present. In addition, both Holnam Texas L.P. and NTCC are permitted to supplement their energy requirements with tire-derived fuel. Secondary steel mills produce steel products by melting scrap steel, such as that found in automobiles. The slag resulting from this process is in turn recycled to produce aggregate for construction.

In order to evaluate the potential impact of emissions from Midlothian industries on the surrounding community, the TNRCC initiated an intensive environmental monitoring program in January of 1991. Sampling of a variety of different matrices, including ambient air and soil, has continued to present The focus of the environmental monitoring program has been on those constituentswhich could potentially be emitted from the four major facilities of concern in the community. The likelihood that adverse health effects could occur in members of the general public, including sensitive subgroups such as children, the elderly, or those with existing respiratoryconditions, was determined by comparing measured concentrations of the various compounds to appropriate state and federal health-based guidance levels. The specific health-based guidance levels employed in evaluating the potential for adverse health effects included Effects Screening Levels (ESLs), National Ambient Air Quality Standards (NAAQS), Soil Screening Levels (SSLs), and state standards. In ddition, the TNRCC has conducted complex risk assessments designed to evaluate potential health risks resulting from the combustion of waste-derived fuels in area cement kilns. The risk assessments considered both direct exposures resulting from inhalation and indirect exposures resulting primarily from the consumption of locally-produced foods. Collectively, these efforts constitute the most intensive assessment of environmental quality, both in terms of the magnitude of the sampling regimen and expenditure of state resources, ever conducted by the State of Texas.

Ambient air samples have been collected using fixed and mobile monitoring techniques. In addition, in order to respond to specific complaints concerning odorous conditions and

respiratory discomfort, a number of event-triggered ambient air samples were collected by TNRCC Regional staff and private citizens. Employing fixed samplers in the community, the TNRCC has collected and analyzed more than 940 samples from 12 different sites for respirable particulate matter (PM_{10}), 188 samples from 5 different sites for respirable metals, more than 120 samples at one site immediately to the north of the steel company for total suspended particulate (TSP) lead, more than 135 samples at one site for volatile organic compounds, and since January of 1995 has collected continuous readings at two sites for sulfur dioxide and hydrogen sulfide. The TNRCC has also conducted four week-long, round-the-clock, intensive ambient air monitoring studies downwind of the industries using specially-equipped vehicles. During each of these trips TNRCC collected hundreds of ambient air samples for compounds of interest, including PM_{10}, respirable metals, volatile organic compounds, sulfur dioxide, hydrogen sulfide, and polycyclic aromatic hydrocarbons. In addition, approximately 20 event-triggered ambient air samples have been collected by TNRCC regional staff or by citizens provided with TNRCC equipment, and all have been analyzed for volatile organic compounds. The TNRCC has also reviewed the results of stack tests conducted to measure concentrations of polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs) emitted from the three cement facilities when burning fossil fuels, tire-derived fuel, and waste-derived fuel (WDF).

Four exhaustive soil studies, designed to provide data on the concentrations of heavy metals in area soils, have been conducted in the community. In the course of these four studies, a total of 175 soil samples were collected at 80 different sites in the Midlothian area. Soil samples were analyzed by the TNRCC for up to 18 different metals, including aluminum, antimony, arsenic, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, strontium, thallium, titanium, and zinc. In addition, a soil study was conducted in 1995 to determine the concentrations of PCDDs and PCDFs in the area. This study involved collecting a total of 60 soil samples at 60 different sites in the Midlothian area and analyzing the samples for each of the 2,3.7,8-substituted PCDD and PCDF congeners.

A number of other miscellaneous matrices were also sampled in the community, including hay, vegetation, wheat, and slag. These samples were all analyzed by the TNRCC for up to 18 different metals, including aluminum, antimony, arsenic, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, strontium, thallium, titanium, and zinc.

In order to specifically address concerns about potential health risks resulting from the combustion of waste-derived fuels (WDF), conservative screening level risk analyses were conducted for the two facilities which have bumed WDF. The exposure scenarios evaluated in the risk assessments included a resident, subsistence beef farmer, subsistence dairy farmer, and subsistence fisher. Both direct (inhalation) and indirect (ingestion of soil, vegetables, beef, milk, and fish) exposures were evaluated. A total of 57 different constituents, including dioxin, lead, mercury, arsenic, benzene, and vinyl chloride, were evaluated in the risk assessments.

Evaluation of the results of over a thousand samples collected indicate that exposure to the

monitored levels are not likely to result in adverse health effects. Further, where relevant comparison data were available, air and soil concentrations measured in Midlothian were found to be similar to those measured in other Texas communities and in local and national background samples. With respect to the risk assessments, all risks and hazard indices (cancer and non-cancer) estimated for the two facilities were below acceptable target risk levels. In addition, in accordance with USEPA guidance, the TNRCC employed more conservative target risk levels than what is traditionally used in order to account for background exposures (i.e., exposures from other sources not specifically evaluate'd in the risk assessment). Therefore, background exposures are also not expected to pose a health risk. Collectively, results of these evaluations indicate that adverse health effects are not expected to occur in area residents, including sensitive subgroups.

In addition, the Texas Department of Health is conducting an independent review of all of the TNRCC monitoring data. In a letter dated January 21, 1994 from David R. Smith, M.D., Commissioner of Health, to Anthony C. Grigsby, TNRCC Executive Director, the TDH stated the only constituents of concern were sulfur compounds. Environmental monitoring data gathered since the date of the letter from Dr. Smith is similar to that originally reviewed by the TDH and therefore, a similar conclusion is expected.

Finally, it is important to note that, due to permitting requirements unique to the State of Texas, the conclusions reached in this report regarding the impact of facility emissions on the surrounding community should not be construed to apply to other communities where cement manufacturing facilities or secondary steel mills are located. Such application of the results outlined in this report requires a detailed case-by-case review of the similarities in control technologies, permit requirements, individual plant operations, waste streams, siting requirements and other regulations.

TABLE OF CONTENTS

LIST OF TABLES. vii

LIST OF FIGURES viii

LIST OF APPENDICES ix
- Appendix A: Air Summary Data ix
- Appendix B: Soil Summary Data ix
- Appendix C: Miscellaneous Samples Summary Data ix
- Appendix D: Dioxin and Furan Stack Test Summary Data ix

LIST OF ACRONYMS x

DEFINITIONS. xii

1.0 INTRODUCTION 1
- 1.1 Background 1
- 1.2 Description of Midlothian Industry 2
  - 1.2.1 Chaparral Steel 2
  - 1.2.2 Holnam Texas L.P. (Formerly BoxCrow Cement) 2
  - 1.2.3 North Texas Cement Company (NTCC) 2
  - 1.2.4 Texas Industries, Inc. (TXI) 4
- 1.3 Regulatory Activities 4
  - 1.3.1 Air Permit History 4
    - 1.3.1.1 Chaparral Steel 4
    - 1.3.1.2 Holnam Texas L.P. (Formerly BoxCrow Cement) 5
    - 1.3.1.3 North Texas Cement Company (NTCC) 5
    - 1.3.1.4 Texas Industries, Inc. (TXI) 5
  - 1.3.2 Public Outreach 6

2.0 ENVIRONMENTAL MONITORING PROGRAM 6
- 2.1 Ambient Air 7
  - 2.1.1 Fixed Monitors 7
    - 2.1.1.1 Respirable Particulate (PM_{10}) 8
    - 2.1.1.2 PM_{10} Metals 11
    - 2.1.1.3 TSPLead 13
    - 2.1.1.4 Volatile Organic Compounds (VOCs) 17
    - 2.1.1.5 Sulfur Compounds 20
  - 2.1.2 Mobile Monitoring 22
  - 2.1.3 Event-Triggered Samples 25

2.2 Soil 26
2.2.1 Metals 26
2.2.1.1 Area-Wide Sampling 26
2.2.1.2 Chaparral Steel Special Study 31
2.2.2 Dioxins and Furans 34
2.3 Miscellaneous 35
2.3.1 Hay, Miscellaneous Vegetation, and Wheat 35
2.3.2 Slag 39
2.4 Dioxin and Furan Stack Sampling 40

3.0 CONSERVATIVE SCREENING LEVEL RISK ANALYSES 42
3.1 Background 42
3.2 Methodology 42
3.2.1 Chemicals of Concern 42
3.2.1.1 Chemicals of Concern for the Indirect Analysis 44
3.2.1.2 Chemicals of Concern for the Direct Analysis 44
3.2.2 Exposure Assessment 44
3.3 Results 47
3.3.1 North Texas Cement Co. (NTCC) 47
3.3.1.1 Results of Indirect Screening Analysis 47
3.3.1.2 Results of Direct Screening Analysis 47
3.3.2 Texas Industries, Inc. (TXI) 51
3.3.2.1 Results of Indirect Screening 51
3.3.2.2 Results of Direct Screening Analysis 51
3.3.2.3 Overall Results of Indirect and Direct Analyses 55
3.4 Conclusions 55

4.0 DISCUSSION 57

5.0 REFERENCES 62

APPENDIX A: AIR SUMMARY DATA

APPENDIX B: SOIL SUMMARY DATA

APPENDIX C: MISCELLANEOUS SAMPLES SUMMARY DATA

APPENDIX D: DIOXIN AND FURAN STACK TEST DATA

LIST OF TABLES

Table 2.1	Description of Fixed Samplers (Ambient Air)
Table 2.2	Mobile Monitoring Results
Table 2.3	Concentrations of DioxinslFurans in Midlothian Soils
Table 2.4	Facility-Specific 2,3,7,8-TCDD TEQ Concentrations Measured During Stack Tests
Table3.1	Chemicals of Concern
Table 3.2	Summary of Pathway Analysis by Scenario
Table 3.3	Summary of Indirect Cancer Risks and Non-Cancer Hazard Indices Estimated for NTCC
Table 3.4	Summary of Indirect Cancer Risks and Non-Cancer Hazard Indices Estimated for TXI
Table 3.5	Summary of Direct Cancer Risks and Non-Cancer Hazard Indices Estimated for TXI
Table 3.6	Summary of Overall (Indirect + Direct) Cancer Risks and Non-Cancer Hazard Indices Estimated for TXI

LIST OF FIGURES

Figure 1.1	Illustration of the Cement Production Process
Figure 2.1	Fixed Sampler Locations (Ambient Air)
Figure 2.2	Annual Average Ambient Air Concentrations of Respirable Particulates (PM_{10})
Figure 2.3	Maximum 24-hour Air Concentrations of Respirable Metals
Figure 2.4	1991 Annual Average Air Concentrations of Respirable Metals
Figure 2.5	Ambient Air: Concentrations of TSP Lead (Location: Highway 67)
Figure 2.6	Maximum 24-Hour Air Concentrations of VOCs (Location: Tayman Drive; Fresh Water Treatment Plant)
Figure 2.7	Distribution of 24-Hour Air Concentrations of Benzene (Location: Tayman Drive; Fresh Water Treatment Plant)
Figure 2.8	Annual Average Air Concentrations of Benzene in 11 Texas Cities
Figure 2.9	Mobile Monitoring Locations
Figure 2.10	Soil Sampling Sites for Metals
Figure 2.11	Maximum Metal Concentrations in Soils from 1991-1995
Figure 2.12	Distribution of Lead in Midlothian Soils
Figure 2.13	Sample Locations for Chaparral Steel Special Study
Figure 2.14	Metal Concentrations in Soils Near Chaparral Steel
Figure 2.15	Soil Sampling Sites for DioxinlFuran Study
Figure 3.1	Summary of Progressive Screening Approach
Figure 3.2	Conceptual Site Model: Indirect Exposure Pathways
Figure 3.3	North Texas Cement Company Modeled Receptor Locations
Figure 3.4	Texas Industries Modeled Receptor Locations

LIST OF APPENDICES

Appendix A: Air Summary Data

Table A.1	Ambient Air: PM_{10} Concentrations
Table A.2	Air Concentrations of Respirable Metals (Location: Waste Water Treatment Plant)
Table A.3	Air Concentrations of Respirable Metals (Location: 801 Auger Road)
Table A.4	Air Concentrations of Respirable Metals (Location: 3330 Cement Valley Road)
Table A.5	Air Concentrations of Respirable Metals (Location:Cedar Hill Fire Department)
Table A.6	Air Concentrations of Respirable Metals (Location: l120A Cedar Drive)
Table A.7	Ambient Air: Concentrations of TSP Lead (Location: Highway 67)
Table A.8	Maximum 24-Hour Air Concentrations of Volatile Organic Compounds (Location: Tayman Drive; Freshwater Treatment Plant)

Appendix B: Soil Summary Data

Table B.1	1991-1995 Metal Concentrations in Midlothian Soils
Table B.2	1995 Metal Concentrations in Midlothian Soils
Table B.3	Concentrations of Metals in Soil Samples Collected Near Chaparral Steel
Table B.4	2,3,7,8-TCDD TEQ Concentrations of Dioxins/Furans in Midlothian Soils

Appendix C: Miscellaneous Samples Summary Data

Table C.l	Metal Concentrations in Hay-Bale Samples Collected Near Chaparral Steel
Table C.2	Metal Concentrations in Miscellaneous Vegetation/Forage Samples Collected Near Chaparral Steel
Table C.3	Metal Concentrations in Wheat-Head Samples Collected Near Chaparral Steel

Appendix D: Dioxin and Furan Stack Test Summary Data

Table D.l	Polychlorinated Dioxin (PCDD) and Furan (PCDF) Emissions from NTCC
Table D.2	Polychlorinated Dioxin (PCDD) and Furan (PCDF) Emissions from TXI
Table D.3	Polychlorinated Dioxin (PCDD) and Furan (PCDF) Emissions from HolnamL.P.

LIST OF ACRONYMS

ATSDR	Agency for Toxic Substances and Disease Registry
CFR	Code of Federal Regulations
EMEG	Environmental Media Evaluation Guide
ESL	Effects Screening Level
H_2S	Hydrogen Sulfide
BEAST	Health Assessment Summary Tables
HpCDD	Heptachlorodibenzo-p-dioxin
HpCDF	Heptachlorodibenzofuran
HxCDD	Hexachlorodibenzo-p-dioxin
HxCDF	Hexachlorodibenzofuran
ICP	Inductively Coupled Plasma Spectroscopy
IRIS	Integrated Risk Information System
MDL	Method Detection Limit
MRL	Minimal Risk Level
MTL	Maximum Tolerable Level
NAAQS	National Ambient Air Quality Standard
ND	Not Detected
NSPS	New Source Performance Standard
NICC	North Texas Cement Company
OCDD	Octachlorodibenzo-p-dioxin
OCDF	Octachlorodibenzofuran
ORO	Office of Research and Development
OSWER	Office of Solid Waste and Emergency Response
PAHs	Polynuclear Aromatic Hydrocarbons
PCDD	Polychlorinated Dibenzo-p-dioxins
PCDF	Polychlorinated Dibenzofurans
PeCDD	Pentachlorodibenzo-p-dioxin
PeCDF	Pentachlorodibenzofuran
PPB	Parts Per Billion
PPM	Parts Per Million
PPI	Parts Per Trillion
PM_{10}	Particulate matter having an aerodynamic diameter 10 microns (µm) or less
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
RID	Reference Dose
RMEG	Reference Dose Media Evaluation Guide
$S0_2$	Sulfur Dioxide
SSL	Soil Screening Level
TACB	Texas Air Control Board
TCDD	Tetrachlorodibenzo-p-dioxin

TCDF	Tetrachlorodibenzofuran
TDF	Tire-Derived Fuel
TEF	Toxic Equivalency Factor
TEQ	Toxicity Equivalent Quotient
TNRCC	Texas Natural Resource Conservation Commission
TSP	Total Suspended Particulate
TXI	Texas Industries Inc.
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOCs	Volatile Organic Compounds
WDF	Waste-Derived Fuel

DEFINITIONS

Direct Exposure	Direct exposure is defined as exposure resulting from direct inhalation of the constituents of concern.
ESL	Effects screening levels (ESLs) are guideline concentrations used to evaluate ambient air concentrations of constituents, and are based on a chemical's potential to cause adverse health effects, odor nuisances, vegetation effects, or materials damage. Health-based ESLs are set at levels many times lower than levels reported to produce adverse health effects, and are set to protect the general public, including sensitive subgroups such as children, the elderly, or people with existing respiratory conditions. Adverse effects are not expected when the air concentration of a constituent is below the ESL. Air concentrations above the ESL are not necessarily indicative of adverse effects but rather suggest that further evaluation is warranted.
Hazard Index	The hazard index is equal to the sum of the hazard quotients.
Hazard Quotient	The quantitative measure used to describe the potential for noncarcinogenic toxicity to occur in an individual of the general public, including sensitive subgroups such as children, the elderly, or people with existing medical conditions. Hazard quotients are ratios of the estimated exposure level for a specified time period (e.g., lifetime) to a reference dose derived for a similar time period.
Indirect Exposure	Indirect exposure is defined as exposure resulting from the transfer of emitted chemicals to soil, vegetation, and water bodies. Humans can be "indirectly" exposed to the constituents in various media (i.e., multimedia) through ingestion of the media and/or ingestion of foods or animal products generated in the area.
Method Detection Limit (MDL)	The constituent concentration of a substance (an analyte) that can be measured and reported with a 99% confidence that the concentration is greater than zero and is determined from replicate analysis of a sample in a given matrix containing the analyte as described in 40 CFR (Code of Federal Regulations) Part 136 Appendix B (Modified National Environmental Laboratory Accreditation Conference [NELAC]/40 CFR Part 136 definition).
Odor Threshold	The concentration at which an odor can be discerned (but not specifically identified) by fifty percent of the population. Concentrations 3-5 times the odor threshold, if they occur frequently or are persistent, may result in nuisance conditions.
	Respirable particulate matter having an aerodynamic diameter of 10 microns (µm) or less.

Quantitative Risk Assessment	A quantitative risk assessment is an analysis of potential human health risks (current or future) that may be associated with modeled emissions from the facilities of concern. Risk assessments estimate the increased probability of developing cancer over a lifetime and, for non-cancer effects, compare predicted human intakes with levels determined to be safe.
Soil Screening Levels (SSL)	Soil Screening Levels (SSLs) ate guideline concentrations used for comparison with measured or modeled soil concentrations. The levels, established by the ATSDR or by TNRCC in accordance with ATSDR or USEPA methodology, are set to be protective of human exposures through the ingestion of soil particles. Exposures to soil containing concentrations below these SSL values are not expected to result in adverse health effects. Soil concentrations in excess of these screening levels only suggest the need for further evaluation of the potential for human exposure, are not necessarily indicative of a health concern.
Toxicity Equivalency Factors (TEFs)	Toxicity equivalency factors (TEFs) are factors used to express the concentrations of 2,3,7,8-substituted congeners as equivalent concentrations of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD).
Toxicity Equivalent Quotient (TEQ)	The toxicity equivalent (TEQ) concentration of a mixture is the sum of the weighted potency of each compound in the mixture.
Waste-Derived Fuel (WDF)	Waste-derived fuel (WDF) is a material that is burned for energy recovery and destruction.

1.0 INTRODUCTION

1.1 Background

Midlothian is a community of approximately 5100 people located 30 miles to the south of the Dallas-Fort Worth, Texas metropolitan area. The local economy consists of both agricultural and industrial enterprises. Major industries in the Midlothian area include three cement manufacturing companies (Holnam Texas L.P., North Texas Cement Company (NTCC), and Texas Industries, Inc. (TXI) and a secondary steel mill (Chaparral Steel). North Texas Cement Company and TXI have been in operation for 30-35 years, while Chaparral Steel and Holnam have been in operation for 20 and 10 years, respectively. Up until 1986, the kilns at NTCC and TXI were fired with natural gas, coal, or petroleum coke. In 1986, NTCC was issued a permit to supplement its fuel requirements with waste-derived fuel (WDF). North Texas Cement Company burned WDF until March, 1991. Waste-derived fuel was also burned at NTCC in November of 1991, June of 1992, and August of 1992 while conducting trial burns and certification of compliance tests under TACB rule 111.124 and USEPA Boiler and Industrial Furnace regulations. Texas Industries began using WDF in 1987 and continues to do so today. In addition, Holnam and NTCC are currently supplementing conventional fuels with tire-derived fuel (TDF). The use of WDF in the cement manufacturing process has been the focus of intense public attention and has resulted in detailed regulatory scrutiny of the major industrial operations in Midlothian.

In January of 1991, the Texas Air Control Board (a predecessor of Texas Natural Resource Conservation Commission, TNRCC) began an intensive environmental monitoring program in Midlothian, Texas. The primary focus of the environmental monitoring program in Midlothian has been to assess overall air quality in the area. As such, the monitoring program has included extensive sampling of ambient air for respirable particulate matter (PM_{10}), metals, sulfur compounds, volatile organics, and polycyclic aromatic hydrocarbons (PAHs). In addition, a number of special monitoring studies were conducted to specifically measure off-property air concentrations of constituents of concern downwind of the four primary Midlothian industries. In order to further address concerns about the impact of industrial operations on overall environmental quality in the community, soils in the area were sampled extensively and analyzed for up to 18 different metals, as well as for polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs). A series of hay, wheat, and vegetation samples were collected in the vicinity of Chaparral Steel in order to determine the potential impact of emissions from the facility on adjacent properties. Slag samples were analyzed for 13 different metals in order to address citizen concerns that slag used in area roads may pose a health risk. In addition, the TNRCC conducted facility-specific quantitative risk assessments designed to evaluate both direct and indirect routes of exposure to combustor emissions.

1.2 Description of Midlothian Industry

The major industries within the Midlothian area include Chaparral Steel, Holnam Texas L.P., North Texas Cement Company (NTCC), and Texas Industries, Inc. (TXI). Each of these facilities is briefly described below.

1.2.1 Chaparral Steel

Chaparral Steel is a secondary steel mill located in Ellis County, approximately 2.4 miles southwest of the city of Midlothian on Highway 67. The operation consists of a scrap yard, an automobile shredder, two 100 ton electric arc furnaces and three rolling mills (Bar Mill, Medium Section Mill and Large Section Mill). The production process involves melting scrap steel and casting into structural steel beams and reinforcing bars. Airemissionsfrom Chaparral Steel are controlled through the use of one positive and two negative pressure baghouses. The facility is permitted to produce 1.78 million tons of structural steel per year.

1.2.2 Rolam Texas L.P. (Formerly BoxCrow Cement)

The Holnam facility is located in Ellis County, approximately 2.5 miles north-northeast of the city of Midlothian on U.S. Highway 67. Portland cement is manufactured at this site via a dry process. The raw materials (limestone, shale, silica, and iron) are ground to form a raw mix. This mix is blended and transported to a 4-stage preheater/precalciner system. The calcined raw feed is then converted to clinker in the kiln and sent directly to a cooler. After it is cooled, the clinker is ground and mixed with gypsum to form Portland cement. The exhaust gases, which contain fine dust and products of combustion, pass through a fabric filter system (baghouse) for abatement and then are vented into the atmosphere via the kiln exhaust stack. The dust collected in the fabric filter system (termed cement kiln dust or CKD) is recycled, sold, or disposed of in an on-site landfill. Holnam is authorized to fire coal, natural gas and tire-derived fuel (TDF) to meet its energy requirements. The facility produces approximately 1,000,000 tons of portland cement annually.

1.2.3 North Texas Cement Company (NTCC)

The NTCC facility is located in Ellis County, approximately 2.5 miles north-northwest of the city of Midlothian and 1.5 miles west of U.S. Highway 67. Portland cement is manufactured at this site via a wet process (Figure 1.1). As with the dry process, the wet process begins with a raw mix of limestone, shale, silica, and iron. In the wet process, however, the mix is combined with water to form a slurry. This slurry is then pumped into one of six feed silos and then into the three kilns at the site. Clinker is formed in the kiln through successive steps of dehydration, calcination, and clinkerization. As in the dry process, the clinker is then cooled, ground, and mixed with gypsum to form Portland

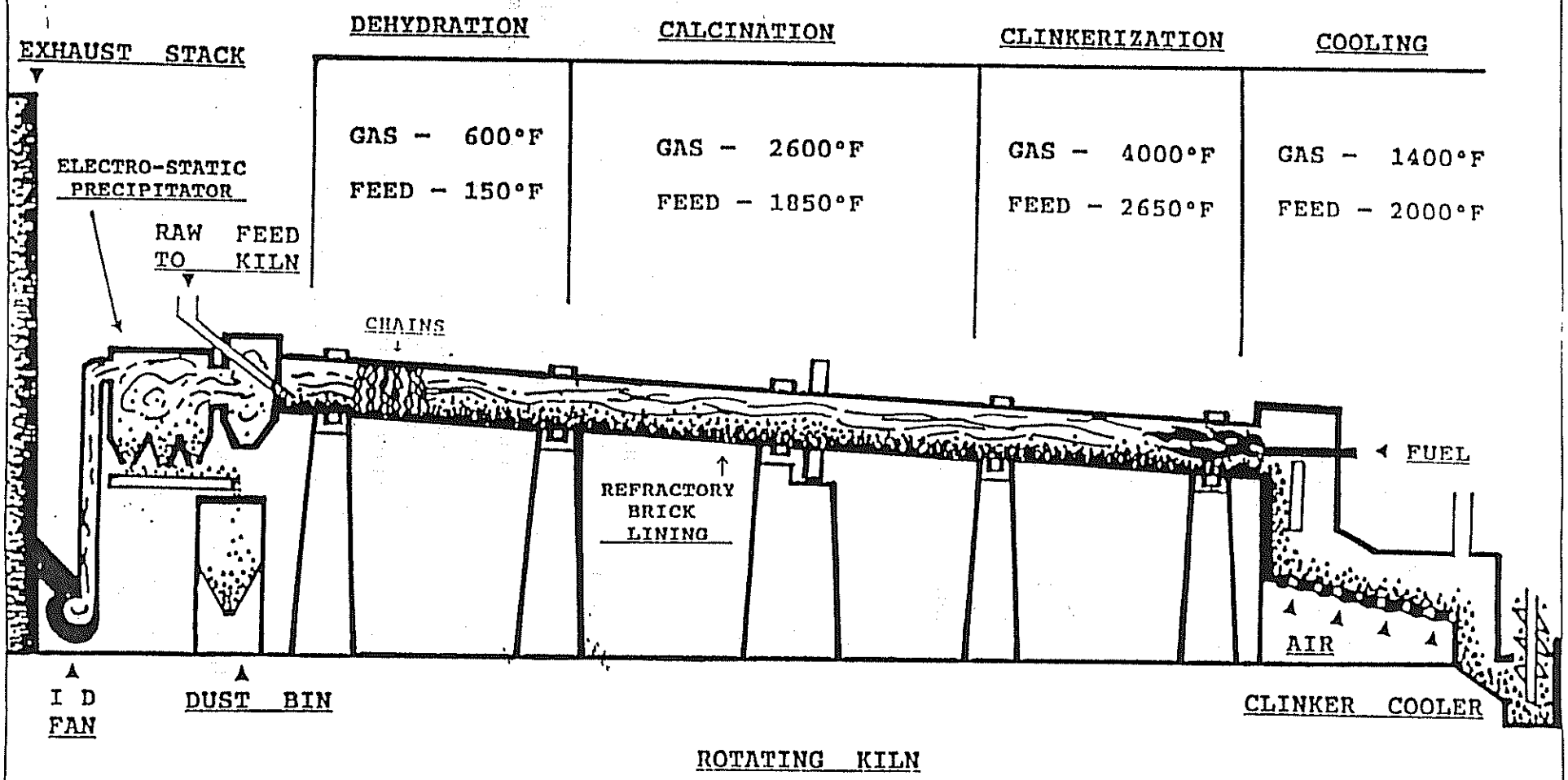


FIGURE 1.1
ILLUSTRATION OF THE CEMENT PRODUCTION PROCESS
TEXAS INDUSTRIES, INC MIDLOTHIAN CEMENT PLANT
MIDLOTHIAN, TEXAS

cement. The exhaust gases, which contain fine dust and products of combustion, pass through an electrostatic precipitator (ESP) for abatement and then are vented into the atmosphere via the kiln exhaust stack. The dust collected in the ESP (termed cement kiln dust or CKD) is disposed of in an on-site landfill. NTCC is currently authorized to fire coal, natural gas, petroleum coke, wood chips, oil, and TDF to meet its energy requirements. In addition, from1986-1991 NICC also supplemented its fuel requirements with WDF. The facility produces approximately 900,000 tons of portland cement annually.

1.2.4 Texas Industries, Inc. (TXI)

The TXI facility is located in Ellis County, approximately 2.1 miles southwest of the city of Midlothian on U.S. Highway 67. Portland cement is manufactured in 4 wet process kilns at this site (see NTCC discussion for description of the wet process). The kilns are authorized to fire coal, natural gas, petroleum coke, fuel oil, natural gas and WDF to meet their energy requirements. The facility produces 1,200,000 tons of portland cement annually.

1.3 Regulatory Activities

1.3.1 Air Permit History

1.3.1.1 Chaparral Steel

Chaparral Steel Company operates an automobile shredder, two electric arc furnaces (A and B) and three mills at its Midlothian mini-mill. Construction ofthe A furnace and bar mill began in 1974 under TACB permits 1634 and 1635 respectively. The A furnace went into operation in 1975. The automobile shredder began operation in 1975 under permit 3026. The slag handling operations went into operation in 1975 under permit 1636 and have since been taken over by International Mill Service under permit 5983. Chaparral Steel was issued permit 8099 in 1980 for construction of the medium section mill. The B furnace was constructed in 1980 under permits 8097 and PSD-TX-138 and is under New Source Performance Standard (NSPS) subpart AA. In 1990, permits 8097 and PSD-TX-138 were amended for construction of a large section mill. In 1994, the A furnace was incorporated into permit 8097 and one permit was issued for both 8097 and PSD-TX-138. The A furnace was constructed prior to NSPS subpart AA for electric arc furnaces.

Both A and B furnaces are electric and all mill reheat furnaces are fueled by natural gas.

The non-metallic residue from the automobile shredder is disposed of in a "fluff landfill" located in the TXI quarry.

1.3.1.2 Holnam Texas L.P. (Formerly BoxCrow Cement)

Holnam Texas L.P. operates one dry process cement kiln at its Midlothian facility. Box Crow Cement Company's kiln began operation in 1987. The plant was constructed under TACB permit 8996 and PSD-TX-454 and is also under United States Environmental Protection Agency (USEPA) New Source Performance Standards 40 CFR 60 Subpart F for portland cement plants. The kiln and precalciner were originally permitted to fire either coal or natural gas. In 1991, Holnam filed an application with the TACB and USEPA to fire WDF, but has never used WDF and has since withdrawn its application.

In 1994, Holnam was issued an amendment to permit 8996 and TX-PSD-454 to burn tire chip fuel in the pre-calciner.

1.3.1.3 North Texas Cement Company (NTCC)

NTCC (Formerly Gifford Hill Cement Company) operates three wet process cement kilns at its Midlothian facility. Gifford Hill Cement Company kiln #1 went into operation in 1966. The two additional kilns (#2 & #3) came on line in 1969 and 1972, respectively. Kilns #1 and #2 pre-date Texas Air Control Board permit requirements. Kiln 3 was constructed under TACB permit 1 and is also under USEPA New Source Performance Standards 40 CFR 60 Subpart F for portland cement plants. All three kilns were originally fired with natural gas.

