Lead Human Exposure and Health Risk Assessments for Selected Case Studies (Draft Report)

Volume II. Appendices

EPA-452/D-07-001b
July 2007

Lead Human Exposure and Health Risk Assessments for Selected Case Studies (Draft Report)

Volume II. Appendices

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina

DISCLAIMER

This document has been reviewed by the Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency (EPA), and approved for publication. This draft document has been prepared by staff from the Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, in conjunction with ICF International (through Contract No. EP-D-06-115). Any opinions, findings, conclusions, or recommendations are those of the authors and do not necessarily reflect the views of the EPA or ICF International. Mention of trade names or commercial products is not intended to constitute endorsement or recommendation for use. This document is being provided to the Clean Air Scientific Advisory Committee for their review, and made available to the public for comment. Any questions or comments concerning this document should be addressed to Zachary Pekar, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, C504-06, Research Triangle Park, North Carolina 27711 (email: pekar.zachary@epa.gov).

PREFACE

This document is part of the Environmental Protections Agency's (EPA's) review of the National Ambient Air Quality Standards (NAAQS) for lead (Pb). As part of that review, the Agency has prepared the *Air Quality Criteria Document for Lead* (the "CD", October, 2006; available at http://www.epa.gov/ttn/naaqs/standards/pb/s_pb_cr_cd.html), a draft Staff Paper (*Review of the National Ambient Air Quality Standards for Lead: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper – First Draft*, December, 2006; available at http://www.epa.gov/ttn/naaqs/standards/pb/s_pb_cr_sp.html), and a draft technical report of pilot phase risk assessments (*Lead Human Exposure and Health Risk Assessments and Ecological Risk Assessment for Selected Areas,* December, 2006; available at http://www.epa.gov/ttn/naaqs/standards/pb/s_pb_cr_td.html). These documents were developed under our historic approach for reviewing NAAQS, which has included the completion of a policy assessment, in the form of a Staff Paper, and of any related risk and exposure assessments (risk/exposure reports) prior to development of notices of proposed and final rulemakings. The policy assessment, considering the adequacy of the current standard and policy alternatives, is intended to help "bridge the gap" between the scientific assessment contained in the CD and the judgments required of the EPA Administrator in determining whether it is appropriate to retain or revise the NAAQS.

The Agency is now moving forward to implement a new, improved process for conducting NAAQS reviews (http://www.epa.gov/ttn/naaqs/) and is transitioning to that new process during the course of the Pb NAAQS review, beginning with this document (the risk/exposure report). Under the new process, the risk/exposure report precedes the policy assessment (rather than accompanying it), and the policy assessment is included in an Advance Notice of Proposed Rulemaking (ANPR) rather than a Staff Paper. Accordingly, it is the Agency's intention that the results of the assessments described in the final risk/exposure assessment report for Pb will be considered, in combination with an evaluation of the policy implications of the key studies and scientific information contained in the CD and ambient Pb analyses, in the development of the policy assessment to be published in the *Federal Register* in an ANPR this fall.[1]

Volume I of this document has been drafted by EPA staff, and the appendices (contained in Volume II) have been drafted by EPA staff, in conjunction with ICF International (through Contract No. EP-D-06-115). This draft document is being provided to the Clean Air Scientific Advisory Committee (CASAC) for their review, and is being made available to the public for

[1] EPA's preference is to issue the policy assessment as part of an ANPR and not in the form of a final Staff Paper. EPA is currently, however, under a court order to issue a final Staff Paper and has moved for modification of that order to allow EPA to issue an ANPR in place of a final Staff Paper. In the event EPA's motion is not granted, EPA intends to fully comply with the existing order.

comment. A final version of this document will be prepared taking into consideration CASAC and public comments.

This document is limited in focus to the human exposure and risk assessments. As stated in the December draft Staff Paper, a full-scale ecological risk assessment is not being performed for this review. The pilot phase ecological risk assessment is presented in the December 2006 draft technical report of pilot phase risk assessments and discussed in the December 2006 draft Staff Paper. Accordingly, the focus for this review with regard to the policy assessment for the secondary standard will be on what we have learned from the pilot phase risk assessment, in addition to the science assessment in the CD.

List of Appendices

July 2007

Appendix A. Sources, Emissions and Air Quality in the U.S. with Particular Focus on Urban Areas

Prepared by:

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina

List of Tables

List of Figures

List of Attachments

A. SOURCES, EMISSIONS AND AIR QUALITY IN THE U.S. WITH PARTICULAR FOCUS ON URBAN AREAS

Due to its physical and chemical properties, lead (Pb) exists in the environment predominantly in solid form. Consequently upon emission into the air, Pb deposits onto surfaces or exists in the atmosphere as a component of atmospheric aerosol, and usually in the form of various Pb compounds (CD[1], Section 2.1). The National Ambient Air Quality Standard (NAAQS) for Pb pertains to the Pb content of all Pb compounds that may be emitted to air.

The major environmental transport pathway for anthropogenic Pb is the atmosphere, in which it can also undergo secondary dispersal via the deposition and resuspension of particles containing Pb (CD, p 2-52 and Section 2.3.1). Airborne Pb particles generally have a bimodal distribution with the greater mass of Pb found in the fine fraction (CD, p. 2-52), for which deposition is slower and less efficient than for larger particles (CD, p. 2-59). Accordingly Pb may be widely dispersed (CD, pp. 2-52, 3-3). Wet and dry deposition are the ultimate paths by which Pb particles are removed from the atmosphere.

This appendix describes information on sources and emissions of Pb to the atmosphere (Section A.1), and Pb air monitoring data (Section A.2).

A.1 SOURCES AND EMISSIONS

The purpose of this section is to summarize available information on sources of Pb into the ambient air. The section does not provide a comprehensive list of all sources of Pb, nor does it provide estimates of emission rates or emission factors for all source categories. Rather, the discussion here is intended to identify the larger sources, either on a national or local scale, and provide some characterization of their emissions and distribution within the U.S. The primary data source for this discussion is the National Emissions Inventory (NEI) for 2002 (USEPA, 2007a). As a result of Clean Air Act requirements, emissions standards promulgated for many source categories since then are projected to result in much lower emissions at the current time or in the near future.

It is noted that the Pb emissions estimates in the NEI, and presented in this Appendix, are a mixture of estimates specific to Pb (regardless of the compound in which it may have been emitted) and estimates specific to the Pb compounds emitted. That is, emissions estimates for some of the point sources are in terms of mass of Pb compounds, whereas the non point source and mobile source emissions estimates are in terms of mass of the Pb only. For the point sources, approximately 80% are reported as mass of Pb and most of the other 20% are reported

[1] As in Volume I, the *Air Quality Criteria Document for Lead* (USEPA, 2006) is abbreviated here as "CD".

as mass of Pb compounds. The high molecular weight of Pb (as compared to elements with which it is associated in Pb compounds), however, reduces the impact of this reporting inconsistency.

The larger categories of Pb sources are presented in Section A.1.1, while Section A.1.2 describes the number of and geographic distribution of Pb sources and associated emissions. Section A.1.3 describes the largest Pb stationary sources in the NEI. Lastly, the data sources, limitations of and confidence in the Pb emissions and source information presented here is discussed in Section A.1.4.

A.1.1 Types of Pb Sources

Lead is emitted from a wide variety of source types, some of which are small individually but the cumulative emissions of which are large, and some for which the opposite is true. The categories of Pb sources estimated via the 2002 NEI to emit –as a category- more than 5 tons per year (tpy) of Pb are listed in Table A-1. The main sources of emissions in the 2002 NEI are comprised primarily of combustion-related emissions and industrial process-related emissions. Point source emissions account for about 66% of the national Pb emissions in the 2002 NEI. The point source emissions are roughly split between combustion and industrial processes, while mobile, non-road sources (general aviation aircraft – leaded fuel) account for 29%.

A.1.1.1 Stationary Sources

Table A-1 presents emissions estimates for stationary sources grouped into descriptive categories. Presence and relative position of a source category on this list does not necessarily provide an indication of the significance of the emissions from individual sources within the source category. A source category, for example, may be composed of many small (i.e., low-emitting) sources, or of just a few very large (high-emitting) sources. Such aspects of a source category, which may influence its potential for human and ecological impacts, are included in the short descriptions of the largest stationary source categories presented in Attachment A-1. The relative sizes of stationary sources represented in the NEI, and the geographic distribution of the larger sources are presented in Sections A.1.2 and A.1.3.

Table A-1. Source categories emitting greater than 5 tpy of Pb in the 2002 NEI.

Source Category Description	Total Emissions (tpy)
ALL CATEGORIES	1711
Mobile Sources	495
Industrial/Commercial/ Institutional Boilers & Process Heaters	190
Utility Boilers	176
Iron and Steel Foundries	110
Solvent Use	63
Primary Lead Smelting	59
Hazardous Waste Incineration	47
Secondary Lead Smelting	46
Municipal Waste Combustors	33
Stainless and Nonstainless Steel Manufacturing	32
Integrated Iron & Steel Manufacturing	32
Pressed and Blown Glass and Glassware Manufacturing	30
Mining	27
Lead Acid Battery Manufacturing	27
Secondary Nonferrous Metals	24
Primary Copper Smelting	22
Portland Cement Manufacturing	22
Primary Metal Products Manufacturing	20
Mineral Products	11
Sewage Sludge Incineration	10
Industrial Inorganic Chemical Manufacturing	10
Incineration	10
Pulp & Paper Production	9
Secondary Aluminum Production	9
Synthetic Rubber Manufacturing	9
Secondary Copper Smelting	8
Stationary Reciprocating Internal Combustion Engines	8
Industrial Machinery and Equipment	7
Nonferrous Foundries, Not Elsewhere Classified	7
Ferroalloys Production	7
Residential Heating	6
Fabricated Metal Products Manufacturing	6
Electrical and Electronics Equipment Manufacturing	6
Commercial and Industrial Solid Waste Incineration	6
Miscellaneous Metal Parts & Products (Surface Coating)	5
Primary Nonferrous Metals--Zinc, Cadmium and Beryllium	5
Coke Ovens	5
Plastics Products	5

A.1.1.2 Mobile Sources

Thirty-five years ago, combustion of leaded gasoline was the main contributor of Pb to the air. In the early 1970s, EPA set national regulations to gradually reduce the Pb content in gasoline. In 1975, unleaded gasoline was introduced for motor vehicles equipped with catalytic converters. EPA banned the use of leaded gasoline in highway vehicles after December 1995. Currently, Pb is still added to aviation gasoline (commonly referred to as avgas) used in most piston-engine aircraft and some types of race cars. Lead emissions from the combustion of avgas are discussed below. Vehicles used in racing are not regulated by the EPA under the Clean Air Act and can therefore use alkyl-Pb additives to boost octane. EPA has formed a voluntary partnership with NASCAR with the goal of permanently removing alkyl-Pb from racing fuels used in the Nextel Cup, Busch and Craftsman Truck Series (CD, p. 2-50). In January of 2006, NASCAR agreed to switch to unleaded fuel in its race cars and trucks beginning in 2008. NASCAR initiated this switch in 2007.

Lead is also present as a trace contaminant in gasoline and diesel fuel and is a component of lubricating oil (CD, pp. 2-45 to 2-48). Inventory estimates from these sources are not currently available. Additional mobile sources of Pb include brake wear, tire wear, and loss of Pb wheel weights (CD, pp. 2-48 to 2-50). Emission rates for Pb from brake wear have been published but inventory estimates have not yet been developed from these data (Schauer et al., 2006). Robust estimates of Pb from tire wear and wheel weights are not available. Currently, Pb from combustion of leaded avgas is the only mobile source of Pb included in the 2002 NEI.

Emissions of Pb in the 2002 NEI from the use of avgas are estimated to be 491 tons which comprises 29% of the national inventory. The majority of this leaded avgas is commonly referred to as 100 Low Lead (100LL) which contains 0.56 g of Pb per liter (2.12 g Pb per gallon) (ChevronTexaco, 2005). In 2002 approximately 280,644,000 gallons of avgas were supplied in the U.S. (DOE, 2006).

Lead emissions from piston-engine aircraft in the NEI are allocated to 3,410 airports (USEPA, 2007b). These Pb emissions are allocated to each airport in proportion to the operation of piston-engine aircraft at each airport as a fraction of the national piston-engine aircraft activity. There are many small airports not included in the NEI and estimates for the piston-engine activity at these airports is being evaluated. Airport-specific Pb emissions estimates in the NEI include Pb emitted during the entire flight (i.e., not limited to the landing and take-off cycle).[2] EPA is using this inventory approach for Pb because it is important to account for all of

[2]Lead emissions from general aviation are calculated as the product of the fuel consumed, the concentration of Pb in the fuel and the factor 0.75 to account for an estimated 25% of Pb being retained in the engine and/or exhaust system of the aircraft. The estimate of 25% Pb retention was derived from measurements of light-duty gas

the Pb emitted due to its persistence in the environment. In addition, there is currently not an alternative approach for incorporating all the Pb emissions from aircraft into the NEI. In order to conduct a risk assessment specific to Pb exposures experience near an airport, more refined analyses can be conducted that, among other variables, could include an inventory developed from local data (e.g., fuel consumption, numbers of flights by piston-engine aircraft). As described in the footnote above, in estimating Pb emissions in the NEI, piston-engine aircraft emissions have been discounted by a significant fraction to account for an estimated fraction of Pb lost to engine components (25%) so not all the Pb potentially emitted has been included in the inventory.

Airport-specific Pb emissions estimates in the 2002 NEI do not include the following airport-related source of Pb: evaporative losses of Pb from fuel storage and distribution, military aircraft combustion emissions, and the small amounts of tetraethyl Pb (TEL) discarded on the tarmac by pilots after their fuel check. Pb from fuel storage and distribution is estimated to be 0.3 tons nationally and is included in the NEI, but not assigned to specific airports. Data regarding military piston engine aircraft emissions are supplied to EPA by states and the 2002 version 3.1 inventory estimates did not include state-submitted data, but future updates to the inventory will include these estimates.

Among the airports in the NEI where piston-engine aircraft operate, the majority of airports (62%) are estimated to have Pb emissions less than 0.1 ton per year, 37% are estimated to have Pb emissions between 0.1 to 1.0 ton per year and 1%, or 36 airports, are estimated to have Pb emissions over 1.0 ton (Table A-2).

---

vehicles operating on leaded fuel and is likely an upper-bound estimate of the amount of Pb retained in a piston-engine aircraft.

Table A-2. Lead emissions from leaded aviation gas use in the 2002 NEI version 3.1.

Emissions Range (tpy)	Number of Airports	Total Emissions (tpy)
< 0.1	2,104	76.7
0.1 to 1.0	1,270	367.5
> 1	36	47.1
Summary	3,410	491.3

The 36 airports for which the NEI estimates Pb emissions are greater than one ton are presented in Figure A-1. Van Nuys airport in Los Angeles County is estimated to have the largest annual emissions of Pb from combustion of avgas (over 2 tons). In the NEI, there are 15 airports in Los Angeles County with piston-engine aircraft activity, which combined, are estimated to emit more than 10 tons of Pb annually. On a national basis, there are 78 counties in which Pb emissions from piston-engine aircraft are greater than one ton Pb. The Pb emissions in these 78 counties account for 158 tons or 32% of the Pb emissions from piston-engine aircraft nationally.

Figure A-1. Airports in NEI 2002 with piston-engine aircraft activity where more than one ton of Pb is emitted annually.

A.1.1.3 Resuspension of Previously Deposited Pb and other Sources

Although the resuspension of soil-bound Pb particles and contaminated road dust has been reported to be a significant source of airborne Pb (CD, Section 2.3.3, and p. 2-62), estimates of resuspension-related emissions are not included in the 2002 NEI. Studies of emissions in southern California, however, indicate that Pb in resuspended road dust may represent between 40% and 90% of Pb emissions in some areas (CD, p. 2-65). Lead concentrations in suspended soil and dust, however, vary significantly (CD, p. 2-65). In general, the main drivers of particle resuspension are typically mechanical stressors such as vehicular traffic, construction and agricultural operations, and to a lesser extent, the wind. Lead resuspended in soil near roadways that was in place during the use of leaded gasoline may be a notable emissions source if/when such soil is disturbed (e.g., road widening or building construction).

Understanding the physics of resuspension from natural winds requires analyzing the wind stresses on individual particles and although this analysis can be accurate on a small scale, predicting resuspension on a large scale generally focuses on empirical data for soil movement due to three processes: saltation, surface creep, and suspension (CD, pp. 2-62 to 2-63). Further, rather than a continuous process, resuspension may occur as a series of events. Short episodes of high wind speed, dry conditions, and other factors conducive to resuspension may dominate annual averages of upward flux (CD, p. 2-65). All of these factors complicate emissions estimates (CD, Section 2.2.1) such that quantitative estimates for these processes remain an area of significant uncertainty.

Other sources not currently included in the NEI are emissions of Pb from natural sources, such as wind-driven resuspension of soil with naturally occurring Pb, sea salt spray, volcanoes, wild forest fires, and biogenic sources (CD, Section 2.2.1). Estimates for these emissions, some of which have significant variability (CD, p. 2-13) have not been developed for the NEI, as quantitative estimates for these processes remain an area of significant uncertainty.

A.1.2 Number and Geographic Distribution of Sources

The geographic distribution and magnitude of Pb emissions in the U.S. from all sources identified in the 2002 NEI is presented in Figure A-2, in terms of emissions density (defined here as tons per area, square mile, per county). This presentation indicates a broad distribution of Pb emissions across the U.S., with the highest emitting counties scattered predominantly within a broad swath from Minnesota to southern New England southward.

Within the NEI, emissions may be associated with specific "points" (i.e., point sources) or with activities estimated to occur with some frequency within an "area" such as a county (area sources) or with mobile sources (see Section 1.1.1.2).

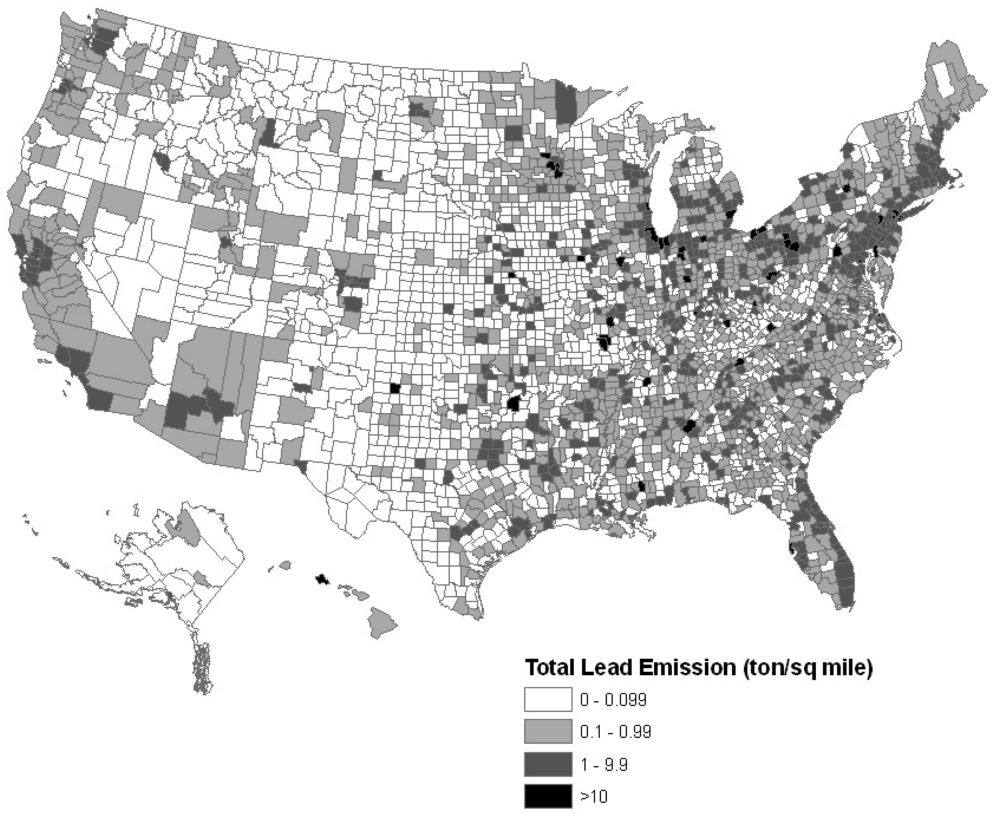


Figure A-2. Emissions density of all Pb sources in the 2002 NEI.

There are some 13,067 point sources (industrial, commercial or institutional) in the 2002 NEI, each with one or more processes that emit Pb to the atmosphere (Table A-3). Most of these sources emit < 0.1 tpy. There are approximately 1300 point sources of Pb in the NEI with estimates of emissions greater than or equal to 0.1 tpy and these point sources, combined, emit 1058 tpy, or 94% of the Pb point source emissions. In other words, 94% of Pb point source emissions are emitted by the largest 10% of these sources. The geographic distribution of point sources estimated to emit greater than 1 tpy is presented in Figure A-3.

Table A-3. Distribution of point sources within the 2002 NEI and associated estimated emissions.

Emissions Range (tpy)	Number of Sources	Total Emissions (tpy)	Average Emissions per Source (tpy)
< 0.1	11,800	73	<0.01
0.1 to 1.0	1,026	326	0.3
1.0 to 5	211	424	2
> 5	30	308	10
Summary	13,067	1131	

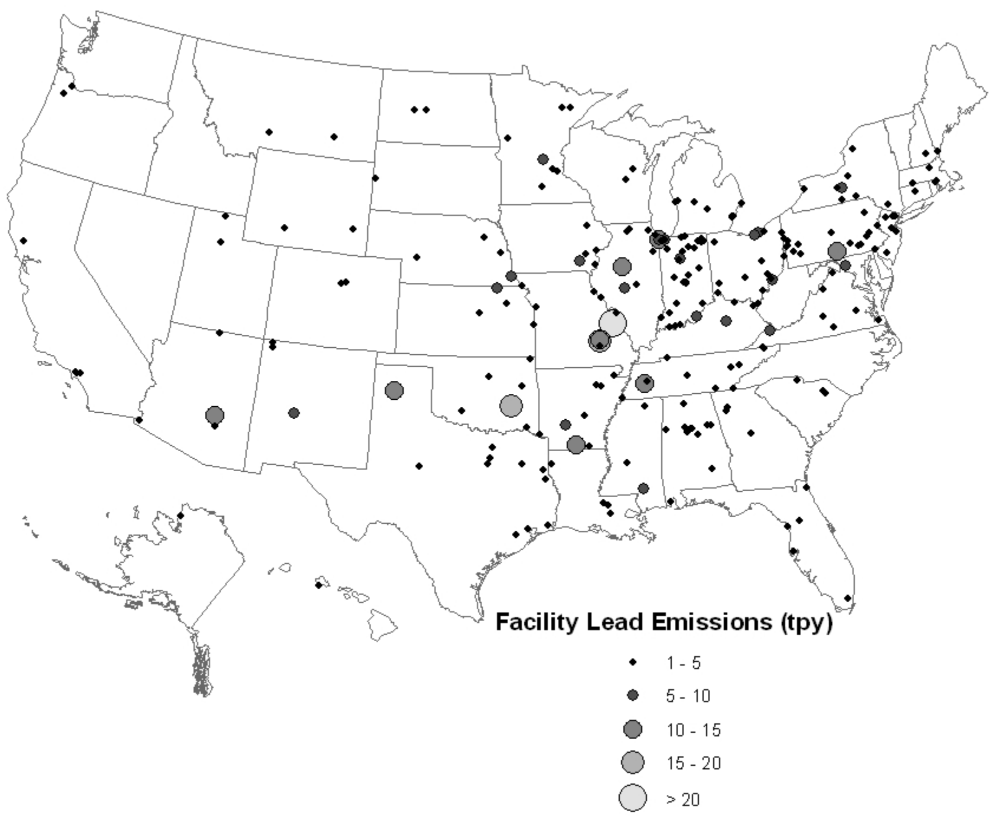


Figure A-3. Geographic distribution of point sources with >1 tpy Pb emissions in 2002 NEI.

Figure A-4 shows the geographic distribution of NEI emissions specifically for mobile sources, which, as discussed in Section A.1.1.2, are limited in this NEI to airport Pb emissions associated with use of general aviation gasoline in piston-engine aircraft.

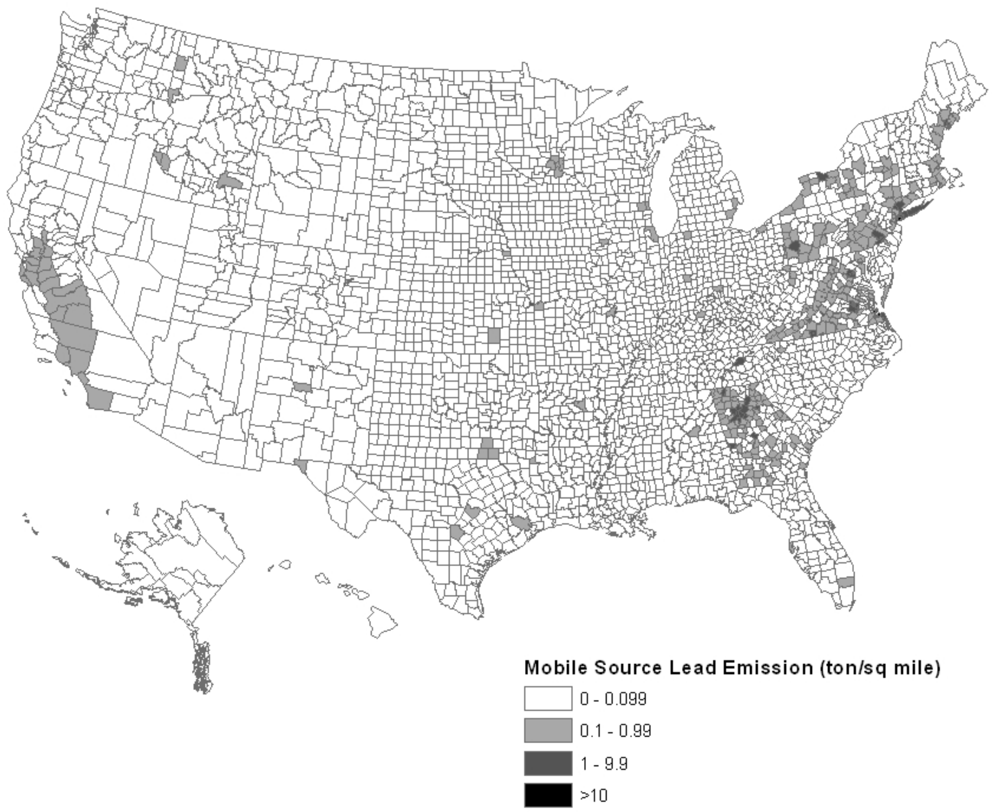


Figure A-4. Emissions density of mobile sources of Pb (general aviation gasoline) in 2002 NEI.

A.1.3 Largest Pb Point Sources in the 2002 NEI

While Section A.1.1 focuses on source categories that rank highest due to cumulative national Pb emissions, this section is intended to consider Pb emissions on the individual source level. As mentioned in Section A.1.2, the 2002 NEI includes 30 facilities with emissions estimated to be greater than or equal to 5 tons per year (see Table A-3). Most of these sources (Table A-4) are metallurgical industries, followed by waste disposal facilities and manufacturing processes.

Table A-4. Point Sources with Pb emissions in 2002 NEI greater than or equal to 5 tpy.

Source Category Name	State	County Name	2002 Point Emissions (TPY)
Primary Lead Smelting	MO	Jefferson County	58.8
Military Installation	OK	Pittsburg County	17.2
Mining	MO	Reynolds County	15.4
Secondary Nonferrous Metals	TX	Potter County	13.9
Primary Copper Smelting	AZ	Gila County	12.8
Electric Arc Furnaces	IL	Peoria County	12.5
Secondary Lead Smelting	MO	Iron County	12.4
Integrated Iron & Steel Manufacturing	IN	Lake County	11.3
Pressed and Blown Glass and Glassware Manufacturing	TN	Madison County	10.9
Military Installation	PA	Franklin County	10.4
Hazardous Waste Incineration	AR	Union County	10.2
Lead Acid Battery Manufacturing	KY	Madison County	9.9
Industrial and Commercial Machinery Manufacturing	KS	Marshall County	8.2
Synthetic Rubber Products Manufacturing - Fabric Coating	IN	Cass County	7.4
Commercial and Industrial Solid Waste Incineration	AR	Clark County	7.3
Utility Boiler	IN	Floyd County	7.3
Iron and Steel Foundries	OH	Cuyahoga County	7.3
Integrated Iron & Steel Manufacturing	IN	Porter County	7.2
Integrated Iron & Steel Manufacturing	IN	Lake County	6.1
Mineral Products Manufacturing	NM	Socorro County	6.1
Commercial and Industrial Solid Waste Incineration	CT	Windham County	5.8
Ferroalloys Production	OH	Washington County	5.7
Nonferrous Foundries	NE	Nemaha County	5.5
Portland Cement Manufacturing	MD	Frederick County	5.4
Hazardous Waste Incineration	OH	Lorain County	5.4
Coke Oven	VA	Buchanan County	5.1
Iron and Steel Foundries	IA	Jefferson County	5.1
Mining	MO	Reynolds County	5

A.1.4 Data Sources, Limitations and Confidence

The Pb emissions information presented in the previous sections is drawn largely from EPA's NEI for 2002 (USEPA, 2007a). The NEI is based on information submitted from State, Tribal and local air pollution agencies and data obtained during the preparation of technical support information for the EPA's hazardous air pollutant regulatory programs. The Agency has recently developed version 3 of the NEI for 2002 and that version is anticipated to be posted on the EPA's CHIEF website soon at (http://www.epa.gov/ttn/chief/net/2002inventory.html). The information presented in this draft document is based on version 3.

The process of identifying sources that emit Pb into the air has been ongoing since before the Clean Air Act of 1970. The comprehensiveness of emission inventories generally, and the

NEI, specifically, depends upon what is known regarding which source types emit Pb, their locations and their operating characteristics, as well as the reporting of this information to the inventory. As noted above, the NEI relies on information that is available from a variety of sources for this information. There are numerous steps, each with its own uncertainties, associated with the development of this information for use in the emissions inventory. First, the categories emitting Pb must be identified. Second, the sources' processes and control devices must be known. Third, the activity throughputs and operating schedules of these sources must be known. Finally, we must have emission factors to relate emissions to the operating throughputs, process conditions and control devices. The process, control device, throughputs and operating schedules are generally available for each source. However, the emission factors represent average emissions for a source type and average emissions may differ significantly from source to source. For some cases, emissions testing information provides source-specific information. More information on emission factors and the estimation of emissions is found in the introduction to EPA's Compilation of Air Pollutant Emissions Factors (USEPA, 2006b). Further information on emission factors is available at: http://www.epa.gov/ttn/chief/ap42/.

The NEI is limited with regarding to Pb emissions estimates for some sources such as resuspended road dust (Section A.1.1.3), biomass burning and trace levels of Pb in motor fuel and lubricating oil (Section A.1.1.2), and others. We have not yet developed estimates for the NEI of Pb emissions associated with resuspension of Pb residing in roadway dust and nearby surface soil. And emissions estimates are not yet in the NEI for the miscellaneous categories of on-road emissions (e.g., combustion of fuel with Pb traces, lubricating oil, mechanical wear of vehicle components, etc.). Emissions of Pb that may be emitted from wildfires, etc, are also not quantified in the NEI.

Two aspects of the 2002 NEI development contribute to our assessment of the Pb emissions information compiled in the 2002 NEI. The 2002 NEI has undergone extensive external review, including the process for developing the inventory which includes extensive quality assurance and quality assurance steps (QA/QC). For example, external reviewers had a period of 3 months to review the draft 2002 NEI. In addition for point sources, we created a QA/QC process and tracking database to provide feedback reports to data providers at regular intervals during the QA of the data. The feedback reports include the following 4 QC reports. Data integrity, latitude/longitudes QC, stack parameters QC, and emissions QC. Further, there was additional QA/QC conducted for emission inventory information for facilities that are included in the Risk and Technology Review (RTR) source categories (60FR14734). Version 3 of the 2002 NEI used in RTR have undergone additional QA/QC including SAB review and comments received to Docket # EPA-HQ-OAR-2006-0859. For the RTR facilities, we have strong confidence in the quality of the data. The largest point source facility emitting Pb is included in NEI data used in the RTR.

Generic limitations to the 2002 NEI include the following:

- Consistency: The 2002 NEI for Pb is a composite of emissions estimates generated by state and local regulatory agencies, industry, and EPA. Because the estimates originated from a variety of sources, as well as for differing purposes, they will in turn vary in quality, whether Pb is reported for particular source types, method of reporting compound classes, level of detail, and geographic coverage.
- Variability in Quality and Accuracy of Emission Estimation Methods: The accuracy of emission estimation techniques vary with pollutants and source categories. In some cases, an estimate may be based on a few or only one emission measurement at a similar source. The techniques used and quality of the estimates will vary between source categories and between area, major, and mobile source sectors. Generally, the more review and scrutiny given to emissions data by States and other agencies, the more certainty and accuracy there is in that data.

A.2 AIR QUALITY MONITORING DATA

The EPA has been measuring Pb in the atmosphere since the 1970s. For the most part, Pb concentrations have decreased dramatically over that period. This decrease is primarily attributed to the removal of Pb from gasoline; however, some individual locations still have Pb concentrations above the level of the NAAQS. The following sections describe the ambient Pb measurement methods, the sites and networks where these measurements are made, as well as how the ambient Pb concentrations vary geographically and temporally.

Ambient air Pb concentrations are measured by four monitoring networks in the United States, all funded in whole or in part by EPA. These networks provide Pb measurements for three different size classes of airborne PM: total suspended PM (TSP), PM less than or equal to 2.5 µm in diameter ($PM_{2.5}$), and PM less than or equal to 10 µm in diameter (PM_{10}). The networks include the Pb TSP network, the $PM_{2.5}$ Chemical Speciation Network (CSN), the Interagency Monitoring of Protected Visual Environments (IMPROVE) network, and the National Air Toxics Trends Stations (NATTS) network. The subsections below describe each network and the Pb measurements made at these sites.

In addition to these four networks, various organizations have operated other sampling sites yielding data on ambient air concentrations of Pb, often for limited periods and/or for primary purposes other than quantification of Pb itself. Most of these data are accessible via EPA's Air Quality System (AQS): http://www.epa.gov/ttn/airs/airsaqs/. In an effort to gather as much air toxics data, including Pb, into one database, the EPA and State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials (STAPPA/ALAPCO) created the Air Toxics Data Archive. The Air Toxics Data Archive can be accessed at: http://vista.cira.colostate.edu/atda/.

A.2.1 Ambient Pb Measurement Methods

A number of methods are used to collect Pb and measure Pb concentrations in the atmosphere, however, most methods use a similar sample collection approaches. Ambient air is drawn through an inlet for a predetermined amount of time (typically 24 hours) and the PM is collected on a suitable filter media. After the sample has been collected, the filter may be used to determine the mass of PM collected prior to then being used for determination of Pb. The filter is chemically extracted and analyzed to determine the Pb concentration in the particulate material. The concentration of Pb found in the atmosphere, in $\mu g/m^3$, is calculated based on the concentration of Pb in the volume extracted, the size of the collection filter, and the volume of air drawn through the filter.

The primary factors affecting the measurements made are the sampling frequency, duration of sampling, type of inlet used, volume of air sampled, and the method of analyzing the filter for Pb content. The following paragraphs describe how these factors affect the Pb measurements.

A.2.1.1 Sampling Frequency

The frequency of Pb sampling used in the U.S. varies between one sample every day (1 in 1 sampling) to the more common frequency of one sample every 6 days (1 in 6 sampling). Semi-continuous methods for the measurement of ambient metals (including Pb) are currently being explored which would allow for more frequent sampling (as frequent as 1 sample per hour), but more work is needed on these methods before they can be deployed in a network setting.

More frequent sampling reduces the uncertainty in estimates of quarterly or annual averages associated with temporal variations in ambient concentrations. However, the costs of sampling and analysis are directly tied to sample frequency. As such, it is necessary to evaluate the reduction in measurement error versus the increase in sampling and analysis costs when selecting the required sampling frequency. A discussion of the observed temporal variation of Pb measurements is given later in this section.

A.2.1.2 Inlet Design

In ambient air monitors, a number of inlet designs have been developed that allow certain particle size ranges to be sampled. The inlets use either impaction or cyclone techniques to remove particles larger than a certain size (the size cutpoint) from the sample stream. Three particle size cutpoints are used in ambient Pb measurements including TSP, $PM_{2.5}$, PM_{10}. The TSP inlet is designed to allow as much suspended particulate into the sampling device as possible while protecting against precipitation and direct deposition on to the filter (nominally 25 to 45 micrometers) (USEPA, 2004c).

Sampling systems employing inlets other than the TSP inlet will not collect Pb contained in the PM larger than the size cutpoint. Therefore, they do not provide an estimate of the total Pb in the ambient air. This is particularly important near sources which may emit Pb in the larger PM size fractions (e.g., fugitive dust from materials handling and storage).

A.2.1.3 Volume of Air Sampled

The amount of Pb collected is directly proportional to the volume of air sampled. Two different sampler types have evolved for PM and Pb sampling – a high-volume and a low-volume sampler. High-volume samplers draw between 70 and 100 m^3/hr of air through an 8 inch by 10 inch filter (0.05 m^2 filter area). Low-volume samplers typically draw 1 m^3/hr through a 47 mm diameter filter (0.002 m^2 filter area). Currently all Federal Reference Method (FRM) and Federal Equivalence Method (FEM) for Pb-TSP are based on high-volume samplers.

A.2.1.4 Sample Analysis

After the samples have been collected on filters and the filters have been weighed, the filters are analyzed for Pb content. A number of analytical methods can be used to analyze the filters for Pb content including x-ray fluorescence analysis (XRF), proton-induced x-ray emission (PIXE), neutron activation analysis (NAA), atomic absorption (AA), or inductively-coupled plasma mass spectrometry (ICP-MS) (CD, pp. 2-80 to 2-81). A detailed discussion of these methods was given in the 1986 CD (USEPA, 1986), and the reader is referred to that document for more information on these analytical methods. A search conducted on the AQS database[3] shows that the method detection limits for all of these analytical methods (coupled with the sampling methods) are very low, ranging from 0.01 µg/m^3 to as low as 0.00001 µg/m^3, and are adequate for NAAQS compliance purposes.

A.2.2 Pb-TSP

This network is comprised of state and locally managed Pb monitoring stations which measure Pb in TSP, i.e., particles up to 25 to 45 microns. These stations use samplers and laboratory analysis methods which have either FRM or FEM status. The FRM and FEM method descriptions can be found in the U.S. Code of Federal Regulations, Section 40 part 50, Appendix G. Sampling is conducted for 24-hour periods, with a typical sampling schedule of 1 in 6 days. Some monitoring agencies "composite" samples by analyzing several consecutive samples together to save costs and/or increase detection limits.

A.2.2.1 Monitor Locations

The locations of Pb-TSP sites in operation between 2003 and 2005 are shown in Figure A-5. The state and local agencies which operate these sites report the data to EPA's AQS where they are accessible via several web-based tools. EPA's series of annual air quality trends reports have used data from this network to quantify trends in ambient air Pb concentrations. The most recent Trends report for Pb-TSP can be found at http://www.epa.gov/airtrends/lead.html.

A review of the Pb-TSP network's coverage of the highest Pb emitting sources (as identified in the current version of the 2002 NEI) was conducted as part of preparing this document. This review indicates that many of the highest Pb emitting sources in the 2002 NEI do not have nearby Pb-TSP monitors. This review indicates that only 2 of 26 facilities (both Pb

[3] EPA's AQS can be accessed at http://www.epa.gov/ttn/airs/airsaqs/

smelters[4]) identified as emitting greater than 5 tpy have a Pb-TSP monitor within 1 mile. The lack of monitors near large sources should be addressed in the network design for the revised rule in order to get monitors at these locations in the future. Additionally, none of the 189 Pb-TSP sites included in the 2003-2005 analysis described in Sections A.2.2.2 and A.2.2.3 are located within a mile of airports identified in the NEI as an airport where piston-engine aircraft operate (i.e., aircraft that still use leaded aviation fuel). However, there are historical data for 12 Pb-TSP monitoring sites operating within 1 mile of such airports (going back to 1993). The average maximum quarterly mean (for 1993-2002) of these 12 sites is less than 0.05 µg/m^3.

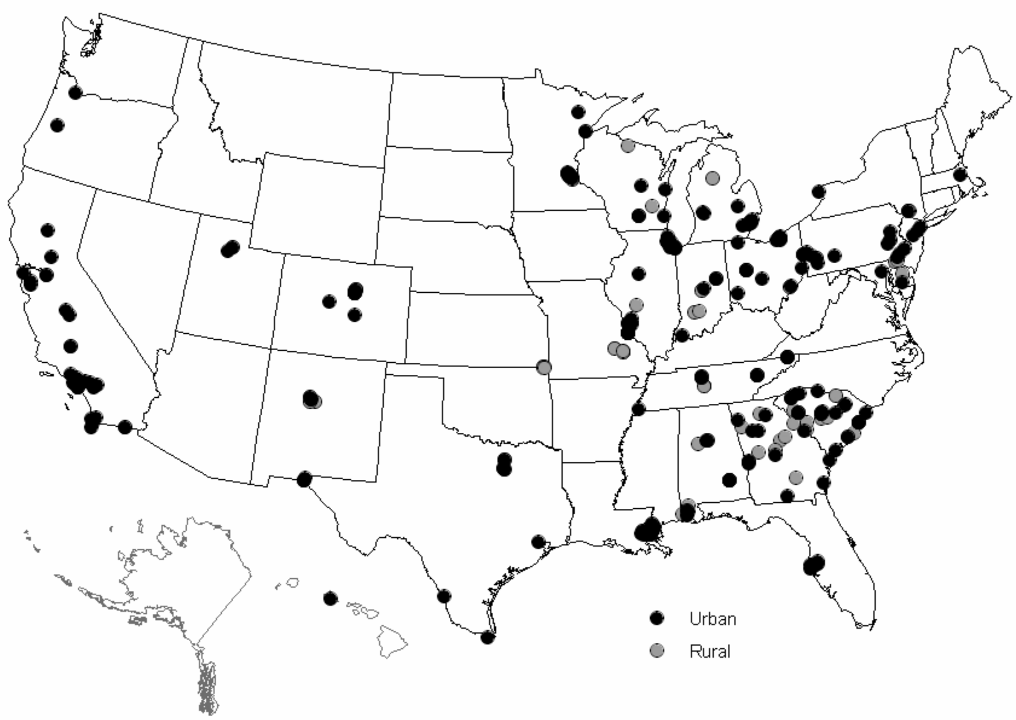


Figure A-5. Pb-TSP monitoring sites: 2003-2005.

The number of sites in the Pb-TSP network has decreased significantly since the 1980s (see Figure A-6). The number of sites in the network reached its highest point in 1981 (946 sites). About 250 sampling sites operated during 2005. This decline in the number of Pb-TSP sites is attributable to the dramatic decrease in Pb concentrations observed since the 1980s and the need to fund new monitoring objectives (e.g., $PM_{2.5}$ and ozone monitoring). Lead-TSP sites

[4] Primary and secondary smelters were the source types given particular priority at the time of the last Pb NAAQS review (USEPA, 1990; USEPA, 1991).

in lower concentration areas were shut down to free up resources needed for monitoring of other pollutants such as $PM_{2.5}$ and ozone.

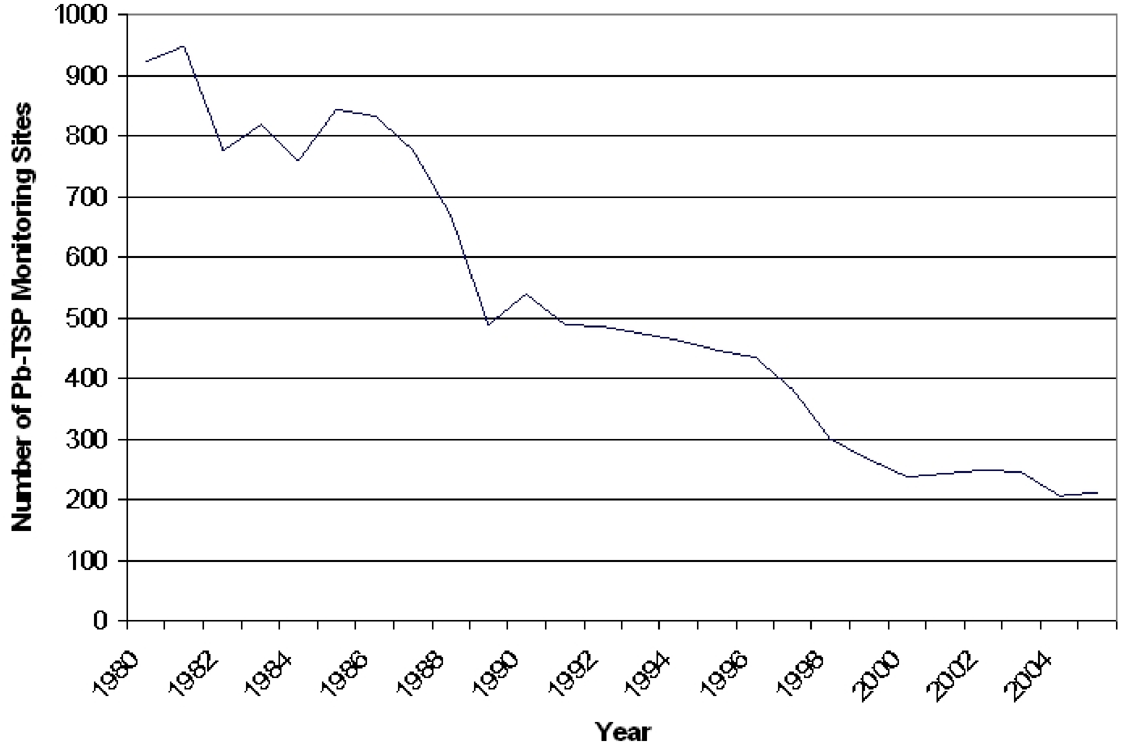


Figure A-6. Change in the number of Pb-TSP monitoring sites from 1980 to 2005.

A.2.2.2 Data Analysis Details

Lead-TSP data collected in 2003-2005 (parameter code 12128, durations '7' and 'C') were extracted from EPA's AQS on May 22, 2007. Most of the monitors reporting data for that timeframe utilized FRM or FEM, and therefore, are candidates for comparisons to the NAAQS. Some of the Pb-TSP monitors, however, were placed for non-regulatory purposes (e.g., for toxics monitoring initiatives) and utilize methods other than a FRM or FEM. Although measurements from these monitors cannot be compared to the NAAQS for purposes of non-attainment decisions, they were considered worthy for inclusion in this national Pb-TSP characterization. The non-FRM/FEM Pb-TSP methods typically have lower uncertainties and detection limits than the FRM/FEM. Detection limits vary significantly even for the data generated using FRM or FEM. In summary aggregations, the AQS generally substitutes one half the method detection level (MDL) for reported concentration readings less than or equal MDL. That protocol was not utilized in this national aggregation; data were used 'as reported' to AQS. Only a small number of Pb-TSP measurements for 2003-2005 were flagged for exceptional events, none of the exceptional event flags were concurred (i.e., approved) by the associated EPA Regional Office. Data flags were ignored in this analysis.

A.2.2.2.1 Screening Criteria

Measurements of Pb-TSP with 24-hour sample collection duration were reported to AQS for more than 350 monitors for the years 2003 to 2005. 189 of those monitors met the following screening criteria and were used in this national characterization. The completeness criteria employed for this national characterization were: 1) a minimum of 10 observations per quarter, 2) for at least one full year (all 4 quarters), and 3) at least 9 months with 4 observations each; all three criteria had to be met for inclusion. 209 monitors met the 3-pronged criteria; of these 209 monitors, 20 were collocated with another complete monitor. Only one monitor from each collocated pair (i.e., from each site location) was kept in the analysis, specifically the one with highest maximum quarterly mean. Thus, data from 189 monitors at 189 distinct locations were actually used; 110 of these monitors/sites had 3 complete years (and thus, 12 complete quarters), 36 monitors/sites had 2 complete years (and at least 8 complete quarters), and 43 monitors/sites had only one compete year (thus, at least 4 complete quarters). Complete quarters that were not part of a complete year were used. Likewise, all complete months were used, even if they did not correspond to the complete years. The 189 sites have an average of about 28 complete months. The 189 utilized monitors are listed along with various summary and demographic data in Attachment A-2, Table 1.

A.2.2.2.2 Urban Classifications

The 189 monitors are located in 86 counties, in 23 States. 140 of the 189 sites were deemed ‘urban’ and aggregated as such. Sites were labeled ‘urban’ if they located within a defined urbanized area or urban cluster (per 2000 Census geographic definitions). All of the ‘urban’ designated sites were located in a Core Based Statistical Area (CBSA) per 2003 CBSA geographic definitions. CBSA is a collective term for both metropolitan and micropolitan statistical areas. A metro area contains a core urban area of 50,000 or more population, and a micro area contains an urban core of at least 10,000 (but less than 50,000) population. Each metro or micro area consists of one or more whole counties and includes the counties containing the core urban area, as well as any adjacent counties that have a high degree of social and economic integration with the urban core. The monitors in the analysis map to 65 unique CBSA’s. Only 10 of the 189 monitors are not located within a CBSA. CBSA’s do not always exclusively encompass wholes or parts of urbanized areas and/or urbanized clusters. 39 of the 189 Pb monitoring sites are located in a CBSA but are not classified as ‘urban’. Although ‘urban’ locations (i.e., parts of urbanized areas or urban clusters) are found in counties not defined as (or part of) a CBSA, all of the 140 urban sites in this characterization are located in a

CBSA. 91 of the 140 urban sites are located in CBSA's with 1 million or greater population. Note that the 65 CBSA's containing the Pb-TSP monitoring sites are generally among the largest in the nation (with respect to total population). Almost 75 percent of the Pb-TSP CBSA's are larger (in population) than the 75 percent of all U.S. CBSA's. With respect to total CBSA population, the 5 overall largest CBSA's and 18 of the largest 25 contain at least one Pb-TSP monitor.

A.2.2.2.3 Source-oriented Categorizations

Monitoring sites were classified as being 'source oriented' with regard to sources of Pb emissions if: 1) they met a graduated cumulative emission ton per year by distance criterion, or 2) they were classified as source oriented in previous EPA analysis. Sixty of the 189 Pb-TSP sites met at least one of these criteria. Of the 60 total source-oriented sites, 40 met the first criterion and 51 met the second.

The graduated cumulative emission ton per year to distance criterion (criterion #1) utilized the 2002 (version 3) national emission inventory (NEI) for Pb point sources and Pb area non-point sources. The Pb point source emissions were assigned to the specific facility point locations (longitude/latitude coordinates), and the area non-point inventory was allocated to Census tracts and assumed uniform across those extents. To meet the graduated 'source-oriented' criterion, a Pb monitoring site had to be within at least one multiplier of 0.1 miles (checking up to 1 mile away) for a corresponding multiplier of 0.1 tpy of total point and non-point emissions (e.g., Within 0.1 mile of a cumulative 0.1 tpy, within 0.2 miles of a cumulative 0.2 tpy, within 0.3 miles of a cumulative 0.3 tpy, …, or within 1.0 miles of a cumulative 1.0 tpy) The area non-point contribution to the comparison cumulative inventory was based on the composite emission densities of the Census tract in which a site was located and all other tracts with population centroids within a mile of the monitoring site.

The sites 'classified as source oriented in previous EPA analysis' (criterion #2) were identified via a reference list that was last updated in 2003 (but currently under review); this list has been utilized in recent EPA Trends Report analysis. The list encompasses 114 sites. Many of the monitoring sites on this list did not have data that met the data completeness criteria for 2003–2005 because they have permanently discontinued Pb monitoring, most ostensibly because the associated nearby Pb emission source(s) has implemented controls, closed operations, and/or reduced production. Some ambient monitoring sites continue monitoring even after significant assumed reductions in nearby new Pb emissions. Sites were not screened out of the source-oriented classification in those instances. In addition to including such sites in the source-oriented category, these sites were separately reviewed to see if they still had higher concentrations than non-source sites because of previously emitted Pb becoming resuspended into the air and/or possible emission estimate errors. These sites are termed, "'previous' source-oriented sites" in relevant figures and tables.

There are only nine sites that were categorized as "previous" source-oriented in this national analysis. The particular circumstances related to the emission sources associated with these nine monitoring sites vary considerably. In some instances the emission sources have been closed for more than a decade and the facility locations have undergone remediation. For other sources, production and clean-up status was not fully ascertained. In the case of one emission source (that has numerous nearby monitoring sites), production was presumably halted at the end of 2003 and no significant clean-up activity has yet been undertaken. For the monitoring sites associated with this source, two sets of statistics were generated (or attempted). Statistics representing the entire 3-year period were calculated and used everywhere applicable except for the "previous" category, and statistics representing the post-production period (2004-2005) were generated and used for the "previous" classification. Note that some of these monitoring sites met the data completeness criteria for the 3-year period (2003-2005) but not for the 2-year period (2004-2005). Because of the small number of sites included in the "previous" source oriented classification and the uncertainty in the emission source status, results for this category should be viewed with caution.

A.2.2.2.4 Population Associations

Two population statistics were summarized with the Pb concentration data, the 'total population' within 1 mile of the site (a.k.a., a "radial mile") and the 'under age 5 population' within 1 mile of the site. Populations assigned sites were based on Census block group population densities, specifically the density of the block group in which the site was located and (if relevant) the density of other block groups with population centroids within 1 mile of the site. The average population density (expressed in square miles) was multiplied by pi (3.143) to obtain a radial mile population. Population data and block group definitions utilized are from the 2000 Census.

The median size of populations associated with the Pb-TSP monitors in this analysis is about 6,200 and the corresponding under age 5 median population is around 420. These median populations are slightly smaller than the overall U.S. block group median radial mile populations (19 percent smaller for total and 7 percent smaller for under age 5). Attachment A-2, Table 1 shows the assigned site-level populations and corresponding ranks (in relation to other monitoring sites); CBSA information for each site is also shown. Based on the radial mile population association (described above) approximately 1.73 million people (0.125 million under the age of 5) are in proximity of a 2003-2005 Pb-TSP monitor included in this analysis.

A.2.2.2.5 Statistical Metrics

Three basic statistics were computed for the 2003-2005 Pb-TSP concentration data: annual means, maximum quarterly means, and maximum monthly means. These metrics were calculated at the site level. The annual mean statistic is actually the average of the annual means for the complete years; thus it is the average of three annual means, the average of two annual means, or the only available single complete annual mean. The maximum quarterly mean statistic represents the highest quarterly mean of the complete ones (sites have from four to 12 complete quarters), and the maximum monthly mean represents the highest monthly mean of the complete ones (each site has from nine to 36 complete months).

Population weighted means were also calculated for the three metrics for various aggregation levels. The site-level means were weighted by both total population and under age 5 population. To compute the population weighted measures, 1) the mean for each site in a specific category was multiplied by its associated population (i.e., within a mile radius), 2) these products (of #1) and the associated populations were summed, and 3) the sum of the products of #1 were divided by the population sums. Theoretically, these population weighted means show the average concentration exposure for each individual within a mile of a monitoring site. That supposition, of course, assumes that concentrations reported at the monitor are uniform over the entire radial mile

A.2.2.3 Current Concentrations

In the following subsections, analyses are presented for the different categorizations of Pb-TSP monitoring sites described above. These are all Pb-TSP sites meeting screening criteria, and the following subsets: sites in urban areas, sites in urban areas of population greater than 1 million, sites that are source-oriented, sites that are not known to be source-oriented, and sites that were previously source-oriented.

A.2.2.3.1 All Sites

The site-level Pb-TSP concentrations and associated ranks for each of the three statistics (annual mean, maximum quarterly mean, and maximum monthly mean) during the three-year period, 2003-2005, are shown in Attachment A-2, Table 1. The distributions of sites for the three statistics are shown in Figure A-7; the boxes depict inter-quartile ranges and medians, whiskers depict the 5^{th} and 95^{th} percentiles, and asterisks identify composite averages. Additional points on the distributions for these statistics are given in Attachment A-2, Table 2. For example, the national composite average annual mean was 0.09 µg/m^3, and the corresponding median annual mean was 0.02 µg/m^3. The national composite average maximum quarterly mean was 0.17 µg/m^3 and the corresponding median maximum quarterly mean was

0.03 µg/m³. The national composite average maximum monthly mean was 0.30 µg/m³ and the median maximum monthly mean was 0.04 µg/m³.

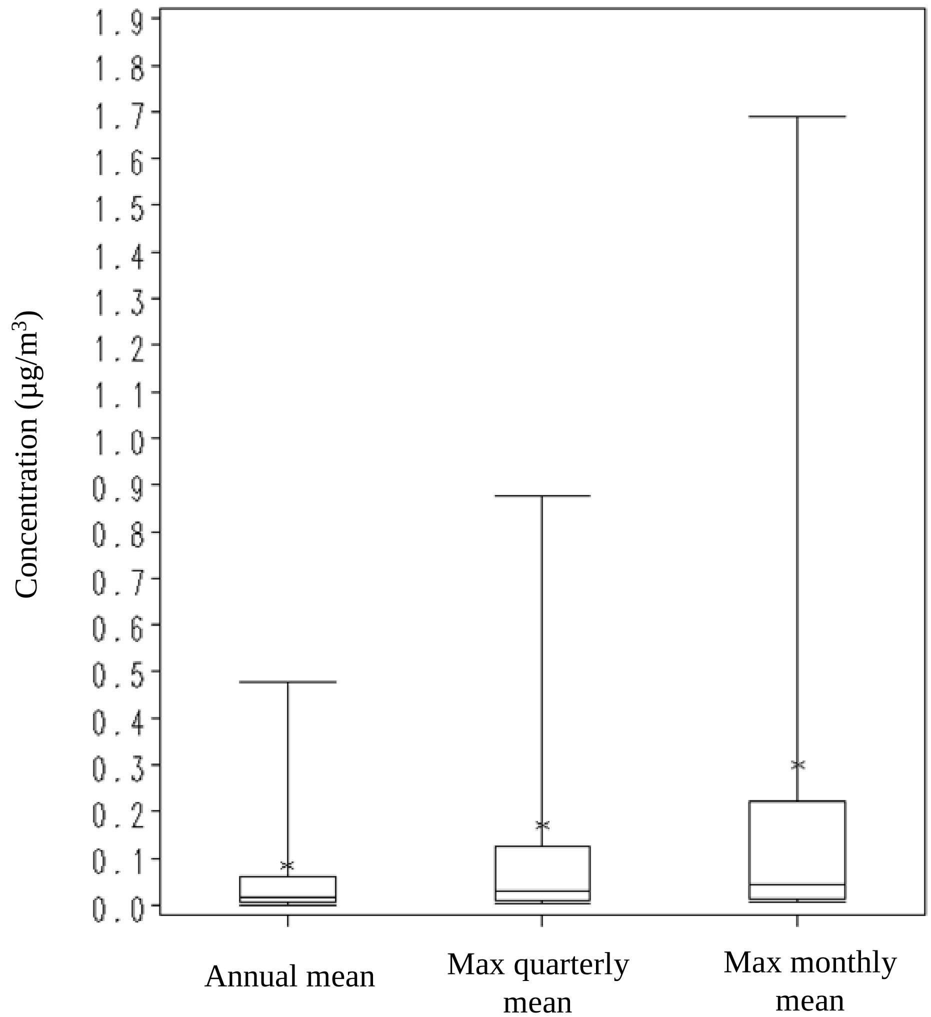


Figure A-7. Distribution of Pb-TSP concentrations (represented by 3 different statistics) at the 189 Pb-TSP monitoring sites, 2003-2005.

Figure A-8 shows cumulative percentages of monitored populations ("total" and "under age 5") associated with each of the three Pb metrics for various levels [≥0.01 µg/m³ (for annual mean only), ≥ 0.05 µg/m³, ≥ 0.20 µg/m³, ≥ 0.50 µg/m³, and ≥ 1.55 µg/m³]. The phrase "monitored populations" refers to populations residing in proximity to monitors as described in Section A.2.2.2.4. The site-level values for the three statistical metrics (annual average, maximum quarterly mean, and maximum quarterly mean) are mapped in Figures A-9, A-10, and A-11. As seen when comparing these figures, the geographic locations of the high (and low) concentration values for all three metrics are generally the same. In fact, there are significant correlations among all three summary metrics; see Attachment A-2, Table 3.

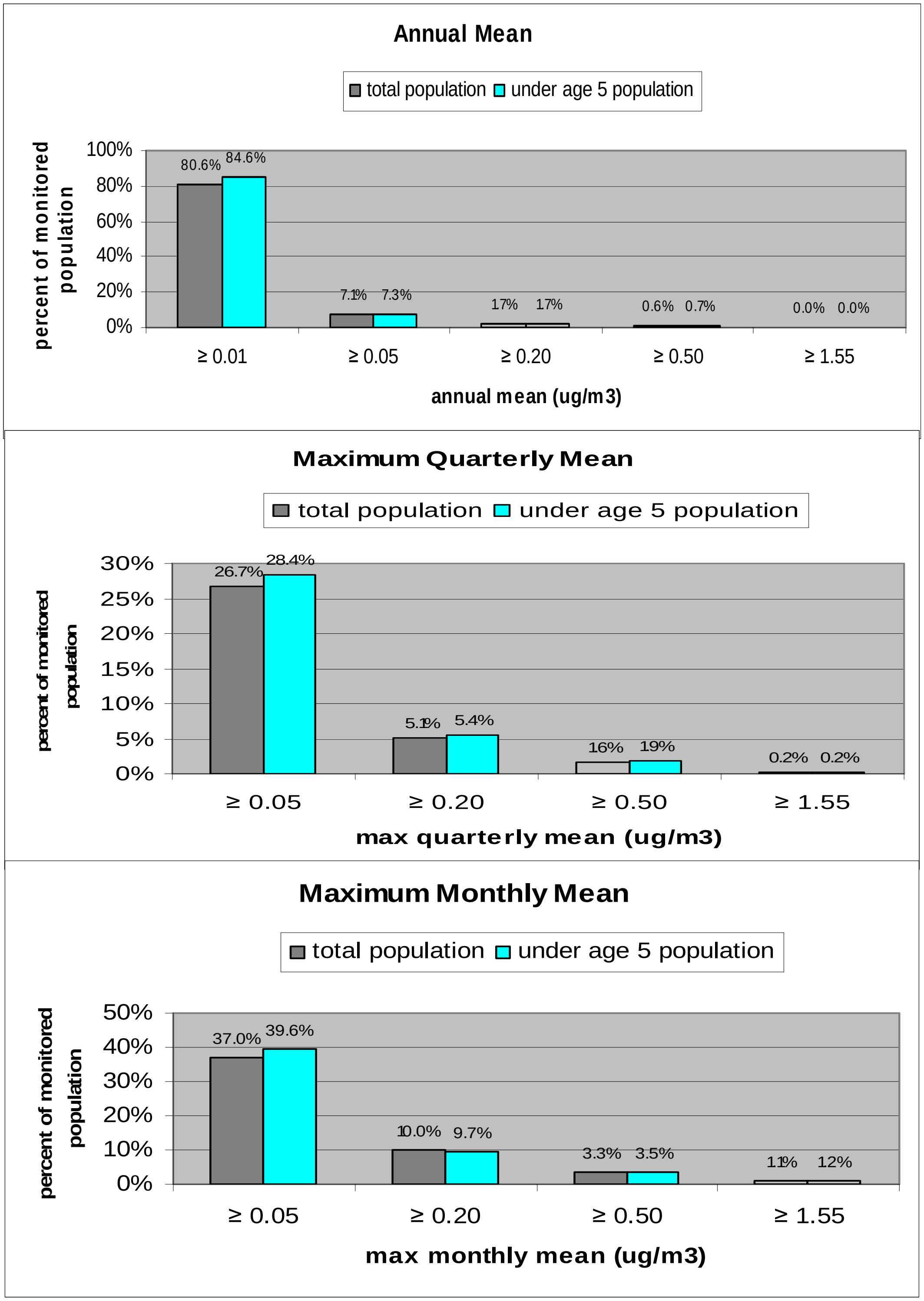


Figure A-8. Percentages of Pb-TSP monitored populations residing in areas exceeding various concentrations (for 3 different statistics).

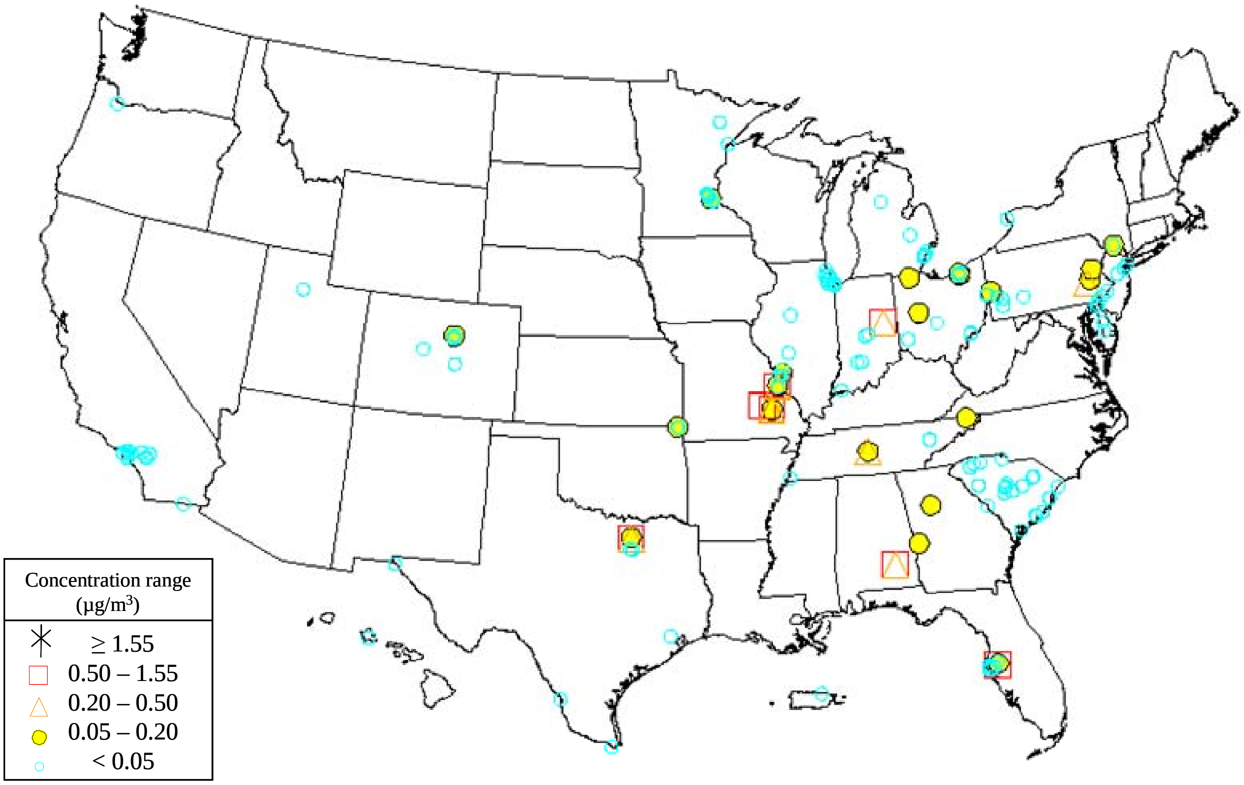


Figure A-9. Pb-TSP annual means (for all sites), 2003-2005.

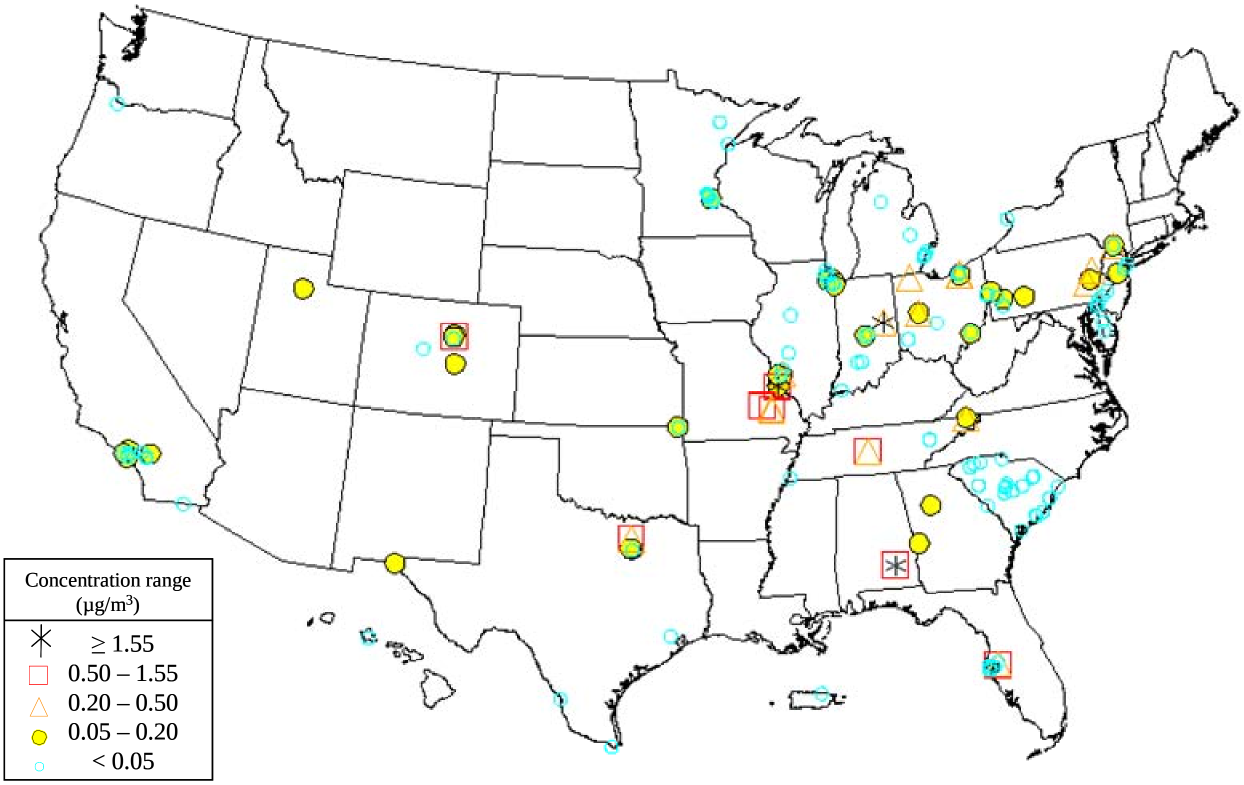


Figure A-10. Pb-TSP maximum quarterly means (for all sites), 2003-2005.

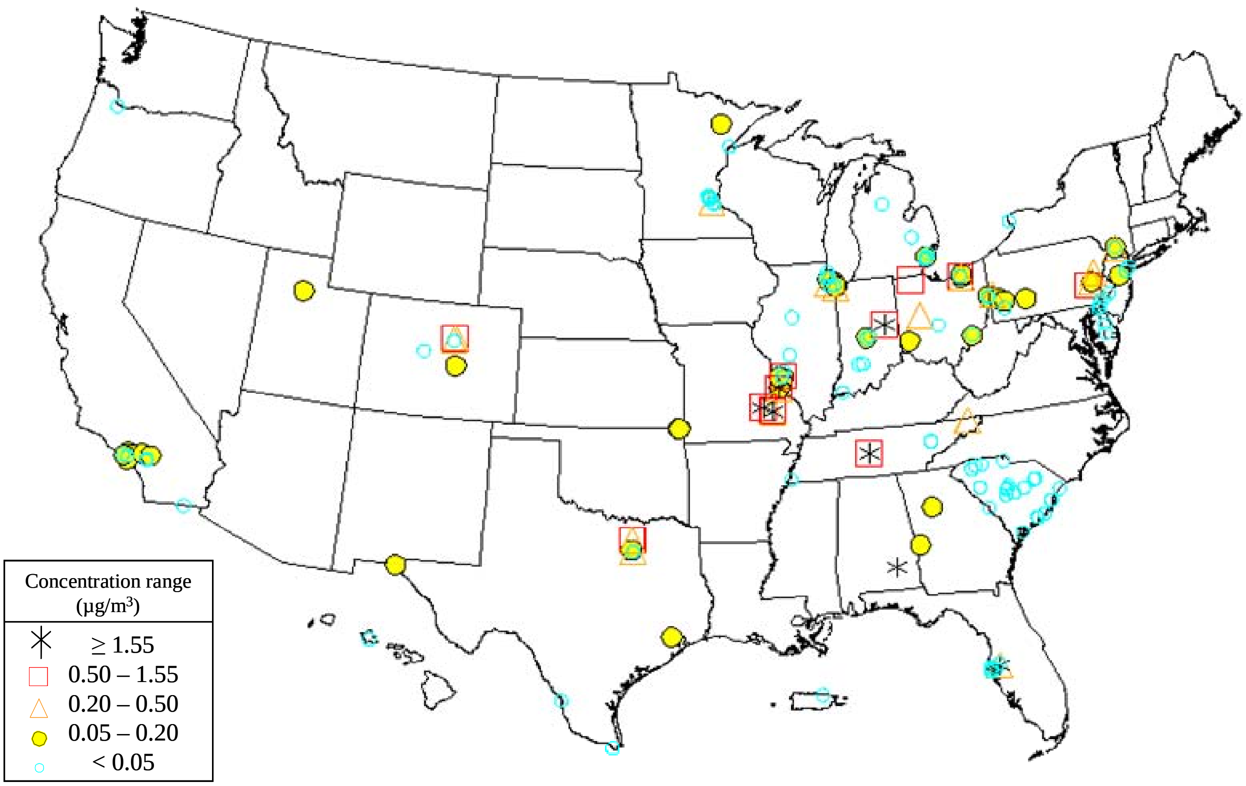


Figure A-11. Maximum monthly Pb-TSP means (all sites), 2003-2005.