In 1974, Gifford Hill was issued permit 838 which authorized the firing of all three kilns with fuel oil. Permit 838 was amended to allow the use of WDF in 1987. All three kilns were authorized to burn coal under permit 4791A (kiln #1), 4791B (kiln #2) and 4791C (kiln #3) in 1977. Additional alternate fuels were authorized under permit 4791 by amendments for coal/coke and wood chips in 1983 and 1988, respectively. Permit 16731, issued in 1986, authorized the burning ofWDF.

In 1991, the Texas Air Control Board adopted Rille 111.124 to regulate the burning of WDF in commercial combustion facilities. The USEPA also published its Boiler and Industrial Furnace rules in 1991. North Texas Cement was required to comply with both of these regulations, in addition to permit 16731, while conducting WDF trial burns and/or certification of compliance tests in March of 1991, June of 1992, and August of 1992. The company ceased burning WDF after the 1992 trial burn.

In 1995, NTCC elected to no longer pursue its application to burn WDF. The company also received an amendment to permit 4791 to burn whole tires in 1995.

1.3.1.4 Texas Industries, Inc. (TXI)

TXI operates four wet process cement kilns at its Midlothian facility. Construction of

kiln I began in 1959 and production began in 1960. The three additional kilns (#2, #3, & #4) came on line in 1964, 1967, and 1972, respectively. All four kilns pre-date Texas Air Control Board permit requirements and were originally fired with natural gas.

In 1974, TXl was issued permit 1360 which authorized the firing of all four kilns with fuel oil. Additional alternate fuels were authorized under permit 1360A by amendments for coal, coal/coke and WDF in 1980, 1983, and 1987, respectively.

In 1991, the Texas Air Control Board adopted Rule 111.124 to regulate the burning of waste-derived fuel in commercial combustion facilities. The USEPA also published its Boiler and Industrial Furnace rules in 1991. TXI is required to comply with both of these regulations, in addition to permit 1360A. TXI is currently operating under BIF interim requirements and has applied for a full Resource Conservation and Recovery Act (RCRA) permit.

1.3.2 Public Outreach

In an effort to keep citizens and elected officials informed of agency activities in the Midlothian area, the TNRCC and its predecessor agencies have held numerous public outreach forums. These public forums include: a public meeting in Midlothian early in 1990; a public meeting in Midlothian, May 20, 1992; an Agenda meeting of the Texas Air Control Board in Dallas, July 23, 1992; a meeting with the City of Dallas Environmental Health Advisory Commission in Dallas, April 5, 1993; a meeting with the City of Fort Worth Environmental Advisory Group in Fort Worth, June 17, 1993; a TNRCC Environmental Forum regarding Midlothian issues in Arlington, September 27, 1993; a meeting with the City of Dallas Environmental Health Advisory Commission in Dallas, January 27, 1995; a meeting to brief Midlothian city officials, April 20, 1995; a meeting to brief Midlothian industry representatives, April 21, 1995; and a meeting on June 20, 1995 to brief Cedar Hill city officials. In addition, the companies have appeared repeatedly at public Agenda meetings of the TNRCC and its predecessor agencies to address various aspects of their operations.

2.0 ENVIRONMENTAL MONITORING PROGRAM

An exhaustive environmental monitoring program was undertaken in the Midlothian area in order to assess overall environmental quality and the potential impact of area industries. The monitoring program has involved collection of ambient air samples, soil samples, and stack samples. The focus of the environmental monitoring program has been on those types of substances reasonably anticipated to be emitted from the types of industries located in the community. Ambient air samples have been collected using both fixed and mobile monitoring techniques. In addition, in order to respond to specific complaints concerning odorous conditions and respiratory discomfort, a number of event-triggered ambient air samples were collected by TNRCC Regional staff and private

citizens. These samples have been analyzed for a number of compounds including respirable particulate matter (PM_{10}), respirable metals, volatile organic compounds (VOCs), hydrogen sulfide (H_2S), sulfur dioxide ($S0_2$), and polycyclic aromatic hydrocarbons (PAHs). Soil samples, collected since 1991 using a periodic sampling regimen, have been analyzed for a number of metals including aluminum, antimony, arsenic, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, strontium, thallium, titanium, and zinc. Additionally, soil samples collected in 1995 were analyzed for PCDDs and PCDFs. The TNRCC has also evaluated the PCDD and PCDF results obtained during stack tests conducted by Holnam, NTCC, and TXI.

2.1 Ambient Air

The TNRCC assessed ambient air quality in the Midlothian area using fixed and mobile monitoring techniques, as well as by collection of event-triggered samples. Fixed monitors were used to gather data on the ambient levels of air contaminants to which members of the general public could potentially be exposed to on a regular basis. Mobile monitoring was conducted to collect data downwind of specific industries. TNRCC Regional staff and citizens also collected a number of event-triggered samples at various locations in the Midlothian area. This specific sampling regimen allowed citizens to collect air samples, using TNRCC equipment, when odors or discomfort were perceived.

2.1.1 Fixed Monitors

In order to assess overall air quality in the Midlothian area and to evaluate potential public exposures, the TNRCC has placed a series of samplers at fixed sites. The specific types of monitors employed by the agency include a high-volume sampler to gather data on air concentrations of lead, high-volume samplers fitted with a size-selective inlet to gather data on air concentrations of respirable particulate and metals, an air toxics sampler to gatherdata on volatile organic compounds, and continuous $H_2S/S0_2$ monitors. PM_{10} samplers have been used to gather data on PM_{10} and respirable metals at 12 different locations in the Midlothian area. Sampling for PM_{10} and respirable metals has been ongoing at various sites since January 1991. Four of the PM_{10} samplers are still in operation today. In addition, since January of 1993, a high-volume sampler located immediately north of Chaparral Steel has been used to gather data on ambient lead concentrations. An air toxics sampler went into operation at the community's Fresh Water Treatment Plant in January of 1993 and is still in operation today. In addition, two continuous $H_2S/S0_2$ monitors went into operation in the Midlothian area in January 1995 and both are still in operation today. Results of these long-term sampling efforts are described in the sections which follow.

2.1.1.1 Respirable Particulate (PM_{10})

In January 1991, two PM_{10} samplers were placed in the vicinity of the TXI and NTCC plants: one at a private residence at 801 Auger Road and the second at the Waste Water Treatment Plant at 1969 Auger Road (Figure 2.1). Additional PM_{10} samplers were added in 1992 at 3330 Cement Valley Road, 5050 Gorman Road, 440 Tayman Drive, 462 Waterworks Road, 1120A Cedar Drive, 490 Hidden Valley Trail, and at the main fire station on 1212 Beltline Road in Cedar Hill. After collecting data for a period of two years, the sampler at 801 Auger Road was shutdown on January 28, 1993. The sampler on Cement Valley Road was only operated until June 5, 1992, while the samplers at 5050 Gorman Road and 462 Waterworks Road were shutdown after collecting data for one year. In 1993, a sampler was again placed at the Waste Water Treatment Plant at 1969 Auger Road where it operated until the fall of 1994. An additional sampler went into operation during the fall of 1993 at the Tar Road location. After collecting data for a period of one year, this sampler was shutdown on January 17, 1995. During the fall of 1994, additional samplers were placed on Old Fort Road and at the AT&T Tower. These two samplers, along with the samplers located at 440 Tayman Drive and at the main fire station on 1212 Beltline Road in Cedar Hill are still in operation. Inclusive sampling dates for all PM_{10} sampler locations are summarized in Table 2.1. The movement of these samplers reflects the desire of the TNRCC to work within resource limitations to gather spatially representative data. As such, these special study samplers are operated for a period of time to allow for collection of sufficient data for valid data analysis and are then moved to another location.

Respirable particulate (PM_{10}) samples were collected on quartz filters using size selective inlet (SSI) high volume air samplers in accordance with USEPA Reference Methods RFPS-1087-062 and RFPS-1287-063 through 065. As such, ambient air was drawn through the filter for a period of 24 hours at a specific flow rate. Total flow of air through the filter was recorded. Samples were collected on an every sixth-day schedule. The filters were returned to the TNRCC laboratory in Austin for analysis. Total mass of particulates deposited on the filter was determined by subtracting the mass of the unexposed filter from the mass of the exposed filter. By calculating the ratio of the total mass and the total flow of air, concentrations of PM_{10} in the ambient air were determined as micrograms per cubic meter ($\mu g/m^3$) of air.

Monitored levels of PM_{10} were compared to the appropriate National Ambient Air Quality Standard (NAAQS) established by the USEPA. The current NAAQS for PM_{10} do not permit ambient concentrations to exceed 50 $\mu g/m^3$ for an annual arithmetic average and 150 $\mu g/m^3$ for a 24-hour average more than three times in three years. In all cases, regardless of the year or monitor location, measured 24-hour PM_{10} concentrations were well below the corresponding 24-hour NAAQS of 150 $\mu g/m^3$. The highest 24-hour concentration reported for all sites ranged from 12-99 $\mu g/m^3$ (Table A.I). A summary of the annual average PM_{10} concentrations for each of the 12 sites in the Midlothian area is

Figure 2.1

FIXED SAMPLER LOCATIONS
(AMBIENT AIR)

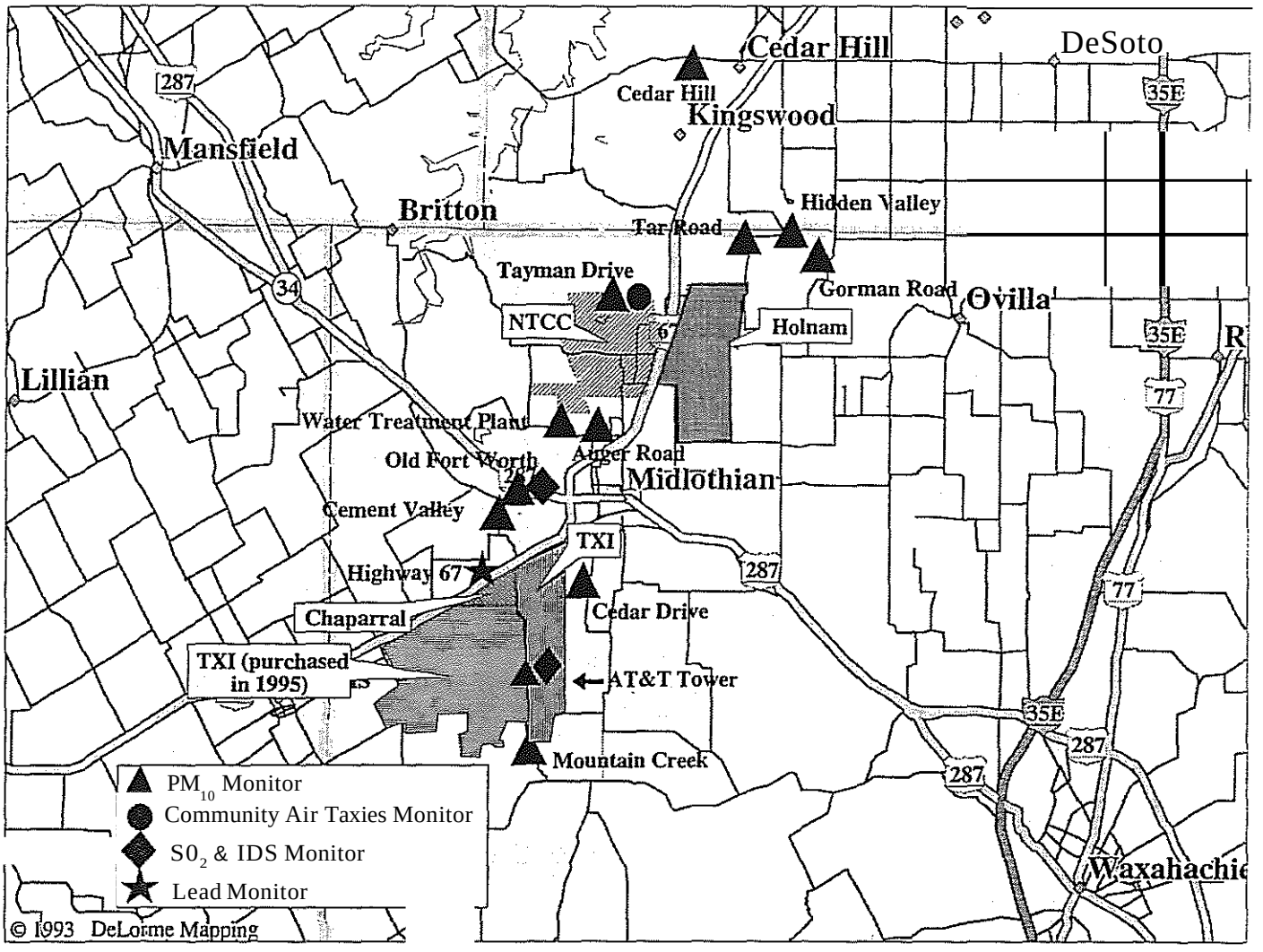


Table 2.1
DESCRIPTION OF FIXED SAMPLERS
(AMBIENT AIR)

Sampler Type	SAROAD #	Monitor Location	Monitoring Dates Operational	Monitoring Dates Completed
PM_{10} Monitor	1690015	AT&T Tower	10/20/94	ongoing
	1690004	Auger Road, 801	1/18/91	1/27/93
	1690084	Cedar Drive, 1120A	1/1/92	10/20/94
	1320072	Cedar Hill Fire Department (1212 W. Beltline)	7/30/92	ongoing
	1690005	Cement Valley Road, 3330	1/4/92	6/5/92
	1690006	Gorman Road, 550	3/10/92	4/12/93
	1690011	Hidden Valley Trail, 490	9/1/92	10/19/93
	1690016	Old Fort Worth Road	11/3/94	ongoing
	1690014	Tar Road (Rt. 2 Tar Rd. Box 485)	11/6/93	1/17/95
	1690007	Tayman Drive, 440 (Fresh Water Treatment Plant)	3/19/92	ongoing
	1690003	Waste Water Treatment Plant (1969 Auger Rd.)	1/27/93	11/3/94
	1690003	Waste Water Treatment Plant (1969 Auger Rd.)	1/18/91	1/4/92
	1690008	Waterworks Road, 462 (Mountain Creek Water Plant)	3/19/92	4/12/93
Lead Monitor	1690012	Highway 67 (2060 S. Hwy. 67)	1/15/93	ongoing
Community Air Toxics Monitor	1390007 (AIRS #)	Tayman Drive, 440 (Fresh Water Treatment Plant)	1/25/93	ongoing
SO_2 and H_2S Monitor	1690015	AT&T Tower	1/1/95	ongoing
	1690016	Old Fort Worth Road (TAMS 196)	1/1/95	ongoing

provided in Figure 2.2. For sites where there was not a full year worth of data, an annual average was calculated based on the assumption that the data gathered during the time that the monitor was in operation was representative of an annual average. There is, however, some uncertainty inherent in this assumption. In all cases, measured annual averages were well below the corresponding NAAQS of 50 $\mu g/m^3$. The highest annual average PM_{10} concentration was reported for the Gorman Road site in 1992 (31 $\mu g/m^3$), while the annual average concentration for all other sites ranged from 10-24 $\mu g/m^3$ (Table A.1). Further, annual average concentrations detected in Midlothian were similar to those reported for comparable communities in Texas (Figure 2.2). Adverse health effects are not expected to result from exposure to the measured 24-hour or annual average concentrations of PM_{10}.

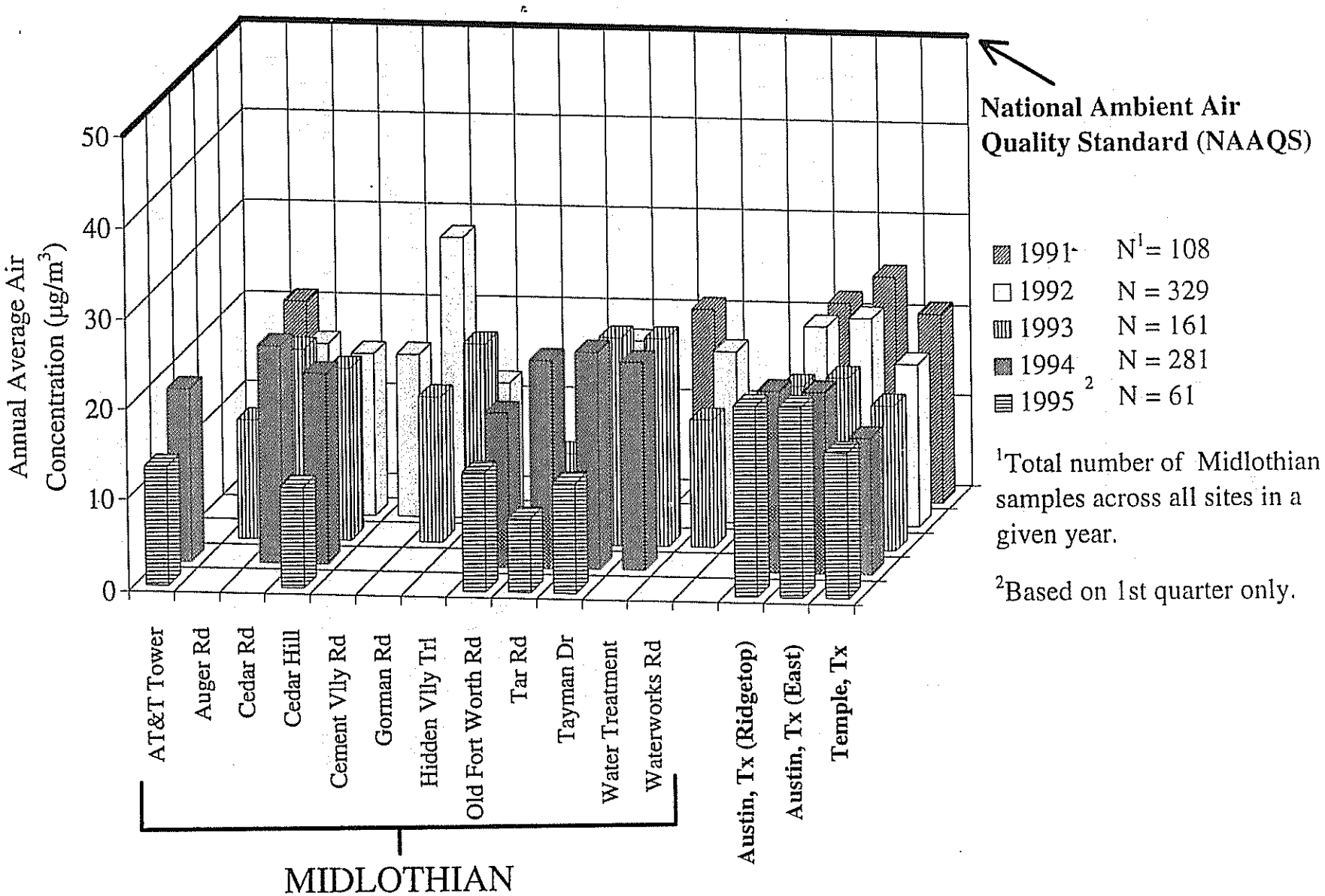
2.1.1.2 PM_{10} Metals

A select number of the PM_{10} sample filters from five of the sites (Waste Water Treatment Plant, 801 Auger Road, 3330 Cement Valley Road, Cedar Hill Fire Department, and 1120A Cedar Drive) were also analyzed for metals. Such an approach allows for evaluation of exposure to the respirable fraction of metals in ambient air. The analytical procedure involved cutting a subsample from each filter following the determination of PM_{10} mass. The sample strips were prepared for analysis using a TNRCC-developed acid digestion technique and analyzed by either x-ray fluorescence spectroscopy (XRF) or inductively coupled plasma spectroscopy (ICP) using modified USEPA SW-846 Method 6010. The XRF methodology was the primary analytical technique employed and was supplemented with ICP instrumentation. All samples were analyzed for vanadium, total chromium, manganese, nickel, arsenic, selenium, cadmium, antimony, mercury, lead, iron, titanium, beryllium, aluminum, strontium, and thallium.

Measured concentrations of the respirable fraction of each of the metals were then compared to the appropriate NAAQS, TNRCC Regulation, or TNRCC ESL. Results for total chromium were compared with the ESL for trivalent chromium (metallic chromium has the same ESL), because it was assumed that the majority (>98%) of chromium emissions expected from Midlothian industries are likely to be in a chemical form other than chromium VI. This assumption is based on data which suggests that the estimated percentages of chromium VI emissions resulting from cement production and speciality/steel production are 0.2% and 2.2%, respectively (ATSDR,1992). In addition, data collected by TXI during their 1992 trial burn using waste-derived fuel demonstrated that chromium VI accounted for less than 0.004% of the total chromium emissions (TXI, 1992).

Individual sample results for each site are presented in Tables A.2-A.6. In all cases, the measured concentrations were below the corresponding health-based guidance level and many were in fact below the method detection limits (MDLs). It should be noted that all MDLs were below the corresponding 24-hour ESLs. Maximum 24-hour air

Figure 2.2
ANNUAL AVERAGE AMBIENT AIR CONCENTRATIONS
OF RESPIRABLE PARTICULATES (PM_{10})



concentrations are presented in Figure 2.3 for those metals which were detected more than 10% of the time. All 24-hour maximum air concentrations, regardless of the element or sampling location, were less than 58% of the corresponding ESL. In fact, with the exception of nickel and thallium, all measured concentrations were less than 17% of the ESL (Figure 2.3). Thus, adverse health effects are not expected to result from exposure to the measured 24-hour concentrations of any of the respirable metals.

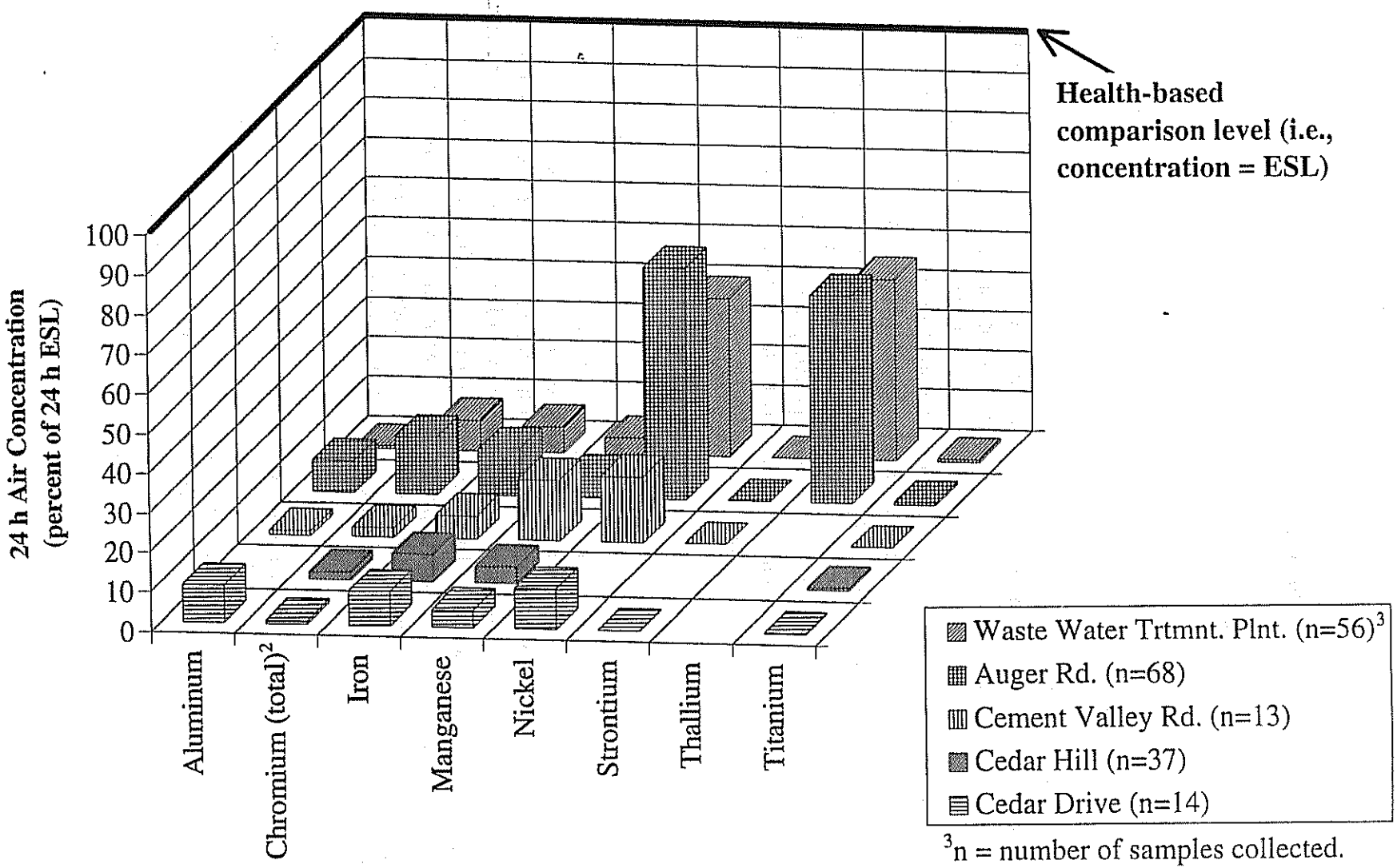
Two sites (Waste Water Treatment Plant and 801 Auger Road) had sufficient data for calculation o f annual average concentrations of respirable metals. For the purpose of calculating an annual average, when metal concentrations were reported as below the MDL, it was conservatively assumed that they were actually present at concentrations equal to 1/2 the MDL. Such an assumption is conservative given the likelihood that the compounds were actually present at concentrations below one-half the MDL, but were not reported because there was less than a 99% level of confidence in the value. Annual average concentrations were calculated for those metals detected more than 10% of the time in a given year. Of those metals detected more than 10% of the time, only chromium (total), manganese, and nickel were found to have annual average concentrations greater than the MDL. Annual average concentrations for these three metals were all well below the corresponding annual ESL (Figure 2.4). Further, it should be noted that all MDLs were below the corresponding annual ESLs. Adverse health effects are not expected to result from exposure to the estimated annual average concentrations of respirable metals.

2.1.1.3 TSP Lead

In January of 1993, a high volume air sampler was sited in the vicinity of Chaparral Steel at 2060 South Highway 67. This sampler, which is stilI in operation, collects total suspended particulate (TSP) samples on fiberglass filters. As described for the PM_{10} samplers, ambient air was drawn through the filter for a period of 24 hours at a specific flow rate. Total flow of air through the filter was recorded. Samples were collected on an every sixth-day schedule. The filters were retumed to the TNRCC laboratory in Austin for analysis. A 3/4 inch strip was cut from each filter and prepared using acid digestion. Following preparation, the samples were analyzed for lead by atomic absorption spectroscopy in accordance with USEPA Reference Method 40 CFR 50 Appendix G.

Measured lead concentrations (n=127) were compared to the USEPA National Ambient Air Quality Standard (NAAQS) of 1.5 $\mu g/m^3$ of air averaged over a calendar quarter. The quarterly average lead concentrations detected at this site were all well below the corresponding NAAQS of 1.5 $\mu g/m^3$ (Figure 2.5, Table A.7). Measured levels reported since the onset of monitoring at this site have ranged from 0.09-0.36 $\mu g/m^3$. The two highest levels reported occurred during the second and third quarters of 1993 (0.36 and 0.30 $\mu g/m^3$, respectively; Table A.7). Adverse health effects are not expected to result

Figure 2.3
MAXIMUM 24-HOUR AIR CONCENTRATIONS OF RESPIRABLE METALS[1]

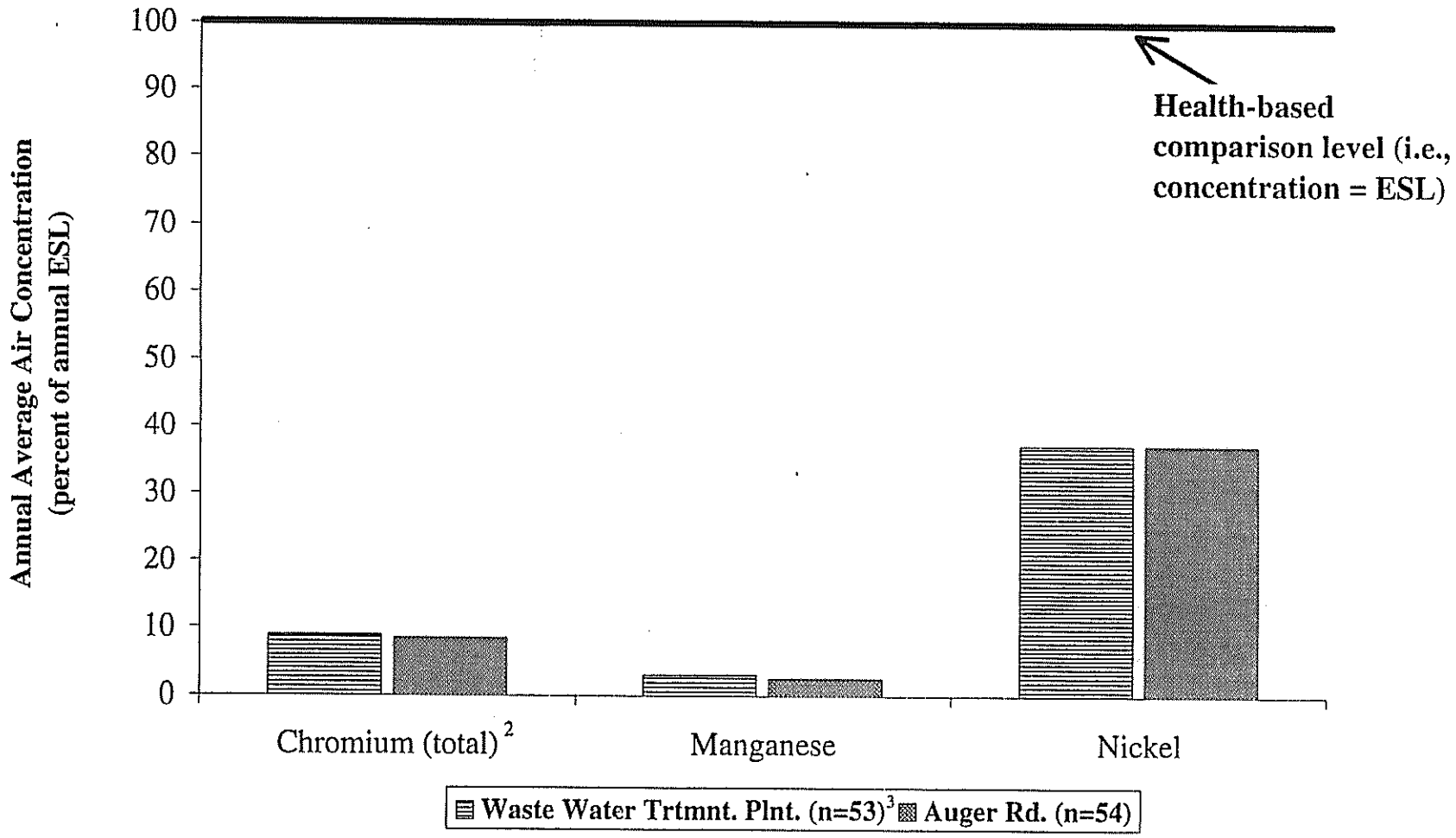


[3]n = number of samples collected.

[1]Samples were collected between 1/91 and 6/93. **Vanadium, Arsenic, Selenium, Cadmium, Antimony, Mercury, and Beryllium** were detected less-than 10% of the time.

[2]Percent concentration of total chromium is relative to metallic or Cr(III) ESL and is based on the assumption that the total chromium is predominantly metallic or Cr(III) (see text for details).

Figure 2.4
1991 ANNUAL AVERAGE AIR CONCENTRATIONS OF RESPIRABLE METALS[1]

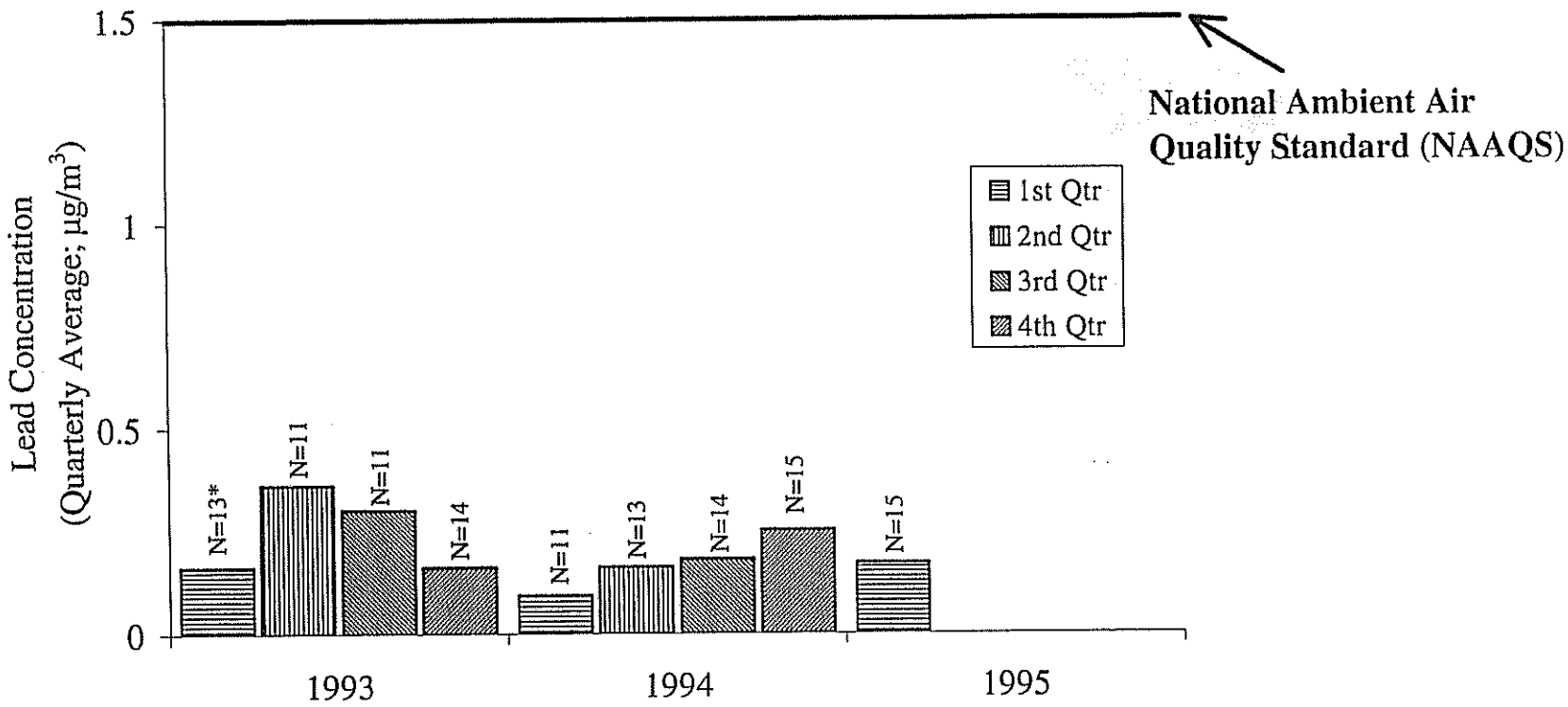


[1]Chromium, Manganese, and Nickel are the only metals shown because **Vanadium, Arsenic, Selenium, Cadmium, Antimony, and Mercury** were detected less-than 10% of the time.

[2]Percent concentration of total chromium is relative to metallic or Cr(III) annual ESL and is based on the assumption that the total chromium is predominantly metallic or Cr(III) (see text for details).

[3]n = number of samples collected.

Figure 2.5
AMBIENT AIR CONCENTRATIONS OF TSP LEAD
(Location: Highway 67)



* N; number of valid samples

from exposure to any of the measured concentrations of lead at this site.

2.1.1.4 Volatile Organic Compounds (VOCs)

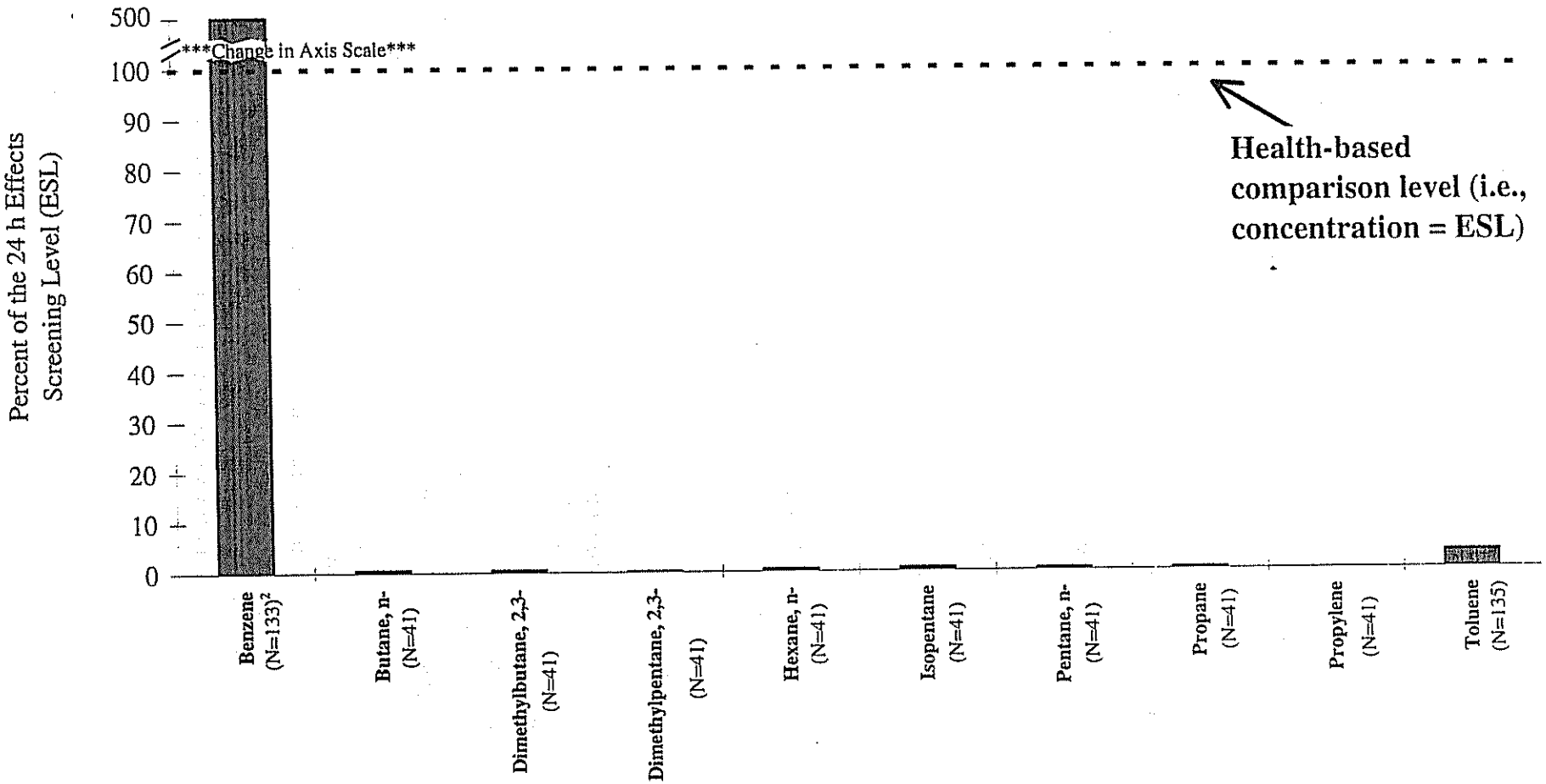
A volatile organics sampler went into operation at the Midlothian Water Treatment Plant at 440 Tayman Drive on January 25, 1993. This sampler is still in operation. Air samples are collected using passivated stainless steel canisters. Ambient air is continuously drawn into the canisters through a sampling train at a rate of 10 centimeters per minute (cm^3/min) for a period of 24 hours from midnight to midnight every sixth day. Samples are analyzed at the TNRCC's Austin laboratory in accordance with modified USEPA Method TO-14 using gas chromatography mass spectroscopy. Since 1993, samples have been analyzed for 20 specific compounds: benzene, bromomethane, 1,3-butadiene, carbon tetrachloride, chlorobenzene, chloroform, 2-chloropentane, 1,2-dichloroethane, 1,2-dichloropropane, ethyl benzene, methylene chloride, perchloroethylene, styrene, toluene, 1,1,1-trichloroethane, trichloroethylene, trichlorofluoromethane, vinyl chloride, o-xylene, and m- and p-xylene. In the fall of 1994, the TNRCC laboratory increased its ability to measure VOCs and began including additional target compounds for analysis. As of June 15, 1995, the laboratory analyzed for a total of 72 VOCs (Table A.8).

The maximum 24-hour concentrations for the 72 analyzed VOCs are shown in Table A.8. Sixty-two of the 72 VOCs were detected less than 10% of the time. The MDLs for the VOCs listed in Table A.8 are all below their respective ESLs. In order to evaluate potential acute health impacts, the maximum 24-hour sample concentrations for VOCs were compared to their corresponding 24-hour ESL. With the exception of benzene, maximum 24-hour concentrations for all of the measured VOCs were significantly below the corresponding 24-hour ESL (Table A.8). In fact, the majoritu of those compounds detected more than 10% of the time were actually present at concentrations which were all less than 4% of the corresponding ESLs (Figure 2.6). Since 1993, 24-hour benzene concentrations have been measured in a total of 133 valid samples and only two of these samples have shown levels greater than the corresponding 24-hour ESL of 4 ppb. An evaluation of the distribution of 24-hour benzene concentrations measured since January of 1993 indicates that 99.1% of all valid samples contained less than 4 ppb benzene, with 95.5% of the samples actually containing less than 1 ppb benzene (Figure 2.7). As stated in the definition of an ESL, air concentrations of a chemical above this guideline concentration are not necessarily indicative of adverse health effects, but rather suggest the need for further evaluation. As such, the frequency of occurrence and magnitude by which the ESL was exceeded in each relevant sample was determined. Based on the limited number of samples that exceeded the 24-hour ESL for benzene (only 2 out of 133 samples), as well as the relatively low concentrations in those samples, adverse health effects are not expected to result from exposure to the measured levels of benzene.

Figure 2.6

MAXIMUM 24-HOUR AIR CONCENTRATIONS OF VOCs[1]

(Location: Tayman Drive; Fresh Water Treatment Plant)



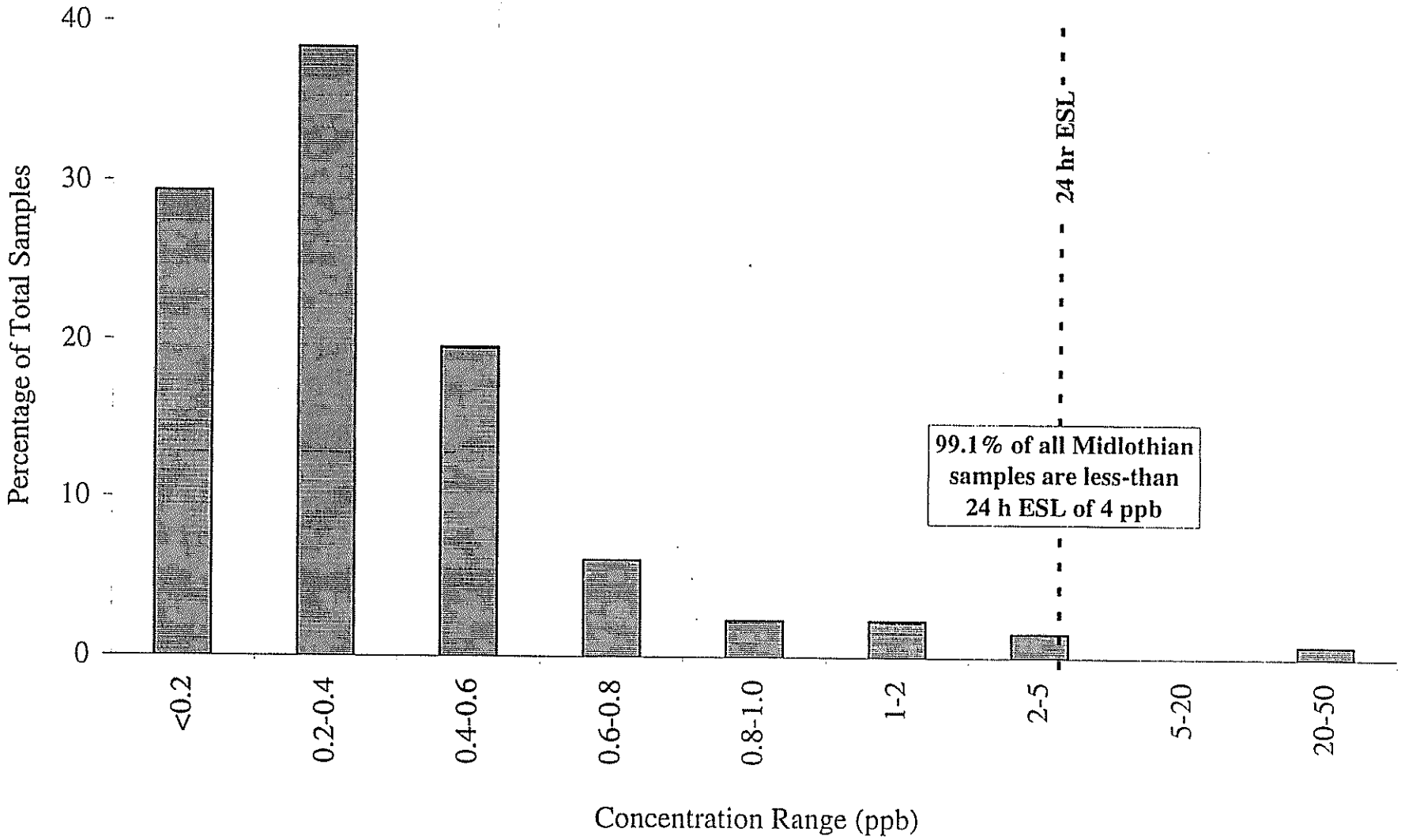
[1]VOCs; Volatile Organic Compounds. VOCs detected greater than 10% of the time (10 out of 72 VOCs) are shown here. and were selected from data collected in 1993-1995. Refer to Table A.8 for maximum 24-hour concentrations.

[2]N = number of valid samples.

Figure 2.7

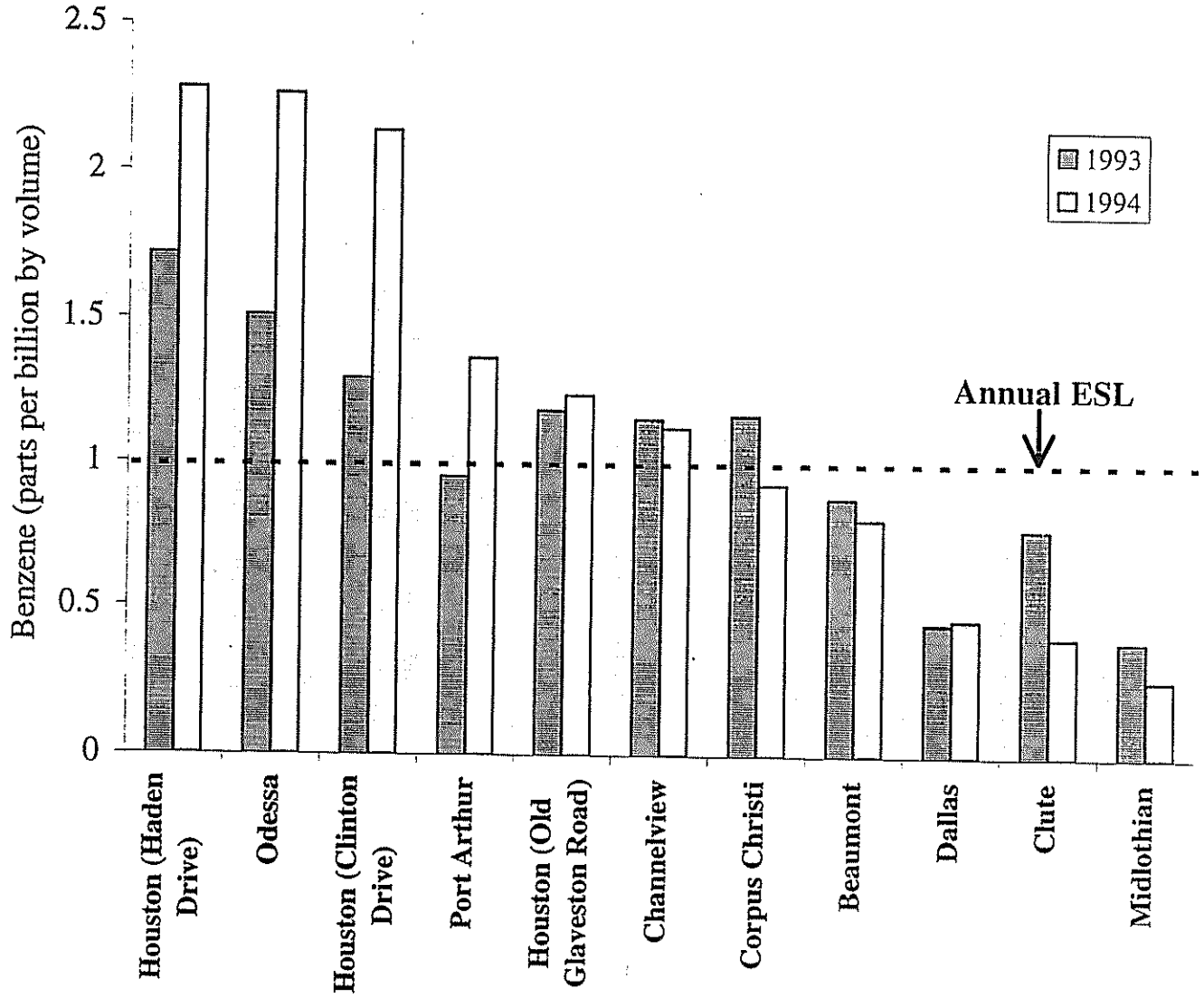
DISTRIBUTION OF 24-HOUR AIR CONCENTRATIONS OF BENZENE[1]

(Location: Tayman Drive - Fresh Water Treatment Plant)



[1]A total of 133 samples were collected once every six days between January, 1993 and June, 1995.

Figure 2.8
ANNUAL AVERAGE AIR CONCENTRATIONS OF BENZENE IN 11 TEXAS CITIES



AT&T Tower location was limited to a two-day period (March 26-27,1995), with concentrations ranging from 0.007-0.013 ppm during that time. At the Old Fort Worth Road location, the occurrence of H_2S at levels greater than the odor threshold was an even more sporadic event, occurring during a single one hour period on 3/22/95 (0.015 ppm) and a three hour period on 3/23/95 (0.008 ppm). Adverse health effects are not expected to result from exposure to the measured concentrations of SO_2 or H_2S. Nonetheless, odors may have been discerned during the sampling periods when the odor threshold for H_2S was significantly exceeded.

2.1.2 Mobile Monitoring

The goal of the mobile monitoring efforts was to locate specially-equipped monitoring vehicles downwind of the facilities of interest in order to obtain air samples that were representative of the emissions from the facilities. This was accomplished by adjusting vehicle locations based on shifts in meteorological conditions. The mobile monitoring was conducted in intensive, week-long projects, and provided round-the-clock data for the period sampled.

Since January 1991, four mobile monitoring trips have been conducted in the areas adjacent to NTCC, TXI, Holnam, and Chaparral Steel. The sampling locations for three of the mobile monitoring trips are indicated on Figure 2.9. The remaining mobile monitoring trip was conducted specifically to collect samples downwind of TXI and NTCC during trial burns using waste-derived fuel (June, 1992), and thus, specific sampling locations cannot be identified.

The primary purpose of the first sampling trip, conducted in January of 1991, was to determine ambient air concentrations of H_2S and $S0_2$ downwind of TXI, NTCC, and Holnam. Analyses for H_2S and $S0_2$ were conducted as described in Section 2.1.1.5 (Sulfur Compounds). Samples were analyzed at 19 different locations as indicated on Figure 2.9. A second sampling trip was conducted in November of 1991 to determine ambient air concentrations of VOCs (Modified USEPA Method TO-2), PAHs (Modified USEPA Method TO-13), respirable particulate (PM_{10}) and PM_{10} metals (analyzed as described in Sections 2.1.1.1 and 2.1.1.2), H_2S, and $S0_2$ downwind of TXI, NTCC, Holnam, and Chaparral Steel. During this monitoring trip, samples were analyzed at 27 different sites, with most analyzed in areas downwind of NTCC and Chaparral Steel. The third sampling trip was conducted in June of 1992 during facility-specific trial bums, with samples collected downwind of TXI and NTCC and analyzed for VOCs, PAHs, PM_{10} and metals. The final sampling trip (in June 1994) was conducted to determine ambient air concentrations of H_2S and $S0_2$ downwind of NTCC, TXI, Holnam, and Chaparral Steel. Samples were collected at 12 different locations during this trip, with the majority of samples collected in the vicinity of the TXI, NTCC, and Holnam facilities (Figure 2.9). Those compounds or classes of compounds (e.g., alkanes) analyzed for during the four mobile monitoring trips are outlined in Table 2.2.

Figure 2.9

MOBILE MONITORING LOCATIONS (AMBIENT AIR)

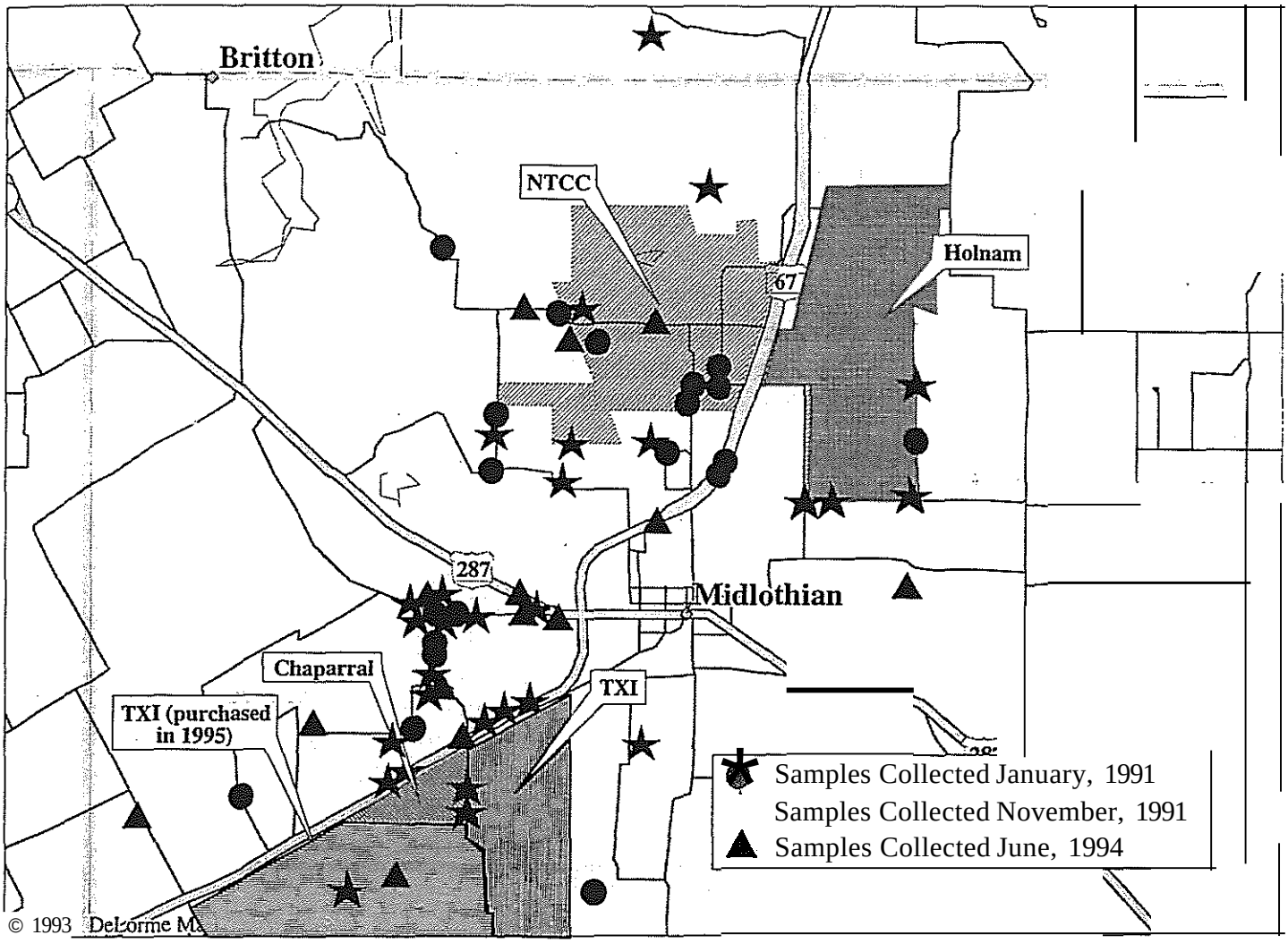


Table 2.2
MOBILE MONITORING RESULTS

Constituent	Results[2]	Monitoring Trip Dates
Volatile Organics:[1]		
Alkanes	< Health-based ESL, but exceeded odor threshold	1/1991; 6/1992
Alkenes	< Health-based ESL, but exceeded odor threshold	1/1991; 6/1992
Benzene	<ESL	1/1991; 11/1991; 6/1992
Butadiene, 1,3-	ND[3]	11/1991
Carbon Tetrachloride	Trace[4]	11/1991
Styrene	Trace	11/1991
Toluene	<ESL	11/1991; 6/1992
Trichloroethane, 1,1,1-	Trace	11/1991; 6/1992
Xylenes, total	<ESL	11/1991; 6/1992
Sulfur Compounds:		
Hydrogen Sulfide	< TNRCC Reg. II Standard, but exceeded odor threshold	1/1991; 11/1991; 6/1992
Sulfur Dioxide	< TNRCC Reg. II Standard	1/1991; 11/1991; 6/1992
PAHs:	<ESL	11/1991; 6/1992
Metals:		
Aluminum[5]	<ESL	11/1991; 6/1992
Cadmium	<ESL	11/1991; 6/1992
Chromium	<ESL	11/1991; 6/1992
Lead	<quarterly NAAQS	11/1991; 6/1992
Iron	<ESL	11/1991; 6/1992
Manganese	<ESL	11/1991; 6/1992
Nickel	<ESL	11/1991; 6/1992
Strontium[5]	<ESL	11/1991; 6/1992
Titanium	<ESL	11/1991; 6/1992

[1]Other analyses include "other aromatics" and "substituted benzenes"
[2]Sample times vary
[3]ND = Not detected: <0.1 parts per billion (ppb)
[4]Trace = 0.1-0.5 ppb
[5]Only detected during the 6/19/92 trip.

Concentrations of VOCs in the majority of samples were not detected (ND) (0.1 ppbv), detected in trace amounts (0.1 ppbv - 0.5 ppbv) that were well below the corresponding ESLs, or were not detected at levels above the corresponding ESLs (Table 2.2). Thus, adverse health effects are not expected to result from exposure to any of the measured concentrations of VOCs. The measured concentrations of total alkanes and alkenes did, however, exceed the odor threshold for the most odorous compound in each class during the June 1992 monitoring trip. Therefore, odors may have been discerned during the sampling periods when the odor thresholds for alkanes and alkenes were significantly exceeded.

All SO_2 and H_2S concentrations measured during the mobile monitoring trips were below the corresponding TNRCC Regulation II Standards of 0.4 ppm and 0.08 ppm, respectively. The concentrations of SO_2 at the various sites ranged from ND-0.064 ppm, while the concentrations of H_2S ranged from ND-0.045 ppm. Concentrations of H_2S in some of the samples collected downwind of Holnam and TXI did exceed the corresponding odor threshold of 0.005 ppm (Table 2.2). Adverse health effects are not expected to result from exposure to the measured concentrations of SO_2 or H_2S. However, odors may have been discerned during the sampling periods when the odor threshold for H_2S was significantly exceeded.

Analytical results from the PAH analyses showed that only four PAHs were detected at concentrations above their corresponding MDLs. The concentrations of all four of the four PAHs were less than the corresponding ESL. Therefore, adverse health effects are not expected to result from exposure to any of the measured concentrations of PAHs.

The measured concentrations of PM_{10} were all less than the corresponding 24-hour NAAQS of 150 $\mu g/m^3$. Analysis of the PM_{10} filters for various metals indicated that all measured levels were below the corresponding ESL or NAAQS. In fact, only aluminum, cadmium, chromium, iron, lead, manganese, nickel, strontium, and titanium were detected at concentrations greater than the MDLs. Adverse health effects are not expected to result from exposure to any of the measured concentrations of PM_{10} or respirable metals.

2.1.3 Event-Triggered Samples

Since the fall of 1990, approximately 20 event-triggered samples (i.e., canister grab samples or time-integrated samples) have been collected at various locations in the Midlothian area by TNRCC Regional staff and local citizens. The purpose of this type of monitoring was to collect samples at times when citizens reported odors or discomfort in an effort to identify the potential causative agents. Sampling durations ranged from instantaneous to 1 hour. All samples were analyzed for volatile organic compounds as described in section, 2.1.1.4 (Volatile Organic Compounds).

Measured concentrations were compared to the corresponding ESL. In a number of instances, concentrations of classes of compounds rather than individual compounds were reported. In this case, a worst-case comparison was made where the total measured concentration for the compound class was compared with the most conservative ESL for the class. For the majority of samples analyzed, concentrations of VOCs were either trace (0.1-0.5 ppbv) or below the MDL. Further, measured levels of VOCs in all samples collected between 1990-1995 were below corresponding ESLs. Therefore, adverse health effects would not be expected to occur as a result of exposure to the measured levels of VOCs. A single sample collected in March of 1995 did, however, contain concentrations of acetaldehyde at levels slightly above the odor threshold (l.3x). Thus, odors may have been discerned during the time when the sample was collected.