The site-level ratios of 1) maximum quarterly mean to annual mean, and 2) maximum monthly mean to annual mean are presented in Attachment A-2, Table 4. For all TSP-Pb sites included in the analysis, the national median for the ratio of site-level maximum quarterly average to site-level annual mean was about 1.8; the national median for the ratio of site-level maximum monthly mean to site-level annual mean was about 2.9.

Some seasonal variability is common for air Pb concentrations. However, the extent to which seasonal variability is present depends on precipitation trends, changes in wind direction, and mixing height variability for a given area. For monitors situated near Pb point sources, factors related to the facilities' operations also contribute to temporal variability. Variation at near-source locations is better characterized by short-term averaging times (e.g., monthly) than longer-term averaging times (e.g., yearly). This is demonstrated in Table A-5. This table shows the number of TSP monitors, in the all sites database and the urban sites subset, that exceed average levels of 0.05 to 1.5 µg/m^3 with averaging times or forms of maximum quarterly, and maximum monthly. For example, with a stated level equal to the current standard of 1.5 µg/m^3, 3 sites in 3 counties (1 urban site) exceed with a quarterly averaging time and 11 sites in 6 counties (5 urban sites in 2 counties) with a maximum monthly average. Using the lowest level examined, 0.05 µg/m^3, however, 75 sites in 36 counties (48 urban sites in 30 counties) would exceed that level with a maximum quarterly average form and 88 sites in 41 counties (58 urban sites in 34 counties) would exceed that level with a maximum monthly average form.

Table A-5. Comparison of numbers of sites that exceed various Pb-TSP levels using different averaging times or forms, 2003-2005.

	Number of Sites/Counties that Exceed Level							
	Maximum Quarterly Mean				Maximum Monthly Mean			
	All Sites (189 in 86 counties)		Urban Sites (140 in 73 counties)		All Sites (189 in 86 counties)		Urban Sites (140 in 73 counties)	
Level	Sites	Counties	Sites	Counties	Sites	Counties	Sites	Counties
0.05	75	36	48	30	88	41	58	34
0.10	52	24	28	17	69	33	43	27
0.20	36	15	17	10	49	21	26	16
0.30	26	11	10	6	37	16	17	11
0.40	19	8	7	3	31	13	14	8
0.50	18	8	6	2	27	12	11	7
0.60	17	7	6	2	26	11	10	6
0.70	13	6	5	2	23	10	9	5
0.80	11	6	5	2	20	10	8	4
0.90	9	6	4	2	19	9	7	3
1.00	7	5	4	2	15	7	6	2
1.10	7	5	4	2	14	7	5	2
1.20	7	5	4	2	13	6	5	2
1.30	6	4	3	1	13	6	5	2
1.40	4	3	2	1	13	6	5	2
1.50	3	3	1	1	11	6	5	2
1.55	3	3	1	1	11	6	5	2

A.2.2.3.2 Source-oriented Sites

As seen in the previously discussed Figure A-7, the national ("all sites") means are substantially higher than the national medians for all three statistical metrics (annual mean, maximum quarterly mean, and maximum monthly mean). This is due to a small number of monitors with significantly higher levels. These monitors with higher concentrations are almost exclusively associated with industrial point sources. Eliminating the source-oriented monitors from the national aggregations lowers most of the corresponding distribution statistics and makes the means more comparable to the medians.

The distributions of the site-level metrics for the source-oriented sites, the non-source oriented sites, and the "previous" source-oriented sites, are presented in Figures A-12, A-13, and A-14, respectively. For comparison purposes, Figures A-15, A-16, and A-17 present the categorical data distributions for each of the three statistical metrics on the same scales. In all of these figures, the boxes depict inter-quartile ranges and medians, whiskers depict the 5^{th} and 95^{th} percentiles, and asterisks identify composite averages. Additional points on the distributions of these statistical metrics for these three categories of monitoring sites are given in Attachment A-2, Table 2.

Per Figure A-16, the median maximum quarterly mean for source-oriented sites (0.25 $\mu g/m^3$) is about 14 times greater than the same statistic for non source-oriented sites (0.02 $\mu g/m^3$); in fact, that median (50^{th} percentile) maximum quarterly mean for non-source oriented sites is approximately the same value as the 5^{th} percentile for source-oriented sites. The medians, means, and population-weighted means of the site-level values of the three statistical metrics are presented in Figure A-18 for the source-oriented and other groupings of monitoring sites.

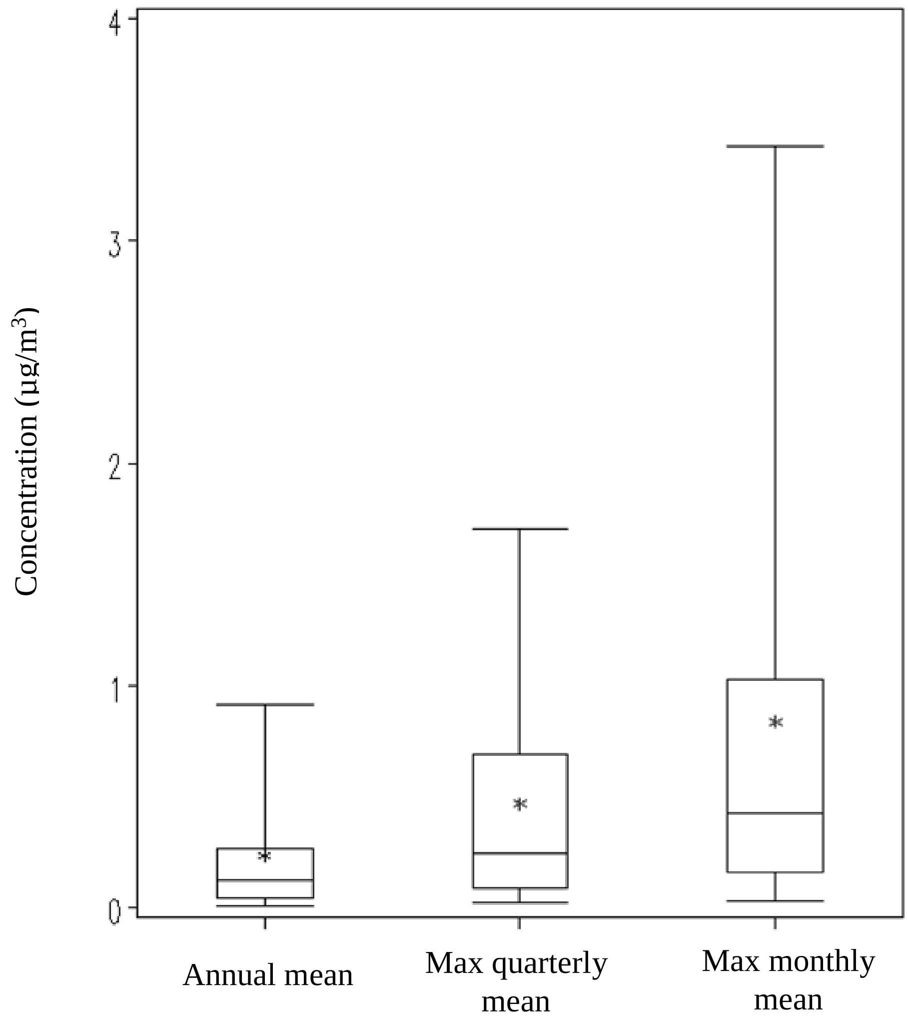


Figure A-12. Distribution of Pb-TSP concentrations (represented by 3 different statistics) at source-oriented monitoring sites, 2003-2005.

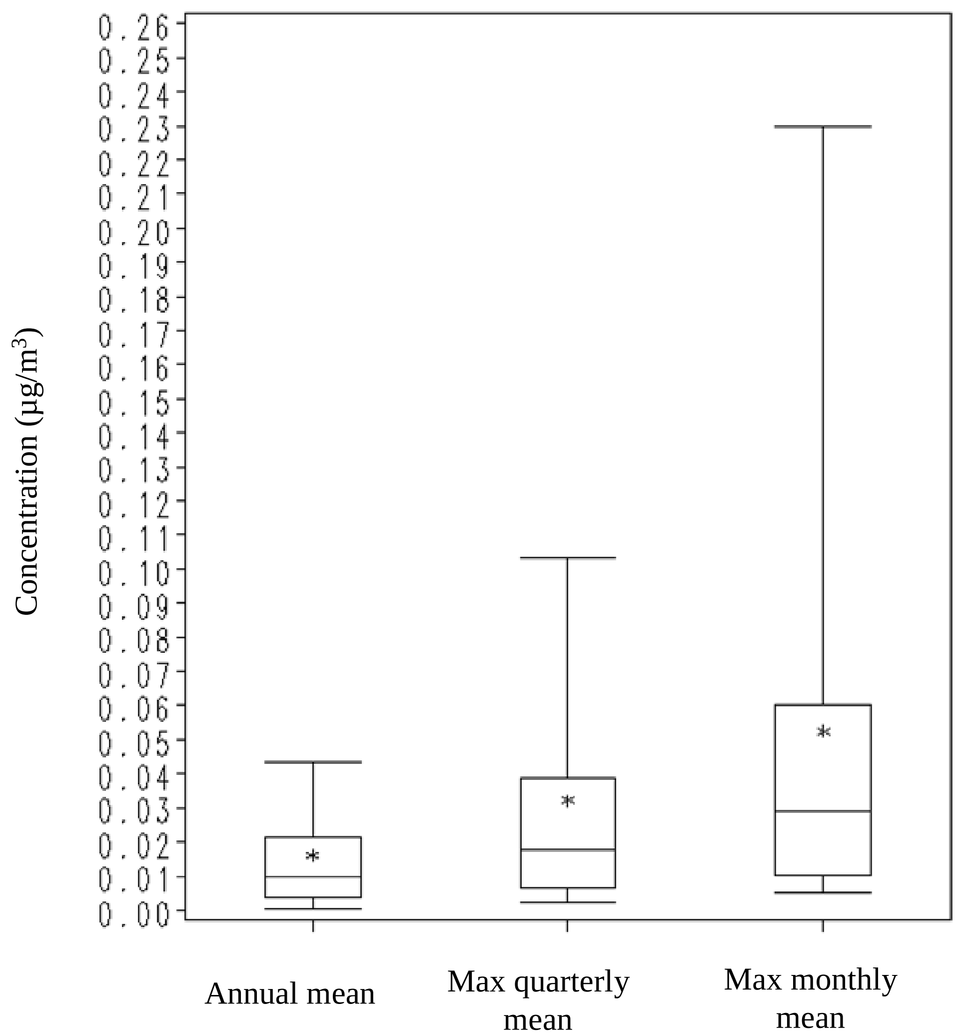


Figure A-13. Distribution of Pb-TSP concentrations (represented by 3 different statistics) at non-source-oriented monitoring sites, 2003-2005.

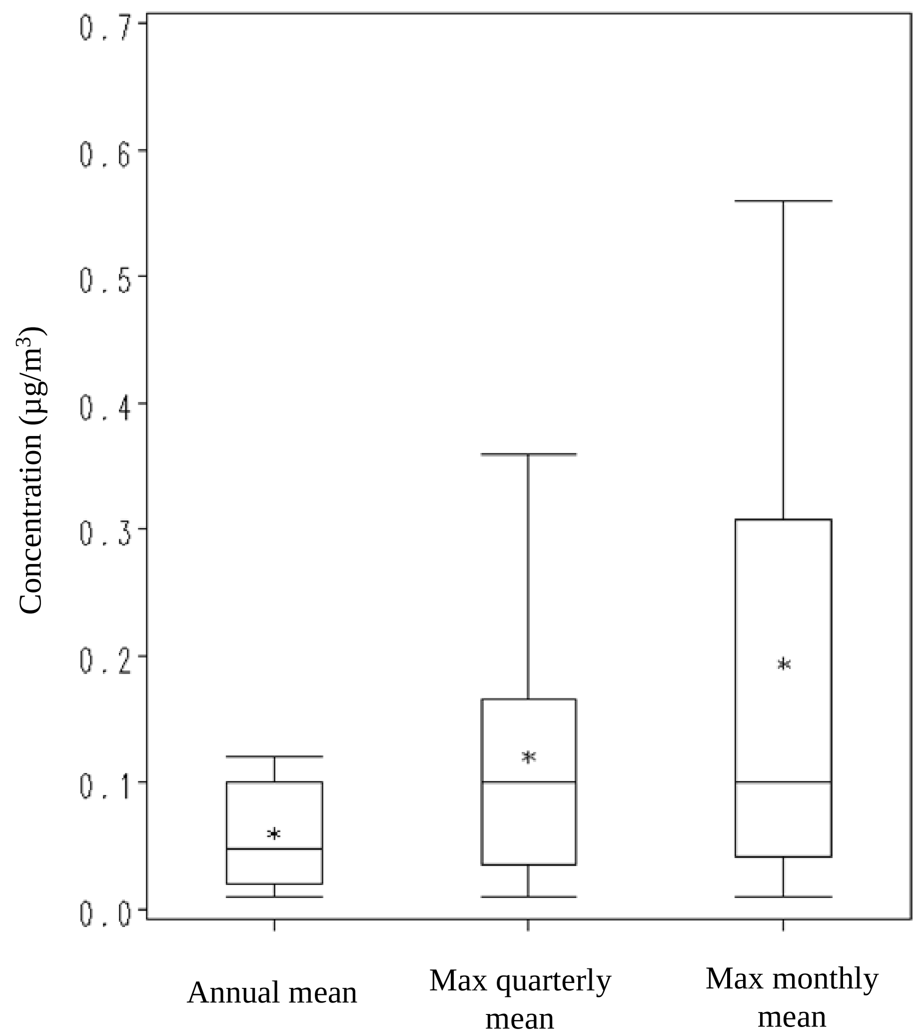


Figure A-14. Distribution of Pb-TSP concentrations (represented by 3 different statistics) at monitoring sites near previous large emission sources, 2003-2005.

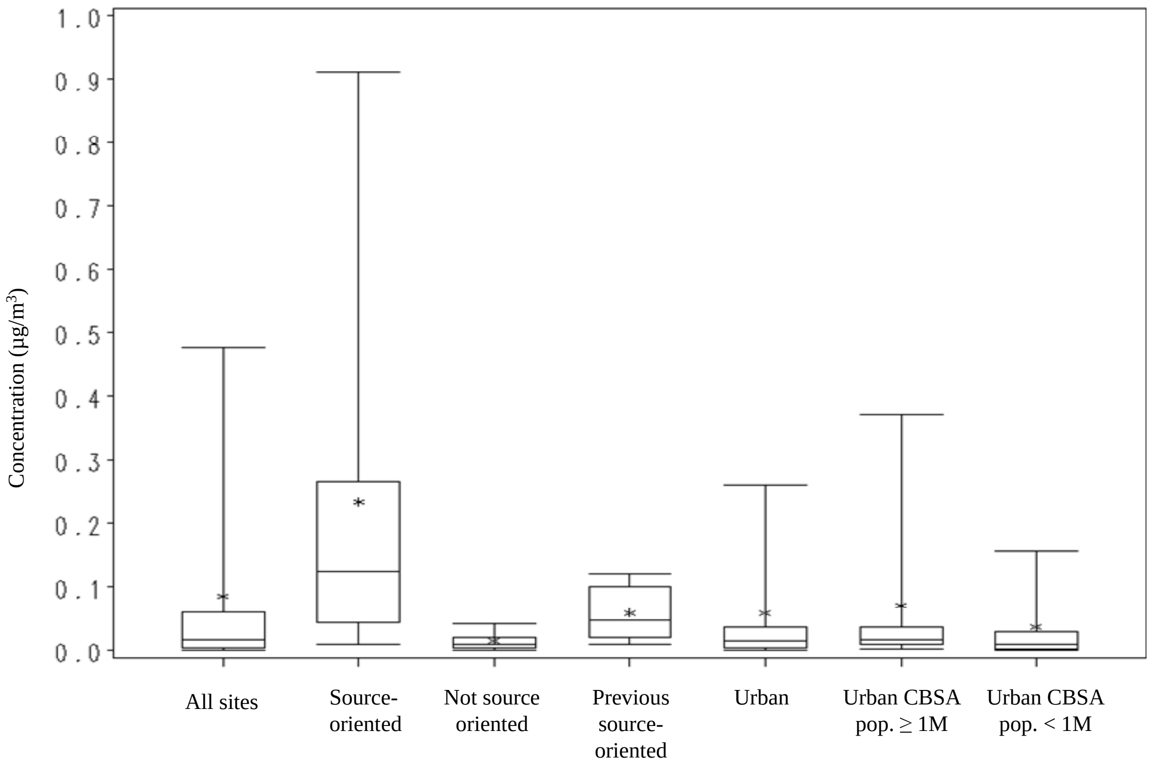


Figure A-15. Distribution of Pb-TSP annual mean concentrations at different categories of sites, 2003-2005.

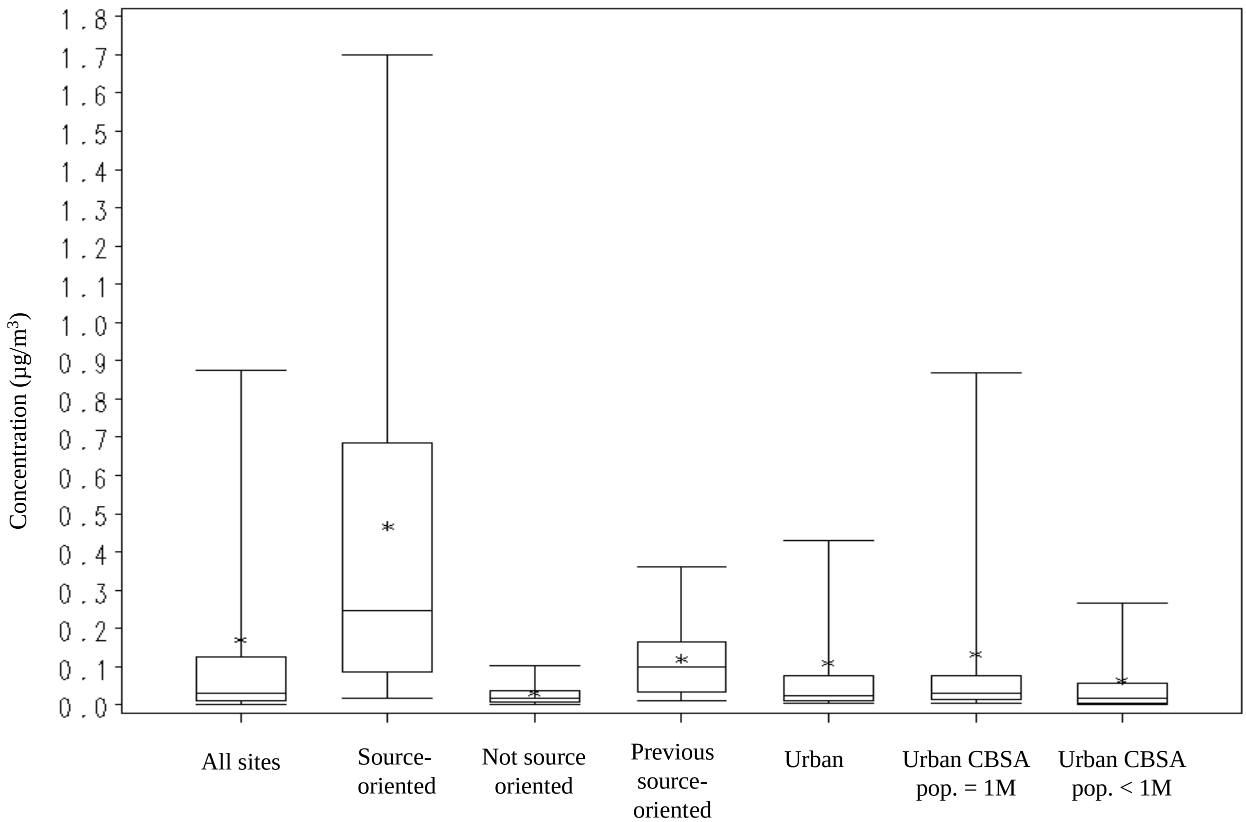


Figure A-16. Distribution of Pb-TSP maximum quarterly mean concentrations at different categories of sites, 2003-2005.

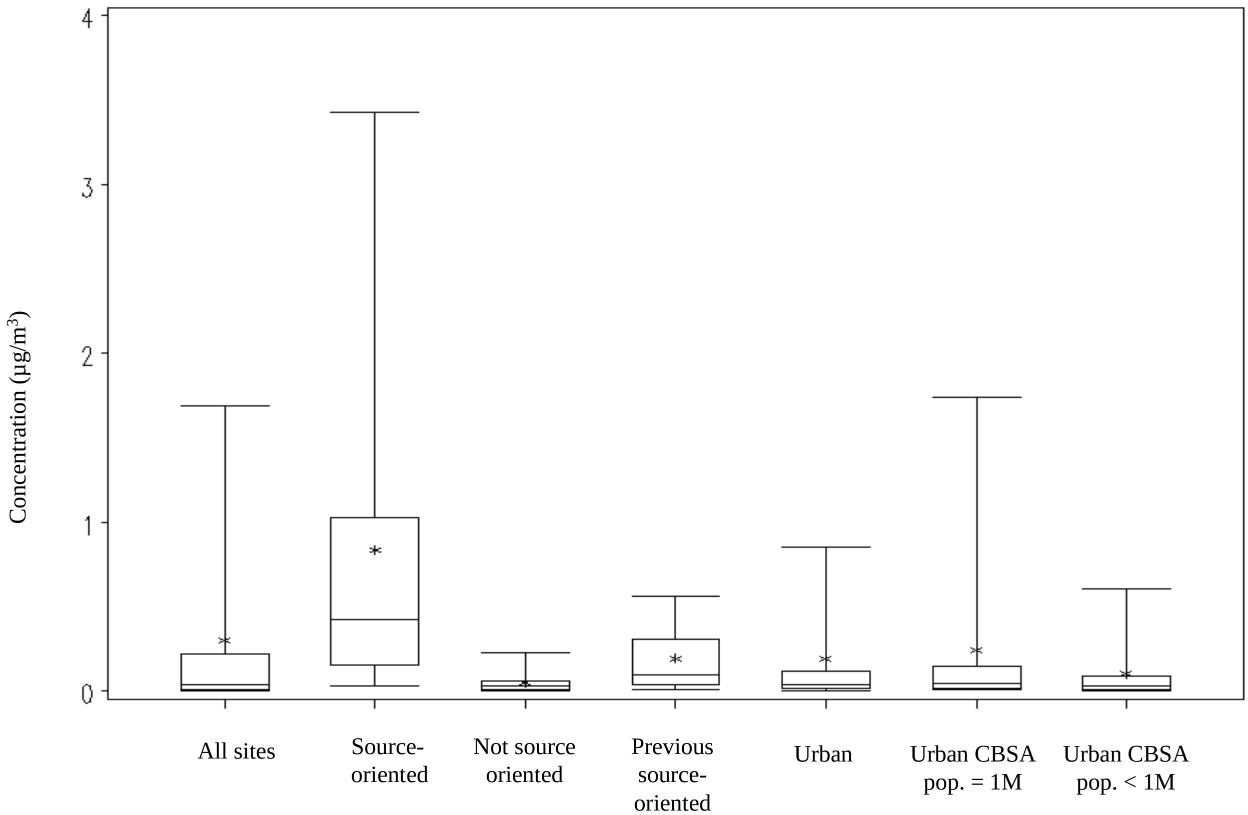


Figure A-17. Distribution of Pb-TSP maximum monthly mean concentrations at different categories of sites, 2003-2005.

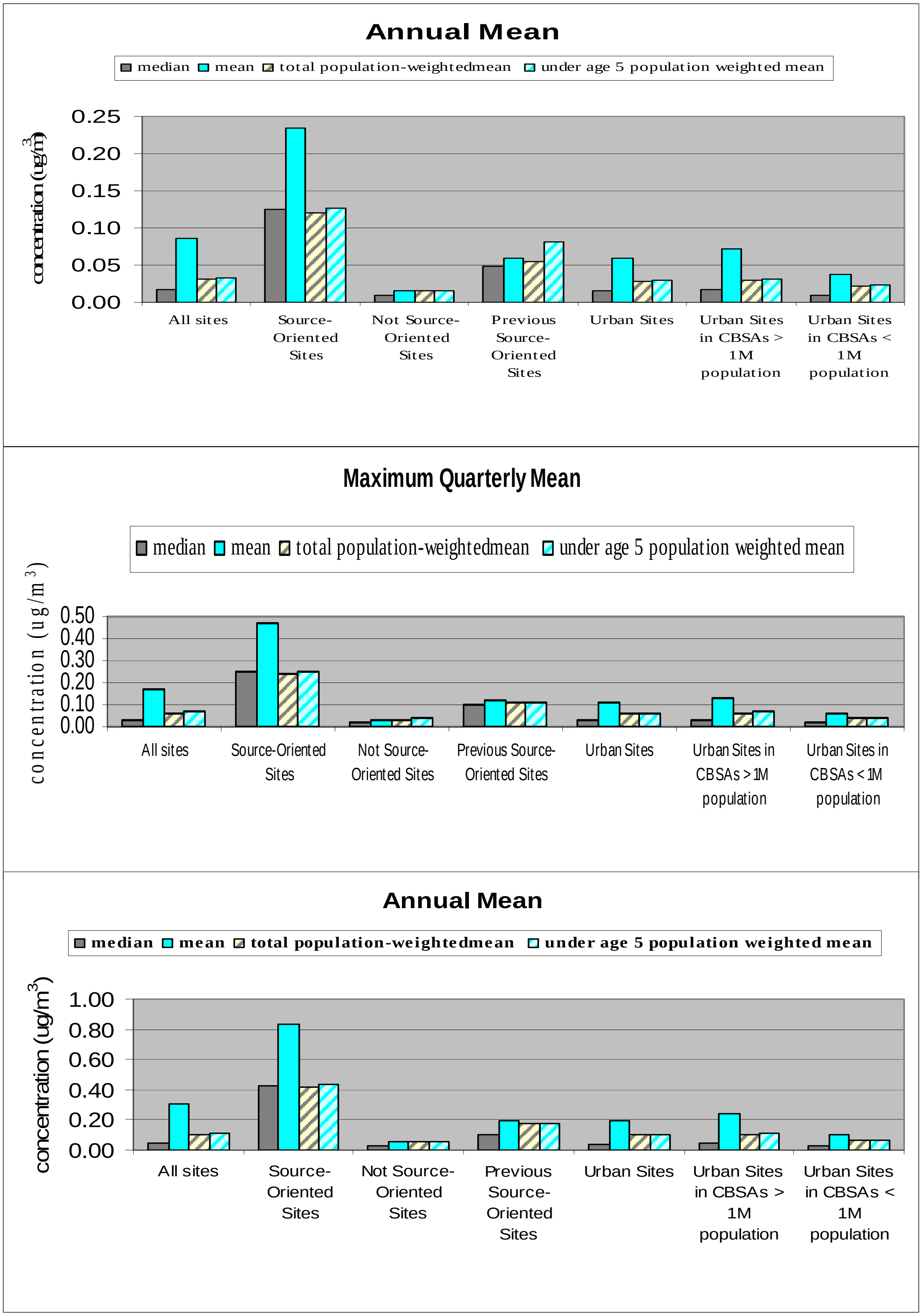


Figure A-18. Medians, means, and population-weighted means for 3 site-level statistics.

Although 60 Pb-TSP monitoring sites met the source oriented classification criteria, that number does not correspond to the number of represented or 'covered' significant emission sources. Recall that the emission sliding scale was based on the aggregate emissions within one mile of the site. Thus, instead of having only one significant source within a specified range, a site tagged as source-oriented could actually have several nearby moderate sized emission sources and/or many nearby small sources. However, the majority of the source-oriented sites in this national analysis do have just one nearby significant emission source. Furthermore, many of these significant emission sources have multiple Pb-TSP monitors in the vicinity. For example, the Herculaneum primary Pb smelter has 7 nearby Pb-TSP monitoring sites that are included in this national characterization (as well as others that operated during 2003-2005 but that did not meet the screening criteria). Thus, the 60 source-oriented sites really represent fewer than 60 significant emission sources. For the 60 source-oriented sites, there are only 37 unique closest emission sources (i.e., NEI site ID's). The 60 source-oriented sites are located in 29 different counties.

Although the "previous" source-oriented category contains only a limited number of sites (nine) with varied and irresolute circumstances, the distribution statistics for that category (for all three metrics) are generally much higher than the non-source oriented levels; for example, the "previous" median maximum quarterly mean of 0.10 $\mu g/m^3$ is more than five times higher than the comparable non-source oriented level of 0.02 $\mu g/m^3$.

A.2.2.3.3 Urban Sites

The distributions of the site-level values for the three statistical metrics for the set of 140 sites classified as "urban" are presented in Figure A-19. The distributions for the subset of sites (n = 91) located in a CBSA with one million or more population are presented in Figure A-20, and for the subset of sites (n=49) located in a CBSA with less than a million population, in Figure A-21. In these figures, the boxes depict inter-quartile ranges and medians, whiskers depict the 5^{th} and 95^{th} percentiles, and asterisks identify composite averages. Additional points on the distributions for these statistics for these three groupings of monitoring sites are given in Attachment A-2, Table 2.

Previously mentioned Figures A-15, A-16, and A-17 plot on uniform scales the three statistical metrics for these three categories of urban sites. The median and mean values for all three concentration metrics are lower for sites in less populated CBSA's than they are for sites in high population CBSA's. Figure A-22 shows cumulative percentages of urban monitored populations ("total" and "under age 5") associated with each of the three Pb metrics for various concentration ranges [≥0.01 $\mu g/m^3$ (for annual mean only), ≥ 0.05 $\mu g/m^3$, ≥ 0.20 $\mu g/m^3$, ≥ 0.50

μg/m³, and ≥ 1.55 μg/m³]. The phrase "monitored populations" refers to populations residing in proximity to monitors as described in Section A.2.2.2.4.

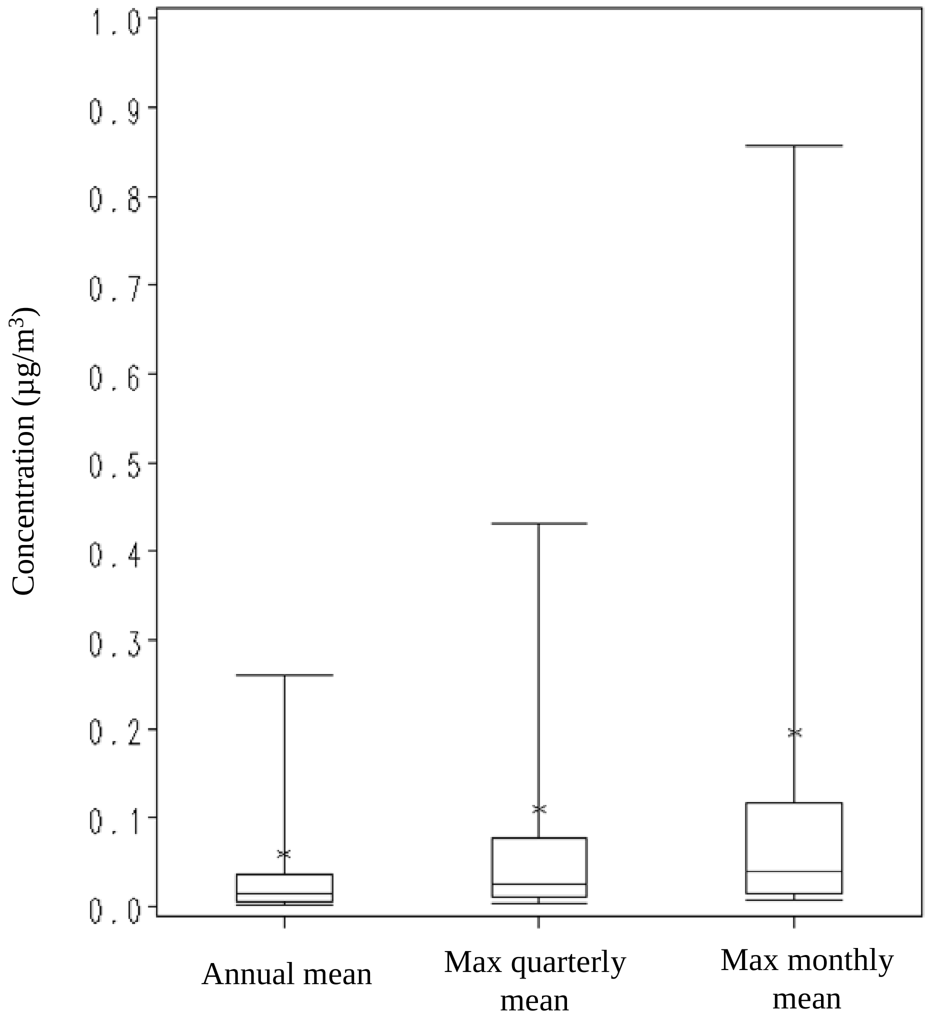


Figure A-19. Distribution of Pb-TSP concentrations (represented by 3 different statistics) at urban monitoring sites, 2003-2005.

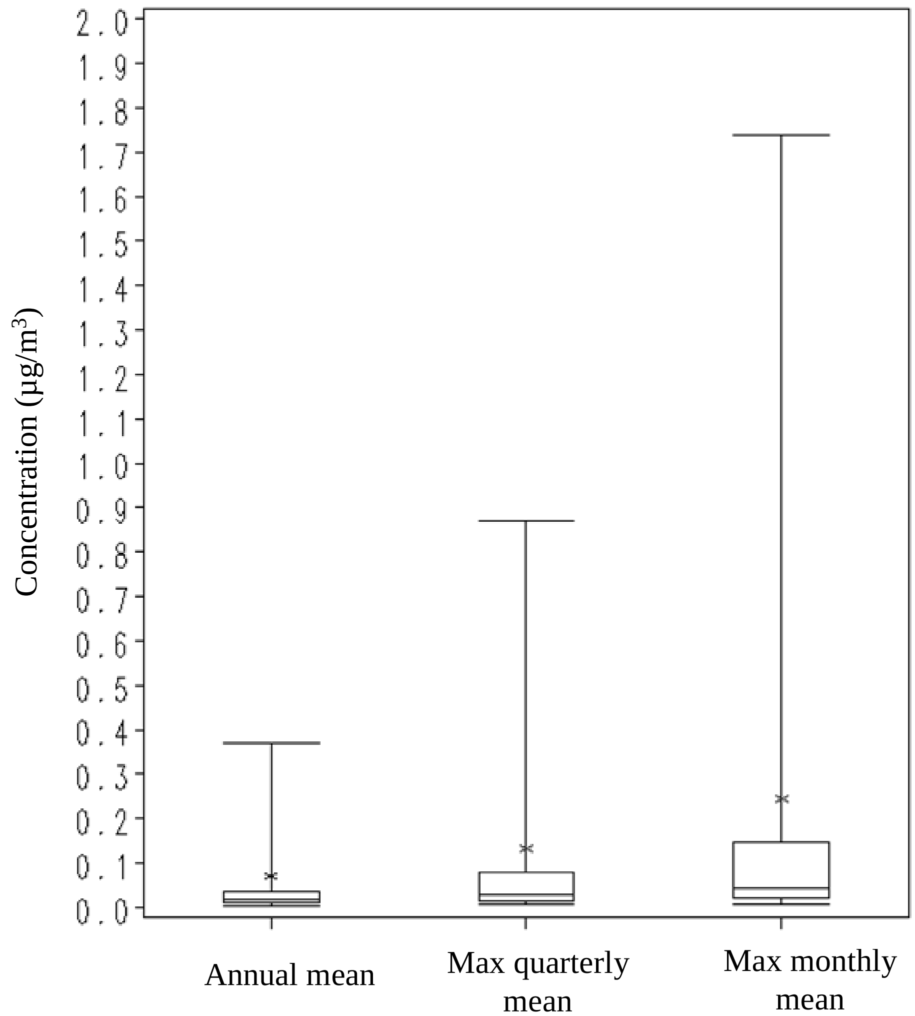


Figure A-20. Distribution of Pb-TSP concentrations (represented by 3 different statistics) at urban monitoring sites located in metropolitan areas (CBSAs) with 1 million or more population, 2003-2005.

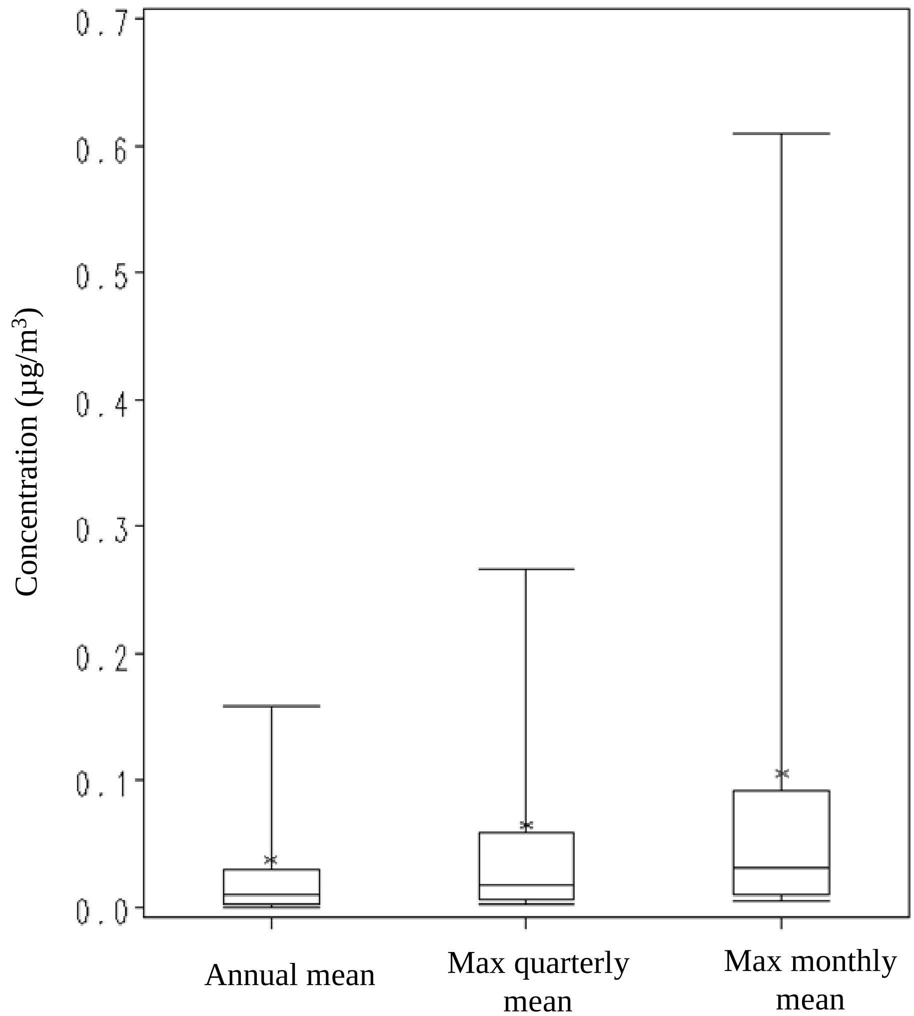


Figure A-21. Distribution of Pb-TSP concentrations (represented by 3 different statistics) at urban monitoring sites located in CBSA's with less than 1 million population, 2003-2005.

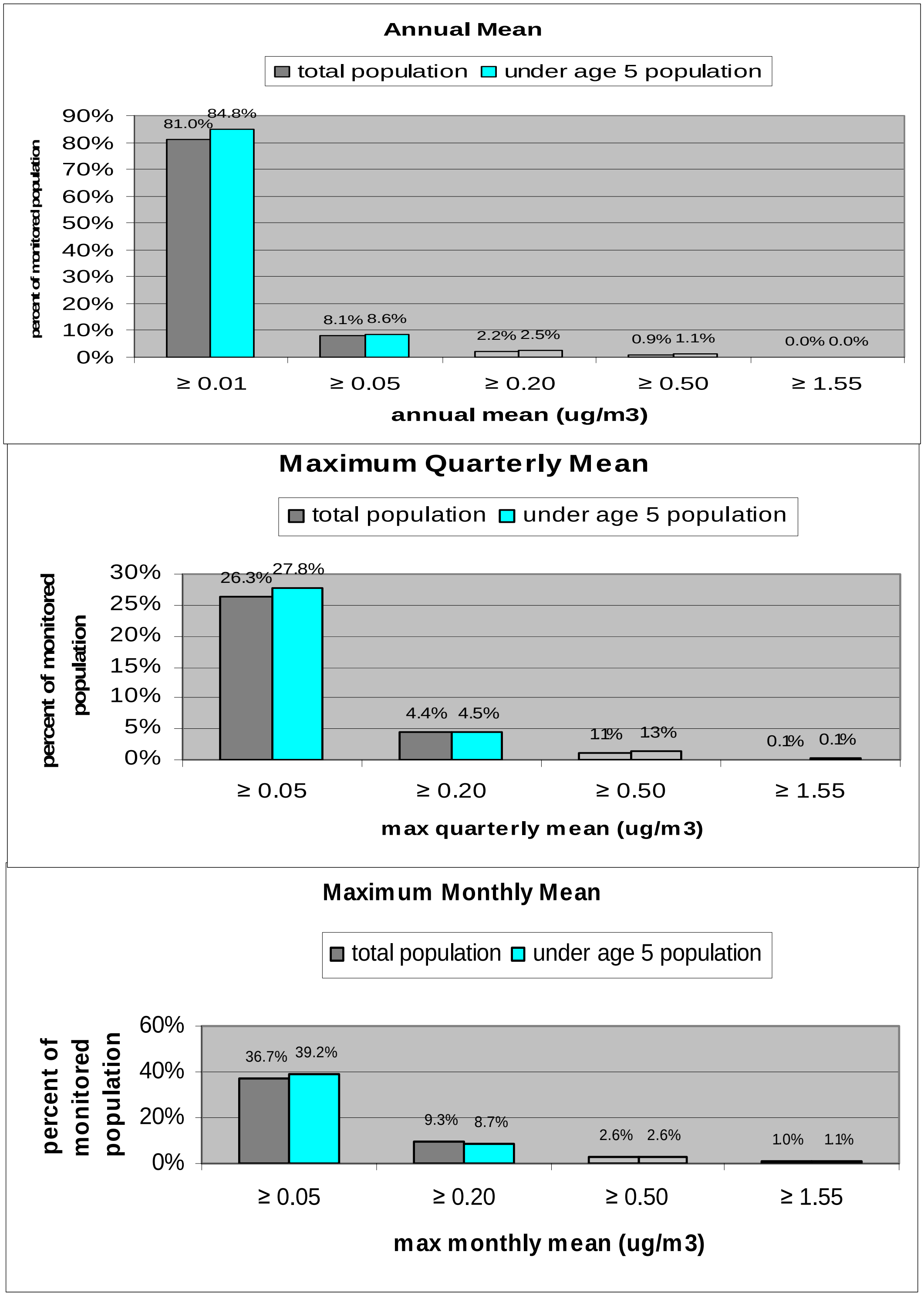


Figure A-22. Percentages of Pb-TSP urban monitored populations residing in areas (represented by 3 different statistics) exceeding various levels. (Note: Site statistics were rounded to 2 decimal places before comparing to stated levels.)

A.2.3 Pb-PM_{10}

The NATTS network includes 23 sites in mostly urban, but some rural, areas (Figure A-23). These sites are also operated by 21 state or local host agencies. All collect particulate matter as PM_{10} for toxic metals analysis, typically on a 1 in 6 day sampling schedule. Lead in the collected sample is quantified via the ICP/MS method. The standard operating procedure for metals by ICP/MS is available at: http://www.epa.gov/ttn/amtic/airtox.html. These NATTS sites are relatively new, with 2004 being the first year in which all were operating. The AQS can be accessed at http://www.epa.gov/ttn/airs/airsaqs/.

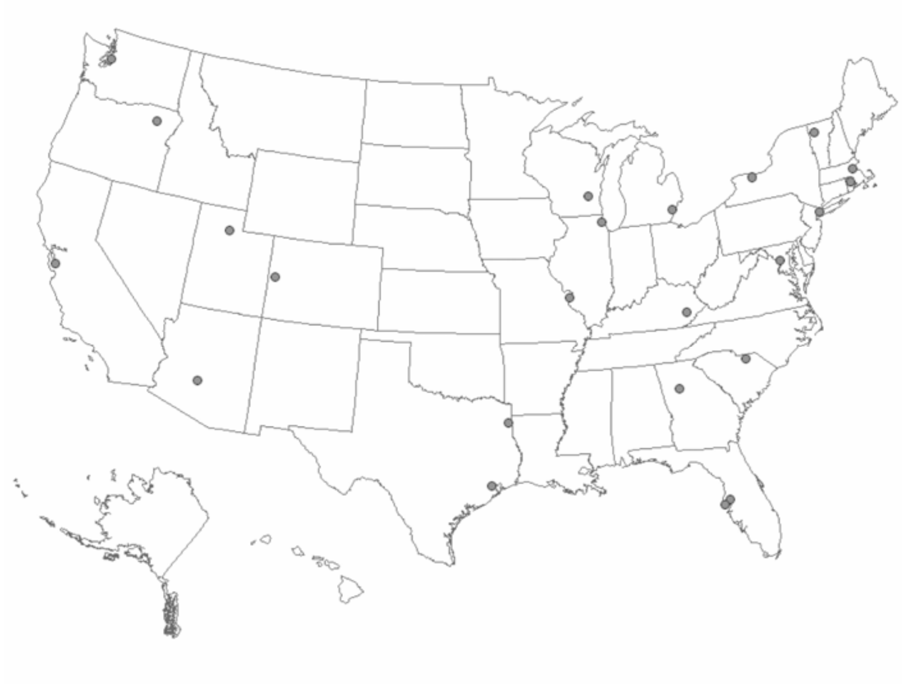


Figure A-23. Pb-PM_{10} (NATTS) monitoring sites network.

A.2.3.1 Data Analysis Details

Lead -PM_{10} data collected in 2003-2005 (parameter code 82128, duration '7') were extracted from EPA's AQS on May 22, 2007. Most of the monitoring sites reporting such data are in the NATTS network. The same screening criteria utilized for Pb-TSP were also implemented for Pb-PM_{10}: 1) a minimum of 10 observations per quarter, 2) for at least one full year (all 4 quarters), and 3) at least 9 months with 4 observations each; all three criteria had to be met for inclusion. 30 monitors met the 3-pronged criteria; six of the 30 sites had complete data for all three years (2003-2005), 7 sites had only two years of complete data; and 17 sites had only one usable year of data. As with the Pb-TSP data processing, the PM_{10} data were used "as reported"; that is, ½ MDL substitutions were not made for reported concentrations less than or equal MDL. Populations were associated with the Pb-PM_{10} sites in the same manner as for Pb-TSP. And, Pb-PM_{10} sites were categorized similarly to the Pb-TSP sites. However, no Pb-PM_{10} sites fell into the source-oriented classification. 21 of the 30 Pb-PM_{10} sites were classified as urban; 14 of those 21 sites are located in CBSA's of 1 million or more population and the other 7 are located in smaller CBSA's. The 30 Pb-PM_{10} monitors are listed with various summary and demographic data in Attachment A-2, Table 5.

A.2.3.2 Current Concentrations

Monitoring site-level concentrations and associated ranks for each of the 3 statistical metrics (annual mean, maximum quarterly mean, and maximum monthly mean) are provided in Attachment A-2, Table 5, referenced above. Figure A-24 shows the distributions of the annual means, maximum quarterly averages, and maximum monthly means for the 30 Pb-PM_{10} sites. The national composite average annual mean for Pb-PM_{10} was 0.007 $\mu g/m^3$ for the 3-year period, 2003-2005; the corresponding median annual mean was 0.006 $\mu g/m^3$. The national composite average maximum quarterly mean was 0.013 $\mu g/m^3$ for 2003-2005 and the corresponding median maximum quarterly mean was 0.010 $\mu g/m^3$. The national composite average maximum monthly mean was 0.023 $\mu g/m^3$ and the median maximum monthly mean was 0.014 $\mu g/m^3$. Figure A-25 shows distribution boxplots for the 21 urban sites and Figure A-26 shows distribution boxplots for the 17 urban sites located in CBSA's with one million or more population. In these three figures, the boxes depict inter-quartile ranges and medians, whiskers depict the 5^{th} and 95^{th} percentiles, and asterisks identify composite averages. Additional points on the distribution for these statistics are given in Attachment A-2, Table 6.

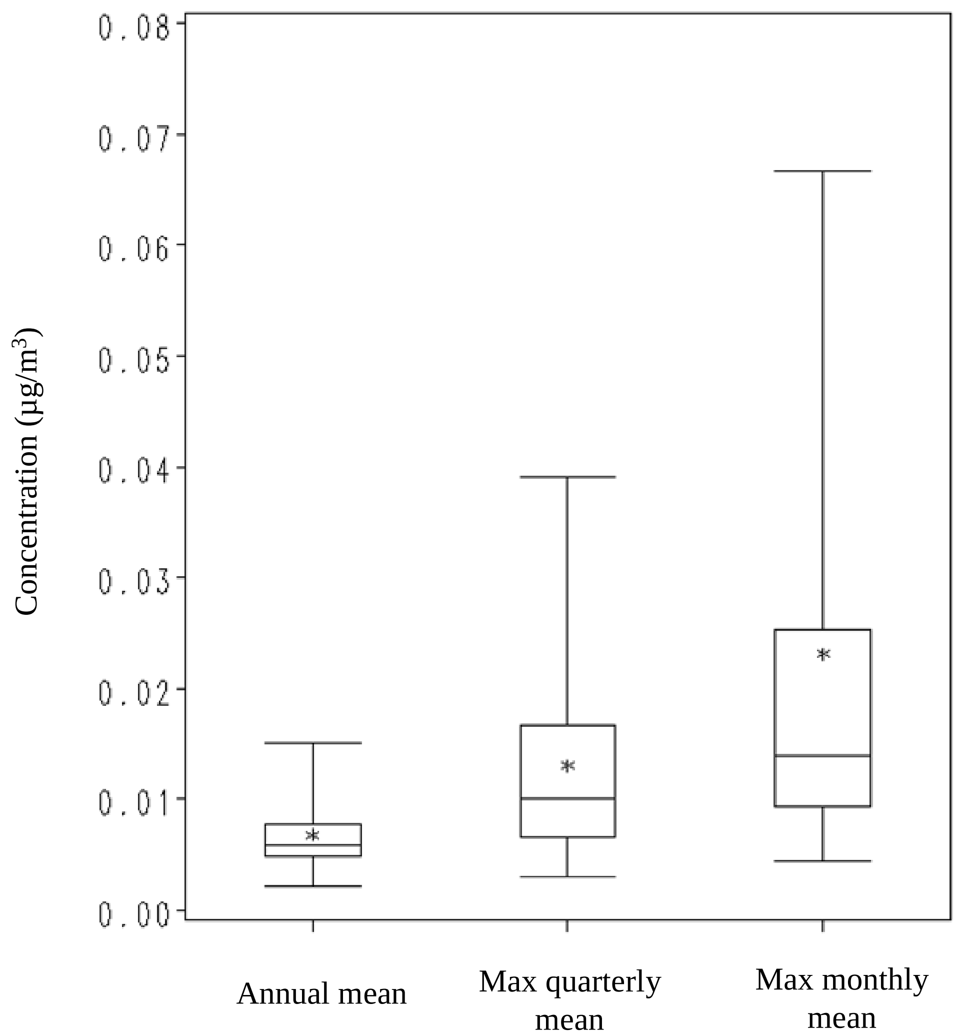


Figure A-24. Distribution of Pb-PM_{10} concentrations (represented by 3 different statistics) at all Pb monitoring sites, 2003-2005.

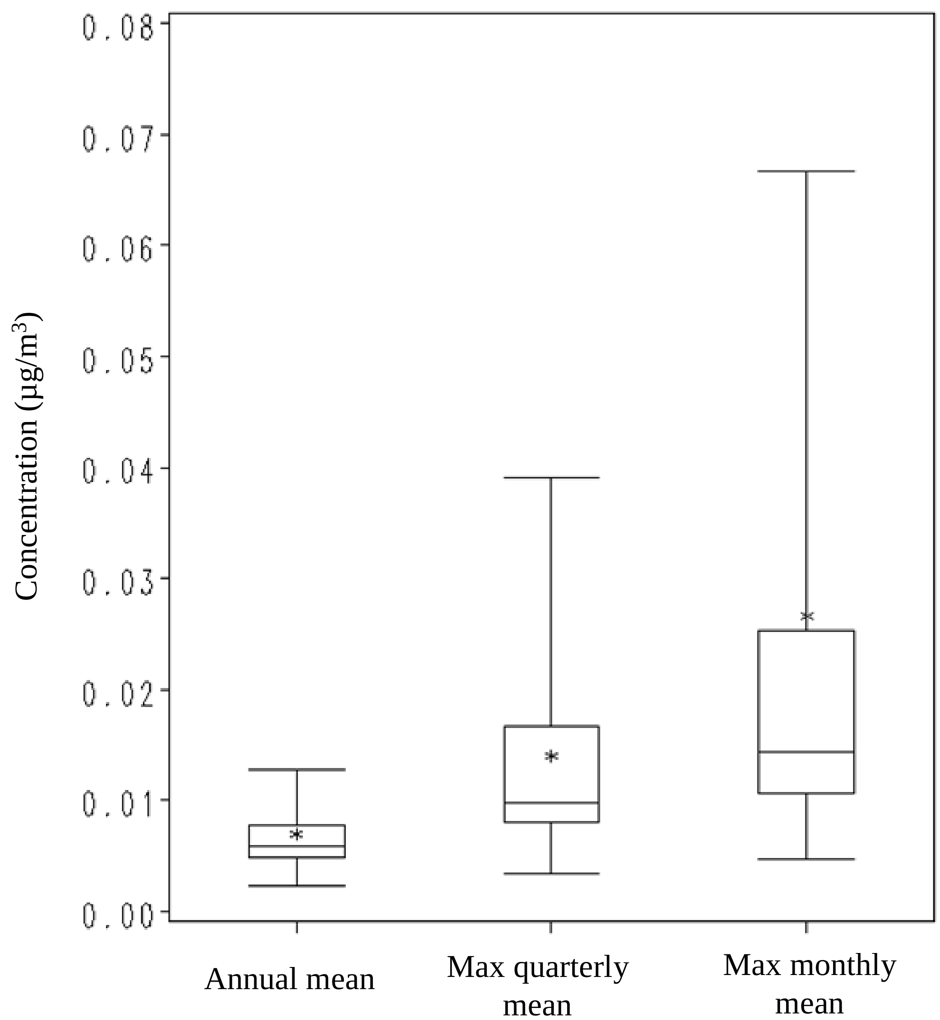


Figure A-25. Distribution of Pb-PM_{10} concentrations (represented by 3 different statistics) at urban monitoring sites, 2003-2005.

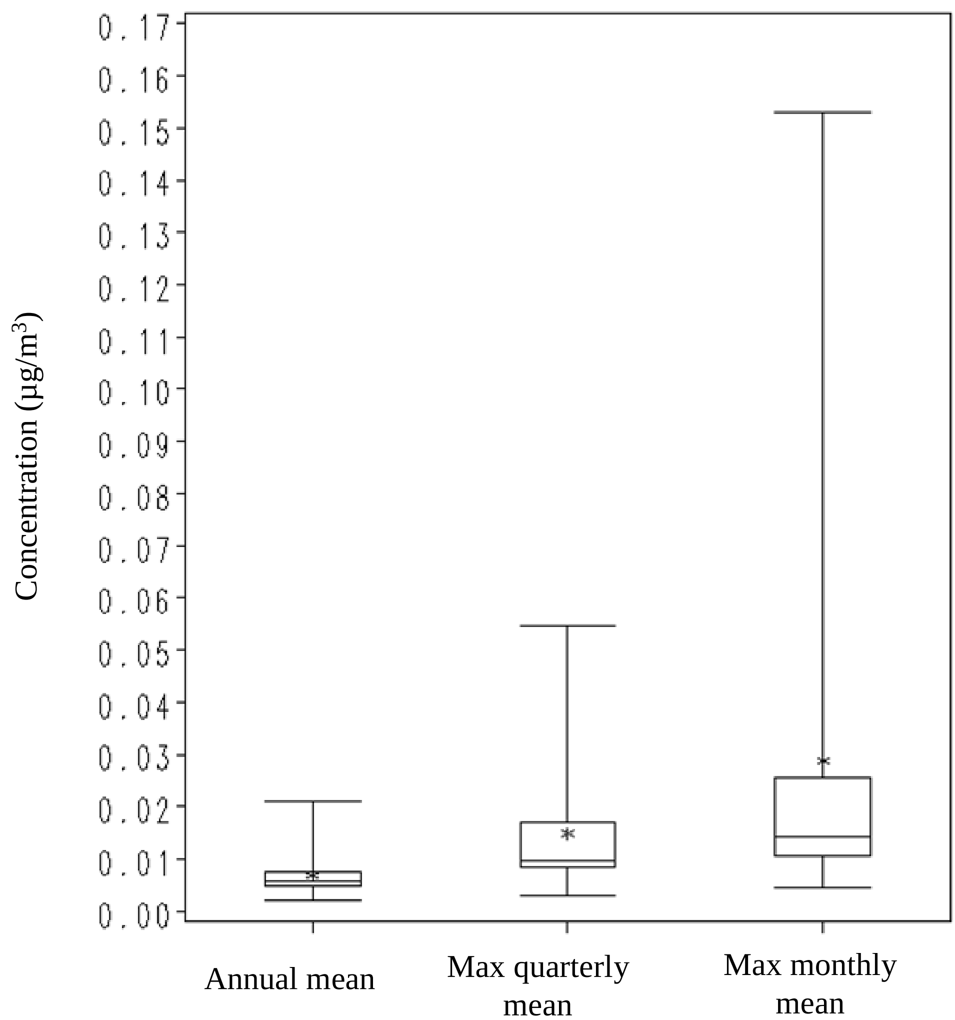


Figure A-26. Distribution of Pb-PM_{10} concentrations (represented by 3 different statistics) at urban monitoring sites in CBSAs of ≥1 million population, 2003-2005.

Site-level annual means are mapped in Figure A-27 and the corresponding maximum quarterly means are mapped in Figure A-28.

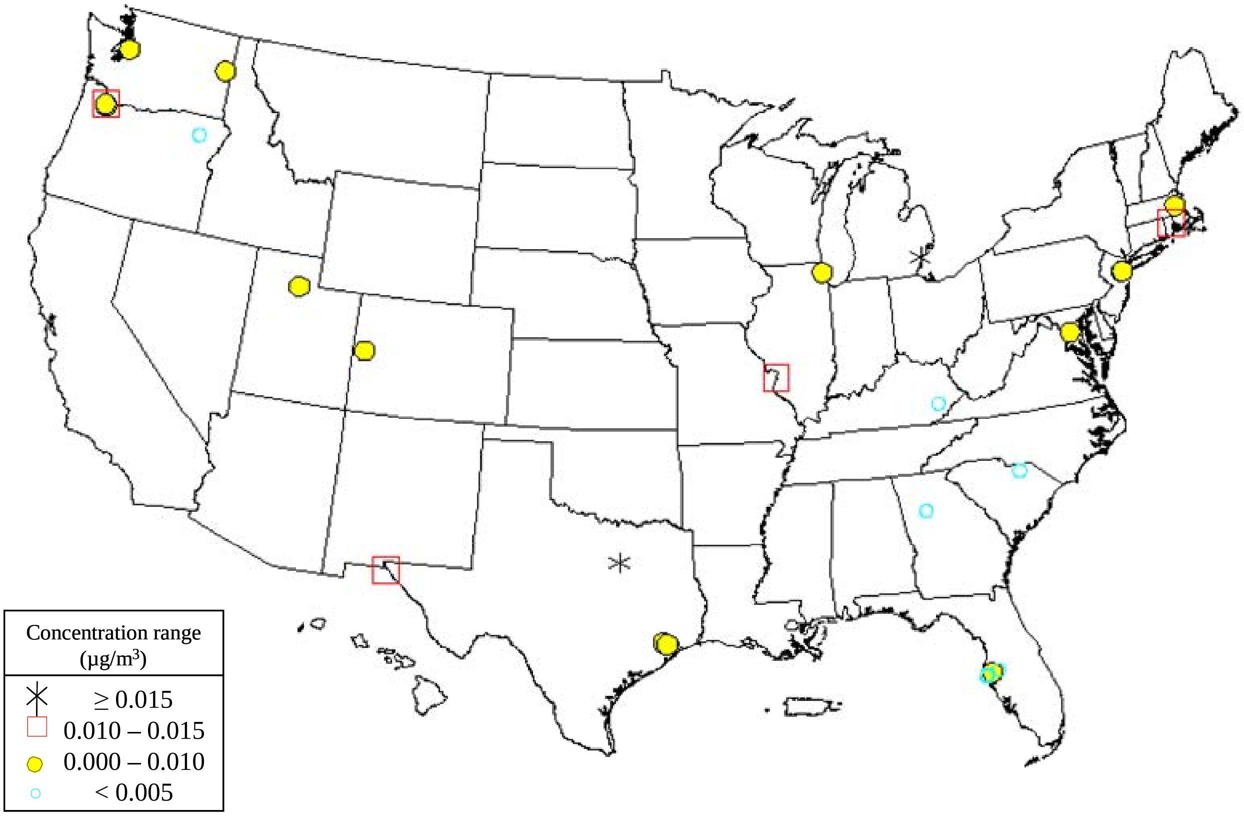


Figure A-27. Pb-PM_{10} annual means (for all sites), 2003-2005.

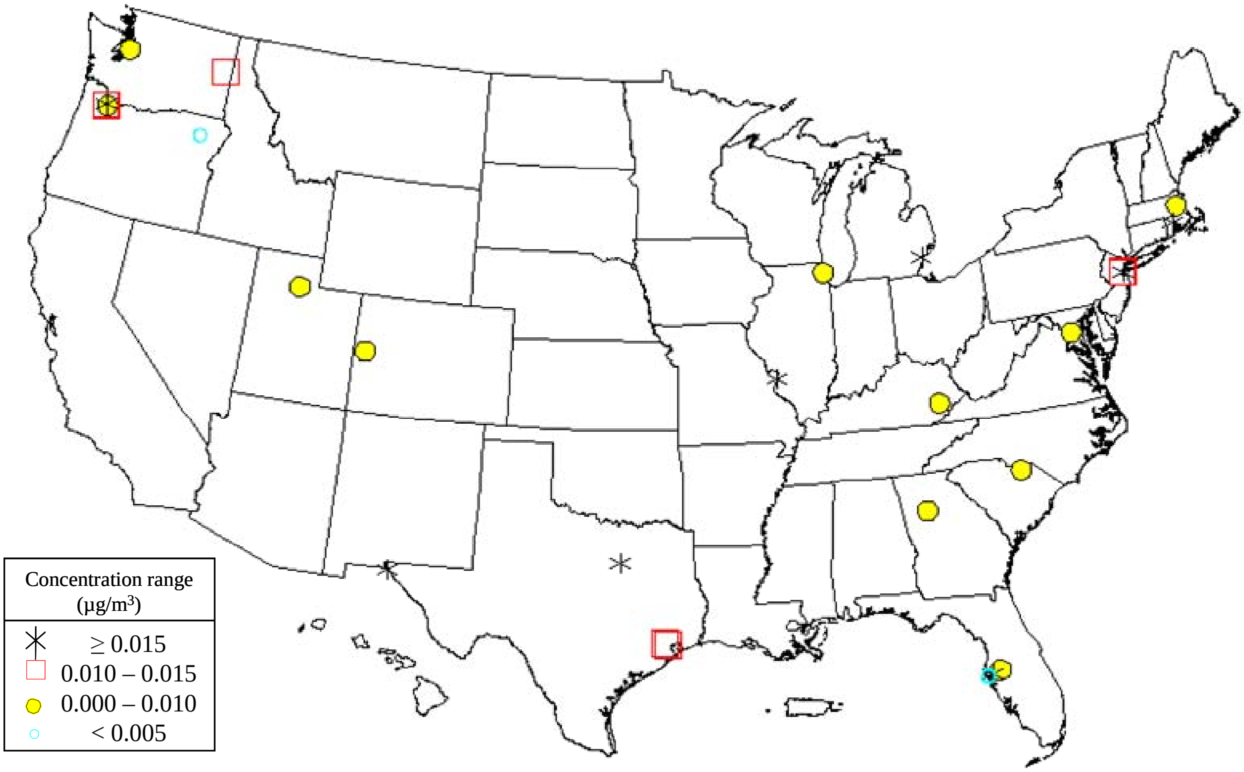


Figure A-28. Pb-PM_{10} maximum quarterly means (for all sites), 2003-2005

A.2.4 Pb-$PM_{2.5}$

Two networks measure Pb in $PM_{2.5}$, the EPA CSN and the IMPROVE network. The CSN consists of 54 long-term trends sites [commonly referred to as the Speciation Trends Network (STN)] and about 150 supplemental sites, all operated by state and local monitoring agencies. Most STN sites operate on a 1 in 3 day sampling schedule, while most supplemental sites operate on a 1 in 6 day sampling schedule. Sites in the CSN network determine the Pb concentrations in $PM_{2.5}$ samples and, as such, do not measure Pb in the size fraction >2.5 µm in diameter. Lead is quantified via the XRF method. The standard operating procedure for metals by XRF is available at: http://www.epa.gov/ttnamti1/files/ambient/pm25/spec/xrfsop.pdf. Data are managed through the AQS.

The IMPROVE network is administered by the National Park Service, largely with funding by EPA, on behalf of federal land management agencies and state air agencies that use the data to track trends in rural visibility. Lead in the $PM_{2.5}$ is quantified via the XRF method, as in the CSN. Data are managed and made accessible mainly through the IMPROVE website (http://vista.cira.colostate.edu/IMPROVE/), but also are available via the AQS. Samplers are operated by several different federal, state, and tribal host agencies on the same 1 in 3 day schedule as the STN.

The locations of the CSN are shown in Figure A-29. Nearly all of the CSN sites are in urban areas, often at the location of highest known $PM_{2.5}$ concentrations. The CSN sites generally began operation around 2000.

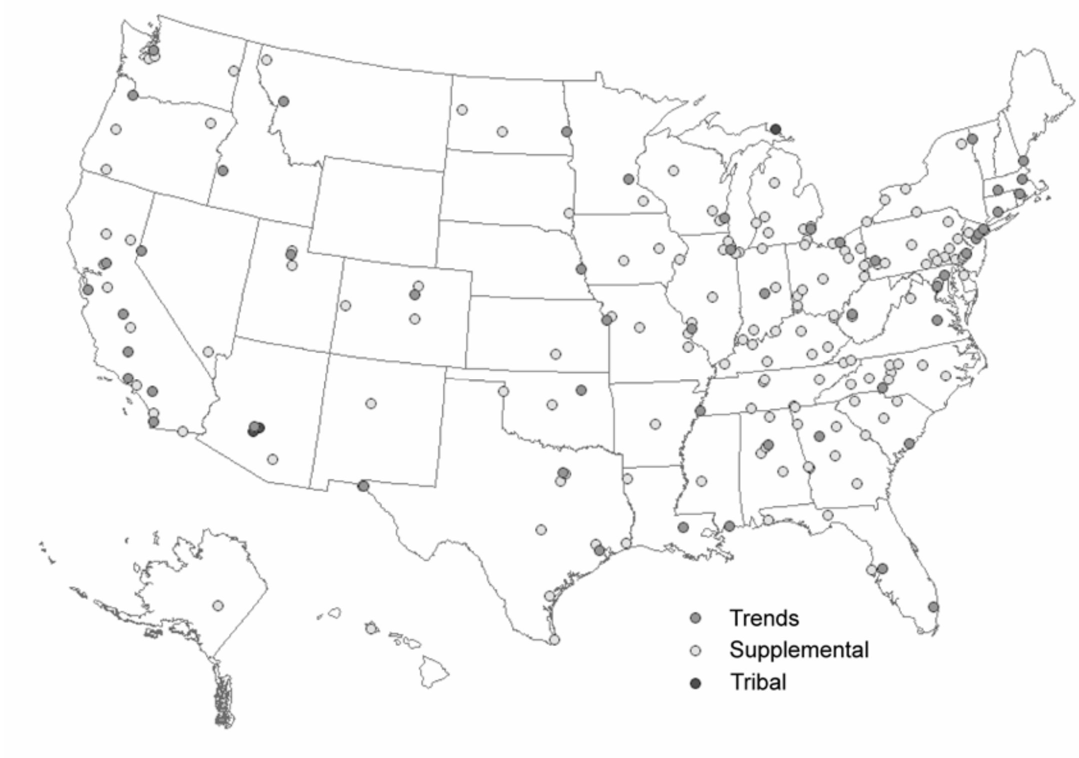


Figure A-29. Pb-$PM_{2.5}$ (STN) monitoring sites.

In the IMPROVE network, $PM_{2.5}$ monitors are placed in "Class I" areas (including National Parks and wilderness areas) and are mostly in rural locations. The oldest of these sites began operation in 1988, while many others began in the mid 1990s. The locations of these sites are shown in Figure A-30. There are 110 formally designated IMPROVE sites located in or near national parks and other Class I visibility areas, virtually all of these being rural. Approximately 80 additional sites at various urban and rural locations, requested and funded by various parties, are also informally treated as part of the network.

Figure A-30. Pb-$PM_{2.5}$ (IMPROVE) monitoring sites.

A.2.4.1 Data Analysis Details

2003-2005 Pb-$PM_{2.5}$ data (parameter code 88128, duration '7') were extracted from EPA's AQS on May 22, 2007. Data generated with IMPROVE collection/analysis methods were excluded from the national characterization on the basis that most of the monitors utilizing those methods are located in rural or remote areas. Most remaining data are associated with EPA's CSN program.

The same screening criteria utilized for Pb-TSP and Pb-PM_{10} were also implemented for Pb-$PM_{2.5}$: 1) a minimum of 10 observations per quarter, 2) for at least one full year (all 4 quarters), and 3) at least 9 months with 4 observations each; all three criteria had to be met for inclusion. 257 monitors met the data completeness criteria; 149 of the 257 sites had complete data for all three years (2003-2005), 66 sites had only two years of complete data; and 42 sites had only one usable year of data. Pb-$PM_{2.5}$ data were used "as reported"; ½ MDL substitutions were not made for reported concentrations less than or equal MDL.

Populations were associated with the Pb-$PM_{2.5}$ sites in the same manner as for Pb-TSP and Pb-PM_{10}. $PM_{2.5}$ sites were also categorized similarly to the sites in the other size cuts.

Seven Pb-PM_{10} sites were classified as source-oriented. 204 of the 257 Pb-$PM_{2.5}$ sites were classified as urban; 97 of those 204 sites are located in CBSA's of 1 million or more population and the other 107 are located in smaller CBSA's. The 257 Pb-$PM_{2.5}$ monitors are listed with various summary and demographic data in Attachment A-2, Table 7.

A.2.4.2 Current Concentrations

The site-level Pb-$PM_{2.5}$ concentrations and associated ranks for each of the three statistics (annual mean, maximum quarterly mean, and maximum monthly mean) during the three-year period, 2003-2005, are shown in Attachment A-2, Table 7. Figure A-31 shows the distributions of the three statistical metrics for the 257 Pb-$PM_{2.5}$ sites; the boxes depict inter-quartile ranges and medians, whiskers depict the 5^{th} and 95^{th} percentiles, and asterisks identify composite averages. Additional points on the distribution for these statistics are given in Attachment A-2, Table 8. The national composite average annual mean was 0.004 $\mu g/m^3$ for the 3-year period, 2003-2005; the corresponding median annual mean was 0.003 $\mu g/m^3$. The national composite average maximum quarterly mean was 0.008 $\mu g/m^3$ for 2003-2005 and the corresponding median maximum quarterly mean was 0.005 $\mu g/m^3$. The national composite average maximum monthly mean was 0.012 $\mu g/m^3$ and the median maximum monthly mean was 0.007 $\mu g/m^3$. As also shown in Attachment A-2, Table 8, the median and mean site-level annual mean and maximum quarterly mean levels for source oriented sites were approximately double those for the non-source-oriented sites. Figure A-32 maps the annual means for Pb-$PM_{2.5}$ sites.