2.2 Soil

2.2.1 Metals

2.2.1.1 Area-Wide Sampling

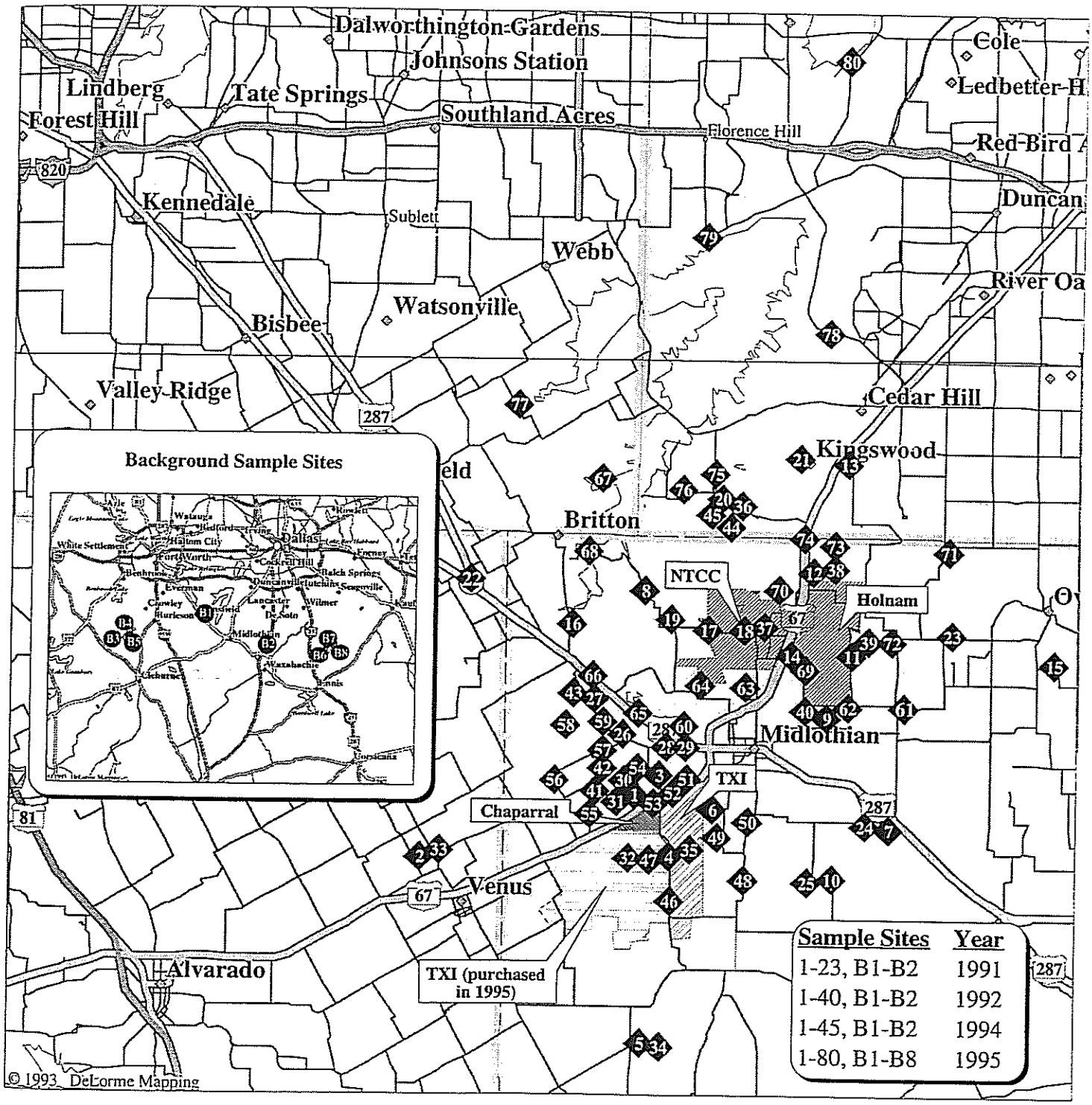
In order to further assess the potential impacts of emissions from local industrial activities, the TNRCC collected surface soil samples (1/4-1/2 inch depth) at 80 different sites in the Midlothian area. Soils in the community have been sampled on a periodic basis since 1991. Additionally, during the 1995 sampling trip, soil samples were collected at eight background sampling sites located several miles to the east and west of the city of Midlothian. The location of the individual sampling sites in the Midlothian area is indicated on Figure 2.10.

Soil samples were analyzed for up to eighteen metals including aluminum, antimony, arsenic, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, strontium, thallium, titanium, and zinc in accordance with Modified EPASW-846. The soil samples were mixed, dried, weighed, pulverized and ground to obtain homogenous aliquots on a dry weight basis. These aliquots underwent acid digestion and were then analyzed by ICP.

Reported soil concentrations of metals were compared with soil screening levels (SSLs) developed by the Agency for Toxic Substances and Disease Registry (ATSDR) or the USEPAwhere available (Table B.1). The measured concentrations of total chromium were compared to the SSL for trivalent chromium. As discussed in Section 2.1.1.2 (PM_{10} Metals), such a comparison is warranted given that the trivalent form is the predominant form (>98%) expected to be emitted by the four major industries in Midlothian. Additionally, under most soil conditions, hexavalent chromium is readily converted to trivalent chromium (Dragun, 1988). Soil concentrations of arsenic, copper, mercury, and zinc were compared to SSLs developed by staff of the TNRCC Toxicology & Risk Assessment (TARA) Section in accordance with ATSDR methodology. Soil

Figure 2.10

SOIL SAMPLING SITES FOR METALS



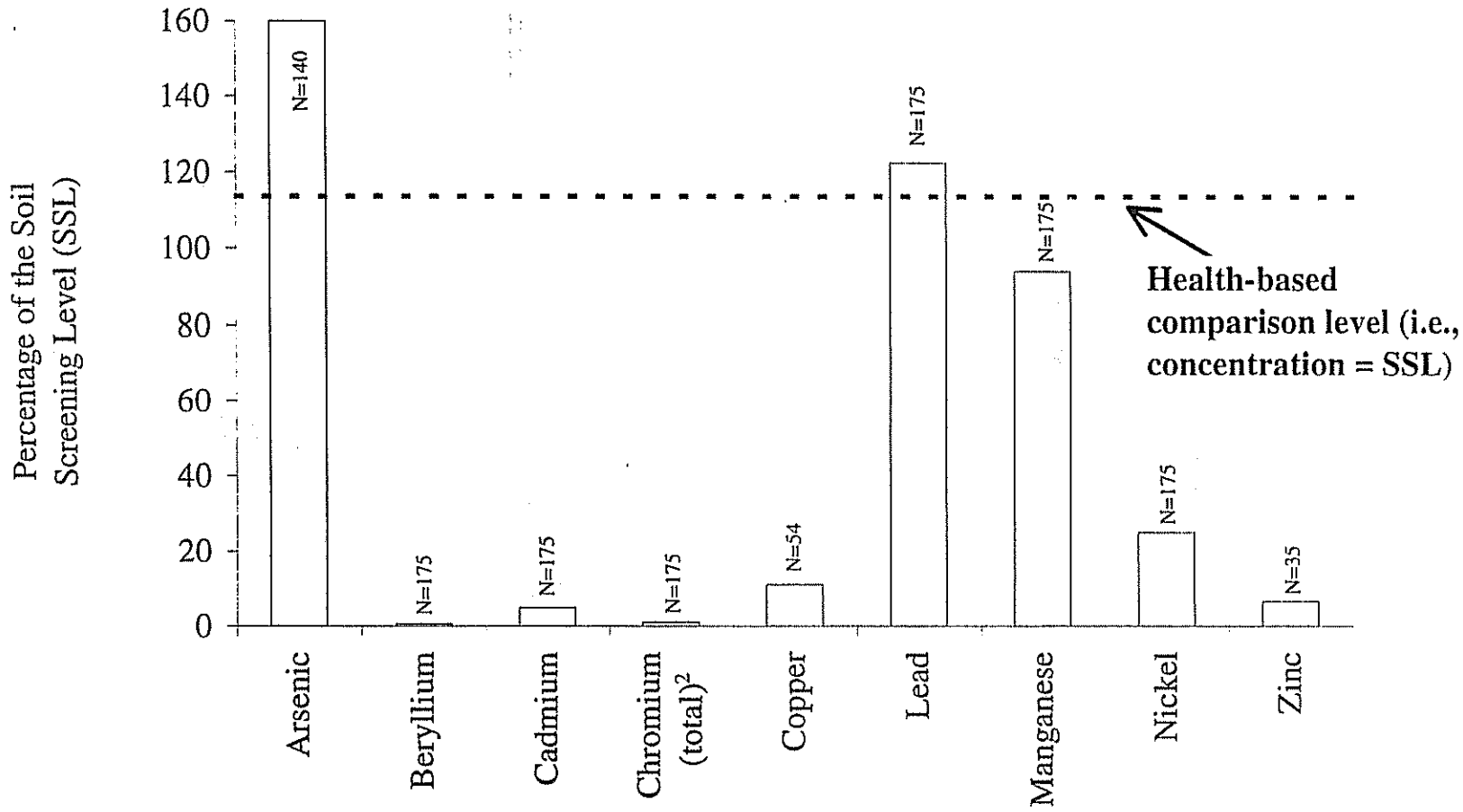
concentrations of aluminum, iron, strontium, and titanium were compared with soil concentrations reported in local and national background sampling as sufficient toxicity data were not available for deriving SSL values. Measured soil concentrations of the other metals were also compared with their respective local and national background ranges (Table B.2).

Measured soil concentrations of all metals except lead and arsenic were below their respective SSLs (Figure 2.11) and are therefore not expected to result in adverse health effects. Of the 175 soil samples collected between 1991-1995, 99.8% contained lead concentrations below the SSL of 400 mg/kg (Figure 2.12). The one sample which contained lead at a concentration above the SSL was collected near the base of the AT&T Tower (Figure 2.10, Site #46-490 mg/kg). This site is surrounded on all sides by TXl property and therefore, long-term exposure to children is unlikely. This finding, considered in conjunction with the fact that the SSL for lead was only slightly exceeded, indicates that the measured levels of lead are not likely to pose a health risk to children. Further, comparison of the distribution of lead in Midlothian and U.S. soils indicates that there were no significant differences between the two (Figure 2.12). Both distributions were characterized by having a large percentage of samples at the lower end of the concentration distribution, with only a small percentage of samples containing higher lead concentrations (Figure 2.12). Accordingly, the distribution of lead in Midlothian soils appears to be inconsistent with an air deposition pattern, and is unlikely to be related to air emissions from Midlothian industries.

With respect to arsenic, 134 of the 140 (96%) soil samples collected between 1991-1995 contained arsenic concentrations below the SSL of 20 mg/kg (Table B.1). The highest arsenic concentrations were measured in soil samples collected from a cotton field, where the arsenic is more likely to have been associated with agricultural practices than industrial emissions. In the most recent 1995 soil sampling, only one sample contained an arsenic concentration above 20 mg/kg (Figure 2.10, Site #41-21 mg/kg). Given the conservative nature of the SSL for arsenic and the fact that the reported soil concentrations did not significantly exceed the SSL, adverse health effects are not expected.

Concentrations of the various metals measured in Midlothian soils were compared to relevant background levels. It should be noted that background metal concentrations can vary significantly between soil types, as the ranges of metal concentrations in soils are dependent on the rock material from which the soil was formed, as well as on human activities (e.g., agricultural practices). As there are approximately 27 soil types in Ellis County alone (USDA, 1992), the extensive sampling in Midlothian included samples from multiple soil types. However, in collecting local background soil samples, it was not technically feasible to adequately characterize background metal ranges within all of the different soil types in the Midlothian area. Therefore, local background samples only provide an estimate of metal concentrations within a specific unimpacted area and are

Figure 2.11
MAXIMUM METAL CONCENTRATIONS
IN SOIL FROM 1991-1995[1]

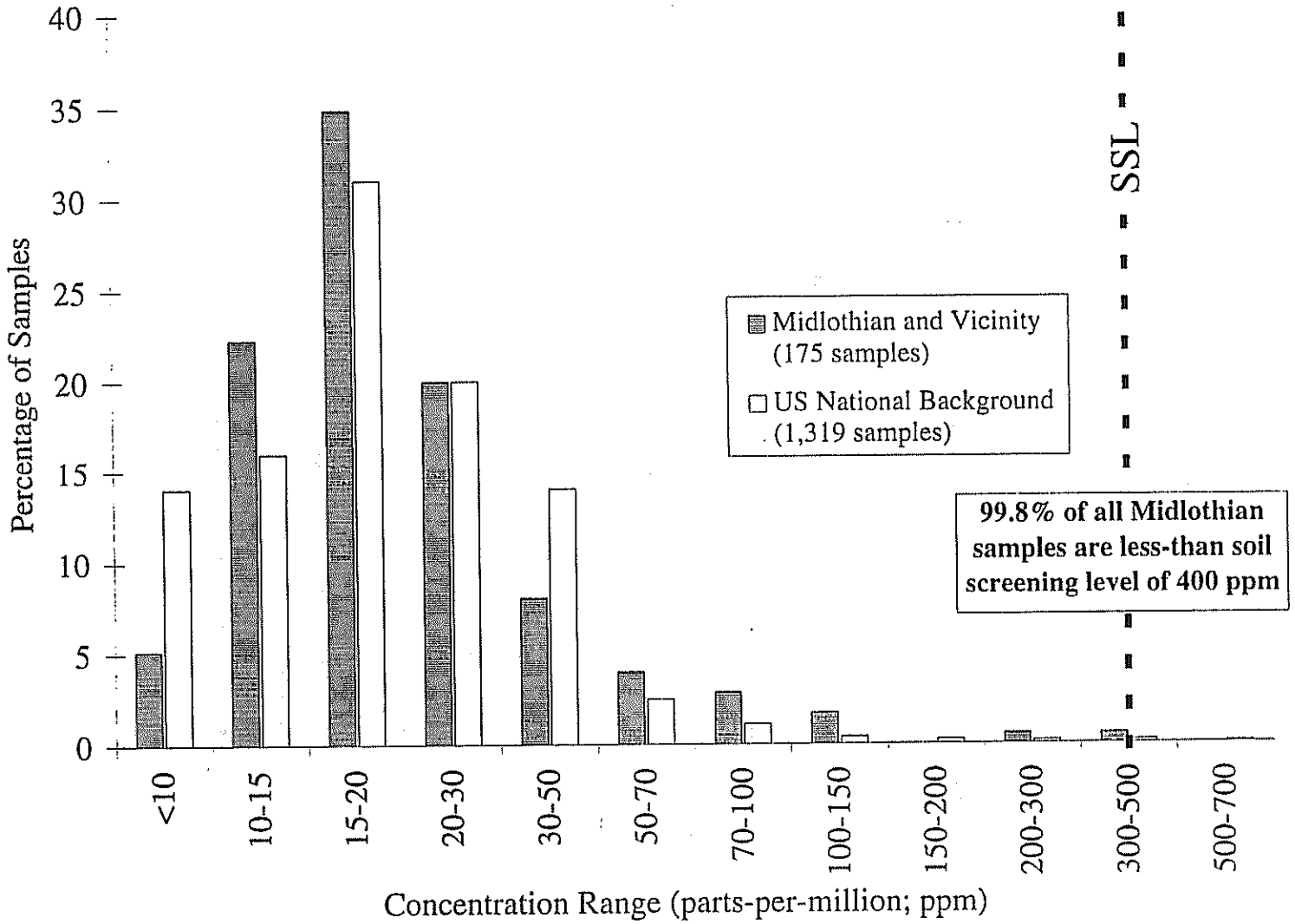


[1]Maximum concentrations are expressed as a percentage of the soil screening values. **Antimony, Mercury, Selenium, and Thallium** were detected less-than 10% of the time.

[2]Percent concentration of total chromium is relative to Cr(III)/metallic Cr soil screening value and is based on the assumption that the total chromium is predominantly Cr(III)/metallic Cr (see text for details).

Figure 2.12

Distribution of Lead in Midlothian Soil



unlikely to be representative of the broad range of soil types covered by the Midlothian soil sampling efforts. For this reason, metal concentrations in Midlothian soils were also compared with U.S. background ranges recognized by the USGS (United States Geological Survey), which include a greater diversity of soil types.

For all eighteen metals, the soil concentrations reported in Midlothian were within the range of metal concentrations reported in background soils across the United States (Table B.2). In addition, based on the 1995 soil sampling results, the median soil concentrations in Midlothian were equal to or lower than the local background median concentration for seven metals (antimony, chromium, mercury, molybdenum, nickel, selenium, and thallium) and higher than the local background median concentration for the remaining metals (aluminum, beryllium, cadmium, copper, iron, lead, manganese, strontium, titanium, and zinc) (Table B.2).

2.2.1.2 Chaparral Steel Special Study

Based on concerns expressed by a rancher in Midlothian, surface soil samples (1/4-1/2 inch depth) were collected at 22 sites near Chaparral Steel property (Figure 2.13). The samples were analyzed for up to eighteen metals including aluminum, antimony, arsenic, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, strontium, thallium, titanium, and zinc. Metal concentrations in the soil samples were determined using the methodology described in Section 2.2.1.1 (Area-Wide Sampling).

With the exception of cadmium and lead, soil concentrations of all metals at all sites were below their respective SSLs or within the range of background U.S. soil concentrations. The range of measured soil concentrations, SSLs, and range of background U.S. soil concentrations are outlined in Table B.3.

In order to discuss the results for cadmium and lead concentrations in the soil collected near Chaparral Steel, the sampling sites were assigned to three zones (Figure 2.14). Zone 1 is the area where samples 17-20 were collected and is immediately north of Chaparral (north of Highway 67). Zone 2 is the area where samples 2-8 were collected and is the property that was immediately south of Chaparral's southern property line. Zone 3 is the area where samples 9-16 were collected and is immediately south of Zone 2. The measured concentrations of cadmium and lead at each site in the respective zones are shown in Figure 2.14. The median concentrations of cadmium and lead in Midlothian soil (excluding data from zones 1-3), as determined from data collected during 1991-1995 (refer to section 2.2.1.1 Area-Wide Sampling), are also shown in Figure 2.14.

Zone 2 is the only zone where soil concentrations of cadmium and lead exceeded their respective SSLs of 40 and 400 ppm. Specifically, soil concentrations of cadmium and lead at sites 2 and/or 8 are significantly greater than their respective Midlothian median

Figure 2.13

SAMPLE LOCATIONS FOR CHAPARRAL STEEL SPECIAL STUDY

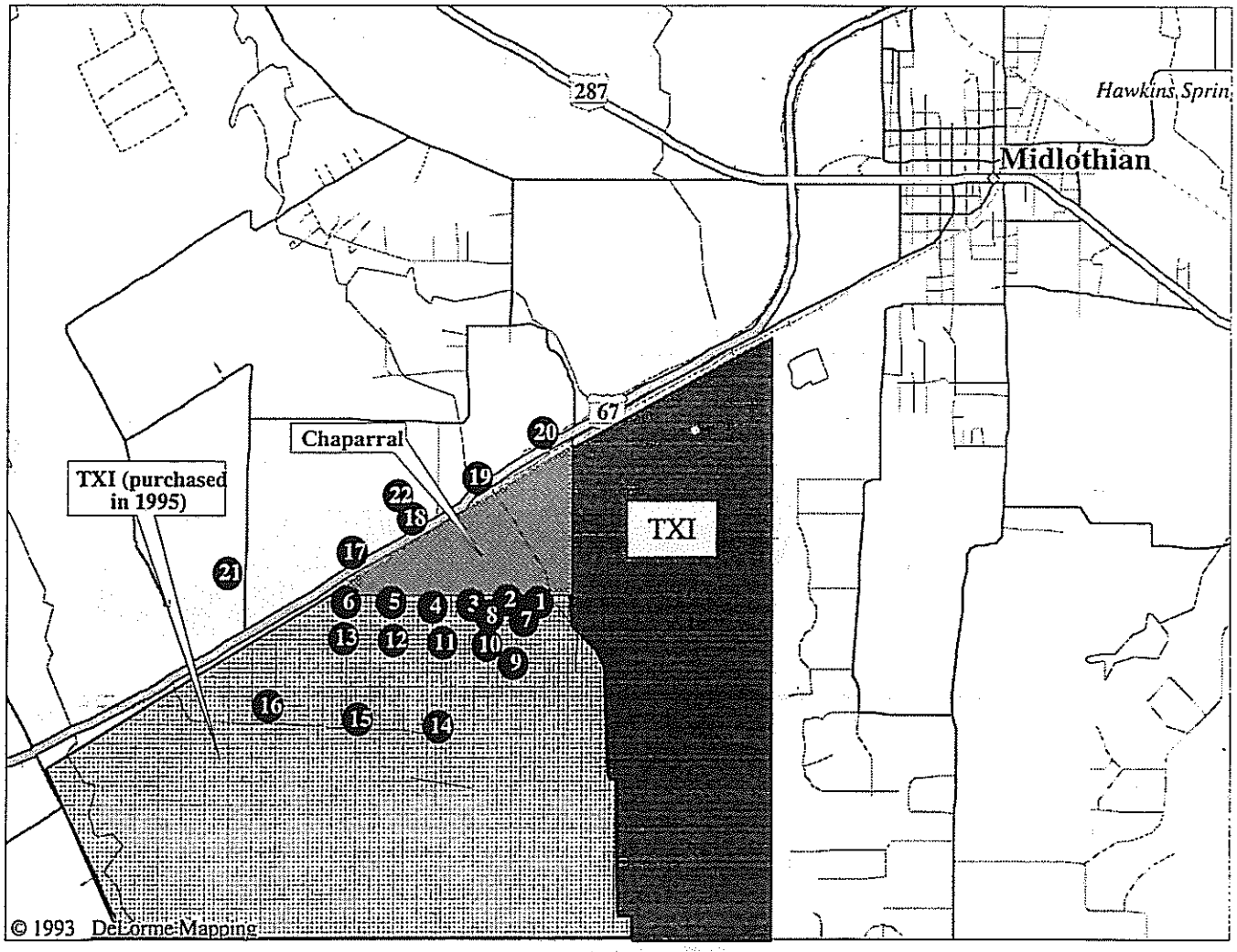
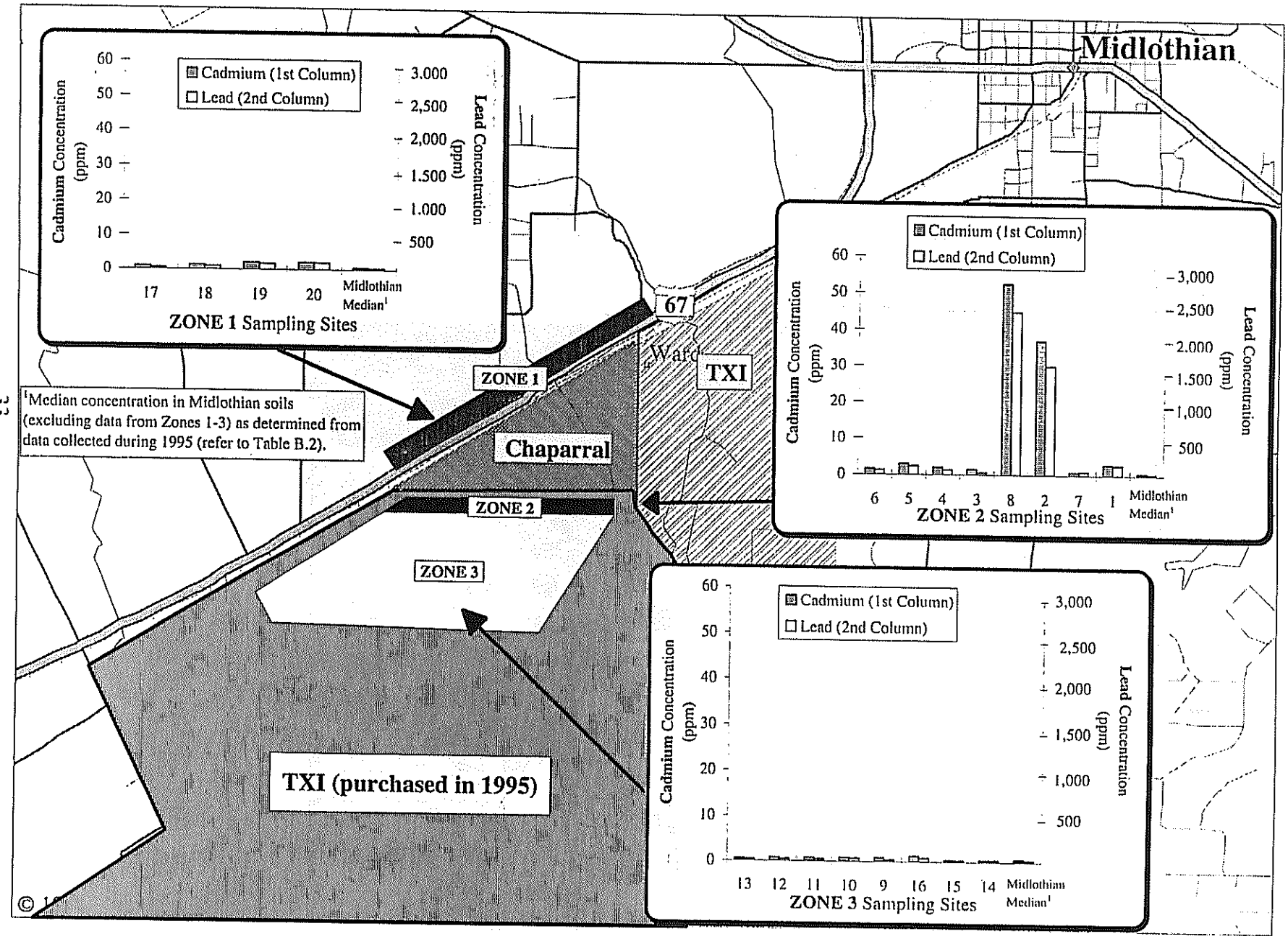


Figure 2.14
METAL CONCENTRATIONS IN SOILS NEAR CHAPARRAL STEEL
(special monitoring study)



concentrations and are the only sites where the SSLs are exceeded. As shown in Figure 2.14, the soil concentrations of cadmium and lead in Zones 1 and 3 approach the Midlothian median concentrations, which are well below the SSLs.

In conclusion, the extent to which soil concentrations of cadmium and lead exceed their respective SSLs was limited to a very isolated area immediately south of Chaparral's property. However, TXI has since purchased the property south of Chaparral Steel and Chaparral is leasing this property from TXI for industrial use. Since public exposure is unlikely on the property sampled south of the facility, we would not expect adverse health effects to result from exposure to the concentrations of metals measured in the soil samples collected south of the facility (sites 1-16; Figure 2.13). The metal concentrations for all areas sampled to the north of the facility were below their respective SSLs. Therefore, adverse health effects are not expected to occur'as a result of exposure to the measured levels of metals in the soil samples collected from the property north of the facility (sites 17-22; Figure 2.13).

In addition, pursuant to an Agreed Order with the TNRCC, Chaparral Steel will further investigate the soil, sediment, and water concentrations of metals on the property immediately north of Chaparral and on the property they are leasing from TXI, which is south of their current facility. Chaparral will also monitor ambient air, both to the north and south of their facility, and determine air concentrations of PM_{10}, TSP, and metals.

2.2.2 Dioxins and Furans

Soil sampling and analysis for PCDDs/PCDFs was conducted in Midlothian in order to assess the likelihood that PCDD/PCDF deposition was occurring as a result of emissions from local industries. The focus on PCDDs and PCDFs in Midlothian soils was due to information in the literature which indicated that cement kilns and secondary steel mills are among the industrial processes recognized as potential emissions sources of this class of compounds (USEPA, 1994a). Through atmospheric deposition, emitted PCDDs/PCDFs may then be transferred from the air to environmental media such as soils.

The purpose of the sampling was to characterize the concentrations ofPCDDs/PCDFs in Midlothian area soils and to evaluate the potential for health impacts. In addition, the concentrations of PCDDs and PCDFs in Midlothian soils were compared with those measured in local background soil samples. A total of sixty soil samples were collected in the Midlothian area using a standard TNRCC protocol. Six of the sixty samples were background samples collected to the east and west of the city at sites unlikely to be impacted by the four major industries. In order to obtain a worst-case exposure estimate, individual sampling sites were located in areas which were expected to contain the highest PCDD/PCDF concentrations (e.g., drainage areas, areas predicted to experience the greatest atmospheric deposition of PCDDs/PCDFs based on computer modeling, and

knowledge of predominant wind directions). Refer to Figure 2.15 for the location of soil sampling sites in the Midlothian area.

Soil samples were analyzed for the seventeen PCDDs/PCDFs which are of concern from a toxicological standpoint (i.e., 2,3,7,8 substituted PCDDs/PCDFs) using modified USEPA Method 1613. Modified USEPA Method 1613 employs gas chromatography with high resolution mass spectroscopy. Toxicity Equivalency Factors (TEFs) were applied to the measured soil concentrations of each respective 2,3,7,8-PCDD and PCDF, in order to normalize the concentrations based on their potency relative to 2,3,7,8-TCDD. These values were then summed to obtain a single soil concentration, known as a Toxicity Equivalency Quotient (TEQ). The potential toxicity of the complex mixture of PCDDs and PCDFs in each of the soil samples was then assessed by comparing the total 2,3,7,8-TCDD TEQ concentration to the health-based guidance level for 2,3,7,8-TCDD.

The TEQ concentrations measured in Midlothian soils ranged from 0.3-17.9 parts per trillion (ppt), while TEQ concentrations at local background sites ranged from 0.8-3.2 ppt (Table B.4). The measured soil PCDD/PCDF concentrations for all sixty samples were well below the Agency for Toxic Substances and Disease Registry (ATSDR) health-based guidance level of 1000 ppt. Therefore, adverse health effects are not expected to result from exposures to the measured levels of PCDDs and PCDFs.

In addition, eighty-three percent of the Midlothian samples had TEQ concentrations within the range of the six local background samples. It should be noted that a comprehensive characterization of PCDD/PCDF concentrations in background soils would be likely to generate a broader concentration range than was reported in this limited background sampling. The median TEQ concentration for Midlothian sampling sites and background sampling sites were 1.4 and 1.8, respectively (Table 2.3). These median TEQ soil concentration were both below the estimated median TEQ concentration for North American soils of 7.7 ppt, and all measured concentrations were within the North American background range (USEPA, 1994a). Therefore, based on these results, the PCDD/PCDF concentrations measured in Midlothian soils do not appear to be significantly different than background. In addition, the distribution of PCDD/PCDF concentrations in Midlothian soils does not seem to be consistent with an air deposition pattern, and is unlikely to be related to air emissions from Midlothian industries.

2.3 Miscellaneous

2.3.1 Hay, Miscellaneous Vegetation, and Wheat

As part of the special monitoring study that was conducted near Chaparral Steel, hay-bale, miscellaneous vegetation (i.e., forage), and wheat-head samples were collected and analyzed for up to eighteen metals including aluminum, antimony, arsenic, beryllium,

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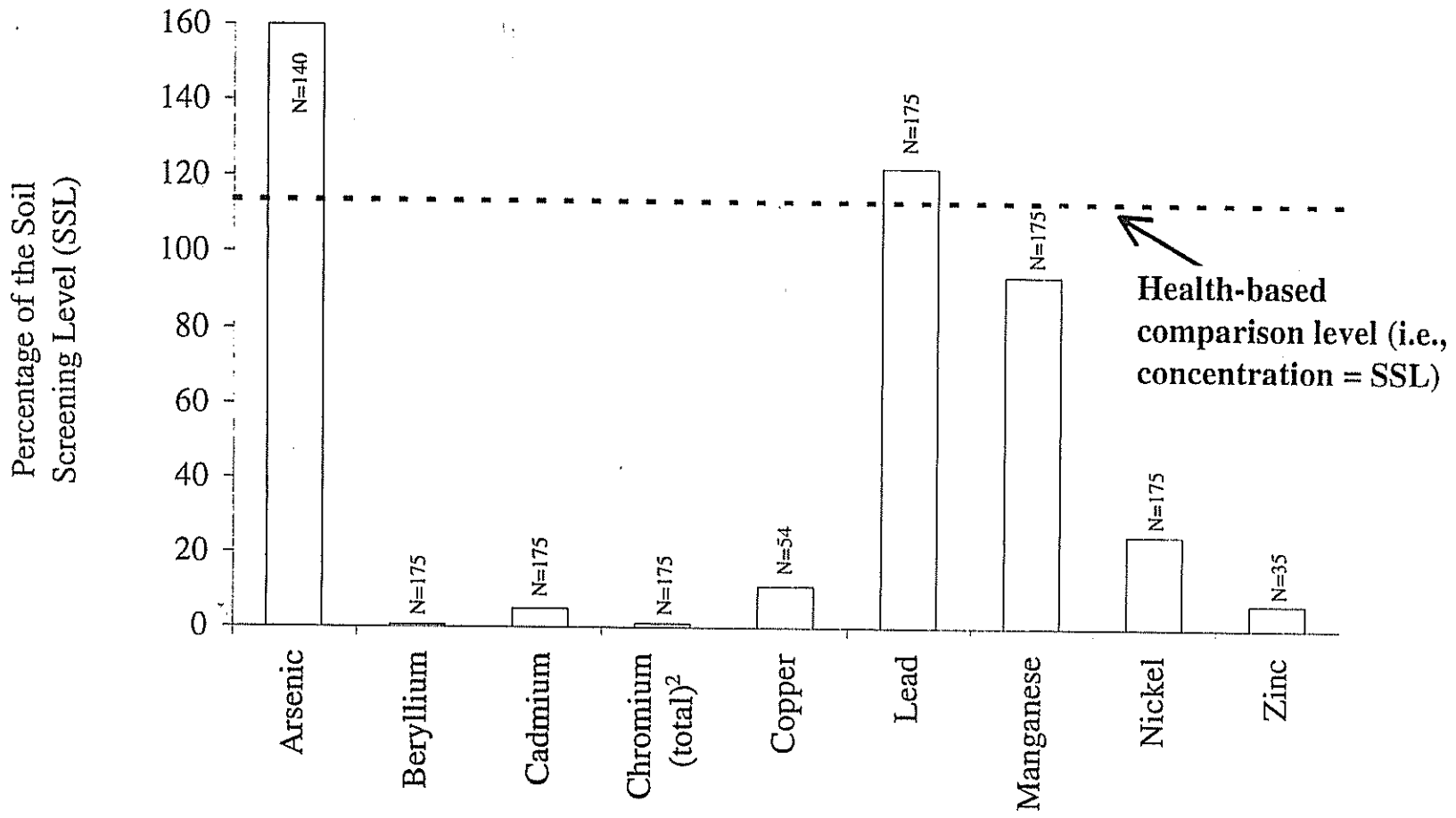

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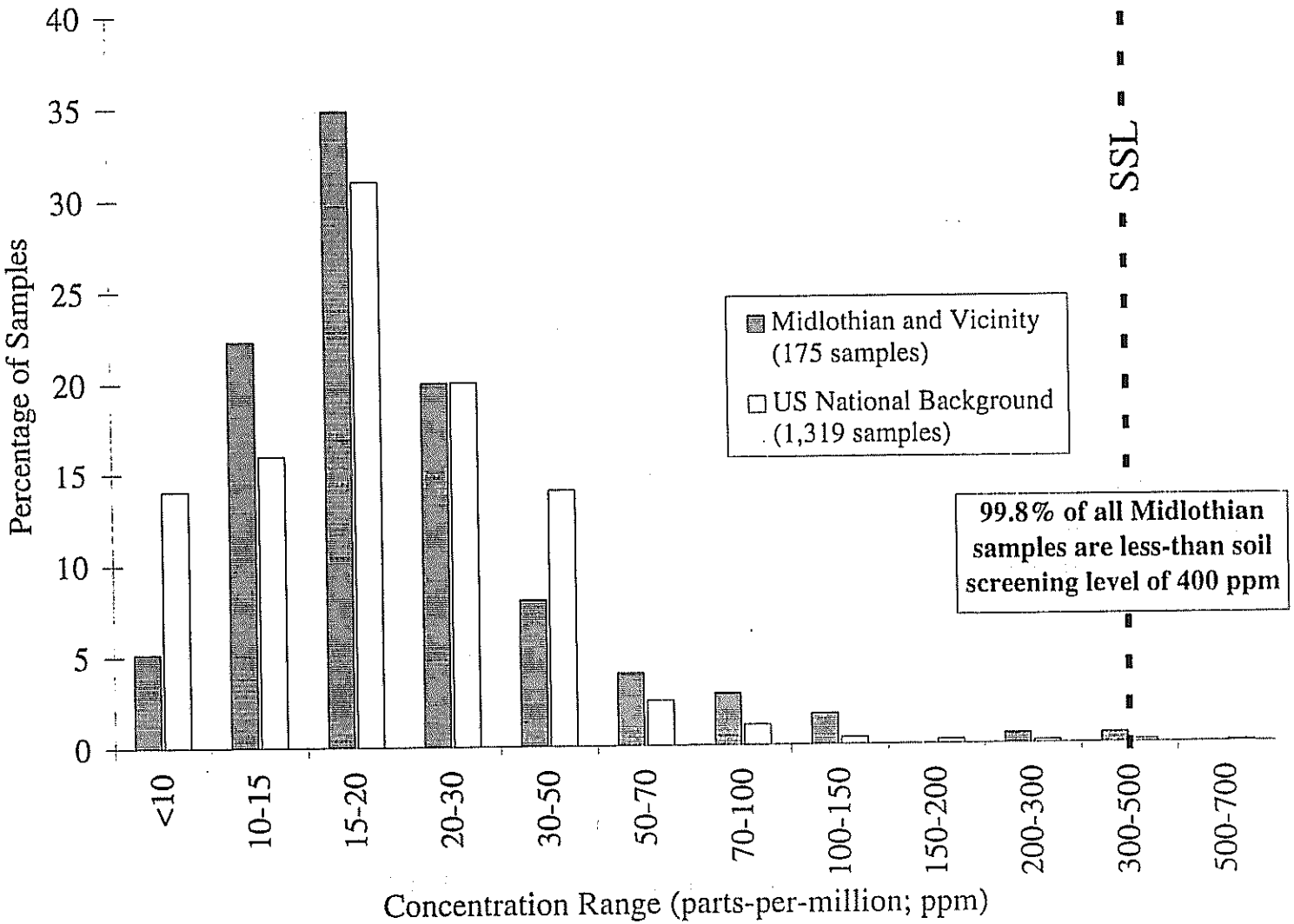

unlikely to be representative of the broad range of soil types covered by the Midlothian soil sampling efforts. For this reason, metal concentrations in Midlothian soils were also compared with U.S. background ranges recognized by the USGS (United States Geological Survey), which include a greater diversity of soil types.

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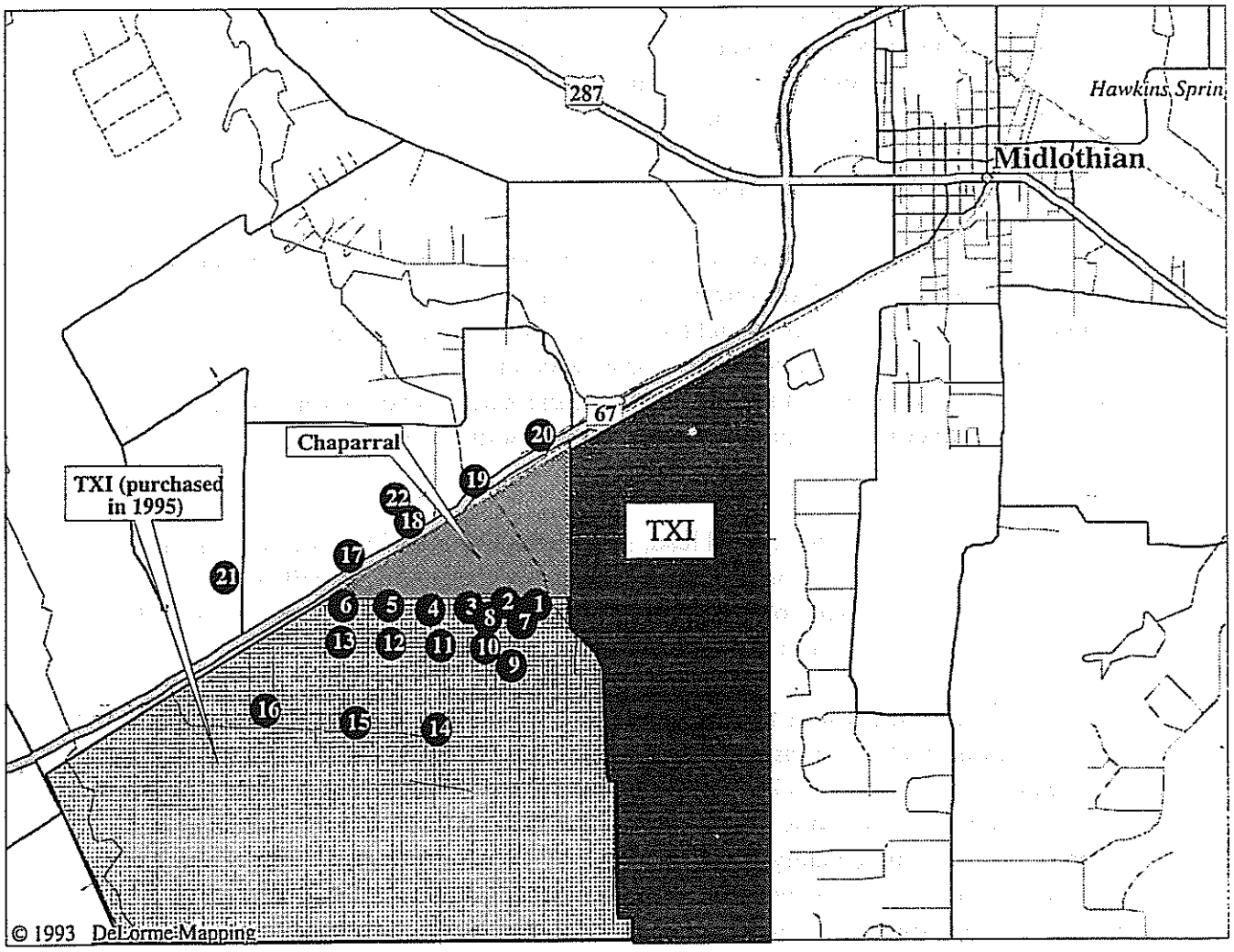

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METAL CONCENTRATIONS IN SOILS NEAR CHAPARRAL STEEL
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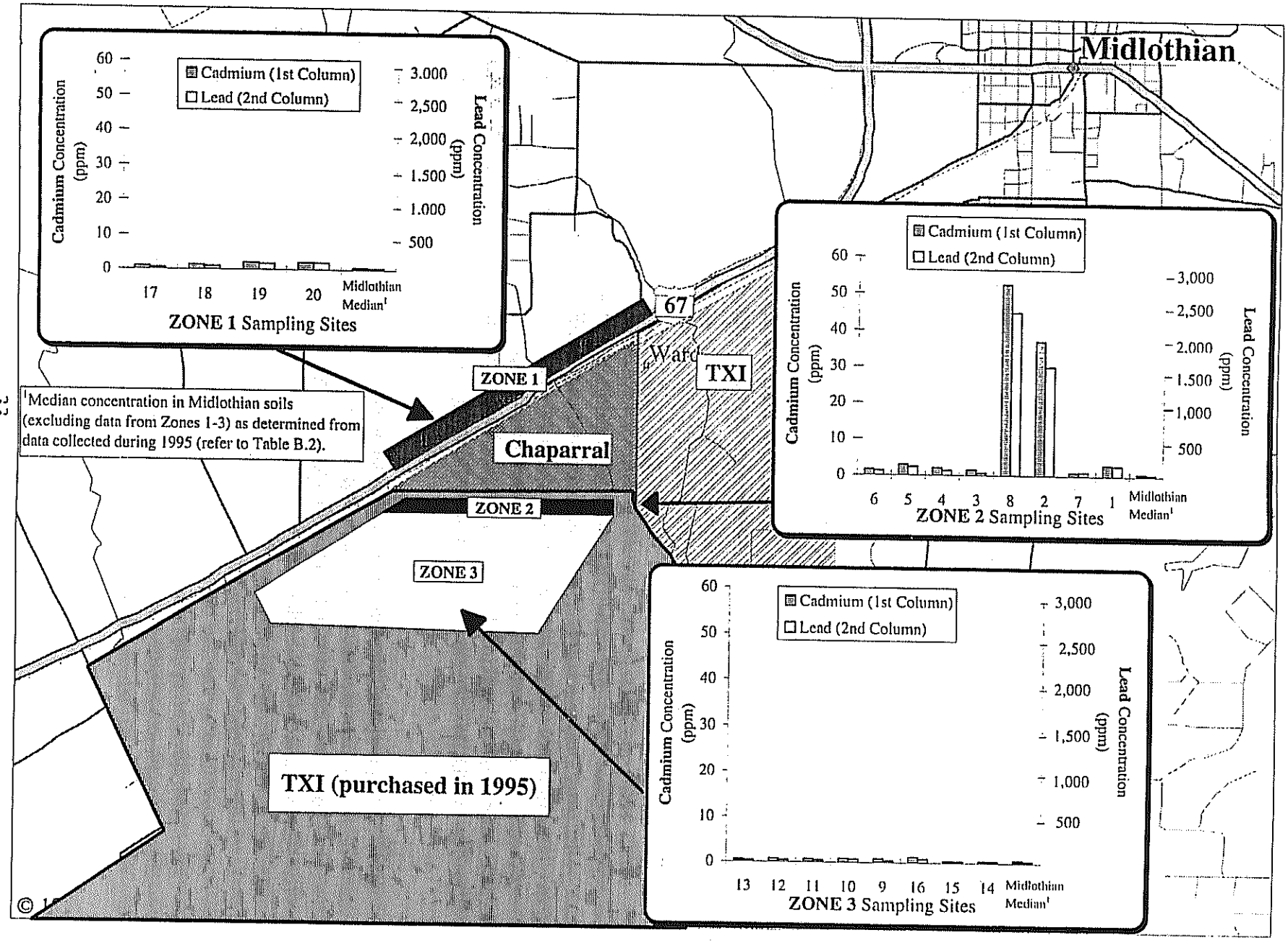

[1]Median concentration in Midlothian soils (excluding data from Zones 1-3) as determined from data collected during 1995 (refer to Table B.2).

concentrations and are the only sites where the SSLs are exceeded. As shown in Figure 2.14, the soil concentrations of cadmium and lead in Zones 1 and 3 approach the Midlothian median concentrations, which are well below the SSLs.

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The purpose of the sampling was to characterize the concentrations of PCDDs/PCDFs in Midlothian area soils and to evaluate the potential for health impacts. In addition, the concentrations of PCDDs and PCDFs in Midlothian soils were compared with those measured in local background soil samples. A total of sixty soil samples were collected in the Midlothian area using a standard TNRCC protocoL Six of the sixty samples were background samples collected to the east and west of the city at sites unlikely to be impacted by the four major industries. In order to obtain a worst-case exposure estimate, individual sampling sites were located in areas which were expected to contain the highest PCDD/PCDF concentrations (e.g., drainage areas, areas predicted to experience the greatest atmospheric deposition ofPCDDs/PCDFs based on computer modeling, and

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As part of the special monitoring study that was conducted near Chaparral Steel, hay-bale, miscellaneous vegetation (i.e., forage), and wheat-head samples were collected and analyzed for up to eighteen metals including aluminum, antimony, arsenic, beryllium,

Figure 2.15
SOIL SAMPLING LOCATIONS FOR DIOXINmURANSTUDY

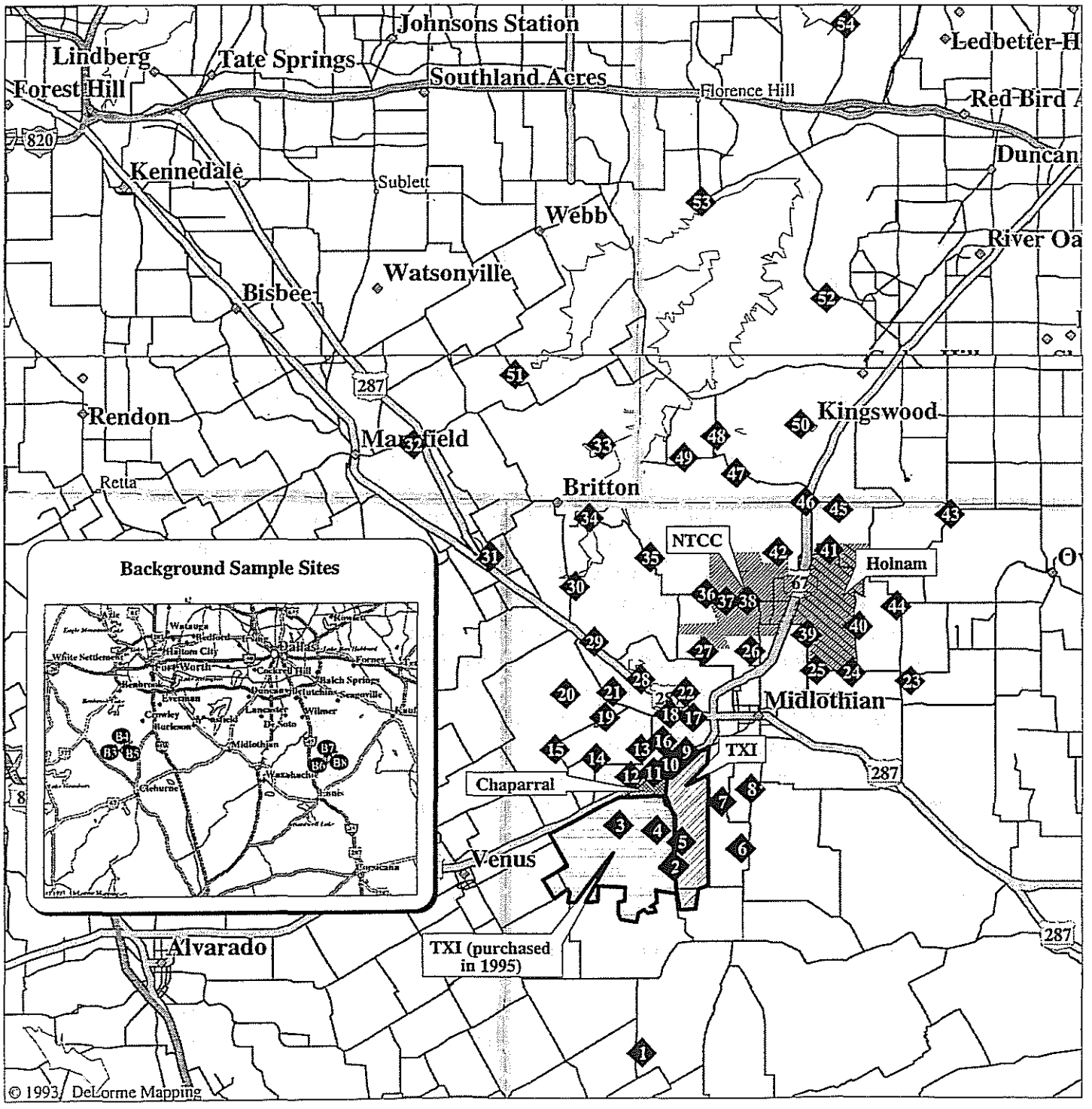


Table 2.3

CONCENTRATIONS OF DIOXINS/FURANS IN MIDLOTHIAN SOILS [1]

Location	Concentration (parts-parts-per-trillion; ppt)
Midlothian	
Median TEQ Concentration (N=54)[2]	**1.4**
TEQ Range	0.3-17.9
Local Background Median TEQ Concentration (N=6)	**1.8**
Local Background TEQ Range	0.8-3.2
North America[3]	
Median TEQ Concentration	**7.7**
TEQ Range	<DL[4]-25.1
ATSDR Health-Based TEQ Guidance Level	1,000

[1]TEQ; Toxicity Equivalency Quotient (USEPA, 1989). Refer to Figure 2.15 in the report for location of Midlothian sampling sites.

[2]N; number of samples.

[3]USEPA, 1994a.

[4]DL; Detection Limit. Approximate range based on three times the standard deviation reported in USEPA (1994a).

cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, strontium, thallium, titanium, and zinc. All samples were analyzed as described previously in Section 2.2.1.1 (Area-Wide Sampling). Hay-bale (sites 8 and 16; Figure 2.13) and miscellaneous vegetation/forage (sites 1-6, 8,16-20; Figure 2.13) samples were collected from property near Chaparral Steel at the request of a local rancher. In addition, wheat-head samples were collected from a wheat field (sites 9-16; Figure 2.13), which was located approximately 50 yards south of the hay field.

The results of the hay-bale and miscellaneous vegetation sample analyses were compared with the maximum tolerable levels (MTL) for cattle. As defined by the National Academy of Science's Subcommittee on Mineral Toxicity, an MTL is, "that dietary level that, when fed for a limited period, will not impair animal performance and should not produce unsafe residues in human food derived from the animal (NAS, 1980). The MTLs are also used as official guidelines suggested for contaminants in individual mineral feed ingredients by *The Association of American Feed Control Officials Incorporated* as described in their 1994 Official Publication (Georgia Dept. of Agric., 1994). In addition, the Agricultural Division of the Food and Drug Administration (FDA) consistently uses MTLs to determine if the levels of minerals in an animals diet are acceptable.

With the exception of aluminum, cadmium, and iron in samples collected in the field immediately south of Chaparral, all measured metal concentrations in the hay-bale samples (Table C.1) and the miscellaneous vegetation samples (Table C.2) were below their respective MTLs. The land immediately south of Chaparral Steel was used by the rancher for agricultural purposes (i.e., production of hay) at the time the hay-bale and miscellaneous vegetation samples were collected. However, this property is currently owned by TXI and is being leased for industrial purposes by Chaparral Steel. Therefore, although the concentrations of aluminum, cadmium, and iron exceeded their respective MTLs in select hay-bale and/or miscellaneous vegetation samples collected from sites south of Chaparral, the potential to cause adverse health effects in cattle is no longer a concern since the property is no longer used for agricultural purposes. The concentrations of all measured metals in miscellaneous vegetation samples collected from the sites north of the facility were below their respective MTLs, suggesting that adverse health effects to cattle would not be expected. In addition, pursuant to an agreed order with the TNRCC, Chaparral Steel will further investigate the impact of metals on soil north of their property. Since the levels of metals in vegetation are directly related to the concentrations of metals in soil, the data collected by Chaparral Steel from property north of their facility will be used to confirm the finding that adverse health effects would not be expected in animals consuming vegetation grown on property north of the facility.

The range and median concentrations of the measured metals in wheat-head samples collected from sites 9-16 (Figure 2.13) are shown in Table C.3. In order to review the potential for adverse health effects in humans that may result from ingestion of the wheat grown in the field south of Chaparral Steel (sites 9-16; Figure 2.13), the daily exposure

level to each of the measured metals (using the maximum metal concentrations) was estimated and compared with the corresponding USEPA-derived acceptable daily intake levels. The results of this exercise indicate that adverse health effects are not expected to result from human consumption of the wheat based on the measured concentrations of metals. For a detailed review of the methodology and results, please refer to the TNRCC Interoffice Memorandum dated September 22, 1994 from Loren Lund to Melvin Lewis (a copy of this memo can be obtained from the TNRCC). In addition, Chaparral Steel has indicated to the TNRCC that the property where the wheat-head samples were collected, which is now leased by Chaparral, will be used for industrial purposes.

2.3.2 Slag

Slag, a by-product from steel mills, is widely used throughout the nation as aggregate for roads and airport runways. Due to concerns expressed by area residents that metals in the slag used for roads in Ellis County could pose a risk to their health, the TNRCC collected slag samples from International Mill Service in Midlothian. The samples were analyzed for thirteen metals including beryllium, antimony, arsenic, cadmium, chromium, mercury, nickel, selenium, lead, iron, manganese, aluminum, and strontium. All samples were analyzed as previously described in Section 2.2.1.1 (Area-Wide Sampling). An initial review of the results indicated that adverse health effects would not be expected from exposure to the measured levels of most of the metals in the slag samples. The one exception was chromium, which required further evaluation.

The concentration of total chromium in the slag samples ranged from 3,700-6,400 ppm, which was less than the SSL of 50,000 ppm for chromium III, but exceeded the SSL of 300 ppm for chromium VI. In order to adequately address the potential for exposure to chromium VI in slag, the samples were re-analyzed for chromium VI using spectrophotometry according to TACB Method 34. Concentrations of Chromium VI ranged from approximately 1 ppm to 13 ppm, which are well below the respective SSL of 300 ppm, as well as below levels where contact sensitivity has been observed (Paustenbach et al., 1991 and 1992). Therefore, adverse health effects are not expected to result from exposure to the measured levels of chromium in slag.

In order to determine whether the levels of chromium would be elevated in ambient air near roads where slag had been used, air samples were collected and analyzed for total chromium and chromium VI. Samples were collected immediately adjacent to a "slag road" during the dustiest conditions likely to occur. The ambient air concentrations of both total chromium and chromium VI were less than their respective MDLs, which were less than the corresponding ESLs. Therefore, adverse health effects are not expected to result from exposure to the measured air concentrations of chromium VI or total chromium.

2.4 Dioxin and Furan Stack Sampling

As part of their permit requirements for burning WDF and as required under 30 TAC 111.124, TXI and NTCC were required to perform stack sampling for: 1) two principle organic hazardous constituents (POHCs) as indicators of system destruction and removal efficiency for organics, criteria pollutants, heavy metals, hydrogen chloride, and chlorine gas. At the time of this testing (1991), both companies also elected to conduct stack sampling and analysis for PCDDs and PCDFs while firing coal and while firing WDF. North Texas Cement Company tested under two different conditions while burning WDF (36% and 60% replacement of coal with WDF). Texas Industries, Inc. tested while burning 100% WDF.

Holnam was authorized in 1991 to burn tire-derived fuel on a trial basis. As a part of their permit, stack sampling was required for PCDDs and PCDFs, as well as criteria pollutants, metals, a variety of organic compounds, hydrogen chloride, and chlorine gas. All of these compounds were sampled while firing tire-derived fuel and while firing coal (as a baseline case).

USEPA Reference Method 23 was used to quantify the levels of PCDDs and PCDFs present in stack gases for all 3 facilities. Stack gas concentrations of PCDDs and PCDFs were then employed in conjunction with modeling results for each of the facilities to estimate maximum ground level concentrations for all 2,3,7,8-substituted congeners. The potential toxicity of the complex mixture of PCDDs and PCDFs emitted from each of the facilities was then assessed by expressing the concentrations of 2,3,7,8-substituted congeners as an equivalent concentration of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and summing the results (Tables D.I-D.3). As such, the total toxic equivalency (TEQ) of the mixture emitted is the sum of the weighted potency of each compound in the mixture.

The total 2,3,7,8-TCDD TEQ concentration estimated for each of the test conditions was then compared to the corresponding annual ESL for 2,3,7,8-TCDD of 3.0×10^{-8} µg/m^3. All TEQ concentrations for the three facilities, regardless of the specific test conditions, were below the annual ESL for 2,3,7,8-TCDD (Table 2.4). For Holnam, the total TEQ concentration estimated when burning 30% TDF (5.01×10^{-11}) was similar to that estimated when burning 100% coal (4.21×10^{-11}). For NTCC, total TEQ concentrations ranged from 4.93×10^{-9} to 6.42×10^{-10} µg/m^3 while burning WDF. The total TEQ concentration estimated when burning 100% coal (1.19×10^{-10} µg/m^3) was similar to that measure when burning WDF (Table 2.4). Total TEQ concentrations estimated for TXl were 6.73×10^{-11} and 4.60×10^{-10} µg/m^3 when burning 100% coal and 100% WDF, respectively (Table 2.4). Based on these results, inhalation exposure to the estimated levels would not be expected to produce adverse health effects.

Table 2.4
FACILITY-SPECIFIC 2,3,7,8-TCDD TEQ
CONCENTRATIONS MEASURED DURING STACK TESTS

Facility	Test Condition	TotaI2,3,7,8-TCDD TEQs
NTCC	100% coal	1.19×10^{-10}
	36% WDF	6.42×10^{-10}
	60%WDF	4.9×10^{-9}
TXI	100% coal	6.73×10^{-11}
	100% WDF	4.60×10^{-10}
Holnam	100% coal	4.21×10^{-11}
	30% TDF	5.01×10^{-11}

3.0 CONSERVATIVE SCREENING LEVEL RISK ANALYSES

3.1 Background

In the Spring of 1993 the USEPA announced a National Hazardous Waste Reduction and Combustion Strategy (USEPA, 1993a), which applied to incinerators and industrial furnaces burning hazardous waste. In the course of implementing the National Strategy, the USEPA recommended that risk assessments, evaluating both direct and indirect routes of exposures, be included as part of the review of the permit application for all incinerators and BIFs burning hazardous waste. In accordance with this recommendation, the TNRCC has conducted risk assessments for the two Midlothian facilities which have burned or continue to burn waste-derived fuel (i.e., NTCC and TXI). Holnam Texas L.P. and Chaparral Steel were not specifically evaluated in the risk assessment as neither facility burns hazardous waste but rather were factored in by setting conservative target risk levels to account for such background exposures.

3.2 Methodology

The risk assessments performed for NTCC and TXI were conducted in accordance with the guidance provided in the *Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes* (USEPA, 1994b; hereafter referred to as the Indirect Screen document). The TNRCC developed a progressive screening approach for applying USEPA's Indirect Screen document methodology. The progressive screening approach developed by the TNRCC involves two tiers: 1) an initial screening evaluation; and 2) a refined screening evaluation. Such an approach allows for progression from a generic worst-case risk assessment to an increasingly more detailed (site-specific) risk assessment. The various components of the progressive screening approach developed by TNRCC are outlined in Figure 3.1.

3.2.1 Chemicals of Concern

The Indirect Screen document (USEPA, 1994b) provided the list of chemicals of concern for evaluation in the indirect screening risk assessment. However, the Indirect Screen document (USEPA, 1994b) does not provide the list of chemicals of concern for evaluation in the direct screening evaluation. Therefore, a preliminary list of potential chemicals of concern was developed for the direct evaluation based on the chemicals recommended for identification in the Implementation Guidance (USEPA, 1994c) and the Draft Addendum (USEPA, 1993b).