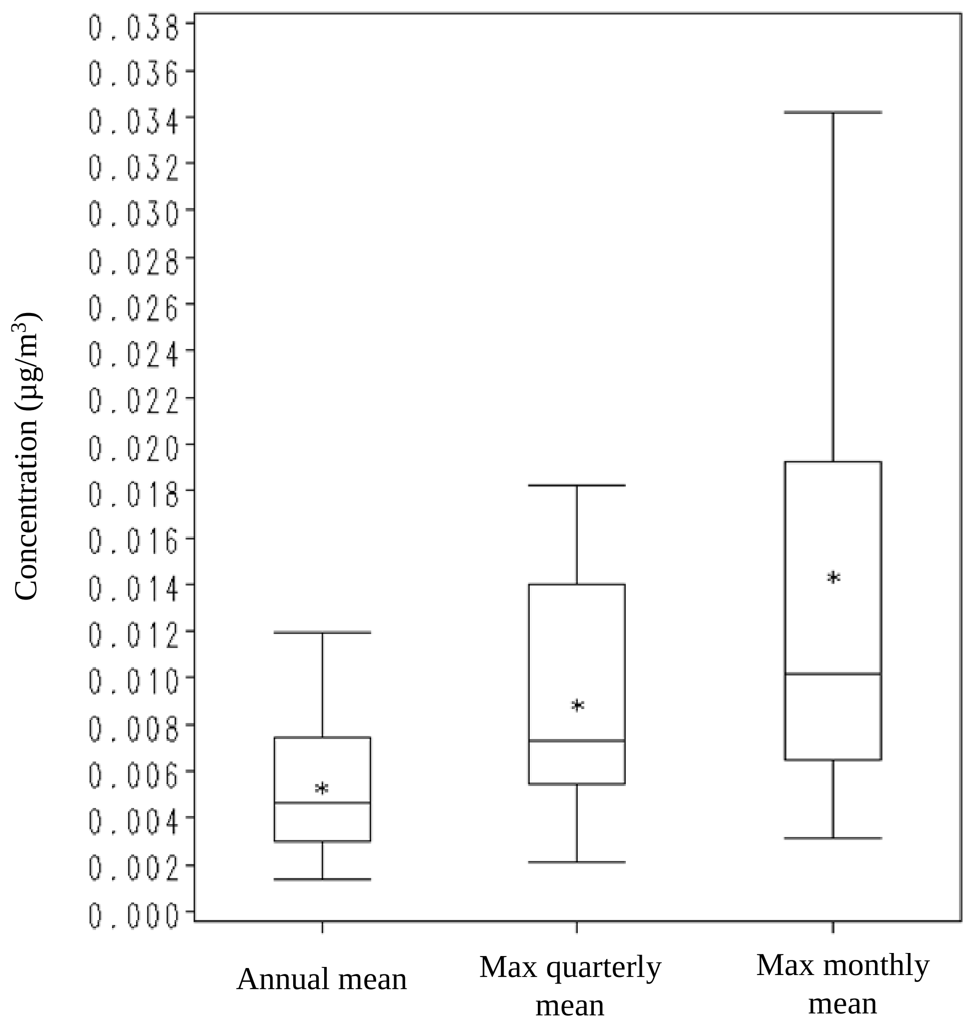


Figure A-31. Distribution of Pb-$PM_{2.5}$ concentrations (represented by 3 different statistics) at all Pb-$PM_{2.5}$ monitoring sites, 2003-2005.

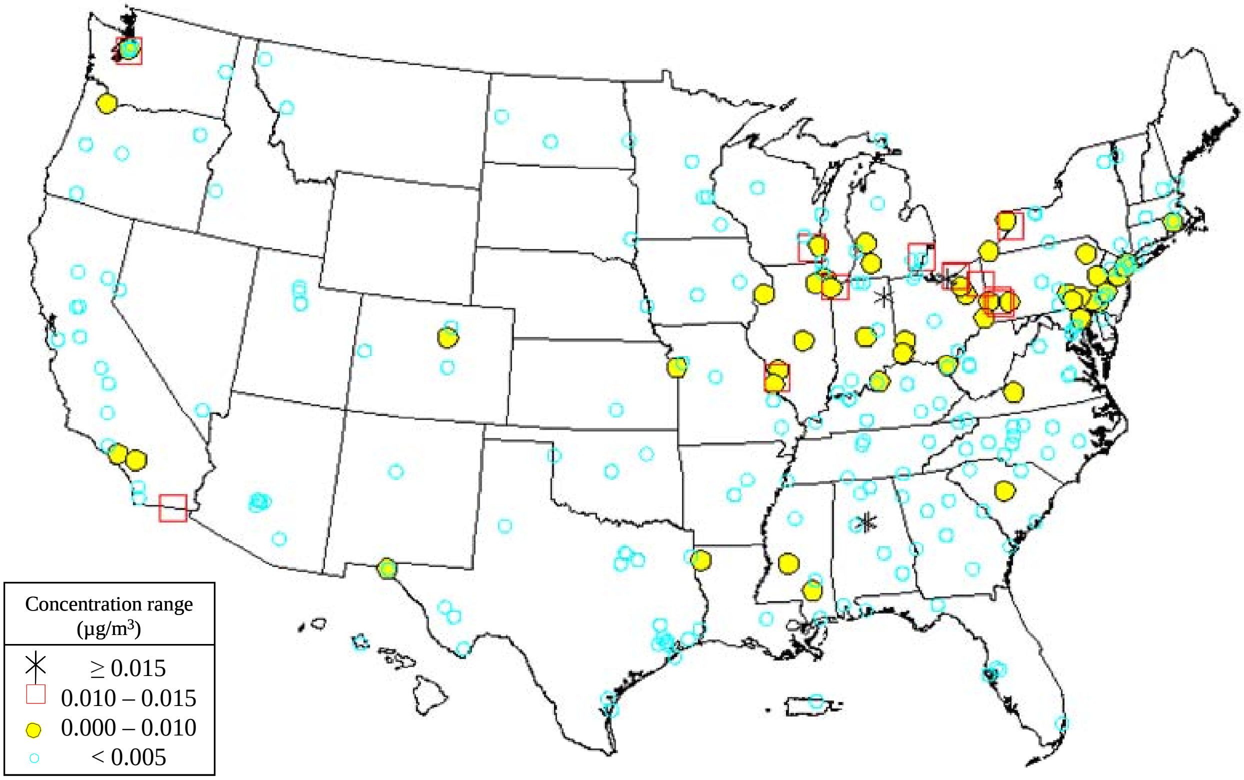


Figure A-32. Pb-$PM_{2.5}$ annual means (for all sites), 2003-2005.

REFERENCES

Calspan Corporation. (1977) Assessment of Industrial Hazardous Waste Practices in the Metal Smelting and Refining Industry. Volume III: Ferrous Smelting and Refining. Prepared for EPA's Office of Solid Waste. No. SW-145c.3 1977.

ChevronTexaco. (2005) Aviation Fuels Technical Review. FTR-3. http://www.chevronglobalaviation.com/docs/aviation_tech_review.pdf.

DOE Energy Information Agency. (2006) Fuel production volume data obtained from http://tonto.eia.doe.gov/dnav/pet/hist/mgaupus1A.htm accessed November 2006.

Eastern Research Group. (2002a) Development of Average Emission Factors and Baseline Emission Estimates for the Industrial, Commercial, and Institutional Boilers and Process Heaters NESHAP. Memorandum to Jim Eddinger, Office of Air Quality Planning and Standards, U.S. EPA. October, 2002. Docket number - 0AR-2002-0058-0022.

Eastern Research Group. (2002b) National Emission Trends for Large Municipal Waste Combustion Units, (years 1090 to 2005). Memorandum to Walt Stevenson. June 17, 2002, EPA Docket A-90-45 / Item VIII-B-7;

Eastern Research Group. (2002c) National Emission Trends for Small Municipal Waste Combustion Units. Memo to Walt Stevenson. June 12, 2002, EPA Docket A-98-18 / Item VI-B-2

EC/R Incorporated. (2006) Secondary Lead Smelter Industry – Source Characterization for Residual Risk Assessment. Prepared for USEPA Office of Air and Radiation, Office of Air Quality Planning and Standards, Research Triangle Park, NC. November.

Lehigh University. 1982. Characterization, Recovery, and Recycling of Electric Arc Furnace Dust. Final report prepared for the U.S. Department of Commerce. February 1982.

RTI International. (2005) Summary of EPA's 2004 Survey of Minimills. June.

RTI International. (2006) Characterization of the Glass Manufacturing Industry, Glass Manufacturing Area Source NESHAP. Memorandum to Susan Fairchild, Office of Air Quality Planning and Standards. May 5

Schauer JJ, Lough GC, Shafer MM, Christensen WF, Arndt MF, DeMinter JT, Park J-S. (2006) Characterization of metals emitted from motor vehicles. Health Effects Institute Report Number 113.

Stevenson, W. (2002) Emissions from Large MWCs at MACT Compliance. Memo to Docket from Walt Stevenson. EPA Docket a-90-45 / Item VIII-B-11.

U.S. Environmental Protection Agency. (1986) Air Quality Criteria for Lead. Washington, DC, EPA/600/8-83/028AF (NTIS PB87142386). Available online at: http://www.epa.gov/ttn/naaqs/standards/pb/s_pb_pr_cd.html

U.S. Environmental Protection Agency. (1995) National Emission Standards for Hazardous Air Pollutants for Secondary Lead Smelting. Federal Register, (60FR32587), June 23, 1995. Available at: http://www.epa.gov/ttn/atw/mactfnlalph.html

U.S. Environmental Protection Agency. (1998) Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units – Final Report to Congress. Office of Air Quality Planning and Standards. EPA 453/R-98-004a. February.

U.S. Environmental Protection Agency. (1999a) National Emission Standards for Hazardous Air Pollutants for Primary Lead Smelters: Final Rule. 4 June 1999. Federal Register, Volume 64, No. 107, page 30194. Available at: http://www.epa.gov/ttn/atw/mactfnlalph.html

U.S. Environmental Protection Agency. (1999b) National Emission Standards for Hazardous Air Pollutants for Portland Cement Manufacturing: Final Rule. 14 June 1999. Federal Register, Volume 64, No. 113. Available at: http://www.epa.gov/ttn/atw/pcem/pcempg.html

U.S. Environmental Protection Agency. (2002a) National Emission Standards for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries--Background Information for Proposed Standards. EPA-453/R-02-013. Office of Air Quality Planning and Standards, Research Triangle Park, NC. December.

U.S. Environmental Protection Agency. (2002b) National Emission Standards for Hazardous Air Pollutants (NESHAP) for Primary Copper Smelters: Final Rule. 12 June 2002. Federal Register, 67(113): 40478. Available at: http://www.epa.gov/ttn/atw/copper/fr12jn02.pdf.

U.S. Environmental Protection Agency. (2003a) Emission estimates for integrated iron and steel plants. Memorandum to Docket, February 3, 2003. Document no. IV-B-4 in Docket No. OAR-2002-0083

U.S. Environmental Protection Agency. (2003b) National Emission Standards for Hazardous Air Pollutants for Integrated Iron and Steel Manufacturing: Final Rule. 20 May 2003. Federal Register, Volume 68, No. 97. Available at: http://www.epa.gov/ttn/atw/iisteel/iisteelpg.html

U.S. Environmental Protection Agency. (2004a) National Emission Standards for Hazardous Air Pollutants for Industrial/Commercial/Institutional Boilers and Process Heaters: Final Rule. 13 September 2004. Federal Register, Volume 69, No. 176. Available at: http://www.epa.gov/ttn/atw/boiler/boilerpg.html

U.S. Environmental Protection Agency. (2004b) National Emission Standards for Hazardous Air Pollutants for Iron and Steel Foundries; Final Rule. Federal Register 69(78): 21906-21940. April 22.

U.S. Environmental Protection Agency. (2005) “Technical Support Document for HWC MACT Replacement Standards, Volume V: Emission Estimates and Engineering Costs,” September 2005, Appendix C.

U.S. Environmental Protection Agency. (2006) Air Quality Criteria for Lead. Washington, DC, EPA/600/R-5/144aF. Available online at: www.epa.gov/ncea/

U.S. Environmental Protection Agency. (2007a) National Emissions Inventory for 2002, version 3, draft. Office of Air Quality Planning and Standards, Research Triangle Park, NC. June 22, 2007.

U.S. Environmental Protection Agency. (2007b) Airport-specific emissions of lead from combustion of leaded aviation gasoline. http://www.epa.gov/ttn/chief/net/2002inventory.html

Attachment A-1. Largest Stationary Source Categories for Pb in the 2002 NEI.

Boilers and Process Heaters

Materials including coal, oil, natural gas (or, at times, other substances such as wood and petroleum coke) are burned in boilers and process heaters to produce steam. With regard to boilers, the steam is used to produce electricity or provide heat, while process heaters are used in industrial processes. Lead is present naturally in the fuel and is emitted to air following combustion. The extent of emissions depends on the concentration of Pb in the fuel, the quantity of fuel burned, and PM control devices applied.

Industrial, commercial and institutional boilers and process heaters are used at a wide variety of facilities (e.g., refineries, chemical and manufacturing plants, etc), as well as in a “stand alone” mode to provide heat for large building complexes. Consequently, there are thousands of these sources throughout the country, generally located in urban areas, and they range widely in size. Most coal-fired industrial boilers emit about 0.06 tpy, with the larger ones emitting about 0.07 tpy due to the use of high efficiency particulate matter (PM) control (ERG, 2002a). Reductions in Pb emissions are projected as a result of the national emissions standard promulgated for this category in 2004 (U.S. EPA, 2004a).

Among utility boilers, coal-fired boilers have the highest Pb emissions, oil-fired utility plants emit somewhat lower amounts, and gas-fired plants emit very low levels of Pb (USEPA, 1998). There are approximately 1,300 coal-fired electric utility boilers in the U.S. ranging in size from 25 to approximately 1,400 MWe. Based on emission factor calculations, a 325 MWe coal-fired boiler would be expected to emit approximately 0.021 tpy Pb, based on the use of an electrostatic precipitator for PM control (USEPA, 1998). Although there are exceptions, coal-fired utility boilers tend to be located in non-urban areas.

Iron and Steel Foundries

Iron and steel foundries melt scrap, ingot, and other forms of iron and steel and pour the molten metal into molds for particular products. While located in 44 of the lower 48 states (in both cities and rural areas), the 650 existing foundries in the U.S., are most heavily concentrated in the Midwest (IN, IL, OH, MI, WI, and MN) - roughly 40% of foundries with almost 60% of U.S. production (USEPA, 2002a). Most are iron foundries operated by manufacturers of automobiles and large industrial equipment and their suppliers. The largest Pb emission sources at iron foundries are large furnaces, emissions from which generally range from about 0.3 to 3 tpy (generally released at heights of 25-30 feet), depending on the throughput of the furnace, the type and operating characteristics of the emission control system, and the Pb content in the metal charged to the furnace. Regulations promulgated in 2004 are projected to yield emissions reductions of approximately 25 tpy for this category (USEPA, 2004b).

Hazardous Waste Incineration/ Combustion Facilities

Hazardous waste combustors include hazardous waste incinerators, as well as boilers and industrial furnaces that burn hazardous waste for energy or material recovery (e.g., production of halogen acid from the combustion of chlorine-bearing materials). Industrial furnaces burning hazardous waste include cement kilns, lightweight aggregate kilns, and hydrochloric acid production furnaces. Lead is a trace contaminant in the hazardous waste, fossil fuels, and raw materials used in the combustors. In 2005, there were nearly 270 hazardous waste combustor sources in operation in the United States (70 FR at 59530), with approximately 40 percent of them in the states of Texas and Louisiana. As a result of emissions standards promulgated in 2005, EPA estimates that cumulative Pb emissions from hazardous waste combustors will be reduced to approximately 4.0 tons per year by the compliance in 2008 (USEPA, 2005), a 95% reduction from 1990 levels.

Primary Lead Smelting

At primary Pb smelters, Pb-bearing ore concentrates are smelted to produce Pb metal. Lead is emitted from primary Pb smelters as process emissions, process fugitive emissions, and fugitive dust emissions (CD, p. 2-21). U.S. EPA promulgated a national emissions standard in 1999 for this category which includes an emissions limit for Pb (U.S. EPA 1999a). In the 1990s, there were three operating primary Pb smelters in the U.S: one in Montana and two in Missouri, emitting an estimated total of about 260 tpy Pb. In 2002, there were two in operation (estimated emissions shown in Table A-1); one of the two had less than 1 tpy Pb emissions. As of 2005, there was only one operating primary Pb smelter in the U.S., located in Missouri with estimated total emissions of 25 tpy (CD, p. 2-20). Thus, total Pb emissions from this category have decreased about 90% since 1990.

Secondary Lead Smelting

Secondary Pb smelters are recycling facilities that use blast, rotary, reverberatory, and/or electric furnaces to recover Pb metal from Pb-bearing scrap materials, primarily Pb-acid batteries. This category does not include remelters and refiners or primary Pb smelters. At secondary Pb smelters, Pb may be emitted from process emissions, process fugitive emissions and fugitive dust emissions from wind or mechanically induced entrainment of dust from stockpile and plant yards and roadways. In 1995, U.S. EPA promulgated a national emissions standard for this category which

Attachment A-1. Largest Stationary Source Categories for Pb in the 2002 NEI.
includes an emissions limit for Pb (USEPA, 1995). In 2002, there were 15 secondary smelters operating in 11 states, most of which are in the eastern half of the U.S. Estimates of total emissions (process and fugitive) for individual facilities as of 2002 range between 1 and 4 tpy, with one facility having total emissions on the order of 12 tpy (USEPA, 2007a; EC/R, 2006). Total Pb emissions (tpy) for this category decreased about 60% from 1990 to 2002.
Military Installations This source category includes sources that are military facilities. The types of sources contributing to Pb emissions from this category include, among others, rocket and engine test facilities, ammunition manufacturing, weapons testing, waste combustion and boilers. While there are over 300 military facilities in the NEI, only 10% emit over 0.1 tpy of Pb and only 3% emit over 1 tpy. The two largest facilities (listed in Table A-4) are a missile ammunition production plant and a weapons testing facility and these two facilities account for over 75% of the category emissions.
Mining This category includes various mining facilities that extract ore from the earth containing Pb, zinc, copper and/or other non-ferrous metals (such as gold and silver), and/or non-metallic minerals such as talc and coal. This category does not include the smelting or refining of the metals and minerals. These facilities produce ore concentrates (such as Pb, zinc, and copper concentrates) that are transported to other facilities where further processes, such as smelting and refining take place. The 2002 NEI indicates that there are 3 mining facilities in the U.S. emitting greater than 0.5 tpy Pb, one of which emits more than 5 tpy. This facility is in Missouri and produces Pb, zinc, and copper concentrates that are shipped to customers for further processing.
Integrated Iron & Steel Manufacturing Integrated iron and steel manufacturing includes facilities engaged in the production of steel from iron ore. The processes involved include sinter plants, blast furnaces that produce iron, and basic oxygen process furnaces that produce steel, as well as several ancillary processes including hot metal transfer, desulfurization, slag skimming, and ladle metallurgy. There are currently 17 facilities. The range of Pb emissions is from 2 to 8 tpy per facility. Stack heights range from heights of 30 - 50 feet. The facilities are located in 9 states; mostly in the Midwest (USEPA, 2003a). U.S. EPA promulgated a national emissions standard in 2003 for this category which includes an emissions limit for PM (USEPA, 2003b).
Municipal Waste Combustors: Small & Large Municipal waste combustors (MWCs) incinerate municipal or municipal-type solid waste. The amount of municipal waste incinerated (about 14% of U.S. municipal waste) has remained stable over the past decade. The amount of Pb emitted from municipal waste combustors depends on the amount of Pb in the refuse, with typical sources including paper, inks, cans and other metal scrap and plastics (CD, pp. 2-35 to 2-36). As of 2005, Clean Air Act required MACT was completed for all and existing new municipal waste incineration units and national Pb emissions from municipal waste incineration are now less than 10 tons per year, about a 97% reduction since 1990. There are currently 66 large MWC plants and 26 small MWC plants operating nationally, with individual large MWC plants projected to emit less than 0.1 tpy Pb, and small MWC plants less than 0.02 tpy Pb (ERG, 2002b,c; Stevenson, 2002).
Pressed and Blown Glass and Glassware Manufacturing This category includes manufacturers of flat glass, glass containers, and other pressed and blown glass and glassware, with Pb emitted primarily from the pressed and blown glass industry sector. Some container plants also make a leaded-glass product, but this is not typical of container glass plants. Lead may also be added to flat glass for use in microwaves and flat-screen TVs. Emissions from individual facilities may range from a few pounds per year up to several tons per year depending on Pb content of their glass and the level of control. Furnace stacks for these facilities are typically of the order of 35-60 feet high. As of 2005, about 22 tons of Pb is emitted from glass manufacturing annually. Glass plants are located in 35 States (RTI, 2006). U.S. EPA is currently developing an emissions regulation for this category, scheduled for promulgation in December 2007.
Electric Arc Furnace Steelmaking In the steelmaking process that uses an electric arc furnace (EAF), the primary raw material is scrap metal, which is melted and refined using electric energy. Since scrap metal is used instead of molten iron, there are no cokemaking or ironmaking operations associated with steel production that use an EAF. There are currently 141 EAFs at 93 facilities, with estimated total nationwide Pb and Pb compound emissions of approximately 80 tons, and the average per facility is approximately 0.75 tpy. Stack heights range from heights of 30 - 50 feet. The facilities are located in 32 states; mostly in the northeast and Midwest, with ninety percent of the facilities located in urban areas. This information is drawn from multiple sources (Lehigh, 1982; Calspan, 1977; RTI, 2005). U.S. EPA is developing a hazardous air pollutant (HAP) emissions regulation for this category, scheduled for promulgation in December 2007.
Lead Acid Battery Manufacturing The Pb acid battery manufacturing category includes establishments primarily engaged in manufacturing storage batteries from Pb alloy ingots and Pb oxide. The Pb oxide may be prepared by the battery manufacturer or may be

Attachment A-1. Largest Stationary Source Categories for Pb in the 2002 NEI.
purchased from a supplier. There has been a general decline in number of facilities, with 58 facilities currently in operation (data obtained from the Battery Council International (BCI)). The range of facility specific Pb and Pb compound emissions is from 1 x 10^{-5} to just below 10 tpy, with an average of about 0.5 tpy. The facilities are located in urban and rural areas of 23 states and Puerto Rico (2002 NEI).
Primary Copper Smelting This source category includes all industries which refine copper concentrate from mined ore to anode grade copper, using pyrometallic processes. Seven primary copper smelters are currently operating in the U.S. Six of these seven smelters use conventional smelter technology which includes batch converter furnaces for the conversion of matte grade copper to blister copper, while the seventh uses a continuous flash furnace. Two of the three largest smelters are located in AZ, and the third is in Utah. The largest facility emitted an estimated 12.8 tons Pb in 2002, while emissions for the other two large facilities are estimated between 0.1 to 5 tpy. No other source in this category emits more than 0.1 tpy. In 2002, U.S. EPA promulgated a national emissions standard, including limits for PM, for this category (USEPA, 2002b).
Portland Cement Manufacturing Portland cement manufacturing is an energy intensive process in which cement is made by grinding and heating a mixture of raw materials such as limestone, clay, sand, and iron ore in a rotary kiln (a large furnace fueled by coal, oil, gas, coke and/or various waste materials). Lead, a trace contaminant both of the raw materials and some fuel materials (e.g., coal), is emitted with particulate material from the kiln stacks, which range in height from near 10 meters to more than 100 meters. Relatively smaller Pb emissions occur from grinding, cooling, and materials handling steps in the manufacturing process. These facilities are generally located in areas with limestone deposits and in rural areas or near small towns. The largest numbers of facilities are in Pennsylvania and California, although a significant percentage of facilities are in the Midwest. As of 2004, there were 107 Portland cement plants in the U.S. (O'Hare, 2006), with all but three reporting less than 1 tpy of Pb emissions. The highest estimated Pb emissions for a facility in the 2002 NEI is 5.4 tpy. In 1999, U.S. EPA promulgated a national emissions standard, including a limit for PM (as a surrogate for metal HAP, including Pb), for this category (USEPA, 1999b).

Attachment A-2.

Additional Details of Air Quality Analyses

														data completeness (complete periods)			3-year metrics			metric and population ranks (of all Pb-TSP sites)				
site	poc	lat	long	state	county_name	cbsa_name	population (mile radius)	under age 5 population (mile radius)	urban	cbsa_pop00	sum point/non-pt Pb EI TPY w/in 1 mile	source oriented?	prev. source oriented? (see end notes)	qtrs	years	months	annual mean	max quarterly mean	max monthly mean	annual mean	max quarterly mean	max monthly mean	pop. (M rad.)	under age 5 pop (M rad.)
011090003	2	31.79056	-85.97917	AL	Pike	Troy, AL	461	31		29,605	4.45	1		10	2	31	0.6875	1.9233	2.6600	5	3	5	162.5	162.5
011090006	1	31.79278	-85.98056	AL	Pike	Troy, AL	461	31		29,605	4.45	1		10	2	31	0.3808	0.9100	1.6900	11	9	10	162.5	162.5
060250005	1	32.67611	-115.48333	CA	Imperial	El Centro, CA	16,385	1,290	1	142,361	0.01			11	2	34	0.0175	0.0248	0.0404	92	108	98	28	25
060371103	2	34.06659	-118.22688	CA	Los Angeles	Los Angeles-Long Beach-Sant	29,329	1,633	1	12,365,627	0.30			12	3	36	0.0225	0.0627	0.1460	81	67	57	8	18
060371301	1	33.92899	-118.21071	CA	Los Angeles	Los Angeles-Long Beach-Sant	47,423	5,066	1	12,365,627	0.00			12	3	34	0.0188	0.0313	0.0440	87	92	93	3	3
060371601	1	34.01407	-118.06056	CA	Los Angeles	Los Angeles-Long Beach-Sant	13,333	1,066	1	12,365,627	0.00			9	2	27	0.0186	0.0300	0.0480	89	93	89	49	37
060374002	2	33.82376	-118.18921	CA	Los Angeles	Los Angeles-Long Beach-Sant	20,131	1,232	1	12,365,627	0.00			12	3	36	0.0149	0.0400	0.0960	101	79	70	18	27
060374004	2	33.79236	-118.17533	CA	Los Angeles	Los Angeles-Long Beach-Sant	61,497	6,697	1	12,365,627	0.00			10	2	28	0.0112	0.0938	0.1020	116	55	66	2	1
060375001	1	33.92288	-118.37026	CA	Los Angeles	Los Angeles-Long Beach-Sant	19,148	1,680	1	12,365,627	0.00			5	1	14	0.0222	0.0667	0.1700	82	66	53	20	15
060375005	1	33.95080	-118.43043	CA	Los Angeles	Los Angeles-Long Beach-Sant	33,968	1,358	1	12,365,627	0.00			7	1	17	0.0057	0.0118	0.0150	138	134	139	7	24
060651003	2	33.94603	-117.40063	CA	Riverside	Riverside-San Bernardino-Onta	16,320	1,278	1	3,254,821	0.00			12	3	36	0.0097	0.0114	0.0160	124	137	137	29	26
060658001	3	33.99958	-117.41601	CA	Riverside	Riverside-San Bernardino-Onta	16,247	1,678	1	3,254,821	0.00			12	3	35	0.0121	0.0179	0.0220	111	122.5	130	31	16
060711004	1	34.10374	-117.62914	CA	San Bernardino	Riverside-San Bernardino-Onta	18,777	1,578	1	3,254,821	0.00			12	3	35	0.0142	0.0343	0.0800	106	90	77.5	22	19
060719004	1	34.10688	-117.27411	CA	San Bernardino	Riverside-San Bernardino-Onta	14,861	1,755	1	3,254,821	0.00			12	3	36	0.0186	0.0773	0.1420	88	60	58	37	13
080010005	1	39.79601	-104.97754	CO	Adams	Denver-Aurora, CO	2,025	183		2,157,756	1.86	1		12	3	36	0.1697	0.5558	1.1037	25	18	14	137	133
080010006	1	39.82574	-104.93699	CO	Adams	Denver-Aurora, CO	3,313	256	1	2,157,756	0.00			12	3	31	0.0304	0.0957	0.2086	72	53	49	124	118
080310002	4	39.75119	-104.98762	CO	Denver	Denver-Aurora, CO	22,019	974	1	2,157,756	0.01			12	3	34	0.0315	0.1780	0.2955	68	40	38	16	42
080310015	1	39.70012	-104.98714	CO	Denver	Denver-Aurora, CO	14,438	809	1	2,157,756	0.00			7	1	20	0.0153	0.0212	0.0305	99	117	119	42	51
080410011	1	38.83139	-104.82778	CO	El Paso	Colorado Springs, CO	10,581	552	1	537,484	0.04			12	3	35	0.0156	0.0891	0.1387	98	56	59	59	75
080650001	1	39.24778	-106.29139	CO	Lake	Edwards, CO	5,903	361	1	49,471	0.00			11	2	28	0.0165	0.0224	0.0310	96	114	117	100	106
100010002	1	38.98472	-75.55556	DE	Kent	Dover, DE	352	22		126,697	0.00			4	1	12	0.0033	0.0040	0.0051	160	173	183	166	167
100031007	1	39.55111	-75.73083	DE	New Castle	Philadelphia-Camden-Wilmingt	2,041	209		5,687,147	0.00			4	1	10	0.0039	0.0046	0.0058	154	168	178	136	125
100031008	1	39.57778	-75.61111	DE	New Castle	Philadelphia-Camden-Wilmingt	3,170	160		5,687,147	0.00			4	1	9	0.0052	0.0063	0.0081	142	161	166	125	135
100032004	1	39.73944	-75.55806	DE	New Castle	Philadelphia-Camden-Wilmingt	34,053	2,649	1	5,687,147	0.01			4	1	11	0.0097	0.0115	0.0163	123	135	136	6	6
100051002	1	38.64444	-75.61306	DE	Sussex	Seaford, DE	5,450	390	1	156,638	0.00			4	1	12	0.0033	0.0042	0.0048	159	170	185	102	102
120571065	5	27.89222	-82.53861	FL	Hillsborough	Tampa-St. Petersburg-Clearwa	14,463	612	1	2,395,997	0.00			4	1	12	0.0049	0.0062	0.0094	146	162	162	41	64
120571066	1	27.96028	-82.38250	FL	Hillsborough	Tampa-St. Petersburg-Clearwa	5,793	465	1	2,395,997	1.26	1		12	3	35	0.5835	1.2600	1.7400	7	7	9	101	87
120571073	1	27.96583	-82.37944	FL	Hillsborough	Tampa-St. Petersburg-Clearwa	4,541	340	1	2,395,997	1.26	1		12	3	35	0.1934	0.2933	0.4800	24	27	28	111	109
120571075	5	28.05000	-82.37806	FL	Hillsborough	Tampa-St. Petersburg-Clearwa	10,691	490	1	2,395,997	0.00			4	1	12	0.0041	0.0054	0.0105	153	166	156	58	85
121030004	5	27.94639	-82.73194	FL	Pinellas	Tampa-St. Petersburg-Clearwa	13,048	557	1	2,395,997	0.00			4	1	12	0.0028	0.0041	0.0067	164	172	175	50	73
121030018	5	27.78556	-82.74000	FL	Pinellas	Tampa-St. Petersburg-Clearwa	11,289	571	1	2,395,997	0.00			8	2	24	0.0042	0.0071	0.0112	152	153	153	55	72
121033005	1	27.87583	-82.69639	FL	Pinellas	Tampa-St. Petersburg-Clearwa	2,151	58	1	2,395,997	0.00			12	3	36	0.0006	0.0067	0.0200	182	157	132.5	134	158
130890003	2	33.69833	-84.27333	GA	DeKalb	Atlanta-Sandy Springs-Marietta	7,888	663	1	4,247,981	0.00			12	3	36	0.1000	0.1000	0.1000	36.5	51.5	68	79	62
132150011	1	32.43083	-84.93167	GA	Muscogee	Columbus, GA-AL	10,871	1,037	1	281,768	0.25	1	1	10	1	34	0.1000	0.1000	0.1000	36.5	51.5	68	57	39
150032004	1	21.39667	-157.97167	HI	Honolulu	Honolulu, HI	23,622	1,207	1	876,156	0.07			12	3	35	0.0014	0.0029	0.0072	175	181	172	13	29
170310001	1	41.67275	-87.73246	IL	Cook	Chicago-Naperville-Joliet, IL-IN	13,648	971	1	9,098,316	0.00			12	3	35	0.0143	0.0229	0.0360	105	113	108	48	43
170310022	2	41.68920	-87.53932	IL	Cook	Chicago-Naperville-Joliet, IL-IN	22,040	1,708	1	9,098,316	0.18			12	3	36	0.0270	0.0353	0.0440	77	88	93	15	14
170310026	1	41.87333	-87.64507	IL	Cook	Chicago-Naperville-Joliet, IL-IN	28,739	1,203	1	9,098,316	0.01			12	3	34	0.0405	0.0613	0.0900	55	68	75	9	30
170310052	1	41.96743	-87.74982	IL	Cook	Chicago-Naperville-Joliet, IL-IN	42,187	2,877	1	9,098,316	0.00			12	3	32	0.0214	0.0260	0.0400	84	102	101	5	5
170313103	1	41.96528	-87.87639	IL	Cook	Chicago-Naperville-Joliet, IL-IN	10,302	670	1	9,098,316	0.01			12	3	34	0.0149	0.0271	0.0440	102	99	93	60	60
170313301	1	41.78278	-87.80528	IL	Cook	Chicago-Naperville-Joliet, IL-IN	23,749	1,678	1	9,098,316	0.01			12	3	35	0.0308	0.0750	0.1950	70	63	50	12	17
170314201	1	42.14000	-87.79917	IL	Cook	Chicago-Naperville-Joliet, IL-IN	6,070	303	1	9,098,316	0.00			8	2	24	0.0113	0.0133	0.0175	115	131	135	97	113
170316003	1	41.87194	-87.82611	IL	Cook	Chicago-Naperville-Joliet, IL-IN	14,862	1,071	1	9,098,316	0.00			12	3	32	0.0303	0.0387	0.0500	73	82	87.5	36	36
171170002	2	39.39804	-89.80975	IL	Macoupin	St. Louis, MO-IL	40	2		2,721,491	0.00			12	3	36	0.0103	0.0113	0.0140	119	138	142.5	184	183
171190010	1	38.69417	-90.15361	IL	Madison	St. Louis, MO-IL	8,014	529	1	2,721,491	1.31	1		12	3	34	0.0768	0.3280	0.9100	44	24	19	77	78
171193007	2	38.86056	-90.10583	IL	Madison	St. Louis, MO-IL	5,397	360	1	2,721,491	0.10			12	3	36	0.0150	0.0193	0.0320	100	121	114	103	107
171430037	1	40.69889	-89.58474	IL	Peoria	Peoria, IL	12,643	1,109	1	366,899	0.00			12	3	35	0.0137	0.0279	0.0320	109	98	115.5	51	34
171630010	2	38.61222	-90.16028	IL	St. Clair	St. Louis, MO-IL	3,512	430	1	2,721,491	0.27			12	3	36	0.0433	0.0707	0.1050	52	64	64	120	92
180350008	1	40.15806	-85.42111	IN	Delaware	Muncie, IN	2,108	104	1	118,769	0.00	1		12	3	34	0.2944	0.4657	0.7371	13	19	22	135	148
180350009	1	40.15944	-85.41556	IN	Delaware	Muncie, IN	980	82		118,769	0.00	1		12	3	35	1.1901	3.4750	4.5582	2	1	1	153	153
180890023	1	41.65278	-87.43944	IN	Lake	Chicago-Naperville-Joliet, IL-IN	5,959	603	1	9,098,316	6.53	1		12	3	34	0.0389	0.0691	0.0910	58	65	73	99	66
180892008	1	41.63944	-87.49361	IN	Lake	Chicago-Naperville-Joliet, IL-IN	7,144	612	1	9,098,316	0.00			12	3	33	0.0219	0.0296	0.0590	83	96	85	87	65
180892011	2	41.59250	-87.47194	IN	Lake	Chicago-Naperville-Joliet, IL-IN	9,815	729	1	9,098,316	0.04			12	3	34	0.0368	0.1352	0.3050	62	47	37	64	58
180930004	1	38.88944	-86.55194	IN	Lawrence	Bedford, IN	393	32		45,922	0.00			10	2	26	0.0270	0.0270	0.0270	78	100	125	165	161
180970063	1	39.76083	-86.29722	IN	Marion	Indianapolis-Carmel, IN	12,176	875	1	1,525,104	1.71	1		12	3	36	0.0320	0.0770	0.1123	66	61	63	53	46
180970076	1	39.75889	-86.28972	IN	Marion	Indianapolis-Carmel, IN	9,171	602	1	1,525,104	1.71	1		12	3	35	0.0142	0.0254	0.0360	107	104	106.5	68	67
180970078	1	39.81110	-86.11447	IN	Marion	Indianapolis-Carmel, IN	14,196	1,175	1	1,525,104	0.02			11	2	33	0.0108	0.0251	0.0288	117	107	123	44	31
181010001	1	38.89028	-86.76083	IN	Martin		84	5			0.00			12	3	34	0.0272	0.0299	0.0358	76	95	109	179	178
181630006	2	37.97167	-87.56722	IN	Vanderburgh	Evansville, IN-KY	13,666	817	1	342,815	0.00			12	3	33	0.0065	0.0126	0.0286	134	133	124	47	50
260490021	4	43.04722	-83.67028	MI	Genesee	Flint, MI	9,889	994	1	436,141	0.00			12	3	36	0.0100	0.0153	0.0209	122	128	131	63	41
261130001	1	44.31056	-84.89194	MI	Missaukee	Cadillac, MI	58	3		44,962	0.00			12	3	33	0.0032	0.0056	0.0080	161	165	167	181	182
261630001	2	42.22861	-83.20833	MI	Wayne	Detroit-Warren-Livonia, MI	14,329	798	1	4,452,557	0.00			12	3	35	0.0087	0.0107	0.0124	127	139	148	43	52
261630005	1	42.26722	-83.13222	MI	Wayne	Detroit-Warren-Livonia, MI	11,314	923	1	4,452,557	0.22			11	2	34	0.0166	0.0259	0.0340	95	103	113	54	44
261630015	4	42.30278	-83.10667	MI	Wayne	Detroit-Warren-Livonia, MI	17,729	1,771	1	4,452,557	0.01			12	3	36	0.0178	0.0252	0.0299	91	106	121	24	11
261630019	1	42.43083	-83.00028	MI	Wayne	Detroit-Warren-Livonia, MI	28,362	2,628	1	4,452,557	0.00			12	3	34	0.0103	0.0138	0.0149	120	130	140	10	7

site	poc	lat	long	state	county_name	cbsa_name	population (mile radius)	under age 5 population (mile radius)	urban	cbsa_pop00	sum point/non-pt Pb EI TPY w/in 1 mile	source oriented?	prev. source oriented? (see end notes)	data completeness (complete periods) qtrs	years	months	3-year metrics annual mean	max quarterly mean	max monthly mean	metric and population ranks (of all Pb-TSP sites) annual mean	max quarterly mean	max monthly mean	pop. (M rad.)	under age 5 pop (M rad.)
261630027	1	42.29222	-83.10694	MI	Wayne	Detroit-Warren-Livonia, MI	6,024	516	1	4,452,557	1.10	1		5	1	14	0.0256	0.0267	0.0353	79	101	111	98	79
261630033	2	42.30667	-83.14889	MI	Wayne	Detroit-Warren-Livonia, MI	17,402	1,843	1	4,452,557	0.55			12	3	34	0.0236	0.0410	0.0601	80	77	82	25	9
270370001	1	44.83333	-93.11500	MN	Dakota	Minneapolis-St. Paul-Blooming	5,074	404	1	2,968,806	3.16	1		8	2	24	0.0781	0.1153	0.2300	42	49	47	106	100
270370020	1	44.76535	-93.03248	MN	Dakota	Minneapolis-St. Paul-Blooming	162	7		2,968,806	0.05			12	3	32	0.0051	0.0100	0.0200	144	142.5	132.5	175	176
270370421	1	44.77720	-93.04097	MN	Dakota	Minneapolis-St. Paul-Blooming	478	24		2,968,806	0.05			9	1	27	0.0037	0.0069	0.0120	158	155	150	161	164
270370423	1	44.77500	-93.06278	MN	Dakota	Minneapolis-St. Paul-Blooming	886	83		2,968,806	0.00			12	3	34	0.0018	0.0050	0.0100	173	167	160	157	152
270370442	1	44.74036	-93.00556	MN	Dakota	Minneapolis-St. Paul-Blooming	168	11		2,968,806	0.26			10	2	28	0.0027	0.0062	0.0080	165	163	169.5	171	169
270530050	1	45.00123	-93.26712	MN	Hennepin	Minneapolis-St. Paul-Blooming	16,318	923	1	2,968,806	0.01			12	3	35	0.0051	0.0093	0.0120	143	146	150	30	45
270530963	1	44.95540	-93.25827	MN	Hennepin	Minneapolis-St. Paul-Blooming	46,218	3,929	1	2,968,806	0.16			12	3	36	0.0039	0.0071	0.0100	156	152	160	4	4
270530964	1	44.88855	-93.19538	MN	Hennepin	Minneapolis-St. Paul-Blooming	209	0	1	2,968,806	0.00			4	1	14	0.0045	0.0114	0.0180	151	136	134	170	189
270530965	1	45.00448	-93.24005	MN	Hennepin	Minneapolis-St. Paul-Blooming	19,106	1,095	1	2,968,806	0.41			12	3	35	0.0039	0.0080	0.0140	155	150.5	144	21	35
270530966	1	44.98133	-93.26615	MN	Hennepin	Minneapolis-St. Paul-Blooming	17,156	439	1	2,968,806	0.05			12	3	35	0.0047	0.0080	0.0120	149	150.5	150	26	90
270530967	1	44.99646	-93.23488	MN	Hennepin	Minneapolis-St. Paul-Blooming	14,621	580	1	2,968,806	0.42	1		7	1	20	0.0075	0.0142	0.0225	130	129	129	40	69
270530968	1	44.89301	-93.23323	MN	Hennepin	Minneapolis-St. Paul-Blooming	11,243	789	1	2,968,806	0.00			6	1	18	0.0019	0.0033	0.0080	171	177	169.5	56	53
270531007	1	45.04182	-93.29873	MN	Hennepin	Minneapolis-St. Paul-Blooming	14,889	1,118	1	2,968,806	0.00			12	3	35	0.0026	0.0067	0.0080	166	158	169.5	34	33
271231003	1	44.96322	-93.19023	MN	Ramsey	Minneapolis-St. Paul-Blooming	9,247	474	1	2,968,806	0.07			12	3	33	0.0065	0.0129	0.0350	135	132	112	67	86
271377001	1	47.52336	-92.53631	MN	St. Louis	Duluth, MN-WI	8,942	428	1	275,486	0.09			12	3	33	0.0047	0.0362	0.0900	148	87	74	70	93
271377555	1	46.73264	-92.16337	MN	St. Louis	Duluth, MN-WI	4,527	287	1	275,486	0.02			12	3	34	0.0014	0.0031	0.0050	177	180	184	112	116
290930016	1	37.62528	-91.12917	MO	Iron		58	4			0.01	1		12	3	34	0.6918	1.3070	4.1933	4	5	2	182.5	180.5
290930021	1	37.65417	-91.13056	MO	Iron		58	4			0.00	1		12	3	36	0.5460	0.7187	0.9960	8	12	16	182.5	180.5
290930023	1	37.50333	-90.69556	MO	Iron		138	7			0.00	1	1 *#	6	1	18	0.2291	0.3433	0.6320	21	23	24.5	176.5	174.5
290930024	1	37.47972	-90.69028	MO	Iron		32	2			0.01	1	1 *#	6	1	18	0.5898	0.6677	1.6026	6	17	11	187	186
290930025	1	37.51056	-90.69750	MO	Iron		138	7			0.00	1	1 *#	5	1	14	0.2477	0.3263	0.6320	20	25	24.5	176.5	174.5
290930026	1	37.45917	-90.68639	MO	Iron		32	2			0.00	1	1 *#	5	1	15	0.2266	0.2523	0.3555	23	30	35	187	186
290930027	1	37.48611	-90.69000	MO	Iron		32	2			0.01	1	1 *	12	3	33	0.2678	0.8761	1.4414	15	10	13	187	186
290930029	1	37.47167	-90.68944	MO	Iron		32	2			0.01	1	1 *	12	3	32	0.2824	0.7148	1.4740	14	13	12	187	186
290930030	1	37.46639	-90.69000	MO	Iron		32	2			0.01	1	1 *#	6	1	18	0.1665	0.2017	0.3330	26	36	36	187	186
290990004	1	38.26330	-90.37850	MO	Jefferson	St. Louis, MO-IL	2,418	197	1	2,721,491	58.80	1		8	2	24	1.1300	1.4750	2.0731	3	4	7	130.5	128.5
290990005	3	38.26722	-90.37944	MO	Jefferson	St. Louis, MO-IL	2,418	197	1	2,721,491	58.80	1		12	3	36	0.3711	0.6779	1.0655	12	16	15	130.5	128.5
290990008	1	38.26194	-90.39417	MO	Jefferson	St. Louis, MO-IL	2,418	197		2,721,491	58.80	1		10	1	31	0.0910	0.1857	0.3700	40	38	32	130.5	128.5
290990009	1	38.28444	-90.38194	MO	Jefferson	St. Louis, MO-IL	9,804	820	1	2,721,491	0.00	1		11	2	31	0.0957	0.1664	0.1750	38	41	52	65	49
290990010	1	38.24110	-90.37680	MO	Jefferson	St. Louis, MO-IL	2,799	215	1	2,721,491	0.00	1		11	2	34	0.0388	0.0813	0.1680	59	58	54	126	124
290990011	1	38.26820	-90.37380	MO	Jefferson	St. Louis, MO-IL	2,418	197	1	2,721,491	58.80	1		12	3	36	0.4778	1.3047	2.2070	10	6	6	130.5	128.5
290990013	1	38.27361	-90.38000	MO	Jefferson	St. Louis, MO-IL	3,570	318	1	2,721,491	58.80	1		12	3	35	0.2633	0.8683	3.5680	16	11	3	119	112
290990015	1	38.26167	-90.37972	MO	Jefferson	St. Louis, MO-IL	1,988	178	1	2,721,491	58.80	1		12	3	36	1.4501	1.9277	3.2884	1	2	4	138	134
291892003	1	38.64972	-90.35056	MO	St. Louis	St. Louis, MO-IL	12,303	512	1	2,721,491	0.01			11	2	34	0.0063	0.0500	0.0500	136	75	87.5	52	81
295100085	6	38.65630	-90.19810	MO	St. Louis (City)	St. Louis, MO-IL	9,140	783	1	2,721,491	0.01			4	1	11	0.0134	0.0216	0.0290	110	116	122	69	54
340231003	1	40.47222	-74.47139	NJ	Middlesex	New York-Northern New Jerse	13,850	1,124	1	18,323,002	1.70	1		10	2	27	0.0403	0.1537	0.1878	56	42	51	45	32
360470122	1	40.71980	-73.94788	NY	Kings	New York-Northern New Jerse	92,660	5,785	1	18,323,002	0.07			9	2	22	0.0276	0.0333	0.0360	74	91	106.5	1	2
360632008	1	43.08216	-79.00099	NY	Niagara	Buffalo-Niagra Falls, NY Metro	6,795	386	1	1,170,111	0.03			4	1	12	0.0054	0.0060	0.0080	140	164	169.5	90	103
360713001	1	41.46107	-74.36343	NY	Orange	Poughkeepsie-Newburgh-Midd	1,481	99		621,517	1.80	1		9	2	26	0.0606	0.0820	0.1580	48	57	55.5	150	149
360713002	1	41.45887	-74.35392	NY	Orange	Poughkeepsie-Newburgh-Midd	1,257	86		621,517	1.80	1		9	2	26	0.1257	0.2417	0.4025	31	32	31	151	151
360713004	1	41.47633	-74.36827	NY	Orange	Poughkeepsie-Newburgh-Midd	6,816	434	1	621,517	0.00			9	2	26	0.0305	0.0386	0.0400	71	83	101	89	91
360850067	1	40.59733	-74.12619	NY	Richmond	New York-Northern New Jerse	21,834	1,373		18,323,002	0.00			4	1	11	0.0059	0.0082	0.0140	137	148	142.5	17	23
390170015	2	39.48990	-84.36407	OH	Butler	Cincinnati-Middletown, OH-KY-	4,668	373	1	2,009,632	0.00			8	2	24	0.0107	0.0248	0.0650	118	109	80	109	105
390290019	1	40.63111	-80.54694	OH	Columbiana	East Liverpool-Salem, OH	5,385	322	1	112,075	0.00			12	3	36	0.0144	0.0253	0.0300	103	105	120	104	111
390290020	1	40.63972	-80.52389	OH	Columbiana	East Liverpool-Salem, OH	6,414	354	1	112,075	0.00			12	3	36	0.0158	0.0247	0.0310	97	110	118	94	108
390290022	1	40.63500	-80.54667	OH	Columbiana	East Liverpool-Salem, OH	3,318	202	1	112,075	0.00			12	3	36	0.0139	0.0367	0.0800	108	86	77.5	123	126
390350038	1	41.47694	-81.68194	OH	Cuyahoga	Cleveland-Elyria-Mentor, OH	7,329	585	1	2,148,143	0.06			12	3	36	0.0205	0.0300	0.0600	85	94	83.5	85	68
390350042	1	41.48222	-81.70889	OH	Cuyahoga	Cleveland-Elyria-Mentor, OH	18,776	1,575	1	2,148,143	0.00			11	2	35	0.0169	0.0280	0.0430	94	97	95	23	20
390350049	1	41.44667	-81.65111	OH	Cuyahoga	Cleveland-Elyria-Mentor, OH	9,720	758	1	2,148,143	0.04	1	1	12	3	36	0.1214	0.2367	0.4500	33	33	30	66	57
390350050	1	41.44250	-81.64917	OH	Cuyahoga	Cleveland-Elyria-Mentor, OH	8,771	695	1	2,148,143	0.04	1	1	12	3	36	0.0362	0.0550	0.1000	64	74	68	71	59
390350061	2	41.47506	-81.67596	OH	Cuyahoga	Cleveland-Elyria-Mentor, OH	6,141	444	1	2,148,143	0.33	1	1	12	3	36	0.0477	0.3600	0.5600	51	21	27	96	89
390350069	1	41.51918	-81.63794	OH	Cuyahoga	Cleveland-Elyria-Mentor, OH	23,566	1,961	1	2,148,143	0.09			6	1	35	0.0170	0.0233	0.0470	93	112	91	14	8
390490025	1	39.92806	-82.98111	OH	Franklin	Columbus, OH	15,220	1,226	1	1,612,694	0.62	1		12	3	36	0.0114	0.0197	0.0270	114	119	126	33	28
390510001	1	41.57528	-83.99639	OH	Fulton	Toledo, OH	1,503	110	1	659,188	0.34	1		11	2	36	0.1332	0.2667	0.6100	29	28.5	26	148	145
390910003	1	40.34306	-83.75500	OH	Logan	Bellefontaine, OH	1,536	108	1	46,005	0.12			12	3	36	0.0922	0.1467	0.2700	39	44	42	147	146
390910005	1	40.34278	-83.76028	OH	Logan	Bellefontaine, OH	1,546	126	1	46,005	0.12	1		12	3	36	0.1058	0.1467	0.2200	35	45	48	146	136
390910006	1	40.34111	-83.75778	OH	Logan	Bellefontaine, OH	1,217	87	1	46,005	0.12	1		12	3	36	0.1578	0.2667	0.3600	27	28.5	33	152	150
390910007	1	40.34472	-83.75444	OH	Logan	Bellefontaine, OH	2,156	185	1	46,005	0.12			12	3	36	0.1497	0.2200	0.2600	28	34	43	133	132
391670008	1	39.43361	-81.50250	OH	Washington	Parkersburg-Marietta, WV-OH	1,947	114		164,624	0.00			12	3	36	0.0054	0.0100	0.0130	139	142.5	145	139	144
391670009	1	39.37696	-81.53730	OH	Washington	Parkersburg-Marietta, WV-OH	314	21		164,624	0.00			5	1	14	0.0073	0.0495	0.0880	131	76	76	168	168
401159005	2	36.98580	-94.84920	OK	Ottawa	Miami, OK	1,573	117		33,194	0.00			4	1	11	0.0412	0.0613	0.0927	54	69	71	143.5	139.5
401159006	1	36.98460	-94.82490	OK	Ottawa	Miami, OK	1,573	117		33,194	0.00			4	1	11	0.0316	0.0378	0.0623	67	84	81	143.5	139.5
401159007	1	36.97190	-94.85180	OK	Ottawa	Miami, OK	1,573	117		33,194	0.00			4	1	11	0.0505	0.1030	0.1257	50	50	60	143.5	139.5

site	poc	lat	long	state	county_name	cbsa_name	population (mile radius)	under age 5 population (mile radius)	urban	cbsa_pop00	sum point/non-pt Pb EI TPY w/in 1 mile	source oriented?	prev. source oriented? (see end notes)	data completeness (complete periods): qtrs	data completeness (complete periods): years	data completeness (complete periods): months	3-year metrics: annual mean	3-year metrics: max quarterly mean	3-year metrics: max monthly mean	metric and population ranks (of all Pb-TSP sites): annual mean	ranks: max quarterly mean	ranks: max monthly mean	ranks: pop. (M rad.)	ranks: under age 5 pop (M rad.)
401159008	1	36.97160	-94.82500	OK	Ottawa	Miami, OK	1,573	117		33,194	0.00			4	1	11	0.0312	0.0408	0.0708	69	78	79	143.5	139.5
410510246	7	45.56130	-122.67878	OR	Multnomah	Portland-Vancouver-Beaverton	24,303	1,771	1	1,927,881	0.00			4	1	11	0.0081	0.0101	0.0110	129	140	154	11	10
420030002	1	40.50056	-80.07194	PA	Allegheny	Pittsburgh, PA	19,559	1,045	1	2,431,087	0.02			12	3	30	0.0096	0.0378	0.0503	125	85	86	19	38
420032001	1	40.39667	-79.86361	PA	Allegheny	Pittsburgh, PA	10,120	769	1	2,431,087	0.20			12	3	35	0.0396	0.0567	0.1140	57	73	62	62	55
420070505	1	40.68500	-80.32500	PA	Beaver	Pittsburgh, PA	6,497	218	1	2,431,087	0.01			11	2	31	0.0563	0.1531	0.2300	49	43	46	92	123
420110005	1	40.46630	-75.75890	PA	Berks	Reading, PA	692	44		373,638	4.81	1		11	2	33	0.0618	0.0940	0.1580	46	54	55.5	159	159
420110717	1	40.47667	-75.75917	PA	Berks	Reading, PA	575	39	1	373,638	4.81	1		11	2	30	0.1301	0.1800	0.2820	30	39	41	160	160
420111717	1	40.37722	-75.91444	PA	Berks	Reading, PA	7,376	390	1	373,638	2.11	1		12	3	33	0.2570	0.3967	0.8020	18	20	20	84	101
420210808	1	40.34806	-78.88278	PA	Cambria	Johnstown, PA	2,606	115	1	152,598	0.01			12	3	36	0.0383	0.0569	0.0920	60	72	72	127	143
420250105	1	40.80306	-75.60833	PA	Carbon	Allentown-Bethlehem-Easton,	8,477	513	1	740,395	0.00			11	2	33	0.0779	0.2493	0.3560	43	31	34	74	80
420450002	1	39.83556	-75.37250	PA	Delaware	Philadelphia-Camden-Wilmingt	10,156	859	1	5,687,147	0.02			12	3	35	0.0372	0.0400	0.0400	61	80.5	101	61	47
421010449	1	39.98250	-75.08306	PA	Philadelphia	Philadelphia-Camden-Wilmingt	8,653	413	1	5,687,147	0.01	1	1	12	3	31	0.0203	0.0350	0.0380	86	89	104	72	98
421290007	1	40.16667	-79.87500	PA	Westmoreland	Pittsburgh, PA	7,739	445	1	2,431,087	0.01			12	3	36	0.0352	0.0400	0.0400	65	80.5	101	82	88
450031001	1	33.43253	-81.89233	SC	Aiken	Augusta-Richmond County, GA	437	24		499,684	0.00			4	1	12	0.0000	0.0000	0.0000	189	189	189	164	165
450130007	1	32.43654	-80.67785	SC	Beaufort	Hilton Head Island-Beaufort, S	4,928	330	1	141,615	0.00			12	3	34	0.0006	0.0022	0.0070	183	183	173	108	110
450190003	2	32.88394	-79.97754	SC	Charleston	Charleston-North Charleston, S	4,401	275	1	549,033	0.01			12	3	34	0.0014	0.0041	0.0104	176	171	157	115	117
450190046	1	32.94275	-79.65718	SC	Charleston	Charleston-North Charleston, S	63	4		549,033	0.00			12	3	33	0.0005	0.0032	0.0068	184	179	174	180	179
450190047	1	32.84461	-79.94804	SC	Charleston	Charleston-North Charleston, S	7,000	294	1	549,033	0.00			4	1	12	0.0022	0.0037	0.0058	169	174	179	88	114
450410001	1	34.19794	-79.79885	SC	Florence	Florence, SC	3,426	224	1	193,155	0.00			4	1	13	0.0010	0.0026	0.0063	180	182	176	122	121
450410002	1	34.16764	-79.85040	SC	Florence	Florence, SC	1,795	106	1	193,155	0.00			8	2	24	0.0011	0.0034	0.0102	179	176	158	140	147
450430006	1	33.36378	-79.29426	SC	Georgetown	Georgetown, SC	5,247	427	1	55,797	0.29	1		11	2	32	0.0072	0.0166	0.0420	132	125	97	105	94
450430007	1	33.34973	-79.29821	SC	Georgetown	Georgetown, SC	1,579	119		55,797	0.29			12	3	35	0.0002	0.0017	0.0054	186	185	180	141	137
450430009	1	33.37399	-79.28570	SC	Georgetown	Georgetown, SC	2,447	185	1	55,797	0.29			12	3	35	0.0038	0.0081	0.0158	157	149	138	128	131
450430010	1	33.36960	-79.29840	SC	Georgetown	Georgetown, SC	6,173	511	1	55,797	0.29			12	3	33	0.0049	0.0169	0.0265	145	124	127	95	82
450450008	2	34.84045	-82.40291	SC	Greenville	Greenville, SC	7,967	381	1	559,940	0.00			12	3	34	0.0023	0.0071	0.0125	168	154	146.5	78	104
450452002	1	34.94165	-82.22961	SC	Greenville	Greenville, SC	7,266	494	1	559,940	0.00			12	3	32	0.0001	0.0006	0.0018	187	188	188	86	83
450470001	1	34.18111	-82.15224	SC	Greenwood	Greenwood, SC	7,853	667	1	66,271	0.03			12	3	32	0.0028	0.0063	0.0112	163	160	152	80	61
450470002	1	34.16520	-82.16048	SC	Greenwood	Greenwood, SC	1,490	116		66,271	0.02			12	3	31	0.0071	0.0163	0.0320	133	126.5	115.5	149	142
450510002	2	33.70460	-78.87745	SC	Horry	Myrtle Beach-Conway-North M	4,510	227	1	196,629	0.00			12	3	35	0.0009	0.0020	0.0053	181	184	181	113	120
450630005	2	33.78560	-81.11978	SC	Lexington	Columbia, SC	736	66		647,158	0.00			4	1	12	0.0018	0.0033	0.0052	174	178	182	158	154
450631002	2	33.96900	-81.06533	SC	Lexington	Columbia, SC	8,086	551	1	647,158	0.00			12	3	32	0.0046	0.0179	0.0356	150	122.5	110	76	76
450790006	4	34.00740	-81.02329	SC	Richland	Columbia, SC	17,143	574	1	647,158	0.01			4	1	12	0.0030	0.0069	0.0090	162	156	163.5	27	71
450790007	2	34.09584	-80.96230	SC	Richland	Columbia, SC	4,405	233	1	647,158	0.00			12	3	36	0.0004	0.0014	0.0042	185	186	186	114	119
450790019	1	33.99330	-81.02414	SC	Richland	Columbia, SC	15,569	287	1	647,158	0.00			12	3	35	0.0048	0.0097	0.0144	147	145	141	32	115
450790021	1	33.81655	-80.78114	SC	Richland	Columbia, SC	123	10		647,158	0.00			12	3	35	0.0001	0.0012	0.0038	188	187	187	178	170
450830001	2	34.94774	-81.93255	SC	Spartanburg	Spartanburg, SC	7,505	552	1	253,791	0.00			12	3	34	0.0018	0.0035	0.0062	172	175	177	83	74
450850001	1	33.92423	-80.33774	SC	Sumter	Sumter, SC	4,990	407	1	104,646	0.00			12	3	35	0.0025	0.0064	0.0108	167	159	155	107	99
450910005	1	34.96303	-81.00085	SC	York	Charlotte-Gastonia-Concord, N	3,453	221	1	1,330,448	0.00			11	2	27	0.0021	0.0042	0.0082	170	169	165	121	122
470930027	1	35.98306	-83.95222	TN	Knox	Knoxville, TN	8,586	826	1	616,079	5.76	1		9	1	26	0.0182	0.0233	0.0400	90	111	101	73	48
470931017	1	35.97500	-83.95444	TN	Knox	Knoxville, TN	7,817	763	1	616,079	5.76	1		9	1	26	0.0143	0.0193	0.0375	104	120	105	81	56
471570044	1	35.08750	-90.07250	TN	Shelby	Memphis, TN-MS-AR	6,730	548	1	1,205,204	0.00	1	1	6	1	17	0.0100	0.0100	0.0100	121	142.5	160	91	77
471633001	1	36.52556	-82.27333	TN	Sullivan	Kingsport-Bristol-Bristol, TN-VA	942	65		298,484	0.37	1		12	3	35	0.1249	0.1959	0.2843	32	37	40	155	156
471633002	3	36.52472	-82.26806	TN	Sullivan	Kingsport-Bristol-Bristol, TN-VA	942	65		298,484	0.37	1		12	3	36	0.0614	0.1463	0.2920	47	46	39	155	156
471633003	1	36.52806	-82.26833	TN	Sullivan	Kingsport-Bristol-Bristol, TN-VA	942	65		298,484	0.37	1		12	3	35	0.0651	0.1259	0.2322	45	48	45	155	156
471870100	2	35.80222	-86.66028	TN	Williamson	Nashville-Davidson--Murfreesb	165	10		1,311,789	2.55	1		8	2	23	0.2527	0.9867	1.9120	19	8	8	173	172
471870102	2	35.80222	-86.66028	TN	Williamson	Nashville-Davidson--Murfreesb	165	10		1,311,789	2.55	1		8	2	23	0.2575	0.6953	0.9460	17	15	18	173	172
471871101	1	35.79944	-86.66500	TN	Williamson	Nashville-Davidson--Murfreesb	165	10		1,311,789	2.55	1		8	2	24	0.0811	0.3027	0.7020	41	26	23	173	172
480610006	1	25.89251	-97.49382	TX	Cameron	Brownsville-Harlingen, TX	14,803	1,422	1	335,227	0.00			12	3	35	0.0053	0.0085	0.0090	141	147	163.5	38	22
480850003	1	33.14250	-96.82472	TX	Collin	Dallas-Fort Worth-Arlington, TX	3,837	415		5,161,544	3.18	1		12	3	35	0.2271	0.3453	0.7954	22	22	21	117	96
480850007	2	33.14722	-96.82556	TX	Collin	Dallas-Fort Worth-Arlington, TX	3,837	415		5,161,544	3.18	1		12	3	34	0.1186	0.2111	0.4760	34	35	29	117	96
480850009	1	33.14472	-96.82889	TX	Collin	Dallas-Fort Worth-Arlington, TX	3,837	415		5,161,544	3.18	1		12	3	33	0.4961	0.6982	0.9692	9	14	17	117	96
481130018	1	32.74556	-96.78250	TX	Dallas	Dallas-Fort Worth-Arlington, TX	6,451	491	1	5,161,544	0.00			12	3	34	0.0274	0.0804	0.2338	75	59	44	93	84
481130057	2	32.77890	-96.87306	TX	Dallas	Dallas-Fort Worth-Arlington, TX	4,591	578	1	5,161,544	0.00			12	3	35	0.0362	0.0611	0.1029	63	70	65	110	70
481130066	2	32.73972	-96.78278	TX	Dallas	Dallas-Fort Worth-Arlington, TX	8,270	622	1	5,161,544	0.00	1	1	7	1	20	0.0090	0.0209	0.0420	126	118	96	75	63
481410033	1	31.77694	-106.50167	TX	El Paso	El Paso, TX	13,680	1,005	1	679,622	0.00			6	1	17	0.0120	0.0585	0.0600	113	71	83.5	46	40
482011034	4	29.76799	-95.22058	TX	Harris	Houston-Sugar Land-Baytown,	14,785	1,770	1	4,715,407	0.00			12	3	36	0.0081	0.0220	0.0478	128	115	90	39	12
484790016	1	27.51083	-99.51972	TX	Webb	Laredo, TX	14,880	1,441	1	193,117	0.01			12	3	36	0.0121	0.0163	0.0230	112	126.5	128	35	21
490351001	1	40.70861	-112.09472	UT	Salt Lake	Salt Lake City, UT	215	23	1	968,858	0.00			11	2	32	0.0421	0.0762	0.1188	53	62	61	169	166
721270003	1	18.44917	-66.05306	PR	San Juan	San Juan-Caguas-Guaynabo,	319	5	1	2,509,007				12	3	36	0.0014	0.0100	0.0125	178	142.5	146.5	167	177

* These sites were classified as "previous" source-oriented but because production (and related lead emissions) at the associated source was not terminated until December, 2003, only data for 2004-2005 were considered for the "previous" source oriented characterization.

\# Data for 2004-2005 did not meet completeness criteria..

All sites

	n	min	pct5	pct10	pct15	pct20	pct25	pct30	pct35	pct40	pct45	median	mean	pct55	pct60	pct65	pct70	pct75	pct80	pct85	pct90	pct95	max
annual mean	189	0.0000	0.0010	0.0019	0.0032	0.0042	0.0052	0.0071	0.0097	0.0114	0.0143	0.0166	0.0856	0.0203	0.0272	0.0316	0.0396	0.0606	0.0957	0.1332	0.2527	0.4778	1.4501
max quarter mean	189	0.0000	0.0031	0.0041	0.0063	0.0071	0.0100	0.0126	0.0179	0.0224	0.0254	0.0299	0.1705	0.0367	0.0495	0.0627	0.0820	0.1259	0.1857	0.2667	0.4657	0.8761	3.4750
max monthly mean	189	0.0000	0.0054	0.0080	0.0100	0.0112	0.0140	0.0200	0.0288	0.0320	0.0380	0.0430	0.3015	0.0503	0.0880	0.1000	0.1460	0.2200	0.2955	0.4760	0.9100	1.6900	4.5582

Source-oriented sites

	n	min	pct5	pct10	pct15	pct20	pct25	pct30	pct35	pct40	pct45	median	mean	pct55	pct60	pct65	pct70	pct75	pct80	pct85	pct90	pct95	max
annual mean	60	0.0072	0.0095	0.0142	0.0229	0.0375	0.0440	0.0616	0.0775	0.0933	0.1122	0.1253	0.2348	0.1455	0.1815	0.2281	0.2549	0.2655	0.3327	0.4869	0.5866	0.9109	1.4501
max quarter mean	60	0.0100	0.0180	0.0221	0.0309	0.0731	0.0880	0.1206	0.1502	0.1829	0.2064	0.2470	0.4678	0.2800	0.3272	0.3526	0.5107	0.6866	0.7167	0.8930	1.2823	1.6992	3.4750
max monthly mean	60	0.0100	0.0311	0.0378	0.0420	0.1000	0.1580	0.1814	0.2311	0.2881	0.3577	0.4263	0.8369	0.5200	0.6320	0.7663	0.9280	1.0307	1.4577	1.7150	2.1401	3.4282	4.5582

Not source-oriented sites

	n	min	pct5	pct10	pct15	pct20	pct25	pct30	pct35	pct40	pct45	median	mean	pct55	pct60	pct65	pct70	pct75	pct80	pct85	pct90	pct95	max
annual mean	129	0.0000	0.0006	0.0014	0.0021	0.0028	0.0038	0.0045	0.0051	0.0057	0.0081	0.0100	0.0162	0.0113	0.0142	0.0153	0.0175	0.0214	0.0272	0.0308	0.0372	0.0433	0.1497
max quarter mean	129	0.0000	0.0022	0.0033	0.0042	0.0060	0.0067	0.0080	0.0100	0.0114	0.0138	0.0179	0.0322	0.0229	0.0253	0.0280	0.0343	0.0386	0.0495	0.0613	0.0773	0.1030	0.2493
max monthly mean	129	0.0000	0.0051	0.0062	0.0080	0.0090	0.0105	0.0120	0.0140	0.0160	0.0220	0.0290	0.0525	0.0320	0.0360	0.0404	0.0480	0.0600	0.0880	0.1000	0.1387	0.2300	0.3560

Previous source-oriented sites

	n	min	pct5	pct10	pct15	pct20	pct25	pct30	pct35	pct40	pct45	median	mean	pct55	pct60	pct65	pct70	pct75	pct80	pct85	pct90	pct95	max
annual mean	20	0.0090	0.0095	0.0107	0.0158	0.0282	0.0375	0.0432	0.0717	0.0978	0.1107	0.1440	0.2265	0.1966	0.2279	0.2384	0.2578	0.2751	0.2884	0.4202	0.5679	0.8899	1.1901
max quarter mean	20	0.0100	0.0148	0.0203	0.0280	0.0450	0.0682	0.0907	0.1332	0.1840	0.2192	0.2445	0.4563	0.2893	0.3348	0.3517	0.4128	0.5667	0.6913	0.7167	0.7974	2.1755	3.4750
max monthly mean	20	0.0100	0.0185	0.0325	0.0400	0.0710	0.1000	0.1340	0.1715	0.2540	0.3442	0.4027	0.7216	0.5050	0.5960	0.6320	0.6846	0.8666	1.2187	1.4577	1.5383	3.0804	4.5582

Urban sites

	n	min	pct5	pct10	pct15	pct20	pct25	pct30	pct35	pct40	pct45	median	mean	pct55	pct60	pct65	pct70	pct75	pct80	pct85	pct90	pct95	max
annual mean	140	0.0001	0.0012	0.0021	0.0032	0.0045	0.0052	0.0074	0.0097	0.0112	0.0138	0.0149	0.0594	0.0168	0.0187	0.0230	0.0304	0.0365	0.0404	0.0780	0.1200	0.2601	1.4501
max quarter mean	140	0.0006	0.0032	0.0042	0.0067	0.0080	0.0104	0.0131	0.0174	0.0214	0.0247	0.0260	0.1100	0.0300	0.0364	0.0405	0.0612	0.0766	0.0979	0.1534	0.2430	0.4312	1.9277
max monthly mean	140	0.0018	0.0062	0.0081	0.0103	0.0120	0.0149	0.0204	0.0287	0.0315	0.0360	0.0400	0.1958	0.0440	0.0502	0.0800	0.1000	0.1164	0.1814	0.2469	0.4050	0.8560	3.5680

Urban sites, located in MSA's >= 1 million population

	n	min	pct5	pct10	pct15	pct20	pct25	pct30	pct35	pct40	pct45	median	mean	pct55	pct60	pct65	pct70	pct75	pct80	pct85	pct90	pct95	max
annual mean	91	0.0006	0.0026	0.0042	0.0051	0.0075	0.0090	0.0103	0.0113	0.0142	0.0150	0.0178	0.0711	0.0205	0.0225	0.0276	0.0315	0.0368	0.0396	0.0563	0.1000	0.3711	1.4501
max quarter mean	91	0.0033	0.0060	0.0071	0.0100	0.0114	0.0133	0.0197	0.0220	0.0252	0.0267	0.0300	0.1343 *	0.0353	0.0400	0.0567	0.0667	0.0773	0.0957	0.1537	0.2367	0.8683 *	1.9277
max monthly mean	91	0.0067	0.0082	0.0110	0.0124	0.0160	0.0200	0.0290	0.0340	0.0360	0.0400	0.0440	0.2442	0.0500	0.0601	0.0960	0.1029	0.1460	0.1878	0.2338	0.4760	1.7400	3.5680

Urban sites, located in CBSA's < 1 million population

	n	min	pct5	pct10	pct15	pct20	pct25	pct30	pct35	pct40	pct45	median	mean	pct55	pct60	pct65	pct70	pct75	pct80	pct85	pct90	pct95	max
annual mean	49	0.0001	0.0006	0.0010	0.0014	0.0018	0.0025	0.0030	0.0046	0.0048	0.0065	0.0100	0.0378	0.0121	0.0143	0.0156	0.0175	0.0305	0.0779	0.1000	0.1332	0.1578	0.2944
max quarter mean	49	0.0006	0.0020	0.0026	0.0034	0.0037	0.0063	0.0069	0.0085	0.0126	0.0166	0.0179	0.0649	0.0224	0.0248	0.0279	0.0386	0.0585	0.1000	0.1467	0.2493	0.2667	0.4657
max monthly mean	49	0.0018	0.0048	0.0053	0.0063	0.0072	0.0102	0.0108	0.0144	0.0209	0.0286	0.0310	0.1060	0.0320	0.0400	0.0404	0.0800	0.0920	0.1387	0.2600	0.3560	0.6100	0.8020

* These values rounded to 0.14 and 0.87 µg/m^3, respectively, in a preliminary analysis based on 92 sites in this subset. Subsequent QA led to a change in the data set and in the value for the first statistical metric.