FIGURE3.l
Summary of Progressive Screening Approach

Initial Screening Evaluation	Refined Screening Evaluation
Emission Estimates	
REPRESENTATIVE OF CONSERVATIVE WORST-CASE EMISSIONS	INCREASINGLY MORE REPRESENTATIVE OF ACTUAL EMISSIONS
● METALS ● Permit limits or highest of test	● METALS ● Reductions inpermit limit-based emission rates by comparing to test data
● ORGANICS ● Highest of test data (when available) or conservative surrogate data	● PROXIES ● Reductions in proxy-based emission rates by comparing to detection limits more appropriate for use in risk assessment (SQLs)
● PROXIES ● One-half of MDL used for non-detected for chemicals	
● SURROGATE DATA ● Conservative surrogate data used for chemicals not on analyte list	
Air Modeling	
CONSERVATIVE MODEL INPUTS	MORE REFINED MODEL INPUTS
● MAXIMUM OFF-PROPERTY LOCATION ● Location at which the combined off-property wet and dry deposition estimated by the model is greatest; all other model outputs are assumed to simultaneously occur at the same location	● DISCRETE RECEPTOR LOCATIONS ● Representative of actual current receptor locations or future potential receptor locations
Exposure Assessment	
BOUNDING EXPOSURE ESTIMATES	INCREASINGLY MORE REPRESENTATIVE OF ACTUAL EXPOSURES
● HIGH RISK ACTIVITY PATTERNS ● Evaluated using maximum concentrations for all media even if maximum media concentrations occur at different locations	● HIGH RISK ACTIVITY PATTERNS ● Evaluated at locations where activities actually occur or could potentially occur in future
● EXPOSURE PATHWAYS ● Exposure assumed via all pathways identified for scenario	● EXPOSURE PATHWAYS ● Local activity patterns considered in determining appropriate exposure pathways for scenario
Risk Characterization	
BOUNDING RISK ESTIMATES	INCREASINGLY MORE REPRESENTATIVE OF LIKELY RISKS
Based on very conservative exposure assumptions that, when applied together, cascade into highly improbable risk estimates	Representative of conservative, yet reasonable, estimates of risk based on high-end actual exposures

3.2.1.1 Chemicals of Concern for the Indirect Analysis

The Indirect Screen document (USEPA, 1994b) focused on those compounds that are:

a) judged to be of the greatest concern due to their toxicity and/or environmental persistence by one or more indirect routes of exposure;
b) most frequently detected during stack testing of combustion devices; or
c) believed to be products of incomplete combustion.

The chemicals of concern that were assessed in the indirect assessment conducted by the TNRCC included arsenic, beryllium, benzo(a)pyrene toxicity equivalency quotients (TEQs), bis(2-ethylhexyl)phthalate, 1,3-dinitrobenzene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, di-n-octyl phthalate, hexachlorobenzene, lead, mercury, nitrobenzene, polychlorinated biphenyls (PCBs), pentachloronitrobenzene, pentachlorophenol, and 2,3,7,8-tetrachlorodibenzo(*p*)dioxin TEQs.

3.2.1.2 Chemicals of Concern for the Direct Analysis

There are many constituents that could potentially pose a health risk as a result of inhalation exposure. The chemicals identified for potential evaluation in the Draft Addendum and Implementation Guidance (USEPA, 1993b and 1994c) were based on data in USEPA's possession, as well as lists of toxic compounds from certain USEPA programs. Source lists included: the Hazardous Waste Constituent list in 40 CFR 261, Appendix VIII; the Hazardous Air Pollutants (HAPs) list; and the list of organic compounds found in combustion devices developed for the Draft Addendum (USEPA, 1993b). In accordance with USEPA methodology (USEPA, 1994c), relevant compounds were selected for analysis of direct inhalation risks. The final list consisted of 41 chemicals (Table 3.1).

3.2.2 Exposure Assessment

The USEPA Indirect Screen document (USEPA, 1994b) specifies the exposure scenarios that are to be evaluated and provides conservative default values for most input parameters. However, the guidance also allows for the use of available site-specific information to refine certain assumptions. Site-specific land use and activity pattern information was used to determine when conservative assumptions regarding exposure scenarios were implausible (e.g., that exposure occurs at the point of maximum deposition) and to make alternative assumptions (e.g., to identify locations at which the exposure scenarios used for the screening analysis were plausible).

The exposure scenarios and pathways included in the screening analysis are those considered to be most significant for combustion sources (Figure 3.2). Selection of the most significant pathways was based on a multi-pathway evaluation, emphasizing food

Table 3.1
CHEMICALS OF CONCERN

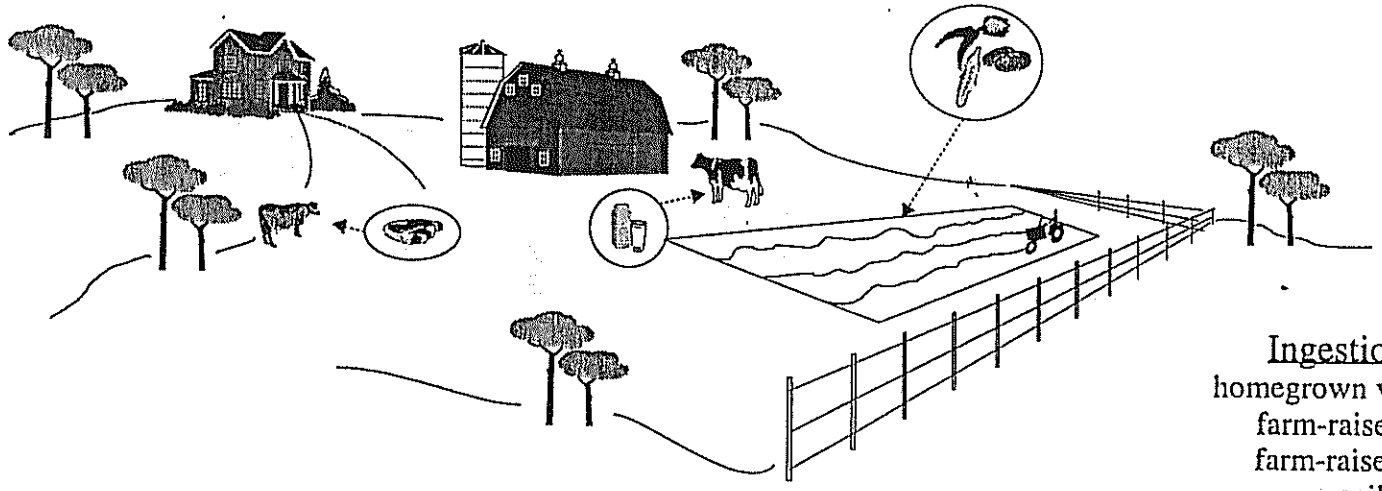
Direct Analysis

Acrylonitrile[a,b]	Ethyl Benzene[a,b]
Aniline[a]	Formaidehyde[a,b]
Arsenic[a,b]	Hexachiorobenzene[a,b]
Benzene[a,b]	Hexachiorobutadiene[a,b]
Beryllium[a,b]	Hexachlorocyciopentadiene[a]
Bis(2-chioroethyl) Ether[a,b]	Hexachloroethane[a,b]
Bromoform[a]	n-Hexane[a]
Bromomethane[a,b]	Mercuric Chioride[b]
,1 3-Butadiene[a,b]	Methylene Chioride[a,b]
Cadmium[a,b]	Methyl Ethyl Ketone[a,b]
Carbon Disulfide[a,b]	Nickel[a,b]
Carbon Tetrachioride[a,b]	o-Nitroaniline[b]
Chloroform[a,b]	Styrene, monomer[b]
Chloromethane[a,b]	1,1,2,2-Tetrachiroethane[b,c]
Cumene[a,b]	Toluene[a,b]
Chromium VI[a,b]	1,2,4-Trichlorobenzene[a,b]
1,2-Dichloroethane[a,b]	1,1,2-Trichloroethane[a,b]
1,I-Dichloroethylene[a,b]	2,4,6-Trichlorophenol[a,b]
Dichioromethane[b]	Vinyl Acetate[a]
1,2-Dichioropropane[a]	Vinyl Chloride[a]
Tetrachlorodibenzo(*p*)dioxin TEQs[a,b]	

[a] Chemical identified in the Implementation Guidance (EPA, 1994c).
[b] Chemical identified in the Draft Addendum (EPA, 1993b).

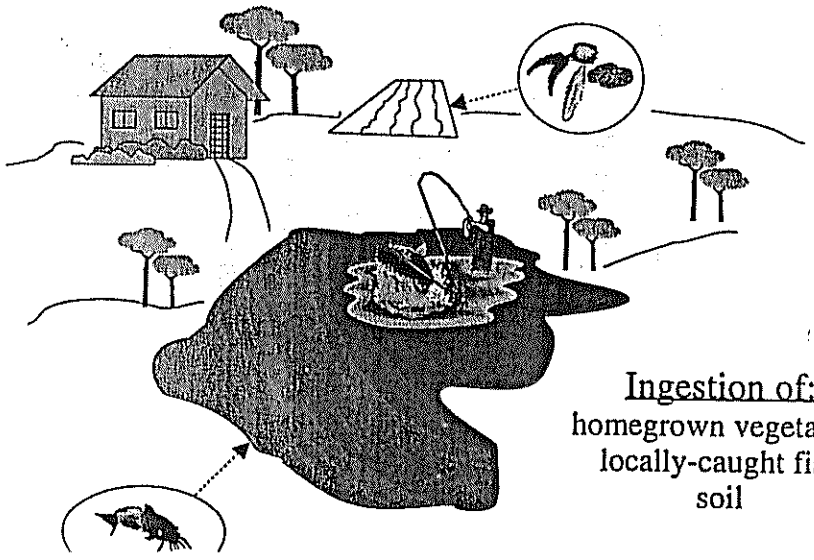
Figure 3.2
CONCEPTUAL SITE MODEL FOR INDIRECT EXPOSURE PATHWAYS

Subsistence Farmer Scenario



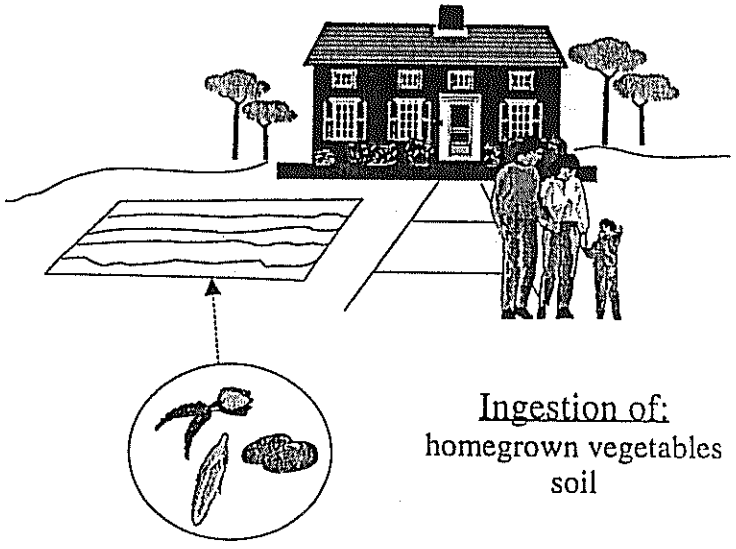
Ingestion of:
homegrown vegetables
farm-raised beef
farm-raised milk
soil

Subsistence Fisher Scenario



Ingestion of:
homegrown vegetables
locally-caught fish
soil

Residential Scenario



Ingestion of:
homegrown vegetables
soil

chain exposures, conducted by USEPA for 105 chemicals. A summary of the pathways evaluated for each exposure scenario in the initial and refined screening evaluation is provided in Table 3.2.

3.3 Results

3.3.1 North Texas Cement Co. (NTCC)

3.3.1.1 Results of Indirect Screening Analysis

Figure 3.3 shows the location of each receptor evaluated and identifies the maximally impacted resident, beef farmer, dairy farmer, and fisher. To identify the maximally impacted receptor, media concentrations were estimated for each identified discrete receptor location and risk characterizations were performed. The maximally impacted receptor was identified as the receptor location at which the total excess lifetime cancer risk and the hazard index, representing the combined HQs for those chemicals with the same target organ effects, were greatest. Table 3.3 presents the total lifetime excess cancer risk and hazard indices from the more refined evaluation at the maximally impacted receptor location for each scenario.

As shown in Table 3.3, the subsistence fisher scenario is the major contributor to the cancer risk and non-cancer hazard indices for the indirect analysis. Ingestion of benzo(a)pyrene, contaminated fish accounts for the majority of the cancer risk associated with this scenario. The hazard quotient associated with ingestion of methyl mercury contaminated fish comprises the majority of the non-cancer hazard index for the subsistence fisher.

The concentration of lead in soil for the NTCC facility was 0.007 mg/kg when maximum off-property dispersion and deposition values were used in the fate and transport modeling. This value is clearly below the media-specific concentration of 100 mg/kg recommended for direct comparison in the Indirect Screen document (USEPA, 1994b).

3.3.1.2 Results of Direct Screening Analysis

Although risks from the inhalation pathway typically contribute much less to the overall risks associated with exposure to combustor emissions than do the indirect pathways, the Indirect Screen document (USEPA, 1994b) suggests conducting a risk-based assessment of direct (inhalation) exposure pathways as well. The State of Texas typically evaluates the potential for inhalation risk during the permitting process by comparing modeled (or monitored) concentrations of chemicals in the air to chemical-specific guideline concentrations called Effects Screening Levels (ESLs).

Table 3.2
SUMMARY OF PATHWAY ANALYSIS BY SCENARIO

Initial Screening Evaluation - Off-Property Maximum			
Pathway	Scenario		
	Residential	Subsistence Farmer	Subsistence Fisher
Soil Ingestion	✓	✓	✓
Vegetable Ingestion	✓	✓	✓
Beef Ingestion		✓	
Milk Ingestion		✓	
Fish Ingestion			✓
Inhalation	✓	✓	✓

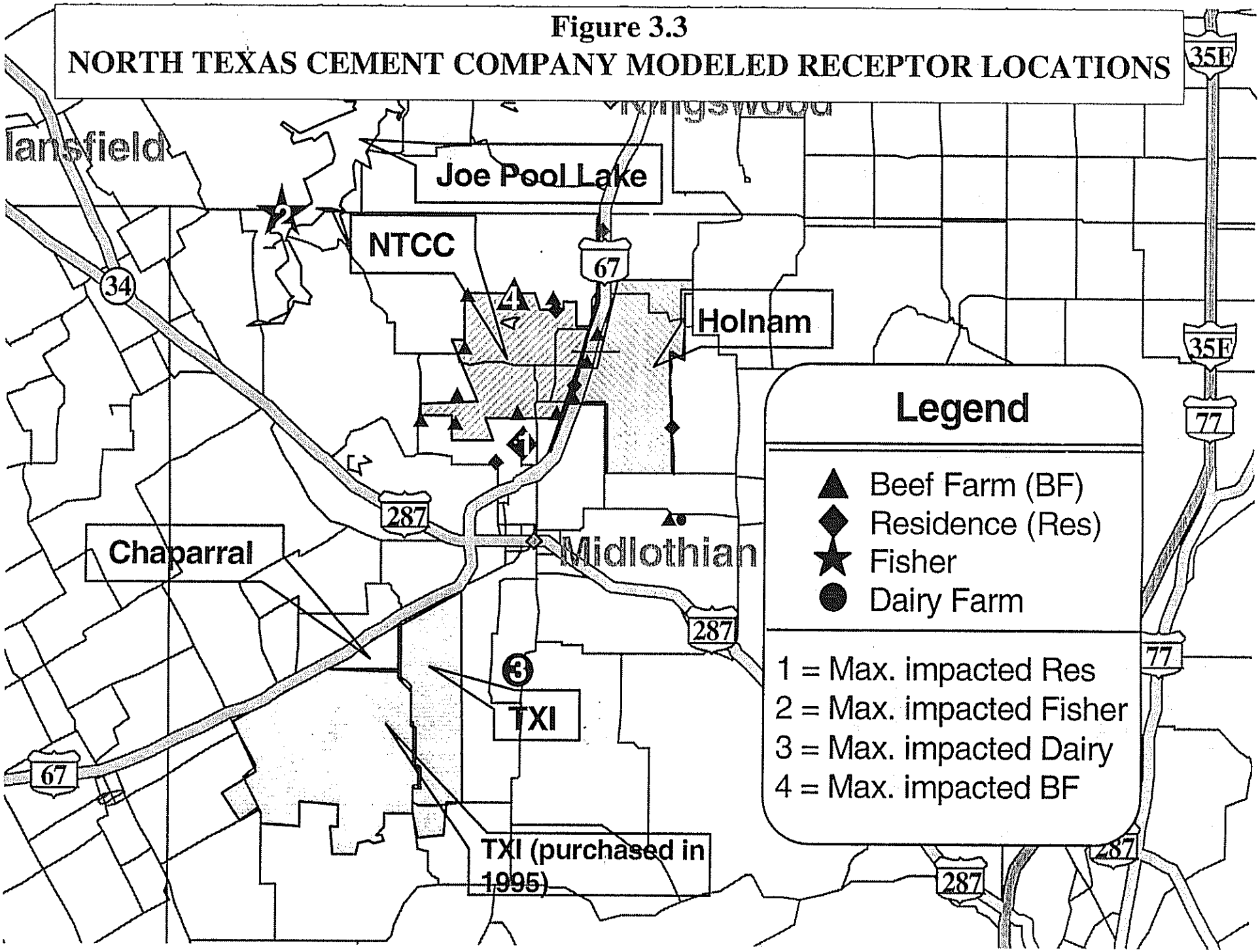
Refined Screening Evaluation - Discrete Receptor Locations				
Pathway	Scenario			
	Residential	Subsistence Beef Farmer	Subsistence Dairy Farmer	Subsistence Fisher
Soil Ingestion	✓	✓	✓	✓
Vegetable Ingestion	✓	✓	✓	✓
Beef Ingestion		✓	x	
Milk Ingestion			✓	
Fish Ingestion				✓
Inhalation	✓	✓	✓	✓

✓ Pathway evaluated at all receptor locations
x Pathway evaluated at selected receptor locations

Table 3.3
SUMMARY OF INDIRECT CANCER RISKS AND NON-CANCER HAZARD INDICES ESTIMATED FOR NTCC

Scenario	Cancer Risk	Non-Cancer Hazard Index
Resident		
Adult	3E-08	0.0019
Child	6E-08	0.0173
Subsistence Beef Farmer	4E-06	0.0052
Subsistence Dairy Farmer	2E-06	0.0017
Subsistence Fisher	1E-05	0.4650

Figure 3.3
NORTH TEXAS CEMENT COMPANY MODELED RECEPTOR LOCATIONS



NTCC submitted a letter to the TNRCC (August 1, 1995) as a follow up on a prior request to stay the processing of their RCRA application. As stated in that letter, NTCC has made a decision not to pursue the use of waste-derived fuel (WDF) at this time. Therefore,the TNRCC does not plan to proceed on a risk-based direct review for the NTCC facility at this time. An ESL review was conducted for the NTCC facility in 1994 as part of the review for their amendment to increase permit VOC allowables. Ground level concentrations were evaluated for all compounds listed on the TNRCC ESL list. Based on the modeling conducted and the emission rate assumptions that were made, it was determined that it was unlikely that any of the ESLs would ever be exceeded. Therefore, inhalation exposure to the estimated levels emitted from NTCC while burning WDF are not expected to result in adverse health effects.

3.3.2 Texas Industries, Inc. (TXI)

3.3.2.1 Results of Indirect Screening Analysis

Figure 3.4 shows the location of each receptor evaluated and identifies the maximally impacted resident, beef farmer, dairy farmer, and fisher. Table 3.4 presents the total lifetime excess cancer risk and hazard indices from the more refined evaluation at the maximally impacted receptor location for each scenario. As shown in Table 3.4, the subsistence fisher scenario is the major contributor to the cancer risk and non-cancer hazard indices for the indirect analysis. Ingestion of benzo(a)pyrene, hexachlorobenzene, and PCB contaminated fish account for the majority of the cancer risk associated with this scenario. The hazard quotient associated with ingestion of methyl mercury contaminated fish comprises the majority of the non-cancer hazard index for the subsistence fisher.

The concentration of lead in soil for the TXI facility was 0.001 mg/kg when maximum off-property dispersion and deposition values were used in the fate and transport modeling. This value is clearly below the media-specific concentration of 100 mg/kg recommended for direct comparison in the Indirect Screen document (USEPA, 1994b).

3.3.2.2 Results of Direct Screening Analysis

In addition to conducting the ESL evaluation routinely performed during the permit review process, TNRCC has also conducted a risk-based direct review for the TXI facility to satisfy the direct risk assessment component of Combustion Strategy.

Risks estimated during both the initial and refmed direct analyses were below the target cancer risk of 10^{-5} and the target hazard index of 0.5 for all receptors evaluated (i.e., adult and child resident, subsistence farmers, and subsistence fisher). Table 3.5 presents the total lifetime excess cancer risks and hazard indices from the refined direct evaluation at the maximally impacted receptor locations for each scenario. As shown in Table 3.5, the

Figure 3.4
TEXAS INDUSTRIES MODELED RECEPTOR LOCATIONS

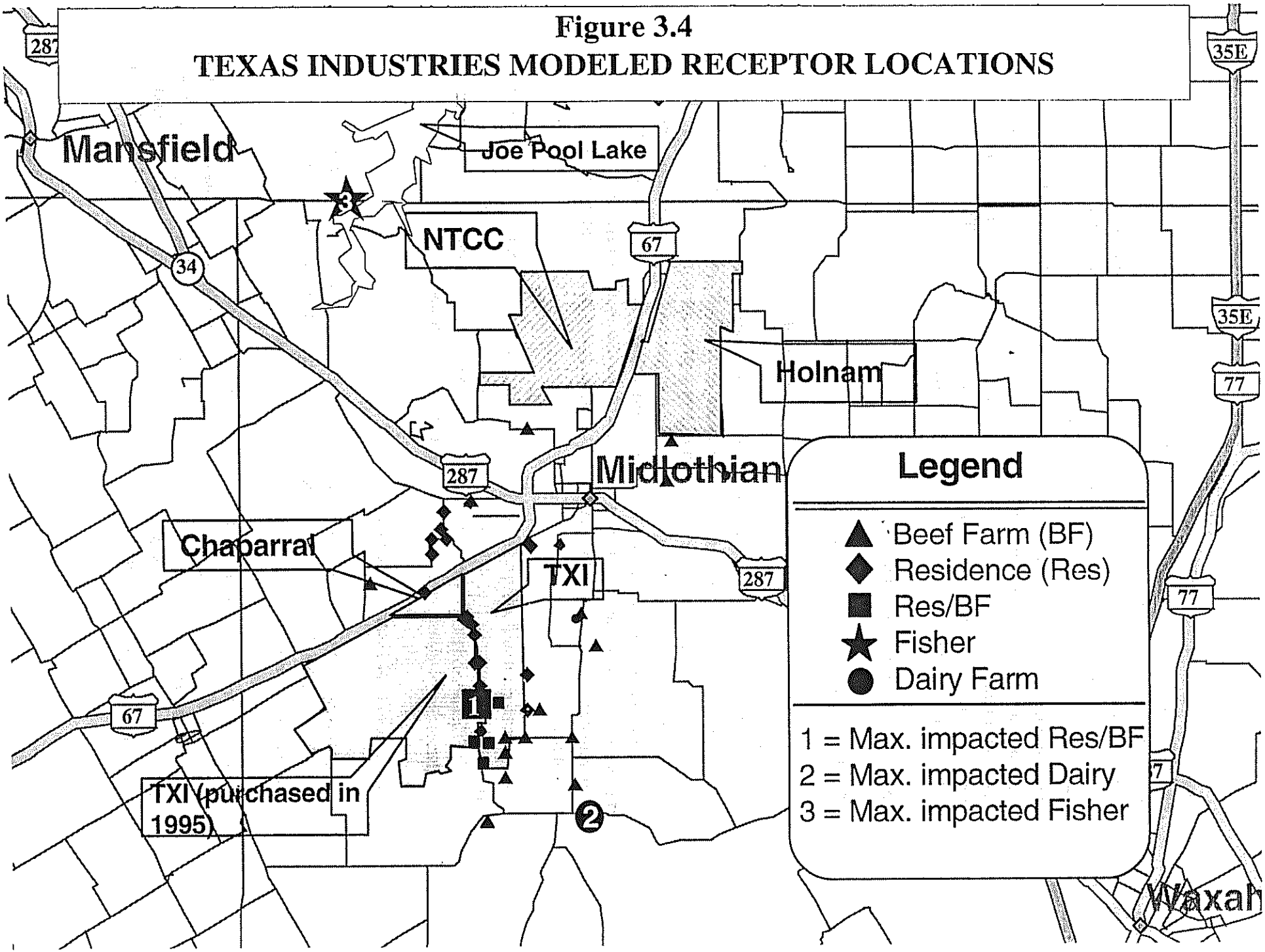


Table 3.4
SUMMARY OF INDIRECT CANCER RISKS AND NON-CANCER HAZARD INDICES ESTIMATED FOR TXI

Scenario	**Cancer Risk**	**Non-Cancer Hazard Index**
Resident		
Adult	8E-08	0.001
Child	1E-0	0.013
Subsistence Beef Farmer	4E-06	0.002
Subsistence Dairy Farmer	7E-07	0.0005
Subsistence Fisher	1E-05	0.401

Table 3.5
SUMMARY OF DIRECT CANCER RISKS AND NON-CANCER HAZARD INDICES ESTIMATED FOR TXI

Scenario	**Cancer Risk**	**Non-Cancer Hazard Index**
Resident		
Adult	1E-06	0.001
Child	4E-07	0.001
Subsistence Beef Farmer	1E-06	0.002
Subsistence Dairy Farmer	2E-07	0.0002
Subsistence Fisher	1E-07	0.0001

adult resident is the major contributor to the cancer risk and non cancer hazard indices for the direct analysis. Inhalation of 1,3-butadiene, formaldehyde, and nickel account for the majority of the cancer risk associated with this scenario. The hazard quotients associated with inhalation of mercuric chloride and *o*-nitroaniline are the major contributors to the non-cancer hazard index for the adult resident scenario.

3.3.2.3 Overall Results ofIndirect and Direct Analyses

Table 3.6 presents the overall cancer risks and hazard indices from the refined evaluation at the maximally impacted receptor locations for each scenario. As shown in Table 3.6, the subsistence fisher scenario is the major contributor to the overall cancer risk and non-cancer hazard indices for the TXI facility. The overall cancer risk and non-cancer hazard index for the subsistence fisher is dominated by contributions from indirect exposure (i.e., dietary intake) with ingestion ofbenzo(a)pyrene, hexachlorobenzene, and PCB contaminated fish providing the major contributions. The hazard quotients associated with ingestion of methyl mercury contaminated fish comprises the majority of the overall non-cancer hazard index fur the subsistence fisher.

3.4 Conclusions

All of the risks and hazard indices estimated at discrete receptor locations identified in the refined screening evaluations of the NTCC and TXI facility were below the target risk levels identified for the screening analyses (cancer risk of 10^{-5} or hazard index of 0.5). In addition, the lead concentrations in soil were all well below the media-specific concentration of 100 mg/kg recommended for direct comparison in the Indirect Screen document (USEPA, 1994b). Therefore, based on the estimated emissions and the assumptions made during these analyses, the excess lifetime carcinogenic risks and non-cancer hazards that result from indirect and direct exposures to contaminants potentially emitted from the NTCC and TXI facilities are considered to be within an acceptable range. In addition, in accordance with USEPA guidance (USEPA, 1994c), the TNRCC employed more conservative target risk levels than what is traditionally used in order to account for background exposures (i.e., exposures from other sources not specifically evaluated in the risk assessment). Therefore, background exposures are also not expected to pose a health risk.

Efforts were made to ensure that the indirect screening risk analyses for the NTCC and TXI facilities were as realistic as possible. For example, site-specific information about land use and activity patterns was used to determine when exposure scenarios were implausible and to make alternative assumptions. Site-specific information was also used in selecting receptor locations for the refined screening evaluation and many of the inputs required for the fate and transport modeling. However, due to the conservative nature of the screening methodology, the risk estimates reported for the refined screening analyses are generally plausible estimates of individual risk for those persons at the upper end of

Table 3.6
SUMMARY OF OVERALL (INDIRECT AND DIRECT) CANCER RISKS AND NON-CANCER HAZARD INDICES ESTIMATED FOR TXI

Scenario	**Cancer Risk**	**Non-Cancer Hazard Index**
Resident		
Adult	1E-06	0.002
Child	5E-07	0.014
Subsistence Beef Farmer	5E-06	0.003
Subsistence Dairy Farmer	9E-07	0.0007
Subsistence Fisher	1E-05	0.401

the distribution of individual exposures. Assuming that the high risk activities evaluated in the screening analyses (i.e., subsistence behavior) take place at the identified locations, the reported risks represent conservative high-end estimates. If subsistence activities do not occur at these locations, however, the risk estimates calculated in the refined screening evaluation represent bounding estimates for the general population. Bounding risk estimates are defined as risks that are not likely to be exceeded. Therefore, it is likely that the "true risks" from exposure to contaminants potentially emitted from the NTCC and TXI facilities will not exceed the risks estimated in these analysis. In fact, it is likely that the "true risks" are less than those estimated in these screening analyses. A more sophisticated and refined risk assessment would likely describe risks that are much lower than those presented here.

4.0 DISCUSSION

In order to evaluate the potential impact of emissions from Midlothian industries on the surrounding community, the TNRCC initiated an intensive environmental program in January of 1991. Sampling of a variety of different matrices, including ambient air and soil, has continued to present. The comprehensive nature of the sampling locations allows for adequate characterization of community exposures. The focus of the environmental monitoring program has been on those constituents which could potentially be emitted from the facilities of concern in the community. Samples have been imalyzed for over 100 different compounds including respirable particulate (PM_{10}); metals, VOCs, sulfur compounds, PAHs, PCDDs, and PCDFs. Measured concentrations of the various compounds analyzed for in the various matrices were compared to the appropriate federal and state health-based guidance levels in order to determine the likelihood for adverse health effects. The specific health-based guidance levels employed in evaluating the likelihood for adverse health effects have included Effects Screening Levels (ESLs), National Ambient Air Quality Standards (NAAQS), and Soil Screening Levels (SSLs).

Effects Screening Levels (ESLs) are guideline concentrations used to evaluate ambient air concentrations of constituents, and are based on a chemical's potential to cause adverse health effects, odor nuisances, vegetation effects, or materials damage. Health-based ESLs are set at levels many times lower than levels reported to produce adverse health effects, and are set to protect the general public, including sensitive subgroups such as children, the elderly, or people with existing respiratory conditions. Air concentrations of a constituent below the ESL indicates that adverse health effects are unlikely. In contrast, air concentrations of a chemical above the ESL are not indicative of adverse health effects but rather suggest that further evaluation is warranted. Primary NAAQS are legally enforceable standards rather than guideline concentrations and as such, should not be exceeded. These standards are set, with a margin of safety, at the maximum permissible ambient air level which will protect the health of any [sensitive] group of the population (U.S. Congress, 1970). The SSLs are guideline concentrations used to

evaluate soil concentrations of constituents, and are set to be protective of childhood exposures resulting from ingestion of soils. These guideline concentrations for soils have been established by the ATSDR, USEPA, or by TNRCC in accordance with ATSDR methodology. As is the case for the health-based guidance levels for ambient air (ESLs), exposures to soil containing concentrations below the corresponding SSL values are not expected to result in adverse health effects. Soil concentrations in excess of corresponding SSLs are not indicative of adverse health effects but rather suggest that further evaluation is warranted.