All sites

	Annual mean	Maximum quarterly mean	Maximum monthly mean
Annual mean	1.00	0.92	0.87
Maximum quarterly mean		1.00	093
Maximum monthly mean			1.00

Urban sites

	Annual mean	Maximum quarterly mean	Maximum monthly mean
Annual mean	1.00	0.95	0.83
Maximum quarterly mean		1.00	0.93
Maximum monthly mean			1.00

Source-oriented sites

	Annual mean	Maximum quarterly mean	Maximum monthly mean
Annual mean	1.00	0.89	0.82
Maximum quarterly mean		1.00	0.91
Maximum monthly mean			1.00

Urban sites located in MSA ≥ 1M population

	Annual mean	Maximum quarterly mean	Maximum monthly mean
Annual mean	1.00	0.95	0.83
Maximum quarterly mean		1.00	0.93
Maximum monthly mean			1.00

TSP Category	Ratio	n	min	pct5	pct10	pct15	pct20	pct25	pct30	pct35	pct40	pct45	median	mean	pct55	pct60	pct65	pct70	pct75	pct80	pct85	pct90	pct95	max
All sites	ratio of max quarterly mean to annual mean	189	1.0000	1.1135	1.2080	1.2852	1.3433	1.3848	1.4837	1.5299	1.6157	1.7256	1.7970	2.3614	1.8916	2.0053	2.1595	2.3170	2.5890	2.7976	3.2023	3.9233	5.9868	12.0000
	ratio of max monthly mean to annual mean		1.0000	1.3553	1.5556	1.8176	1.9537	2.1483	2.3056	2.4173	2.5481	2.6417	2.8558	4.4247	2.9726	3.5128	4.0128	4.4273	4.9871	5.7675	6.5038	8.5462	11.8424	39.0000
Source-oriented sites	ratio of max quarterly mean to annual mean	60	1.0000	1.0787	1.2484	1.3167	1.3529	1.3966	1.5077	1.5205	1.5749	1.7261	1.7773	2.0702	1.8582	1.9280	2.0220	2.2286	2.3849	2.6159	2.8588	3.2865	3.8592	7.5516
	ratio of max monthly mean to annual mean		1.0000	1.4735	1.8318	1.9768	2.1856	2.2786	2.4255	2.5440	2.6154	2.7606	2.9639	3.7763	3.1613	3.5393	3.7682	4.0401	4.5092	4.6536	5.3012	6.2826	10.2029	13.5518
Non-source-oriented sites	ratio of max quarterly mean to annual mean	149	1.0000	1.1368	1.2034	1.2648	1.3095	1.3826	1.4753	1.5591	1.6332	1.7079	1.8151	2.4980	1.9665	2.0293	2.2498	2.4153	2.6899	2.9390	3.4555	4.1647	7.3577	12.0000
	ratio of max monthly mean to annual mean		1.0000	1.3140	1.4769	1.6578	1.8680	2.0164	2.2496	2.3671	2.5200	2.5851	2.7967	4.7287	2.9508	3.4823	4.0858	4.5723	5.5927	6.3223	7.6473	9.1396	12.1935	39.0000
Previous source-oriented sites	ratio of max quarterly mean to annual mean	9	1.0000	1.0000	1.0567	1.1228	1.1718	1.2639	1.3167	1.4079	1.5090	1.5505	1.6536	2.0260	1.7261	1.7327	1.8440	2.0234	2.2073	2.4242	2.7257	3.0956	5.4114	7.5516
	ratio of max monthly mean to annual mean		1.0000	1.0000	1.2843	1.6963	1.8265	1.8518	1.9373	2.1845	2.4362	2.5272	2.6341	3.2812	2.7379	2.7606	3.2344	3.7682	4.0814	4.4902	4.9340	5.3012	8.5646	11.7469
Urban sites	ratio of max quarterly mean to annual mean	140	1.0000	1.0000	1.0000	1.0000	1.0000	1.2844	1.2844	1.4769	1.4769	1.4961	1.4961	2.1334	1.4961	1.7310	1.7310	1.7620	1.7620	1.9586	1.9586	7.4913	7.4913	7.4913
	ratio of max monthly mean to annual mean		1.0000	1.0000	1.0000	1.0000	1.0000	1.7515	1.7515	1.8793	1.8793	2.7692	2.7692	3.2977	2.7692	2.7863	2.7863	3.1159	3.1159	3.7241	3.7241	11.6532	11.6532	11.6532
Urban sites in CBSAs ≥ 1M population	ratio of max quarterly mean to annual mean	91	1.0000	1.1077	1.2080	1.2745	1.3095	1.3759	1.4753	1.5167	1.6157	1.6829	1.7366	2.3159 *	1.7900	1.8451	2.0496	2.3164	2.4317	2.7033	3.0063	3.8141	7.3577 *	12.0000
	ratio of max monthly mean to annual mean		1.0000	1.3046	1.4769	1.6578	1.8346	1.9910	2.2676	2.3690	2.5370	2.5619	2.6726	4.0747 *	2.8714	2.9508	3.5868	4.0253	4.6478	5.6357	6.4892	8.0000	9.3770	36.0000
Urban sites in CBSAs < 1M population	ratio of max quarterly mean to annual mean	49	1.0000	1.2648	1.3522	1.3838	1.4152	1.5299	1.5608	1.6127	1.6901	1.9505	2.0025	2.3597	2.0091	2.1715	2.2498	2.6223	2.7241	3.1395	3.4555	3.9762	4.8718	7.6772
	ratio of max monthly mean to annual mean		1.0000	1.4392	1.7365	1.9615	2.0898	2.2033	2.3056	2.5035	2.6417	2.9528	3.1207	4.5456	3.5286	4.4055	4.5723	5.0000	5.5497	5.8680	7.3340	9.3326	12.1935	19.1113

* These values rounded to 2.5, 7.6, and 4.0 µg/m^3, respectively, in a preliminary analysis based on 92 sites in this subset. Subsequent QA led to a change in the data set and the statistical metric values.

													data completeness (complete periods)			3-year metrics			metric and population ranks (of all Pb-PM_{10} sites)				
site	poc	lat	long	state	county_name	cbsa_name	population (mile radius)	under age 5 population (mile radius)	urban	cbsa_pop00	sum point/nonpt Pb EI TPY w/in 1 mile	source oriented?	qtrs	years	months	annual mean	max quarterly mean	max monthly mean	annual mean	max quarterly mean	max monthly mean	pop. (M rad.)	under age 5 pop (M rad.)
080770017	1	39.06363	-108.56102	CO	Mesa	Grand Junction, CO	11,955	783	1	116,255	0.001		4	1	13	0.0049	0.0056	0.0085	22	24	24	15	14
110010043	1	38.91889	-77.01250	DC	District of Columbi	Washington-Arlington-Alexandr	42,772	2,494	1	4,796,183	0.006		7	1	20	0.0052	0.0085	0.0097	20	20	22	2	3
120571065	5	27.89222	-82.53861	FL	Hillsborough	Tampa-St. Petersburg-Clearwa	14,463	612	1	2,395,997	0.000		8	2	23	0.0062	0.0207	0.0469	13	6	4	12	17
120573002	5	27.96565	-82.23040	FL	Hillsborough	Tampa-St. Petersburg-Clearwa	1,163	94		2,395,997	0.000		8	2	24	0.0035	0.0048	0.0075	25	26	26	24	24
121030018	5	27.78556	-82.74000	FL	Pinellas	Tampa-St. Petersburg-Clearwa	11,289	571	1	2,395,997	0.002		4	1	12	0.0022	0.0030	0.0047	29	29	28	18	18
121030026	5	27.85004	-82.71459	FL	Pinellas	Tampa-St. Petersburg-Clearwa	14,792	950	1	2,395,997	0.002		6	1	17	0.0023	0.0034	0.0045	28	28	29	11	11
130890002	1	33.68750	-84.29028	GA	DeKalb	Atlanta-Sandy Springs-Marietta	3,554	210	1	4,247,981	0.002		12	3	34	0.0026	0.0046	0.0106	27	27	21	23	23
170314201	6	42.14000	-87.79917	IL	Cook	Chicago-Naperville-Joliet, IL-IN	6,070	303	1	9,098,316	0.000		4	1	12	0.0060	0.0076	0.0094	14	22	23	22	22
211930003	1	37.28306	-83.22028	KY	Perry		731	37			0.000		12	3	34	0.0040	0.0066	0.0078	24	23	25	25	25
250250042	6	42.32944	-71.08278	MA	Suffolk	Boston-Cambridge-Quincy, MA	59,254	3,235	1	4,391,344	0.006		6	1	22	0.0049	0.0085	0.0151	23	18	12	1	1
261630033	1	42.30667	-83.14889	MI	Wayne	Detroit-Warren-Livonia, MI	17,402	1,843	1	4,452,557	0.548		12	3	35	0.0212	0.0390	0.0667	1	2	2	9	4
295100085	6	38.65630	-90.19810	MO	St. Louis (City)	St. Louis, MO-IL	9,140	783	1	2,721,491	0.011		10	2	30	0.0127	0.0170	0.0256	3	7	7	19	13
360850106	1	40.57811	-74.18430	NY	Richmond	New York-Northern New Jerse	37	5		18,323,002	0.005		4	1	11	0.0071	0.0117	0.0150	10	10	13	30	29
360850111	1	40.57997	-74.19872	NY	Richmond	New York-Northern New Jerse	189	18		18,323,002	0.005		4	1	11	0.0074	0.0123	0.0160	9	9	11	27	26
360850131	1	40.58806	-74.16882	NY	Richmond	New York-Northern New Jerse	15,295	895		18,323,002	0.004		4	1	10	0.0069	0.0115	0.0120	11	11	18	10	12
360850132	1	40.58061	-74.15158	NY	Richmond	New York-Northern New Jerse	18,213	1,054		18,323,002	0.004		4	1	11	0.0095	0.0223	0.0300	7	4	6	7	10
410510030	7	45.49742	-122.67467	OR	Multnomah	Portland-Vancouver-Beaverton	11,525	323	1	1,927,881	0.002		4	1	11	0.0056	0.0104	0.0123	17	15	17	17	21
410510080	7	45.49667	-122.60222	OR	Multnomah	Portland-Vancouver-Beaverton	23,978	1,464	1	1,927,881	0.001		7	1	22	0.0055	0.0088	0.0144	19	17	15	5	7
410510244	8	45.53500	-122.69889	OR	Multnomah	Portland-Vancouver-Beaverton	17,548	415	1	1,927,881	0.020		7	1	21	0.0063	0.0098	0.0190	12	16	10	8	20
410510246	7	45.56130	-122.67878	OR	Multnomah	Portland-Vancouver-Beaverton	24,303	1,771	1	1,927,881	0.001		8	2	23	0.0097	0.0273	0.0608	6	3	3	4	5
410610119	7	45.33897	-117.90480	OR	Union	La Grande, OR	41	3		24,530	0.000		7	1	20	0.0018	0.0027	0.0030	30	30	30	29	30
440070022	1	41.80795	-71.41500	RI	Providence	Providence-New Bedford-Fall R	35,343	3,116	1	1,582,997	0.005		12	3	36	0.0098	0.0547	0.1529	5	1	1	3	2
450250001	2	34.61712	-80.19879	SC	Chesterfield		165	14			0.000		8	2	20	0.0029	0.0049	0.0071	26	25	27	28	28
481390017	1	32.47361	-97.04250	TX	Ellis	Dallas-Fort Worth-Arlington, TX	239	17		5,161,544	0.000		6	1	17	0.0151	0.0211	0.0370	2	5	5	26	27
481410041	1	31.76054	-106.50045	TX	El Paso	El Paso, TX	18,637	1,480	1	679,622	0.011		4	1	12	0.0118	0.0167	0.0253	4	8	8	6	6
482011035	1	29.73371	-95.25759	TX	Harris	Houston-Sugar Land-Baytown,	8,874	764	1	4,715,407	0.004		12	3	36	0.0077	0.0106	0.0116	8	14	19	20	15
482011039	1	29.67005	-95.12849	TX	Harris	Houston-Sugar Land-Baytown,	13,417	1,183	1	4,715,407	0.002		12	3	31	0.0056	0.0113	0.0136	18	12	16	14	9
490110004	1	40.90297	-111.88447	UT	Davis	Ogden-Clearfield, UT	13,879	1,301	1	442,656	0.000		10	2	29	0.0059	0.0081	0.0111	15	21	20	13	8
530330080	1	47.57027	-122.30860	WA	King	Seattle-Tacoma-Bellevue, WA	11,847	695	1	3,043,878	0.000		11	2	32	0.0049	0.0085	0.0146	21	19	14	16	16
530630016	1	47.66083	-117.35722	WA	Spokane	Spokane, WA	6,466	527	1	417,939	0.000		4	1	12	0.0059	0.0108	0.0211	16	13	9	21	19

All sites

	n	min	pct5	pct10	pct15	pct20	pct25	pct30	pct35	pct40	pct45	median	mean	pct55	pct60	pct65	pct70	pct75	pct80	pct85	pct90	pct95	max
annual mean	30	0.0018	0.0022	0.0024	0.0029	0.0038	0.0049	0.0049	0.0052	0.0055	0.0056	0.0059	0.0068	0.0060	0.0062	0.0069	0.0073	0.0077	0.0096	0.0098	0.0123	0.0151	0.0212
max quarter mean	30	0.0027	0.0030	0.0040	0.0048	0.0053	0.0066	0.0078	0.0085	0.0085	0.0088	0.0101	0.0131	0.0106	0.0110	0.0115	0.0120	0.0167	0.0189	0.0211	0.0248	0.0390	0.0547
max monthly mean	30	0.0030	0.0045	0.0059	0.0075	0.0081	0.0094	0.0101	0.0111	0.0118	0.0123	0.0140	0.0231	0.0146	0.0150	0.0160	0.0201	0.0253	0.0278	0.0370	0.0539	0.0667	0.1529

Urban sites

	n	min	pct5	pct10	pct15	pct20	pct25	pct30	pct35	pct40	pct45	median	mean	pct55	pct60	pct65	pct70	pct75	pct80	pct85	pct90	pct95	max
annual mean	21	0.0022	0.0023	0.0026	0.0049	0.0049	0.0049	0.0052	0.0055	0.0056	0.0056	0.0059	0.0070	0.0059	0.0060	0.0062	0.0063	0.0077	0.0097	0.0098	0.0118	0.0127	0.0212
max quarter mean	21	0.0030	0.0034	0.0046	0.0056	0.0076	0.0081	0.0085	0.0085	0.0085	0.0088	0.0098	0.0140	0.0104	0.0106	0.0108	0.0113	0.0167	0.0170	0.0207	0.0273	0.0390	0.0547
max monthly mean	21	0.0045	0.0047	0.0085	0.0094	0.0097	0.0106	0.0111	0.0116	0.0123	0.0136	0.0144	0.0266	0.0146	0.0151	0.0190	0.0211	0.0253	0.0256	0.0469	0.0608	0.0667	0.1529

Urban sites, located in MSA's >= 1 million population

	n	min	pct5	pct10	pct15	pct20	pct25	pct30	pct35	pct40	pct45	median	mean	pct55	pct60	pct65	pct70	pct75	pct80	pct85	pct90	pct95	max
annual mean	17	0.0022	0.0022	0.0023	0.0026	0.0049	0.0049	0.0052	0.0052	0.0055	0.0056	0.0056	0.0070	0.0060	0.0062	0.0063	0.0063	0.0077	0.0097	0.0098	0.0127	0.0212	0.0212
max quarter mean	17	0.0030	0.0030	0.0034	0.0046	0.0076	0.0085	0.0085	0.0085	0.0085	0.0088	0.0098	0.0149	0.0104	0.0106	0.0113	0.0113	0.0170	0.0207	0.0273	0.0390	0.0547	0.0547
max monthly mean	17	0.0045	0.0045	0.0047	0.0094	0.0097	0.0106	0.0116	0.0116	0.0123	0.0136	0.0144	0.0290	0.0146	0.0151	0.0190	0.0190	0.0256	0.0469	0.0608	0.0667	0.1529	0.1529

Urban sites, located in CBSA's < 1 million population

	n	min	pct5	pct10	pct15	pct20	pct25	pct30	pct35	pct40	pct45	median	mean	pct55	pct60	pct65	pct70	pct75	pct80	pct85	pct90	pct95	max
annual mean	4	0.0049	0.0049	0.0049	0.0049	0.0049	0.0054	0.0059	0.0059	0.0059	0.0059	0.0059	0.0071	0.0059	0.0059	0.0059	0.0059	0.0089	0.0118	0.0118	0.0118	0.0118	0.0118
max quarter mean	4	0.0056	0.0056	0.0056	0.0056	0.0056	0.0069	0.0081	0.0081	0.0081	0.0081	0.0095	0.0103	0.0108	0.0108	0.0108	0.0108	0.0137	0.0167	0.0167	0.0167	0.0167	0.0167
max monthly mean	4	0.0085	0.0085	0.0085	0.0085	0.0085	0.0098	0.0111	0.0111	0.0111	0.0111	0.0161	0.0165	0.0211	0.0211	0.0211	0.0211	0.0232	0.0253	0.0253	0.0253	0.0253	0.0253

site	poc	lat	long	state	county_name	cbsa_name	population (mile radius)	under age 5 population (mile radius)	urban	cbsa_pop00	sum point/non-pt Pb EI TPY w/in 1 mile	source oriented?	data completeness (complete periods) qtrs	years	months	3-year metrics annual mean	max quarterly mean	max monthly mean	metric and population ranks (of all Pb-$PM_{2.5}$ sites) annual mean	max quarterly mean	max monthly mean	pop. (M rad.)	under age 5 pop (M rad.)
010050002	5	31.66414	-85.60623	AL	Barbour	Eufaula, AL-GA	197	6		31,636	0.00		8	1	25	0.0027	0.0033	0.0053	168	212	197	237	244
010730023	5	33.55306	-86.81500	AL	Jefferson	Birmingham-Hoover, AL	6,693	450	1	1,052,238	3.88	1	12	3	36	0.0180	0.0296	0.0475	4	5	4	148	143
010731009	5	33.45972	-87.30556	AL	Jefferson	Birmingham-Hoover, AL	71	2		1,052,238	0.00		11	2	34	0.0024	0.0032	0.0044	196	213	221	248	252
010732003	5	33.49972	-86.92417	AL	Jefferson	Birmingham-Hoover, AL	4,052	284	1	1,052,238	0.71		12	3	36	0.0450	0.0967	0.2091	2	2	2	181	173
010890014	5	34.69083	-86.58306	AL	Madison	Huntsville, AL	5,583	298	1	342,376	0.00		12	3	34	0.0024	0.0040	0.0057	193	175	183	163	170
010970003	5	30.76972	-88.08750	AL	Mobile	Mobile, AL	5,526	413	1	399,843	0.00		12	3	36	0.0038	0.0060	0.0096	95	100	83	164	151
011011002	5	32.40694	-86.25639	AL	Montgomery	Montgomery, AL	5,481	333	1	346,528	0.00		12	3	34	0.0045	0.0083	0.0115	68	51	58	165	163
011030011	5	34.51861	-86.97694	AL	Morgan	Decatur, AL	975	52	1	145,867	0.00		11	2	30	0.0028	0.0042	0.0060	163	169	170	216	217
020200018	5	61.20667	-149.82083	AK	Anchorage Municip	Anchorage, AK	15,123	1,295	1	319,605	0.01		6	1	17	0.0043	0.0067	0.0101	72	76	71	68	53
040130019	5	33.48385	-112.14257	AZ	Maricopa	Phoenix-Mesa-Scottsdale, AZ	18,127	1,987	1	3,251,876	0.01		7	1	20	0.0044	0.0057	0.0100	69	112	75	45	26
040137003	5	33.28936	-112.15732	AZ	Maricopa	Phoenix-Mesa-Scottsdale, AZ	111	14		3,251,876	0.00		4	1	10	0.0027	0.0049	0.0067	175	136	148	244	231
040137020	5	33.47333	-111.85418	AZ	Maricopa	Phoenix-Mesa-Scottsdale, AZ	560	51		3,251,876	0.00		4	1	11	0.0026	0.0038	0.0058	181	190	177	224	218
040139997	7	33.50364	-112.09500	AZ	Maricopa	Phoenix-Mesa-Scottsdale, AZ	29,451	3,131	1	3,251,876	0.01		12	3	36	0.0027	0.0047	0.0069	177	143	137	20	13
040139998	5	33.45513	-111.99610	AZ	Maricopa	Phoenix-Mesa-Scottsdale, AZ	19,938	2,547	1	3,251,876	0.01		6	1	18	0.0033	0.0047	0.0075	133	142	123	42	19
040191028	5	32.29515	-110.98230	AZ	Pima	Tucson, AZ	8,520	426	1	843,746	0.00		12	3	35	0.0017	0.0022	0.0035	240	245	244	128	148
051190007	5	34.75611	-92.27583	AR	Pulaski	Little Rock-North Little Rock, Al	3,841	271	1	610,518	0.01		12	3	33	0.0029	0.0042	0.0061	155	165	168	183	178
051450001	5	35.24861	-91.71528	AR	White	Searcy, AR	3,081	122	1	67,165	0.00		7	1	22	0.0021	0.0046	0.0063	217	148	156	196	205
060070002	5	39.75750	-121.84222	CA	Butte	Chico, CA	16,060	1,003	1	203,171	0.01		12	3	36	0.0026	0.0039	0.0054	179	182	192.5	63	75
060190008	5	36.78139	-119.77222	CA	Fresno	Fresno, CA	21,144	1,825	1	799,407	0.01		12	3	36	0.0030	0.0050	0.0066	152	132	149	35	29
060250005	5	32.67611	-115.48333	CA	Imperial	El Centro, CA	16,385	1,290	1	142,361	0.01		12	3	36	0.0119	0.0172	0.0342	10	15	11	61	56
060290014	5	35.35611	-119.04028	CA	Kern	Bakersfield, CA	18,619	1,625	1	661,645	0.05		11	2	32	0.0026	0.0046	0.0061	180	144	164	44	41
060371103	5	34.06659	-118.22688	CA	Los Angeles	Los Angeles-Long Beach-Santa	29,329	1,633	1	12,365,627	0.30		12	3	36	0.0053	0.0098	0.0228	46	40	26	21	40
060631009	5	39.80833	-120.47167	CA	Plumas		420	23	1		0.00		12	3	36	0.0025	0.0041	0.0054	190	174	192.5	227	227
060658001	5	33.99958	-117.41601	CA	Riverside	Riverside-San Bernardino-Onta	16,247	1,678	1	3,254,821	0.00		12	3	36	0.0058	0.0088	0.0151	40	46	47	62	39
060670006	5	38.61417	-121.36694	CA	Sacramento	Sacramento--Arden-Arcade--Ro	16,004	820	1	1,796,857	0.00		12	3	36	0.0022	0.0031	0.0047	211	219	215	64	89
060670010	5	38.55833	-121.49194	CA	Sacramento	Sacramento--Arden-Arcade--Ro	20,302	1,058	1	1,796,857	0.00		12	3	36	0.0029	0.0037	0.0052	159	197	200	38	68
060730003	5	32.79139	-116.94167	CA	San Diego	San Diego-Carlsbad-San Marco	31,832	2,817	1	2,813,833	0.01		12	3	36	0.0039	0.0059	0.0078	90	103	117	18	15
060731002	5	33.12778	-117.07417	CA	San Diego	San Diego-Carlsbad-San Marco	32,726	3,429	1	2,813,833	0.01		12	3	36	0.0035	0.0050	0.0064	122	133	153	17	9
060850005	5	37.34850	-121.89500	CA	Santa Clara	San Jose-Sunnyvale-Santa Cla	23,283	1,608	1	1,735,819	0.01		12	3	36	0.0026	0.0063	0.0138	185	90	50	33	42
060990005	5	37.64167	-120.99361	CA	Stanislaus	Modesto, CA	12,894	1,023	1	446,997	0.00		12	3	36	0.0033	0.0065	0.0090	130	83	89	88	72
061072002	5	36.33222	-119.29028	CA	Tulare	Visalia-Porterville, CA	17,172	1,813	1	368,021	0.02		12	3	36	0.0034	0.0046	0.0060	128	146	172	56	30
061112002	5	34.27750	-118.68472	CA	Ventura	Oxnard-Thousand Oaks-Ventur	3,102	212	1	753,197	0.00		12	3	33	0.0020	0.0032	0.0042	228	215	224	195	185
080010006	5	39.82574	-104.93699	CO	Adams	Denver-Aurora, CO	3,313	256	1	2,157,756	0.00		12	3	36	0.0077	0.0163	0.0185	24	16	37	191	181
080410011	5	38.83139	-104.82778	CO	El Paso	Colorado Springs, CO	10,581	552	1	537,484	0.04		12	3	34	0.0019	0.0028	0.0048	232	229	214	110	129
080770017	5	39.06363	-108.56102	CO	Mesa	Grand Junction, CO	11,955	783	1	116,255	0.00		9	2	25	0.0023	0.0035	0.0056	205	200	189	96	96
081230008	5	40.20917	-104.82306	CO	Weld	Greeley, CO	5,349	489		180,936	0.00		12	3	36	0.0020	0.0034	0.0054	229	205	194	167	142
090090027	5	41.30111	-72.90278	CT	New Haven	New Haven-Milford, CT	17,229	1,454	1	824,008	0.08		8	2	20	0.0029	0.0043	0.0066	157	159	150	54	48
100010003	5	39.15500	-75.51806	DE	Kent	Dover, DE	10,128	677	1	126,697	0.00		12	3	34	0.0024	0.0038	0.0051	192	192	204	114	108
100032004	5	39.73944	-75.55806	DE	New Castle	Philadelphia-Camden-Wilmingt	34,053	2,649	1	5,687,147	0.01		11	2	32	0.0046	0.0084	0.0114	65	49	61	14	16
110010042	6	38.88083	-77.03250	DC	District of Columbia	Washington-Arlington-Alexandr	5,251	170	1	4,796,183	0.00		6	1	18	0.0037	0.0058	0.0075	106	107	122	170	196
110010043	5	38.91889	-77.01250	DC	District of Columbia	Washington-Arlington-Alexandr	42,772	2,494	1	4,796,183	0.00		12	3	36	0.0035	0.0063	0.0093	119	87	87	10	21
120330004	6	30.52500	-87.20417	FL	Escambia	Pensacola-Ferry Pass-Brent, F	4,934	273	1	412,153	0.00		12	3	36	0.0019	0.0026	0.0042	234	237	223	173	176
120571075	5	28.05000	-82.37806	FL	Hillsborough	Tampa-St. Petersburg-Clearwa	10,691	490	1	2,395,997	0.00		4	1	12	0.0023	0.0034	0.0052	206	209	199	109	141
120573002	5	27.96565	-82.23040	FL	Hillsborough	Tampa-St. Petersburg-Clearwa	1,163	94		2,395,997	0.00		8	2	24	0.0027	0.0042	0.0069	170	171	140	212	211
120730012	5	30.43972	-84.34833	FL	Leon	Tallahassee, FL	3,291	173	1	320,304	0.00		12	3	36	0.0020	0.0034	0.0049	227	207	209	192	194
120861016	5	25.79417	-80.20611	FL	Miami-Dade	Miami-Fort Lauderdale-Miami E	23,836	1,804	1	5,007,564	0.00		12	3	36	0.0020	0.0068	0.0163	224	75	43	29	31
121030026	5	27.85004	-82.71459	FL	Pinellas	Tampa-St. Petersburg-Clearwa	14,792	950	1	2,395,997	0.00		5	1	16	0.0025	0.0039	0.0088	191	185	92	71	77
130210007	5	32.77944	-83.64694	GA	Bibb	Macon, GA	6,732	599		222,368	0.01		12	3	34	0.0029	0.0069	0.0147	156	72	48	145	119
130510017	5	32.09278	-81.14417	GA	Chatham	Savannah, GA	6,616	612	1	293,000	0.03		8	2	22	0.0017	0.0029	0.0041	238	226	229	149	116
130590001	5	33.94583	-83.37222	GA	Clarke	Athens-Clarke County, GA	13,999	364	1	166,079	0.04		11	2	29	0.0022	0.0029	0.0041	208	228	231	78	160
130690002	5	31.52430	-82.76510	GA	Coffee	Douglas, GA	1,072	90		45,022	0.01		12	3	30	0.0013	0.0022	0.0032	245	246	248	213	212
130890002	5	33.68750	-84.29028	GA	DeKalb	Atlanta-Sandy Springs-Marietta	3,554	210	1	4,247,981	0.00		12	3	36	0.0027	0.0042	0.0077	174	164	119	188	187
131150005	5	34.26333	-85.27250	GA	Floyd	Rome, GA	2,911	172		90,565	0.00		12	3	33	0.0023	0.0030	0.0040	202	223	235	198	195
132150011	5	32.43083	-84.93167	GA	Muscogee	Columbus, GA-AL	10,871	1,037	1	281,768	0.25	1	12	3	32	0.0036	0.0101	0.0086	111	38	100	108	71
132450091	5	33.43333	-82.02194	GA	Richmond	Augusta-Richmond County, GA	6,898	593	1	499,684	0.02		12	3	32	0.0025	0.0038	0.0067	188	188	144	143	120
150032004	5	21.39667	-157.97167	HI	Honolulu	Honolulu, HI	23,622	1,207	1	876,156	0.07		12	3	34	0.0010	0.0021	0.0031	253	247	249	32	60
160270004	5	43.56240	-116.56323	ID	Canyon	Boise City-Nampa, ID	13,093	1,291	1	464,840	0.01		12	3	36	0.0022	0.0046	0.0096	207	149	82	86	55
170310057	5	41.91473	-87.72273	IL	Cook	Chicago-Naperville-Joliet, IL-IN	86,435	8,481	1	9,098,316	0.02		12	3	35	0.0071	0.0115	0.0172	29	34	39	4	3
170310076	5	41.75137	-87.71375	IL	Cook	Chicago-Naperville-Joliet, IL-IN	33,132	2,642	1	9,098,316	0.00		12	3	36	0.0054	0.0063	0.0087	44	88	95	15	17
170314201	5	42.14000	-87.79917	IL	Cook	Chicago-Naperville-Joliet, IL-IN	6,070	303	1	9,098,316	0.00		12	3	36	0.0040	0.0054	0.0085	89	121	104	157	169
170434002	5	41.77120	-88.15250	IL	DuPage	Chicago-Naperville-Joliet, IL-IN	11,993	699	1	9,098,316	0.00		8	2	23	0.0047	0.0063	0.0072	62	86	131	95	104
171150013	5	39.86694	-88.92556	IL	Macon	Decatur, IL	5,738	531		114,706	1.01	1	12	3	35	0.0067	0.0142	0.0228	31	23	27	161	132
171192009	5	38.90278	-90.14306	IL	Madison	St. Louis, MO-IL	7,856	504	1	2,721,491	0.00		11	2	32	0.0079	0.0208	0.0413	21	9	7	135	137
180030004	5	41.09472	-85.10194	IN	Allen	Fort Wayne, IN	11,028	813	1	390,156	0.01		7	1	20	0.0474	0.1674	0.3091	1	1	1	105	90
180372001	5	38.39139	-86.92917	IN	Dubois	Jasper, IN	4,115	289	1	52,511	0.04		4	1	12	0.0042	0.0051	0.0063	83	129	157	180	171

													data completeness (complete periods)			3-year metrics			metric and population ranks (of all Pb-$PM_{2.5}$ sites)				
site	poc	lat	long	state	county_name	cbsa_name	population (mile radius)	under age 5 population (mile radius)	urban	cbsa_pop00	sum point/non-pt Pb EI TPY w/in 1 mile	source oriented?	qtrs	years	months	annual mean	max quarterly mean	max monthly mean	annual mean	max quarterly mean	max monthly mean	pop. (M rad.)	under age 5 pop (M rad.)
180390003	5	41.66778	-85.96944	IN	Elkhart	Elkhart-Goshen, IN	15,220	1,526	1	182,791	0.00		4	1	12	0.0044	0.0048	0.0056	71	140	185	67	45
180650003	5	40.01167	-85.52361	IN	Henry	New Castle, IN	230	15		48,508	0.00		12	3	36	0.0037	0.0055	0.0074	108	120	125	233	230
180890022	5	41.60667	-87.30472	IN	Lake	Chicago-Naperville-Joliet, IL-IN	20,723	1,880	1	9,098,316	0.00		11	2	32	0.0102	0.0128	0.0204	14	29	29	36	27
180892004	5	41.58528	-87.47444	IN	Lake	Chicago-Naperville-Joliet, IL-IN	9,253	647	1	9,098,316	0.04		8	2	24	0.0090	0.0120	0.0244	19	32	23	124	111
180970078	5	39.81110	-86.11447	IN	Marion	Indianapolis-Carmel, IN	14,196	1,175	1	1,525,104	0.02		12	3	36	0.0048	0.0071	0.0087	59	65	94	77	62
181411008	5	41.69361	-86.23667	IN	St. Joseph	South Bend-Mishawaka, IN-MI	11,117	439	1	316,663	0.09		4	1	12	0.0042	0.0054	0.0072	77	122	132	103	145
181630012	5	38.02167	-87.56944	IN	Vanderburgh	Evansville, IN-KY	8,186	415	1	342,815	0.00		12	3	34	0.0031	0.0057	0.0080	145	109	113	131	150
191130037	5	42.00833	-91.67861	IA	Linn	Cedar Rapids, IA	12,081	699	1	237,230	0.00		12	3	35	0.0033	0.0044	0.0071	132	156	136	93	103
191530030	5	41.60306	-93.64306	IA	Polk	Des Moines-West Des Moines,	18,800	1,587	1	481,394	0.00		12	3	33	0.0027	0.0037	0.0058	167	194	179	43	43
191630015	5	41.53000	-90.58750	IA	Scott	Davenport-Moline-Rock Island,	14,648	1,126	1	376,019	0.21		11	2	33	0.0063	0.0084	0.0118	37	50	57	74	65
201730010	5	37.70111	-97.31389	KS	Sedgwick	Wichita, KS	9,916	925	1	571,166	0.01		7	1	18	0.0023	0.0032	0.0053	199	214	195	117	79
202090021	5	39.11750	-94.63556	KS	Wyandotte	Kansas City, MO-KS	16,777	1,476	1	1,836,038	0.08		12	3	36	0.0048	0.0066	0.0100	56	80	73	58	47
210190017	5	38.45917	-82.64056	KY	Boyd	Huntington-Ashland, WV-KY-O	10,273	493	1	288,649	0.00		12	3	35	0.0043	0.0060	0.0096	76	96	81	112	140
210590005	5	37.78083	-87.07556	KY	Daviess	Owensboro, KY	1,966	109	1	109,875	0.00		4	1	12	0.0037	0.0044	0.0061	105	154	167	206	207
210590014	5	37.74111	-87.11806	KY	Daviess	Owensboro, KY	12,807	693	1	109,875	0.00		7	1	19	0.0020	0.0027	0.0036	226	234	241	89	107
210670012	5	38.06500	-84.50000	KY	Fayette	Lexington-Fayette, KY	11,049	541	1	408,326	0.00		12	3	36	0.0038	0.0066	0.0101	97	79	72	104	130
211110043	5	38.23222	-85.82528	KY	Jefferson	Louisville-Jefferson County, KY	6,017	441	1	1,161,975	0.44		12	3	36	0.0042	0.0070	0.0100	82	68	74	158	144
211110048	5	38.24056	-85.73167	KY	Jefferson	Louisville-Jefferson County, KY	18,033	1,511	1	1,161,975	0.01		12	3	36	0.0048	0.0071	0.0133	58	66	52	47	46
211170007	5	39.07250	-84.52500	KY	Kenton	Cincinnati-Middletown, OH-KY-	13,446	890	1	2,009,632	0.00		12	3	36	0.0048	0.0106	0.0170	54	37	40	80	81
211250004	5	37.08722	-84.06333	KY	Laurel	London, KY	1,533	98	1	52,715	0.00		12	3	36	0.0037	0.0048	0.0095	107	139	86	209	210
211451004	5	37.06556	-88.63778	KY	McCracken	Paducah, KY-IL	6,540	385	1	98,765	0.00		12	3	36	0.0029	0.0043	0.0059	158	160	175	152	157
211930003	5	37.28306	-83.22028	KY	Perry		731	37			0.00		12	3	34	0.0041	0.0059	0.0079	87	102	116	218	222
212270007	5	36.99333	-86.41833	KY	Warren	Bowling Green, KY	4,261	198	1	104,166	0.00		11	2	35	0.0035	0.0056	0.0098	117	116	77	179	189
220150008	5	32.53417	-93.74972	LA	Bossier	Shreveport-Bossier City, LA	1,442	115		375,965	0.00		11	2	32	0.0050	0.0089	0.0147	50	45	49	210	206
220330009	5	30.46111	-91.17694	LA	East Baton Rouge	Baton Rouge, LA	6,220	426	1	705,973	0.00		11	2	31	0.0036	0.0101	0.0198	113	39	31	154	149
240030019	5	39.10111	-76.72944	MD	Anne Arundel	Baltimore-Towson, MD	6,013	584	1	2,552,994	0.00		7	1	17	0.0032	0.0061	0.0087	137	93	99	159	123
240053001	5	39.31083	-76.47444	MD	Baltimore	Baltimore-Towson, MD	13,104	646	1	2,552,994	0.00		9	1	26	0.0063	0.0080	0.0101	36	55	70	85	112
240330030	5	39.05528	-76.87833	MD	Prince George's	Washington-Arlington-Alexandr	2,200	175	1	4,796,183	0.02		4	1	12	0.0039	0.0069	0.0099	94	73	76	203	193
250130008	5	42.19446	-72.55571	MA	Hampden	Springfield, MA	9,610	436		680,014	0.00		8	1	25	0.0024	0.0035	0.0045	197	203	218	120	147
250250042	6	42.32944	-71.08278	MA	Suffolk	Boston-Cambridge-Quincy, MA	59,254	3,235	1	4,391,344	0.01		12	3	35	0.0027	0.0039	0.0056	176	184	187	6	12
260050003	5	42.76778	-86.14861	MI	Allegan	Allegan, MI	2,452	148	1	105,665	0.00		11	2	35	0.0039	0.0055	0.0079	91	119	114	201	199
260330901	5	46.49361	-84.36417	MI	Chippewa	Sault Ste. Marie, MI	12,252	501	1	38,543	0.00		12	3	36	0.0023	0.0038	0.0046	200	191	217	92	138
260770008	5	42.27806	-85.54194	MI	Kalamazoo	Kalamazoo-Portage, MI	2,717	165	1	314,866	0.00		11	2	33	0.0049	0.0068	0.0097	53	74	80	199	197
260810020	5	42.98417	-85.67139	MI	Kent	Grand Rapids-Wyoming, MI	17,217	1,764	1	740,482	0.01		12	3	35	0.0048	0.0083	0.0104	57	52	67	55	34
261130001	5	44.31056	-84.89194	MI	Missaukee	Cadillac, MI	58	3		44,962	0.00		12	3	33	0.0022	0.0057	0.0102	209	111	69	249	247
261150005	5	41.76389	-83.47194	MI	Monroe	Monroe, MI	245	13		145,945	0.00		11	2	32	0.0042	0.0049	0.0074	78	137	124	231	234
261610008	5	42.24056	-83.59972	MI	Washtenaw	Ann Arbor, MI	13,440	879	1	322,895	0.00		10	2	30	0.0038	0.0060	0.0087	104	95	93	81	83
261630001	5	42.22861	-83.20833	MI	Wayne	Detroit-Warren-Livonia, MI	14,329	798	1	4,452,557	0.00		12	3	36	0.0042	0.0051	0.0063	79	130	159	76	92
261630033	5	42.30667	-83.14889	MI	Wayne	Detroit-Warren-Livonia, MI	17,402	1,843	1	4,452,557	0.55		12	3	33	0.0118	0.0182	0.0329	11	13	12	52	28
270530963	5	44.95540	-93.25827	MN	Hennepin	Minneapolis-St. Paul-Blooming	46,218	3,929	1	2,968,806	0.16		12	3	36	0.0031	0.0041	0.0072	143	172	130	9	7
270953051	5	46.20703	-93.75941	MN	Mille Lacs		44	3			0.00		11	2	31	0.0015	0.0023	0.0036	242	243	242	250	248
271095008	5	43.99691	-92.45037	MN	Olmsted	Rochester, MN	8,145	539	1	163,618	0.00		12	3	35	0.0027	0.0043	0.0067	169	158	146	133	131
271230871	5	44.96145	-93.03589	MN	Ramsey	Minneapolis-St. Paul-Blooming	23,791	2,265	1	2,968,806	0.00		9	2	27	0.0042	0.0073	0.0084	80	60	107	31	25
280350004	5	31.32364	-89.28717	MS	Forrest	Hattiesburg, MS	7,946	635	1	123,812	0.00		12	3	35	0.0048	0.0128	0.0302	55	28	14	134	114
280430001	5	33.83611	-89.79722	MS	Grenada	Grenada, MS	92	6		23,263	0.00		11	2	31	0.0021	0.0032	0.0056	218	216	186	246	245
280470008	5	30.39014	-89.04972	MS	Harrison	Gulfport-Biloxi, MS	8,284	576	1	246,190	0.00		11	2	32	0.0023	0.0034	0.0062	198	206	163	130	125
280490018	5	32.29681	-90.18831	MS	Hinds	Jackson, MS	3,728	230	1	497,197	0.00		11	2	31	0.0045	0.0071	0.0112	67	64	64	186	184
280670002	5	31.68844	-89.13506	MS	Jones	Laurel, MS	5,587	438	1	83,107	0.00		12	3	35	0.0030	0.0073	0.0180	153	58	38	162	146
290470005	5	39.30306	-94.37639	MO	Clay	Kansas City, MO-KS	471	33		1,836,038	0.00		12	3	36	0.0026	0.0040	0.0050	186	179	207	226	225
290530001	5	38.79500	-92.91806	MO	Cooper		36	2			0.00		11	2	33	0.0022	0.0028	0.0041	212	232	227	253	253
290990012	5	38.43778	-90.36139	MO	Jefferson	St. Louis, MO-IL	5,285	346	1	2,721,491	0.01		12	3	36	0.0089	0.0126	0.0191	20	30	34	169	162
291860005	5	37.89694	-90.42222	MO	Ste Genevieve		237	10			0.00		11	2	34	0.0041	0.0060	0.0095	85	99	84	232	240
292070001	5	36.97000	-90.14000	MO	Stoddard		164	7			0.00		4	1	11	0.0034	0.0044	0.0068	125	153	141	241	242
295100085	6	38.65630	-90.19810	MO	St. Louis (City)	St. Louis, MO-IL	9,140	783	1	2,721,491	0.01		12	3	36	0.0095	0.0140	0.0192	16	25	32	125	95
300530018	5	48.38417	-115.54806	MT	Lincoln		6,215	322	1		0.01		12	3	35	0.0017	0.0029	0.0039	239	225	236	155	164
300630031	5	46.87491	-113.99525	MT	Missoula	Missoula, MT	13,208	583	1	95,802	0.00		12	3	36	0.0020	0.0035	0.0051	223	204	205	83	124
310550019	5	41.24722	-95.97556	NE	Douglas	Omaha-Council Bluffs, NE-IA	20,254	1,392	1	767,041	0.01		12	3	35	0.0030	0.0042	0.0055	150	170	190	39	51
320030560	5	36.15861	-115.11083	NV	Clark	Las Vegas-Paradise, NV	29,471	2,516	1	1,375,765	0.00		5	1	15	0.0025	0.0039	0.0061	189	181	166	19	20
320030561	5	36.16399	-115.11393	NV	Clark	Las Vegas-Paradise, NV	35,010	3,377	1	1,375,765	0.00		7	1	20	0.0027	0.0044	0.0086	165	155	101.5	13	10
320310016	5	39.52508	-119.80772	NV	Washoe	Reno-Sparks, NV	17,291	1,022	1	342,885	0.01		12	3	36	0.0024	0.0040	0.0060	194	180	173	53	73
330110020	5	43.00056	-71.46806	NH	Hillsborough	Manchester-Nashua, NH	17,718	1,125	1	380,841	0.01		12	3	34	0.0034	0.0053	0.0062	129	123	161	51	66
330150014	5	43.07528	-70.74806	NH	Rockingham	Boston-Cambridge-Quincy, MA	10,536	348	1	4,391,344	0.01		12	3	36	0.0024	0.0028	0.0036	195	233	240	111	161
340070003	5	39.92304	-75.09762	NJ	Camden	Philadelphia-Camden-Wilmingt	28,490	2,404	1	5,687,147	0.00		11	2	33	0.0043	0.0052	0.0069	74	125	138	23	22
340230006	6	40.47279	-74.42251	NJ	Middlesex	New York-Northern New Jersey	12,900	608	1	18,323,002	0.00		11	2	24	0.0047	0.0063	0.0114	64	89	60	87	117
340273001	5	40.78763	-74.67630	NJ	Morris	New York-Northern New Jersey	981	73	1	18,323,002	0.00		12	3	35	0.0027	0.0038	0.0059	172	189	176	215	215

site	poc	lat	long	state	county_name	cbsa_name	population (mile radius)	under age 5 population (mile radius)	urban	cbsa_pop00	sum point/non-pt Pb EI TPY w/in 1 mile	source oriented?	data completeness (complete periods) qtrs	years	months	3-year metrics annual mean	max quarterly mean	max monthly mean	metric and population ranks (of all Pb-PM$_{2.5}$ sites) annual mean	max quarterly mean	max monthly mean	pop. (M rad.)	under age 5 pop (M rad.)
340390004	5	40.64144	-74.20836	NJ	Union	New York-Northern New Jersey	28,906	2,313	1	18,323,002	0.01		12	3	36	0.0044	0.0059	0.0067	70	106	145	22	24
350010023	5	35.13426	-106.58551	NM	Bernalillo	Albuquerque, NM	17,981	1,254	1	729,649	0.02		8	2	22	0.0013	0.0020	0.0027	247	251	254	48	58
360050083	6	40.86586	-73.88075	NY	Bronx	New York-Northern New Jersey	141,922	12,738	1	18,323,002	0.07		12	3	36	0.0040	0.0059	0.0067	88	101	147	3	2
360050110	5	40.81616	-73.90207	NY	Bronx	New York-Northern New Jersey	143,387	13,236	1	18,323,002	0.05		12	3	36	0.0047	0.0064	0.0079	63	84	115	2	1
360290005	6	42.87684	-78.80988	NY	Erie	Buffalo-Niagra Falls, NY Metrop	14,765	866	1	1,170,111	1.56	1	12	3	36	0.0106	0.0157	0.0192	13	18	33	73	84
360310003	5	44.39309	-73.85892	NY	Essex		40	3			0.00		12	3	34	0.0015	0.0021	0.0028	243	248	250	252	249
360551007	5	43.14620	-77.54813	NY	Monroe	Rochester, NY	11,659	642	1	1,037,831	0.03		7	1	20	0.0036	0.0040	0.0048	114	177	211	98	113
360556001	5	43.16100	-77.60357	NY	Monroe	Rochester, NY	21,463	1,565	1	1,037,831	0.10		5	1	15	0.0031	0.0037	0.0045	141	193	219	34	44
360610062	1	40.72052	-74.00409	NY	New York	New York-Northern New Jersey	217,799	7,958	1	18,323,002	0.17		4	1	12	0.0070	0.0092	0.0190	30	44	36	1	4
360632008	1	43.08216	-79.00099	NY	Niagara	Buffalo-Niagra Falls, NY Metrop	6,795	386	1	1,170,111	0.03		4	1	11	0.0052	0.0063	0.0065	47	91	151	144	156
360710002	1	41.49947	-74.00973	NY	Orange	Poughkeepsie-Newburgh-Midd	24,210	2,633	1	621,517	0.01		4	1	11	0.0034	0.0040	0.0053	123	176	196	27	18
360810124	6	40.73620	-73.82317	NY	Queens	New York-Northern New Jersey	76,878	5,204	1	18,323,002	0.02		12	3	36	0.0038	0.0055	0.0068	96	117	143	5	5
361010003	5	42.09071	-77.21025	NY	Steuben	Corning, NY	590	33		98,726	0.00		12	3	36	0.0028	0.0034	0.0042	161	208	225	222	224
361030001	1	40.74583	-73.42028	NY	Suffolk	New York-Northern New Jersey	3,109	230	1	18,323,002	0.02		4	1	11	0.0032	0.0039	0.0051	139	183	206	194	183
370210034	5	35.60972	-82.35083	NC	Buncombe	Asheville, NC	716	44	1	369,171	0.00		12	3	36	0.0019	0.0031	0.0052	230	217	201	219	220
370350004	5	35.72889	-81.36556	NC	Catawba	Hickory-Lenoir-Morganton, NC	3,399	272	1	341,851	0.00		12	3	35	0.0025	0.0036	0.0060	187	198	169	189	177
370510009	5	35.04142	-78.95311	NC	Cumberland	Fayetteville, NC	7,337	607	1	336,609	0.00		8	2	22	0.0021	0.0037	0.0057	220	195	182	139	118
370570002	5	35.81444	-80.26250	NC	Davidson	Thomasville-Lexington, NC	4,897	380	1	147,246	0.01		8	2	23	0.0032	0.0047	0.0087	138	141	96	174	158
370670022	5	36.11056	-80.22667	NC	Forsyth	Winston-Salem, NC	9,488	797	1	421,961	0.00		12	3	36	0.0026	0.0036	0.0063	182	199	158	122	93
370810013	5	36.10917	-79.80111	NC	Guilford	Greensboro-High Point, NC	8,152	567	1	643,430	0.00		8	2	23	0.0028	0.0043	0.0064	164	161	155	132	126
371070004	5	35.23146	-77.56879	NC	Lenoir	Kinston, NC	185	11		59,648	0.13		11	2	34	0.0028	0.0046	0.0062	162	147	160	239	236
371190041	5	35.24028	-80.78556	NC	Mecklenburg	Charlotte-Gastonia-Concord, N	11,143	765	1	1,330,448	0.00		12	3	36	0.0029	0.0042	0.0052	160	168	202	102	97
371590021	5	35.55187	-80.39504	NC	Rowan	Salisbury, NC	2,190	137	1	130,340	0.00		4	1	11	0.0032	0.0040	0.0057	134	178	181	204	200
371830014	5	35.85611	-78.57417	NC	Wake	Raleigh-Cary, NC	20,076	1,730	1	797,071	0.00		12	3	34	0.0021	0.0038	0.0041	216	186	232	40	37
380150003	5	46.82543	-100.76821	ND	Burleigh	Bismarck, ND	18,067	1,001	1	94,719	0.00		12	3	36	0.0012	0.0023	0.0036	249	244	243	46	76
380171004	5	46.93375	-96.85535	ND	Cass	Fargo, ND-MN	206	21		174,367	0.00		12	3	36	0.0019	0.0027	0.0038	233	236	237	235	228
380530002	5	47.58120	-103.29950	ND	Mc Kenzie		3	0			0.00		12	3	35	0.0012	0.0026	0.0040	251	238	233	255	256
390171004	5	39.53000	-84.39250	OH	Butler	Cincinnati-Middletown, OH-KY-	2,001	128	1	2,009,632	0.00		12	3	36	0.0092	0.0147	0.0273	18	22	18	205	203
390350038	6	41.47694	-81.68194	OH	Cuyahoga	Cleveland-Elyria-Mentor, OH	7,329	585	1	2,148,143	0.06		12	3	35	0.0120	0.0163	0.0282	9	17	17	140	122
390350060	5	41.49396	-81.67854	OH	Cuyahoga	Cleveland-Elyria-Mentor, OH	10,123	1,169	1	2,148,143	0.27		12	3	36	0.0123	0.0207	0.0270	8	10	19	115	63
390490081	6	40.08778	-82.95972	OH	Franklin	Columbus, OH	16,557	1,216	1	1,612,694	0.00		12	3	34	0.0038	0.0052	0.0073	100	126	128	60	59
390530003	5	38.94996	-82.10910	OH	Gallia	Point Pleasant, WV-OH	132	10		57,026	0.00		6	1	16	0.0043	0.0072	0.0085	75	61	105	243	241
390610040	5	39.12861	-84.50417	OH	Hamilton	Cincinnati-Middletown, OH-KY-	25,543	1,269	1	2,009,632	0.12		8	2	25	0.0056	0.0069	0.0113	43	70	63	25	57
390610042	5	39.10500	-84.55111	OH	Hamilton	Cincinnati-Middletown, OH-KY-	11,153	827	1	2,009,632	1.55	1	4	1	11	0.0079	0.0114	0.0286	22	35	15	101	88
390870010	5	38.51972	-82.66556	OH	Lawrence	Huntington-Ashland, WV-KY-O	3,726	191	1	288,649	0.00		11	2	33	0.0048	0.0095	0.0137	61	42	51	187	190
390930016	5	41.43944	-82.16167	OH	Lorain	Cleveland-Elyria-Mentor, OH	8,851	738	1	2,148,143	0.00		4	1	10	0.0157	0.0244	0.0450	5	7	6	127	100
390933002	5	41.46306	-82.11444	OH	Lorain	Cleveland-Elyria-Mentor, OH	2,913	318		2,148,143	0.00		8	2	20	0.0238	0.0337	0.0465	3	4	5	197	166
390950026	5	41.62056	-83.64139	OH	Lucas	Toledo, OH	7,401	510	1	659,188	0.00		12	3	36	0.0035	0.0053	0.0069	120	124	139	137	136
390990014	5	41.09587	-80.65843	OH	Mahoning	Youngstown-Warren-Boardman	7,317	498	1	602,964	0.00		12	3	35	0.0131	0.0253	0.0382	7	6	9	141	139
391510020	5	40.80056	-81.37333	OH	Stark	Canton-Massillon, OH	15,043	1,441	1	406,934	0.00		8	2	24	0.0060	0.0082	0.0157	38	53	45	69	49
391530023	5	41.08806	-81.54167	OH	Summit	Akron, OH	20,652	1,394	1	694,960	0.00		11	2	29	0.0050	0.0069	0.0098	51	71	78	37	50
400450890	5	36.08518	-99.93494	OK	Ellis		196	10			0.00		12	3	34	0.0012	0.0019	0.0027	248	252	253	238	237
401091037	5	35.61278	-97.47222	OK	Oklahoma	Oklahoma City, OK	3,759	176	1	1,095,421	0.00		12	3	36	0.0022	0.0033	0.0046	210	210	216	185	192
401431127	5	36.20490	-95.97654	OK	Tulsa	Tulsa, OK	5,312	409	1	859,532	0.00		12	3	36	0.0031	0.0045	0.0056	144	151	188	168	153
410170120	5	44.06390	-121.31258	OR	Deschutes	Bend, OR	5,467	316	1	115,367	0.00		4	1	11	0.0014	0.0018	0.0021	244	253	257	166	167
410290133	5	42.31408	-122.87924	OR	Jackson	Medford, OR	9,659	807	1	181,269	0.00		12	3	35	0.0019	0.0029	0.0035	235	227	246	119	91
410390060	5	44.02631	-123.08374	OR	Lane	Eugene-Springfield, OR	15,018	560	1	322,959	0.00		12	3	35	0.0015	0.0025	0.0041	241	241	230	70	128
410510246	6	45.56130	-122.67878	OR	Multnomah	Portland-Vancouver-Beaverton	24,303	1,771	1	1,927,881	0.00		12	3	36	0.0075	0.0182	0.0398	25	12	8	26	32
410610119	5	45.33897	-117.90480	OR	Union	La Grande, OR	41	3		24,530	0.00		8	2	20	0.0012	0.0020	0.0026	250	250	255	251	251
420010001	5	39.92000	-77.31000	PA	Adams	Gettysburg, PA	1,430	127		91,292	0.00		12	3	35	0.0037	0.0070	0.0082	109	67	111	211	204
420030008	6	40.46556	-79.96111	PA	Allegheny	Pittsburgh, PA	19,960	889	1	2,431,087	0.10		12	3	36	0.0112	0.0141	0.0252	12	24	21	41	82
420030064	6	40.32361	-79.86833	PA	Allegheny	Pittsburgh, PA	6,909	279	1	2,431,087	0.00		9	2	23	0.0143	0.0239	0.0356	6	8	10	142	174
420270100	5	40.81139	-77.87703	PA	Centre	State College, PA	17,851	310	1	135,758	0.01		12	3	35	0.0032	0.0043	0.0061	140	162	165	49	168
420290100	5	39.83444	-75.76861	PA	Chester	Philadelphia-Camden-Wilmingt	6,584	529		5,687,147	0.01		12	3	32	0.0046	0.0086	0.0105	66	48	66	150	134
420430401	5	40.24500	-76.84472	PA	Dauphin	Harrisburg-Carlisle, PA	6,731	615	1	509,074	1.75	1	12	3	34	0.0063	0.0122	0.0190	35	31	35	146	115
420450002	5	39.83556	-75.37250	PA	Delaware	Philadelphia-Camden-Wilmingt	10,156	859	1	5,687,147	0.02		12	3	34	0.0042	0.0057	0.0073	81	110	129	113	85
420490003	5	42.14175	-80.03861	PA	Erie	Erie, PA	9,507	936	1	280,843	0.08		12	3	34	0.0057	0.0153	0.0323	42	19	13	121	78
420692006	5	41.44278	-75.62306	PA	Lackawanna	Scranton--Wilkes-Barre, PA	3,176	136	1	560,625	0.00		12	3	33	0.0054	0.0087	0.0115	45	47	59	193	201
420710007	5	40.04667	-76.28333	PA	Lancaster	Lancaster, PA	23,906	1,757	1	470,658	0.23		12	3	35	0.0073	0.0175	0.0231	28	14	25	28	35
420950025	5	40.62806	-75.34111	PA	Northampton	Allentown-Bethlehem-Easton, F	12,539	1,013	1	740,395	0.00		12	3	36	0.0065	0.0095	0.0152	33	41	46	91	74
420990301	5	40.45694	-77.16556	PA	Perry	Harrisburg-Carlisle, PA	216	10		509,074	0.00		12	3	36	0.0035	0.0056	0.0084	121	115	108	234	239
421010004	7	40.00889	-75.09778	PA	Philadelphia	Philadelphia-Camden-Wilmingt	40,153	3,461	1	5,687,147	0.03		12	3	36	0.0052	0.0071	0.0090	48	63	88	11	8
421010136	5	39.92750	-75.22278	PA	Philadelphia	Philadelphia-Camden-Wilmingt	49,302	4,171	1	5,687,147	0.01		12	3	34	0.0038	0.0061	0.0104	101	94	68	7	6
421255001	5	40.44528	-80.42083	PA	Washington	Pittsburgh, PA	157	10		2,431,087	0.00		12	3	36	0.0050	0.0067	0.0084	52	78	106	242	238
421290008	5	40.30469	-79.50567	PA	Westmoreland	Pittsburgh, PA	2,609	106	1	2,431,087	0.00		12	3	35	0.0051	0.0070	0.0097	49	69	79	200	208

site	poc	lat	long	state	county_name	cbsa_name	population (mile radius)	under age 5 population (mile radius)	urban	cbsa_pop00	sum point/non-pt Pb EI TPY w/in 1 mile	source oriented?	data completeness (complete periods) qtrs	years	months	3-year metrics annual mean	max quarterly mean	max monthly mean	metric and population ranks (of all Pb-$PM_{2.5}$ sites) annual mean	max quarterly mean	max monthly mean	pop. (M rad.)	under age 5 pop (M rad.)
421330008	5	39.96528	-76.69944	PA	York	York-Hanover, PA	10,121	696	1	381,751	0.06		12	3	34	0.0058	0.0112	0.0169	39	36	42	116	105
440070022	5	41.80795	-71.41500	RI	Providence	Providence-New Bedford-Fall R	35,343	3,116	1	1,582,997	0.00		12	3	36	0.0065	0.0432	0.1103	32	3	3	12	14
440071010	5	41.84092	-71.36094	RI	Providence	Providence-New Bedford-Fall R	7,855	412	1	1,582,997	0.00		5	1	14	0.0030	0.0037	0.0051	147	196	203	136	152
450190049	5	32.79098	-79.95869	SC	Charleston	Charleston-North Charleston, S	17,744	647	1	549,033	0.00		12	3	36	0.0022	0.0035	0.0048	213	202	213	50	110
450250001	5	34.61712	-80.19879	SC	Chesterfield		165	14			0.00		12	3	36	0.0021	0.0035	0.0044	219	201	220	240	232
450450009	5	34.90105	-82.31307	SC	Greenville	Greenville, SC	9,032	592	1	559,940	0.00		12	3	36	0.0026	0.0050	0.0060	184	134	171	126	121
450790019	5	33.99330	-81.02414	SC	Richland	Columbia, SC	15,569	287	1	647,158	0.00		12	3	34	0.0048	0.0092	0.0122	60	43	56	65	172
460990006	5	43.54429	-96.72644	SD	Minnehaha	Sioux Falls, SD	15,357	1,086	1	187,093	0.01		12	3	36	0.0022	0.0031	0.0052	214	218	198	66	67
470370023	5	36.17633	-86.73890	TN	Davidson	Nashville-Davidson--Murfreesb	12,600	739	1	1,311,789	0.00		11	2	34	0.0038	0.0065	0.0107	99	82	65	90	99
470654002	5	35.05093	-85.12631	TN	Hamilton	Chattanooga, TN-GA	4,702	187	1	476,531	0.00		12	3	34	0.0038	0.0050	0.0071	103	131	134	175	191
470931020	5	36.01944	-83.87361	TN	Knox	Knoxville, TN	3,772	211	1	616,079	0.06		10	2	29	0.0039	0.0049	0.0059	93	138	174	184	186
470990002	5	35.11611	-87.47000	TN	Lawrence	Lawrenceburg, TN	202	12		39,926	0.00		12	3	35	0.0021	0.0030	0.0040	215	221	234	236	235
471570047	5	35.16895	-90.02157	TN	Shelby	Memphis, TN-MS-AR	13,177	1,051	1	1,205,204	0.00		12	3	36	0.0033	0.0045	0.0076	131	152	120	84	69
471631007	5	36.54065	-82.52167	TN	Sullivan	Kingsport-Bristol-Bristol, TN-VA	6,580	321	1	298,484	0.00		12	3	33	0.0031	0.0049	0.0086	142	135	101.5	151	165
471650007	5	36.29778	-86.65278	TN	Sumner	Nashville-Davidson--Murfreesb	4,332	387	1	1,311,789	0.00		11	2	32	0.0030	0.0051	0.0068	146	128	142	178	154
480430002	5	30.36580	-103.64910	TX	Brewster		1,792	105			0.00		7	1	20	0.0011	0.0017	0.0043	252	255	222	207	209
480430101	5	29.30250	-103.16782	TX	Brewster		2	0			0.00		8	2	25	0.0008	0.0013	0.0028	256	257	252	256	255
481130050	5	32.77417	-96.79778	TX	Dallas	Dallas-Fort Worth-Arlington, TX	3,394	151	1	5,161,544	0.02		12	3	34	0.0027	0.0041	0.0055	166	173	191	190	198
481130069	5	32.81995	-96.86008	TX	Dallas	Dallas-Fort Worth-Arlington, TX	1,034	76	1	5,161,544	0.01		12	3	36	0.0036	0.0077	0.0169	110	56	41	214	214
481390015	5	32.43694	-97.02500	TX	Ellis	Dallas-Fort Worth-Arlington, TX	658	43		5,161,544	0.00		11	2	31	0.0034	0.0057	0.0085	126	108	103	221	221
481410044	5	31.76567	-106.45523	TX	El Paso	El Paso, TX	16,581	1,695	1	679,622	0.01		12	3	34	0.0036	0.0060	0.0090	116	97	90	59	38
481410053	5	31.75852	-106.50105	TX	El Paso	El Paso, TX	16,866	1,295	1	679,622	0.01		12	3	34	0.0078	0.0148	0.0236	23	21	24	57	54
481670014	5	29.26332	-94.85657	TX	Galveston	Houston-Sugar Land-Baytown,	4,521	260		4,715,407	0.00		11	2	32	0.0023	0.0028	0.0041	201	230	228	177	179
482010024	5	29.90111	-95.32694	TX	Harris	Houston-Sugar Land-Baytown,	12,022	1,163	1	4,715,407	0.00		12	3	35	0.0041	0.0066	0.0087	86	81	98	94	64
482010026	5	29.80250	-95.12555	TX	Harris	Houston-Sugar Land-Baytown,	8,454	914	1	4,715,407	0.00		11	2	31	0.0027	0.0038	0.0056	178	187	184	129	80
482010055	5	29.69574	-95.49924	TX	Harris	Houston-Sugar Land-Baytown,	32,884	3,369	1	4,715,407	0.01		11	2	32	0.0020	0.0026	0.0037	225	239	239	16	11
482011034	5	29.76799	-95.22058	TX	Harris	Houston-Sugar Land-Baytown,	14,785	1,770	1	4,715,407	0.00		11	2	31	0.0030	0.0073	0.0160	149	59	44	72	33
482011039	7	29.67005	-95.12849	TX	Harris	Houston-Sugar Land-Baytown,	13,417	1,183	1	4,715,407	0.00		10	2	30	0.0023	0.0042	0.0072	204	166	133	82	61
482030002	5	32.66900	-94.16745	TX	Harrison	Marshall, TX	78	3		62,110	0.00		11	2	32	0.0018	0.0027	0.0035	236	235	245	247	250
482430004	5	30.66938	-104.02463	TX	Jeff Davis		2	0			0.00		9	1	25	0.0008	0.0014	0.0028	257	256	251	257	257
482450022	5	29.86395	-94.31776	TX	Jefferson	Beaumont-Port Arthur, TX	259	13		385,090	0.00		11	2	32	0.0021	0.0030	0.0049	221	220	210	230	233
482570005	5	32.56917	-96.31583	TX	Kaufman	Dallas-Fort Worth-Arlington, TX	9,794	856	1	5,161,544	0.00		11	2	30	0.0029	0.0063	0.0128	154	85	54	118	86
482730314	5	27.42694	-97.29861	TX	Kleberg	Kingsville, TX	4,535	240		31,963	0.00		10	2	29	0.0009	0.0017	0.0024	255	254	256	176	182
483030001	5	33.59085	-101.84759	TX	Lubbock	Lubbock, TX	9,473	855	1	249,700	0.00		10	2	28	0.0010	0.0024	0.0062	254	242	162	123	87
483390078	5	30.35030	-95.42514	TX	Montgomery	Houston-Sugar Land-Baytown,	561	55		4,715,407	0.00		11	2	32	0.0032	0.0042	0.0058	135	167	180	223	216
483550034	5	27.81180	-97.46563	TX	Nueces	Corpus Christi, TX	5,907	531	1	403,280	0.00		12	3	36	0.0013	0.0021	0.0033	246	249	247	160	133
483611100	5	30.19417	-93.86694	TX	Orange	Beaumont-Port Arthur, TX	345	20		385,090	0.00		11	2	32	0.0019	0.0028	0.0041	231	231	226	228	229
490110004	5	40.90297	-111.88447	UT	Davis	Ogden-Clearfield, UT	13,879	1,301	1	442,656	0.00		10	2	29	0.0035	0.0059	0.0071	118	105	135	79	52
490353006	5	40.73639	-111.87222	UT	Salt Lake	Salt Lake City, UT	23,803	1,757	1	968,858	0.00		12	3	36	0.0042	0.0077	0.0131	84	57	53	30	36
490494001	5	40.34139	-111.71361	UT	Utah	Provo-Orem, UT	6,101	659	1	376,774	0.00		12	3	36	0.0034	0.0072	0.0095	127	62	85	156	109
500070012	5	44.48028	-73.21444	VT	Chittenden	Burlington-South Burlington, VT	14,539	564	1	198,889	0.07		12	3	35	0.0023	0.0029	0.0037	203	224	238	75	127
510870014	5	37.55833	-77.40028	VA	Henrico	Richmond, VA	11,300	1,040	1	1,096,957	0.02		8	2	24	0.0030	0.0042	0.0064	148	163	154	100	70
511390004	5	38.66333	-78.50472	VA	Page		754	33			0.00		8	2	24	0.0027	0.0045	0.0081	171	150	112	217	223
515200006	5	36.60778	-82.16444	VA	Bristol (City)	Kingsport-Bristol-Bristol, TN-VA	5,019	276	1	298,484	0.04		12	3	35	0.0036	0.0057	0.0083	112	114	109.5	172	175
517600020	5	37.51056	-77.49833	VA	Richmond (City)	Richmond, VA	11,322	736	1	1,096,957	0.03		4	1	12	0.0027	0.0033	0.0064	173	211	152	99	101
517700014	5	37.25611	-79.98500	VA	Roanoke (City)	Roanoke, VA	10,951	755	1	288,309	0.01		8	2	24	0.0074	0.0140	0.0283	26	26	16	106	98
530330024	6	47.75333	-122.27722	WA	King	Seattle-Tacoma-Bellevue, WA	7,357	368	1	3,043,878	0.00		12	3	35	0.0030	0.0046	0.0073	151	145	127	138	159
530330032	6	47.54556	-122.32222	WA	King	Seattle-Tacoma-Bellevue, WA	6,716	386	1	3,043,878	0.25		7	1	22	0.0095	0.0134	0.0201	17	27	30	147	155
530330048	6	47.61846	-122.32972	WA	King	Seattle-Tacoma-Bellevue, WA	47,956	795	1	3,043,878	0.00		12	3	33	0.0032	0.0052	0.0089	136	127	91	8	94
530330057	6	47.56333	-122.33833	WA	King	Seattle-Tacoma-Bellevue, WA	2,325	133	1	3,043,878	0.26		12	3	33	0.0074	0.0150	0.0260	27	20	20	202	202
530330080	6	47.57027	-122.30860	WA	King	Seattle-Tacoma-Bellevue, WA	11,847	695	1	3,043,878	0.00		12	3	36	0.0034	0.0055	0.0075	124	118	121	97	106
530630016	5	47.66083	-117.35722	WA	Spokane	Spokane, WA	6,466	527	1	417,939	0.00		4	1	11	0.0038	0.0062	0.0087	102	92	97	153	135
540390011	5	38.44861	-81.68389	WV	Kanawha	Charleston, WV	708	45		309,635	0.00		9	2	25	0.0026	0.0043	0.0048	183	157	212	220	219
540391005	5	38.36806	-81.69361	WV	Kanawha	Charleston, WV	4,033	202	1	309,635	0.33	1	8	2	25	0.0043	0.0067	0.0077	73	77	118	182	188
540511002	5	39.91597	-80.73406	WV	Marshall	Wheeling, WV-OH	5,133	256	1	153,172	0.00		6	1	19	0.0065	0.0081	0.0124	34	54	55	171	180
550270007	5	43.43500	-88.52778	WI	Dodge	Beaver Dam, WI	100	6		85,897	0.00		12	3	36	0.0036	0.0059	0.0083	115	104	109.5	245	243
550590019	5	42.50472	-87.80930	WI	Kenosha	Chicago-Naperville-Joliet, IL-IN	1,595	85		9,098,316	0.00		12	3	36	0.0038	0.0057	0.0073	98	113	126	208	213
550710007	5	44.13861	-87.61611	WI	Manitowoc	Manitowoc, WI	529	29		82,887	0.00		8	2	25	0.0039	0.0060	0.0113	92	98	62	225	226
550790026	5	43.06111	-87.91250	WI	Milwaukee	Milwaukee-Waukesha-West All	27,788	2,359	1	1,500,741	0.00		12	3	36	0.0058	0.0115	0.0245	41	33	22	24	23
551198001	5	45.20389	-90.60000	WI	Taylor		16	1			0.00		12	3	36	0.0020	0.0030	0.0050	222	222	208	254	254
551330027	5	43.02028	-88.21500	WI	Waukesha	Milwaukee-Waukesha-West All	10,917	707	1	1,500,741	0.03		12	3	36	0.0097	0.0185	0.0217	15	11	28	107	102
720610001	5	18.42472	-66.11639	PR	Guaynabo	San Juan-Caguas-Guaynabo, P	319	5	1	2,509,007	0.10		12	3	36	0.0018	0.0026	0.0058	237	240	178	229	246

July 25, 2007

Appendix B: Background on Case Studies

Prepared by:

ICF International
Research Triangle Park, NC

Prepared for:

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina

Contract No. EP-D-06-115
Work Assignment No. 0-4

Table of Contents

List of Exhibits

List of Attachments

B. BACKGROUND ON CASE STUDIES

This appendix provides descriptions of the primary lead (Pb) smelter and secondary Pb smelter case study locations, accompanied by an overview of the available human exposure measurements (i.e., human blood Pb [PbB] levels), emissions, and environmental data for each site. The primary Pb smelter is discussed in Section B.1; the secondary Pb smelter is discussed in Section B.2.

B.1. PRIMARY PB SMELTER CASE STUDY

The Herculaneum Lead Smelter (HLS) is currently the largest source of Pb metal and the only currently operating Pb smelter in the United States (Missouri Department of Natural Resources (MDNR), 2005). The HLS facility (hereafter referred to as the "primary Pb smelter") represents a relatively large point source that has been active for more than a century (MDNR, 2005) and for which a large amount of site-specific data characterizing both media concentrations (soil, indoor dust, and ambient air) and human PbB levels is available. Pb contaminant conditions for the area surrounding this facility are dominated by emissions from this facility, with older historical automobile and other point source emissions being of relatively lesser importance. Environmental sampling conducted around the primary Pb smelter has shown Pb contamination throughout the community surrounding the smelter. Available environmental data are discussed in Section B.1.5 and presented in Attachments B-1 through B-13.

B.1.1. Description of Case Study Location

The primary Pb smelter facility is located in Herculaneum, Missouri. The City of Herculaneum is in Jefferson County, about 42 kilometers (km) (26 miles [mi]) southwest of St. Louis, and its approximate area is 9 square kilometers (km^2). As of 2000, an estimated 37,562 people were living within a 10-km radius of the primary Pb smelter (2,064 within 2 km; 14,237 between 2 and 5 km; and 21,261 between 5 and 10 km). Of this population in 2000, 3,880 were children 7 years of age and younger (171 within 2 km; 1,545 between 2 and 5 km; and 2,164 between 5 and 10 km) (U.S. Census Bureau, 2005).[1]

---

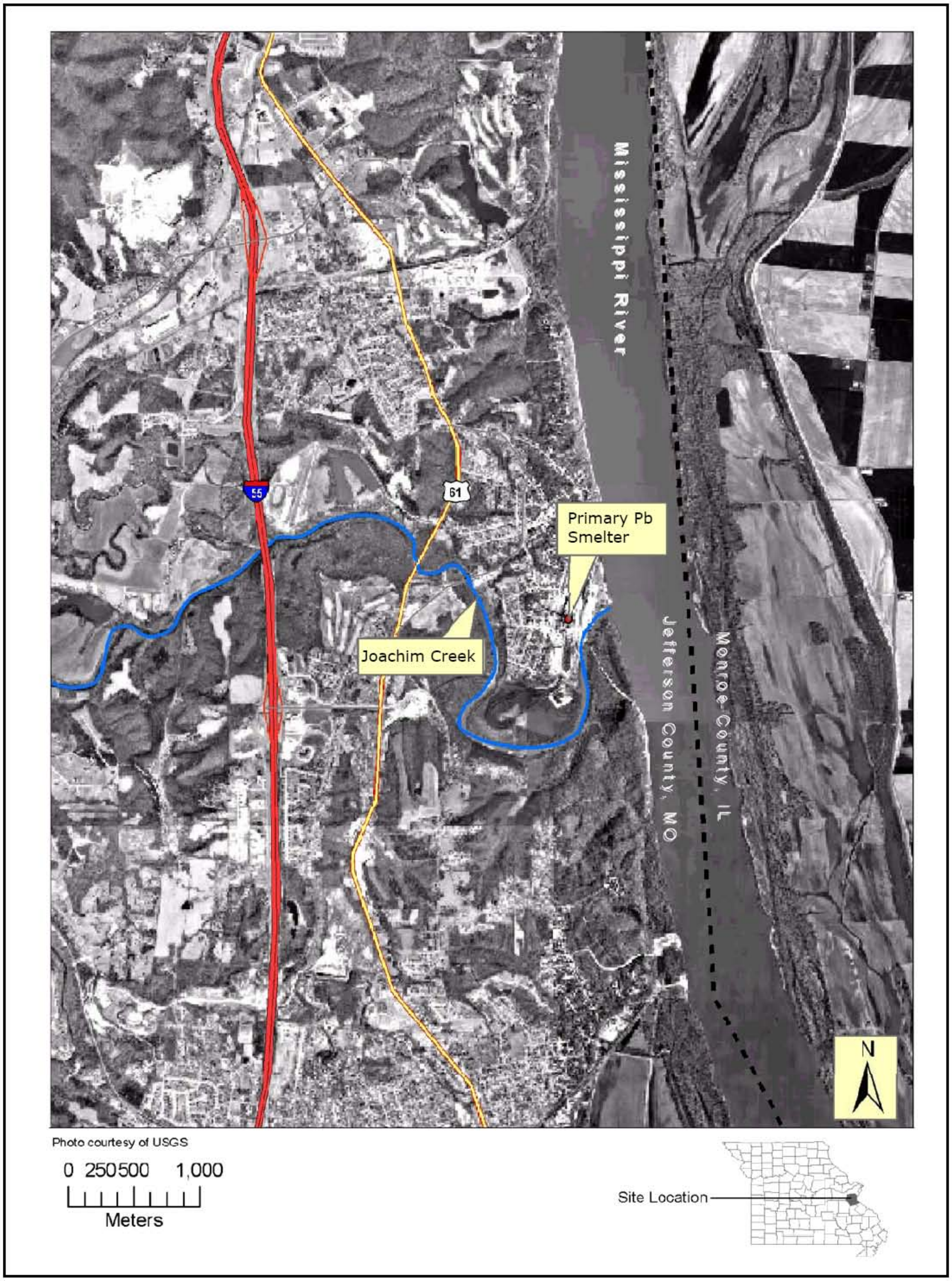
[1] In 2002, the company that owns the primary Pb smelter facility offered a voluntary property acquisition of homes within a specified geographic area, approximately 3/8 mile around the smelter. The 2000 U.S. Census population counts in the U.S. Census blocks that comprise the buy-out area were excluded from these population estimates (since it is known that individuals no longer reside in these areas).

B.1.2. Description of Primary Pb Smelter

The primary Pb smelter facility is located at 881 Main Street in Herculaneum, Missouri (see Exhibit B-1). The property associated with this facility covers 52 acres and consists of 3 main areas: (1) the smelter plant, which is located on the east side of Main Street; (2) office buildings located on the west side of Main Street; and (3) a 40- to 50- foot (ft) high furnace waste (i.e., slag) storage pile that covers 24 acres. The facility is bordered on the east by the Mississippi River, on the southeast by Joachim Creek, on the west and north-northwest by residential areas, and on the south-southwest by the slag pile. A large part of the slag pile is located in the floodplain wetlands of Joachim Creek and the Mississippi River.

The principal processing occurring at the facility includes: (1) sintering, smelting, and refining of Pb ore; (2) sulfuric acid production from waste sulfur-containing gases generated by the sintering operation; and (3) wastewater treatment. Sources at the facility include various stacks and vents from plant processes, fugitive emissions from ore handling operations, wind erosion from the slag pile, and fugitive emissions from transport of Pb concentrate over local roads. A Pb ore concentrate, consisting of approximately 80 percent Pb sulfide, is processed at the smelter. The ore is transported by truck from eight Pb mines near Viburnum, Missouri, approximately 121 km (75 mi) south-southwest of Herculaneum. The smelting operation generates a molten slag, 20 percent of which is sent to the slag storage pile as waste. Stack and fugitive emissions from the facility and deposition of these emissions to soil and surface water have resulted in elevated Pb concentrations in the surrounding areas (MDNR, 1999), as cited in Agency for Toxic Substances and Disease Registry (ATSDR) (2003).

1 **Exhibit B-1. Facility Location Map – Primary Pb Smelter**



2
3

B.1.3. Human Exposure Measurements

PbB levels at or above 10 micrograms (µg) per deciliter (dL) have been recorded for Herculaneum residents, including children less than 72 months of age (ATSDR, 2002; 2003). The U.S. Department of Health and Human Services (DHSS) and the Jefferson County Health Department (JCHD), in cooperation with ATSDR, have offered PbB testing to the residents of Herculaneum and surrounding communities. Results of two such testing events conducted in 2001 and 2002 have been documented in DHSS/ATSDR health consultation reports (ATSDR, 2002; 2003) and are summarized here.

A total of 935 Herculaneum residents were tested in 2001. A summary of PbB results by age group is provided in Exhibit B-2. Of the children less than 72 months old that were tested in 2001, 33 (28 percent) had PbBs of 10 µg/dL or greater. In the area closest to the primary Pb smelter, 30 out of 67 (45 percent) of the children under 72 months of age who were tested in 2001 had PbBs equal to or above 10 µg/dL (ATSDR, 2002).

Exhibit B-2. Summary of 2001 PbB Measurements for Herculaneum Residents

PbB (µg/dL)	Number of Individuals Tested [a]	Percent of Individuals Tested in PbB Range [b]
Children Less than 72 Months of Age		
0 to 9	85	72%
10 to 19	27	23%
20 to 29	5	4%
30 or Higher	1	1%
Children Between 6 and 17 Years of Age		
0 to 9	149	92%
10 to 19	13	8%
20 to 29	0	-
30 or Higher	0	-
Adults 18 Years of Age or Older		
0 to 24	653	>99%
25 to 39	1	<1%
40 to 49	0	-
50 or Higher	1	<1%

[a] Data derived from ATSDR (2002).
[b] Percentile estimates (based on reported values and the total sample size of the study) have been added to the tables to facilitate interpretation of the results.

In September 2002, DHSS and JCHD conducted a voluntary community-wide PbB testing event, during which 340 Herculaneum residents were tested. Exhibit B-3 summarizes results sorted by age group for Herculaneum residents. As shown in Exhibit B-3, of the children less than 72 months old that were tested in 2002, 8 (14 percent) had PbBs of 10 µg/dL or higher.

Exhibit B-3. Summary of 2002 PbB Measurements for Herculaneum Residents

PbB (µg/dL)	Number of Individuals Tested [a]	Percent of Individuals Tested in PbB Range [b]
Children Less than 72 Months of Age		
0 to 9	50	86%
10 to 19	6	10%
20 to 29	2	4%
30 or Higher	0	-
Children Between 6 and 17 Years of Age		
0 to 9	127	98%
10 to 19	2	2%
20 to 29	0	-
30 or Higher	0	-
Adults 18 Years of Age or Older		
0 to 24	147	96%
25 to 39	5	3%
40 to 49	1	1%
50 or Higher	0	-

[a] Data derived from ATSDR (2003, Tables 1 to 3).
[b] Percentile estimates (based on reported values and the total sample size of the study) have been added to the tables to facilitate interpretation of the results.

While summarized data for Herculaneum are not available for more recent years than 2002, county-level information on the numbers of children with PbB levels above 10 µg/dL is available from the State of Missouri web site through 2005 (although 2004 data are not available). While not necessarily specific to the town of Herculaneum, it is noted that the percentage of tested children with PbB levels above 10 µg/dL in Jefferson County declined slightly in 2005 as compared to 2002 and 2003 (see Exhibit B-4).

Exhibit B-4. Percentage of Tested Children with PbB Levels above 10 µg/dL in Jefferson County (1997 through 2003; 2005)

Parameter	Year							
	1997	1998	1999	2000	2001	2002	2003	2005
Number of Children Tested	367	412	293	656	1207	1355	2070	1607
Percent Tested Above 10 µg/dL	8%	3%	4%	4%	4%	2%	2%	1%

Note: Data derived from State of Missouri Department of Health and Senior Services (DHSS) (2007).

B.1.4. Emissions

The Pb emissions estimates used for the National Ambient Air Quality Standard (NAAQS) scenario for the primary Pb smelter case study were obtained from U.S. EPA Region 7 and reflect the proposed 2007 Revision of the State Implementation Plan (SIP) developed for the facility (MDNR, 2007a; 2007b). Rather than representing current conditions at the facility, these emissions represent the maximum allowable Pb emissions (per the proposed 2007 SIP) estimated to result in attainment of the current NAAQS.[2]

---

[2] Several different Herculaneum emission situations are alternately discussed within this report and other appendices. While they are related, each is distinct and provides a different type of information. The 2002 NEI emissions (discussed in Appendix A) are emissions reported by the Doe Run Company to the state. While these emissions may be derived from stack tests and should reflect 2002 production levels, emissions such as building or storage pile fugitives and emissions from materials handling or activity on facility roads may be less completely accounted for in the 2002 reported values. These 2002 NEI emissions should not be confused with current conditions or maximum allowable Pb emissions. "Current conditions at the facility" may be described as the actual emissions being released from all facility-related sources at present, given current controls, work practices, and process throughputs. The "maximum allowable Pb emissions" refers to the emissions allowed under the proposed 2007 SIP revision. The 2007 SIP revision proposes a portfolio of controls focused on reducing Pb emissions from sources identified as significant contributors to recent NAAQS exceedances (e.g., Pb emissions associated with materials handling, activity on facility roads, building fugitives, among others). A lesser contributor to air Pb concentrations in Herculaneum, but a large source of measured emissions, is the facility's main stack. Due to the main stack height and the high process temperature, considerable dispersion occurs resulting in a low impact from the main stack on the air concentrations in the City of Herculaneum. As a result of this condition, in combination with lower actual production and other process controls at the Herculaneum plant, the reported main stack emissions (either in the 2002 NEI or the current actual emissions) are considerably lower than their SIP allowable level. Altogether, the maximum allowable emissions from facility-related sources have been modeled by Missouri in their 2007 SIP revision for the purpose of demonstrating attainment of the 1.5 $\mu g/m^3$ per quarter NAAQS. Thus, it is the maximum allowable emissions under the proposed 2007 SIP revision that are used for the current NAAQS scenario for this case study.

The proposed 2007 SIP describes maximum allowable Pb emissions from processes at the facility, fugitive emissions from transferring of materials, fugitive emissions from storage at the slag pile and other process storage piles, building fugitives, and emissions associated with dust from roadways in the vicinity of the smelter. Particle sizes for emissions from road segment emission points around the primary Pb smelter ranged from 1.6 to 25.3 micrometers (µm). Particle sizes for emissions from all other emission points at the primary Pb smelter ranged from 1.6 to 45 µm. Note that EPA has not completed its review of the proposed 2007 SIP revision associated with these emissions. Consequently, the dispersion model runs completed for this assessment using these emissions should be considered illustrative only. Emissions and release parameters, particle size inputs, and other inputs used for fate and transport modeling of the primary Pb smelter are provided in Appendix D, Attachments D-1 to D-6.

B.1.5. Summary of Environmental Data

The environmental data sets available for the primary Pb smelter case study are summarized in Exhibit B-5. These data are discussed in the sections following this exhibit.

Exhibit B-5. Summary of Environmental Data Sources for Primary Pb Smelter Case Study

Medium	Data Set [a]	Timeframe	Locations	Comments
Ambient air	EPA Air Quality System (AQS) Database	2001 to 2005	9 locations	Pb-total suspended particulate matter (TSP) monitors located within 10 km of facility; see Attachments B-1 and B-2
	Monitors not in AQS [b]	2001 to 2003	4 locations	Pb-TSP monitors located along roads; see Attachments B-1 and B-3
Residential Soil	Pre-excavation	2000 to 2004	Over 900 locations around the primary Pb smelter	Locations within approximately 2.4 km (1.5 mi) of facility; see Attachment B-4
	Post-excavation	2000 to 2004	Approximately 300 locations around the primary Pb smelter	Locations within approximately 2.4 km (1.5 mi) of facility; see Attachment B-5
	Recontamination assessment	2002 to 2006	31 residences	Locations within approximately 1.6 km (1 mi) of facility; see Attachments B-6 and B-7
Indoor dust	Recontamination assessment	2002 to 2006	17 residences	Locations within approximately 1.6 km (1 mi) of facility; see Attachment B-8
Deposition to soil	Soil boxes	2003 to 2004 [c]	10 locations	See Attachments B-9 and B-10
Deposition to air	Filters	2003 to 2004 [c]	10 locations	See Attachments B-9 and B-11

[a] Several data sources existed, including analyses conducted by the U.S. EPA, the primary Pb smelter facility, ATSDR, MDNR, and various consultants. Aside from the U.S. EPA's AQS air monitoring data, the data represented in this table were obtained electronically from the U.S. EPA Region 7 (2006). The data presented in this table are the only environmental data discussed and summarized for the primary Pb smelter in this appendix and in the associated attachments. Attempts were made to obtain environmental data from sources outside the U.S. EPA, but no additional data were received within the time available for this assessment.
[b] The four monitors not in AQS were placed by the Superfund program for their objectives, and are additional to the nine AQS monitors in place for U.S. EPA's air monitoring program objectives. The data for the four Superfund monitors are not stored in AQS, but were received directly from the U.S. EPA Region 7.
[c] These are the most recent data available from the U.S. EPA Region 7.

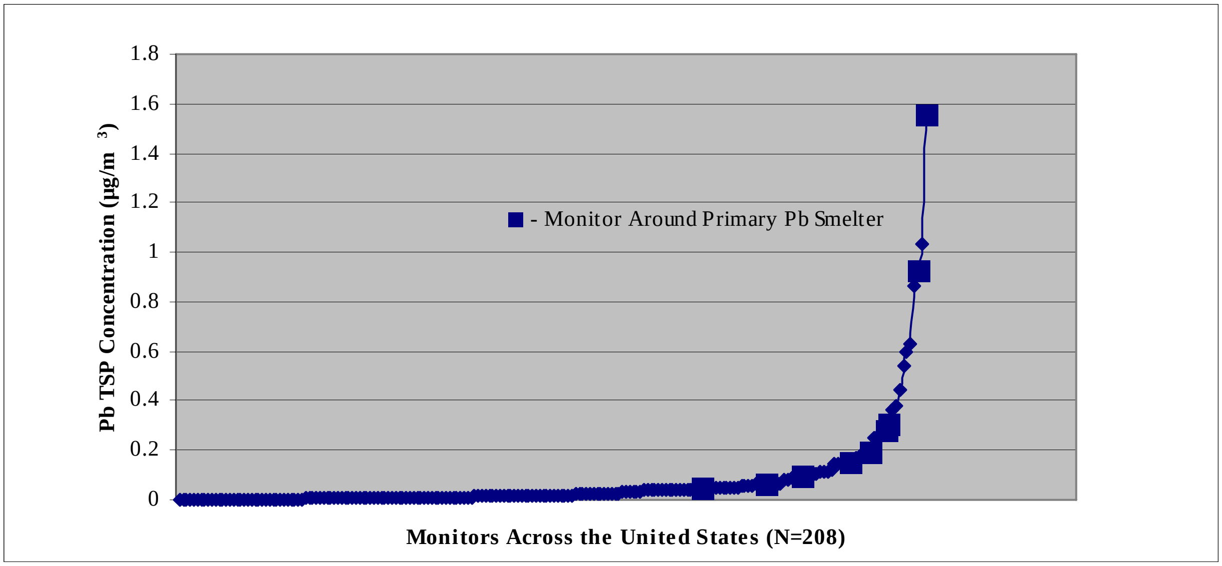
B.1.5.1. Air Monitoring

As shown in Exhibit B-5, two air monitoring data sets are available from the U.S. EPA for the primary Pb smelter. Attachment B-1 shows the locations of the 13 air monitoring locations relative to the facility.

Air monitoring data for the nine AQS monitors are provided by year in Attachment B-2. These data indicate a reduction in average annual Pb concentration between 2001 and the subsequent years. The largest difference was observed for Monitor ID 290990005 (located near a public school, approximately 0.8 km (0.5 mi) from the smelter's main stack [see Attachment B-1]), where average annual Pb concentrations decreased from 2.10 µg/m^3 in 2001 to 0.28 to 0.44 µg/m^3 for the subsequent years. It is additionally noted that for 2005, however, the most recent year for which annual average values are reported in Attachment B-2, exceedances of the NAAQS (1.5 µg/dL as a maximum quarterly average) occurred at a different monitor during three of the four quarters (USEPA, 2007). Air monitoring data for the four additional monitoring sites not in AQS are provided by year in Attachment B-3. In general, data were collected from the four monitors for portions of years over the period of 2001 through 2003. A complete year's set of data (for 2002) was available for only two monitors (Full-Scale Analysis IDs 100 and 102).

For comparison purposes, the average annual Pb concentrations for 2005 from AQS monitors located around the primary Pb smelter were compared to AQS monitor results across the United States. Exhibit B-6 shows the distribution of average annual Pb concentrations in TSP for 208 monitoring sites across the United States (with average annual monitored Pb concentrations sorted in ascending order). The 2005 monitor results for the nine AQS monitors located in the vicinity of the primary Pb smelter are indicated using a solid square (■). The annual average Pb concentrations for the 208 monitoring sites ranged from 0.001 to 1.56 µg/m^3. The 1.56 µg/m^3 maximum annual average is associated with monitoring site 290990015, one of the monitoring sites identified within 10 km of the primary Pb smelter. Of the 208 monitoring site locations, the nine within 10 km of the primary Pb smelter all fall within the top 30 percent of annual average values for all 208 monitoring sites, with four of the nine monitoring sites in the top 10 percent.

Exhibit B-6. Distribution of 2005 Annual Average Values for Pb-TSP Measurements at Monitor Sites across the United States Relative to Monitors near the Primary Pb Smelter



B.1.5.2. Soil

As shown in Exhibit B-5, three soil data sets are available from the U.S. EPA for the primary Pb smelter: pre-excavation, post-excavation, and recontamination assessment data. Pre-excavation soil samples were collected from residential locations around the smelter prior to soil removal activities. Pre-excavation soil sample results for over 900 residential locations around the primary Pb smelter are presented in Attachment B-4. Average soil concentrations at these sampling locations ranged from 53 to 23,350 milligrams per kilogram (mg/kg).

Based on pre-excavation sampling results, Pb-contaminated soil in a subset of the 900 sampled residential yards near the smelter was removed, replaced with clean backfill, and re-seeded with grass. Post-excavation soil data were available for over 300 residential locations. Post-excavation soil samples were collected immediately following excavation, prior to the yards being backfilled with clean soil. Post-excavation results are presented in Attachment B-5. Average soil concentrations at these properties ranged from 70 to 2,757 mg/kg.

The U.S. EPA has recently conducted post-remediation residential yard soil sampling at 31 locations within a radius of approximately 1.6 km (1 mi) of the primary Pb smelter to determine whether residential yards in which Pb-contaminated soil was removed and replaced with clean soil are becoming recontaminated. Results from the recontamination assessment samples are provided in Attachment B-6. For most of the 31 recontamination assessment locations within 1.3 km (0.8 mi) of the facility, average Pb concentrations in the replacement “clean” soil increased between 2002 and 2006. Refer to Attachment B-7 for a summary of the pre-excavation, post-excavation, and recontamination assessment data for these 31 residential locations.

B.1.5.3. Indoor Dust

The interiors of 17 of the 31 residential properties identified for the soil recontamination assessment were also assessed for Pb levels in indoor dust. Indoor dust removal (in which areas inside homes were wiped and/or vacuumed) was performed at these residences prior to recontamination sampling. Attachment B-8 provides a summary of recontamination indoor dust sample results for these 17 properties. Carpet dust samples collected during recontamination sampling events at these residences contained Pb concentrations that ranged from 122 to 4,350 mg/kg. Pb loadings in window sill wipe samples ranged from 5.6 to 1,385 µg per square foot (ft^2). No general patterns were identified at homes during successive sampling events. Pb concentrations and/or loadings may have increased, decreased, or remained generally the same (see Attachment B-8). This lack of pattern may be attributed in part to inconsistent house cleaning protocols within the homes.

B.1.5.4. Deposition

As shown in Exhibit B-5, soil boxes[3] were set up at 10 locations (primarily along roads) within approximately 1.8 km (1.1 mi) of the main stack at the primary Pb smelter. Deposition monitoring locations are shown in Attachment B-9. From 2003 to 2004, samples were collected monthly to measure Pb deposition on soil; results for these locations are presented in Attachment B-10. Maximum concentrations at the nine locations (excluding the control site) ranged from 25 to 406 mg/kg in 2003 and from 25.3 to 527 mg/kg in 2004. The overall average Pb concentration in these soil boxes across all nine locations increased from 49 mg/kg in 2003 to 96.5 mg/kg in 2004, an increase of almost 100 percent.

Air deposition monitoring data were available for the same 10 locations around the primary Pb smelter for which soil box monitoring data were available (see Attachment B-9). Dry deposition samples were collected monthly at two levels (1 ft and 10 ft) above the ground surface from April 2003 through April 2004. Data collected at each level for these locations are presented in Attachment B-11. The annual Pb deposition rates at a height of 1 ft for the nine monitoring locations (excluding the control site) ranged from 0.34 to 22 mg/ft^2, and the overall average Pb deposition rate across all nine locations at the height of 1 ft was 4.8 mg/ft^2. The annual Pb deposition rates at a height of 10 ft for the nine monitoring locations ranged from 0.26 to 33 mg/ft^2, and the overall average Pb deposition rate across all nine locations at the height of 10 ft was 5.0 mg/ft^2. The average annual Pb air deposition rates at each level by location are provided in Attachment B-11.

B.2. SECONDARY PB SMELTER CASE STUDY

The secondary Pb smelter case study focused on the impacts of emissions from a smaller point source (compared to the primary Pb smelter) located in Alabama. Fewer site-specific data characterizing media concentrations and human exposure levels were available for this study area than for the primary Pb smelter case study. However, recent air concentration data from the area surrounding the facility and facility characterization data (including emission estimates) were readily available.

---

[3] Clean soil is placed in containers that measure approximately 2 ft by 3 ft, 8 to 12 inches deep and are set on the ground. Soil box measurements were taken by placing an X-ray fluorescence (XRF) meter directly on the soil surface in the soil box. Soil boxes were intended to provide a repeatable means of measuring Pb deposition on soil that would be less likely to be disturbed than soil in residential yards (Staley et al., 2002).

B.2.1. Description of Case Study Location

The secondary Pb smelter case study location is in Troy, Alabama. Troy is a city located in Pike County, positioned in the south-central portion of the state, and its approximate area is 68 km^2. As of 2000, an estimated 17,910 people were living within a 10-km radius of the facility (2,186 within 2 km; 10,634 between 2 and 5 km; and 5,090 between 5 and 10 km). Of this population, 1,672 are children ages 7 years and under (187 [11 percent] within 2 km; 896 [54 percent] between 2 and 5 km; and 589 [35 percent] between 5 and 10 km) (U.S. Census Bureau, 2005).

As of 2002, 15 secondary Pb smelters in the United States were operating in 11 states (EC/R Incorporated, 2006). Population data (total population and population of children 7 years and under) around these 15 facilities are provided in Exhibit B-7. Of these 15 facilities, the secondary Pb smelter in Troy, Alabama, had the highest percentage (at 11 percent) of children ages 7 years and under living within 2 km of the facility. The percentage of children ages 7 years and under living within 2 km of secondary Pb smelters in other parts of the United States ranged from 0 to 6 percent (see Exhibit B-7).

Exhibit B-7. Population Data around Secondary Pb Smelters in the United States

No.	Location	Population Numbers at Select Distances [a]								
		0 to 2 km			2 to 5 km			5 to 10 km		
		Total	Children 0 to 7		Total	Children 0 to 7		Total	Children 0 to 7	
1	***Troy, AL***	***2,186***	***187***	***11%***	***10,634***	***896***	***54%***	***5,090***	***589***	***35%***
2	Vernon, CA	29,609	5,334	2%	323,643	55,079	24%	1,122,949	172,709	74%
3	City of Industry, CA	15,311	1,858	2%	141,005	19,517	20%	565,507	77,962	78%
4	Tampa, FL	6,302	650	2%	34,361	4,232	14%	201,068	24,718	84%
5	Muncie, IN	1,352	152	3%	5,535	600	13%	51,174	4,074	87%
6	Indianapolis, IN	5,649	716	3%	41,129	4,872	20%	155,030	19,261	78%
7	Baton Rouge, LA	2,931	251	3%	13,427	1,715	19%	52,086	7,247	82%
8	Eagan, MN	6,034	929	5%	33,383	4,756	24%	132,923	14,486	72%
9	Boss, MO	2,064	171	4%	14,237	1,545	40%	21,261	2,164	56%
10	Forest City, MO	22	4	2%	79	6	3%	1,676	159	95%
11	Middletown, NY	983	0	0%	33,589	4,016	54%	33,791	3,719	50%
12	Lyon Station, PA	1,059	111	3%	12,569	995	30%	26,684	2,356	71%
13	Reading, PA	9,416	746	4%	58,609	7,444	37%	112,425	11,834	59%
14	College Grove, TN	335	36	6%	1,233	108	19%	4,476	434	75%
15	Frisco, TX	5,097	863	4%	27,691	4,938	24%	92,476	14,620	72%

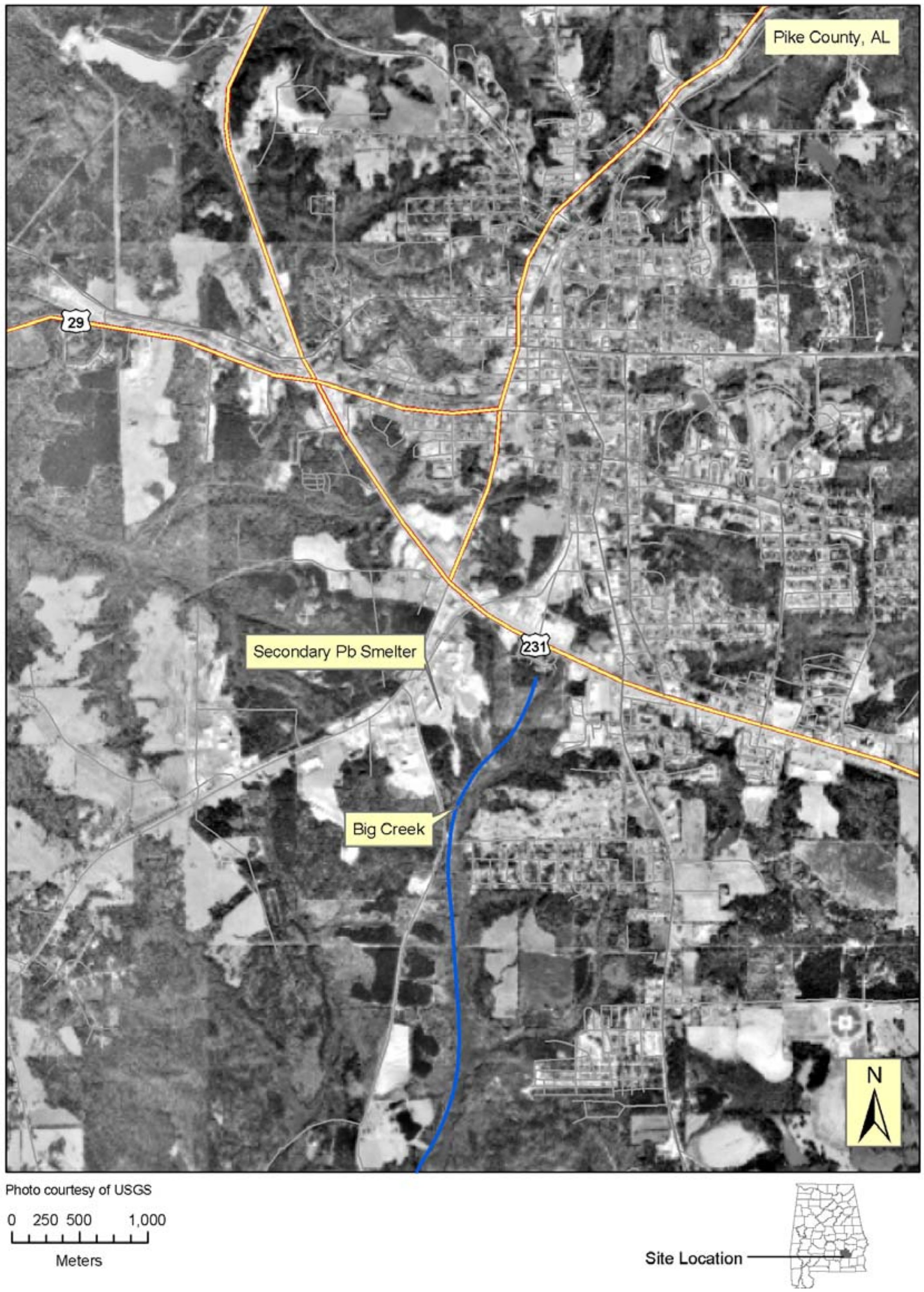
[a] Data derived from U.S. Census Bureau (2005).

B.2.2. Description of Secondary Pb Smelter

The location of this facility is bordered by US-231 to the north-northeast and by a railroad line and Henderson Highway along the north-northwestern and western boundaries of the facility. The area located directly west of Henderson Highway is forested. To the south and south-southwest are other industries and businesses. Big Creek appears to be the closest major water body, located approximately 0.8 km (0.5 mi) south-southeast from the center of the facility. The City of Troy is located north and east of the facility and north of US-231 (see Exhibit B-8).

Secondary Pb smelters produce Pb from scrap and provide the primary means for recycling Pb-acid automotive batteries. Approximately 95 percent of all Pb-acid batteries are recycled at secondary Pb smelters. Secondary Pb smelters perform three basic unit operations: battery breaking, smelting, and refining and alloying. Battery breaking is accomplished by either crushing or cutting battery cases into pieces. The plastic, spent acid, and Pb-bearing materials are then separated. Pb-bearing materials are processed in one of three types of smelting furnaces: blast, reverberatory, or rotary. Molten Pb from these furnaces is further processed in refining kettles and subsequently cast into molds. The waste stream from the furnaces (i.e., slag) is either returned to the primary smelting furnace or treated in a separate furnace dedicated to slag cleaning to recover additional Pb. Three types of emission sources occur at secondary Pb facilities: process sources, process fugitive sources, and fugitive dust sources. The types of sources at the secondary Pb smelter analyzed in these assessments include: blast furnace, agglomeration furnace, alloying kettles and heating system, flue dust storage bins, and slag treatment furnace. Stack emissions from the facility and fugitive emissions associated with materials storage and handling and roadway dust have resulted in releases of Pb to the air and soil (EC/R Incorporated, 2006).

Exhibit B-8. Facility Location Map – Secondary Pb Smelter



B.2.3. Human Exposure Measurements

No information on children's PbB levels specific to the area around the secondary Pb smelter was identified. However, the Lead Poisoning Prevention Branch of the Centers for Disease Control and Prevention (CDC) collected PbB surveillance data for children less than 72 months of age in Pike County, Alabama, in 2005. Of the 154 children tested by the CDC, there were 19 (approximately 12 percent) confirmed cases of elevated PbB (i.e., PbB above 10 μg/dL). For children less than 72 months of age in the state of Alabama and in the United States as a whole, the confirmed elevated PbBs as a percent of children tested in 2005 was 1.4 percent and 1.6 percent, respectively (CDC, 2005). Note, however, that the statistics for children in Pike County do not necessarily represent PbBs for children living in Troy, Alabama, or children living in the areas immediately impacted by emissions from the secondary Pb smelter. In addition, it is not known to what extent older housing (with elevated concentrations of Pb in drinking water and paint) may be contributing to elevated Pb levels in the surveyed population.

B.2.4. Emissions

As of June 9, 1994, when the U.S. EPA proposed the secondary Pb smelter MACT standard (59 FR 63941), 23 secondary Pb smelters were operating in the United States. As of 2002, 15 facilities were operating. Of these 15 facilities, the secondary Pb smelter analyzed in this study is the third highest emitter of Pb (EC/R Incorporated, 2006).

The estimates for process emissions for the secondary Pb smelter analyzed in this assessment were calculated from Pb emissions measured during stack tests performed in 2005 and 2006 (URS Corporation, 2005a; 2005b; 2006b). Fugitive emissions for four fugitive sources (associated with the smelter building, materials handling, loader traffic, and truck traffic) were estimated based on 1987 Prevention of Significant Deterioration (PSD) data (URS Corporation, 2006a), which were the most recent available data on fugitive emissions from the facility. The cumulative Pb emissions from this facility, including facility process and fugitive emissions were estimated to be 3.11 tons per year (tons/year).

Particle sizes for emissions from point sources at the facility ranged from 0.5 to 10 μm, and particle sizes for emissions from area sources at the facility ranged from 1.25 to 22.5 μm. Emissions and release parameters, particle size inputs, and other inputs for fate and transport modeling for the facility are provided in Appendix E, Attachments E-1 and E-2.

The emissions used in this assessment differ slightly from those used in the pilot-scale assessment, which matched estimates for the facility contained in the 2002 National Emissions Inventory (NEI). The 2002 NEI process emissions were estimated based on stack tests performed in December 1997, November 1999, and February 2000 (EC/R Incorporated, 2006), and fugitive emissions were estimated by comparing the modeled concentrations from the process emissions to background Pb concentrations and monitored concentrations (EC/R Incorporated, 2006). The cumulative emissions estimate in the 2002 NEI, and modeled in the pilot-scale assessment, including facility process and fugitive emissions, was approximately 4.6 tons/year. For this assessment, the use of more recent stack test data has produced a process emissions estimate that is approximately 30 percent lower.

B.2.5. Summary of Environmental Data

The environmental data sets available for the secondary Pb smelter case study are summarized in Exhibit B-9.

Exhibit B-9. Summary of Environmental Data Sources for Secondary Pb Smelter Case Study

Medium	Data Set [a]	Timeframe	Locations	Comments
Ambient air	EPA's AQS	1998 to 2002 [b]	2 locations	Pb-TSP monitors located 400 and 680 meters (m) from the facility; see Attachments B-12, B-13.
Residential soil	No data identified.			
Indoor dust	No data identified.			
Deposition	No data identified.			

[a] In general, site characterization information was lacking for this secondary Pb smelter. Data, with the exception of limited air monitoring data, were not available based on information from the U.S. EPA Region 4. Information from the Alabama Department of Environmental Management (ADEM) indicates relevant soil data may be available from the facility (ADEM, 2006); however, no data have been obtained to date.
[b] Monitor values from 1998 to 2002 were obtained from U.S. EPA's Air Quality System (AQS) database for the purpose of comparing monitored values to modeled air concentrations (see Appendix E). Note that the comparison of these monitoring data to modeling results (presented in Appendix E) is limited by the fact that the modeled emissions are based on a combination of emission estimates from 1987, 2005, and 2006 and thus may not be completely representative of the emissions captured in these monitoring data.

B.2.5.1. Air Monitoring

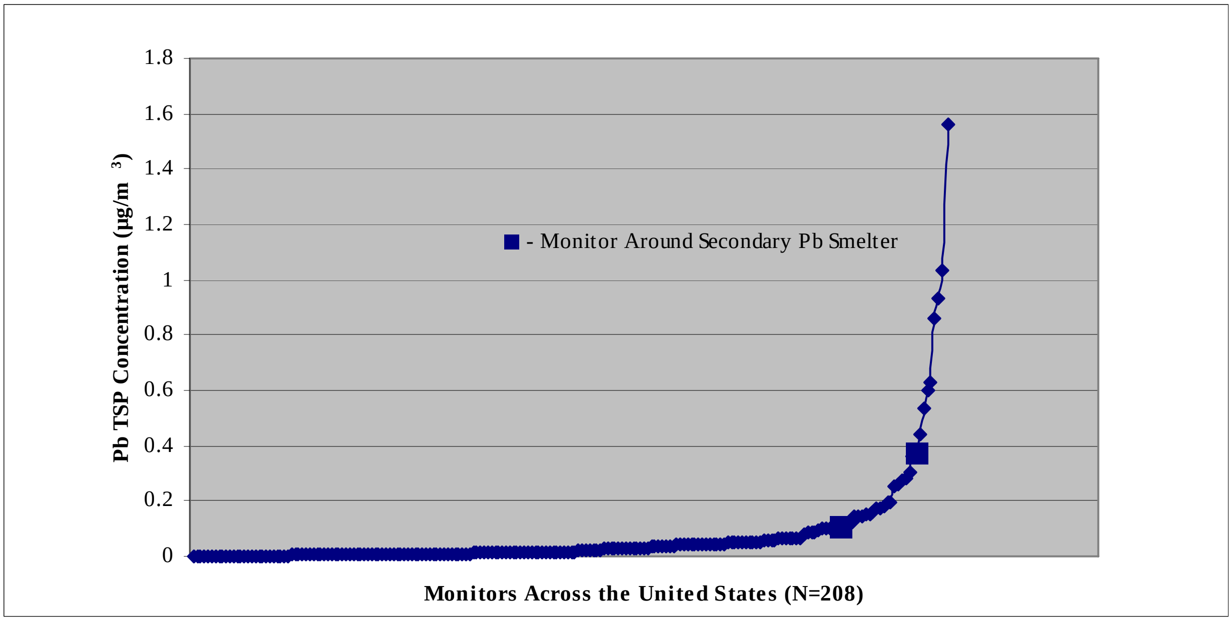
As shown in Exhibit B-9, average annual Pb concentrations in the vicinity of the secondary Pb smelter were available from U.S. EPA's AQS database (USEPA, 2007) for two air monitors located near the facility (see Attachment B-12). Data from these two air monitoring sites for 1998 through 2002 (see Attachment B-13) were compared to the modeled air concentrations. These years of monitoring data were selected to correspond to the years of meteorological data used in the air modeling.[4] Over this period, average annual Pb concentrations at the monitor closer to the facility ranged from 0.28 to 0.47 μg/m^3, with the lowest average annual concentration in the year 2002. Average annual Pb concentrations at the second monitor ranged from 0.13 to 0.20 μg/m^3. While no exceedances of the NAAQS (1.5 μg/dL as a maximum quarterly average) occurred during the 1998 to 2002 time period, it is noted that since that time, an exceedance has occurred (during the 4th quarter of 2003) (MDNR, 2007b).

For comparison purposes, the average annual Pb concentrations for 2005 from AQS monitors located around the secondary Pb smelter case study location were compared to AQS monitor results across the United States. Exhibit B-10 shows the distribution of average annual Pb concentrations in TSP for 208 monitoring sites across the United States (with average annual Pb concentrations per location sorted in ascending order). The 2005 results for the two AQS monitoring sites located in the vicinity of the secondary Pb smelter are indicated using a solid square (■). The annual average Pb concentrations for the 208 monitoring sites ranged from 0.001 to 1.56 μg/m^3. Both of the monitoring sites located near the secondary Pb smelter fall into the top 15 percent of the 208 locations.

---

[4] Note that the emissions data used in this modeling represent stack testing performed in 2005 and 2006 and fugitives emission estimates from 1987. Given that these emissions data, when used together, are not clearly representative of any specific time period, the decision was made to use monitoring data corresponding to the years of meteorological data used in the modeling (i.e., 1998 to 2002).

Exhibit B-10. Distribution of 2005 Annual Average Values for Pb-TSP at Monitor Sites across the United States Relative to Monitors near the Secondary Pb Smelter



B.2.5.2. Soil

No soil measurement data for Pb were identified in the vicinity of the secondary Pb smelter case study location. For the human exposure and health risk assessments, soil concentrations were estimated by defining the spatial pattern of soil concentrations around the facility using air and soil model results and then adjusting the magnitude of the concentrations based on measured concentrations from a similar facility. See Appendix E for details.

B.2.5.3. Indoor Dust

No indoor dust data for Pb were available from homes located in the vicinity of the secondary Pb smelter. Indoor dust concentrations were estimated using an empirical model that relates ambient air concentrations to indoor dust concentrations, as discussed in Appendix E.

B.2.5.4. Deposition

No Pb deposition monitoring data were identified in the vicinity of the secondary Pb smelter case study location. Pb deposition resulting from emissions from the secondary Pb smelter was modeled using U.S. EPA's AERMOD air dispersion model, as discussed in Appendix E.

REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR). (2002) Health Consultation; Public Health Implications From Attending or Working at Herculaneum Schools; Herculaneum Lead Smelter Site; Herculaneum, Jefferson County, Missouri. June.

Agency for Toxic Substances and Disease Registry (ATSDR). (2003) Health Consultation; Blood Lead Results for 2002 Calendar Year; Herculaneum Lead Smelter Site; Herculaneum, Jefferson County, Missouri, EPA Facility ID MOD006266373. August.

Alabama Department of Environmental Management (ADEM). (2006) Conversations With Representative of ADEM Regarding Available Measured Data From Media in and Around the Secondary Pb Smelter in Troy, AL. October 31 and November 1, 2006.

Centers for Disease Control and Prevention (CDC). (2005) CDC Surveillance Data, 1997 to 2005. Available online at: http://0-www.cdc.gov.mill1.sjlibrary.org/nceh/lead/surv/stats.htm.

EC/R Incorporated. (2006) Secondary Lead Smelter Industry: Residual Risk Assessment (Draft). Research Triangle Park, NC: Prepared for U.S. EPA Office of Air and Radiation, Office of Air Quality Planning and Standards; May.

Missouri Department of Natural Resources (MDNR). (1999) Preliminary Assessment: Herculaneum Lead Smelter Site, Jefferson County, Missouri. Division of Environmental Quality; March 30, 1999.

Missouri Department of Natural Resources (MDNR). (2005) Analysis of Lead Recontamination and Deposition in Soils Adjacent to the Doe Run Company's Herculaneum Smelter, Herculaneum, Missouri; February 2002 Through July 2005. Division of Environmental Quality; November 8, 2005.

Missouri Department of Natural Resources (MDNR). (2007a) 2007 Revision of the State Implementation Plan for the Herculaneum Lead Nonattainment Area, As Adopted by the Missouri Air Conservation Commission. April 26, 2007.

Missouri Department of Natural Resources (MDNR). (2007b) Doe Run - Herculaneum State Implementation Plan (SIP) Dispersion Modeling Review. Memorandum From Jeffry D. Bennett to John Rustige. February 12, 2007. Available online at: http://www.dnr.mo.gov/env/apcp/herculaneumsip.htm.

Staley, C. S.; Ritter, P. D.; Rood, A. S. (2002) Quality Assurance Project Plan for Lead Deposition at Herculaneum, Missouri. Prepared for U.S. EPA National Exposure Research Laboratory, Technology Support Center, and U.S. Department of Energy; August.

State of Missouri Department of Health and Senior Services (DHSS). (2007) Data & Statistical Reports; Childhood Lead Poisoning Prevention; Blood Lead Screening for 1997-2003 and 2005. Available online at: http://www.dhss.mo.gov/ChildhoodLead/Reports.html.

URS Corporation. (2005a) Periodic NESHAP-Required Inorganic Lead Source Emissions Testing Program Conducted February 15, 2005 on Stack No. 10.

URS Corporation. (2005b) Periodic NESHAP-Required Inorganic Lead Source Emissions Testing Program Conducted October 18, 2005 on Stack No. 4.

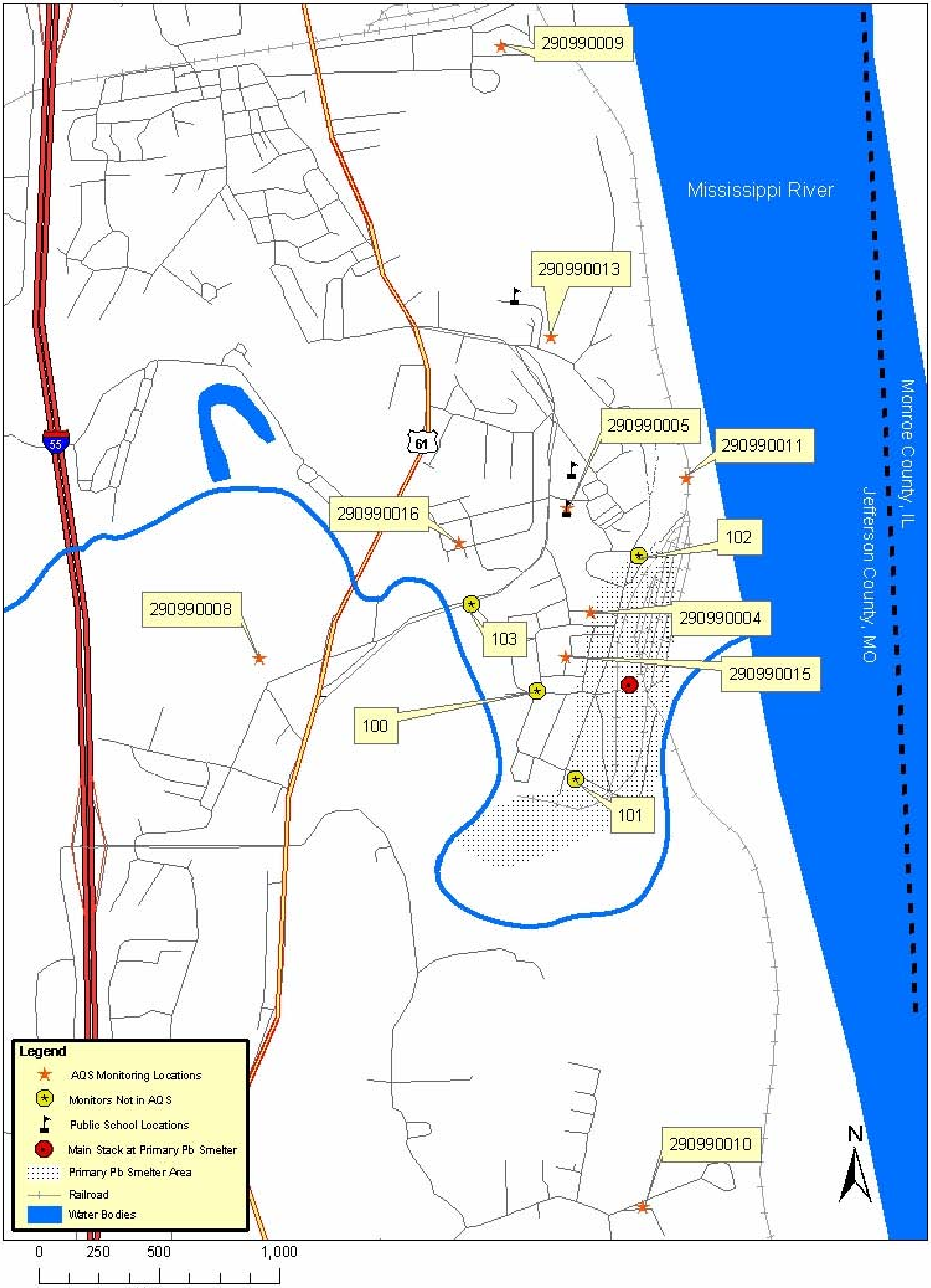
URS Corporation. (2006a) Memorandum From Billy R. Nichols at URS Corporation to Ronald W. Gore at Alabama Department of Environmental Management (ADEM) Regarding 2005 Annual Emission Estimates for the Secondary Pb Smelter. April 26, 2006.

URS Corporation. (2006b) Periodic NESHAP-Required Inorganic Lead Source Emissions Testing Program Conducted February 7 and 8, 2006 on Stack No. 1 and Stack No. 5.

U.S. Census Bureau. (2005) United States Census 2000: Summary File 1. Public Information Office. Available online at: http://www.census.gov/Press-Release/www/2001/sumfile1.html.

U.S. Environmental Protection Agency (USEPA). (2007) Air Quality System (AQS) Database. Available online at: http://www.epa.gov/ttn/airs/airsaqs/aqsweb/aqswebwarning.htm.

Attachment B-1. Air Monitoring Locations around the Primary Pb Smelter



Attachment B-2. Average Annual Pb Concentrations from AQS Monitors Located around the Primary Pb Smelter

Monitor ID	Average Monitored Pb Concentrations ($\mu g/m^3$)[a,b]				
	2001	2002	2003	2004	2005
290990004	-	-	-	1.27	0.94
290990005	2.10	0.39	0.31	0.44	0.28
290990008	0.27	0.068	0.10	0.097	0.10
290990009	0.33	0.054	0.086	0.11	0.063
290990010	0.13	0.074	0.033	0.046	0.046
290990011	1.52	0.51	0.41	0.56	0.31
290990013	0.98	0.24	0.20	0.44	0.16
290990015	3.79	1.29	1.31	1.37	1.56
290990016	-	-	-	0.30	0.20

[a] Data are for average annual Pb concentrations in total suspended particulate matter (TSP) and were calculated from the daily U.S. EPA Air Quality System (AQS) data, including data from State and Local Air Monitoring Stations (SLAMS) and other air monitoring networks (designated as 'others' in the AQS database). The daily data were extracted from AQS using an AMP350 report, with the mean daily statistic selected and the units selected as reported. Events and nulls were not included in the AMP350 report.

[b] "--" indicates that data were not available.

Attachment B-3. Air Monitoring Results for Pb from Monitors Not In AQS Located around the Primary Pb Smelter

Full-Scale Analysis ID	Sampling Dates and Results (µg/m³) [a,b,c]							
	2001		2002			2003		
	Date		Date			Date		
100	--	--	3-Jan-02	0.5		1-Jan-03	0.316	
100	--	--	7-Jan-02	0.52		4-Jan-03	1.26	
100	--	--	10-Jan-02	0.51		7-Jan-03	0.547	
100	--	--	13-Jan-02	4.5		10-Jan-03	0.291	
100	--	--	16-Jan-02	0.97		13-Jan-03	1.03	
100	--	--	19-Jan-02	2.2		16-Jan-03	1.09	
100	--	--	22-Jan-02	2.4		19-Jan-03	0.531	
100	--	--	25-Jan-02	0.75		22-Jan-03	0.095	
100	--	--	28-Jan-02	2		25-Jan-03	0.811	
100	--	--	5-Feb-02	1.5		28-Jan-03	2.28	
100	--	--	8-Feb-02	0.97		31-Jan-03	0.118	
100	--	--	11-Feb-02	0.59		3-Feb-03	0.15	
100	--	--	14-Feb-02	0.33		9-Feb-03	1.29	
100	--	--	18-Feb-02	2.3		12-Feb-03	0.901	
100	--	--	21-Feb-02	0.24		15-Feb-03	0.514	
100	--	--	26-Feb-02	0.23	ND	18-Feb-03	0.406	
100	--	--	1-Mar-02	3.8		21-Feb-03	0.527	
100	--	--	4-Mar-02	0.57		24-Feb-03	0.119	
100	--	--	7-Mar-02	1.7		27-Feb-03	0.05	ND
100	--	--	11-Mar-02	2.3		2-Mar-03	0.095	
100	--	--	14-Mar-02	1.3		5-Mar-03	0.138	
100	--	--	17-Mar-02	0.78		8-Mar-03	1.63	
100	--	--	20-Mar-02	0.24	ND	11-Mar-03	1.99	
100	--	--	23-Mar-02	0.25	ND	14-Mar-03	1.53	
100	--	--	26-Mar-02	0.41		17-Mar-03	2.86	
100	--	--	29-Mar-02	0.76		20-Mar-03	2.07	
100	--	--	1-Apr-02	0.93		23-Mar-03	0.352	
100	--	--	4-Apr-02	0.24	ND	26-Mar-03	0.58	
100	--	--	7-Apr-02	0.61		29-Mar-03	0.05	ND
100	--	--	10-Apr-02	4.9		1-Apr-03	0.399	
100	--	--	16-Apr-02	2		4-Apr-03	0.397	
100	--	--	18-Apr-02	3		7-Apr-03	0.238	
100	--	--	22-Apr-02	0.41		10-Apr-03	0.19	
100	--	--	25-Apr-02	0.23	ND	13-Apr-03	1.95	
100	--	--	28-Apr-02	0.25	ND	16-Apr-03	0.376	
100	--	--	1-May-02	2.2		19-Apr-03	5.48	
100	--	--	4-May-02	0.55		22-Apr-03	0.357	
100	--	--	7-May-02	2		25-Apr-03	0.092	
100	--	--	10-May-02	3.58		28-Apr-03	3.37	
100	--	--	13-May-02	0.144		1-May-03	0.309	
100	--	--	16-May-02	0.932		4-May-03	0.715	
100	--	--	19-May-02	0.0913		7-May-03	0.59	
100	--	--	22-May-02	2.33		10-May-03	0.437	
100	--	--	25-May-02	0.193		13-May-03	1.4	
100	--	--	29-May-02	1.59		16-May-03	2.08	
100	--	--	31-May-02	0.397		19-May-03	0.493	
100	--	--	3-Jun-02	0.32		22-May-03	0.108	
100	--	--	6-Jun-02	0.359		25-May-03	0.505	
100	--	--	9-Jun-02	0.326		28-May-03	0.242	
100	--	--	12-Jun-02	0.716		31-May-03	0.165	
100	--	--	15-Jun-02	0.141		3-Jun-03	0.21	
100	--	--	18-Jun-02	1.1		6-Jun-03	0.603	

Attachment B-3. Air Monitoring Results for Pb from Monitors Not In AQS Located around the Primary Pb Smelter

Full-Scale Analysis ID	Sampling Dates and Results ($\mu g/m^3$) [a,b,c]					
	2001		2002		2003	
	Date		Date		Date	
100	--	--	21-Jun-02	1.49	9-Jun-03	0.121
100	--	--	24-Jun-02	2.17	12-Jun-03	0.627
100	--	--	27-Jun-02	0.24	15-Jun-03	0.063
100	--	--	30-Jun-02	0.091	18-Jun-03	1.51
100	--	--	3-Jul-02	0.861	21-Jun-03	0.216
100	--	--	6-Jul-02	1.68	24-Jun-03	0.433
100	--	--	9-Jul-02	0.439	27-Jun-03	0.184
100	--	--	12-Jul-02	2.92	30-Jun-03	0.803
100	--	--	15-Jul-02	1.04	6-Jul-03	0.06
100	--	--	18-Jul-02	1.09	--	--
100	--	--	22-Jul-02	0.771	--	--
100	--	--	29-Jul-02	0.553	--	--
100	--	--	4-Aug-02	0.225	--	--
100	--	--	7-Aug-02	0.511	--	--
100	--	--	10-Aug-02	1.28	--	--
100	--	--	13-Aug-02	0.181	--	--
100	--	--	16-Aug-02	0.994	--	--
100	--	--	19-Aug-02	1.27	--	--
100	--	--	22-Aug-02	0.547	--	--
100	--	--	25-Aug-02	0.064	--	--
100	--	--	28-Aug-02	0.204	--	--
100	--	--	31-Aug-02	0.465	--	--
100	--	--	3-Sep-02	0.439	--	--
100	--	--	6-Sep-02	4.11	--	--
100	--	--	9-Sep-02	1.19	--	--
100	--	--	12-Sep-02	0.473	--	--
100	--	--	15-Sep-02	0.0875	--	--
100	--	--	18-Sep-02	0.739	--	--
100	--	--	21-Sep-02	0.107	--	--
100	--	--	24-Sep-02	0.223	--	--
100	--	--	27-Sep-02	0.183	--	--
100	--	--	30-Sep-02	0.395	--	--
100	--	--	3-Oct-02	1.57	--	--
100	--	--	6-Oct-02	0.21	--	--
100	--	--	9-Oct-02	0.983	--	--
100	13-Oct-01	0.41	12-Oct-02	0.498	--	--
100	16-Oct-01	0.24	15-Oct-02	0.256	--	--
100	18-Oct-01	1.7	18-Oct-02	0.457	--	--
100	23-Oct-01	0.32	21-Oct-02	4.63	--	--
100	26-Oct-01	0.24 ND	24-Oct-02	1.89	--	--
100	29-Oct-01	5	27-Oct-02	1.26	--	--
100	1-Nov-01	1.4	30-Oct-02	0.359	--	--
100	4-Nov-01	0.69	2-Nov-02	0.053	--	--
100	8-Nov-01	0.71	5-Nov-02	0.506	--	--
100	11-Nov-01	3.9	8-Nov-02	0.319	--	--
100	14-Nov-01	2.8	11-Nov-02	0.129	--	--
100	16-Nov-01	1	14-Nov-02	0.627	--	--
100	19-Nov-01	0.45	17-Nov-02	0.485	--	--
100	22-Nov-01	1.1	20-Nov-02	0.765	--	--
100	26-Nov-01	2	23-Nov-02	0.498	--	--
100	28-Nov-01	0.24 ND	26-Nov-02	0.818	--	--
100	1-Dec-01	0.66	29-Nov-02	0.518	--	--

Attachment B-3. Air Monitoring Results for Pb from Monitors Not In AQS Located around the Primary Pb Smelter

Full-Scale Analysis ID	Sampling Dates and Results (μg/m³) [a,b,c]					
	2001		2002		2003	
	Date		Date		Date	
100	4-Dec-01	4.6	2-Dec-02	0.954	--	--
100	7-Dec-01	2.5	5-Dec-02	0.057	--	--
100	10-Dec-01	2.5	8-Dec-02	0.112	--	--
100	13-Dec-01	0.25 ND	11-Dec-02	2.57	--	--
100	17-Dec-01	0.31	14-Dec-02	0.264	--	--
100	19-Dec-01	0.23 ND	17-Dec-02	1.89	--	--
100	22-Dec-01	0.24 ND	20-Dec-02	0.382	--	--
100	26-Dec-01	0.27	23-Dec-02	0.895	--	--
100	28-Dec-01	1.3	26-Dec-02	0.086	--	--
100	31-Dec-01	0.27	29-Dec-02	1.72	--	--
100 Summary:	**2001**	**Max = 5 Avg = 1.3**	**2002**	**Max = 4.9 Avg = 1**	**2003**	**Max = 5.5 Avg = 0.79**
101	--	--	3-Jan-02	0.25 ND	--	--
101	--	--	7-Jan-02	0.25 ND	--	--
101	--	--	10-Jan-02	0.3	--	--
101	--	--	13-Jan-02	17	--	--
101	--	--	16-Jan-02	0.35	--	--
101	--	--	19-Jan-02	0.6	--	--
101	--	--	22-Jan-02	0.55	--	--
101	--	--	25-Jan-02	0.24 ND	--	--
101	--	--	28-Jan-02	0.34	--	--
101	--	--	31-Jan-02	0.24 ND	--	--
101	--	--	5-Feb-02	0.52	--	--
101	--	--	8-Feb-02	0.3	--	--
101	--	--	11-Feb-02	0.23 ND	--	--
101	--	--	14-Feb-02	0.27	--	--
101	--	--	18-Feb-02	0.6	--	--
101	--	--	21-Feb-02	0.24 ND	--	--
101	--	--	26-Feb-02	0.24 ND	--	--
101	--	--	1-Mar-02	0.65	--	--
101	--	--	7-Mar-02	1.6	--	--
101	--	--	11-Mar-02	0.24 ND	--	--
101	--	--	14-Mar-02	1.2	--	--
101	--	--	17-Mar-02	0.65	--	--
101	--	--	20-Mar-02	0.46	--	--
101	--	--	23-Mar-02	0.25 ND	--	--
101	--	--	26-Mar-02	0.24 ND	--	--
101	--	--	29-Mar-02	0.48	--	--
101	--	--	1-Apr-02	0.26 ND	--	--
101	--	--	4-Apr-02	1.8	--	--
101	--	--	7-Apr-02	0.26 ND	--	--
101	--	--	10-Apr-02	0.69	--	--
101	--	--	16-Apr-02	1.8	--	--
101	--	--	18-Apr-02	0.55	--	--
101	--	--	25-Apr-02	0.25 ND	--	--
101	--	--	28-Apr-02	0.27 ND	--	--
101	--	--	1-May-02	0.34	--	--
101	--	--	4-May-02	0.51	--	--
101	--	--	7-May-02	0.54	--	--
101	--	--	10-May-02	2.14	--	--
101	--	--	13-May-02	0.054	--	--
101	--	--	16-May-02	0.28	--	--

Attachment B-3. Air Monitoring Results for Pb from Monitors Not In AQS Located around the Primary Pb Smelter

Full-Scale Analysis ID	Sampling Dates and Results (μg/m³) [a,b,c]								
	2001			2002			2003		
	Date			Date			Date		
101	--	--		19-May-02	0.0617		--	--	
101	--	--		22-May-02	0.921		--	--	
101	--	--		25-May-02	0.123		--	--	
101	--	--		29-May-02	0.562		--	--	
101	--	--		31-May-02	0.0993		--	--	
101	--	--		3-Jun-02	0.677		--	--	
101	--	--		6-Jun-02	0.962		--	--	
101	--	--		9-Jun-02	0.245		--	--	
101	--	--		12-Jun-02	0.085		--	--	
101	--	--		15-Jun-02	0.0693		--	--	
101	--	--		18-Jun-02	0.261		--	--	
101	--	--		21-Jun-02	0.375		--	--	
101	--	--		24-Jun-02	0.935		--	--	
101	--	--		27-Jun-02	0.0751		--	--	
101	--	--		30-Jun-02	0.05	ND	--	--	
101	--	--		3-Jul-02	0.225		--	--	
101	--	--		6-Jul-02	1.11		--	--	
101	--	--		9-Jul-02	1.66		--	--	
101	--	--		12-Jul-02	3.58		--	--	
101	--	--		15-Jul-02	0.655		--	--	
101	--	--		18-Jul-02	0.131		--	--	
101	--	--		22-Jul-02	0.092		--	--	
101	--	--		26-Jul-02	1.36		--	--	
101	--	--		29-Jul-02	0.213		--	--	
101	--	--		1-Aug-02	1.29		--	--	
101	--	--		4-Aug-02	0.22		--	--	
101	--	--		7-Aug-02	9.13		--	--	
101	--	--		10-Aug-02	0.656		--	--	
101	--	--		13-Aug-02	0.05	ND	--	--	
101	--	--		16-Aug-02	6.68		--	--	
101	--	--		19-Aug-02	1.69		--	--	
101	--	--		22-Aug-02	0.059		--	--	
101	--	--		25-Aug-02	0.701		--	--	
101	--	--		28-Aug-02	10		--	--	
101	--	--		31-Aug-02	0.378		--	--	
101	--	--		3-Sep-02	1.22		--	--	
101	--	--		6-Sep-02	1.09		--	--	
101	13-Oct-01	0.096		--	--		--	--	
101	16-Oct-01	0.075		--	--		--	--	
101	18-Oct-01	0.18		--	--		--	--	
101	23-Oct-01	0.3	ND	--	--		--	--	
101	26-Oct-01	0.23	ND	--	--		--	--	
101	29-Oct-01	1.4		--	--		--	--	
101	1-Nov-01	0.41		--	--		--	--	
101	4-Nov-01	0.23	ND	--	--		--	--	
101	8-Nov-01	0.26		--	--		--	--	
101	11-Nov-01	2.4		--	--		--	--	
101	14-Nov-01	1.5		--	--		--	--	
101	16-Nov-01	0.24	ND	--	--		--	--	
101	19-Nov-01	0.24	ND	--	--		--	--	
101	22-Nov-01	0.38		--	--		--	--	
101	26-Nov-01	0.24	ND	--	--		--	--	

Attachment B-3. Air Monitoring Results for Pb from Monitors Not In AQS Located around the Primary Pb Smelter

Full-Scale Analysis ID	Sampling Dates and Results (μg/m³) [a,b,c]								
	2001			2002			2003		
	Date			Date			Date		
101	28-Nov-01	1.7		--	--		--	--	
101	1-Dec-01	0.62		--	--		--	--	
101	4-Dec-01	0.25	ND	--	--		--	--	
101	7-Dec-01	1.7		--	--		--	--	
101	10-Dec-01	1.4		--	--		--	--	
101	13-Dec-01	0.3		--	--		--	--	
101	17-Dec-01	0.24	ND	--	--		--	--	
101	19-Dec-01	0.23	ND	--	--		--	--	
101	22-Dec-01	0.23	ND	--	--		--	--	
101	26-Dec-01	0.22	ND	--	--		--	--	
101	28-Dec-01	0.23	ND	--	--		--	--	
101	31-Dec-01	0.24	ND	--	--		--	--	
101 Summary:	**2001**	**Max = 2.4 Avg = 0.52**		**2002**	**Max = 17 Avg = 1.1**		**2003**	**--**	
102	--	--		03-Jan-02	0.59		01-Jan-03	0.147	
102	--	--		07-Jan-02	0.65		04-Jan-03	0.326	
102	--	--		10-Jan-02	1.4		07-Jan-03	0.63	
102	--	--		13-Jan-02	15		10-Jan-03	0.257	
102	--	--		16-Jan-02	4.4		13-Jan-03	0.388	
102	--	--		19-Jan-02	0.24	ND	16-Jan-03	0.322	
102	--	--		22-Jan-02	25		19-Jan-03	0.986	
102	--	--		28-Jan-02	8.1		22-Jan-03	0.172	
102	--	--		31-Jan-02	0.39		25-Jan-03	0.684	
102	--	--		05-Feb-02	2.7		28-Jan-03	1.52	
102	--	--		08-Feb-02	5		31-Jan-03	2.33	
102	--	--		11-Feb-02	4.4		03-Feb-03	2.69	
102	--	--		14-Feb-02	14		06-Feb-03	0.342	
102	--	--		18-Feb-02	13		09-Feb-03	0.265	
102	--	--		21-Feb-02	0.38		12-Feb-03	0.46	
102	--	--		26-Feb-02	0.25		15-Feb-03	0.05	ND
102	--	--		01-Mar-02	6.1		18-Feb-03	0.173	
102	--	--		04-Mar-02	4.4		21-Feb-03	0.281	
102	--	--		07-Mar-02	11		24-Feb-03	0.279	
102	--	--		14-Mar-02	17		27-Feb-03	0.056	
102	--	--		17-Mar-02	0.26	ND	02-Mar-03	0.181	
102	--	--		20-Mar-02	0.23	ND	05-Mar-03	0.363	
102	--	--		23-Mar-02	2.4		08-Mar-03	1.85	
102	--	--		26-Mar-02	0.45		11-Mar-03	3.25	
102	--	--		29-Mar-02	0.81		14-Mar-03	0.224	
102	--	--		01-Apr-02	13		17-Mar-03	1.25	
102	--	--		04-Apr-02	0.24	ND	20-Mar-03	0.349	
102	--	--		07-Apr-02	6.4		23-Mar-03	0.504	
102	--	--		10-Apr-02	0.86		26-Mar-03	0.476	
102	--	--		16-Apr-02	11		29-Mar-03	0.107	
102	--	--		18-Apr-02	3.1		01-Apr-03	1.56	
102	--	--		25-Apr-02	1.1		04-Apr-03	4.11	
102	--	--		28-Apr-02	0.25	ND	07-Apr-03	0.184	
102	--	--		01-May-02	0.87		10-Apr-03	0.16	
102	--	--		04-May-02	0.6		13-Apr-03	0.441	
102	--	--		07-May-02	0.98		16-Apr-03	10	
102	--	--		10-May-02	0.551		19-Apr-03	4.33	
102	--	--		13-May-02	0.679		22-Apr-03	0.215	

Attachment B-3. Air Monitoring Results for Pb from Monitors Not In AQS Located around the Primary Pb Smelter

Full-Scale Analysis ID	Sampling Dates and Results (μg/m^3) [a,b,c]					
	2001		2002		2003	
	Date		Date		Date	
102	--	--	16-May-02	2.19	28-Apr-03	0.435
102	--	--	19-May-02	0.148	01-May-03	0.926
102	--	--	22-May-02	3.84	04-May-03	0.671
102	--	--	25-May-02	1.72	13-May-03	1.41
102	--	--	29-May-02	0.645	16-May-03	0.319
102	--	--	31-May-02	1.26	19-May-03	0.512
102	--	--	03-Jun-02	2.27	22-May-03	0.11
102	--	--	06-Jun-02	0.441	25-May-03	0.05 ND
102	--	--	09-Jun-02	1.96	28-May-03	0.245
102	--	--	12-Jun-02	0.962	31-May-03	0.274
102	--	--	15-Jun-02	0.365	03-Jun-03	0.188
102	--	--	18-Jun-02	2.89	06-Jun-03	0.381
102	--	--	21-Jun-02	1.12	09-Jun-03	1.35
102	--	--	24-Jun-02	1.72	12-Jun-03	0.418
102	--	--	27-Jun-02	1.06	15-Jun-03	0.096
102	--	--	30-Jun-02	0.273	18-Jun-03	0.406
102	--	--	03-Jul-02	1.23	21-Jun-03	0.475
102	--	--	06-Jul-02	0.747	24-Jun-03	2.33
102	--	--	09-Jul-02	0.739	27-Jun-03	0.469
102	--	--	12-Jul-02	0.616	30-Jun-03	2.29
102	--	--	15-Jul-02	0.522	03-Jul-03	0.964
102	--	--	18-Jul-02	0.967	06-Jul-03	1.15
102	--	--	22-Jul-02	0.667	--	--
102	--	--	26-Jul-02	6.48	--	--
102	--	--	29-Jul-02	0.913	--	--
102	--	--	01-Aug-02	1.18	--	--
102	--	--	04-Aug-02	0.663	--	--
102	--	--	07-Aug-02	0.434	--	--
102	--	--	10-Aug-02	0.932	--	--
102	--	--	13-Aug-02	2.86	--	--
102	--	--	16-Aug-02	4.93	--	--
102	--	--	19-Aug-02	1.04	--	--
102	--	--	22-Aug-02	3.8	--	--
102	--	--	25-Aug-02	0.135	--	--
102	--	--	28-Aug-02	0.262	--	--
102	--	--	31-Aug-02	0.205	--	--
102	--	--	03-Sep-02	0.411	--	--
102	--	--	06-Sep-02	0.586	--	--
102	--	--	09-Sep-02	0.614	--	--
102	--	--	12-Sep-02	0.318	--	--
102	--	--	21-Sep-02	0.29	--	--
102	--	--	24-Sep-02	0.261	--	--
102	--	--	27-Sep-02	0.314	--	--
102	--	--	30-Sep-02	4.56	--	--
102	--	--	03-Oct-02	1.53	--	--
102	--	--	06-Oct-02	0.611	--	--
102	--	--	09-Oct-02	1.77	--	--
102	--	--	12-Oct-02	0.412	--	--
102	--	--	15-Oct-02	0.17	--	--
102	16-Oct-01	0.31	18-Oct-02	2.44	--	--
102	18-Oct-01	16	21-Oct-02	0.759	--	--
102	23-Oct-01	2.5	24-Oct-02	0.215	--	--

Attachment B-3. Air Monitoring Results for Pb from Monitors Not In AQS Located around the Primary Pb Smelter

Full-Scale Analysis ID	Sampling Dates and Results (µg/m^3) [a,b,c]								
	2001			2002			2003		
	Date			Date			Date		
102	26-Oct-01	0.25		27-Oct-02	0.152		--	--	
102	29-Oct-01	14		30-Oct-02	0.125		--	--	
102	01-Nov-01	18		02-Nov-02	0.069		--	--	
102	04-Nov-01	0.48		05-Nov-02	0.099		--	--	
102	08-Nov-01	0.83		08-Nov-02	10.7		--	--	
102	11-Nov-01	0.58		11-Nov-02	0.15		--	--	
102	14-Nov-01	4.2		14-Nov-02	1.07		--	--	
102	16-Nov-01	0.99		17-Nov-02	0.108		--	--	
102	19-Nov-01	0.4		20-Nov-02	0.708		--	--	
102	22-Nov-01	13		23-Nov-02	0.287		--	--	
102	26-Nov-01	65		26-Nov-02	0.145		--	--	
102	28-Nov-01	0.24	ND	29-Nov-02	0.15		--	--	
102	04-Dec-01	7.5		02-Dec-02	0.776		--	--	
102	07-Dec-01	0.85		05-Dec-02	0.896		--	--	
102	10-Dec-01	1.4		08-Dec-02	0.376		--	--	
102	13-Dec-01	0.22	ND	11-Dec-02	0.919		--	--	
102	17-Dec-01	0.23	ND	14-Dec-02	0.568		--	--	
102	19-Dec-01	0.85		17-Dec-02	2.32		--	--	
102	22-Dec-01	5.1		20-Dec-02	0.224		--	--	
102	26-Dec-01	0.49		23-Dec-02	0.233		--	--	
102	28-Dec-01	0.53		26-Dec-02	0.083		--	--	
102	31-Dec-01	0.25		29-Dec-02	5.24		--	--	
102 Summary:	**2001**	**Max = 65 Avg = 6.2**		**2002**	**Max = 25 Avg = 2.4**		**2003**	**Max = 10 Avg = 1**	
103				3-Jan-02	0.92		10-Jan-03	0.402	
103				7-Jan-02	0.43		13-Jan-03	0.621	
103				10-Jan-02	0.73		16-Jan-03	0.23	
103				13-Jan-02	1.3		19-Jan-03	0.155	
103				16-Jan-02	1.5		22-Jan-03	0.058	
103				19-Jan-02	0.25	ND	25-Jan-03	0.326	
103				22-Jan-02	2.1		28-Jan-03	0.864	
103				25-Jan-02	0.59		31-Jan-03	0.075	
103				28-Jan-02	1.9		3-Feb-03	0.069	
103				31-Jan-02	0.46		6-Feb-03	0.283	
103				5-Feb-02	1		9-Feb-03	0.566	
103				8-Feb-02	0.61		12-Feb-03	0.65	
103				11-Feb-02	0.49		15-Feb-03	0.05	ND
103				14-Feb-02	0.38		18-Feb-03	1.22	
103				18-Feb-02	1.4		21-Feb-03	0.104	
103				21-Feb-02	0.32		24-Feb-03	0.135	
103				26-Feb-02	0.24	ND	27-Feb-03	0.05	ND
103				1-Mar-02	6.1		2-Mar-03	0.085	
103				4-Mar-02	0.49		5-Mar-03	0.105	
103				7-Mar-02	0.94		8-Mar-03	0.377	
103				11-Mar-02	1.2		11-Mar-03	0.993	
103				14-Mar-02	1.5		14-Mar-03	0.395	
103				17-Mar-02	0.25	ND	17-Mar-03	2.2	
103				20-Mar-02	0.26	ND	20-Mar-03	0.655	
103				23-Mar-02	0.25	ND	23-Mar-03	0.422	
103				26-Mar-02	0.3		26-Mar-03	0.421	
103				29-Mar-02	2.1		29-Mar-03	0.056	
103				1-Apr-02	0.62		1-Apr-03	0.236	

Attachment B-3. Air Monitoring Results for Pb from Monitors Not In AQS Located around the Primary Pb Smelter

Full-Scale Analysis ID	Sampling Dates and Results (µg/m³) [a,b,c]					
	2001		2002		2003	
	Date		Date		Date	
103			4-Apr-02	0.24 ND	4-Apr-03	0.169
103			7-Apr-02	1.4	7-Apr-03	0.205
103			10-Apr-02	3.8	10-Apr-03	0.113
103			16-Apr-02	1.2	13-Apr-03	0.908
103			18-Apr-02	1.7	16-Apr-03	0.218
103			22-Apr-02	1.1	19-Apr-03	2.15
103			25-Apr-02	0.23 ND	22-Apr-03	0.145
103			28-Apr-02	0.25 ND	25-Apr-03	0.093
103			1-May-02	1.8	1-May-03	0.242
103			4-May-02	0.4	7-May-03	0.455
103			7-May-02	0.42	10-May-03	0.369
103			10-May-02	1.43	13-May-03	0.679
103			13-May-02	0.0822	16-May-03	0.14
103			22-May-02	1.53	19-May-03	0.383
103			25-May-02	0.232	22-May-03	0.078
103			29-May-02	0.906	25-May-03	0.06
103			31-May-02	0.449	28-May-03	0.164
103			3-Jun-02	0.342	31-May-03	0.166
103			6-Jun-02	0.338	3-Jun-03	0.105
103			9-Jun-02	0.35	6-Jun-03	1.15
103			15-Jun-02	0.204	9-Jun-03	0.126
103			18-Jun-02	0.86	12-Jun-03	0.511
103			21-Jun-02	1.11	15-Jun-03	0.05 ND
103			24-Jun-02	1.06	18-Jun-03	0.907
103			27-Jun-02	0.46	21-Jun-03	0.133
103			30-Jun-02	0.097	24-Jun-03	0.32
103			3-Jul-02	0.68	27-Jun-03	0.098
103			6-Jul-02	0.286	30-Jun-03	0.453
103			9-Jul-02	0.342	3-Jul-03	0.159
103			12-Jul-02	0.276	6-Jul-03	0.051
103			15-Jul-02	0.244	--	--
103			18-Jul-02	0.878	--	--
103			22-Jul-02	0.728	--	--
103			26-Jul-02	0.537	--	--
103			29-Jul-02	0.422	--	--
103			1-Aug-02	2.59	--	--
103			4-Aug-02	0.258	--	--
103			7-Aug-02	0.159	--	--
103			10-Aug-02	0.379	--	--
103			13-Aug-02	0.077	--	--
103			16-Aug-02	0.46	--	--
103			19-Aug-02	0.756	--	--
103			22-Aug-02	0.296	--	--
103			25-Aug-02	0.057	--	--
103			28-Aug-02	0.107	--	--
103			31-Aug-02	0.33	--	--
103			3-Sep-02	0.291	--	--
103			6-Sep-02	1.11	--	--
103	13-Oct-01	0.994	--	--	--	--
103	16-Oct-01	0.56	--	--	--	--
103	18-Oct-01	0.96	--	--	--	--
103	23-Oct-01	0.32 ND	--	--	--	--

Attachment B-3. Air Monitoring Results for Pb from Monitors Not In AQS Located around the Primary Pb Smelter

Full-Scale Analysis ID	Sampling Dates and Results (µg/m³) [a,b,c]							
	2001			2002		2003		
	Date			Date		Date		
103	26-Oct-01	0.33		--	--	--	--	
103	29-Oct-01	2.5		--	--	--	--	
103	01-Nov-01	0.86		--	--	--	--	
103	04-Nov-01	0.25		--	--	--	--	
103	08-Nov-01	0.87		--	--	--	--	
103	11-Nov-01	0.59		--	--	--	--	
103	14-Nov-01	3.6		--	--	--	--	
103	16-Nov-01	1		--	--	--	--	
103	19-Nov-01	0.35		--	--	--	--	
103	22-Nov-01	1.1		--	--	--	--	
103	26-Nov-01	2.9		--	--	--	--	
103	28-Nov-01	0.23	ND	--	--	--	--	
103	01-Dec-01	0.85		--	--	--	--	
103	04-Dec-01	2.1		--	--	--	--	
103	07-Dec-01	1.3		--	--	--	--	
103	10-Dec-01	2.3		--	--	--	--	
103	13-Dec-01	0.26		--	--	--	--	
103	17-Dec-01	0.24	ND	--	--	--	--	
103	19-Dec-01	0.39		--	--	--	--	
103	22-Dec-01	0.25	ND	--	--	--	--	
103	26-Dec-01	0.4		--	--	--	--	
103 Summary:	**2001**	**Max = 3.6 Avg = 1**		**2002**	**Max = 6.1 Avg = 0.8**	**2003**	**Max = 2.2 Avg = 0.39**	

[a] Daily data obtained from U.S. EPA Region 7 (2006).