Since January of 1991, over a thousand ambient air samples have been collected using fixed and mobile monitoring techniques. In addition, in order to respond to specific complaints concerning odorous conditions and respiratory discomfort, a number of event-triggered ambient air samples were collected by TNRCC Regional staff and private citizens. These samples have been analyzed for a number of air contaminants including respirable particulate matter (PM_{10}) and respirable metals, volatile organic compounds (VOCs), sulfur dioxide, hydrogen sulfide, and polycyclic aromatic hydrocarbons (PAHs). With the exception of benzene, measured levels of all of the aforementioned constituents were below corresponding health-based guidance levels and therefore, adverse health effects are not expected to result from inhalation exposures. With respect to benzene, further evaluation was necessary to determine the biological significance of exceeding the 24-hour ESL. The first tier of this refined evaluation involved assessment of the frequency at which the ESL was exceeded. Twenty-four hour concentrations of benzene exceeded the corresponding ESL in only two of the 133 valid samples collected by the community air toxics sampler located at the Fresh Water Treatment Plant at 440 Tayman Drive. Evaluation of the distribution of 24-hour concentrations of benzene in all valid samples analyzed since 1993 indicated that 99.1% contained measured levels which were less than the corresponding ESL. Therefore, given the extremely low frequency of occurrence, acute health effects are not expected.

With the exception of H_2S and acetaldehyde, measured concentrations of all relevant compounds were also below established odor thresholds. Since the initiation of ambient air monitoring for sulfur compounds in January of 1995 at the AT&T Tower and the Old Fort Worth Road locations, measured levels of H_2S have occasionally exceeded the odor threshold and thus, odors may have been discerned during those times when the odor threshold was significantly exceeded. Further, a single event-triggered sample collected in March of 1995 by a local citizen was found to contain levels of acetaldehyde which slightly exceeded the odor threshold. Odors may have been discerned during those times when the odor thresholds were significantly exceeded.

Soil sampling was initiated in the Midlothian area in 1991. Since that time, a total of 175 samples have been collected from 80 different sites. These samples have been analyzed for up to 18 metals including aluminum, antimony, arsenic, beryllium, cadmium, total chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium,

strontium, thallium, titanium, and zinc. In 1995, sixty of the soil samples collected in the Midlothian area were also analyzed for PCDDs and PCDFs. With the exception of lead and arsenic, measured soil concentrations of all metals, as well as concentrations of all PCDDs and PCDFs, were below their respective SSLs.

With respect to lead and arsenic, further evaluation was necessary to determine the biological significance of exceeding the SSL. As was the case in evaluating ambient air samples, the first tier of the refined evaluation involved assessment of the frequency at which the SSL was exceeded. One hundred and seventy-four out of a total of 175 (99.8%) samples collected between 1991-1995 contained lead at levels below the SSL of 400 ppm, while only one sample contained levels of lead which exceeded the SSL. It should be noted that the SSL for lead is unique in that it was established by the USEPA to protect against elevated blood lead levels in children. The single sample which contained lead at levels above the SSL was collected at the base of the AT&T Tower. This site is surrounded on all sides by TXI property and therefore, long-term exposure to children is unlikely. This finding, considered in conjunction with the fact that the SSL for lead was only slightly exceeded (490 ppm), indicates that the measured levels of lead are not likely to pose a health risk to children, the most sensitive population. Further, the distribution of lead concentrations in Midlothian soils relative to U.S. background soils indicates that the pattern is inconsistent with an air deposition and therefore is most likely not related to air emissions from Midlothian industries. With respect to arsenic, further evaluation indicated that only 6 out of 140 samples (4%) collected between 1991 and 1995 contained levels above the corresponding SSL, and even in those 6 samples, the SSL was only slightly exceeded. As a result, and given the conservative nature of the SSL for this compound, adverse health effects are not expected to occur in association with exposure to the measured levels of arsenic. Further, it should be noted that the highest arsenic levels were detected in soil samples collected from a cotton field. Thus, measured levels are most likely due to agricultural practices rather than industrial emissions. In summary, adverse health effects are not expected to occur as a result of exposure to any of the metals at levels measured in Midlothian soils.

Additional soil samples were also collected as a part of the Chaparral Steel Special study. With the exception of cadmium and lead, soil concentrations of all metals at all 22 sites were below their respective SSL or within the range of background U.S. soil concentrations. The sample sites where the cadmium and lead were measured at concentrations above their respective SSLs were confined to a single zone immediately adjacent to the southern boundary of Chaparral Steel. As this property has since been purchased by TXI and is leased to Chaparral Steel for industrial purposes, public exposure is unlikely.

In addition, where relevant comparison data were available, air and soil concentrations measured in Midlothian were compared to those measured in other Texas cities, as well as to local and national background concentrations. Such comparisons provided

additional information on the potential impact of Midlothian industries on overall environmental quality in the community. With respect to ambient air, the concentrations of PM_{10} measured at the 12 Midlothian sites from 1991-present are comparable to those measured in similar non-industrial Texas cities. Annual average concentrations of benzene, the most frequently detected VOC in the state, were lower in Midlothian than at any other air toxics monitoring site in Texas during 1993 and 1994. With respect to soils, the concentrations of all eighteen metals measured in Midlothian soils, as well as 2,3,7,8-TCDD TEQ concentrations were within the range of concentrations reported for background soils across North America. Further, the median 2,3,7,8-TCDD TEQ soil concentration detected in Midlothian was below that reported for North American soils.

In order to specifically address concerns about potential health risks resulting from the combustion of waste-derived fuel, conservative screening level risk analyses were conducted for the two cement companies which have burned WDF. The compounds evaluated in the risk assessment were those judged to be of the greatest concern due to their toxicity and/or persistence in the environment. The exposure scenarios and pathways evaluated in the risk assessment were those considered to be most significant for combustion sources. All of the cancer risk estimates and hazard indices were below the target risk levels. As it was assumed that high risk activities (i.e., subsistence behavior) occurred at the identified locations, the reported risk estimates represent conservative high-end estimates. In fact, it is likely that the "true risks" are less than those estimated in the screening analyses. In addition, in accordance with USEPA guidance, the TNRCC employed more conservative target risk levels than what is traditionally used in order to account for background exposures (i.e., exposures from other sources not specifically evaluated in the risk assessment). Therefore, background exposures are also not expected to pose a health risk.

In summary, citizen concerns about the potential impact of emissions from industries in their community mandated an intensive environmental monitoring program. Evaluation of the results for over a thousand air and soil samples indicates that the measured levels are not expected to result in adverse health effects. Further, the concentrations of various compounds measured in the Midlothian area are similar to those at other locations in Texas and are also similar to local and national background concentrations. Thus, the monitoring data indicate that industrial operations in the community do not appear to be adversely impacting health or environmental quality. This conclusion is also supported by the results from the conservative screening level risk analyses conducted for the two facilities which have burned waste-derived fuel.

In addition, the Texas Department of Health is conducting an independant review of all of the TNRCC monitoring data. In a letter dated January 21, 1994 from David R. Smith, M.D., Commissioner of Health, to Anthony C. Grigsby, TNRCC Executive Director, the TDH stated the only constituents of concern were sulfur compounds. Environmental monitoring data gathered since the date of the letter from Dr. Smith is similar to that

originally reviewed by the TDH and therefore, a similar conclusion is expected.

Finally, it is important to note that, due to permitting requirements unique to the State of Texas, the conclusions reached in this report regarding the impact of facility emissions on the surrounding community should not be construed to apply to other communities where cement manufacturing facilities or secondary steel mills are located. Such application of the results outlined in this report requires a detailed case-by-case review of the similarities in control technologies, permit requirements, individual plant operations, waste streams, siting requirements and other regulations.

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APPENDIX A: AIR SUMMARY DATA

Table A.1

AMBIENT AIR: PM_{10} CONCENTRATIONS ($\mu g/m^3$)[1]

Sample Location	1991			1992			1993			1994			First Quarter 1995		
	N[2]	Mean (+/-sd)[3]	High[4]	N	mean (+/-sd)	high	N	mean (+/- sd)	high	N	mean (+/- sd)	high	N	mean (+/- sd)	high
AT&T Tower										9	19(6)	28	15	13(7)	27
Auger Road	55	21(12)	84	58	17(9)	47	5	13(6)	20						
Cedar Drive				61	19(10)	52	61	21(13)	67	46	24(13)	79			
Cedar Hill Fire Dept.				23	18(8)	37	60	19(13)	66	59	21(12)	74	14	11(4)	24
Cement Valley Road				24	18(7)	30									
Gorman Road				49	31(21)	99	17	16(6)	25						
Hidden Valley Trail				21	15(7)	34	47	22(14)	72						
Old Fort Worth Road										9	17(6)	26	15	13(8)	32
Tar Road							8	10(2)	14	55	23(12)	79	3	8(4)	12
Tayman Drive				48	20(10)	50	56	23(15)	74	57	24(12)	83	14	12(6)	27
Waste Water Treatment Plant	53	21(11)	70				49	23(15)	68	46	23(11)	68			
Waterworks Road				45	19(9)	52	17	14(5)	22						
Austin, Tx; East	60	25 (12)	81	60	23 (12)	78	60	19 (10)	53	59	20 (9)	45	30	21 (9)	55
Austin, Tx; Ridgetop	47	22 (13)	88	60	22 (12)	78	60	18 (11)	53	60	20 (10)	47	28	21 (11)	60
Temple, Tx	57	21 (15)	111	60	18 (10)	63	61	16 (10)	50	57	15 (8)	39	30	16 (11)	58

[1]All values compared to PM_{10} NAAQS of 50 g/m^3 (annual), high compared to PM_{10} NAAQS of 150 g/m^3 (24 h). The NAAQS standards were not exceeded for any of the samples collected between 1991-1995. If a value is not listed, the monitor was not in operation at the specified location.

[2]N = number of valid samples analyzed.

[3]Annual mean, with the standard deviation (SD) shown in parenthesis.

[4]High = highest 24 h sample during the specified time period.

Table A.2

Air Concentrations of Respirable Metals (μg/m^3)

(Location: Waste Water Treatment Plant)

SAROAD	DATE	Vanadium	Chromium	Manganese	Nickel	Arsenic	Selenium	Cadmium	Antimony	Mercury	Lead	Iron	Titanium	Beryllium	Aluminum	Strontium	Thallium
Method Detection Limits (MDL):	1/18/91-6/11/91	0.002	0.002	0.002	0.002	0.004	0.002	0.02	0.04	0.004	0.007	0.01		0.0008			0.003
(XRF: 1/91-2/92)	6/17/91-9/27/91	0.003	0.002	0.002	0.004	0.004	0.004	0.008	0.023	0.013	0.008	0.008	0.012	0.0008			
(ICP: 3/92-6/93)	10/3/91-2/27/92	0.004	0.002	0.002	0.006	0.008	0.004	0.014	0.028	0.02	0.016	0.008	0.004				
	3/92-6/93		0.0005	0.001	0.0007	0.007	0.007	0.0004	0.007	0.004	0.005	0.01	0.001	0.00006	0.01	0.001	0.007
24 h ESL/TNRCC Regulation:		0.2	0.4	0.8	0.06	0.04	0.8	0.04	2	0.2			20	20	0.01	20	8
Annual ESL/Quarterly NAAQS (Pb):		0.05	0.1	0.2	0.015	0.01	0.2	0.01	0.5	0.05	1.5						
1690003F01	1/18/91	<MDL	0.01	0.003	0.008	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL						<MDL
1690003F01	1/24/91	<MDL	0.015	0.006	0.011	<MDL	<MDL	<MDL	<MDL	<MDL	0.009						<MDL
1690003F01	1/30/91	<MDL	0.014	0.004	0.01	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL						0.005
1690003F01	2/5/91	<MDL	0.009	<MDL	0.009	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL						<MDL
1690003F01	2/11/91	<MDL	0.014	0.025	0.008	<MDL	<MDL	<MDL	<MDL	<MDL	0.034						0.006
1690003F01	2/17/91	<MDL	0.014	0.015	0.007	0.007	<MDL	<MDL	<MDL	<MDL	<MDL						0.005
1690003F01	2/23/91	<MDL	0.011	0.017	0.009	<MDL	0.003	<MDL	<MDL	<MDL	0.011						0.011
1690003F01	3/7/91	<MDL	0.01	0.009	0.009	<MDL	<MDL	<MDL	<MDL	<MDL	0.01						<MDL
1690003F01	3/13/91	0.012	0.014	0.034	0.009	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL						0.183
1690003F01	3/31/91	<MDL	0.007	0.008	0.009	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL						<MDL
1690003F01	4/6/91	<MDL	0.009	0.004	0.008	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL						<MDL
1690003F01	4/12/91	<MDL	0.007	0.003	0.008	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL						<MDL
1690003F01	4/18/91	<MDL	0.015	0.014	0.008	<MDL	<MDL	<MDL	<MDL	<MDL	0.02						<MDL
1690003F01	4/24/91	<MDL	0.01	0.005	0.008	<MDL	<MDL	<MDL	<MDL	<MDL	0.008						0.004
1690003F01	4/30/91	<MDL	0.015	0.007	0.01	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL						0.016
1690003F01	5/6/91	<MDL	0.011	0.008	0.009	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL						0.003
1690003F01	5/12/91	<MDL	0.031	0.005	0.024	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL						0.004
1690003F01	5/18/91	<MDL	0.011	0.003	0.005	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL						<MDL
1690003F01	5/24/91	<MDL	0.014	0.005	0.012	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL						<MDL
1690003F01	5/30/91	<MDL	0.013	0.004	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL						0.023
1690003F01	6/5/91	<MDL	0.01	0.007	0.005	<MDL	<MDL	<MDL	<MDL	<MDL	0.013						0.005
1690003F01	6/11/91	<MDL	0.011	0.006	0.008	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL						<MDL
1690003F01	6/17/91	<MDL	0.017	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.156	<MDL				
1690003F01	6/23/91	<MDL	0.018	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.526	0.028				
1690003F01	6/29/91	<MDL	0.021	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.81	0.086				
1690003F01	7/11/91	<MDL	0.008	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.687	0.078				
1690003F01	7/17/91	<MDL	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.345	0.024				
1690003F01	7/23/91	<MDL	0.007	<MDL	<MDL	<MDL	<MDL	0.01	<MDL	<MDL	<MDL	0.139	0.011				
1690003F01	7/29/91	<MDL	0.01	<MDL	<MDL	<MDL	<MDL	0.014	<MDL	<MDL	<MDL	0.217	0.012				
1690003F01	8/4/91	<MDL	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.257	0.019				
1690003F01	8/10/91	<MDL	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.196	0.007				
1690003F01	8/16/91	<MDL	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.653	0.071				
1690003F01	8/22/91	<MDL	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.325	0.033				
1690003F01	8/28/91	<MDL	0.004	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.223	0.005				
1690003F01	9/3/91	<MDL	0.005	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.051	0.002				
1690003F01	9/9/91	<MDL	0.008	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	1.316	0.136				
1690003F01	9/15/91	<MDL	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.056	0.002				
1690003F01	9/21/91	<MDL	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.161	0.009				
1690003F01	9/27/91	<MDL	0.008	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.28	0.016				
1690003F01	10/3/91	<MDL	0.003	0.002	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.239	0.013				
1690003F01	10/9/91	<MDL	0.004	0.016	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.31	0.025				
1690003F01	10/15/91	<MDL	0.005	0.021	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.552	0.039				

1690003F01	10/21/91	<MDL	0.005	0.018	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.485	0.036				
1690003F01	10/27/91	<MDL	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.02	0.006				
1690003F01	11/2/91	<MDL	0.002	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.136	0.016				
1690003F01	11/8/91	<MDL	0.004	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.11	0.006				
1690003F01	11/20/91	<MDL	0.003	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.045	0.006				
1690003F01	11/26/91	<MDL	<MDL	0.003	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.074	0.006				
1690003F01	12/2/91	<MDL	0.003	0.01	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.161	0.006				
1690003F01	12/8/91	<MDL	0.003	0.004	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.085	0.006				
1690003F01	12/14/91	<MDL	0.002	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.088	0.006				
1690003F01	12/20/91	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.03	0.006				
1690003F01	12/26/91	<MDL	0.003	<MDL	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.058	0.006				
1690003F01	2/27/93		<MDL	0.003	<MDL	<MDL	<MDL	0.0003	<MDL	<MDL	0.007	0.08	0.002	<MDL	0.04	0.001	<MDL
1690003F01	4/10/93		0.004	0.02	0.0031	<MDL	<MDL	0.0008	<MDL	<MDL	0.011	0.41	0.005	<MDL	0.16	0.003	<MDL
1690003F01	6/15/93		0.0021	0.014	0.0028	<MDL	<MDL	<MDL	<MDL	<MDL	0.005	0.38	0.005	<MDL	0.15	0.005	<MDL
1991 Annual Average (assumed 1/2 MDL)		0.002	0.0088	0.0058	0.0056	0.003	0.002	0.0076	0.016	0.006							

Table A.3
Air Concentrations of Respirable Metals
(Location: 801 Auger Road)

SAROAD	DATE	Vanadium	Chromium	Manganese	Nickel	Arsenic	Selenium	Cadmium	Antimony	Mercury	Lead	Iron	Titanium	Beryllium	Aluminum	Strontium	Thallium
Method Detection Limits (MDL):	1/18/91-6/11/91	0.002	0.002	0.002	0.002	0.004	0.002	0.02	0.04	0.004	0.007	0.01		0.0008			0.003
(XRF: 1/91-2/92)	6/17/91-9/27/91	0.003	0.002	0.002	0.004	0.004	0.004	0.008	0.023	0.013	0.008	0.008	0.012	0.0008			
(ICP: 3/92-6/93)	10/3/91-2/27/92	0.004	0.002	0.002	0.006	0.008	0.004	0.014	0.028	0.02	0.016	0.008	0.004				
	3/92-6/93		0.0005	0.001	0.0007	0.007	0.007	0.0004	0.007	0.004	0.005	0.01	0.001	0.00006	0.01	0.001	0.007
24 h ESL/TNRCC Regulation:		0.2	0.4	0.8	0.06	0.04	0.8	0.04	2	0.2			20	20	0.01	20	8
Annual ESL/Quarterly NAAQS (Pb):		0.05	0.1	0.2	0.015	0.01	0.2	0.01	0.5	0.05							
1690004F01	1/18/91	<MDL	0.012		0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.081					0.002
1690004F01	1/24/91	<MDL	0.008	0.003	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.167					0.006
1690004F01	1/30/91	<MDL	0.011		0.008	<MDL	0.002	<MDL	<MDL	<MDL	<MDL	0.144					0.002
1690004F01	2/5/91	<MDL	0.01		0.005	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.1					<MDL
1690004F01	2/11/91	<MDL	0.008	0.014	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	0.02	0.392					0.007
1690004F01	2/17/91	<MDL	0.01	0.005	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	0.011	0.148					0.003
1690004F01	2/23/91	<MDL	0.012	0.005	0.01	<MDL	0.003	<MDL	<MDL	<MDL	<MDL	0.221					0.006
1690004F01	3/7/91	<MDL	0.008	0.006	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.249					0.009
1690004F01	3/13/91	<MDL	0.012	0.037	0.004	0.005	<MDL	<MDL	<MDL	<MDL	<MDL	2.38					0.21
1690004F01	3/31/91	<MDL	0.012	0.005	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.39					0.013
1690004F01	4/6/91	<MDL	0.01	0.003	0.01	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.157					0.003
1690004F01	4/12/91	<MDL	0.008		0.011	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.115					<MDL
1690004F01	4/18/91	<MDL	0.012	0.005	0.009	0.005	<MDL	<MDL	<MDL	<MDL	<MDL	0.25					<MDL
1690004F01	4/24/91	<MDL	0.01	0.006	0.009	<MDL	0.003	<MDL	<MDL	<MDL	0.011	0.271					0.004
1690004F01	4/30/91	<MDL	0.013	0.008	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.363					0.017
1690004F01	5/6/91	<MDL	0.009	0.003	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.179					0.004
1690004F01	5/12/91	<MDL	0.039	0.006	0.035	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.347					<MDL
1690004F01	5/18/91	<MDL	0.009		0.008	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.16					0.004
1690004F01	5/24/91	<MDL	0.011	0.005	0.007	<MDL	0.004	<MDL	<MDL	<MDL	<MDL	0.162					0.004
1690004F01	5/30/91	<MDL	0.015	0.003	0.009	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.332					0.025
1690004F01	6/5/91	<MDL	0.025	0.007	0.013	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.29					0.003
1690004F01	6/11/91	<MDL	0.02	0.005	0.007	0.005	<MDL	<MDL	<MDL	<MDL	<MDL	0.238					0.005
1690004F01	6/17/91	<MDL	0.015	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.188	0.002				
1690004F01	6/29/91	<MDL	0.021	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.913	0.089				
1690004F01	7/5/91	<MDL	0.005	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.234	0.018				
1690004F01	7/11/91	<MDL	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.707	0.081				
1690004F01	7/17/91	<MDL	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.325	0.021				
1690004F01	7/23/91	<MDL	0.005	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.122	0.007				
1690004F01	7/29/91	<MDL	0.005	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.258	0.014				
1690004F01	8/4/91	<MDL	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.263	0.019				
1690004F01	8/10/91	<MDL	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.281	0.007				
1690004F01	8/16/91	<MDL	0.009	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.643	0.069				
1690004F01	8/22/91	<MDL	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.362	0.033				
1690004F01	8/28/91	<MDL	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.122	0.004				
1690004F01	9/3/91	<MDL	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.072	0				
1690004F01	9/9/91	<MDL	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	1.197	0.128				
1690004F01	9/15/91	<MDL	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.06	0.002				
1690004F01	9/21/91	<MDL	0.005	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.174	0.006				
1690004F01	9/27/91	<MDL	0.005	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.2	0.011				
1690004F01	10/3/91	0.004	0.004	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.135	0.014				
1690004F01	10/9/91	<MDL	0.003	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.198	0.021				
1690004F01	10/15/91	<MDL	0.009	0.043	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.95	0.044				
1690004F01	10/21/91	<MDL	0.004	0.014	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.047	0.035				

1690004F01	10/27/91	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.03	0.006				
1690004F01	11/2/91	<MDL	<MDL	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.157	0.015				
1690004F01	11/8/91	<MDL	0.002	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.143	0.006				
1690004F01	11/14/91	<MDL	0.003	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.094	0.006				
1690004F01	11/20/91	<MDL	0.004	0.004	0.008	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.117	0.006				
1690004F01	11/26/91	<MDL	0.002	0.004	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.101	0.006				
1690004F01	12/2/91	<MDL	0.005	0.005	0.011	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.12	0.006				
1690004F01	12/8/91	<MDL	0.005	<MDL	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.028	0.006				
1690004F01	12/14/91	<MDL	0.002	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.146	0.006				
1690004F01	12/20/91	<MDL	0.002	<MDL	0.011	<MDL	<MDL	<MDL	<MDL	0.024	<MDL	0.063	0.006				
1690004F01	12/26/91	<MDL	0.002	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.081	0.006				
1690004F01	1/4/92	<MDL	<MDL	0.005	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.093	0.006				
1690004F01	1/7/92	<MDL	<MDL	0.005	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.203	0.006				
1690004F01	1/13/92	<MDL	0.007	0.031	0.008	<MDL	<MDL	<MDL	<MDL	0.022	<MDL	0.469	0.013				
1690004F01	1/19/92	<MDL	<MDL	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.091	0.006				
1690004F01	1/28/92	<MDL	0.058	0.009	0.012	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.181	0.006				
1690004F01	2/3/92	0.004	0.012	0.007	0.009	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.125	0.006				
1690004F01	2/9/92	<MDL	<MDL	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.161	0.006				
1690004F01	2/15/92	<MDL	0.004	0.014	0.012	<MDL	<MDL	<MDL	<MDL	0.02	<MDL	0.333	0.019				
1690004F01	2/21/92	0.004	<MDL	0.01	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.186	0.015				
1690004F01	2/27/92	<MDL	0.002	0.04	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	0.034	0.799	0.006				
1690004F01	3/22/92		0.0009	0.004	0.0008	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.1	0.002	<MDL	0.08	0.002	<MDL
1690004F01	7/8/92		0.0024	0.034	0.0012	<MDL	<MDL	<MDL	<MDL	<MDL	0.005	1.61	0.043	0.00006	1.59	0.006	<MDL
1690004F01	8/19/92		0.0009	0.006	<MDL	<MDL	<MDL	0.0004	<MDL	<MDL	0.012	0.19	0.002	<MDL	0.05	0.001	<MDL
1690004F01	10/12/92		0.0015	0.021	0.0008	<MDL	<MDL	0.0005	<MDL	<MDL	0.012	0.41	0.007	<MDL	0.21	0.005	<MDL
1991 Annual Average (assumed 1/2 MDL)		0.001	0.0084	0.005	0.0056	0.003	0.002	0.0073	0.016	0.006							

Table A.4

Air Concentrations of Respirable Metals

(Location: 3330 Cement Valley Road)

SAROAD	DATE	Vanadium	Chromium	Manganese	Nickel	Arsenic	Selenium	Cadmium	Antimony	Mercury	Lead	Iron	Titanium	Beryllium	Aluminum	Strontium	Thallium
Minimum Detection																	
Limits (MDL):	1/18/91-6/11/91	0.002	0.002	0.002	0.002	0.004	0.002	0.02	0.04	0.004	0.007	0.01		0.0008			0.003
(XRF: 1/91-2/92)	6/17/91-9/27/91	0.003	0.002	0.002	0.004	0.004	0.004	0.008	0.023	0.013	0.008	0.008	0.012	0.0008			
(ICP: 3/92-6/93)	10/3/91-2/27/92	0.004	0.002	0.002	0.006	0.008	0.004	0.014	0.028	0.02	0.016	0.008	0.004				
	3/92-6/93		0.0005	0.001	0.0007	0.007	0.007	0.0004	0.007	0.004	0.005	0.01	0.001	0.00006	0.01	0.001	0.007
24 h ESL/TNRCC Regulation:		0.2	0.4	0.8	0.06	0.04	0.8	0.04	2	0.2			20	20	0.01	20	8
1690005F01	1/4/92	0.004	0.010	0.062	0.008	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	1.186	0.015				
1690005F01	1/10/92	<MDL	0.004	0.037	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.946	0.024				
1690005F01	1/16/92	<MDL	0.005	0.080	0.007	<MDL	<MDL	<MDL	<MDL	0.022	0.027	1.109	0.018				
1690005F01	1/22/92	<MDL	<MDL	0.012	0.010	<MDL	<MDL	<MDL	<MDL	0.023	<MDL	0.420	0.006				
1690005F01	1/28/92	<MDL	<MDL	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.058	<MDL				
1690005F01	2/3/92	<MDL	<MDL	0.004	0.008	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.093	0.004				
1690005F01	2/9/92	<MDL	<MDL	0.008	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.141	0.012				
1690005F01	2/15/92	<MDL	<MDL	0.012	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.235	0.013				
1690005F01	2/21/92	<MDL	0.005	0.123	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.060	0.979	0.010				
1690005F01	2/27/92	<MDL	0.009	0.065	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.839	0.025				
1690005F01	3/22/92		0.002	0.026	0.0023	<MDL	<MDL	0.0009	<MDL	<MDL	0.03	0.55	0.002	<MDL	0.06	0.001	<MDL
1690005F01	4/15/92		0.0082	0.07	0.0017	<MDL	<MDL	0.0003	<MDL	<MDL	0.007	0.66	0.009	<MDL	0.23	0.007	<MDL
1690005F01	5/9/92		0.0064	0.1	0.0024	<MDL	<MDL	0.0016	<MDL	<MDL	0.068	1.16	0.008	<MDL	0.25	0.004	<MDL

Table A.5
Air Concentrations of Respirable Metals
(Location: Cedar Hill Fire Department)

SAROAD	DATE	Vanadium	Chromium	Manganese	Nickel	Arsenic	Selenium	Cadmium	Antimony	Mercury	Lead	Iron	Titanium	Beryllium	Aluminum	Strontium	Thallium
Minimum Detection																	
Limits (MDL):	1/18/91-6/11/91	0.002	0.002	0.002	0.002	0.004	0.002	0.02	0.04	0.004	0.007	0.01		0.0008			0.003
(XRF: 1/91-2/92)	6/17/91-9/27/91	0.003	0.002	0.002	0.004	0.004	0.004	0.008	0.023	0.013	0.008	0.008	0.012	0.0008			
(ICP: 3/92-6/93)	10/3/91-2/27/92	0.004	0.002	0.002	0.006	0.008	0.004	0.014	0.028	0.02	0.016	0.008	0.004				
	3/92-6/93		0.0005	0.001	0.0007	0.007	0.007	0.0004	0.007	0.004	0.005	0.01	0.001	0.00006	0.01	0.001	0.007
24 h ESL/TNRCC Regulation:		0.2	0.4	0.8	0.06	0.04	0.8	0.04	2	0.2			20	20	0.01	20	8
1320072F01	7/23/91	<MDL	0.005	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.28	0.019				
1320072F01	7/29/91	<MDL	0.005	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.279	0.025				
1320072F01	8/4/91	<MDL	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.356	0.032				
1320072F01	8/10/91	<MDL	0.008	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.307	0.023				
1320072F01	8/16/91	<MDL	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.772	0.084				
1320072F01	8/22/91	<MDL	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.375	0.04				
1320072F01	8/28/91	<MDL	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.251	0.018				
1320072F01	9/3/91	<MDL	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.101	<MDL				
1320072F01	9/9/91	<MDL	0.006	<MDL	<MDL	<MDL	<MDL	0.008	<MDL	<MDL	<MDL	1.398	0.139				
1320072F01	9/15/91	<MDL	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.087	0.006				
1320072F01	9/21/91	<MDL	0.005	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.011	0.219	0.018				
1320072F01	9/27/91	<MDL	0.005	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.394	0.033				
1320072F01	10/3/91	<MDL	0.006	0.034	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.376	0.024				
1320072F01	10/9/91	<MDL	0.004	0.018	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.477	0.044				
1320072F01	10/15/91	0.004	0.004	0.017	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.72	0.076				
1320072F01	10/21/91	<MDL	0.003	0.021	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.737	0.068				
1320072F01	10/27/91	<MDL	<MDL	0.002	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.031	0.007				
1320072F01	11/2/91	<MDL	<MDL	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.206	0.024				
1320072F01	11/8/91	<MDL	0.003	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.24	0.021				
1320072F01	11/14/91	<MDL	0.003	0.005	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.153	0.019				
1320072F01	11/20/91	<MDL	0.002	0.002	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.089	0.012				
1320072F01	11/26/91	0.004	0.002	0.005	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.193	0.021				
1320072F01	12/2/91	<MDL	0.003	0.009	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.148	0.011				
1320072F01	12/8/91	<MDL	<MDL	0.003	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.06	0.005				
1320072F01	12/14/91	<MDL	0.006	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.218	0.021				
1320072F01	12/20/91	<MDL	0.005	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.034	0.007				
1320072F01	12/26/91	0.004	0.002	0.002	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.09	0.012				
1320072F01	1/4/92	<MDL	<MDL	0.018	0.006	<MDL	<MDL	<MDL	<MDL	0.021	<MDL	0.377	0.015				
1320072F01	1/7/92	<MDL	<MDL	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.3	0.019				
1320072F01	1/16/92	<MDL	<MDL	0.015	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.3	0.015				
1320072F01	1/22/92	<MDL	<MDL	0.007	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.212	0.019				
1320072F01	1/28/92	<MDL	<MDL	0.008	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.19	0.014				
1320072F01	1/31/92	<MDL	<MDL	0.009	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.204	0.013				
1320072F01	2/9/92	<MDL	<MDL	0.007	<MDL	<MDL	0.004	<MDL	<MDL	<MDL	<MDL	0.215	0.02				
1320072F01	2/15/92	<MDL	<MDL	0.006	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.354	0.032				
1320072F01	2/21/92	<MDL	<MDL	0.007	0.009	<MDL	0.005	<MDL	<MDL	0.025	<MDL	0.186	0.013				
1320072F01	2/27/92	<MDL	<MDL	0.008	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.207	0.015				

Table A.6
Air Concentrations of Respirable Metals
(Location: 1120A Cedar Drive)

SAROAD	DATE	Vanadium	Chromium	Manganese	Nickel	Arsenic	Selenium	Cadmium	Antimony	Mercury	Lead	Iron	Titanium	Beryllium	Aluminum	Strontium	Thallium
Minimum Detection																	
Limits (MDL):	1/18/91-6/11/91	0.002	0.002	0.002	0.002	0.004	0.002	0.02	0.04	0.004	0.007	0.01		0.0008			0.003
(XRF: 1/91-2/92)	6/17/91-9/27/91	0.003	0.002	0.002	0.004	0.004	0.004	0.008	0.023	0.013	0.008	0.008	0.012	0.0008			
(ICP: 3/92-6/93)	10/3/91-2/27/92	0.004	0.002	0.002	0.006	0.008	0.004	0.014	0.028	0.02	0.016	0.008	0.004				
	3/92-6/93		0.0005	0.001	0.0007	0.007	0.007	0.0004	0.007	0.004	0.005	0.01	0.001	0.00006	0.01	0.001	0.007
24 h ESL/TNRCC Regulation:		0.2	0.4	0.8	0.06	0.04	0.8	0.04	2	0.2			20	20	0.01	20	8
1690084F01	1/4/92	<MDL	<MDL	0.002	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.042	<MDL				
1690084F01	1/10/92	<MDL	0.003	0.021	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.842	0.012				
1690084F01	1/16/92	<MDL	<MDL	0.015	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.255	0.013				
1690084F01	1/22/92	<MDL	<MDL	0.011	<MDL	<MDL	<MDL	<MDL	<MDL	0.024	<MDL	0.169	0.006				
1690084F01	1/28/92	<MDL	<MDL	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.072	<MDL				
1690084F01	2/3/92	<MDL	<MDL	0.004	<MDL	<MDL	0.006	<MDL	<MDL	<MDL	<MDL	0.088	0.005				
1690084F01	2/9/92	<MDL	<MDL	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.103	0.011				
1690084F01	2/15/92	<MDL	<MDL	0.017	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.309	0.016				
1690084F01	3/22/92		0.0005	0.006	0.001	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.13	0.003	<MDL	0.09	0.003	<MDL
1690084F01	7/8/92		0.0023	0.034	0.0015	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	1.69	0.048	<MDL	1.84	0.006	<MDL
1690084F01	8/19/92		<MDL	0.006	<MDL	<MDL	<MDL	0.0006	<MDL	<MDL	0.009	0.14	0.002	<MDL	0.08	0.002	<MDL
1690084F01	2/27/93		<MDL	0.003	<MDL	<MDL	<MDL	0.0003	<MDL	<MDL	0.005	0.09	0.002	<MDL	0.06	0.001	<MDL
1690084F01	4/10/93		<MDL	0.006	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.17	0.005	<MDL	0.16	0.003	<MDL
1690084F01	6/27/93		0.0013	0.015	0.0013	<MDL	<MDL	0.0004	<MDL	<MDL	<MDL	0.72	0.019	<MDL	0.79	0.004	<MDL

Table A.7

Ambient Air: Concentrations of TSP Lead (Location: Highway 67)

		Ambient Air Lead Concentration (µg/m^3)[1]		
		1993	1994	1995
1st Quarter	# samples	13	11	15
	mean+/- SD[2]	0.16 +/- 0.21	0.09 +/- 0.12	0.17 +/- 0.17
2nd Quarter	# samples	11	13	NA[3]
	mean+/- SD	0.36 +/- 0.35	0.16 +/- 0.15	NA
3rd Quarter	# samples	11	14	NA
	mean +/- SD	.30 +/- 0.37	0.18 +/- 0.23	NA
4th Quarter	# samples	14	15	NA
	mean+/- SD	0.16 +/- 0.21	0.25 +/- 0.29	NA

[1]All values compared to quarterly NAAQS (1.5 µg/m^3). No exceedances of NAAQS observed.
[2]Quarterly mean +/- standard deviation (SD).
[3]NA; data not yet available.