[b] "--" indicates that no sample was collected during that time.

[c] A value qualified with an "ND" represents a non-detect. The value presented is the detection limit. For the purpose of calculating averages, one-half the detection limit was used as the value for non-detects.

Attachment B-4. Pre-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]				Property Average (mg/kg) [d]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
140	03-Oct-01	920	853	460	1060	**823**
141	03-Oct-01	1500	724	1470	818	**1128**
142	03-Oct-01	377	602	762	731	**618**
143	03-Oct-01	757	1390	1200	563	**978**
144	03-Oct-01	1680	1030	685	719	**1029**
145	03-Oct-01	2770	2210	1070	783	**1708**
146	03-Oct-01	1280	809	433	731	**813**
147	03-Oct-01	2640	1530	596	674	**1360**
148	03-Oct-01	670	1360	13100	465	**3899**
149	03-Oct-01	2820	2080	1540	1400	**1960**
150	03-Oct-01	403	1330	350	748	**708**
151	03-Oct-01	783	913	736	1240	**918**
152	04-Oct-01	803	1140	660	696	**825**
153	04-Oct-01	270	5530	1140	486	**1857**
154	04-Oct-01	4220	2160	1440	1360	**2295**
155	04-Oct-01	1260	873	1360	612	**1026**
156	04-Oct-01	1260	1450	636	2190	**1384**
157	05-Oct-01	1330	1550	1460	1630	**1493**
158	04-Oct-01	3100	9390	756	781	**3507**
159	04-Oct-01	1660	5780	428	440	**2077**
160	04-Oct-01	1150	853	927	269	**800**
161	04-Oct-01	1720	1790	1420	846	**1444**
162	04-Oct-01	1670	1800	526	2320	**1579**
163	04-Oct-01	13600	4870	2190	8450	**7278**
164	04-Oct-01	6900	10700	8360	5270	**7808**
165	04-Oct-01	6640	6500	7760	6200	**6775**
166	05-Oct-01	16600	11800	5970	8860	**10808**
167	05-Oct-01	28000	32100	8490	14200	**20698**
168	05-Oct-01	16700	18600	10400	2130	**11958**
169	05-Oct-01	12800	5640	4610	15800	**9713**
170	05-Oct-01	8670	4140	3950	4060	**5205**
171	10-Oct-01	1400	2120	461	1470	**1363**
172	10-Oct-01	851	1530	1270	728	**1095**
173	10-Oct-01	1160	1090	751	1570	**1143**
174	10-Oct-01	1270	1260	2530	1320	**1595**
175	10-Oct-01	2750	2580	5200	1260	**2948**
176	10-Oct-01	1720	2030	1620	515	**1471**
177	10-Oct-01	2760	3370	2190	7510	**3958**
178	08-Oct-01	4950	3690	1040	649	**2582**
179	08-Oct-01	1010	1800	1270	1250	**1333**
180	08-Oct-01	1330	2010	1220	899	**1365**
181	08-Oct-01	1070	2260	1160	976	**1367**
182	08-Oct-01	22500	5110	886	302	**7200**
183	08-Oct-01	1980	3020	1210	1050	**1815**
184	08-Oct-01	5830	4370	1510	1520	**3308**
185	09-Oct-01	2230	1670	796	936	**1408**
186	09-Oct-01	1020	1220	652	366	**815**
187	09-Oct-01	833	898	795	1050	**894**
188	09-Oct-01	2350	1820	1100	886	**1539**
189	09-Oct-01	1110	1070	1680	849	**1177**
190	09-Oct-01	930	818	922	910	**895**
191	09-Oct-01	1730	2180	24000	3600	**7878**

Attachment B-4. Pre-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]				Property Average (mg/kg) [d]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
192	09-Oct-01	3150	1230	710	1180	**1568**
193	10-Oct-01	5740	1590	14600	11200	**8283**
194	10-Oct-01	3670	998	1360	3520	**2387**
195	10-Oct-01	7240	1820	906	1880	**2962**
196	10-Oct-01	1180	2310	1550	979	**1505**
197	11-Oct-01	2210	5630	2430	1870	**3035**
198	11-Oct-01	857	850	423	112	**561**
199	11-Oct-01	648	330	310	117	**351**
200	11-Oct-01	559	156	710	296	**430**
201	11-Oct-01	373	86	95	212	**192**
202	12-Oct-01	211	160	389	203	**241**
203	12-Oct-01	870	579	1090	--	**846**
204	12-Oct-01	183	308	174	184	**212**
205	11-Oct-01	326	157	251	66	**200**
206	11-Oct-01	234	236	201	220	**223**
207	09-Oct-01	1040	1140	1150	826	**1039**
208	10-Oct-01	3050	2150	1890	1800	**2223**
209	10-Oct-01	1510	2030	1390	1100	**1508**
210	10-Oct-01	7490	546	1870	3830	**3434**
211	10-Oct-01	2400	2200	952	642	**1549**
212	10-Oct-01	163	273	341	642	**355**
213	10-Oct-01	8500	1640	3340	1020	**3625**
214	11-Oct-01	2100	2010	1150	1010	**1568**
215	11-Oct-01	1320	1020	1160	1420	**1230**
216	11-Oct-01	948	1070	1010	962	**998**
217	10-Oct-01	541	754	826	668	**697**
218	11-Oct-01	1320	671	588	562	**785**
219	11-Oct-01	685	858	1150	773	**867**
220	11-Oct-01	1050	1770	714	1020	**1139**
221	02-Aug-04	395	470	202.7	--	**356**
222	11-Oct-01	1340	676	469	1610	**1024**
223	11-Oct-01	424	555	474	199	**413**
224	11-Oct-01	772	504	459	581	**579**
225	11-Oct-01	1170	592	511	651	**731**
226	11-Oct-01	323	381	357	606	**417**
227	11-Oct-01	475	526	124	612	**434**
228	11-Oct-01	324	680	343	479	**457**
229	11-Oct-01	374	511	307	5430	**1656**
230	11-Oct-01	333	423	492	148	**349**
231	09-Oct-01	501	706	889	873	**742**
232	09-Oct-01	1580	1870	1060	1220	**1433**
233	09-Oct-01	1640	3810	900	686	**1759**
234	09-Oct-01	1100	2350	721	600	**1193**
235	09-Oct-01	1200	1480	636	599	**979**
236	12-Oct-01	1420	614	731	1280	**1011**
237	09-Oct-01	1250	792	1810	981	**1208**
238	11-Oct-01	--	492	1300	3420	**1737**
239	09-Oct-01	9820	2440	1630	2730	**4155**
240	09-Oct-01	2320	3070	4230	1460	**2770**
241	12-Oct-01	691	4130	392	634	**1462**
242	12-Oct-01	495	860	525	460	**585**
243	12-Oct-01	313	354	539	638	**461**

Attachment B-4. Pre-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]				Property Average (mg/kg) [d]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
244	12-Oct-01	671	547	530	731	**620**
245	12-Oct-01	586	785	595	700	**667**
246	12-Oct-01	703	801	468	760	**683**
247	12-Oct-01	498	813	537	484	**583**
248	12-Oct-01	431	368	670	524	**498**
249	12-Oct-01	279	568	1020	1690	**889**
250	12-Oct-02	914	864	830	1200	**952**
251	12-Oct-01	4130	2980	2540	857	**2627**
252	12-Oct-01	2330	1160	1360	1430	**1570**
253	11-Oct-01	413	1180	2140	964	**1174**
254	11-Oct-01	1010	1700	1100	1090	**1225**
255	11-Oct-01	756	890	1360	1290	**1074**
256	11-Oct-01	2090	2480	1130	1800	**1875**
257	09-Oct-01	967	1400	993	933	**1073**
258	11-Oct-01	1680	1420	1430	1660	**1548**
259	11-Oct-01	1290	3420	1670	4400	**2695**
260	11-Oct-01	1200	1460	1470	807	**1234**
261	11-Oct-01	934	1550	1730	1830	**1511**
262	11-Oct-01	1990	1980	1040	1280	**1573**
263	09-Oct-01	1890	1160	1220	1430	**1425**
264	11-Oct-01	1650	2220	1360	1300	**1633**
265	09-Oct-01	1090	1010	1060	885	**1011**
266	11-Oct-01	2390	2460	1210	1850	**1978**
267	11-Oct-01	1440	1770	1230	1930	**1593**
268	11-Oct-01	1040	1080	1220	1040	**1095**
269	11-Oct-01	1230	981	1050	1160	**1105**
270	11-Oct-01	4270	909	917	1030	**1782**
271	11-Oct-01	1360	1060	897	709	**1007**
272	11-Oct-01	612	2060	658	687	**1004**
273	09-Oct-01	315	340	630	232	**379**
274	09-Oct-01	703	719	520	664	**652**
275	09-Oct-01	694	731	660	393	**620**
276	09-Oct-01	254	443	136	216	**262**
277	09-Oct-01	868	797	349	522	**634**
278	09-Oct-01	245	204	59	48	**139**
279	10-Oct-01	1230	1330	982	822	**1091**
280	10-Oct-01	21100	893	475	441	**5727**
281	08-Oct-01	1120	1910	1090	957	**1269**
282	08-Oct-01	7650	6940	3380	4920	**5723**
283	08-Oct-01	4400	3060	2250	2010	**2930**
284	08-Oct-01	4690	6760	3270	4850	**4893**
285	08-Oct-01	4690	6760	3270	4850	**4893**
286	08-Oct-01	8380	8590	6850	6870	**7673**
287	08-Oct-01	6020	5650	2420	3580	**4418**
288	08-Oct-01	19900	20500	9766	9020	**14797**
289	08-Oct-01	1880	602	950	596	**1007**
290	08-Oct-01	887	636	2220	1750	**1373**
291	08-Oct-01	662	398	538	1240	**710**
292	08-Oct-01	2510	1510	3510	2530	**2515**
293	08-Oct-01	436	698	682	528	**586**
294	08-Oct-01	189	330	534	409	**366**
295	10-Oct-01	1130	3180	1580	1070	**1740**

Attachment B-4. Pre-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]				Property Average (mg/kg) [d]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
296	08-Oct-01	3100	3180	2240	1680	**2550**
297	08-Oct-01	1630	1650	1940	1810	**1758**
298	08-Oct-01	993	1080	3700	2010	**1946**
299	10-Oct-01	129	7280	2880	2160	**3112**
300	10-Oct-01	688	1190	1670	1800	**1337**
301	09-Oct-01	4130	6070	1220	989	**3102**
302	10-Oct-01	223	13000	5320	2230	**5193**
303	09-Oct-01	1220	1120	180	640	**790**
304	09-Oct-01	500	667	381	203	**438**
305	09-Oct-01	569	506	650	630	**589**
306	09-Oct-01	818	664	917	1170	**892**
307	10-Oct-01	498	465	492	744	**550**
308	10-Oct-01	954	1360	1050	695	**1015**
309	10-Oct-01	824	581	529	580	**629**
310	09-Oct-01	648	714	809	838	**752**
311	09-Oct-01	977	875	808	926	**897**
312	09-Oct-01	657	728	593	619	**649**
313	10-Oct-01	890	720	612	607	**707**
314	10-Oct-01	11200	1110	177	159	**3162**
315	10-Oct-01	590	858	393	375	**554**
316	10-Oct-01	825	957	794	854	**858**
317	10-Oct-01	658	436	533	503	**533**
318	10-Oct-01	509	578	484	1470	**760**
319	10-Oct-01	1100	1540	1320	397	**1089**
320	10-Oct-01	827	962	--	--	**895**
321	10-Oct-01	1200	1040	1160	2790	**1548**
322	10-Oct-01	2570	3400	1590	2190	**2438**
323	10-Oct-01	814	720	1320	1220	**1019**
324	10-Oct-01	2130	2490	2650	1810	**2270**
325	02-Oct-01	2970	2470	1300	916	**1914**
326	08-Oct-01	20700	10600	8880	2590	**10693**
327	08-Oct-01	6490	8670	2650	3930	**5435**
328	08-Oct-01	8080	6010	3470	2990	**5138**
329	08-Oct-01	5160	2510	996	1040	**2427**
330	09-Oct-01	1040	1900	1330	2040	**1578**
331	12-Oct-01	1800	1480	1470	1400	**1538**
332	12-Oct-01	1530	1720	594	1810	**1414**
333	12-Oct-01	1150	1620	1730	1540	**1510**
334	12-Oct-01	831	619	1360	1210	**1005**
335	12-Oct-01	1630	4470	944	1600	**2161**
336	19-Oct-01	11400	11600	8180	7050	**9558**
337	18-Oct-01	1080	1770	563	854	**1067**
338	18-Oct-01	999	1050	753	772	**894**
339	18-Oct-01	660	3900	1600	1060	**1805**
340	15-Oct-01	945	814	953	954	**917**
341	15-Oct-01	742	2060	1010	778	**1148**
342	15-Oct-01	1290	807	562	244	**726**
343	15-Oct-01	959	1080	1566	1220	**1206**
344	15-Oct-01	801	364	637	472	**569**
345	15-Oct-01	1230	59	419	1080	**697**
346	15-Oct-01	730	348	396	281	**439**
347	19-Oct-01	371	726	964	394	**614**

Attachment B-4. Pre-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]				Property Average (mg/kg) [d]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
348	15-Oct-01	860	527	892	430	**677**
349	15-Oct-01	388	334	266	210	**300**
350	15-Oct-01	128	490	488	161	**317**
351	17-Oct-01	624	869	316	379	**547**
352	17-Oct-01	1250	857	425	1480	**1003**
353	19-Oct-01	2320	2740	1160	2860	**2270**
354	17-Oct-01	1370	3900	1350	1050	**1918**
355	17-Oct-01	180	392	413	413	**350**
356	17-Oct-01	300	263	144	100	**202**
357	17-Oct-01	826	798	496	960	**770**
358	17-Oct-01	919	560	288	771	**635**
359	17-Oct-01	886	617	128	143	**444**
360	17-Oct-01	1110	549	806	--	**822**
361	17-Oct-01	624	886	257	544	**578**
362	15-Oct-01	907	9421	699	1110	**3034**
363	15-Oct-01	890	2160	947	--	**1332**
364	15-Oct-01	372	1110	1240	1060	**946**
365	15-Oct-01	564	913	1220	521	**805**
366	15-Oct-01	231	838	926	244	**560**
367	15-Oct-01	173	330	250	915	**417**
368	18-Oct-01	302	480	688	319	**447**
369	16-Oct-01	12100	5170	9140	4290	**7675**
370	18-Oct-01	1380	855	480	519	**809**
371	16-Oct-01	2740	977	1300	1850	**1717**
372	18-Oct-01	65	210	169	135	**145**
373	16-Oct-01	237	209	197	200	**211**
374	16-Oct-01	691	228	354	197	**368**
375	16-Oct-01	510	341	159	434	**361**
376	16-Oct-01	179	666	1080	41	**492**
377	16-Oct-01	257	229	113	151	**188**
378	16-Oct-01	435	382	498	391	**427**
379	16-Oct-01	237	413	330	309	**322**
380	16-Oct-01	342	448	614	281	**421**
381	17-Oct-01	466	618	532	529	**536**
382	17-Oct-01	454	559	726	629	**592**
383	19-Oct-01	270	383	311	433	**349**
384	19-Oct-01	294	288	815	768	**541**
385	16-Oct-01	367	1690	391	1080	**882**
386	16-Oct-01	4970	4250	3700	2680	**3900**
387	16-Oct-01	3130	2750	3180	2010	**2768**
388	16-Oct-01	1280	1570	5100	1170	**2280**
389	18-Oct-01	1120	8100	159	756	**2534**
390	18-Oct-01	1800	1750	1400	1400	**1588**
391	16-Oct-01	1380	1010	1150	936	**1119**
392	18-Oct-01	977	1330	758	1500	**1141**
393	16-Oct-01	1130	1923	425	741	**1055**
394	16-Oct-01	319	904	584	396	**551**
395	18-Oct-01	523	782	758	766	**707**
396	18-Oct-01	634	800	903	452	**697**
397	18-Oct-01	377	60	658	529	**406**
398	18-Oct-01	289	155	263	868	**394**
399	18-Oct-01	691	464	408	416	**495**

Attachment B-4. Pre-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]				Property Average (mg/kg) [d]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
400	18-Oct-01	451	1010	391	440	**573**
401	15-Oct-01	814	1040	567	969	**848**
402	15-Oct-01	2970	3080	396	513	**1740**
403	18-Oct-01	1670	2290	1440	1230	**1658**
404	15-Oct-01	655	636	401	545	**559**
405	18-Oct-01	679	516	688	519	**601**
406	15-Oct-01	748	1110	311	896	**766**
407	15-Oct-01	440	514	324	346	**406**
408	15-Oct-01	470	682	--	573	**575**
409	15-Oct-01	1010	1060	489	1620	**1045**
410	15-Oct-01	928	1090	682	1500	**1050**
411	15-Oct-01	982	541	791	444	**690**
412	15-Oct-01	768	867	--	649	**761**
413	16-Oct-01	874	1110	1340	767	**1023**
414	16-Oct-01	1160	1150	621	814	**936**
415	16-Oct-01	1160	1130	609	245	**786**
416	16-Oct-01	1240	866	1070	1260	**1109**
417	16-Oct-01	9530	3450	537	2060	**3894**
418	16-Oct-01	1640	1290	331	329	**898**
419	19-Oct-01	332	560	165	440	**374**
420	18-Oct-01	733	455	524	529	**560**
421	18-Oct-01	774	559	341	307	**495**
422	18-Oct-01	492	800	281	639	**553**
423	18-Oct-01	530	804	793	440	**642**
424	18-Oct-01	562	1320	578	619	**770**
425	16-Oct-01	1040	1360	1030	1139	**1142**
426	16-Oct-01	949	1240	850	1110	**1037**
427	18-Oct-01	1230	4410	2010	2230	**2470**
428	17-Oct-01	836	1540	778	934	**1022**
429	17-Oct-01	1710	1490	1160	1940	**1575**
430	17-Oct-01	1530	1170	597	471	**942**
431	17-Oct-01	1990	1820	426	321	**1139**
432	17-Oct-01	945	1250	560	323	**770**
433	17-Oct-01	2050	2990	1970	9410	**4105**
434	17-Oct-01	1270	2660	3930	1140	**2250**
435	19-Oct-01	2670	594	1520	1170	**1489**
436	17-Oct-01	556	1880	1090	1460	**1247**
437	05-Oct-01	3850	5830	5610	3240	**4633**
438	17-Oct-01	515	2150	285	228	**795**
439	18-Oct-01	1880	1220	1960	3230	**2073**
440	16-Oct-01	1380	1070	1480	1880	**1453**
441	16-Oct-01	3780	3230	2240	2430	**2920**
442	19-Oct-01	13500	5180	5590	6500	**7693**
443	16-Oct-01	3500	5010	1630	754	**2724**
444	18-Oct-01	1890	1540	1830	1920	**1795**
445	18-Oct-01	710	719	998	1650	**1019**
446	18-Oct-01	3670	645	1050	1290	**1664**
447	18-Oct-01	564	775	352	631	**581**
448	18-Oct-01	436	854	516	2010	**954**
449	18-Oct-01	858	446	544	719	**642**
450	18-Oct-01	322	635	527	491	**494**
451	18-Oct-01	781	821	661	800	**766**

Attachment B-4. Pre-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]				Property Average (mg/kg) [d]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
452	18-Oct-01	435	249	726	657	**517**
453	18-Oct-01	403	740	556	552	**563**
454	18-Oct-01	682	618	578	788	**667**
455	18-Oct-01	422	402	690	577	**523**
456	19-Oct-01	697	4780	858	408	**1686**
457	18-Oct-01	674	430	390	509	**501**
458	18-Oct-01	124	333	1610	638	**676**
459	18-Oct-01	566	732	406	240	**486**
460	18-Oct-01	865	562	453	670	**638**
461	18-Oct-01	489	386	599	487	**490**
462	18-Oct-01	518	950	548	552	**642**
463	17-Oct-01	829	416	100	194	**385**
464	17-Oct-01	342	718	424	580	**516**
465	17-Oct-01	357	530	343	487	**429**
466	17-Oct-01	553	596	401	581	**533**
467	19-Oct-01	778	33	370	495	**419**
468	17-Oct-01	1330	1310	707	381	**932**
469	17-Oct-01	89	286	464	230	**267**
470	19-Oct-01	1770	903	398	1350	**1105**
471	19-Oct-01	1230	1390	624	379	**906**
472	19-Oct-01	815	835	494	720	**716**
473	15-Oct-01	1670	534	933	1520	**1164**
474	15-Oct-01	569	158	1030	884	**660**
475	15-Oct-01	98	168	299	280	**211**
476	19-Oct-01	603	744	592	607	**637**
477	16-Oct-01	264	1670	2730	1900	**1641**
478	16-Oct-01	1390	999	560	878	**957**
479	16-Oct-01	412	439	570	613	**509**
480	16-Oct-01	669	110	854	602	**559**
481	16-Oct-01	156	862	335	189	**386**
482	16-Oct-01	2280	1340	1860	2820	**2075**
483	16-Oct-01	795	661	1660	1020	**1034**
484	17-Oct-01	2440	2340	1330	1210	**1830**
485	17-Oct-01	1620	1830	826	1390	**1417**
486	17-Oct-01	2450	1240	809	702	**1300**
487	18-Oct-01	1060	3930	1810	974	**1944**
488	17-Oct-01	887	847	1370	625	**932**
489	18-Oct-01	489	618	2760	904	**1193**
490	16-Oct-01	529	721	399	550	**550**
491	18-Oct-01	1400	353	956	784	**873**
492	17-Oct-01	434	903	608	634	**645**
493	17-Oct-01	429	399	492	542	**466**
494	17-Oct-01	592	986	955	1270	**951**
495	17-Oct-01	1640	440	641	749	**868**
496	23-Oct-01	1560	1170	2020	1170	**1480**
497	23-Oct-01	2440	3120	1460	1700	**2180**
498	23-Oct-01	1190	775	1590	1810	**1341**
499	23-Oct-01	313	372	396	365	**362**
500	23-Oct-01	453	301	2820	518	**1023**
501	23-Oct-01	6830	1260	3470	4900	**4115**
502	23-Oct-01	2250	3100	2000	2000	**2338**
503	23-Oct-01	3120	2370	3350	2030	**2718**

Attachment B-4. Pre-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]				Property Average (mg/kg) [d]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
504	23-Oct-01	2530	1550	5480	3190	**3188**
505	23-Oct-01	1110	1570	2250	1380	**1578**
506	23-Oct-01	1020	1100	1010	1250	**1095**
507	23-Oct-01	2640	7230	1120	2030	**3255**
508	23-Oct-01	534	464	988	1040	**757**
509	23-Oct-01	837	755	1560	1170	**1081**
510	23-Oct-01	716	617	768	888	**747**
511	23-Oct-01	2830	2550	1060	--	**2147**
512	23-Oct-01	2130	3110	1390	1420	**2013**
513	23-Oct-01	5350	3330	1090	1300	**2768**
514	23-Oct-01	1020	1690	1290	1500	**1375**
515	23-Oct-01	970	1420	2260	2070	**1680**
516	23-Oct-01	1400	1570	1630	1090	**1423**
517	23-Oct-01	1120	1370	1350	1270	**1278**
518	23-Oct-01	972	1510	1480	1460	**1356**
519	23-Oct-01	1110	797	1110	1590	**1152**
520	23-Oct-01	5490	1770	--	--	**3630**
521	23-Oct-01	3590	2150	12700	7510	**6488**
522	23-Oct-01	505	1040	852	420	**704**
523	23-Oct-01	32800	13300	24100	23200	**23350**
524	23-Oct-01	2530	1860	3070	3400	**2715**
525	23-Oct-01	863	2150	2110	2440	**1891**
526	24-Oct-01	2950	2470	1600	1610	**2158**
527	24-Oct-01	1480	1400	1040	684	**1151**
528	24-Oct-01	642	601	533	619	**599**
529	24-Oct-01	720	1300	903	1070	**998**
530	24-Oct-01	1050	749	801	1700	**1075**
531	24-Oct-01	511	438	641	882	**618**
532	24-Oct-01	1640	1490	8220	8520	**4968**
533	24-Oct-01	215	659	677	624	**544**
534	24-Oct-01	12100	8330	5310	11700	**9360**
535	24-Oct-01	1130	2540	2240	2270	**2045**
536	24-Oct-01	213	211	530	373	**332**
537	24-Oct-01	197	171	--	--	**184**
538	24-Oct-01	1780	2070	1290	1750	**1723**
539	24-Oct-01	408	203	171	529	**328**
540	24-Oct-01	1180	1370	870	644	**1016**
541	24-Oct-01	518	386	831	381	**529**
542	24-Oct-01	806	594	1150	747	**824**
543	24-Oct-01	1180	1280	868	942	**1068**
544	24-Oct-01	2020	814	304	353	**873**
545	25-Oct-01	8630	7640	7030	4840	**7035**
546	25-Oct-01	615	1150	430	930	**781**
547	25-Oct-01	1020	1650	1920	686	**1319**
548	25-Oct-01	1890	2250	1770	3750	**2415**
549	25-Oct-01	2110	2650	3260	3690	**2928**
550	25-Oct-01	1860	2820	2930	1530	**2285**
551	25-Oct-01	7670	14600	308	1120	**5925**
552	25-Oct-01	11500	7460	2620	5670	**6813**
553	25-Oct-01	11300	5310	4030	3570	**6053**
554	25-Oct-01	772	1870	1700	1440	**1446**
555	26-Oct-01	1570	340	4260	2730	**2225**

Attachment B-4. Pre-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]				Property Average (mg/kg) [d]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
556	26-Oct-01	705	645	578	416	**586**
557	26-Oct-01	916	1100	394	662	**768**
558	26-Oct-01	671	389	352	438	**463**
559	26-Oct-01	539	616	576	824	**639**
560	26-Oct-01	4690	7370	7580	6990	**6658**
561	26-Oct-01	942	247	432	817	**610**
562	26-Oct-01	1570	1320	632	501	**1006**
563	26-Oct-01	993	772	1090	859	**929**
564	26-Oct-01	462	313	539	558	**468**
565	26-Oct-01	332	1000	2290	1750	**1343**
566	26-Oct-01	690	366	928	1210	**799**
567	26-Oct-01	478	298	1080	1310	**792**
568	26-Oct-01	917	475	466	1490	**837**
569	26-Oct-01	427	420	468	546	**465**
570	26-Oct-01	2170	2120	3600	4110	**3000**
571	26-Oct-01	1010	599	2870	2170	**1662**
572	26-Oct-01	2520	1380	2850	4000	**2688**
573	27-Sep-01	904	632	684	553	**693**
574	07-Nov-00	1800	5000	2000	1700	**2625**
576	08-Nov-00	1400	1600	2000	1000	**1500**
577	19-Jul-02	1977	1657	1620	1717	**1743**
578	02-Nov-01	241	292	195	111	**210**
579	24-Sep-01	1920	1170	1490	1530	**1528**
580	11-Oct-01	--	492	1300	3420	**1737**
581	31-Oct-01	1170	795	618	764	**837**
582	30-Oct-01	1120	1770	1020	1100	**1253**
583	31-Oct-01	450	281	354	207	**323**
584	31-Oct-01	2550	1920	1170	774	**1604**
585	01-Nov-01	1880	2130	1550	1960	**1880**
586	02-Nov-01	1490	2260	1630	1320	**1675**
587	02-Nov-01	3710	1520	1440	2050	**2180**
588	02-Nov-01	460	489	102	294	**336**
589	02-Nov-01	5540	2410	--	--	**3975**
590	02-Nov-01	267	396	143	165	**243**
591	02-Nov-01	1740	835	538	441	**889**
592	02-Nov-01	538	540	365	381	**456**
593	02-Nov-01	204	407	360	203	**294**
594	02-Nov-01	298	466	375	214	**338**
595	02-Nov-01	894	399	625	1090	**752**
596	02-Nov-01	4480	3670	2000	2440	**3148**
597	02-Nov-01	3020	1450	2350	1160	**1995**
598	02-Nov-01	1850	1620	1450	1640	**1640**
599	02-Nov-01	519	428	858	343	**537**
600	02-Nov-01	994	1360	1730	542	**1157**
601	02-Nov-01	2050	1990	2910	2540	**2373**
602	02-Nov-01	421	458	705	1100	**671**
603	02-Nov-01	622	844	3170	1400	**1509**
604	02-Nov-01	1230	1230	1250	1210	**1230**
605	02-Nov-01	515	321	520	293	**412**
606	02-Nov-01	539	703	849	729	**705**
607	02-Nov-01	761	937	839	1120	**914**
608	02-Nov-01	1470	1130	1110	956	**1167**

Attachment B-4. Pre-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]				Property Average (mg/kg) [d]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
609	02-Nov-01	1070	958	946	299	**818**
610	02-Nov-01	870	1160	1140	938	**1027**
611	02-Nov-01	1860	2090	2200	2100	**2063**
612	02-Nov-01	1160	4770	2280	1160	**2343**
613	02-Nov-01	1840	2680	1190	1170	**1720**
614	02-Nov-01	1380	1830	2170	794	**1544**
615	02-Nov-01	1030	1340	1420	1660	**1363**
616	31-Oct-01	941	446	531	256	**544**
617	31-Oct-01	1320	1300	1060	1500	**1295**
618	31-Oct-01	1020	635	1060	1210	**981**
619	05-Nov-01	179	181	283	571	**304**
620	05-Nov-01	1370	410	221	311	**578**
621	05-Nov-01	2200	2820	4800	1880	**2925**
622	05-Nov-01	815	1460	186	238	**675**
623	05-Nov-01	977	110	199	185	**368**
624	05-Nov-01	393	126	195	672	**347**
625	06-Nov-01	1680	1350	1020	868	**1230**
626	06-Nov-01	488	657	554	717	**604**
627	06-Nov-01	2650	2580	1300	1240	**1943**
628	06-Nov-01	822	745	633	901	**775**
629	06-Nov-01	1240	906	476	555	**794**
630	06-Nov-01	803	562	502	769	**659**
631	06-Nov-01	685	498	--	--	**592**
632	06-Nov-01	441	355	1710	719	**806**
633	06-Nov-01	910	587	653	428	**645**
634	06-Nov-01	965	760	584	421	**683**
635	06-Nov-01	788	682	274	351	**524**
636	06-Nov-01	721	330	449	444	**486**
637	08-Nov-01	1360	1140	1220	1050	**1193**
638	08-Nov-01	492	682	605	367	**537**
639	08-Nov-01	725	706	647	696	**694**
640	08-Nov-01	346	368	122	170	**252**
641	08-Nov-01	--	496	462	662	**540**
642	08-Nov-01	1370	2020	2270	1180	**1710**
643	08-Nov-01	644	944	--	--	**794**
644	08-Nov-01	747	515	--	--	**631**
645	06-Nov-01	596	702	1190	854	**836**
646	06-Nov-01	766	621	626	518	**633**
647	06-Nov-01	1040	846	413	882	**795**
648	06-Nov-01	480	760	795	1010	**761**
649	06-Nov-01	1060	631	532	862	**771**
650	06-Nov-01	384	600	491	566	**510**
651	06-Nov-01	522	690	565	490	**567**
652	06-Nov-01	619	704	587	623	**633**
653	06-Nov-01	256	180	--	160	**199**
654	06-Nov-01	1450	1190	808	844	**1073**
655	06-Nov-01	1040	816	541	647	**761**
656	06-Nov-01	328	409	316	263	**329**
657	06-Nov-01	765	356	952	892	**741**
658	06-Nov-01	556	580	517	261	**479**
659	06-Nov-01	530	890	318	368	**527**
660	08-Nov-01	695	815	771	450	**683**

Attachment B-4. Pre-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]				Property Average (mg/kg) [d]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
661	08-Nov-01	1030	244	2320	3030	**1656**
662	08-Nov-01	920	1410	588	715	**908**
663	08-Nov-01	380	470	690	753	**573**
664	08-Nov-01	1030	776	677	534	**754**
665	08-Nov-01	2590	1880	2350	2780	**2400**
666	08-Nov-01	408	283	--	--	**346**
667	08-Nov-01	822	874	831	895	**856**
668	08-Nov-01	1760	1050	1080	1500	**1348**
669	08-Nov-01	588	255	607	502	**488**
670	31-Oct-01	505	651	545	256	**489**
671	31-Oct-01	448	555	422	580	**501**
672	31-Oct-01	1210	3070	1380	2090	**1938**
673	31-Oct-01	1660	1580	1980	2340	**1890**
674	07-Nov-00	2400	1000	1400	2600	**1850**
675	17-Oct-01	525	657	584	533	**575**
676	06-Feb-02	1633	1440	1173	1210	**1364**
677	26-Nov-02	1197	1220	2857	3177	**2113**
678	26-Nov-02	1747	1210	3680	--	**2212**
679	22-Feb-02	655	287	241	594	**444**
680	05-Mar-02	552	315	641	580	**522**
681	05-Mar-02	541	524	525	801	**598**
682	06-Mar-02	2247	1350	551	615	**1191**
683	06-Mar-02	552	634	650	740	**644**
684	04-Mar-02	4037	4443	4647	14300	**6857**
685	08-Mar-02	1487	916	538	568	**877**
686	07-Mar-02	585	1129	2103	3797	**1904**
687	20-Mar-02	466	1477	547	587	**769**
688	20-Mar-02	1009	2147	805	563	**1131**
689	20-Mar-02	827	1075	322	378	**651**
690	22-Mar-02	464	298	164	203	**282**
691	22-Mar-02	148	205	358	184	**224**
692	22-Mar-02	1627	1753	1370	1357	**1527**
693	22-Mar-02	1147	2900	2562	2217	**2207**
699	04-Oct-01	13600	4870	2190	8450	**7278**
703	15-Apr-02	474	295	599	286	**414**
706	22-Mar-02	6780	1070	--	--	**3925**
707	15-Apr-02	961	906	--	--	**934**
708	08-Aug-02	653	1040	693	443	**707**
709	19-Dec-02	754	469	347	332	**476**
710	15-Aug-03	730	672	773	1036	**803**
711	15-Apr-02	1360	1343	1183	2577	**1616**
714	15-Aug-03	853	1347	901	779	**970**
718	22-Jul-04	1363	--	--	--	**1363**
723	08-Aug-02	967	536	590	999	**773**
725	15-Apr-02	1177	1920	1893	1327	**1579**
726	18-Jul-02	3200	2583	2253	2630	**2667**
728	08-May-02	482	328	422	538	**443**
729	30-Jan-02	329	411	311	282	**333**
730	31-Jan-02	209	433	236	295	**293**
731	08-Mar-02	183	196	211	132	**181**
732	08-Mar-02	462	340	212	243	**314**
733	31-Jan-02	231	191	190	165	**194**

Attachment B-4. Pre-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]								Property Average (mg/kg) [d]
		Quadrant 1		Quadrant 2		Quadrant 3		Quadrant 4		
734	22-Mar-02	148		133		73		64		**105**
735	31-Jan-02	128		96		235		56		**129**
736	31-Jan-02	62		55		47		49		**53**
737	05-Feb-02	72		53		57		61		**61**
738	06-Jun-02	110	ND	130	ND	154		130	ND	**85**
739	06-Jun-02	140	ND	140	ND	150	ND	181		**99**
740	06-Jun-02	152		130	ND	159		120	ND	**109**
741	06-Jun-02	150	ND	140	ND	130	ND	192		**101**
742	06-Jun-02	185		159		170	ND	140	ND	**125**
743	06-Jun-02	140	ND	130	ND	202		140	ND	**102**
744	06-Jun-02	165		415		220		152		**238**
745	06-Jun-02	227		130	ND	140	ND	172		**134**
746	06-Jun-02	200		267		140	ND	130	ND	**151**
747	06-Jun-02	130	ND	154		120	ND	120	ND	**85**
748	10-Jun-02	120	ND	155		140	ND	352		**159**
749	10-Jun-02	397		142		287		140	ND	**224**
750	10-Jun-02	523		296		194		342		**339**
751	10-Jun-02	130	ND	149		157		141		**128**
752	10-Jun-02	130	ND	175		186		150	ND	**125**
753	10-Jun-02	150	ND	212		140	ND	140	ND	**107**
754	11-Jun-02	231		207		257		193		**222**
755	11-Jun-02	207		378		131		140	ND	**197**
756	11-Jun-02	283		201		224		140	ND	**195**
757	11-Jun-02	181		150	ND	140	ND	140	ND	**99**
758	11-Jun-02	140	ND	219		140	ND	140	ND	**107**
759	11-Jun-02	150	ND	140	ND	150	ND	140	ND	**73**
760	11-Jun-02	130	ND	140	ND	140	ND	120	ND	**66**
761	11-Jun-02	140	ND	250		150	ND	288		**171**
762	11-Jun-02	146		170	ND	130	ND	175		**118**
763	11-Jun-02	355		624		130	ND	140	ND	**279**
764	26-Jul-04	332		124		145		193		**199**
765	12-Jun-02	167		163		133		130	ND	**132**
766	31-May-02	159		169		120	ND	197		**146**
767	31-May-02	156		163		156		110	ND	**133**
768	31-May-02	469		118		163		110	ND	**201**
769	31-May-02	370		339		153		216		**270**
770	31-May-02	305		232		150	ND	128		**185**
771	31-May-02	264		173		168		178		**196**
772	31-May-02	465		279		140		132		**254**
773	31-May-02	686		576		288		171		**430**
774	31-May-02	120	ND	220		160		120	ND	**125**
775	31-May-02	256		299		131		107		**198**
776	31-May-02	120	ND	221		182		127		**148**
777	31-May-02	192		328		133		144		**199**
778	31-May-02	1120		398		436		393		**587**
779	31-May-02	224		232		110	ND	177		**172**
780	31-May-02	291		213		100	ND	257		**203**
781	31-May-02	238		215		187		214		**214**
782	31-May-02	178		142		110	ND	120	ND	**109**
783	31-May-02	253		268		110	ND	195		**193**
784	03-Jun-02	458		306		149		144		**264**
785	03-Jun-02	201		201		121		110	ND	**145**

Attachment B-4. Pre-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c] Quadrant 1		Quadrant 2		Quadrant 3		Quadrant 4		Property Average (mg/kg) [d]
786	03-Jun-02	250		130	ND	120	ND	170		**136**
787	04-Jun-02	170		140	ND	130	ND	150	ND	**95**
788	04-Jun-02	147		166		130	ND	140	ND	**112**
789	04-Jun-02	140	ND	150	ND	150	ND	139		**90**
790	04-Jun-02	358		165		289		316		**282**
791	04-Jun-02	140	ND	150	ND	149		130	ND	**90**
792	05-Jun-02	130	ND	140	ND	140	ND	152		**89**
793	06-Jun-02	142		100	ND	226		338		**189**
794	11-Jun-02	183		144		150	ND	150	ND	**119**
796	19-Jun-02	205		182		282		135		**201**
797	20-Jun-02	--		265		161		150	ND	**167**
798	12-Jun-02	182		158		--		180	ND	**143**
799	22-Jun-02	213		150	ND	148		140	ND	**127**
800	19-Jun-02	140	ND	169		170	ND	203		**132**
801	20-Jun-02	288		300		170	ND	157	ND	**188**
802	20-Jun-02	150	ND	170		150	ND	150	ND	**99**
803	18-Jun-02	218		150	ND	165		150	ND	**133**
804	18-Jun-02	150	ND	150	ND	180	ND	180	ND	**83**
805	19-Jun-02	170	ND	140	ND	250		170	ND	**123**
806	18-Jun-02	170	ND	170	ND	150	ND	130	ND	**78**
807	18-Jun-02	187		150	ND	212		150	ND	**137**
808	19-Jun-02	204		147	ND	173		170	ND	**134**
809	19-Jun-02	184		189		228		148		**187**
810	18-Jun-02	245		217		346		371		**295**
811	19-Jun-02	140	ND	150	ND	151		160		**114**
812	20-Jun-02	231		189		150	ND	170	ND	**145**
813	18-Jun-02	173		183		140	ND	140	ND	**124**
814	19-Jun-02	257		163	ND	140		130	ND	**136**
815	19-Jun-02	184		150	ND	170	ND	193		**134**
816	20-Jun-02	588		270		272		365		**374**
817	20-Jun-02	197		263		150	ND	150	ND	**153**
818	27-Jun-02	203		274		207		199		**221**
819	27-Jun-02	140	ND	170	ND	170	ND	222		**116**
820	27-Jun-02	202		298		376		244		**280**
821	27-Jun-02	520		335		277		156		**322**
822	27-Jun-02	205		333		132		194		**216**
823	27-Jun-02	252		212		212		205		**220**
824	27-Jun-02	367		286		180	ND	194		**234**
825	27-Jun-02	221		249		192		192		**214**
826	27-Jun-02	221		191		153		163		**182**
827	26-Jun-02	269		180		199		150	ND	**181**
828	26-Jun-02	384		451		308		150	ND	**305**
829	26-Jun-02	144		188		161		130	ND	**140**
830	26-Jun-02	140		149		179		140	ND	**135**
831	26-Jun-02	130	ND	130	ND	130	ND	120	ND	**64**
832	26-Jun-02	304		110	ND	467		727		**388**
833	26-Jun-02	150	ND	150	ND	197		150	ND	**106**
834	03-Jul-02	2080		5770		1270		1490		**2653**
835	09-Jul-02	185		247		155		198		**196**
836	09-Jul-02	264		181		113		117		**169**
837	09-Jul-02	176		247		218		170		**203**
838	09-Jul-02	148		223		161		185		**179**

Attachment B-4. Pre-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]				Property Average (mg/kg) [d]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
839	03-Jul-02	52.7	129	93	218	**123**
840	03-Jul-02	207	118	169	272	**192**
841	03-Jul-02	--	164	151	134	**150**
842	09-Jul-02	172	80	91	41	**96**
843	09-Jul-02	150	110	86	214	**140**
844	03-Jul-02	99	111	169	211	**148**
845	09-Jul-02	198	135	122	115	**143**
846	03-Jul-02	149	35	35	56	**69**
847	09-Jul-02	109	92	304	583	**272**
848	12-Jul-02	340	743	119	81	**321**
849	12-Jul-02	347	62	195	273	**219**
850	11-Jul-02	73	121	51	36	**70**
851	11-Jul-02	78	101	61	32	**68**
852	11-Jul-02	184	140	121	116	**140**
853	11-Jul-02	518	1210	156	252	**534**
854	11-Jul-02	343	653	199	107	**326**
855	11-Jul-02	418	483	305	361	**392**
856	11-Jul-02	236	164	82	161	**161**
857	11-Jul-02	330	371	164	208	**268**
858	11-Jul-02	191	83	207	150	**158**
859	12-Jul-02	104	107	140	96	**112**
860	12-Jul-02	223	230	284	226	**241**
861	12-Jul-02	193	233	167	236	**207**
862	11-Jul-02	228	261	50	81	**155**
863	11-Jul-02	154	173	111	173	**153**
864	11-Jul-02	25	56	85	71	**59**
865	17-Jul-02	248	277	197	251	**243**
866	12-Jul-02	96	341	141	128	**177**
867	12-Jul-02	129	417	120	85	**188**
868	15-Jul-02	159	277	223	165	**206**
869	15-Jul-02	274	299	206	188	**242**
870	15-Jul-02	298	--	143	186	**209**
871	15-Jul-02	199	341	212	130	**221**
872	15-Jul-02	287	298	220	285	**273**
873	17-Jul-02	127	183	219	152	**170**
874	17-Jul-02	143	150	116	118	**132**
875	18-Jul-02	254	232	91	246	**206**
876	11-Jul-02	177	280	311	526	**324**
877	11-Jul-02	148	89	11	111	**90**
878	18-Jul-02	326	330	297	329	**321**
879	11-Jul-02	168	242	181	116	**177**
880	17-Jul-02	271	441	569	443	**431**
881	17-Jul-02	265	218	303	265	**263**
882	15-Jul-02	441	328	120	207	**274**
883	12-Jul-02	352	355	289	243	**310**
884	18-Jul-02	200	238	109	249	**199**
885	09-Jul-02	228	500	230	235	**298**
886	09-Jul-02	395	293	179	188	**264**
887	09-Jul-02	257	214	181	191	**211**
888	09-Jul-02	215	274	295	252	**259**
889	09-Jul-02	175	385	206	308	**269**
890	09-Jul-02	268	293	311	193	**266**

Attachment B-4. Pre-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]								Property Average (mg/kg) [d]
		Quadrant 1		Quadrant 2		Quadrant 3		Quadrant 4		
891	12-Jul-02	342		370		387		374		**368**
892	12-Jul-02	436		454		359		244		**373**
893	12-Jul-02	303		230		287		310		**283**
894	12-Jul-02	498		342		314		548		**426**
895	16-Jul-02	307		244		147		122		**205**
896	16-Jul-02	156		192		70		98		**129**
897	16-Jul-02	86		133		16		90		**81**
898	15-Jul-02	174		187		186		155		**176**
899	15-Jul-02	194		211		190		163		**190**
900	15-Jul-02	133		108		15		186		**111**
901	15-Jul-02	129		69		235		164		**149**
902	16-Jul-02	185		201		104		135		**156**
903	11-Jul-02	170		83		82		137		**118**
904	18-Jul-02	100		179		248		289		**204**
905	11-Jul-02	177		207		243		130		**189**
906	15-Jul-02	239		217		196		183		**209**
907	15-Jul-02	134		265		234		190		**206**
908	16-Jul-02	133		206		171		130		**160**
909	16-Jul-02	229		162		140		84		**154**
910	15-Jul-02	33		127		128		194		**121**
911	16-Jul-02	116		184		192		155		**162**
912	16-Jul-02	55		163		121		186		**131**
913	16-Jul-02	243		225		141		227		**209**
914	18-Jul-02	296		276		295		235		**276**
915	18-Jul-02	348		361		213		173		**274**
916	18-Jul-02	515		635		175		281		**402**
917	18-Jul-02	513		369		287		295		**366**
918	18-Jul-02	337		208		207		293		**261**
919	18-Jul-02	181		165		391		214		**238**
920	18-Jul-02	363		361		287		367		**345**
921	18-Jul-02	446		360		221		343		**343**
922	03-Jul-02	1220		879		1480		621		**1050**
923	11-Jul-02	4810		3970		--		--		**4390**
924	26-Jun-02	150	ND	120	ND	140	ND	140	ND	**69**
925	07-Aug-02	199		121		112		108		**135**
926	07-Aug-02	538		291		173		235		**309**
927	07-Aug-02	262		156		37		97		**138**
928	07-Aug-02	318		296		247		152		**253**
929	06-Aug-02	317		195		184		264		**240**
930	06-Aug-02	344		266		223		157		**248**
931	06-Aug-02	292		317		239		153		**250**
932	06-Aug-02	279		258		154		205		**224**
933	07-Aug-02	504		314		205		381		**351**
934	07-Aug-02	279		304		141		306		**258**
935	07-Aug-02	269		181		183		145		**195**
936	07-Aug-02	299		210		209		217		**234**
937	06-Aug-02	357		371		262		196		**297**
938	06-Aug-02	148		141		137		179		**151**
939	06-Aug-02	193		268		171		117		**187**
940	06-Aug-02	119		197		210		118		**161**
941	07-Aug-02	314		417		167		236		**284**
942	06-Aug-02	283		362		148		119		**228**

Attachment B-4. Pre-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]								Property Average (mg/kg) [d]
		Quadrant 1		Quadrant 2		Quadrant 3		Quadrant 4		
943	06-Aug-02	368		196		148		225		**234**
944	26-Jun-02	150	ND	140	ND	137		140	ND	**88**
945	11-Jun-02	210		257		150	ND	133		**169**
946	12-Jun-02	140	ND	158		720		150	ND	**256**
947	05-Jun-02	150	ND	133	ND	154		140	ND	**91**
948	29-Aug-02	280		325		332		183		**280**
949	29-Aug-02	597		351		299		259		**377**
950	29-Aug-02	79.6		148		107		166		**125**
951	29-Aug-02	348		223		120		185		**219**
952	29-Aug-02	264		276		167		83.5		**198**
953	27-Aug-02	295		536		482		616		**482**
954	29-Aug-02	247		391		374		295		**327**
955	27-Aug-02	313		343		244		376		**319**
956	27-Aug-02	278		302		316		283		**295**
957	27-Aug-02	216		225		134		331		**227**
958	27-Aug-02	374		202		282		160		**255**
959	27-Aug-02	333		113		182		289		**229**
960	27-Aug-02	385		310		234		115		**261**
961	27-Aug-02	230		245		106		219		**200**
962	27-Aug-02	186		349		238		127		**225**
963	27-Aug-02	288		315		368		222		**298**
964	27-Aug-02	319		433		206		313		**318**
965	27-Aug-02	225		198		333		388		**286**
966	27-Aug-02	225		210		225		305		**241**
967	27-Aug-02	166		235		240		240		**220**
968	27-Aug-02	197		425		229		177		**257**
969	27-Aug-02	478		416		284		164		**336**
970	27-Aug-02	241		235		104		210		**198**
971	27-Aug-02	409		244		188		182		**256**
972	27-Aug-02	263		184		188		303		**235**
973	27-Aug-02	157		268		262		243		**233**
974	27-Aug-02	337		183		367		189		**269**
975	04-Sep-02	284		330		373		374		**340**
976	04-Sep-02	160		246		203		138		**187**
977	04-Sep-02	433		279		124		222		**265**
978	04-Sep-02	210		285		366		237		**275**
979	04-Sep-02	289		264		136		212		**225**
980	04-Sep-02	319		710		252		312		**398**
981	03-Sep-02	14		109		130		89		**86**
982	03-Sep-02	243		160		266		187		**214**
983	03-Sep-02	142		74		197		130		**136**
984	03-Sep-02	215		138		116		163		**158**
985	03-Sep-02	68		64		155		118		**101**
986	03-Sep-02	234		255		226		169		**221**
987	03-Sep-02	188		271		142		211		**203**
988	03-Sep-02	148		66		42		25		**70**
989	03-Sep-02	110		185		195		26		**129**
990	03-Sep-02	201		182		260		195		**210**
991	03-Sep-02	25		--		135		223		**128**
992	30-Aug-02	207		233		229		125		**199**
993	30-Aug-02	95		149		130		106		**120**
994	30-Aug-02	239		171		234		202		**212**

Attachment B-4. Pre-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]				Property Average (mg/kg) [d]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
995	30-Aug-02	276	215	152	298	**235**
996	30-Aug-02	464	230	213	312	**305**
997	30-Aug-02	99	13	50	184	**87**
998	30-Aug-02	62	88	192	218	**140**
999	11-Sep-02	229	350	145	184	**227**
1000	12-Sep-02	311	513	370	231	**356**
1001	11-Sep-02	117	187	146	123	**143**
1002	12-Sep-02	251	200	121	59	**158**
1003	12-Sep-02	167	201	164	108	**160**
1004	12-Sep-02	342	168	128	114	**188**
1005	12-Sep-02	237	157	74	124	**148**
1006	12-Sep-02	203	160	177	55	**149**
1007	12-Sep-02	602	309	329	185	**356**
1008	12-Sep-02	192	224	262	188	**217**
1009	12-Sep-02	104	141	172	272	**172**
1010	10-Sep-02	236	193	139	108	**169**
1011	11-Sep-02	253	179	287	318	**259**
1012	11-Sep-02	84	260	146	119	**152**
1013	11-Sep-02	64	123	19	81	**72**
1014	11-Sep-02	156	170	111	139	**144**
1015	10-Sep-02	256	222	207	95	**195**
1016	06-Sep-02	149	133	36	120	**110**
1017	11-Sep-02	198	215	98	157	**167**
1018	10-Sep-02	137	58	40	122	**89**
1019	10-Sep-02	197	203	221	245	**217**
1020	11-Sep-02	--	92	219	121	**144**
1021	15-Jul-02	170	114	208	175	**167**
1022	06-Sep-02	206	160	230	138	**184**
1023	30-Aug-02	158	169	165	174	**167**
1024	06-Sep-02	355	381	170	186	**273**
1025	06-Sep-02	37	41	72	96	**62**
1026	30-Aug-02	108	60	155	115	**110**
1027	30-Aug-02	24	70	82	137	**78**
1028	06-Sep-02	48	115	113	48	**81**
1029	30-Aug-02	131	177	126	174	**152**
1030	30-Aug-02	212	199	128	163	**176**
1031	30-Aug-02	215	7	51	129	**101**
1032	06-Sep-02	123	123	114	180	**135**
1033	06-Sep-02	10	89	131	137	**92**
1034	06-Sep-02	27	122	159	156	**116**
1035	06-Sep-02	125	119	136	26	**102**
1036	30-Aug-02	504	389	173	282	**337**
1037	06-Sep-02	175	285	139	175	**194**
1038	06-Sep-02	92	151	175	241	**165**
1039	06-Sep-02	170	300	241	228	**235**
1040	10-Sep-02	113	106	268	174	**165**
1041	10-Sep-02	118	199	192	56	**141**
1042	10-Sep-02	314	166	185	335	**250**
1043	11-Sep-02	175	166	299	206	**212**
1044	10-Sep-02	221	170	65	152	**152**
1045	11-Sep-02	783	59	125	45	**253**
1046	11-Sep-02	107	264	133	191	**174**

Attachment B-4. Pre-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]				Property Average (mg/kg) [d]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
1047	11-Sep-02	145	33	--	67	**82**
1048	10-Sep-02	194	281	215	343	**258**
1049	11-Sep-02	64	27	43	107	**60**
1050	10-Sep-02	204	239	153	224	**205**
1051	11-Sep-02	135	155	119	137	**137**
1052	10-Sep-02	169	216	210	--	**198**
1053	11-Sep-02	326	267	172	304	**267**
1054	10-Sep-02	122	152	170	106	**138**
1055	10-Sep-02	221	200	80	150	**163**
1056	10-Sep-02	215	217	136	224	**198**
1057	10-Sep-02	151	237	91	206	**171**
1058	10-Sep-02	225	129	183	207	**186**
1059	10-Sep-02	202	170	200	247	**205**
1060	10-Sep-02	133	58	143	101	**109**
1061	10-Sep-02	114	173	178	96	**140**
1062	10-Sep-02	74	37	101	140	**88**
1063	16-Oct-02	122	92	98	142	**114**
1064	30-Oct-02	86	42	49	74	**63**
1065	30-Oct-02	85	92	117	77	**93**
1066	12-Mar-03	91.4	101.6	77	75.6	**86**
1067	11-Mar-03	1033	1070	506	--	**870**
1068	19-Jun-03	717	542	162	--	**474**
1069	15-Jul-03	2137	1230	1203	1217	**1447**
1074	07-Aug-03	859	787	530	810	**747**
1075	08-Nov-01	1760	1050	1080	1500	**1348**
1076	15-Oct-01	982	541	791	444	**690**
1079	02-Nov-01	16300	2800	11300	6290	**9173**
1080	08-Nov-01	2110	6090	606	680	**2372**
1081	02-Nov-01	5260	10000	8750	6390	**7600**
1082	11-Apr-03	100	133	--	--	**117**
1084	02-Nov-01	5680	1580	4460	1160	**3220**
1086	08-Nov-01	606	--	--	--	**606**
1088	01-Apr-04	935	814	781	715	**811**
1090	22-Jul-04	--	--	--	632	**632**

[a] Data were obtained from U.S. EPA Region 7 (2006).

[b] A value qualified with an "ND" represents a non-detect. The value presented is the detection limit.

For the purpose of calculating the property average, one-half the detection limit was used as the value for non-detects.

[c] "--" indicates that no sample was collected for that quadrant.

[d] Not provided by U.S. EPA Region 7. Averages were calculated by ICF.

Attachment B-5. Post-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b]				Property Average (mg/kg) [c]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
141	17-Jun-02	944	523	1170	587	**806**
142	16-Jun-03	157	215	212	237	**205**
143	16-Jun-03	197	265	207	264	**233**
145	03-Apr-02	880	598	445	493	**604**
146	19-May-03	206	146	270	309	**233**
147	03-Apr-02	368	349	201	247	**291**
148	21-May-02	193	296	208	290	**247**
149	16-Apr-02	1370	612	462	308	**688**
150	16-Dec-02	198	225	--	260	**228**
151	14-Jan-02	281	463	483	279	**377**
153	15-Jun-04	280	295	218	127	**230**
154	17-Jan-02	1550	1457	764	786	**1139**
155	03-Jun-03	109	288	283	378	**265**
156	10-Dec-02	540	332	195	505	**393**
157	08-Jul-02	778	895	876	353	**726**
158	19-Jan-02	675	288	455	539	**489**
159	27-Jun-02	280	193	217	196	**222**
160	26-Jun-02	398	216	188	232	**259**
161	28-Jun-02	490	1297	502	534	**706**
162	12-Jul-02	2630	2137	1400	766	**1733**
163	13-May-02	1898	2946	2078	1688	**2153**
172	21-Oct-02	466	189	769	1010	**609**
175	28-Mar-02	549	104	391	601	**411**
176	22-Jan-02	1217	687	1018	633	**889**
177	13-Nov-02	690	1001	1021	860	**893**
178	27-Nov-02	307	153	71	48	**145**
179	05-Nov-01	334	397	447	254	**358**
180	03-Jun-02	572	240	285	288	**346**
181	20-Nov-01	907	401	771	603	**671**
182	14-Dec-01	1347	1273	911	697	**1057**
183	09-Nov-01	560	834	659	562	**654**
184	07-Feb-02	716	167	475	321	**420**
185	25-Apr-02	125	208	127	123	**146**
191	10-Mar-04	--	--	500	129	**315**
196	07-Dec-01	643	981	760	243	**657**
197	09-Jan-02	872	825	680	847	**806**
200	27-Feb-02	155	--	311	--	**233**
207	11-Jan-02	978	890	485	648	**750**
208	07-Oct-02	499	714	490	1057	**690**
211	07-Oct-03	794	857	693	672	**754**
212	23-Jan-02	--	--	--	568	**568**
213	29-Aug-02	567	684	457	645	**588**
214	05-Mar-02	564	517	1076	496	**663**
215	22-Aug-03	647	386	487	762	**571**
216	23-Mar-04	358	661	400	249	**417**
217	11-Apr-03	627	473	553	271	**481**
218	16-Sep-03	473	300	294	445	**378**
220	19-Aug-03	451	475	592	394	**478**
222	15-Mar-02	139	85	152	166	**136**
225	02-Jun-04	104	110	286	186	**172**
226	20-May-02	--	--	--	155	**155**
230	15-Feb-02	--	119	190	--	**155**
231	21-Mar-02	203	415	429	281	**332**
232	25-Jun-02	520	840	946	275	**645**

Attachment B-5. Post-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b]				Property Average (mg/kg) [c]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
233	13-Feb-02	578	238	357	285	**365**
234	13-Nov-02	74	669	369	254	**342**
235	06-Aug-03	440	532	701	485	**540**
237	21-Aug-03	454	551	589	641	**559**
238	17-Oct-02	2693	--	1095	1100	**1629**
239	04-Mar-02	1400	690	976	1487	**1138**
240	15-Apr-02	488	451	798	220	**489**
241	07-May-04	342	270	--	--	**306**
242	23-Aug-04	49	58	168	271	**137**
246	12-Aug-04	261	258	--	336	**285**
251	26-Aug-02	678	813	793	246	**633**
253	17-Dec-03	599	652	411	563	**556**
254	16-Sep-03	178	668	557	400	**451**
255	16-Sep-03	922	463	446	543	**594**
256	19-Sep-03	536	1040	679	1663	**980**
257	17-Oct-01	523	660	294	333	**453**
258	26-Sep-03	907	972	976	689	**886**
259	29-Aug-02	615	376	527	656	**544**
260	16-Oct-03	292	1143	705	213	**588**
261	11-Mar-02	246	244	721	849	**515**
262	16-Jan-02	395	1110	913	822	**810**
263	15-Oct-01	1197	497	603	1243	**885**
264	18-Sep-03	790	345	1097	860	**773**
265	28-Jan-02	1083	939	694	571	**822**
266	02-Oct-03	1563	653	871	747	**959**
267	22-Oct-03	1620	1830	1123	1280	**1463**
268	26-Sep-03	1087	463	922	842	**829**
269	07-Oct-03	1087	1026	940	702	**939**
272	16-Jan-04	248	444	432	450	**394**
273	14-Mar-02	--	--	165	--	**165**
277	01-Apr-04	205	251	--	181	**212**
279	19-May-03	116	203	252	321	**223**
280	14-Jul-04	221	165	264	269	**230**
282	19-Jun-02	1640	3900	1270	1227	**2009**
283	21-Jun-02	1487	356	597	605	**761**
284	15-Mar-04	355	474	209	296	**334**
285	15-Mar-04	355	474	209	296	**334**
287	15-May-02	1990	1815	1550	1432	**1697**
295	18-Jul-02	1900	2953	1093	895	**1710**
299	24-Jul-02	--	2930	850	195	**1325**
300	09-Aug-02	1260	1150	310	1033	**938**
301	18-Jul-02	239	162	235	210	**212**
302	07-Nov-01	232	270	64	136	**176**
303	15-Mar-04	660	277	--	214	**384**
304	08-Apr-04	326	538	--	--	**432**
306	14-Oct-02	1290	492	192	223	**549**
308	15-Aug-03	1011	532	784	444	**693**
311	10-Aug-04	568	272	417	291	**387**
314	28-Mar-02	575	430	--	--	**503**
316	06-May-04	471	444	129	536	**395**
319	20-Apr-04	927	551	--	--	**739**
320	04-May-04	727	811	--	--	**769**
321	01-Apr-02	402	604	645	1107	**690**
323	26-Sep-02	1536	1540	556	334	**992**

Attachment B-5. Post-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b]				Property Average (mg/kg) [c]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
324	19-Aug-02	111	539	394	317	**340**
325	09-Apr-04	2757	--	--	--	**2757**
326	07-Jun-02	1340	1313	884	1253	**1198**
327	07-Jun-02	921	1011	2223	373	**1132**
328	06-Jun-02	2047	648	1663	756	**1279**
330	24-Jan-02	220	195	146	234	**199**
331	24-Jan-02	416	731	724	360	**558**
337	01-Jul-03	623	833	509	467	**608**
339	08-Feb-02	147	259	124	80	**153**
340	17-Jan-02	823	1277	944	--	**1015**
341	21-Nov-02	371	1530	310	565	**694**
344	01-Apr-02	958	--	1058	6177	**2731**
347	20-Dec-01	--	113	88	--	**101**
353	18-Oct-02	100	210	152	317	**195**
354	23-Feb-04	--	625	147	411	**394**
355	08-Feb-02	--	130	193	179	**167**
357	30-Apr-04	291	393	369	262	**329**
358	30-Apr-04	369	490	--	576	**478**
360	04-May-04	240	142	335	--	**239**
361	22-Apr-04	629	233	568	--	**477**
363	30-Jun-04	331	596	482	--	**470**
364	02-Jul-04	393	517	563	--	**491**
365	08-Jun-04	331	684	173	426	**404**
371	09-Oct-02	96	241	84	60	**120**
384	25-Mar-04	--	--	544	153	**349**
385	20-Dec-01	--	60	--	79	**70**
386	20-Feb-04	1274	837	1267	1072	**1113**
387	27-Feb-04	1253	1001	838	--	**1031**
388	22-Aug-02	292	123	267	425	**277**
389	07-Mar-02	304	324	239	254	**280**
390	04-Aug-03	684	1167	519	530	**725**
391	29-Jan-02	706	709	1220	752	**847**
392	08-Nov-02	401	187	191	376	**289**
395	07-Mar-02	344	435	550	449	**445**
396	11-Sep-03	401	687	792	317	**549**
398	18-Feb-02	--	--	--	160	**160**
400	21-May-04	155	210	--	174	**180**
403	28-Feb-02	445	209	149	376	**295**
404	19-Jul-02	1113	408	--	--	**761**
405	29-Jul-03	356	885	589	341	**543**
406	19-Jul-02	229	--	--	--	**229**
407	22-Feb-02	318	312	--	--	**315**
408	03-Jul-02	339	164	320	308	**283**
410	10-Apr-02	653	862	1490	532	**884**
411	15-Aug-03	632	564	564	353	**528**
412	13-Aug-03	417	442	719	456	**509**
413	29-Jan-02	382	546	267	343	**385**
416	12-Apr-04	398	2000	--	--	**1199**
418	17-Jun-02	186	154	--	--	**170**
419	17-Jun-02	--	263	--	169	**216**
422	04-May-04	97	163	--	108	**123**
425	21-Feb-02	287	285	112	146	**208**
426	18-Jan-02	1180	1913	987	710	**1198**
428	29-Jul-03	525	148	159	237	**267**

Attachment B-5. Post-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b]				Property Average (mg/kg) [c]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
430	30-Apr-03	704	469	282	286	**435**
431	10-Dec-02	478	1527	114	--	**706**
432	02-Jun-03	118	234	220	--	**191**
433	20-Jun-02	64	532	1423	4100	**1530**
435	10-Jul-02	2253	592	1807	835	**1372**
436	10-Jul-02	872	3163	--	--	**2018**
440	09-Aug-02	880	328	1380	1650	**1060**
442	16-Feb-04	859	111	768	608	**587**
444	18-Feb-02	224	321	488	294	**332**
445	27-Apr-04	568	365	820	942	**674**
446	29-Aug-02	1372	1073	596	884	**981**
447	13-Mar-02	178	222	--	89	**163**
448	20-Dec-02	315	616	366	165	**366**
449	27-Apr-04	162	304	227	258	**238**
450	13-May-02	--	130	176	163	**156**
451	14-Apr-04	266	209	235	222	**233**
454	13-Feb-02	274	191	206	63	**184**
456	18-Aug-04	184	123	212	175	**174**
458	29-Apr-04	--	--	228	170	**199**
468	22-Apr-04	264	238	323	--	**275**
470	29-Jul-04	1550	439	--	305	**765**
477	23-Oct-02	1070	733	1210	2233	**1312**
484	16-Jan-02	395	1110	913	822	**810**
485	22-Jul-04	628	713	961	688	**748**
486	24-Sep-03	734	963	779	791	**817**
491	02-Jun-04	358	--	508	395	**420**
492	30-Apr-04	164	257	446	231	**275**
493	05-Feb-02	72	159	129	144	**126**
495	25-Jun-04	303	304	418	328	**338**
496	04-Jun-03	287	279	--	204	**257**
497	22-Aug-02	148	60	429	--	**212**
498	09-Aug-02	1042	686	608	482	**705**
500	18-Feb-04	--	--	310	--	**310**
501	23-Jan-04	1930	675	1180	811	**1149**
503	25-Feb-04	1323	797	--	--	**1060**
504	13-Jun-02	353	177	83	174	**197**
511	03-Apr-02	863	1773	204	209	**762**
512	15-Nov-01	688	752	777	567	**696**
513	15-Nov-01	736	824	743	245	**637**
514	24-Jan-02	209	605	233	840	**472**
517	06-May-04	604	584	471	439	**525**
518	10-Jun-04	380	493	313	602	**447**
520	23-Feb-04	224	--	--	--	**224**
526	16-Jul-02	1007	891	1117	944	**990**
528	03-Aug-04	--	--	130	--	**130**
531	11-Jan-02	567	--	--	--	**567**
532	10-Mar-04	481	1840	114	244	**670**
535	05-May-03	274	148	283	118	**206**
540	10-Sep-03	307	502	1018	568	**599**
542	13-Jan-04	762	357	426	318	**466**
544	08-May-03	479	223	681	--	**461**
557	27-Aug-03	878	789	467	523	**664**
558	15-Feb-02	53	--	--	90	**72**
564	11-Feb-02	57	335	114	55	**140**

Attachment B-5. Post-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b]				Property Average (mg/kg) [c]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
573	30-Oct-01	273	236	214	202	**231**
574	09-Oct-01	614	1057	1363	507	**885**
575	21-Sep-01	1670	1947	186	905	**1177**
576	26-Sep-01	1160	654	512	619	**736**
577	30-Sep-02	1523	1187	469	594	**943**
579	02-Oct-01	1180	937	343	382	**711**
580	17-Oct-02	2693	--	1095	1100	**1629**
581	12-Mar-02	731	403	90	192	**354**
584	23-Feb-04	436	1027	153	--	**539**
585	03-Dec-03	371	669	632	574	**562**
588	11-Feb-02	202	159	--	--	**181**
593	11-Feb-02	--	123	--	--	**123**
596	20-Feb-04	796	235	--	--	**516**
597	15-Apr-03	1257	854	618	893	**906**
600	09-Aug-02	264	866	--	--	**565**
601	22-Jul-02	1333	445	848	2010	**1159**
604	13-Oct-03	809	380	719	680	**647**
605	03-Aug-04	378	--	--	--	**378**
606	03-Aug-04	--	333	--	--	**333**
608	06-Mar-02	847	372	764	882	**716**
609	24-Jun-04	435	402	827	--	**555**
612	07-Mar-02	304	324	239	254	**280**
613	15-Aug-02	432	476	130	661	**425**
614	04-Aug-03	1753	432	904	427	**879**
615	08-Sep-03	641	802	268	548	**565**
617	17-Oct-02	654	1247	535	781	**804**
622	11-Feb-02	553	878	--	--	**716**
625	21-Mar-02	182	434	425	651	**423**
626	29-Jan-02	220	217	172	221	**208**
627	28-Jan-02	989	511	192	2177	**967**
628	07-Aug-03	536	288	238	440	**376**
629	28-Mar-02	506	351	248	219	**331**
632	06-Apr-04	100	--	91	155	**115**
635	21-May-03	182	341	--	--	**262**
636	01-Jul-02	168	--	92	154	**138**
637	19-Dec-02	245	277	1497	320	**585**
642	20-Jun-03	395	881	739	425	**610**
644	29-Jul-03	338	399	152	272	**290**
655	08-Jun-04	623	473	975	769	**710**
657	06-May-04	151	--	279	228	**219**
658	16-Aug-04	70	220	243	--	**178**
660	05-Sep-03	126	165	297	149	**184**
663	11-Mar-02	--	102	244	218	**188**
664	15-Apr-04	431	420	325	305	**370**
668	15-Aug-03	716	753	606	409	**621**
670	12-Apr-02	388	492	519	372	**443**
672	12-Dec-02	623	779	289	375	**517**
674	01-Oct-01	627	854	1413	--	**965**
676	19-Dec-02	589	277	273	771	**478**
677	28-Jun-02	922	605	1253	2840	**1405**
678	28-Jun-02	1247	897	1025	--	**1056**
681	26-Apr-04	343	214	381	377	**329**
684	17-Jul-03	63	388	209	193	**213**
688	14-May-03	458	703	560	618	**585**

Attachment B-5. Post-Excavation Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b]				Property Average (mg/kg) [c]
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	
692	13-Oct-03	1147	930	--	--	**1039**
693	08-Oct-02	1004	802	1683	1513	**1251**
699	13-May-02	1898	2800	2055	1688	**2110**
711	02-Oct-02	566	533	427	301	**457**
714	08-Sep-03	1010	307	740	363	**605**
718	03-Aug-04	628	--	--	--	**628**
725	09-Aug-04	669	810	779	782	**760**
726	15-Oct-02	402	300	429	496	**407**
729	14-Mar-02	192	237	--	131	**187**
795	11-Jul-02	1273	626	1207	1293	**1100**
820	06-May-04	135	186	--	--	**161**
821	23-Dec-02	180	--	--	--	**180**
832	16-Jan-03	--	--	77	101	**89**
847	09-Jan-03	--	--	--	76	**76**
853	13-May-04	84	146	--	--	**115**
889	09-Jan-03	--	419	--	--	**419**
996	10-Jan-03	--	91	--	--	**91**
1074	22-Aug-03	317	307	635	650	**477**
1075	15-Aug-03	575	607	489	476	**537**
1076	15-Aug-03	433	576	723	--	**577**
1079	30-May-02	81	95	--	--	**88**
1080	26-Sep-02	--	514	--	--	**514**
1081	22-May-02	361	109	741	768	**495**
1083	11-Jul-03	102	685	309	194	**323**
1084	26-Jul-02	856	2150	462	--	**1156**
1087	05-Apr-04	1723	843	667	863	**1024**
1088	19-Apr-04	380	197	263	295	**284**
1090	03-Aug-04	--	--	--	463	**463**

[a] Data were obtained from U.S. EPA Region 7 (2006).

[b] "--" indicates that no sample was collected for that quadrant.

[c] Not provided by U.S. EPA Region 7. Averages were calculated by ICF.

Attachment B-6. Recontamination Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]							
		Quadrant 1		Quadrant 2		Quadrant 3		Quadrant 4	
184	16-Apr-02	62		69		58	ND	57	ND
184	21-May-02	54		67		61		49	ND
184	24-Jun-02	92		69		67		48	ND
184	23-Jul-02	48		48	ND	58		49	ND
184	23-Aug-02	86		60		47	ND	50	
579	16-Apr-02	109		125		105		79	
579	21-May-02	95		101		75		55	
579	21-Jun-02	92		92		137		109	
579	23-Jul-02	93		87		67		61	
579	22-Aug-02	80		157		83		100	
579	23-Sep-02	69		92		67		66	
151	11-Feb-02	67	ND	84		65	ND	63	ND
151	14-Mar-02	56		60	ND	75		56	ND
151	16-Apr-02	58	ND	62	ND	60	ND	64	
151	22-May-02	51	ND	50	ND	54		50	ND
151	24-Jun-02	54	ND	64		58		49	ND
151	22-Jul-02	56		54		66		57	
151	23-Aug-02	62		58		50		47	ND
151	25-Sep-02	64		52	ND	64		59	
151	07-Nov-02	60		63		41		55	
151	10-Dec-02	50		49		53		53	
151	15-Jan-03	53	ND	53	ND	61		55	
151	12-Mar-03	53		48		57		57	
151	20-Jun-03	142		59		49	ND	70	
151	22-Sep-03	74		127		70		61	
151	22-Dec-03	49.7		52.8		37.5		43.5	
151	22-Mar-04	53	ND	92		85.9		83.6	
151	21-Jun-04	67		75.2		50.8		67.6	
151	23-Sep-04	96.8		100.3		38.2		60	
151	16-Dec-04	43	ND	69.8		51.4		58.8	
151	28-Mar-05	127		146		85		86	
151	07-Jul-05	83.6		106.1		79		85	
151	03-Oct-05	81		83		67		139	
151	02-May-06	59		83		67		101	
493	17-Apr-02	47	ND	53	ND	49	ND	51	ND
493	21-May-02	48	ND	60		44	ND	45	ND
493	24-Jun-02	53	ND	63		60		51	ND
493	24-Jul-02	45	ND	46	ND	41	ND	41	ND
493	22-Aug-02	45	ND	38	ND	38		55	
493	25-Sep-02	45	ND	58		45	ND	42	ND
493	07-Nov-02	49		54	ND	57	ND	60	
493	09-Dec-02	51	ND	50	ND	53	ND	51	
493	21-Jan-03	72		46	ND	45		50	ND
493	14-Mar-03	37	ND	43		47		53	
340	06-Feb-02	59	ND	58	ND	61		55	ND
340	14-Mar-02	74		56	ND	82		69	
340	16-Apr-02	53	ND	66		59		397	
340	22-May-02	45	ND	47	ND	54	ND	48	
340	24-Jun-02	54		54	ND	55		62	ND
340	24-Jul-02	54		47	ND	68		51	
340	26-Aug-02	49	ND	47		80		66	
340	24-Sep-02	48	ND	53		65		65	
340	07-Nov-02	44	ND	50	ND	56		99	
340	10-Dec-02	63		69		67		111	
340	17-Mar-03	74		58		80		126	

Attachment B-6. Recontamination Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]							
		Quadrant 1		Quadrant 2		Quadrant 3		Quadrant 4	
340	23-Jun-03	63		62		101		106	
340	23-Sep-03	117		96		105		91	
340	22-Dec-03	66		55		119		124	
340	22-Mar-04	67.4		91.9		199		91.7	
340	22-Jun-04	77.1		78.8		153		163	
340	23-Sep-04	134.7		116		141.6		324	
340	16-Dec-04	107.1		128.9		163.3		223	
340	29-Mar-05	97		161		107		155	
340	08-Jul-05	214		97		146		156	
340	03-Oct-05	187		172		258		302	
340	02-May-06	161		261		201		300	
197	11-Feb-02	73		62	ND	63	ND	69	ND
197	14-Mar-02	97		74		66	ND	65	
197	17-Apr-02	96		51		64	ND	48	ND
197	21-May-02	100		60		54		48	ND
197	24-Jun-02	74		95		65		172	
197	22-Jul-02	183		61		75		51	ND
197	23-Aug-02	89		62		60		55	
197	24-Sep-02	164		61		155		53	
197	07-Nov-02	130		81		208		123	
197	10-Dec-02	281		127		302		172	
197	17-Mar-03	78		103		179		82	
197	23-Jun-03	76		133		69		67	
197	23-Sep-03	104		122		130		66	
197	22-Dec-03	81		131		184		105	
197	22-Mar-04	120		188		363		108	
197	21-Jun-04	132		152.7		124		76.7	
197	23-Sep-04	145.4		261.7		332.8		124	
197	16-Dec-04	201.3		63.7		130.1		69.2	
197	30-Mar-05	283		235		145		112	
197	07-Jul-05	143		252		209		91	
197	04-Oct-05	186		182		145		130	
197	02-May-06	148		205		156		181	
531	17-Apr-02	63	ND	65	ND	67	ND	57	ND
531	22-May-02	54	ND	58		56	ND	54	ND
531	24-Jun-02	50	ND	50	ND	51		53	
531	22-Jul-02	164		80		52	ND	41	ND
531	23-Aug-02	73		53		58		49	ND
531	24-Sep-02	51		65		43		46	
531	07-Nov-02	85		50		53	ND	46	ND
531	10-Dec-02	53		44	ND	44	ND	41	ND
531	15-Jan-03	63		56	ND	59		58	ND
531	12-Mar-03	62		94		38	ND	47	
531	20-Jun-03	48		67		83		60	
531	23-Sep-03	64		60		68		77	
531	22-Dec-03	57.6		61.5		41.9		35	
531	22-Mar-04	63.8		64.6		56		67.6	
531	21-Jun-04	56.1		92.5		55.9		50.6	
531	23-Sep-04	192.3		123.3		90.9		67.9	
531	16-Dec-04	179.7		131		92.1		72.1	
531	28-Mar-05	127		103		67		99	
531	07-Jul-05	73		130		128		75	
531	04-Oct-05	101		111		57	ND	65	
531	02-May-06	47		87		65		46	ND
626	11-Feb-02	65	ND	64	ND	56	ND	71	

Attachment B-6. Recontamination Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]							
		Quadrant 1		Quadrant 2		Quadrant 3		Quadrant 4	
626	14-Mar-02	55	ND	58	ND	98		69	
626	16-Apr-02	60		58	ND	69	ND	56	ND
626	20-May-02	52	ND	65		51		47	ND
626	24-Jun-02	74		48	ND	49	ND	51	ND
626	23-Jul-02	47		41	ND	43		40	ND
626	23-Aug-02	45	ND	45	ND	48		41	ND
626	24-Sep-02	45	ND	45	ND	59		49	
626	30-Oct-02	43	ND	50	ND	40	ND	48	ND
626	10-Dec-02	43	ND	50		50		49	ND
626	15-Jan-03	52		48	ND	50		53	
626	17-Mar-03	60		53	ND	58	ND	45	ND
212	20-May-02	61		49	ND	90		116	
212	21-Jun-02	77		323		103		66	
212	23-Jul-02	56		141		127		117	
212	22-Aug-02	54		75		116		116	
212	23-Sep-02	53		57		113		88	
212	01-Nov-02	65		63		101		88	
212	12-Dec-02	78		77		84		76	
212	14-Mar-03	66		122		88		121	
212	23-Jun-03	112		61		156		115	
212	22-Sep-03	131		95		242		145	
212	22-Dec-03	87		122		100		147	
212	22-Mar-04	56.6		69.7		187		77	ND
212	21-Jun-04	131		93.6		175		150	
212	23-Sep-04	88.5		201.7		696.3		235.7	
212	16-Dec-04	87.2		117		406.3		153	
212	29-Mar-05	99		94		210		119	
212	07-Jul-05	147		178		461		215	
212	04-Oct-05	98		157		412		214	
212	01-May-06	109		185		271		229	
454	17-Apr-02	52	ND	53	ND	51	ND	50	ND
454	20-May-02	48	ND	44	ND	50	ND	46	ND
454	24-Jun-02	95		42	ND	49	ND	49	ND
454	24-Jul-02	50	ND	40	ND	48	ND	57	
454	22-Aug-02	46		49	ND	45	ND	46	ND
454	25-Sep-02	45	ND	46	ND	46	ND	48	ND
454	07-Nov-02	56		52	ND	43	ND	52	ND
454	09-Dec-02	53	ND	42	ND	52	ND	49	ND
454	13-Jan-03	47		53		59		54	
454	14-Mar-03	43		34	ND	39		38	ND
239	20-May-02	89	ND	63		54	ND	71	
239	25-Jun-02	284		51		44	ND	48	
239	23-Jul-02	52		50		42	ND	43	ND
239	26-Aug-02	208		87		45	ND	89	
239	23-Sep-02	254		64		48		50	
239	07-Nov-02	159		55		56		63	ND
239	10-Dec-02	160		104		70		63	
239	17-Mar-03	104		93		59		52	
444	16-Apr-02	58	ND	65		55	ND	60	ND
444	21-May-02	44	ND	50	ND	49		50	ND
444	25-Jun-02	118		56		47	ND	45	ND
444	24-Jul-02	61		51		62		69	
444	23-Aug-02	56		49	ND	47		98	
444	25-Sep-02	133	ND	130	ND	137	ND	119	ND
444	07-Nov-02	50	ND	54	ND	52	ND	95	

Attachment B-6. Recontamination Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]			
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4
444	12-Dec-02	47 ND	52	58	54
444	20-Jan-03	57	48	79	63
444	14-Mar-03	76	47	57	62
444	23-Jun-03	3187	43 ND	84	131
444	22-Sep-03	60	46	51	83
444	22-Dec-03	513	57.2	54	107
444	22-Mar-04	256	62	74.5	55.4
444	21-Jun-04	128	51.4 ND	57.4	81
444	23-Sep-04	160.3	237.7	196.7	209
444	16-Dec-04	203.7	280.5	96	259.3
444	28-Mar-05	123	123	109	186
674	31-May-02	99	92	--	88
674	25-Jun-02	109	63	83	85
674	23-Jul-02	62	136	99	77
674	23-Aug-02	95	98	--	90
674	25-Sep-02	140	138	--	127 ND
674	07-Nov-02	137	191	--	178
674	12-Dec-02	183	231	--	177
674	15-Jan-03	201	166	--	133
674	14-Mar-03	205	104	--	175
674	23-Jun-03	175	118	--	134
263	16-Sep-02	74	44 ND	50	93
263	01-Nov-02	63	49 ND	58	79
263	09-Dec-02	73	46	45	44 ND
263	17-Mar-03	65	50 ND	81	63
263	23-Jun-03	58	57	68	60
581	16-Sep-02	67	69	134	63
581	01-Nov-02	55 ND	69	55 ND	44 ND
581	09-Dec-02	54	55	65	67
581	25-Jul-05	78	113	134	107
581	04-Oct-05	65	132	109	103
581	02-May-06	80	122	171	119
240	16-Sep-02	90	61 ND	91 ND	114 ND
240	30-Oct-02	99	78 ND	80 ND	81 ND
240	10-Dec-02	78 ND	76 ND	81 ND	84 ND
240	14-Mar-03	79 ND	80 ND	77	145
240	23-Jun-03	128	100 ND	98 ND	98 ND
240	23-Sep-03	84	76 ND	122	129
240	22-Dec-03	79.4	121.5	62.5	165.5
240	22-Mar-04	110	139.5	85.4	117.5
240	21-Jun-04	107.3 ND	147	91.5 ND	131.5
240	23-Sep-04	93.7	177	91.3	196.5
240	16-Dec-04	103.4 ND	179	97	193.5
240	28-Mar-05	106	163	80 ND	184
240	07-Jul-05	242	232	138	266
240	04-Oct-05	125	224	115	275
240	01-May-06	124	177	120	157
257	11-Feb-02	52	54	62	87
257	14-Mar-02	71	70	79	75
257	15-Apr-02	63	60	71	74
257	21-May-02	122	76	69	57
257	21-Jun-02	79	76	73	99
257	23-Jul-02	54	50	57	54
257	22-Aug-02	60	54	65	46 ND
257	23-Sep-02	81	103	66	59

Attachment B-6. Recontamination Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]							
		Quadrant 1		Quadrant 2		Quadrant 3		Quadrant 4	
257	01-Nov-02	81		77		88		64	
257	12-Dec-02	61		58		179		120	
257	14-Mar-03	61		60		63		57	
257	23-Jun-03	98		56		120		74	
257	23-Sep-03	133		151		72		85	
257	22-Dec-03	75		68		76		68	
257	22-Mar-04	89		73		92		68	ND
257	21-Jun-04	101.6		123		107.4		70.7	
257	23-Sep-04	107.5		222		126		136	
257	16-Dec-04	162.3		128.7		78.9		79.3	
257	29-Mar-05	90		143		127		97	
576	06-Feb-02	71		67		55		120	
576	14-Mar-02	68		62		74		69	ND
576	17-Apr-02	64		63		69		69	
576	21-May-02	74		77		76		68	
576	25-Jun-02	140		76		55		63	
576	23-Jul-02	69		44	ND	53		65	
576	23-Aug-02	55		63		74		65	
576	25-Sep-02	78		79		75		59	
576	07-Nov-02	104		54		75		62	
576	12-Dec-02	111		62		76		60	
576	15-Jan-03	63		71		60		79	
576	14-Mar-03	100		68		85		94	
576	23-Jun-03	68		53		81		57	
576	22-Sep-03	91		45		94		101	
576	22-Dec-03	64.8		56.6		85.7		78	
576	22-Mar-04	83.7		53	ND	71.9		78.9	
576	21-Jun-04	85.7		69.3		78.5		76.5	
576	23-Sep-04	127.8		112.4		101		91.3	
576	16-Dec-04	85.9		99.8		80.9		85.8	
576	28-Mar-05	121		120		76.7		89	
576	07-Jul-05	192		169		145		163	
576	03-Oct-05	147		141		105		137	
576	02-May-06	97		71		92		127	
207	06-Feb-02	53	ND	58	ND	67	ND	82	
207	14-Mar-02	177	ND	160	ND	230	ND	150	ND
207	16-Apr-02	59		67		59		93	
207	22-May-02	54	ND	52	ND	53	ND	95	
207	21-Jun-02	69		54		52	ND	50	ND
207	23-Jul-02	65		52		52		45	ND
207	22-Aug-02	46	ND	75		53		68	
207	23-Sep-02	70		59		52	ND	51	
207	23-Oct-02	51		54	ND	55		56	ND
207	09-Dec-02	50		51	ND	46	ND	56	
207	14-Mar-03	65		49		48		47	
207	23-Jun-03	50		46		44		74	
207	22-Sep-03	110		106		40		107	
207	22-Dec-03	87		51.6		45.1		68	
207	22-Mar-04	63.6		69.2		63.3		157.7	
207	21-Jun-04	61.7		70.2	ND	80.9		70.2	
207	23-Sep-04	111.3		104		179		169	
207	16-Dec-04	126		83.3		75.1		100.4	
207	29-Mar-05	120		123		65	ND	133	
207	14-Jul-05	100		100		75		115	
207	04-Oct-05	69		90		84		107	

Attachment B-6. Recontamination Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]							
		Quadrant 1		Quadrant 2		Quadrant 3		Quadrant 4	
207	01-May-06	98		166		83		137	
347	15-Feb-02	61	ND	62	ND	68		59	
347	14-Mar-02	160		58	ND	59		64	ND
347	16-Apr-02	53	ND	59	ND	57	ND	56	ND
347	20-May-02	107		58		57		56	
347	25-Jun-02	98		56		63		55	
347	24-Jul-02	55		62		66		54	
347	26-Aug-02	60		57		56		121	
347	24-Sep-02	67		71		69		138	
347	07-Nov-02	86		90		126		61	
347	10-Dec-02	74		84		125		113	
347	17-Mar-03	121		164		152		140	
347	23-Jun-03	150		88		179		137	
347	23-Sep-03	245		210		212		132	
347	22-Dec-03	224		128.5		181.5		295	
347	22-Mar-04	175		100		311		216	
347	21-Jun-04	138		76.1		170.3		233	
347	23-Sep-04	268		404.3		338		423.3	
347	16-Dec-04	163		358.3		331.7		290.3	
347	30-Mar-05	239		426		207		177	
347	07-Jul-05	298		376		235		341	
347	04-Oct-05	154		271		357		447	
347	01-May-06	250		382		264		515	
176	13-Feb-02	116		72	ND	67	ND	73	ND
176	14-Mar-02	78		67		69		79	
176	17-Apr-02	59		81		62	ND	59	ND
176	22-May-02	45	ND	57		50	ND	54	
176	25-Jun-02	53	ND	98		55		53	
176	24-Jul-02	60		140		56		54	
176	23-Aug-02	70		102		50		42	
176	25-Sep-02	73		114		75		66	
176	07-Nov-02	60	ND	50		69		54	
176	12-Dec-02	56		88		59		70	
176	15-Jan-03	50	ND	97		61		67	
176	23-Mar-04	152		244		121		134	
176	21-Jun-04	206.7		103.7		94.7		110.7	
176	23-Sep-04	674		244.7		169.7		170.7	
176	16-Dec-04	139.7		205.3		137.7		151.6	
176	28-Mar-05	241		189		136		150	
176	08-Jul-05	233		360		136		193	
176	03-Oct-05	201		306		301		231	
512	06-Feb-02	51		86		46	ND	64	ND
512	14-Mar-02	135		80		78		61	ND
512	17-Apr-02	60	ND	81		61	ND	65	
512	22-May-02	58		158		61		73	
512	25-Jun-02	60		88		52		57	
512	23-Jul-02	67		127		51		53	
512	26-Aug-02	79		154		59		61	
512	24-Sep-02	71		106		70		57	
512	07-Nov-02	99		131		59		69	
512	10-Dec-02	148		234		82		92	
512	23-Jun-03	114		260		95		85	
512	23-Sep-03	130		281		110		182	
512	22-Dec-03	128		290		150		88	
512	22-Mar-04	116		315		191		94.6	

Attachment B-6. Recontamination Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]							
		Quadrant 1		Quadrant 2		Quadrant 3		Quadrant 4	
512	22-Jun-04	112		211.7		84.8		79.4	
512	23-Sep-04	249.3		328.7		202		235	
512	16-Dec-04	102.4		284		75		202.8	
512	30-Mar-05	196		295		188		167	
512	08-Jul-05	184		247		111		180	
512	04-Oct-05	147		259		170		111	
512	02-May-06	275		351		189		187	
398	08-Oct-02	--		--		--		51	ND
398	31-Oct-02	--		--		--		38	ND
398	09-Dec-02	--		--		--		58	
398	13-Jan-03	--		--		--		58	
181	07-Nov-02	193		82		58		73	
181	10-Dec-02	117		64		53		60	
181	17-Mar-03	120		60		99		73	
181	23-Jun-03	141		78		77		57	ND
181	23-Sep-03	163		65		87		131	
181	22-Dec-03	96		72.9		74.5		76.2	
181	22-Mar-04	164		80		92		89.9	
181	22-Jun-04	237.3		112		101.5		106	
181	23-Sep-04	219		141.7		68.2		114.3	
181	16-Dec-04	195		141		68.69		162	
181	30-Mar-05	177		89		90		136	
181	07-Jul-05	140		167		98		113	
181	04-Oct-05	196		218		127		205	
181	02-May-06	220		281		113		95	
328	30-Oct-03	51.7		68.8		--		--	
328	22-Dec-03	173		123		--		--	
328	22-Mar-04	144		169		--		--	
328	22-Jun-04	95.7		137.3		--		--	
328	23-Sep-04	212.3		131.5		--		--	
328	16-Dec-04	173.3		399		--		--	
328	29-Mar-05	196		136		--		--	
328	07-Jul-05	255		144		--		--	
328	03-Oct-05	236		181		--		--	
328	18-May-06	213		248		--		--	
684	22-Dec-03	90.3		53		41		38.8	
684	22-Mar-04	73.6		60.7		77.5		59.9	
684	22-Jun-04	126.4		59.4	ND	75.6		72.4	
684	23-Sep-04	88.9		121.3		126		104.8	
684	16-Dec-04	144.2		227		147		171.3	
684	28-Mar-05	182		171		151		142	
684	08-Jul-05	101		118		116		132	
684	04-Oct-05	91		126		107		109	
684	02-May-06	129		140		169		168	
575	22-Dec-03	257		285		181		250	
575	22-Mar-04	451		530		280		217	
575	21-Jun-04	462		518		208		264	
575	23-Sep-04	495		458.7		325		485	
575	16-Dec-04	837.8		854.5		367.7		299.3	
575	30-Mar-05	551		638		395		296	
575	07-Jul-05	1507		528		557		437	
575	04-Oct-05	390		266		304		512	
575	02-May-06	488		258		258		240	
224	28-Mar-05	44	ND	43	ND	49	ND	55	ND
224	07-Jul-05	52	ND	68		54	ND	54	ND

Attachment B-6. Recontamination Soil Sampling Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]							
		Quadrant 1		Quadrant 2		Quadrant 3		Quadrant 4	
224	03-Oct-05	42	ND	48	ND	50		422	
224	02-May-06	39		37	ND	44	ND	94	
402	28-Mar-05	76.5		48		--		50	
402	07-Jul-05	57	ND	61	ND	--		60	ND
402	03-Oct-05	62		52	ND	--		47	ND
402	01-May-06	50	ND	48		--		41	ND
1078	31-Jan-02	405		--		--		--	
1078	14-Mar-02	173	ND	--		--		--	
1078	17-Apr-02	138		--		--		--	
1078	21-May-02	107		--		--		--	
1078	25-Jun-02	106		--		--		--	
1078	24-Jul-02	250		--		--		--	
1078	26-Aug-02	102		--		--		--	
1078	24-Sep-02	94		--		--		--	
1078	07-Nov-02	80		--		--		--	
1078	10-Dec-02	100		--		--		--	
1078	14-Mar-03	154		--		--		--	
1078	23-Jun-03	206		--		--		--	
1078	23-Sep-03	164		--		--		--	
1078	22-Dec-03	106		--		--		--	
1078	22-Mar-04	184		--		--		--	
1078	21-Jun-04	263.8		--		--		--	
1078	23-Sep-04	845.6		--		--		--	
1078	16-Dec-04	130.5		--		--		--	
1078	28-Mar-05	151		--		--		--	
1078	07-Jul-05	209		--		--		--	
1078	03-Oct-05	287		--		--		--	
1078	01-May-06	277		--		--		--	
1079	22-Dec-03	67		121		--		--	
1079	22-Mar-04	111.7		105.6		--		--	
1079	22-Jun-04	231.3		227.7		--		--	
1079	23-Sep-04	362		329.7		--		--	
1079	16-Dec-04	275		338.3		--		--	
1079	28-Mar-05	338		230		--		--	
1079	07-Jul-05	345		164		--		--	
1079	03-Oct-05	622		590		--		--	
1079	02-May-06	370		1276		--		--	

[a] Data were obtained from U.S. EPA Region 7 (2006).
[b] A value qualified with a "ND" represents a non-detect. The value presented is the detection limit. For the purpose of calculating the property average by year, one-half the detection limit was used as the value for non-detects.
[c] "--" indicates that no sample was collected for that quadrant.

Attachment B-7. Average Soil Pre-Excavation, Post-Excavation, and Recontamination Pb Results for 31 Residential Locations within One Mile of the Primary Pb Smelter

Full-Scale Analysis ID	Pre-Excavation (mg/kg) [a]	Post-Excavation (mg/kg) [a]	Averages (mg/kg) [b,c]				
			2002	2003	2004	2005	2006
151	918	377	47.3	59.8	65.3	97.3	77.5
176	1471	889	62.1	62.5	191.3	223.1	
181	1367	671	87.5	90.1	130.8	146.3	177.3
184	3308	420	51.1	--	--	--	--
197	3035	806	93.8	106.9	162	176.1	172.5
207	1039	750	52.2	64.9	96.9	95.7	121
212	355	568	93.1	119.4	180.4	200.3	198.5
224	579	--	--	--	--	63.4	43.4
239	4155	1138	81.3	77	--	--	--
240	2770	489	50.1	86.2	119.4	175.8	144.5
257	1073	453	73.1	82.3	108.2	114.3	--
263	1425	885	54.1	59.6	--	--	--
328	5138	1279	--	104.1	182.8	191.3	230.5
340	917	1015	59.2	90.2	141.3	171	230.8
347	614	101	69.2	172.4	249.8	294	352.8
398	394	160	34.2	58	--	--	--
402	1740	--	--	--	--	41.7	31.2
444	1795	332	49.4	244.2	149	135.3	--
454	667	184	28.9	41.4	--	--	--
493	466	126	32.5	40.8	--	--	--
512	2013	696	80	159.4	180.2	187.9	250.5
531	618	567	44.6	56.2	91	92.3	55.5
575	--	1177	--	243.3	440.8	531.8	311
576	1500	736	70.2	74.8	84.7	133.8	96.8
579	1528	711	91.5	--	--	--	--
581	837	354	60	--	--	105.1	123
626	604	208	37.1	39.6	--	--	--
674	1850	965	120.8	156.8	--	--	--
684	6857	213	--	55.8	106.6	128.8	151.5
1078	--	--	146.9	157.5	356	215.7	277
1079	9173	88	--	94	247.7	381.5	823

[a] All available pre-excavation and post-excavation results by quadrant are provided in Attachments B-4 and B-5, respectively.
[b] Soil samples from up to four quadrants were collected on each date. The results for the quadrants were first averaged (using one-half the detection limit as the value for non-detects) before determining the final overall average by year for each location.

[c] During the process of summarizing post-excavation and recontamination Pb results for the 31 locations, it was noted that, in general, post-excavation sampling results (collected during 2001 and 2002) were higher than the Pb results for recontamination samples collected subsequently in 2002 or 2003. This observation is due to the fact that post-excavation samples were collected prior to backfilling the excavated areas with clean soil.

Attachment B-8. Indoor Dust/Wipe Sample Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Round No.	Date	Carpet Dust [a, b] Pb Loading (mg/ft^2)	Carpet Dust [a, b] Pb Concentration (mg/kg)	Wipe Window Sill Pb Loading (µg/ft^2)	Wipe Other Wipe Pb Loading (µg/ft^2)
184	Recon #01	16-Apr-02	43	3300	1385	120
184	Recon #02	29-May-02	28.4	4350	881	47
184	Recon #03	26-Jun-02	25.7	3364	630	54
184	Recon #04	24-Jul-02	46.6	3874	1257	69
579	Recon #01	16-Apr-02	0.54	370	413	17
579	Recon #02	31-May-02	0.402	383	293	12
579	Recon #03	28-Jun-02	0.986	539	173	16
579	Recon #04	2-Aug-02	0.548	728	201	9
579	Recon #05	26-Aug-02	0.216	826	225	6.2
151	Recon #01	16-Apr-02	2.1	1000	165	66
151	Recon #02	28-May-02	2.09	918	75	22
151	Recon #03	28-Jun-02	0.448	786	38	14
151	Recon #04	22-Jul-02	0.468	895	27	12
151	Recon #05	28-Aug-02	0.322	559	49	13
151	Recon #06	30-Sep-02	0.696	655	36	11
151	Recon #07	23-Oct-02	2.17	710	36	4.4
151	Recon #08	4-Dec-02	0.619	642	14	7.7
151	Recon #09	10-Jan-03	0.471	675	13	6.9
151	Recon #10	26-Feb-03	0.437	612	23	5.3
151	Recon #11	1-Apr-03	0.623	644	26	8.5
151	Recon #12	16-Jul-03	0.487	435	40	4.6
151	Recon #13	15-Oct-03	0.567	394	17	3.3
151	Recon #14	7-Jan-04	0.605	477	6.7	3.8
151	Recon #15	14-Apr-04	--	--	60	5.1
151	Recon #16	8-Jul-04	--	--	9.4	3.4
151	Recon #17	8-Oct-04	--	--	55	3.1
151	Recon #18	10-Jan-05	--	--	7.5	2.9
151	Recon #19	19-Apr-05	--	--	28	11
151	Recon #20	5-Jul-05	--	--	17	5.2
151	Recon #21	7-Oct-05	--	--	23	6.6
151	Recon #22	24-Apr-06	--	--	21	7.6
493	Recon #01	17-Apr-02	1.4	600	353	19
493	Recon #02	24-May-02	0.258	695	75	15
493	Recon #03	16-Jul-02	2.38	664	67	18
493	Recon #06	20-Sep-02	0.616	426	32	12
493	Recon #07	24-Oct-02	1.01	629	45	12
493	Recon #08	3-Dec-02	0.523	681	17	11
493	Recon #09	27-Jan-03	2.25	845	31	10
493	Recon #10	25-Feb-03	0.631	313	16	6.1
493	Recon #11	24-Mar-03	1.07	613	28	11
340	Recon #01	17-Apr-02	0.66	2200	352	14
340	Recon #02	30-May-02	2.15	3711	508	24
340	Recon #03	26-Jun-02	0.826	2191	638	19
340	Recon #04	30-Jul-02	0.497	2551	185	22
340	Recon #05	6-Sep-02	0.512	1510	60	6.8
340	Recon #07	14-Nov-02	0.334	900	141	7.3
340	Recon #11	3-Apr-03	0.806	1032	576	16
340	Recon #12	30-Jun-03	0.998	1665	912	8.5
340	Recon #13	17-Oct-03	0.824	1377	156	10
197	Recon #01	22-Apr-02	4.7	1900	264	35
197	Recon #02	4-Jun-02	11.3	2603	109	48
197	Recon #03	18-Jul-02	6.26	1783	105	25
531	Recon #01	22-Apr-02	1.6	950	101	18

Attachment B-8. Indoor Dust/Wipe Sample Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Round No.	Date	Carpet Dust [a, b] Pb Loading (mg/ft²)	Carpet Dust [a, b] Pb Concentration (mg/kg)	Wipe Window Sill Pb Loading (µg/ft²)	Wipe Other Wipe Pb Loading (µg/ft²)
531	Recon #02	30-May-02	1.6	1778	35	15
531	Recon #03	27-Jun-02	1.3	1461	10	7.6
531	Recon #04	25-Jul-02	3.19	2477	10	6.1
531	Recon #05	28-Aug-02	1.67	2409	11	7.8
531	Recon #07	24-Oct-02	1.44	860	16	7.2
531	Recon #10	26-Feb-03	1.46	336	23	21
531	Recon #11	9-Apr-03	1.7	579	52	14
531	Recon #12	23-Jul-03	2	428	15	11
531	Recon #14	7-Jan-04	1.85	639	46	11
531	Recon #15	9-Apr-04	2.24	1208	35	14
531	Recon #16	3-Aug-04	0.811	761	21	8.2
531	Recon #17	8-Nov-04	1.02	400	51	9.2
531	Recon #19	22-Mar-05	2.25	647	15	10
531	Recon #20	5-Jul-05	0.56	137	6.9	8.4
531	Recon #21	5-Oct-05	0.106	122	53	11
531	Recon #22	25-Apr-06	0.168	233	41	6.7
626	Recon #01	23-Apr-02	0.53	290	110	44
626	Recon #02	30-May-02	0.393	457	82	6.1
626	Recon #04	26-Jul-02	0.616	410	129	5.5
626	Recon #07	25-Oct-03	0.349	317	71	4.4
212	Recon #01	30-Apr-02	0.46	610	62	10
212	Recon #02	28-May-02	0.327	557	22	14
212	Recon #04	26-Jul-02	0.332	659	62	3.3
212	Recon #05	4-Sep-02	0.578	734	21	3.2
212	Recon #06	2-Oct-02	0.324	531	9	2.6
212	Recon #07	8-Nov-02	0.316	650	6.3	2.2
212	Recon #08	18-Dec-02	0.332	490	6.2	3.2
212	Recon #09	31-Jan-03	0.451	586	12	3.6
212	Recon #10	25-Feb-03	0.524	671	10	4.4
212	Recon #11	8-Apr-03	0.439	512	24	4.4
212	Recon #12	9-Jul-03	0.395	477	6.9	4
212	Recon #14	7-Jan-04	0.283	455	14	2.3
212	Recon #15	15-Apr-04	0.334	457	16	4.6
212	Recon #17	10-Nov-04	0.229	589	11	6
212	Recon #19	29-Mar-05	0.137	321	9	
212	Recon #20	6-Jul-05	0.338	422	6	11
212	Recon #22	25-Apr-06	0.0305	660	22	9.1
454	Recon #01	30-Apr-02	0.22	450	35	8.5
454	Recon #02	3-Jun-02	1.75	1502	33	9.3
454	Recon #03	18-Jul-02	0.22	517	17	8.5
454	Recon #07	28-Oct-02	0.235	526	31	9.2
454	Recon #08	4-Dec-02	0.299	550	28	6.8
454	Recon #09	3-Feb-03	0.0142	247	9	5.9
454	Recon #10	26-Feb-03	0.319	224	16	5.7
239	Recon #01	30-Apr-02	26	3000	405	12

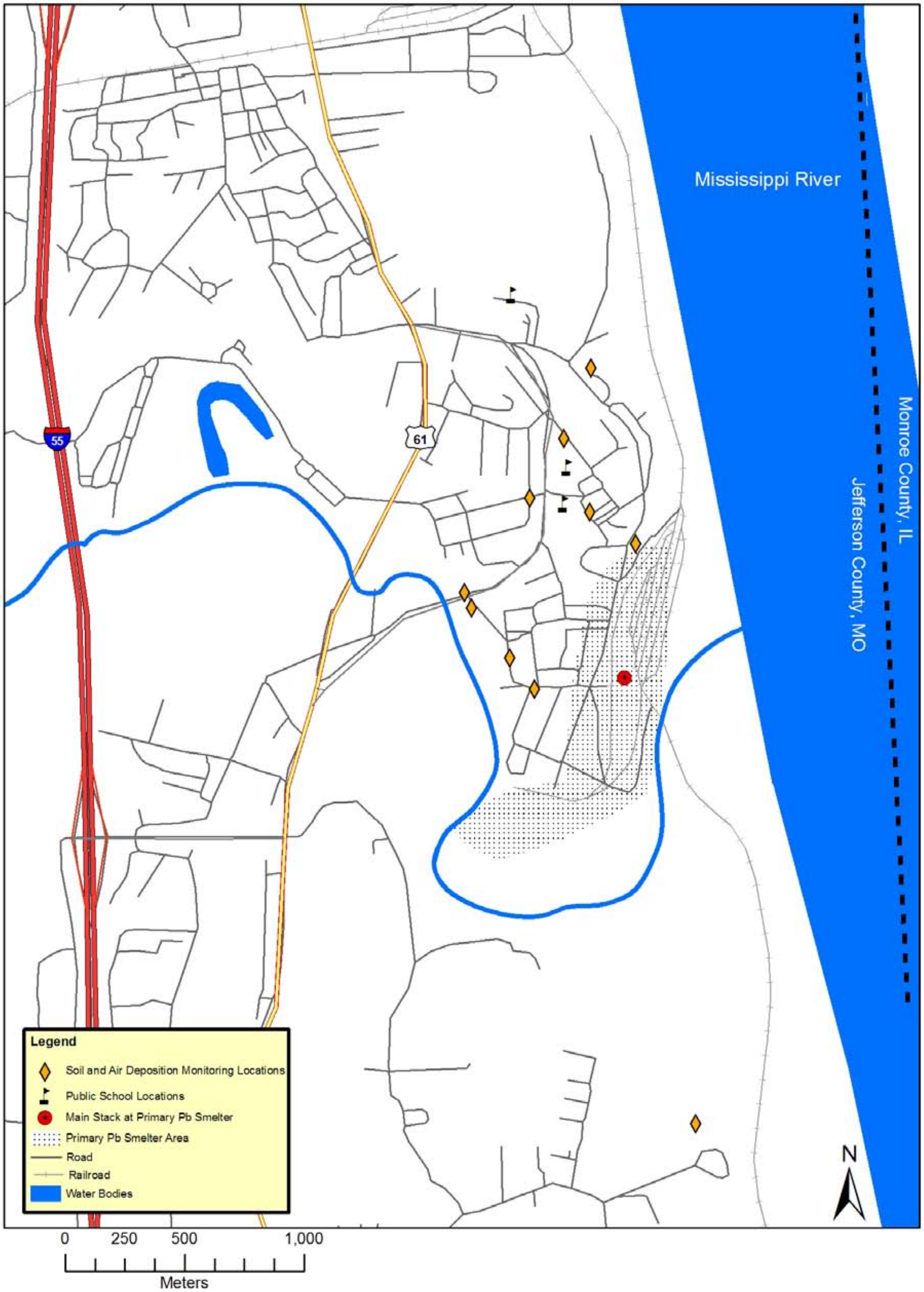
Attachment B-8. Indoor Dust/Wipe Sample Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Round No.	Date	Carpet Dust [a, b] Pb Loading (mg/ft²)	Carpet Dust [a, b] Pb Concentration (mg/kg)	Wipe Window Sill Pb Loading (µg/ft²)	Wipe Other Wipe Pb Loading (µg/ft²)
239	Recon #02	28-May-02	22.6	2124	251	18
239	Recon #03	1-Jul-02	25	1944	292	10
239	Recon #04	2-Aug-02	31	2862	85	11
239	Recon #05	27-Aug-02	11.8	1682	56	8.2
444	Recon #01	6-May-02	9.3	2300	905	72
444	Recon #02	7-Jun-02	6.6	2588	1134	41
674	Recon #02	31-May-02	4.62	1669	40	102
674	Recon #03	25-Jun-02	2.15	1394	33	29
674	Recon #04	25-Jul-02	3	1482	25	24
674	Recon #05	27-Aug-02	2.06	1459	15	12
674	Recon #07	22-Oct-02	2.88	1273	11	31
674	Recon #08	3-Dec-02	1.54	1056	20	31
674	Recon #09	3-Jan-03	2.28	1088	16	10
674	Recon #10	21-Feb-03	2.28	742	11	5.4
674	Recon #11	15-Apr-03	2.09	927	18	11
263	Recon #06	17-Sep-02	0.378	1336	176	4
263	Recon #07	24-Oct-02	0.673	1786	31	6.4
263	Recon #08	2-Dec-02	0.649	1619	34	5.1
263	Recon #09	7-Jan-03	0.514	1196	104	4.4
263	Recon #10	24-Feb-03	0.182	745	23	4
263	Recon #11	24-Mar-03	0.635	1119	57	9.5
263	Recon #12	30-Jun-03	1.39	980	95	6.9
581	Recon #06	27-Sep-02	0.489	369	124	43
581	Recon #07	31-Oct-02	1.19	566	99	6.3
581	Recon #08	11-Dec-02	1.05	426	34	6.5
581	Recon #09	8-Jan-03	1.51	376	24	7.5
581	Recon #20	25-Jul-05	0.0201	131	32	5.3
581	Recon #21	3-Oct-05	0.0483	143	41	8.4
581	Recon #22	25-Apr-06	0.108	271	155	7
240	Recon #06	26-Sep-02	4.48	1795	505	26
240	Recon #07	23-Oct-02	5.04	1633	199	19
240	Recon #08	4-Dec-02	3.99	1700	159	21
240	Recon #09	3-Jan-03	3.58	1591	96	18
240	Recon #10	20-Feb-03	13.8	2877	68	15
240	Recon #11	20-Mar-03	8.22	1813	62	20
240	Recon #12	3-Jul-03	2.93	1075	409	15
240	Recon #13	1-Oct-03	1.7	873	188	19
240	Recon #14	7-Jan-04	1.12	929	133	11
240	Recon #15	7-Apr-04	1.45	1064	108	14
240	Recon #16	16-Jul-04	0.95	805	171	13
240	Recon #17	18-Oct-04	3.03	1170	455	8.3
240	Recon #18	10-Jan-05	1.06	735	72	11
240	Recon #19	19-Apr-05	1.08	834	84	20
240	Recon #20	7-Jul-05	0.68	816	599	28
240	Recon #21	5-Oct-05	0.585	766	89	18
240	Recon #22	5-May-06	0.843	1040	502	24
398	Recon #06	7-Oct-02	0.49	354	19	5.2
398	Recon #07	28-Oct-02	0.342	244	17	5.5
398	Recon #08	3-Dec-02	0.95	322	10	3.7
398	Recon #09	7-Jan-03	0.499	470	5.6	2.8

[a] Data were obtained from U.S. EPA Region 7 (2006).

[b] "--" indicates that no measurement was taken on that date.

Attachment B-9. Soil and Air Deposition Monitoring Locations around the Primary Pb Smelter



Attachment B-10. Soil Deposition Monitoring Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]							
		Round 1		Round 2		Round 3		Round 4	
181	6-Mar-03	40	ND	39	ND	38	ND	--	
	11-Apr-03	58	ND	119		54	ND	63	ND
	7-May-03	36	ND	42	ND	47	ND	--	
	6-Jun-03	116		58	ND	52	ND	51	ND
	11-Jul-03	79.1		55	ND	67.1		--	
	11-Aug-03	80.3		82.3		54	ND	97.8	
	15-Sep-03	57	ND	89.1		78.1		--	
	15-Oct-03	70.3		51.3		98.9		--	
	18-Nov-03	90.5		90.2		140		111	
	17-Dec-03	165		81.4		107		132	
	19-Jan-04	34.9		80.9		105		52.9	
	19-Feb-04	186		159		87.8		--	
	19-Mar-04	81.9		115		136		--	
	21-Apr-04	95.8		213		177		--	
	24-May-04	142		37	ND	36	ND	--	
	24-Jun-04	130		51	ND	139		105	
	27-Aug-04	50.8		70.4		119		--	
207	6-Mar-03	48	ND	31	ND	44	ND	36	ND
	11-Apr-03	50	ND	50	ND	51	ND	--	
	7-May-03	35	ND	48	ND	35	ND	--	
	6-Jun-03	56	ND	35	ND	31	ND	--	
	11-Jul-03	53	ND	39	ND	46	ND	--	
	11-Aug-03	59	ND	48	ND	56	ND	--	
	15-Sep-03	35	ND	51	ND	39	ND	--	
	15-Oct-03	33.4		39.9		30		--	
	17-Nov-03	34	ND	59.4		46.2		--	
	17-Dec-03	54.4		26	ND	37.3		--	
	19-Jan-04	38	ND	31	ND	32	ND	--	
	19-Feb-04	64.3		30		35		--	
	19-Mar-04	43.4		55		42.1		--	
	21-Apr-04	43.8		48.6		46.1		--	
	24-May-04	59.3		135		27	ND	--	
	24-Jun-04	52	ND	64.5		37	ND	--	
	27-Aug-04	36.2		137		34.1		--	
240	6-Mar-03	30	ND	38	ND	37	ND	--	
	16-Apr-03	49	ND	46	ND	43	ND	--	
	7-May-03	42	ND	48	ND	53	ND	--	
	6-Jun-03	35	ND	65	ND	56	ND	--	
	11-Jul-03	62	ND	74	ND	59	ND	--	
	11-Aug-03	54	ND	64	ND	63	ND	--	
	15-Sep-03	50	ND	45	ND	47	ND	--	
	15-Oct-03	33	ND	44.3		47.4		--	
	18-Nov-03	46.5		45.8		37.9		--	
	17-Dec-03	48.7		58.9		30	ND	--	
	19-Jan-04	63.2		57.7		45	ND	--	
	19-Feb-04	51.1		91		69.9		--	
	19-Mar-04	47	ND	75.5		53.2		--	
	21-Apr-04	52.7		49	ND	64.4		--	
	24-May-04	43	ND	62		94.9		--	
	24-Jun-04	67	ND	46	ND	84.1		--	
	27-Aug-04	46.7		36	ND	37.4		--	

Attachment B-10. Soil Deposition Monitoring Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]							
		Round 1		Round 2		Round 3		Round 4	
286	14-Feb-03	25	ND	26	ND	21	ND	--	
	11-Apr-03	60.2		65.5		39	ND	--	
	7-May-03	32	ND	27	ND	29	ND	--	
	6-Jun-03	51	ND	27	ND	48	ND	--	
	11-Jul-03	32	ND	40	ND	30	ND	--	
	11-Aug-03	80.4		47	ND	65.7		43	ND
	15-Sep-03	28	ND	30	ND	36	ND	--	
	15-Oct-03	38.4		28.4		92.4		--	
	17-Nov-03	64.8		105		52.9		--	
	17-Dec-03	198		119		129		--	
	19-Jan-04	83.9		90.1		103		--	
	19-Feb-04	161		106		117		--	
	19-Mar-04	58.9		30	ND	39.1		--	
	21-Apr-04	275		190		216		--	
	24-May-04	155		152		217		--	
	24-Jun-04	330		402		302		--	
	27-Aug-04	66.5		278		59.3		289	
444	6-Mar-03	31	ND	32	ND	34	ND	--	
	11-Apr-03	90	ND	47	ND	56	ND	--	
	7-May-03	32	ND	24	ND	53.5		--	
	6-Jun-03	69	ND	50	ND	48	ND	--	
	11-Jul-03	81	ND	71	ND	39	ND	--	
	11-Aug-03	70		65	ND	49	ND	--	
	15-Sep-03	53		50	ND	56.1		--	
	15-Oct-03	47.4		29	ND	29	ND	--	
	17-Nov-03	73.6		65.2		59.2		--	
	17-Dec-03	79.4		62.4		41.9		--	
	19-Jan-04	58.8		38	ND	36	ND	--	
	19-Feb-04	69.3		83.8		63.9		--	
	19-Mar-04	84.3		46.1		96.2		--	
	21-Apr-04	68.4		131		147		--	
	24-May-04	107		89.4		60.4		--	
	24-Jun-04	160		71.5		55	ND	--	
	27-Aug-04	119		50	ND	102		--	
531	6-Mar-03	22	ND	23	ND	22	ND	--	
	11-Apr-03	34	ND	46	ND	35	ND	--	
	7-May-03	20	ND	22	ND	28	ND	--	
	6-Jun-03	33	ND	34	ND	29	ND	--	
	11-Jul-03	28	ND	31	ND	26	ND	--	
	11-Aug-03	49	ND	57	ND	44	ND	--	
	15-Sep-03	22	ND	22	ND	34	ND	--	
	15-Oct-03	19	ND	19	ND	21	ND	--	
	17-Nov-03	19	ND	19	ND	20	ND	--	
	17-Dec-03	24	ND	27	ND	26	ND	--	
	19-Jan-04	28	ND	28	ND	31	ND	--	
	19-Feb-04	19	ND	20	ND	20	ND	--	
	19-Mar-04	23	ND	23	ND	52.2		--	
	21-Apr-04	28	ND	31.8		29.7		--	
	24-May-04	41.4		24	ND	24	ND	--	
	24-Jun-04	24	ND	29	ND	23	ND	--	
	27-Aug-04	25	ND	26	ND	23	ND	--	

Attachment B-10. Soil Deposition Monitoring Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg)[a, b, c]						
		Round 1		Round 2		Round 3		Round 4
576	6-Mar-03	36	ND	40	ND	42	ND	--
	11-Apr-03	71	ND	42	ND	46	ND	--
	7-May-03	43	ND	35	ND	40	ND	--
	6-Jun-03	43	ND	55	ND	47	ND	--
	11-Jul-03	38	ND	46	ND	50	ND	--
	11-Aug-03	53	ND	51	ND	44	ND	--
	15-Sep-03	38	ND	50	ND	40	ND	--
	15-Oct-03	24	ND	41	ND	35	ND	--
	17-Nov-03	38.8		32.9		29	ND	--
	17-Dec-03	60.4		34	ND	35.1		--
	19-Jan-04	42	ND	50	ND	45	ND	--
	19-Feb-04	41		30	ND	49.5		--
	19-Mar-04	36	ND	74.6		42	ND	--
	21-Apr-04	68.4		63.3		36	ND	--
	24-May-04	62.6		53.6		35.7		--
	24-Jun-04	49	ND	42	ND	64.9		--
	27-Aug-04	54.4		35.9		28	ND	--
1071	7-Jan-03	23	ND	22	ND	26	ND	--
	14-Feb-03	32	ND	35	ND	28	ND	--
	11-Apr-03	135		119		102		--
	7-May-03	47		37.4		37.8		--
	6-Jun-03	115		73.9		133		--
	11-Jul-03	205		153		144		--
	11-Aug-03	336		622		259		--
	15-Sep-03	288		301		294		--
	15-Oct-03	330		143		219		228
	17-Nov-03	309		218		281		--
	17-Dec-03	265		206		176		189
	19-Jan-04	188		317		188		--
	19-Feb-04	404		271		311		291
	19-Mar-04	278		306		434		--
	21-Apr-04	602		515		464		--
	24-May-04	210		229		360		--
	24-Jun-04	279		285		499		279
	27-Aug-04	166		143		143		--
1072 (Control)	7-Mar-03	24	ND	21	ND	21	ND	--
	11-Apr-03	30	ND	36	ND	39	ND	--
	7-May-03	22	ND	22	ND	20	ND	--
	6-Jun-03	22	ND	26	ND	30	ND	--
	11-Jul-03	33	ND	33	ND	33	ND	--
	11-Aug-03	32	ND	25	ND	26	ND	--
	15-Sep-03	26	ND	28	ND	28	ND	--
	15-Oct-03	17	ND	16	ND	17	ND	--
	18-Nov-03	17	ND	15	ND	19	ND	--
	17-Dec-03	20	ND	13	ND	18	ND	--
	19-Jan-04	24	ND	17	ND	24	ND	--
	19-Feb-04	20		17		20		--
	19-Mar-04	13	ND	19	ND	22	ND	--
	21-Apr-04	28	ND	36	ND	23	ND	--
	24-May-04	21	ND	20	ND	19	ND	--
	24-Jun-04	30	ND	30	ND	31	ND	--
	27-Aug-04	20	ND	21	ND	21	ND	--

Attachment B-10. Soil Deposition Monitoring Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/kg) [a, b, c]						
		Round 1		Round 2		Round 3		Round 4
1073	7-Jan-03	25	ND	20	ND	28	ND	--
	14-Feb-03	30	ND	24	ND	25	ND	--
	11-Apr-03	64.1		63	ND	103		77.2
	7-May-03	29	ND	26	ND	28	ND	--
	6-Jun-03	46.1		41.1		57.8		--
	11-Jul-03	93.9		46.4		95.2		--
	11-Aug-03	165		108		190		--
	15-Sep-03	97.6		85.7		125		--
	15-Oct-03	54.5		68.1		75.8		--
	18-Nov-03	74.8		82.3		109		50.8
	17-Dec-03	87		55.2		146		80.3
	19-Jan-04	131		144		107		--
	19-Feb-04	172		125		104		--
	19-Mar-04	36.9		30	ND	187.7		--
	21-Apr-04	207		103		301		--
	24-May-04	95.8		93		189		--
	24-Jun-04	162		114		257		--
	27-Aug-04	205		34.5		136		--

[a] Data were obtained from U.S. EPA Region 7 (2006).
[b] "--" indicates that no sample was during that time.

[c] A value qualified with an "ND" represents a non-detect. The value presented is the detection limit. For the purpose of calculating averages, one-half the detection limit was used as the value for non-detects.

Attachment B-11. Air Deposition Monitoring Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/ft^2) [a, b]	
		Height = 1 ft	Height = 10 ft
181	7-Apr-03	0.774	10.318
	7-May-03	10.928	6.041
	6-Jun-03	3.657	5.266
	11-Jul-03	3.826	3.861
	12-Aug-03	2.669	3.543
	15-Sep-03	13.584	15.058
	15-Oct-03	7.877	6.202
	17-Nov-03	5.903	5.32
	17-Dec-03	15.137	11.899
	19-Jan-04	7.203	5.162
	19-Feb-04	8.152	4.927
	19-Mar-04	6.943	10.346
	21-Apr-04	7.852	6.829
	Annual Averages:	***7.3***	***7.3***
207	7-Apr-03	3.343	4.432
	7-May-03	3.684	2.699
	6-Jun-03	0.516	0.459
	11-Jul-03	2.118	1.986
	12-Aug-03	1.006	1.054
	15-Sep-03	2.306	2.591
	15-Oct-03	1.203	1.494
	17-Nov-03	1.497	2.698
	17-Dec-03	2.552	3.163
	19-Jan-04	2.739	3.025
	19-Feb-04	1.093	2.699
	19-Mar-04	5.124	6.831
	21-Apr-04	4.194	4.202
	Annual Averages:	***2.4***	***2.9***
240	7-Apr-03	3.924	4.128
	7-May-03	3.727	4.01
	6-Jun-03	1.131	1.068
	11-Jul-03	1.666	2.045
	12-Aug-03	1.333	1.337
	15-Sep-03	2.418	2.164
	15-Oct-03	1.62	1.676
	17-Nov-03	1.64	2.322
	17-Dec-03	3.769	4.657
	19-Jan-04	3.627	3.698
	19-Feb-04	1.975	1.603
	19-Mar-04	4.521	5.57
	21-Apr-04	3.363	4.105
	Annual Averages:	***2.7***	***3.0***
286	7-Apr-03	11.904	12.295
	7-May-03	10.046	11.758
	6-Jun-03	2.579	2.57
	11-Jul-03	4.09	4.249
	12-Aug-03	1.047	2.624
	15-Sep-03	3.86	2.916
	15-Oct-03	2.488	2.808
	17-Nov-03	5.848	5.581
	17-Dec-03	11.737	14.01
	19-Jan-04	8.328	3.179
	19-Feb-04	4.011	5.487
	19-Mar-04	9.145	20.996
	21-Apr-04	20.312	33.171
	Annual Averages:	***7.3***	***9.4***

Attachment B-11. Air Deposition Monitoring Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/ft^2) [a, b]	
		Height = 1 ft	Height = 10 ft
444	7-Apr-03	3.937	4.234
	7-May-03	5.204	3.422
	6-Jun-03	1.122	0.798
	11-Jul-03	2.712	2.333
	12-Aug-03	0.803	0.887
	15-Sep-03	1.765	3.073
	15-Oct-03	2.547	1.371
	17-Nov-03	2.376	3.008
	17-Dec-03	3.757	4.646
	19-Jan-04	2.878	5.938
	19-Feb-04	0.452	1.842
	19-Mar-04	4.835	7.211
	21-Apr-04	7	8.862
	Annual Averages:	***3.0***	***3.7***
531	7-Apr-03	2.645	1.523
	7-May-03	1.035	1.193
	6-Jun-03	0.452	0.263
	11-Jul-03	0.917	0.835
	12-Aug-03	0.341	0.484
	15-Sep-03	0.887	0.606
	15-Oct-03	0.514	0.527
	17-Nov-03	0.877	0.542
	17-Dec-03	1.713	1.644
	19-Jan-04	1.735	2.191
	19-Feb-04	0.822	1.073
	19-Mar-04	3.525	1.922
	21-Apr-04	3.323	2.063
	Annual Averages:	***1.4***	***1.1***
576	7-Apr-03	1.991	1.994
	7-May-03	1.827	1.519
	6-Jun-03	0.716	0.514
	11-Jul-03	1.396	1.417
	12-Aug-03	0.596	0.742
	15-Sep-03	0.972	1.406
	15-Oct-03	0.671	0.966
	17-Nov-03	1.183	1.275
	17-Dec-03	2.02	1.99
	19-Jan-04	2.209	1.786
	19-Feb-04	0.596	1.556
	19-Mar-04	3.777	3.707
	21-Apr-04	3.923	4.399
	Annual Averages:	***1.7***	***1.8***
1071	7-Apr-03	14.764	17.635
	7-May-03	19.453	7.265
	6-Jun-03	4.673	4.611
	11-Jul-03	5.802	4.397
	12-Aug-03	6.804	6.784
	15-Sep-03	16.903	31.997
	15-Oct-03	5.247	8.909
	17-Nov-03	5.925	4.734
	17-Dec-03	16.435	13.384
	19-Jan-04	12.265	10.1
	19-Jan-04	7.927	8.057
	19-Mar-04	22.039	13.635
	21-Apr-04	10.718	12.532
	Annual Averages:	***11***	***11***

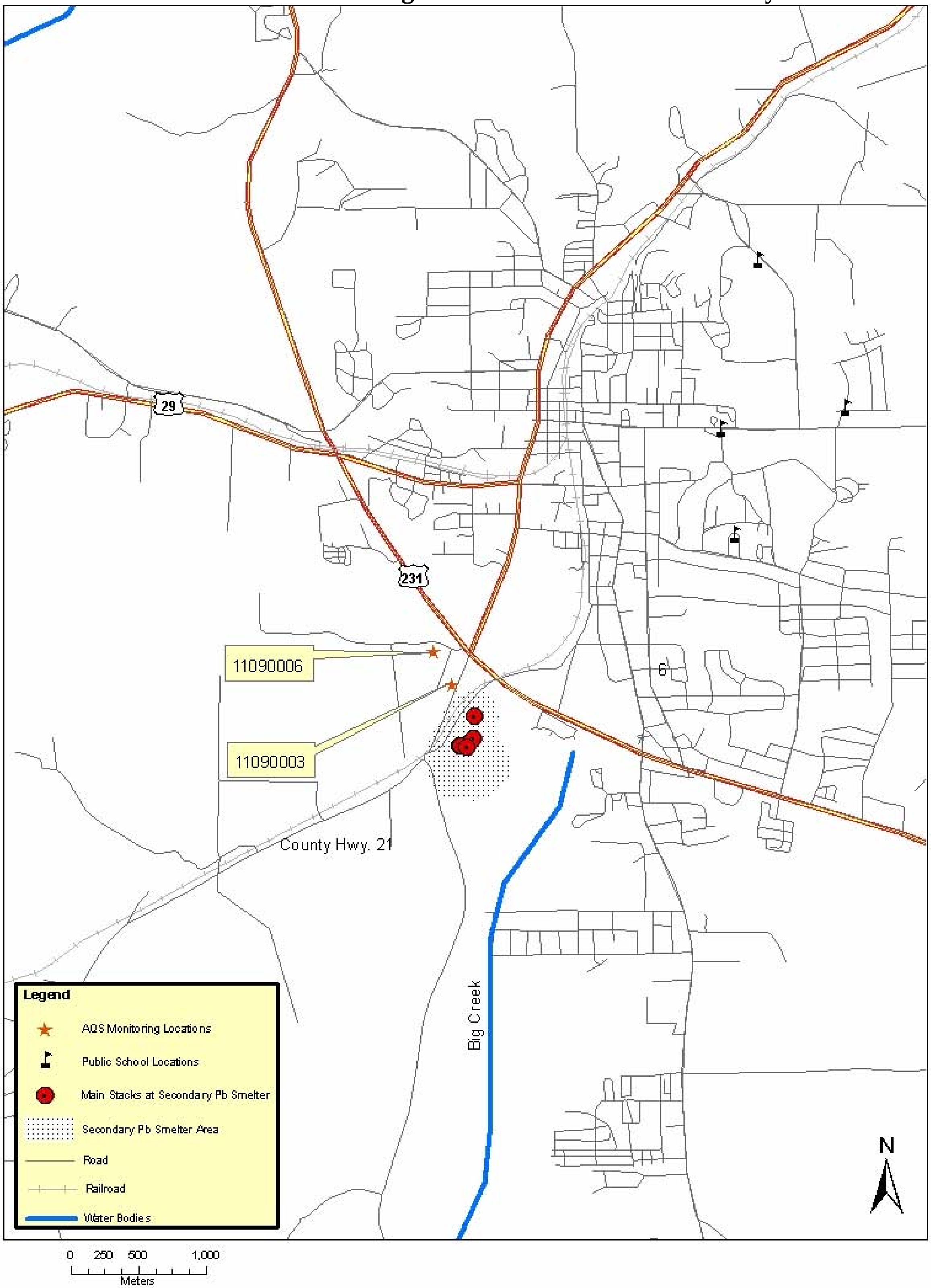
Attachment B-11. Air Deposition Monitoring Results for Pb – Primary Pb Smelter

Full-Scale Analysis ID	Sampling Date	RESULTS (mg/ft^2) [a, b]	
		Height = 1 ft	Height = 10 ft
1072 (Control)	7-Apr-03	0.588	12.125
	7-May-03	0.774	0.601
	6-Jun-03	0.268	0.292
	11-Jul-03	0.363	0.317
	12-Aug-03	0.3	0.456
	15-Sep-03	0.236	0.241
	15-Oct-03	0.203	0.238
	17-Nov-03	0.28	0.426
	17-Dec-03	0.805	0.7
	19-Jan-04	0.676	0.313
	19-Feb-04	0.33	0.282
	19-Mar-04	0.718	0.642
	21-Apr-04	2.382	1.771
	Annual Averages:	***0.61***	***1.4***
1073	7-Apr-03	7.798	8.346
	7-May-03	6.195	6.507
	6-Jun-03	2.296	1.677
	11-Jul-03	3.844	6.033
	12-Aug-03	1.722	1.983
	15-Sep-03	7.751	4.782
	15-Oct-03	4.969	4.071
	17-Nov-03	5.051	3.52
	17-Dec-03	7.816	8.113
	19-Jan-04	4.733	5.148
	19-Feb-04	3.601	4.754
	19-Mar-04	6.899	7.082
	21-Apr-04	8.554	5.393
	Annual Averages:	***5.5***	***5.2***

[a] Data were obtained U.S. EPA Region 7 (2006).

[b] "--" indicates that no sample was taken during that time

1 **Attachment B-12. Air Monitoring Locations around the Secondary Pb Smelter**



2

Attachment B-13. Average Annual Pb Concentrations from AQS Monitors Located around the Secondary Pb Smelter

Monitor ID	Facility (meters)	Average Annual Pb Concentrations from AirData (μg/m^3) [a]				
		1998	1999	2000	2001	2002
11090003	290 to 480	0.47	0.47	0.38	0.44	0.28
11090006	570 to 750	0.16	0.18	0.19	0.20	0.14

[a] Data are for average annual Pb concentrations in total suspended particulate matter (TSP) and were calculated from the U.S. EPA's AQS monthly composite data and weighted by the number of days in a month. The data were extracted from AQS using an AMP350 report, with the units selected as reported. Events and nulls were not included in the AMP350 report.

July 25, 2007

Appendix C: Media Concentrations for the General Urban Case Study

Prepared by:

ICF International
Research Triangle Park, NC

Prepared for:

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina

Contract No. EP-D-06-115
Work Assignment No. 0-4

Table of Contents

List of Exhibits

C. MEDIA CONCENTRATIONS FOR THE GENERAL URBAN CASE STUDY

This appendix presents the methodology used to calculate the concentration of lead (Pb) in various media for the general urban case study, along with the resulting media concentrations. Section C.1 describes the estimation of ambient air and inhalation exposure concentrations; Section C.2 examines soil concentrations; and Section C.3 covers indoor dust concentrations.

C.1. AIR

C.1.1. Ambient Air Concentrations

The air quality scenarios included in the general urban case study are summarized in Exhibit C-1. Two current conditions scenarios are included. The first is based on the 95th percentile monitoring site in urban areas of larger than one million residents, with regard to maximum quarterly average Pb-total suspended particulate matter (TSP) concentration for the time period 2003 to 2005 (using data from the U.S. EPA Air Quality System [AQS] database (USEPA, 2007).[1] It was derived by first calculating the maximum quarterly average concentration of Pb in TSP for the time period 2003 to 2005 for each monitoring site that met completeness criteria and that is located in an urban area with more than one million residents. The value shown in Exhibit C-1 for this first scenario is the 95th percentile of the distribution of those maximum quarterly average values. The value for the second current conditions scenario is the arithmetic mean of those maximum quarterly average values. The third value is for the current National Ambient Air Quality Standard (NAAQS) scenario for Pb, and the last four values are for the alternative NAAQS scenarios included in this assessment.

[1] These statistics and their derivation are described in Appendix A.

Exhibit C-1. Air Quality Scenarios included in the General Urban Case Study

Air Quality Scenario	Level (µg/m³)	Averaging Time	Notes [a]
Current conditions (95th percentile)	0.87	Calendar Quarter (maximum)	This value is the 95th percentile of the maximum quarterly average concentration of Pb in TSP (for period 2003 to 2005) among monitor locations in urban areas having more than one million residents.
Current conditions (mean)	0.14	Calendar Quarter (maximum)	This value is the mean of the maximum quarterly average concentrations of Pb in TSP (for period 2003 to 2005) among monitor locations in urban areas having more than one million residents.
Current NAAQS	1.5	Calendar Quarter (maximum)	--
Alternative NAAQS 1	0.2	Calendar Quarter (maximum)	--
Alternative NAAQS 2	0.5	Monthly (maximum)	--
Alternative NAAQS 3	0.2	Monthly (maximum)	--
Alternative NAAQS 4	0.05	Monthly (maximum)	--

[a] The data used to derive the current conditions concentrations are Pb-TSP monitoring data in the U.S. EPA AQS database for 2003 to 2005, which met certain adequacy criteria. This is further described in Appendix A.

Ratios relating these maximum quarterly or monthly average concentrations to annual average concentrations were used to estimate the annual average ambient air concentrations used in this assessment. The ratios were developed using the same data set as that described above for developing the current conditions scenarios. The ratios and their basis and application for this assessment are provided in Exhibit C-2 below.

Exhibit C-2. Ambient Air Ratios of Monthly or Quarterly Average Concentrations to Annual Average Concentration

Ratio Description	Value (unitless)	Notes [a]
95th percentile ratio of maximum quarterly to annual average Pb-TSP concentrations	7.6	1) For each monitoring site in urban areas of more than one million residents, the maximum quarterly average and the annual average Pb-TSP concentrations, and the ratios of the former to the latter, were derived. This value is the 95th percentile of the distribution of the ratios. 2) This ratio was used to derive the annual average concentration for the current conditions (95th percentile) scenario.
Mean ratio of maximum quarterly to annual average Pb-TSP concentrations	2.5	1) For each monitoring site in urban areas of more than one million residents, the maximum quarterly average and the annual average Pb-TSP concentrations, and the ratios of the former to the latter, were derived. This value is the arithmetic mean of these ratios. 2) This ratio was used to derive the annual average concentration for the current and alternative NAAQS scenarios for which the averaging time is calendar quarter.
Mean ratio of maximum monthly to annual average Pb-TSP concentrations	4.0	1) For each monitoring site in urban areas of more than one million residents, the maximum monthly average and the annual average Pb-TSP concentrations, and the ratios of the former to the latter, were derived. This value is the arithmetic mean of these ratios. 2) This ratio was used to derive the annual average concentration for the alternative NAAQS scenarios for which the averaging time is monthly.

[a] Data derived from U.S. EPA (2007).

The ratios were applied to the concentrations in Exhibit C-1 to estimate the seven annual average ambient air concentrations (i.e., one for each air quality scenario) (see Exhibit C-3).