Table A.8

Maximum 24-hour Air Concentrations of Volatile Organic Compounds[1]
(Location: Tayman Drive; Fresh Water Treatment Plant)

Compound	Years Sampled	# of valid samples	Highest 24 h Sample	MDL[2]	# of Samples > MDL	24 h ESL[3]	# Samples > 24 ESL
benzene	'93-95	133	20.57	0.5	22	4	2
bromomethane	'93-95	73	<MDL	0.62	0	800	0
butadiene, 1,3-	'93-95	119	<MDL	0.63	0	20	0
butane, n-	'94-95	41	14.6	0.74	33	3200	0
butene, 1-	'94-95	41	<MDL	2.56	0	2960	0
butene, c-2	'94-95	41	<MDL	0.31	0	2960	0
butene, t-2-	'94-95	41	0.88	0.2	3	3000	0
carbon tetrachloride	'93-95	81	3.4	0.45	3	8	0
chlorobenzene	'93-95	135	0.77	0.74	2	40	0
chloroform	'93-95	135	<MDL	0.64	0	8	0
chloropentane, 2-	'93-95	68	<MDL	0.5	0	76	0
cumene	'94-95	41	<MDL	0.44	0	196	0
cyclohexane	'94-95	41	<MDL	1.06	0	1000	0
cyclopentane	'94-95	41	<MDL	0.2	0	476	0
cyclopentene	'94-95	27	<MDL	0.39	0	1172	0
decane, n-	'94-95	41	<MDL	0.92	0	690	0
dichloroethane, 1,1-	'94-95	76	<MDL	0.16	0	400	0
dichloroethane, 1,2-	'93-95	135	<MDL	0.52	0	4	0
dichloroethylene, 1,1-	'94-95	76	<MDL	0.15	0	4	0
dichloropropane, 1,2-	'93-95	135	0.44	0.25	1	300	0
dimethylbutane, 2,2-	'94-95	41	<MDL	0.3	0	400	0
dimethylbutane, 2,3-	'94-95	41	1.5	0.17	19	400	0
dimethylpentane, 2,3-	'94-95	41	0.22	0.12	5	400	0
dimethylpentane, 2,4-	'94-95	41	<MDL	0.19	0	400	0
ethylbenzene	'93-95	135	1.38	1.07	1	400	0
heptane, n-	'94-95	41	<MDL	0.93	0	340	0
heptene, 1-	'94-95	27	<MDL	0.2	0	1080	0
hexane, n-	'94-95	41	0.76	0.2	36	200	0
hexene, c-2-	'94-95	41	<MDL	0.41	0	1864	0
hexene, t-2-	'94-95	41	<MDL	0.29	0	1864	0
isobutane	'94-95	41	2.1	1.73	2	3200	0
isopentane	'94-95	41	1.98	0.48	31	400	0
isoprene	'94-95	41	<MDL	0.23	0	56	0
methyl-1-butene, 3-	'94-95	41	<MDL	0.72	0	3200	0
methyl-1-pentene, 2-	'94-95	41	<MDL	0.4	0	3200	0
methyl-1-pentene, 4-	'94-95	41	<MDL	0.5	0	3200	0
methyl-2-butene, 2-	'94-95	41	<MDL	0.4	0	3200	0
methylcyclohexane	'94-95	41	<MDL	0.31	0	1600	0
methylcyclopentane	'94-95	41	<MDL	0.29	0	300	0

Compound	Years Sampled	# of valid samples	Highest 24 h Sample	MDL[2]	# of Samples > MDL	24 h ESL[3]	# Samples > 24 ESL
methylene chloride	'93-95	135	0.4	0.4	1	30	0
methylheptane, 2-	'94-95	41	<MDL	0.89	0	300	0
methylheptane, 3-	'94-95	41	<MDL	0.67	0	400	0
methylhexane, 2-	'94-95	41	<MDL	0.2	0	300	0
methylhexane, 3-	'94-95	41	<MDL	0.27	0	400	0
methylpentane, 2-	'94-95	41	0.39	0.32	2	400	0
methylpentane, 3-	'94-95	41	9.59	0.34	1	400	0
nonane, n-	'94-95	41	<MDL	0.94	0	800	0
octane, n-	'94-95	41	<MDL	0.80	0	300	0
pentane, n-	'94-95	41	1.33	0.58	20	480	0
pentene, 1-	'94-95	41	<MDL	0.31	0	3200	0
pentene, c-2-	'94-95	41	<MDL	0.4	0	3200	0
pentene, t-2-	'94-95	41	<MDL	0.14	0	3200	0
perchloroethylene	'93-95	135	<MDL	0.61	0	20	0
pinene, a-	'94-95	41	1.02	1.14	1	251	0
pinene, b-	'94-95	41	<MDL	6.3	0	251	0
propane	'94-95	41	7.63	1.73	27	4000	0
propylbenzene, n-	'94-95	41	<MDL	0.93	0	80	0
propylene	'94-95	41	5.07	1.34	16	26800	0
styrene	'93-95	133	<MDL	0.9	0	80	0
toluene	'93-95	135	6.7	0.88	19	200	0
trichloroethane, 1,1,1-	'93-95	55	1.77	0.38	5	800	0
trichloroethane, 1,1,2-	'95	14	<MDL	0.18	0	40	0
trichloroethylene	'93-95	135	0.93	0.6	1	100	0
trichlorofluoromethane	'93-95	135	5.85	0.4	6	4000	0
trimethylbenzene, 1,2,4-	'94-95	41	<MDL	1.42	0	100	0
trimethylbenzene, 1,3,5-	'94-95	41	<MDL	0.86	0	100	0
trimethylpentane, 2,2,4-	'95	14	<MDL	0.34	0	300	0
trimethylpentane, 2,3,4-	'94-95	41	<MDL	0.59	0	300	0
undecane, n-	'94-95	41	<MDL	5.04	0	400	0
vinyl chloride	'93-95	135	<MDL	0.45	0	20	0
xylene, o-	'93-95	135	1.8	1.02	2	400	0
xylene, p- & xylene, m-	'93-95	95	2.4	0.68	2	400	0

[1] Concentrations are expressed in parts-per-billion volume (ppb_v) and are through June of 1995.

[2] MDL; method detection limit

[3] ESL; effects screening level

APPENDIX B: SOIL SUMMARY DATA

Table B.1
1991-1995 Metal Concentrations in Midlothian Soils

Element	Number of Samples	Sampling Years	Range (mg/kg)	Soil Screening Level (SSL; mg/kg)	Number Above SSL
ALUMINUM	152	'92,'94,'95	4,300-46,000	N/A[a]	N/A
ANTIMONY	175	'91,'92,'94,'95	<Minimum Detection Limit	20[b]	0
ARSENIC	140	'91,'92,'94,'95	<MDL-32	20[c]	6
BERYLLIUM	175	'91,'92,'94,'95	<MDL-1.7	300[b]	0
CADMIUM	175	'91,'92,'94,'95	<MDL-2.0	40[b]	0
CHROMIUM	175	'91,'92,'94,'95	<MDL-540	Cr VI-300[b]	5
				Cr III-50,000[b]	0
COPPER	54	'95	7.4-110	1000[d]	0
IRON	175	'91,'92,'94,'95	7,900-67,000	N/A	N/A
LEAD	175	'91,'92,'94,'95	7-490	400[e]	1
MANGANESE	175	'91,'92,'94,'95	240-4700	5000[f]	0
MERCURY	175	'91,'92,'94,'95	<MDL-4	15[c]	0
MOLYBDENUM	54	'95	<MDL-36	300[b]	0
NICKEL	175	'91,'92,'94,'95	12-250	1000[b]	0
SELENIUM	175	'91,'92,'94,'95	<MDL	300[b]	0
STRONTIUM	54	'95	58-620	N/A	N/A
THALLIUM	54	'95	<MDL	4[b]	0
TITANIUM	54	'95	24-430	N/A	N/A
ZINC	54	'95	28-1000	15,000[f]	0

[a]NA, not available

[b]ATSDR soil comparison value for children; derived as follows: Chronic EMEG=[(oral MRL x 10 kg) ÷ 200 mg/kg/day] ÷ 0.000001, RMEG=[(oral Rfd x 10 kg) ÷ 200 mg/day] ÷ 0.000001, where 10 kg = ATSDR child default body weight and 200 mg/day = ATSDR child default soil ingestion rate.

[c]Value derived by Toxicology & Risk Assessment Section. Chronic oral RfD obtained from IRIS or HEAST. [(chronic oral Rfd x 10 kg) ÷ 200 mg/day] ÷ 0.000001.

[d]Value derived by Toxicology & Risk Assessment Section. Chronic Oral RfD based on Allowable Daily Intake and Average Background Intake. [(Chronic RfD x 10 kg) ÷ 200 mg/day] ÷ 0.000001.

[e]USEPA, 1994d.

[f]Value derived by Toxicology & Risk Assessment Section. Chronic food ingestion RfD obtained from IRIS. [(Chronic food ingestion RfD x 10 kg) ÷ 200 mg/day] ÷ 0.000001.

Table B.2
1995 Metal Concentrations in Midlothian Soils

Element	Midlothian (1995)		Local Area (1995)		United States	
	Range (ppm)	Median (ppm)	Range (ppm)	Median (ppm)	Range (ppm)[a]	Median (ppm)
ALUMINUM	4,900-47,000	22,000	8,200-24,000	15,000	700->100,000	47,000
ANTIMONY	<MDL[b]	<MDL	<MDL	<MDL	<1-8.8	0.48
ARSENIC	<MDL-21	10	<MDL-7	N/A[c]	<0.1-97	5.2
BERYLLIUM	0.24-1.7	0.8	0.25-0.88	0.7	<1-15	0.63
CADMIUM	<MDL-2.0	0.6	<MDL-0.5	0.3	0.01-7.0[*]	N/A
CHROMIUM	17-540	48	28-200	81	1-2,000	37
COPPER	7.4-110	17	4.8-11	9.3	<1-700	17
IRON	7,000-67,000	18,000	8,200-31,000	15,000	100->100,000	18,000
LEAD	7-490	21	6-23	13	<10-700	16
MANGANESE	300-4,700	820	170-1,500	455	<2-7,000	330
MERCURY	<MDL	<MDL	<MDL	<MDL	<0.01-4.6	0.06
MOLYBDENUM	<MDL-36	2.6	0.5-14	3.1	0.1-40[+]	1.2[+]
NICKEL	18-250	44	27-250	62	<5-700	13
SELENIUM	<MDL	<MDL	<MDL	<MDL	<0.1-4.3	0.3
STRONTIUM	68-620	280	44-320	205	<5-3,000	120
THALLIUM	<MDL	<MDL	<MDL	<MDL	0.3-0.7	N/A
TITANIUM	34-430	91	26-180	53	70-20,000	2,400
ZINC	28-1,000	76	30-56	50	<5-2,900	48

[a]Unless otherwise noted, range and median concentrations taken from, Shacklette and Boerngen, 1984.
[b]MDL; method detection limit.
[c]N/A; not available.
[*]Dragun, J. (1988).
[+]U.S. Fish and Wildlife (1989).

Table B.3

CONCENTRATION OF METALS IN SOIL SAMPLES COLLECTED NEAR CHAPARRAL STEEL

Metal	Range of Concentrations (ppm)[a]	Background U.S. Soil Range (ppm)[b]	Soil Screening Level (ppm)
Aluminum	15,000-38,000	700->100,000	NA*
Antimony	<MDL-4.3	<1-8.8	20[c]
Beryllium	0.6-1.6	<1-15	300[c]
Cadmium	0.4-52	0.01-7[d]	40[c]
Chromium (total)	25-278	1-2000 (total chromium)	300 (CrVI) 50,000 (CrIII)[c]
Copper	12-190	<1-700	1,000[c]
Iron	18,000-52,000	100 - >100,000	NA
Lead	18-2,200	<10-700	400[f]
Manganese	590-4,200	<2-7,000	5,000[e]
Molybdenum	<MDL-6.2	0.1-40[g]	250[e]
Nickel	22-51	<5-700	1,000[c]
Strontium	160-360	<5-3,000	NA
Titanium	30-180	70-20,000	NA
Zinc	49-10,000	5-2,900	15,000[e]

[a] Surface (¼ to ½ inch depth) soil samples were collected at sites 1-22 (Figure 2.13). Eight and two samples were collected at sites 8 and 4, respectively (results were averaged at these sites), while single samples were collected at all other sites. Arsenic, mercury, selenium, and thallium were <MDL. ppm; parts-per-million. MDL; method detection limit.

[b] Unless otherwise noted: Shacklette and Boerngen, 1984.

[c] ATSDR soil comparison value for children; derived as follows: Chronic EMEG = (oral MRL x 10 kg ÷ 200 mg/kg/day) ÷ 0.000001, RMEG = (oral RfD x 10 kg ÷ 200 mg/kg/day) ÷ 0.000001, where 10 kg = ATSDR child default body weight and 200 mg/kg/day = ATSDR child default soil ingestion rate.

[d] Dragun, J., 1988

[e] Value derived by TARA, based on a residential childhood exposure scenario using USEPA derived toxicity information.

[f] USEPA, 1994e.

[g] USEPA, 1989.

Table B.4

2,3,7,8-TCDD TEQ Concentrations in Midlothian Soils

Sample Site[1]	Concentration (ppb[2])	Sample Site	Concentration (ppb)	Sample Site	Concentration (ppb)
1	1.0	21	1.1	41	2.1
2	3.3	22	2.5	42	0.3
3	2.5	23	1.0	43	0.8
4	2.2	24	0.8	44	4.3
5	0.7	25	0.7	45	0.6
6	5.2	26	12.3	46	1.4
7	1.1	27	1.7	47	2.3
8	1.3	28	1.2	48	2.0
9	1.9	29	1.0	49	1.7
10	8.2	30	1.1	50	1.4
11	11.3	31	0.6	51	4.0
12	2.7	32	0.9	52	1.6
13	3.4	33	0.5	53	3.0
14	1.1	34	1.3	54	0.7
15	1.9	35	2.1	Background 1	2.6
16	1.5	36	1.5	Background 2	1.1
17	1.1	37	1.4	Background 3	3.2
18	2.0	38	17.9	Background 4	0.8
19	1.0	39	2.0	Background 5	2.4
20	1.0	40	1.2	Background 6	1.3

[1]Please refer to the report for location of sampling sites.

[2]ppb; parts-per-billion.

APPENDIX C: MISCELLANEOUS SAMPLES SUMMARY DATA

Table C.1
METAL CONCENTRATIONS IN HAY-BALE SAMPLES
COLLECTED NEAR CHAPARRAL STEEL

	Metal Concentration in Hay Sample (ppm)[a]										
	Site 16 (0-3 inch depth)	Site 8									Maximum Tolerable Level (ppm)[b]
		0-3 inch depth					3-6 inch depth				
	Sample	Sample					Sample				
Metal	I	I	II	III	IV	V	I	II	III	IV	
Aluminum	1200	720	980	210	500	270	230	110	685	370	1000
Cadmium	0.1	1.2	1.3	0.5	0.8	0.2	0.6	0.4	0.4	0.2	0.5[c]
Chromium	27	41	44	19	25	17	21	13	20	19	1000
Iron	1200	3400	4300	1200	2200	1100	1000	560	1400	1400	1000
Lead	1.2	12	20	7.0	12	3.7	6.5	3.4	6.3	5.1	30
Manganese	46	280	400	120	200	140	110	77	124	160	1000
Nickel	12	11	8.3	5.2	6.0	4.6	6.6	4.7	6.5	5.1	50
Strontium	52	19	26	22	21	30	18	22	25	31	2000
Titanium	17	32	43	9.0	23	11	8.6	4.9	13	11	no reported toxicity

[a] Please refer to Figure 2.13 for the location of sample sites 8 and 16. Antimony, arsenic, beryllium, mercury, selenium, and thallium were not detected. ppm, parts per million dry weight.
[b] NAS, 1980.
[c] Levels are based on human food residue considerations.

Table C.2
METAL CONCENTRATIONS IN MISCELLANEOUS VEGETATION/FORAGE SAMPLES COLLECTED NEAR CHAPARRAL STEEL

Metal	Metal Concentration in Vegetation Samples (ppm)[a]						Maximum Tolerable Level (ppm)[b]
	Site 1	Site 2	Site 3	Site 4	Site 8	Sites 5-6,16-20	
Aluminum	580	130	540	230	67	71-540	1000
Cadmium	0.3	1.4	0.2	ND[c]	1.0	ND-0.2	0.5[d]
Chromium	16	8.8	17	9.5	3.6	1.9-7.2	1000
Copper	9.2	9.2	14	5.3	5.8	5.5-7.9	100
Iron	2,100	920	2,500	1,020	430	320-770	1000
Lead	10	5.4	5	3.0	3.0	ND-3.2	30[d]
Manganese	170	95	190	115	47	42-72	1000
Molybdenum	1.4	2.2	4.5	1.2	1.4	0.6-5.5	10
Nickel	5.2	4.1	4.6	2.8	2.1	2.0-3.6	50
Strontium	52	88	120	35	81	43-100	2000
Titanium	7.4	5.7	21	11	2.9	3.3-8.4	no reported toxicity
Zinc	90	130	70	34	70	23-47	500

[a] Vegetation samples are defined as samples of live (i.e., miscellaneous). Miscellaneous vegetation samples collected from sites 1-6, 8, and 16-20 (please refer to Figure 2.13 for the location of sampling sites). Antimony, arsenic, beryllium, mercury, selenium, and thallium were not detected. ppm, parts per million dry weight.
[b] NAS, 1980.
[c] ND, not detected.
[d] Levels are based on human food residue considerations.

Table C.3
METAL CONCENTRATIONS IN WHEAT-HEAD SAMPLES COLLECTED NEAR CHAPARRAL STEEL[a]

Metal	Range (ppm)	Median (ppm)
Aluminum	16 - 72	24
Antimony	<MDL (2)[b]	---
Arsenic	<MDL (2)	---
Beryllium	<MDL (0.01)	---
Cadmium	<MDL (0.1)	---
Chromium	1.5 - 6.0	2.2
Copper	3.8 - 5.2	4.1
Iron	58 - 350	97
Lead	<MDL (1)	---
Manganese	27 - 67	44
Mercury	<MDL (0.5)	---
Molybdenum	0.3 - 1.4	0.6
Nickel	2.3 - 14	3.1
Selenium	<MDL (2)	---
Strontium	3.3 - 18	7.8
Thallium	<MDL (2)	---
Titanium	0.68 - 3.1	1.1
Zinc	26 - 38	31

[a] Wheat head samples were collected at sites 9-15, 21, and 22 (please refer to Figure 2.13 for sample locations). Results are expressed in parts-per-million (ppm) dry-weight basis.
[b] MDL, method detection limit, where the number in parenthesis represents the MDL.

APPENDIX D: DIOXIN AND FURAN STACK TEST DATA

Table D.1

POLYCHLORINATED DIOXIN (PCDD) AND FURAN (PCDF) EMISSIONS FROM NTCC: DERIVATION OF 2,3,7,8-TETRACHLORODIBENZODIOXIN TOXICITY EQUIVALENTS (TEQs)

		North Texas-100% Coal*		North Texas-36% WDF**		North Texas -60% WDF**	
Compound+	I-TEF/89++	μg/m³	TEQs	μg/m³	TEQs	μg/m³	TEQs
2378-TCDD	1.0	5.0×10^{-11}	5.0×10^{-11}	5.0×10^{-11}	5.0×10^{-11}	2.9×10^{-10}	2.9×10^{-10}
2378-PeCDD	0.5	5.0×10^{-11}	2.5×10^{-11}	1.9×10^{-10}	9.5×10^{-11}	2.6×10^{-9}	1.3×10^{-9}
2378-HxCDDs	0.1	5.0×10^{-11}	5.0×10^{-12}	5.0×10^{-10}	5.0×10^{-11}	4.14×10^{-9}	4.14×10^{-10}
2378-HpCDD	0.01	5.0×10^{-11}	5.0×10^{-13}	9.1×10^{-9}	9.1×10^{-11}	3.9×10^{-8}	3.9×10^{-10}
OCDD	0.001	5.0×10^{-11}	5.0×10^{-14}	5.0×10^{-11}	5.0×10^{-14}	5.8×10^{-9}	5.8×10^{-12}
2378-TCDF	0.1	5.0×10^{-11}	5.0×10^{-12}	1.1×10^{-9}	1.1×10^{-10}	8.4×10^{-9}	8.4×10^{-10}
12378-PeCDF	0.05	5.0×10^{-11}	2.5×10^{-12}	3.6×10^{-10}	1.8×10^{-11}	1.0×10^{-9}	5.0×10^{-11}
23478-PeCDF	0.5	5.0×10^{-11}	2.5×10^{-11}	3.6×10^{-10}	1.8×10^{-10}	2.9×10^{-9}	1.45×10^{-9}
2378-HxCDFs	0.1	5.0×10^{-11}	5.0×10^{-12}	3.6×10^{-10}	3.6×10^{-11}	1.6×10^{-9}	1.6×10^{-10}
2378-HpCDFs	0.01	5.0×10^{-11}	5.0×10^{-13}	3.7×10^{-10}	3.7×10^{-12}	4.3×10^{-10}	4.3×10^{-12}
OCDF	0.001	5.0×10^{-11}	5.0×10^{-14}	8.14×10^{-9}	8.14×10^{-12}	5.0×10^{-11}	5.0×10^{-14}
TOTAL TEQs			**1.19×10^{-10}**		**6.42×10^{-10}**		**4.9×10^{-9}**

* October 1991 Report.

** January 1992 Report; WDF=Waste Derived Fuel.

\+ TCDD/F=tetrachlordibenzodioxin/furan; PeCDD/F=pentachlorodibenzodioxin/furan; HxCDD/F=hexachlordibenzodioxin/furan; HpCDD/F=heptachlordibenzodioxin/furan; OCDD/F= octachlordibenzodioxin/furan.

++ International Toxic Equivalency Factors (TEFs) adopted by the U.S. Environmental Protection Agency (USEPA, 1989).

Table D.2

POLYCHLORINATED DIOXIN (PCDD) AND FURAN (PCDF) EMISSIONS FROM TXI: DERIVATION OF 2,3,7,8-TETRACHLORODIBENZODIOXIN TOXICITY EQUIVALENTS (TEQs)

		TXI-100% Coal*		TXI-100% WDF*	
Compound**	I-TEF/89***	μg/m³	TEQs	μg/m³	TEQs
2378-TCDD	1.0	7×10^{-12}	7×10^{-12}	1.25×10^{-11}	1.25×10^{-11}
2378-PeCDD	0.5	1.56×10^{-11}	7.8×10^{-12}	1.49×10^{-10}	7.45×10^{-11}
2378-HxCDDs	0.1	1.59×10^{-11}	1.59×10^{-12}	9.2×10^{-10}	9.2×10^{-11}
2378-HpCDD	0.01	4.3×10^{-12}	4.3×10^{-14}	8.4×10^{-9}	8.4×10^{-11}
OCDD	0.001	3.15×10^{-9}	3.15×10^{-12}	2.8×10^{-9}	2.8×10^{-12}
2378-TCDF	0.1	3.09×10^{-11}	3.09×10^{-12}	1.6×10^{-10}	1.6×10^{-11}
12378-PeCDF	0.05	3.06×10^{-11}	1.53×10^{-12}	1.65×10^{-10}	8.25×10^{-12}
23478-PeCDF	0.5	7.8×10^{-11}	3.9×10^{-11}	3.1×10^{-10}	1.55×10^{-10}
2378-HxCDFs	0.1	3.26×10^{-11}	3.26×10^{-12}	1.34×10^{-10}	1.34×10^{-11}
2378-HpCDFs	0.01	5.6×10^{-11}	5.6×10^{-13}	9.1×10^{-11}	9.1×10^{-13}
OCDF	0.001	2.99×10^{-10}	2.99×10^{-13}	2.3×10^{-10}	2.3×10^{-13}
TOTAL TEQs			**6.73×10^{-11}**		**4.60×10^{-10}**

* April 1991 Report; WDF=Waste Derived Fuel.

** TCDD/F=tetrachlordibenzodioxin/furan; PeCDD/F=pentachlorodibenzodioxin/furan; HxCDD/F=hexachlordibenzodioxin/furan; HpCDD/F=heptachlordibenzodioxin/furan; OCDD/F=octachlordibenzodioxin/furan.

*** International Toxic Equivalency Factors (TEFs) adopted by the U.S. Environmental Protection Agency (USEPA, 1989).

Table D.3

POLYCHLORINATED DIOXIN (PCDD) AND FURAN (PCDF) EMISSIONS FROM HOLNAM LP: DERIVATION OF 2,3,7,8-TETRACHLORODIBENZODIOXIN TOXICITY EQUIVALENTS (TEQs)

		Holnam-100% Coal*		Holnam-30% TDF*	
Compound**	I-TEF/89***	$\mu g/m^3$	TEQs	$\mu g/m^3$	TEQs
2378-TCDD	1.0	1.12×10^{-11}	1.12×10^{-11}	1.40×10^{-11}	1.40×10^{-11}
2378-PeCDD	0.5	2.24×10^{-11}	1.12×10^{-11}	3.08×10^{-11}	1.54×10^{-11}
2378-HxCDDs	0.1	5.59×10^{-11}	5.59×10^{-12}	9.52×10^{-11}	9.52×10^{-12}
2378-HpCDD	0.01	2.51×10^{-11}	2.51×10^{-13}	6.16×10^{-11}	6.16×10^{-13}
OCDD	0.001	2.74×10^{-10}	2.74×10^{-13}	3.30×10^{-10}	3.30×10^{-13}
2378-TCDF	0.1	7.82×10^{-12}	7.82×10^{-13}	8.40×10^{-12}	8.40×10^{-13}
12378-PeCDF	0.05	1.40×10^{-11}	6.98×10^{-13}	1.68×10^{-11}	8.40×10^{-13}
23478-PeCDF	0.5	1.40×10^{-11}	6.98×10^{-12}	1.68×10^{-11}	8.40×10^{-12}
2378-HxCDFs	0.1	4.75×10^{-11}	4.75×10^{-12}	7.00×10^{-11}	7.00×10^{-12}
2378-HpCDFs	0.01	3.63×10^{-11}	3.63×10^{-13}	6.72×10^{-11}	6.72×10^{-13}
OCDF	0.001	8.38×10^{-11}	8.38×10^{-14}	7.56×10^{-11}	7.56×10^{-14}
TOTAL TEQs			4.21×10^{-11}		5.01×10^{-11}

* TDF=Tire-Derived Fuel.

** TCDD/F=tetrachlordibenzodioxin/furan; PeCDD/F=pentachlorodibenzodioxin/furan; HxCDD/F= hexachlordibenzodioxin/furan; HpCDD/F=heptachlordibenzodioxin/furan; OCDD/F= octachlordibenzodioxin/furan.

*** International Toxic Equivalency Factors (TEFs) adopted by the U.S. Environmental Protection Agency (USEPA, 1989).