Exhibit C-3. Estimated Annual Average Ambient Air Concentrations by Air Quality Scenario

Air Quality Scenario	Annual Average Pb Concentration (µg/m^3)
Current conditions (95th percentile)	0.11
Current conditions (mean)	0.056
Current NAAQS (1.5 µg/m^3, maximum quarterly average)	0.60
Alternative NAAQS 1 (0.2 µg/m^3, maximum quarterly average)	0.080
Alternative NAAQS 2 (0.5 µg/m^3, maximum monthly average)	0.13
Alternative NAAQS 3 (0.2 µg/m^3, maximum monthly average)	0.050
Alternative NAAQS 4 (0.05 µg/m^3, maximum monthly average)	0.013

The following provides a more detailed description (than that provided in Exhibit C-2) of the derivation of the annual average Pb-TSP concentrations used for the seven air quality scenarios included in the general urban case study.

The annual average concentration for the current conditions (95th percentile) scenario was estimated using the calculation shown below.

$$CC_{95\text{th}-A} = CC_{95\text{th}-Q} \div R_{95\text{th}-Q:A}$$

where:

$CC_{95th\text{-}A}$	=	Annual average concentration for the current conditions (95th percentile) scenario (micrograms [µg] per cubic meter [m^3])
$CC_{95th\text{-}Q}$	=	Maximum quarterly average concentration for the current conditions (95th percentile) scenario (µg/m^3) (from Exhibit C-1)
$R_{95th\text{-}Q:A}$	=	95th percentile ratio of maximum quarterly to annual average concentrations (unitless) (from Exhibit C-2)

A similar calculation was used to estimate the annual average concentration for the current conditions (mean) scenario, which is shown below.

$$CC_{Mean-A} = CC_{Mean-Q} \div R_{Mean-Q:A}$$

where:

$CC_{Mean\text{-}A}$	=	Annual average concentration for the current conditions (mean) scenario (µg/m^3)
$CC_{Mean\text{-}Q}$	=	Maximum quarterly average concentration for the current conditions (mean) scenario (µg/m^3) (from Exhibit C-1)
$R_{Mean\text{-}Q:A}$	=	Mean ratio of maximum quarterly to annual average concentrations (unitless) (from Exhibit C-2)

The annual average concentrations for the current NAAQS scenario and the alternative NAAQS scenario for which the averaging time is calendar quarter were estimated by replacing $CC_{Mean\text{-}Q}$ in the above equation with the maximum quarterly average levels for each scenario (i.e., 1.5 and 0.2 µg/m^3, respectively).

Lastly, the annual average concentrations for the alternative NAAQS scenarios for which the averaging time is monthly were estimated using the calculation below.

$$ALT_A = ALT_M \div R_{M:A}$$

where:

ALT_A	=	Annual average concentration for alternative NAAQS scenarios (for which averaging time is monthly) (µg/m^3)
ALT_M	=	Maximum monthly average concentration for alternative NAAQS scenarios (for which averaging time is monthly), (µg/m^3) (from Exhibit C-1)
$R_{M:A}$	=	Mean ratio of maximum monthly to annual average (unitless) (from Exhibit C-2)

C.1.2. Inhalation Exposure Concentrations

Inhalation exposure concentrations of Pb were estimated for the population of interest (young children) from the annual ambient air concentrations using age group- and location-specific relationships for Pb developed from modeling performed for U.S. EPA's 1999 National-scale Air Toxics Assessment (USEPA, 2006), one of the U.S. EPA's National Air Toxics Assessment (NATA) activities. These relationships account for air concentration differences indoors and outdoors, as well as for mobility or time spent in various locations (e.g., outdoors at home, inside at home) for the population of interest.

The NATA national-scale assessment produced air concentrations of Pb (and other hazardous air pollutants) for each U.S. Census tract using the Assessment System for Population Exposure Nationwide (ASPEN) model, and corresponding exposure concentrations of Pb for each of five age groups at each U.S. Census tract using the Hazardous Air Pollutant Exposure Model (HAPEM). The median ratio of ambient Pb concentration to Pb exposure concentration from the NATA national-scale assessment for the 0- to 4-year-old age group across all the U.S. Census tracts was identified as the best estimate of the relationship between ambient and inhalation exposure concentrations for use in this risk assessment. Data for 0- to 4-year-olds were used because this group is the closest age group for which outputs are available when compared to the age group of interest for this assessment. The result of applying this ratio, which was 0.43, to the annual ambient air concentration is shown in Exhibit C-4.

Exhibit C-4. Estimated Annual Average Inhalation Exposure Air Concentrations for the Air Quality Scenarios

Air Quality Scenario	Annual Average Inhalation Exposure Concentration ($\mu g/m^3$)
Current conditions (95th percentile)	0.049
Current conditions (mean)	0.024
Current NAAQS (1.5 $\mu g/m^3$, max quarterly average)	0.26
Alternative NAAQS 1 (0.2 $\mu g/m^3$, max quarterly average)	0.034
Alternative NAAQS 2 (0.5 $\mu g/m^3$, max monthly average)	0.054
Alternative NAAQS 3 (0.2 $\mu g/m^3$, max monthly average)	0.021
Alternative NAAQS 4 (0.05 $\mu g/m^3$, max monthly average)	5.4E-03

Use of ratios for the 0 to 4 age group across the United States, rather than ratios for 0 to 7 year-olds in only urban areas, contributes some uncertainty to the estimate of children's inhalation exposure concentrations. The use of the arithmetic mean of the ambient-to-inhalation exposure concentration ratios also creates some uncertainty in that it does not capture the inter-individual and inter-location variability in this relationship. In addition, there is some uncertainty in the magnitude of the air concentrations generated using the ASPEN model for the NATA assessment. In a comparison to monitoring data across the country, the ASPEN-modeled air concentrations generally underestimated monitored concentrations (USEPA, 2006; Section on Comparison to Monitored Values). However, the relationship between ambient air concentrations and exposure concentrations (i.e., the comparison used here) is not expected to be affected by underestimated ambient air concentrations from the NATA assessment. Also, some of the exposure modeling inputs used in the NATA simulations were not specific to Pb and thus may introduce additional uncertainties. For example, the penetration factor, which is used to estimate the fraction of the pollutant in outdoor air that reaches indoor air, that was used for Pb in the NATA assessment is based on a study that examined the penetration of hexavalent chromium particles, which are generally more reactive than Pb particles (Long et al., 2004).

C.2. SOIL

In order to determine the soil Pb concentration used for the general urban case study, a survey of the literature regarding Pb concentrations in urban surface soils was undertaken. Information regarding the studies identified during that survey is presented in Exhibit C-5, and the range of soil Pb concentrations presented in these papers is shown in Exhibit C-6. Out of these studies, it was determined that an interim version of the National Study of Lead and Allergens in Housing (NSLAH) as cited in (USEPA, 2000) provided the most recent, nationally representative data for a generalized urban area. When compared to the regional- and state-focused studies presented in Exhibit C-5, the NSLAH goal of producing nationally representative information provided an advantage in the effort to develop a concentration for a generalized area.

Relative to Succop et al. (2001), which is one of the two other national studies identified in the literature, NSLAH presents data that are more accurately representative across public and private housing compared to the Succop et al. (2001) data that focus solely on public housing. NSLAH also has several advantages over the other national survey, the National Survey of Lead-Based Paint in Housing (NSLBPH), which is presented in USEPA (2000). As a larger and more recent survey, NSLAH is better able to capture current conditions across the country, and it utilizes the American Society for Testing and Materials (ASTM) standard E1727-95 core sampling protocol, a standard procedure for residential Pb sampling (USEPA, 2000). The NSLAH summary statistics also do not censor non-detect values as is done in NSLBPH, which can positively skew soil Pb concentrations. Time and resource limitations dictated the use of readily accessible data from the interim NSLAH rather than data from the final version of the report.

The interim NSLAH surveyed 706 homes located in all 50 states and the District of Columbia with construction dates ranging from pre-1940 to 1998. While the surveyed homes are distributed throughout the United States, they are located across both urban and non-urban areas. Soil samples taken to a depth of one-half inch (in) were collected from five sites on each dwelling property between 1998 and 1999. A single soil sample was taken near the house main entrance, while one drip-line sample was taken from the wall containing the main entry and another was taken from a randomly chosen second wall. Similarly, one mid-yard sample was taken from the wall containing the main entry and another was taken from a randomly chosen second wall. The dripline samples were a composite of three core samples, while the mid-yard samples were a composite of up to four core samples. The interim[2] NSLAH yard-wide arithmetic mean soil Pb concentration, which is 198 µg of Pb per gram (g) of soil, was chosen as the soil Pb concentration for the general urban case study. Although NSLAH does provide data that are specific to child play areas in a yard, which may better represent exposures for children because they may spend significantly more time in these particular portions of the yard, the yard-wide average soil concentrations were used because the play area samples were collected from only half the total sites in the study. The arithmetic average of the yard-wide average soil concentrations was used because it represents the expected value of the exposure concentration

[2] The term “interim” is used here to indicate that the data comes from a version of NSLAH that predates the final version of the report.

of a child who randomly "samples" from the underlying distribution of exposures. The average accounts for weights that were assigned to the samples from the various houses based on selection probabilities with the purpose of producing data that are nationally representative. There is some uncertainty associated with the use of a single average soil Pb concentration in that it does not capture inter-city and inter-house variability, which can be significant due to different historical and current land uses, housing vintages, renovation activities, and other more minor factors.

Exhibit C-5. Selected Data - Pb in Urban Surface Soil and Related Urban Measurements

Study Citation	Location and Sampling Scheme	Reported Pb Concentration(s) (total Pb unless otherwise specified)	Other Relevant Information
Adgate et al., 1998	• Jersey City, New Jersey • Ten homes • Samples collected October 1994 to January 1995 • Soil collected from yards of 10 homes screened for participation in the Childhood Lead Exposure Assessment and Reduction Study (CLEARS) • Samples collected in bare, unvegetated areas of the subject child's primary outdoor activity area • All samples were surface soil (top 5 centimeters [cm])	• Geometric mean (GM): 540 parts per million (ppm) • Range: 70 to 2080 ppm • n = 10	• Study examined relationship between indoor dust and outdoor soil/dust • Used ratios of Pb isotopes to trace sources • Outdoor soil and dust determined to act as essentially a single source for indoor dust • Outdoor sources found to contribute about as much as indoor sources to indoor dust
Bornschein et al., 1987	• Inner-city neighborhood in Cincinnati, Ohio • Five square mile area for sampling • Exterior surface dust scrapings were taken from asphalt, concrete, or brick near the dwelling, or hard-packed soil devoid of vegetation • Eighty houses total (20th century public, 19th century rehabilitated, 19th century satisfactory, and 19th century deteriorated)	• All (n=80): mean 1360.32 ppm; range 76 to 54,519 ppm • Public (n=20): GM 247.88 ppm; range 7 to 812 ppm • Rehabilitated (n=29): GM 1654.49 ppm; range 253 to 11889 ppm • Satisfactory (n=9): GM 7361.54 ppm; range 1500 to 54,519 ppm • Deteriorated (n=22): GM 2791.19 ppm; range 108 to 25,180 ppm	• Concentrations were strongly influenced by the housing type, with the lowest concentrations outside public housing units • Seventy-five percent of residences occupied by 18-month-old children had external soil dust concentrations >1,000 ppm
Chirenje et al., 2004	• Gainesville, Florida, relatively undeveloped, low population/traffic density, and Miami, Florida, developed, high population/traffic density • Locations were sampled according to land use characterization as residential, commercial, public parks, or public buildings. • Sampling depths: 0 to 20 cm from surface in Gainesville; 0 to 10 cm in Miami	Miami: • Combined: median 98 ppm; GM 92.9 ppm; arithmetic mean 152 ppm; range 2.13 to 1091 ppm; 55 percent of samples were 51 to 200 ppm • Residential median 121 ppm (n=60) • Commercial median 146 ppm (n=60) • Public parks median 82 ppm (n=60) • Public buildings median 84 ppm (n=60) Gainesville: • Combined median 15 ppm; GM 16.4 ppm; 87 percent of samples <50 ppm • Residential median 20.4 ppm (n=39) • Commercial median 19.2 ppm (n=41) • Public parks median 7.23 ppm (n=38) • Public buildings median 17.4 ppm (n=44)	• In Miami, analyses showed concentrations of samples from 0 to 10 cm were not significantly different from those collected from 10 to 20 cm • Concluded lower Pb in Gainesville was due to lower inputs (low industrial activity, less traffic) but also increased Pb mobility/low retention (lower pH, organic carbon content, and clay content versus Miami soils) • Pb patterns with land use were slightly different between Gainesville and Miami. • Residential and commercial areas generally had higher levels of Pb

Exhibit C-5. Selected Data - Pb in Urban Surface Soil and Related Urban Measurements

Study Citation	Location and Sampling Scheme	Reported Pb Concentration(s) (total Pb unless otherwise specified)	Other Relevant Information
Elhelu et al., 1995	• Washington, District of Columbia • Duplicate soil samples were collected randomly from 239 unpaved front yards of homes (typically row houses) • Sites sampled in each of 8 political wards (30 each, except for one) • Samples were taken at a depth of 15 cm from sites that are 1 meter (m) from each of the surveyed dwellings • Surveyed homes were an average of 4.5 meters (m) from the road	• Medians for eight wards ranged from 53.7 ppm to 471.4 ppm • Seven wards had medians > 129 ppm • Four wards had medians > 221 ppm • Two wards had medians > 440 ppm • Range: 10.2 to 6015 ppm	• Authors suggested that Pb concentrations may be highest in areas adjacent to buildings and suggested that paint was the main source of Pb
Gasana and Charmorro, 2002	• One hundred and twenty homes in Miami, Florida (Little Haiti and Liberty City) • Samples were taken from soil as well as floors, windows, wells, tap water, and air • The presence of Pb paint was also investigated • Investigations were tailored to areas most utilized by children less than 6 years old	• n = 121 • Mean: 275 ppm • Median: 153 ppm • Range: 25 to 1612 ppm	• The playgrounds around the house had the highest concentration of Pb
Johnson and Bretsch, 2002	• Syracuse, New York • Samples of soil were collected at 194 locations within a 600 m by 600 m grid laid out over the City of Syracuse (residential areas, and a city-wide mix of house lots, parks and playgrounds, and street side locations emphasized) • At most sites, two kinds of samples were acquired: (1) a bulk sample of 0.5 to 1 kilogram (kg) from a single location, integrated over a 0 to 10 cm depth; and (2) a composite 0 to 1 cm surface core sample obtained from within a 1 square meter area	• Average: 80 ppm • 95 percent of the soil samples collected had values in the range of 20 to 800 ppm	• Found no significant differences in Pb concentration between 0 to 1 cm and 0 to 10 cm depth • No other Pb soil concentration summary statistics were reported
Kassa et al., 2000	• Toledo, Ohio • Sampled from January 1995 to August 1998 • One-half inch (in) coring device was used to collect soil samples around homes and in play areas adjacent to the home • All pre-1950 housing (n=145 houses) • Sampling depth not specified	• Range: 400 to more than 5,000 ppm • 77 houses had exterior soil levels over 5,000 ppm • 41 houses had soil levels surrounding the house between 2,000 to 5,000 ppm • 63 surrounding play areas had concentrations from 400 to 2,000 ppm	• No other Pb soil summary statistics were reported

Exhibit C-5. Selected Data - Pb in Urban Surface Soil and Related Urban Measurements

Study Citation	Location and Sampling Scheme	Reported Pb Concentration(s) (total Pb unless otherwise specified)	Other Relevant Information
Khandler and Friedman, 2000	• New York City, New York • Thirty-five soil samples were collected from 10 different parks; collected from relatively undisturbed sites 30 to 1000 feet (ft) from highways to park roads	• All parks: range 26 to 1,040 ppm • Central Park: mean 150.96 ppm; range 26 to 225 ppm • Clove Lake Park: mean 149 ppm; range 120.42 to 177 ppm • Conference House Park: mean 311.68 ppm; range 147 to 583 ppm • Forest Park: mean 502 ppm; range 125 to 1040 ppm • Kissena Park: mean 166.54 ppm; range 161.82 to 175 ppm • Owl's Head Park: mean 240.55 ppm; range 177.41 to 303.70 ppm • Prospect Park: mean 190.97 ppm; maximum 321.01 ppm. • Riverside Park and Fort Washington Park: mean 272.45 ppm; range 49 to 444 ppm	• There was a greater concentration of Pb in all parks compared to a renovated lawn • Soils with higher concentrations of metals were found nearer to a highway
Lejano and Ericson, 2005	• Pacoima, California (large amount of highways present) • Study occurred over a 5-month period in 2002 • Two hundred and ten soil samples were collected, from the side of the highways, schools and parks (and >100 m away as a control).	Mean Pb levels: • Random: 111.0 ppm • Schools: 66.7 ppm • Parks: 51.6 ppm • San Fernando Road: 171.3 ppm • Whiteman Airport: 111.6 ppm (without outlier); 232.5 ppm (with outlier) • Interstate 5: 118.6 ppm • Interstate 118: 102.1 ppm • Interstate 210: 43.3 ppm	• The total and bio-available Pb was found to be markedly higher in areas close to major highways • The study concluded that there is an unexpected persistence of Pb deposited by vehicular emissions over a long period of time
Liberti and Pichtel, 1997	• City of Muncie in Center Township, Delaware County, Indiana • One hundred and fifty samples; 3 samples from each of 25 quadrants at 2 soil depths • Sampling depth: 0 to 5 cm and 10 to 25 cm from surface	Depth of 0 to 5 cm: • Mean ± S.D. 203.8 ± 35.9 ppm; range 81.1 to 466.3 ppm Depth of 10 to 25 cm: • Mean ± S.D 172.2 ± 28.9 ppm; range 53.9 to 344.8 ppm	• Pb concentrations were significantly higher in the surface soil as compared to the subsurface soil • Highest concentrations were near the city center and along roadways • The majority of Pb was found in residual forms and considered relatively immobile

Exhibit C-5. Selected Data - Pb in Urban Surface Soil and Related Urban Measurements

Study Citation	Location and Sampling Scheme	Reported Pb Concentration(s) (total Pb unless otherwise specified)	Other Relevant Information
Mielke, 1994	• New Orleans, Louisiana • Soil samples were collected from the surface 2.5 cm within inner-city, mid-city, and suburban residential communities • Samples collected within 1 m from street, within 1 m of house-sides (foundations), and from open spaces (e.g., vacant land or parks far from streets) • n = 3,704 (sampled from 283 U.S. Census tracts in the city)	Inner-city • Foundation: median 840 ppm; range 8 to 69,000 ppm (n=201) • Streetside: median 342 ppm; range 4 to 9,450 ppm (n=723) • Open space: median 212 ppm; range 10 to 10,600 (n=74) Mid-city • Foundation: median 110 ppm; range 1 to 24,400 ppm (n=220) • Streetside: median 110 ppm; range 1 to 6,340 ppm (n=765) • Open space: median 40 ppm; range 2 to 3,960 (n=80)	• Pb peaked in street side soil of the inner-city and steeply declined to the suburban areas of the city • Bare soils immediately adjacent to residential structures in the inner-city had the highest Pb levels, followed by soils along street sides • The lowest Pb levels were found in open areas and in suburban areas
Sheets et al., 2001	• Springfield, Missouri • Nine sampling locations, including three near heavy-traffic streets and two more than 30 m from residential street • At each site, samples were collected in 1999 at depths of 1, 8, and 15 cm and at three distances (1, 2, and 3 m) from air sample stations; same-depth samples were averaged at each site • Excess vegetation was removed before samples were collected	Site average 107 ± 8 ppm; range 18 ppm to 302 ppm Average concentrations for the 9 sites: • Depth 1 cm: 99.5±73 ppm • Depth 8 cm: 104±79 ppm • Depth 15 cm: 116±89 ppm Lowest site concentrations: • Depth 1 cm: 18.0±0.8 ppm • Depth 8 cm: 19.3±13 ppm • Depth 15 cm: 20.8±4.4 ppm Highest site concentrations: • Depth 1 cm: 228±17 ppm • Depth 8 cm: 255±5.8 ppm • Depth 15 cm: 302±6.9 ppm	• Soil Pb was consistently greater with increasing soil depth • Sampling locations may have been vegetated • Authors noted that soil Pb in this city are relatively low, even at high traffic sites
Shinn et al., 2000	• Chicago, Illinois • Sampled bar soil in four-block urban residential area and measured Pb (n=62) • Properties were located on either side of two North/South residential streets within the study area • Developed surface plots of Pb levels via kriging; analyzed patterns by reviewing historical data for potential sources • Sampling depth not specified • Pre-1930 housing in area	• Overall mean 2,180 ppm; median 1,775 ppm; range 175 to 7,935 ppm • Eastern street median 2289 ppm; range 253 to 7,935 ppm • Western street median 1,263 ppm; range 175 to 4,158 ppm	• Pb distribution in soil indicates non-random distribution of Pb sources • Pb surface soil patterns linked to existing and previous potential sources within study area as well as nearby street with high traffic volume • Five sampling sites had Pb levels >5,000 ppm

Exhibit C-5. Selected Data - Pb in Urban Surface Soil and Related Urban Measurements

Study Citation	Location and Sampling Scheme	Reported Pb Concentration(s) (total Pb unless otherwise specified)	Other Relevant Information
Succop et al., 2001	• Sampling was conducted in 67 public housing developments nationwide (a total of 482 dwelling units and associated areas were individually sampled) • Data includes 1,222 soil samples • Soil samples collected from locations near building foundation, elsewhere in the yard, or near walkways	• Near the building foundations: median 194 ppm • Near walkways: median 177 ppm • In yards: median 145 ppm • The maximum concentration, 3,900 ppm, was found in a foundation sample • For 28 housing development assessments, at least 1 sample greater than or equal to 400 ppm	• No other data for soils were reported
Sutherland and Tolosa, 2001	• Manoa basin, Oahu, Hawaii • Sampled two transects at low speed roadways (near park and school) out to 50 m from road • First sample (0 m) from road deposited sediment which was curbside area at edge of road • For each site, Pb was analyzed in topsoil (0 to 2.5 cm) and subsoil (7.5 to 10 cm) • Five supplemental soil samples collected from grass-covered recreational field >100 m from roadway; 10 “control” locations sampled from relatively undisturbed areas	• Park transect: max of 375 ppm (5 m from road); road deposited sediment 285 ppm • School transect: max of 200 ppm in road deposited sediment; all soil samples 25 to 50 ppm, out to 50 m • Measurements for both transects drop to <50 ppm within 5 to 10 m • Median local background soil concentrations: surface samples 13±1; subsurface 14±3 ppm	• Authors suggested that preliminary study data show that remobilization of metals in soils close to roads can prolong contamination of urban road systems
Sutherland et al., 2000	• Samples collected 78 roadside (within 2 m) and 10 background locations within the Manoa watershed, Oahu, Hawaii • For each site, Pb was analyzed in topsoil (0 to 2.5 cm) and subsoil (7.5 to 10 cm)	• Total Pb in roadside samples: median 56±30 ppm; range 10 ppm to 4870 ppm • 10th percentile: 19 ppm • 25th percentile: 34 ppm • 75th percentile: 120 ppm • 90th percentile: 170 ppm • Total Pb in background samples: median 14±2 ppm	• Same sampling locations and scheme as in Teichman et al. (1993) • Appears that reported concentrations are based on samples at both depths. Sutherland et al. (2000) showed the concentrations are similar at the two depths. • Enrichment ratios were calculated based on the degree of anthropogenic influence on Pb levels; Pb was the most significantly enhanced metal. • Enrichment ratio for roadside Pb was four to five times higher than in background soils

Exhibit C-5. Selected Data - Pb in Urban Surface Soil and Related Urban Measurements

Study Citation	Location and Sampling Scheme	Reported Pb Concentration(s) (total Pb unless otherwise specified)	Other Relevant Information
Sutherland, 2000	• Samples collected 78 roadside and 10 background locations within the Manoa watershed, Oahu, Hawaii • For each site, Pb was analyzed in topsoil (0 to 2.5 cm) and subsoil (7.5 to 10 cm) • All sites had some grass cover. • Reported total Pb and HCl extractable (i.e., labile) Pb	• Total Pb in roadside topsoil samples: median 58±27 ppm; range 14 to 4,870 ppm • Total Pb in background topsoil samples: median: 13 ± 1 ppm; range: 10 to 22 ppm	• Roadside labile Pb was four to five times higher than in background soil • Subsoil concentrations were similar to topsoil concentrations at both roadside and background sites
Tiechman et al., 1993	• Alameda County, California • Soils were collected from the yards of homes adjacent the freeway, within a 1-mile radius • Sampling occurred at least 20 m away from the homes to control for Pb from paint • Nineteen subsurface samples were taken	• Surface samples: average 567.7 ppm; range 195.3 ppm to 2,026.6 ppm • Subsurface samples: average 618.3 ppm; range 369.8 to 1,045.7 ppm	• Ninety percent of the soils collected from subsurface contained Pb exceeding the surface samples • Soil downwind from the freeway contained Pb levels that exceed those found on the upwind side by 93 percent
Tong, 1990	• Cincinnati, Ohio, roadside dusts and soils • Sixty sites (n=60) were sampled from either 0 to 5 cm in depth or 15 to 20 cm from the surface • Housing in the study area were grouped into those built before 1950 and those built after 1960 • Samples were taken from the edge of the curb closest to the roadway and 30 m from the roadway	Street dusts and soils: • 0 to 5 cm: arithmetic mean 1,004.1 ± 1,007.8 ppm • 15 to 20 cm: arithmetic mean 1301.0 ± 1313.6 ppm Housing age before 1950: • 0 to 5 cm: arithmetic mean 1,256.2 ± 1,254.3 ppm • 15 to 20 cm: arithmetic mean 1,602.4 ± 1,563.8 ppm Housing age after 1960 • 0 to 5 cm: arithmetic mean 752.0 ± 557.4 ppm • 15 to 20 cm: arithmetic mean 999.7 ± 744.7 ppm	• Ranges not reported

Exhibit C-5. Selected Data - Pb in Urban Surface Soil and Related Urban Measurements

Study Citation	Location and Sampling Scheme	Reported Pb Concentration(s) (total Pb unless otherwise specified)	Other Relevant Information
Turer and Maynard, 2003	• Corpus Christi, Texas • Two sample sites in Texas were chosen along the highway: one in the city center with mostly automotive traffic, and the second near oil refineries with truck traffic • Twenty-two samples were taken along a transect perpendicular to the highway in Corpus Christi	• City center: range 20 (3 miles from the road at 32.5 cm deep) to 820 ppm (3 meters from the road at the 0 to 10 cm depth) • Industrial area: range 15 to 650 ppm (at 5 to 15 cm depth)	• Concluded that Pb has a very low mobility rate, due to the amount of insoluble organic matter • About 40 percent of Pb coming from vehicle exhaust remained in the soil at site 1 and about 28.4 percent remained in the soil at site 2
Turer et al., 2001	• Cincinnati, Ohio; Interstate 75 (I-75) through city; 58 samples • Sampling conducted adjacent to highways on median between lanes (within ~50 m of road) • Sampling depth: 0 to 1 cm; also sampled 1 to 5 cm	• Range for 0 to 1 cm samples: 166 to 942 ppm; range for 1 to 5 cm samples: 59 to 1,073 ppm • Some samples taken at depth of 10 to 15 cm contained total Pb between 1,000 to 2,000 ppm	• Performed mass balance analysis to determine fate of Pb (total emitted historically in exhaust versus Pb currently in soil); results suggest 60 percent of Pb has been lost from study area (roadsides) • Removal via wind-blown dust was proposed as most likely remobilization mechanism; surface runoff may be lesser removal mechanism
USEPA, 1993; 1996	• Cincinnati, Ohio • Sampled three neighborhoods: (A) Pendleton; (B) Findlay, Back, Dandridge; and (C) Glencoe, Mohawk • Compared soil Pb concentrations before and after a total neighborhood Pb abatement project (Area C was abated after this study) • Sampled 1989 to 1992 • Sampling depth: Surface, 0 to 2 cm, 13 to 15 cm • n = 8,127 soil samples	Pre-abatement surface scrapings • GM (95 percentile) • Area A: 189 (1,996) ppm (n=242) • Area B: 101 (776) ppm (n=273) • Area C: 154 (1,653) ppm (n=311) 0 to 2 cm soil samples: • Area A: 200 (2,659) ppm (n=195) • Area B: 103 (780) ppm (n=230) • Area C: 140 (1,200) ppm (n=224) 13 to 15 cm soil samples: • Area A: 215 (1,612) ppm (n=185) • Area B: 162.4 (383) ppm (n=230) • Area C: 114 (848) ppm (n=217) Data analysis by U.S. EPA (2000): • Building: GM 233.9 ppm; range 7.1 to 630 ppm • Bare areas: GM 220.9 ppm; range 5.4 to 4552 ppm • Play area: GM 94.6 ppm; range 20.0 ppm to 192 ppm	• No measurable reduction in PbB was found except in cases where other sources were also removed or abated • Study indicated that Pb in soil was not a significant source of Pb relative to other sources

Exhibit C-5. Selected Data - Pb in Urban Surface Soil and Related Urban Measurements

Study Citation	Location and Sampling Scheme	Reported Pb Concentration(s) (total Pb unless otherwise specified)	Other Relevant Information
USEPA, 1993; 1996	• Baltimore, Maryland • Pre-1950 housing • Lower Park Heights and Walbrook Junction (control area) neighborhoods were the sampling sites • Sixty-three properties were studied • Using a 15-cm soil coring device, nine composite samples were taken from the top 2 cm and 9 from the bottom 2 cm of the soil • Sampled 1988 to 1989 • Samples were taken pre and post soil abatement from the foundation, mid-yard, and boundary line • Sampling depth: 0 to 2 cm and 13 to 15 cm from surface	Pre-abatement soil levels (n=57): • TriMean: 503.6 ± 268.2 ppm (TriMean= (Lower Quartile + 2*median +Upper Quartile)/4)) • Range: 100 to 1,450 ppm Control (n=147) • Mean 501.3 ± 312.1 ppm Reported in U.S. EPA (2000): Dripline top 2 cm: GM 635.9 ppm; range 96 to 4,400 ppm Mid-yard top 2 cm: GM 287.0 ppm; range 31 to 3,500 ppm Remote top 2 cm: GM 337.0 ppm; range 77.2 to 1850 ppm	• No measurable reduction in PbB was found except in cases where other sources were also removed or abated • Study indicated Pb in soil was not a significant source of Pb relative to other sources
USEPA, 1993; 1996	• Boston, Massachusetts • Sampled 1989 to 1991 • Preliminary sampling to determine eligibility consisted of measurements from 150 contaminated properties throughout the city • Eligible properties had at least two samples > 1,500 ppm at the time of preliminary testing • 37 houses were found eligible • Three to four composite soil samples taken within 2 m of the houses • Sampling depth: 0 to 2 cm from surface	Study Group Results (SPI): • Pre-abatement (n=35): • Median: 2,413 ppm • Arithmetic mean: 2,625 ppm	• Children's PbB levels were reduced in areas where soil Pb concentrations were high (> 1,000 ppm) and soil Pb abatement and Pb paint exposure was controlled by paint stabilization

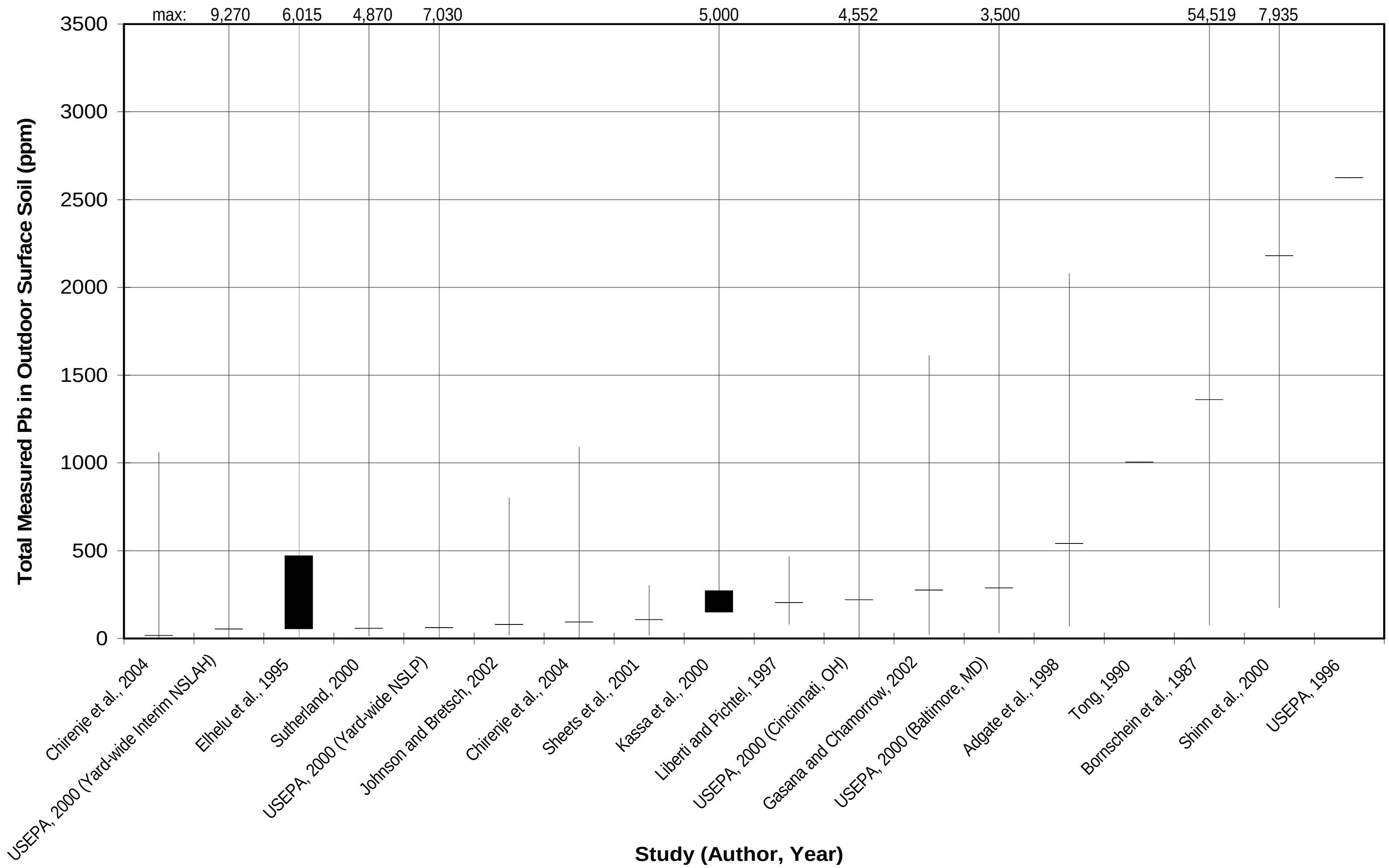
Exhibit C-5. Selected Data - Pb in Urban Surface Soil and Related Urban Measurements

Study Citation	Location and Sampling Scheme	Reported Pb Concentration(s) (total Pb unless otherwise specified)	Other Relevant Information
USEPA, 2000; Westat Inc., 1995; 1996	• National Survey of Lead-Based Paint in Housing surveyed randomly selected 381 housing units (284 private and 97 public houses) in 30 counties across the United States • Three core soil samples were taken from each dwelling unit: one near the main entrance, one along the drip line (soil next to the housing until), and one at a remote location away from the building, but still on property • Sampling 1989 to 1990 • Housing construction years included pre-1940 to 1979 • Sampling depth: 10 cm	Data from Westat Inc. (1996): Private housing • All locations (n=762): mean 324 ppm ; median 54 ppm; 1 to 22,974 ppm • Entrance (n=260): arithmetic mean 327 ppm; GM 85 ppm; median 64.8 ppm; range 2.84 to 6829 • Dripline (n=249): arithmetic mean 448 ppm; GM 74 ppm; median 56.2 ppm; range 1.16 to 22,974 ppm • Remote (n=253): arithmetic mean 204 ppm; GM 46; median 46.7 ppm; range 1.45 to 6951 ppm Analysis by U.S. EPA (2000) • Yard-wide average: arithmetic mean 235 ppm; GM 61.9 ppm; median 49.2 ppm; range 4.63 to 7030 ppm	• Study found that the strongest statistical predictor of soil Pb in private and public housing was the housing units' construction year • Additional significant predictors were U.S. Census region, interaction between building age and U.S. Census region, presence of Pb based paint, and average daily traffic flow • Degree of urbanization and condition of Pb paint were not significant predictors for private housing • In the U.S. EPA (2000)analysis, only households with values > 0 were used to calculate the GM • Yard-wide average was the average of (1) the average of the mid-yard sample results and (2) the average of results for the dripline and entryway samples

Exhibit C-5. Selected Data - Pb in Urban Surface Soil and Related Urban Measurements

Study Citation	Location and Sampling Scheme	Reported Pb Concentration(s) (total Pb unless otherwise specified)	Other Relevant Information
USEPA, 2000; Westat Inc., 2002	• National Survey of Lead and Allergens in Housing surveyed 831 homes in all 50 states (preliminary data evaluated by U.S. EPA (2000)included 706 houses in all 50 states) • 375 of the homes also had children's play area bare soil tested • Sampled 1998 to 1999 • A single soil sample was taken near the house main entrance, one drip-line sample was taken from the wall containing the main entry and another was taken from a randomly chosen second wall, and one mid-yard sample was taken from the wall containing the main entry and another from a random second wall. The dripline samples were a composite of three core samples, while the mid-yard samples were a composite of up to four samples. • Housing construction years were pre-1940 to 1998 • Sampling depth: top 0.5 in	Results for five sampling sites at all 831 homes: • Main Entry (n=707): arithmetic mean 234.8 ppm; GM 43.3 ppm; median 40.2 ppm • Wall 1 Dripline (n=704): arithmetic mean 242.9 ppm; GM 44.5 ppm; median 38.8 ppm • Wall 2 Dripline (n=704): arithmetic mean 404.1 ppm; GM 49.0 ppm; median 40.3 ppm • Wall 1 Mid-yard (n=723): arithmetic mean 87.3 ppm; GM 28.1 ppm; median 27.0 ppm • Wall 2 Mid-yard (n=728): arithmetic mean 123.4 ppm; GM 29.9 ppm; median 29.1 ppm Results for housing where children's play area bare soil was sampled: • 51 percent > 20 ppm • 30 percent > 59 ppm • 5 percent > 400 ppm • 2 percent > 2,000 ppm Analysis of interim data by U.S. EPA (2000): • Yard-wide average with no adjustment to non-detects: arithmetic mean 200 ppm; GM 53.0 ppm; median 41.4 ppm; range 0 to 9270 ppm	• Only households with values > 0 were used to calculate the GM • Yard-wide average was the average of (1) the average of the mid-yard sample results and (2) the average of results for the dripline and entryway samples • Yard-wide average for houses built prior to 1940 had the highest means (arithmetic mean 646 ppm; GM 297 ppm based on interim data and no adjustment for non-detects) • The highest means and values were generally found in the Northeast, and the lowest in the West

Exhibit C-6. Pb Concentrations Measured in Urban Soils in the United States



[a] This chart is intended to convey general levels of total Pb measured in urban soils for which means or medians were reported. For each study, the vertical line represents the approximate range of total Pb reported in upper surface soil samples. The square mark or box represents the mean total Pb for all samples in that study; the geometric (preferred) or arithmetic mean was reported in the study. In some cases, only the mean or median concentrations for selected study locations or sample categories were reported; these cases are represented by a box. Refer to cited publications for details on individual studies.

C.3. INDOOR DUST

For the general urban case study, both the hybrid model and the air-only regression-based model (described in Appendix G) are used to generate separate indoor dust Pb concentration estimates. In addition, the fraction of Pb originating from recent air and other sources (i.e., contributions from indoor paint, outdoor soil/dust, and additional sources including historical air) is estimated in both cases.

For the hybrid model, the fraction of Pb mass from recent air-derived sources is calculated by dividing the hybrid model air-dust Pb loading by the total Pb loading; this fraction is then applied to the total Pb concentration to derive the indoor dust (recent air) portion of the indoor dust Pb concentration. The indoor dust (other) portion is the remainder of the indoor dust Pb concentration. The indoor dust (recent air), indoor dust (other), and indoor dust (total) estimates for the hybrid model are provided in Exhibit C-7 below.

Exhibit C-7. Estimated Annual Indoor Dust Pb Concentrations from the Hybrid Mechanistic-Empirical Model for the Air Quality Scenarios

Air Quality Scenario	Indoor Dust Pb Sources	Dust Pb Concentration (µg/g)
Current conditions (95th percentile)	Recent air	180
	Other	17
	Total	198
Current conditions (mean)	Recent air	122
	Other	24
	Total	146
Current NAAQS (1.5 µg/m³, max quarterly average)	Recent air	418
	Other	8
	Total	426
Alternative NAAQS 1 (0.2 µg/m³, max quarterly average)	Recent air	149
	Other	21
	Total	169
Alternative NAAQS 2 (0.5 µg/m³, max monthly average)	Recent air	189
	Other	17
	Total	206
Alternative NAAQS 3 (0.2 µg/m³, max monthly average)	Recent air	114
	Other	25
	Total	140
Alternative NAAQS 4 (0.05 µg/m³, max monthly average)	Recent air	47
	Other	41
	Total	88

For the air-only regression-based model, the indoor dust (other) portion of the indoor dust Pb concentration estimate is the intercept (60 µg/g) and the indoor dust (recent air) portion is the slope of the function multiplied by the ambient air concentration. The indoor dust (recent air), indoor dust (other), and indoor dust (total) estimates for the air-only regression-based model are provided in Exhibit C-8 below.

Exhibit C-8. Estimated Annual Indoor Dust Pb Concentrations from the Air-Only Regression-Based Model for the Air Quality Scenarios

Air Quality Scenario	Indoor Dust Pb Sources	Dust Pb Concentration (µg/g)
Current conditions (95th percentile)	Recent air	97
	Other	60
	Total	157
Current conditions (mean)	Recent air	47
	Other	60
	Total	107
Current NAAQS (1.5 µg/m^3, max quarterly average)	Recent air	506
	Other	60
	Total	566
Alternative NAAQS 1 (0.2 µg/m^3, max quarterly average)	Recent air	68
	Other	60
	Total	128
Alternative NAAQS 2 (0.5 µg/m^3, max monthly average)	Recent air	106
	Other	60
	Total	166
Alternative NAAQS 3 (0.2 µg/m^3, max monthly average)	Recent air	42
	Other	60
	Total	102
Alternative NAAQS 4 (0.05 µg/m^3, max monthly average)	Recent air	11
	Other	60
	Total	71

REFERENCES

Adgate, J. L.; Rhoads, G. G.; Lioy, P. J. (1998) The Use of Isotope Ratios to Apportion Sources of Lead in Jersey City, NJ, House Dust Wipe Samples. Sci. Total Environ. 221(2-3): 171-180.

Bornschein, R. L.; Succop, P. A.; Krafft, K. M.; Clark, C. S.; Peace, B.; Hammond, P. B. (1987) Exterior Surface Dust Lead, Interior House Dust Lead and Childhood Lead Exposure in an Urban Environment. Vol. 20: 322-332. Columbia, MO: Trace Substances in Environmental Health. Proceedings of University of Missouri's 20th Annual Conference. Conference in Trace Metals in Environmental Health.

Chirenje, T.; Ma, L. Q.; Reeves, M.; Szulczewski, M. (2004) Lead Distribution in Near-Surface Soils of Two Florida Cities: Gainesville and Miami. Geoderma. 119(2): 113-120.

Elhelu, M. A.; Caldwell, D. T.; Hirpassa, W. D. (1995) Lead in Inner-City Soil and Its Possible Contribution to Children's Blood Lead. Arch. Environ. Health. 50(2): 165-169.

Gasana, J.and Chamorro, A. (2002) Environmental Lead Contamination in Miami Inner-City Area. J. Expo. Anal. Environ. Epidemiol. 12(4): 265-272.

Johnson, D. L. and Bretsch, . J. K. (2002) Soil Lead and Children's Blood Lead Levels in Syracuse, NY, USA. Environmental Geochemistry and Health. 24: 375-385.

Kassa, H.; Bisesi, M. S.; Khuder, S. A.; Park, P. C. (2000) Assessment of a Lead Management Program for Inner-City Children. Environmental Health. 15-19.

Khandker, E. H.and Friedman, G. M. (2000) Geochemical Study of Trace Metals in Soils of New York City Parks. Nothern Geology and Environmental Sciences. 22: 50-88.

Lejano, R. P.and Ericson, J. E. (2005) Tragedy of the Temporal Commons: Soil-Bound Lead and the Anachronicity of Risk. Journal of Environmental Planning and Management. 48(2): 301-320.

Liberti, M.and Pichtel, J. (1997) Spatial Distribution of Trace Metals in Delaware County, Indiana, Surface Soils. Proceedings of the Indiana Academy of Science. 106: 233-245.

Long, T.; Johnson, T.; Laurenson, J.; Rosenbaum, A. (2004) Development of Penetration and Proximity Microenvironment Factor Distributions for the HAPEM5 in Support of the 1999 National-Scale Air Toxics Assessment (NATA). Memorandum prepared for Ted Palma, U.S. EPA, Office of Air Quality Planning and Standards (OAQPS); April 5.

Mielke, H. W. (1994) Lead in New Orleans Soils: New Images of an Urban Environment. Environmental Geochemistry and Health. 16: 123-128.

Sheets, R. W.; Kryger, J. R.; Biagioni, R. N.; Probst, S.; Boyer, R.; Barke, K. (2001) Relationship Between Soil Lead and Airborne Lead Concentrations at Springfield, Missouri, USA. Science of Total Environment. 271: 79-85.

Shinn, N. J.; Bing-Canar, J.; Cailas, M.; Peneff, N.; Binns, H. J. (2000) Determination of Spatial Continuity of Soil Lead Levels in an Urban Residential Neighborhood. Environmental Research. 82(Section A): 46-52.

Succop, P.; Clark, S.; Tseng, C.-Y.; Bornschein, R.; Chen, M. (2001) Evaluation of Public Housing Lead Risk Assessment Data. Environmental Geochemistry and Health. 23: 1-15.

Sutherland, R. A. (2000) Depth Variation in Copper, Lead, and Zinc Concentrations and Mass Enrichment Ratios in Soils of an Urban Watershed. J. Environ. Qual. 29: 1414-1422.

Sutherland, R. A.and Tolosa, C. A. (2001) Variation in Total and Extractable Elements With Distance From Roads in an Urban Watershed, Honolulu, Hawaii. Water, Air, and Soil Pollution. 127(4): 315-338.

Sutherland, R. A.; Tolosa, C. A.; Tack, F. M. G.; Verloo, M. G. (2000) Characterization of Selected Element Concentrations and Enrichment Ratios in Background and Anthropogenically Impacted Roadside Areas. Archives of Environmental Contamination and Toxicology. 38: 428-438.

Teichman, J.; Coltrin, D.; Prouty, K.; Bir, W. A. (1993) A Survey of Lead Contamination in Soil Along Interstate 880, Alameda County, CA. American Industrial Hygiene Association Journal. 54(9): 557-559.

Tiechman, J.; Coltrin, D.; Prouty, K.; Bir, W. A. (1993) A Survey of Lead Contamination in Soil Along Interstate 880, Alameda County, CA. American Industrial Hygiene Association Journal. 54(9): 557-559.

Tong, S. T. (1990) Roadside Dusts and Soils Contamination in Cincinnati, Ohio. Environmental Management. 14(1): 107-114.

Turer, D.; Maynard, J. B.; Sansalone, J. J. (2001) Heavy Metal Contamination in Soils of Urban Highways: Comparison Between Runoff and Soil Concentrations at Cincinnati, Ohio. Water, Air, and Soil Pollution. 132: 293-314.

Turer, D. G.and Maynard, J. B. (2003) Heavy Metal Contamination in Highway Soils. Comparison of Corpus Christi, Texas and Cincinnati, Ohio Shows Organic Matter Is Key to Mobility. Clean Technologies and Environmental Policy. 4(4): 235-245.

U.S. Environmental Protection Agency (USEPA). (1993a) Urban Soil Lead Abatement Demonstration Project. Vol. IV. Cincinnati Report. EPA/600/AP-93/001d. Washington, DC: Office of Research and Development; July.

U.S. Environmental Protection Agency (USEPA). (1993b) Urban Soil Lead Abatement Demonstration Project. Volume II. Part 2. Boston Report. EPA/600/AP-93/001b. Research Triangle Park, NC: Office of Research and Development; July.

U.S. Environmental Protection Agency (USEPA). (1993c) Urban Soil Lead Abatement Demonstration Project. Volume III. Part 1. Baltimore Report. EPA/600/AP-93/001c. Research Triangle Park, NC: Office of Research and Development; July. Available online at: http://www.epa.gov/oppt/lead/pubs/es_con.htm.

U.S. Environmental Protection Agency (USEPA). (1996) Urban Soil Lead Abatement Demonstration Project. Volume 1: EPA Integrated Report. EPA/600/P-93/001aF. Washington, DC: Office of Research and Development; April.

U.S. Environmental Protection Agency (USEPA). (2000) Hazard Standard Risk Analysis Supplement - TSCA Section 403: Risk Analysis to Support Standards to Lead in Paint, Dust, and Soil: Supplemental Report. EPA 747-R-00-004. Available online at: http://www.epa.gov/lead/pubs/403risksupp.htm.

U.S. Environmental Protection Agency (USEPA). (2006a) 1999 National-Scale Air Toxics Assessment. Available online at: http://www.epa.gov/ttn/atw/nata1999/nsata99.html.

U.S. Environmental Protection Agency (USEPA). (2006b) 1999 National-Scale Air Toxics Assessment. Available online at: http://www.epa.gov/ttn/atw/nata1999/nsata99.html.

U.S. Environmental Protection Agency (USEPA). (2007) Air Quality System (AQS) Database. Available online at: http://www.epa.gov/ttn/airs/airsaqs/aqsweb/aqswebwarning.htm.

Westat Inc. (1995) Report on the National Survey of Lead-Based Paint in Housing, Base Report. US Environmental Protection Agency (USEPA) and HUD; June.

Westat Inc. (1996) Distributions of Soil Lead in the Nation's Housing Stock. EPA 747-R-96-003. Washington, D.C.: Office of Pollution Prevention and Toxics; May.

Westat Inc. (2002) National Survey of Lead and Allergens in Housing. Volume I: Analysis of Lead Hazards. Final Report. Revision 7.1. Washington, D.C.: Office of Health Homes and Lead Hazard Control, U.S. Department of Housing and Urban Development.

July 25, 2007

Appendix D: Media Concentrations for the Primary Pb Smelter Case Study

Prepared by:

ICF International
Research Triangle Park, NC

Prepared for:

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina

Contract No. EP-D-06-115
Work Assignment No. 0-4

Table of Contents

List of Exhibits

List of Attachments

D. MEDIA CONCENTRATIONS FOR THE PRIMARY PB SMELTER CASE STUDY

This appendix discusses methods, results, limitations, and uncertainties associated with the estimation of environmental media concentrations for the primary lead (Pb) smelter case study included in the human exposure and health risk assessments. These media concentrations were estimated using a combination of modeling approaches and monitoring data. Estimates presented in this appendix are specified with regard to number of decimal places, which results in various numbers of implied significant figures. This is not intended to convey greater precision for some estimates than others; it is simply an expedient and initial result of the software used for the calculation. Greater attention is given to significant figures in the presentation of estimates in the main body of the report.

For this analysis, five air quality scenarios were evaluated, including attainment of the current National Ambient Air Quality Standard (NAAQS) and four possible alternative standards, as described below:

- Attainment of air concentration of 1.5 microgram per cubic meter ($\mu g/m^3$), based on a maximum calendar quarter average (i.e., current NAAQS scenario);
- Attainment of air concentration of 0.2 $\mu g/m^3$, based on a maximum calendar quarter averaging period;
- Attainment of air concentration of 0.5 $\mu g/m^3$, based on a maximum monthly averaging period;
- Attainment of air concentration of 0.2 $\mu g/m^3$, based on a maximum monthly averaging period; and
- Attainment of air concentration of 0.05 $\mu g/m^3$, based on a maximum monthly averaging period.

This analysis focused on three primary environmental media and their exposure concentrations: ambient air, indoor dust, and outdoor soil/dust. Estimated inhalation and indoor dust exposure concentrations differed for the five air quality scenarios because they both were based, at least in part, on the estimated ambient air concentrations, which varied across scenarios. The outdoor soil/dust exposure concentrations estimated for the current NAAQS scenario were also used for the alternative NAAQS scenarios (i.e., it was assumed that reductions in ambient air concentrations associated with the alternative NAAQS scenarios did not have a significant impact on soil concentrations).[1] The approaches used and estimated exposure concentrations for air, outdoor soil, and indoor dust are described in the remainder of this appendix.

D.1. SPATIAL TEMPLATE

The outer boundary of the study area for the primary Pb smelter case study was set to approximately 10 kilometers (km), which was expected to capture the population experiencing the most significant impacts of the facility's emissions, while recognizing limitations of the modeling tools, demands of associated ("downstream") analyses, and available time and resources.[2]

The 29 U.S. Census block groups that are predominantly within 10 km of the facility were selected to define the spatial extent of the study area (U.S. Census Bureau, 2005). Because of the irregular shape of block groups, not all of the block groups that overlap with the 10-km radius around the facility were included, and some that were included have portions falling outside this 10-km radius. Block groups falling along the 10-km radius were generally included if most of their area fell within the radius. All U.S. Census block centroids within these 29 block groups were included as receptors in the air dispersion model runs (i.e., air model results were output for each U.S. Census block centroid). There are 1,321 U.S. Census blocks within these block groups. Of these U.S. Census blocks, 14 were located either within facility boundaries or adjacent to the facility in the Mississippi River.[3] These 14 U.S. Census blocks were removed from the assessment. A total of 1,307 U.S. Census block centroids were included as receptors in the air dispersion model simulations, including blocks within the study area with zero population. The U.S. Census blocks with no children under age seven were included in the

---

[1] Derivation of outdoor soil/dust estimates for the current NAAQS scenario is further discussed in Section D.3.

[2] Previous analyses of modeled air concentrations of Pb from the primary Pb smelter performed using the pilot assessment scenario indicated a potential contribution from the smelter to air concentrations at distances of more than 50 km (ICF, 2006). Within 10 km, however, air Pb concentrations estimated in the pilot assessment were reduced by 0.43 percent for U.S. Census blocks and block groups with at least one child under the age of seven years from the highest concentrations predicted outside the primary Pb smelter property. Although this assessment utilized a different set of emissions data than the pilot assessment, the overall trends in air Pb concentrations are expected to be similar. See Appendix M for a discussion of sources of uncertainty associated with this assessment.

[3] All territory in the United States is delineated into U.S. Census blocks (U.S. Census Bureau, 2005). Therefore, large water bodies like the Mississippi River often contain U.S. Census blocks, although there is no population associated with these blocks.

modeling simulations to aid in understanding the patterns of air concentrations in the study area. These locations, however, were not included in the exposure assessment and are not included in exhibits summarizing modeling results (with the exception of isopleths diagrams), because the exposure assessment focuses on the effects of Pb in children under age seven. The elevation of each block centroid was generated using U.S. Geological Survey (USGS) digital elevation model files (U.S. Department of the Interior U.S. Geological Survey, 1993) and the AERMAP preprocessor model (USEPA, 2004).

For purposes of efficiency (i.e., to provide sufficient spatial resolution to capture significant concentration gradients, while minimizing the number of computations required for estimating other media concentrations, blood Pb (PbB) levels, and associated risks), the spatial template for primary Pb smelter case study is a combination of block-level results in areas of larger air Pb concentration gradients and block group-level results in areas of more gradual changes in air Pb concentrations. The spatial template used here was developed in the pilot assessment. In the pilot assessment, the annual average concentration in each block group was calculated by spatially weighting estimates derived at the block level from the pilot analysis modeling scenario. The area of each block was obtained from the U.S. Census Bureau (2005). The decision of whether to include the block or block group in the spatial template was made by considering the range of block-level concentrations within a block group (see Exhibit D-1). If the ratio of the maximum block-level air concentration in the block group to the mean annual average air concentration in the block group was greater than 2.0, the individual U.S. Census blocks in the block group were included. Otherwise, the full block group was included. This method generally resulted in assessment at the block level near the facility. Some U.S. Census blocks located far from the facility that fall within very large block groups were also evaluated individually. A total of 22 U.S. Census block groups and 115 U.S. Census blocks (all with at least one child under seven years of age) comprise the spatial template for the primary Pb smelter case study (see Exhibit D-2).

Exhibit D-1. Ratios of the Maximum-to-Mean Block-level Annual Average Air Concentrations in each Block Group

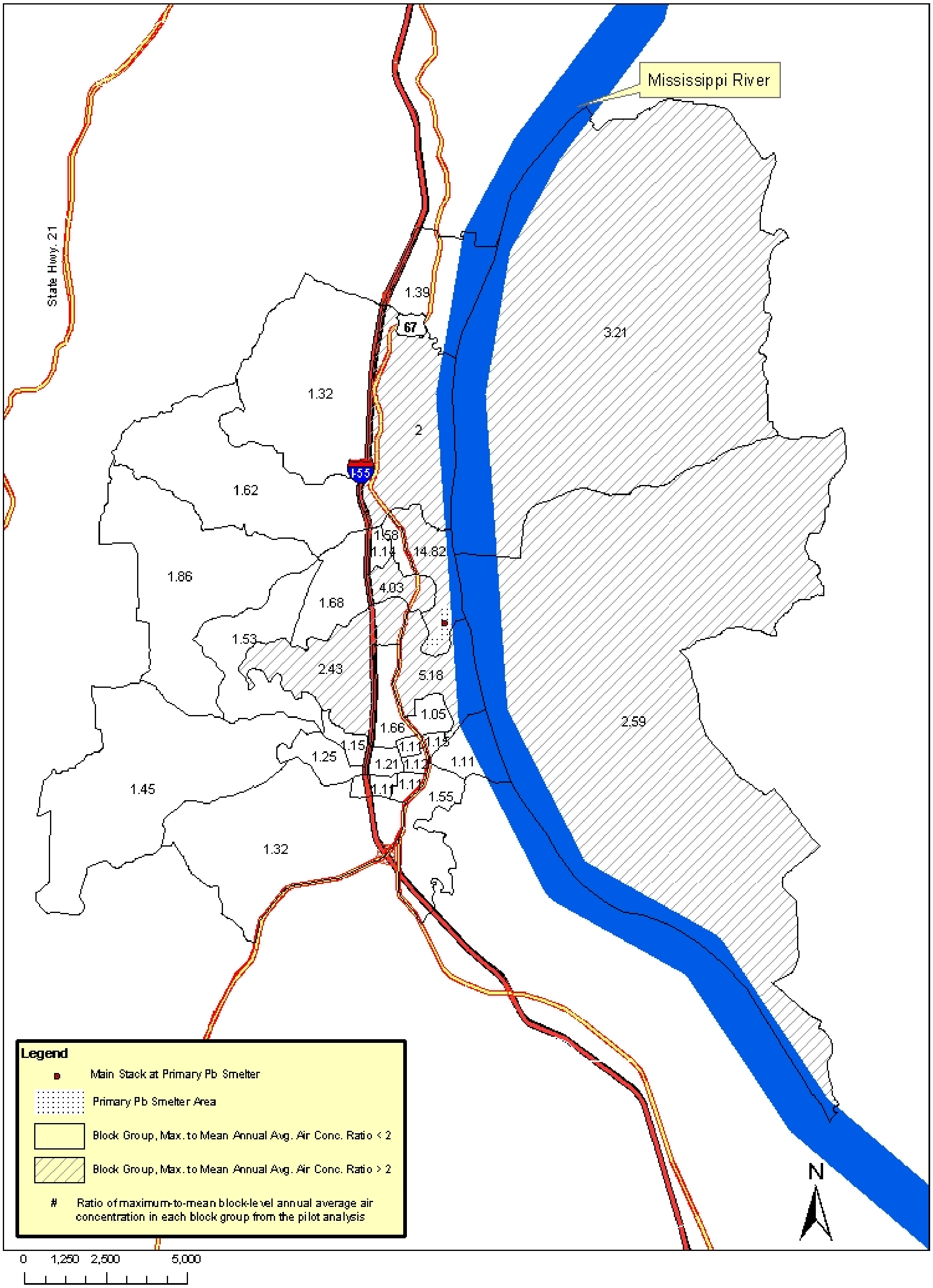
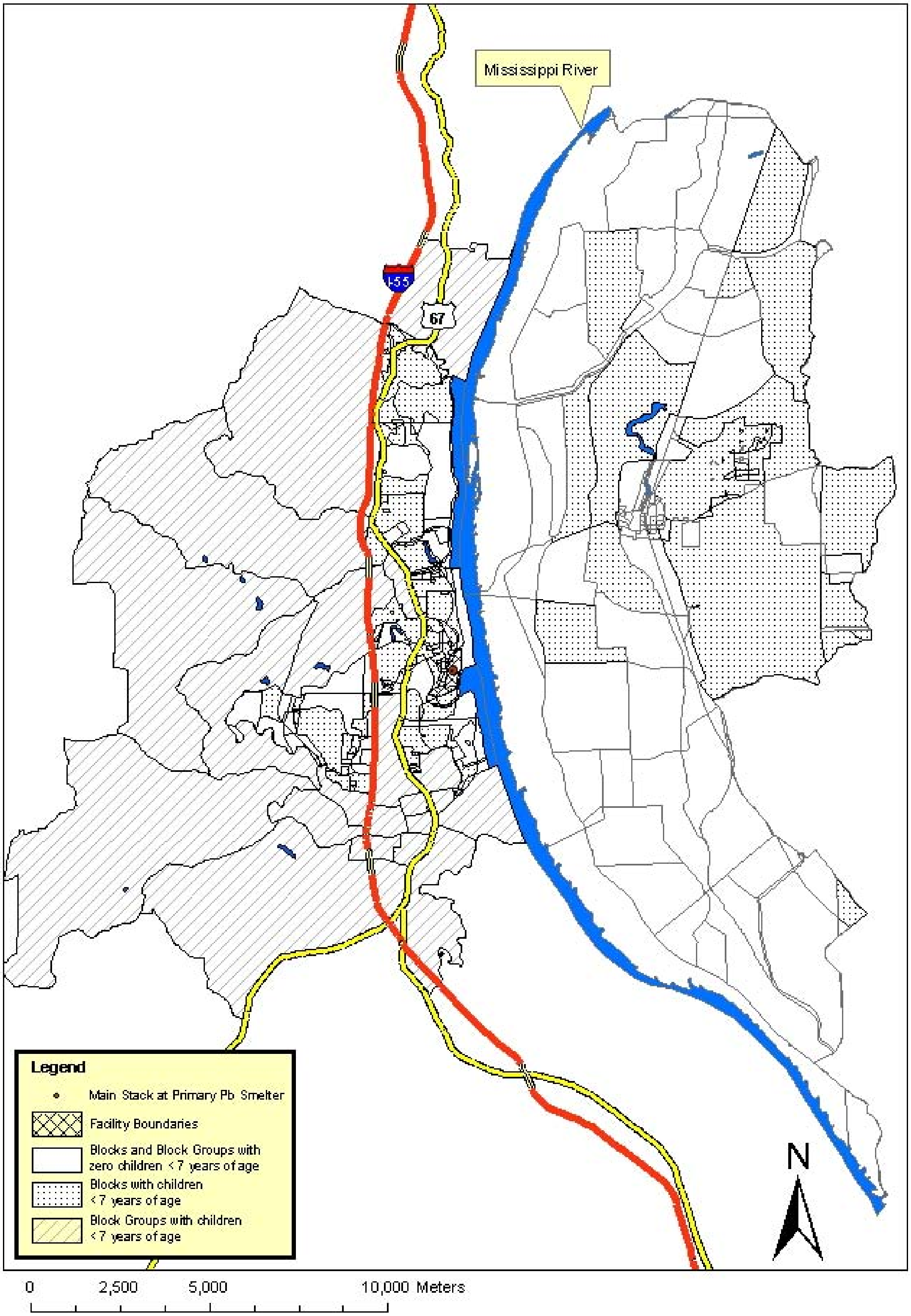


Exhibit D-2. Spatial Template for the Primary Pb Smelter Case Study (Including U.S. Census Blocks and Block Groups with Children under the Age of Seven)



D.2. AIR

The air concentrations of Pb resulting from emissions at the primary Pb smelter facility were estimated using the ISC-PRIME air dispersion model (USEPA, 1995; Schulman et al., 1997), as described in Section D.2.1. The outputs from this modeling were processed to estimate air concentrations for each air quality scenario as described in Section D.2.2. These air concentrations were used to estimate inhalation exposure concentrations (as described in Section D.2.3) and as inputs to the calculation of indoor dust concentrations (as described in Section D.4). Model performance analysis is described in Section D.2.4.

D.2.1. Air Dispersion Modeling

Air dispersion modeling for this case study (for the current NAAQS scenario) relied on the model and the emissions and source parameters used in developing the 2007 proposed revision to the State Implementation Plan for the primary Pb smelter (Missouri Department of Natural Resources (MDNR), 2007; 2007). The air dispersion model ISC-PRIME was used for the air quality modeling. The meteorological data used for the model simulations included 24 consecutive months (April 1, 1997, to March 31, 1999) of on-site data.[4] These meteorological data were also used for the analysis of model performance submitted with the proposed revision to the SIP (MDNR, 2007). Emissions, release parameters, particle size parameters, and building downwash inputs were all provided by U.S. EPA Region 7 in the form of an input runstream file (USEPA, 2007). All of the inputs used in this modeling are presented in Attachments D-1 through D-6. Monthly average air concentrations were output from the dispersion model at each receptor (i.e., block or block group, as described in Section D.1) and Pb-TSP monitor location (see Appendix B). Use of these air concentrations in the current NAAQS scenario, and derivation of air concentrations for the alternative NAAQS scenarios is described in Section D.2.2.

---

[4] Although air quality modeling guidance generally suggests that five consecutive years of meteorological data be used for modeling annual average air concentrations, in the primary Pb smelter case study, 24 consecutive months of on-site meteorological data were used for modeling Pb concentrations at receptor locations. The use of on-site meteorological data, even with coverage of less than five years, was considered preferable to the use of meteorological data from the nearest National Weather Service station, which is located in St Louis, Missouri approximately 31 miles (50 km) from the facility, because they are much more likely to capture local meteorological conditions. Note, however, that the use of two years of meteorological data limits the ability of this assessment to fully capture year-to-year variability in meteorological conditions.

D.2.2. Air Concentrations

The monthly air concentration model results calculated at the centroid of each U.S. Census block group, block, and monitor receptor point for the 137 U.S. Census blocks or block groups with at least one child under seven years of age, generated as described in Section D.2.1, were averaged over both years of the modeling period to generate one set of representative annual average air concentrations for the current NAAQS scenario.

To confirm that the estimated air concentrations for this scenario were at or below the current NAAQS standard, the concentrations were also averaged quarterly and compared to the current NAAQS (1.5 $\mu g/m^3$, max quarterly average). None of the modeled quarterly averaged Pb air concentrations exceeded the current NAAQS; therefore, annual averages for the current NAAQS scenario were calculated directly from the model results (see Exhibit D-3).

Monthly and quarterly averages were also compared to four alternative NAAQS scenarios including: maximum monthly average alternative scenarios of 0.5 $\mu g/m^3$, 0.2 $\mu g/m^3$, and 0.05 $\mu g/m^3$; and one maximum quarterly alternative scenario of 0.2 $\mu g/m^3$. For these alternative scenarios there were several modeled U.S. Census blocks which did not meet the alternative NAAQS, in which case a ratio was developed from the maximum monthly or quarterly averaged value and the alternative NAAQS. This roll-back factor was then applied to scale down the concentrations at each of the 1,307 receptors and a new combined annual average was calculated from the scaled data set (i.e., a proportional rollback of all modeled locations was implemented). These 1,307 receptors were narrowed down to the 137 U.S. Census blocks and block groups included in the exposure assessment by (1) spatially weighting and averaging results for all blocks within each block group selected (see Section D.1) and (2) removing all blocks with no children under the age of seven.

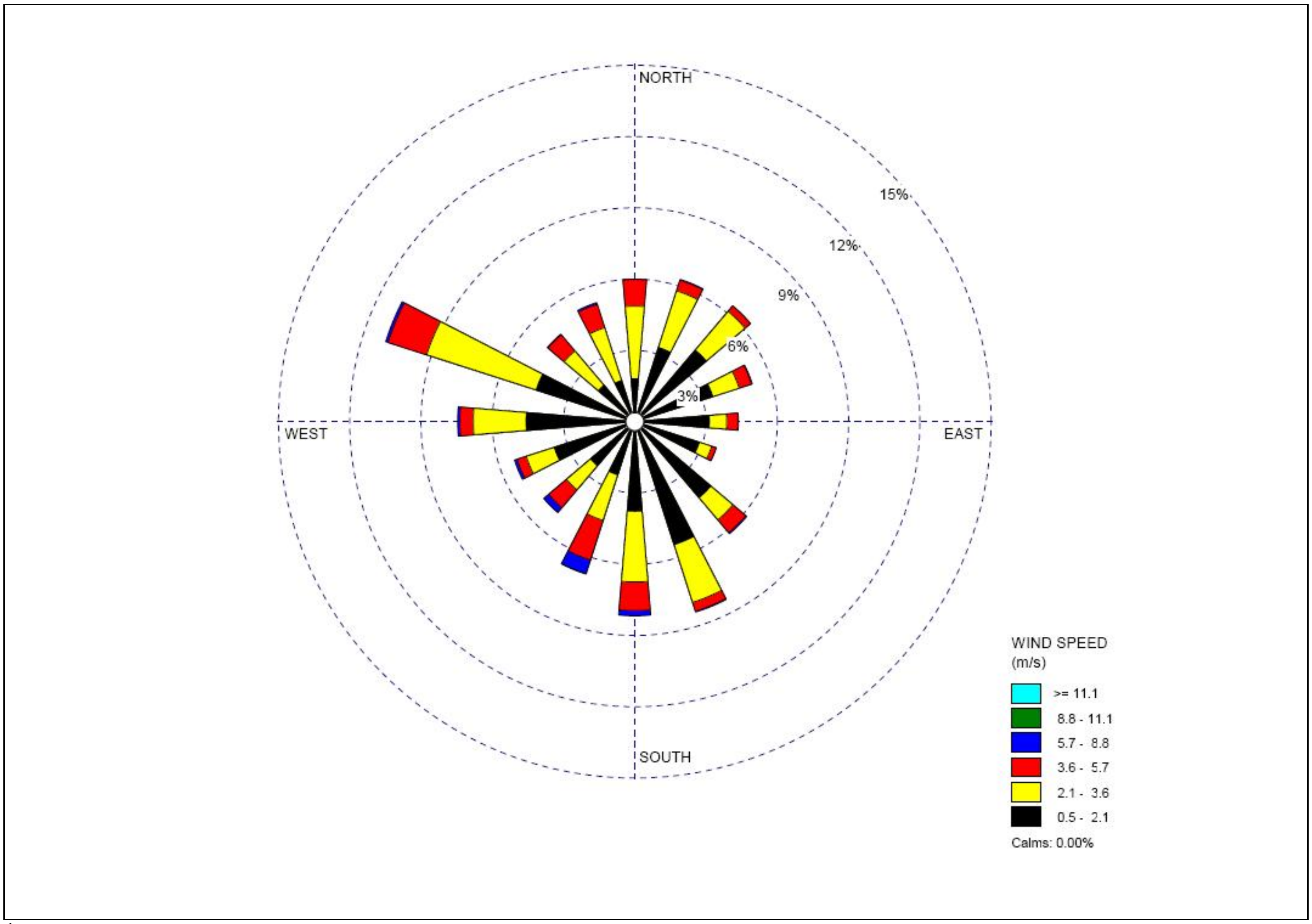
The air concentration estimates modeled for the 137 U.S. Census blocks and block groups with at least one child under seven years of age are presented in Attachments D-7 through D-11 for all scenarios. Exhibit D-3 presents the distribution of annual average Pb concentrations associated with the five NAAQS scenarios. A wind rose created from 24 consecutive months (April 1, 1997 to March 31, 1999) of on-site meteorological data at the primary Pb smelter shows that the predominant direction in which the wind is blowing from is the west and south (see Exhibit D-4). Exhibit D-5 shows the isopleths of the block-level modeled air concentration results for all 1,307 U.S. Census blocks modeled using the air dispersion model.

Exhibit D-3. Annual Average Air Concentrations for the Primary Pb Smelter Case Study

Statistic [b]	Average Annual Pb Air Concentration (µg/m^3) [a]				
	Current NAAQS Scenario	Alternative NAAQS Scenario			
		1 0.2 µg/m^3, Max Quarterly	2 0.5 µg/m^3, Max Monthly	3 0.2 µg/m^3, Max Monthly	4 0.05 µg/m^3, Max Monthly
Maximum	0.7	0.2	0.3	0.1	0.03
95th Percentile	0.4	0.09	0.2	0.07	0.02
Median	0.1	0.01	0.03	0.01	3.0E-03
5th Percentile	0.01	2.8E-03	5.6E-03	2.2E-03	5.6E-04
Minimum	5.8E-03	1.3E-03	2.5E-03	1.0E-03	2.5E-04

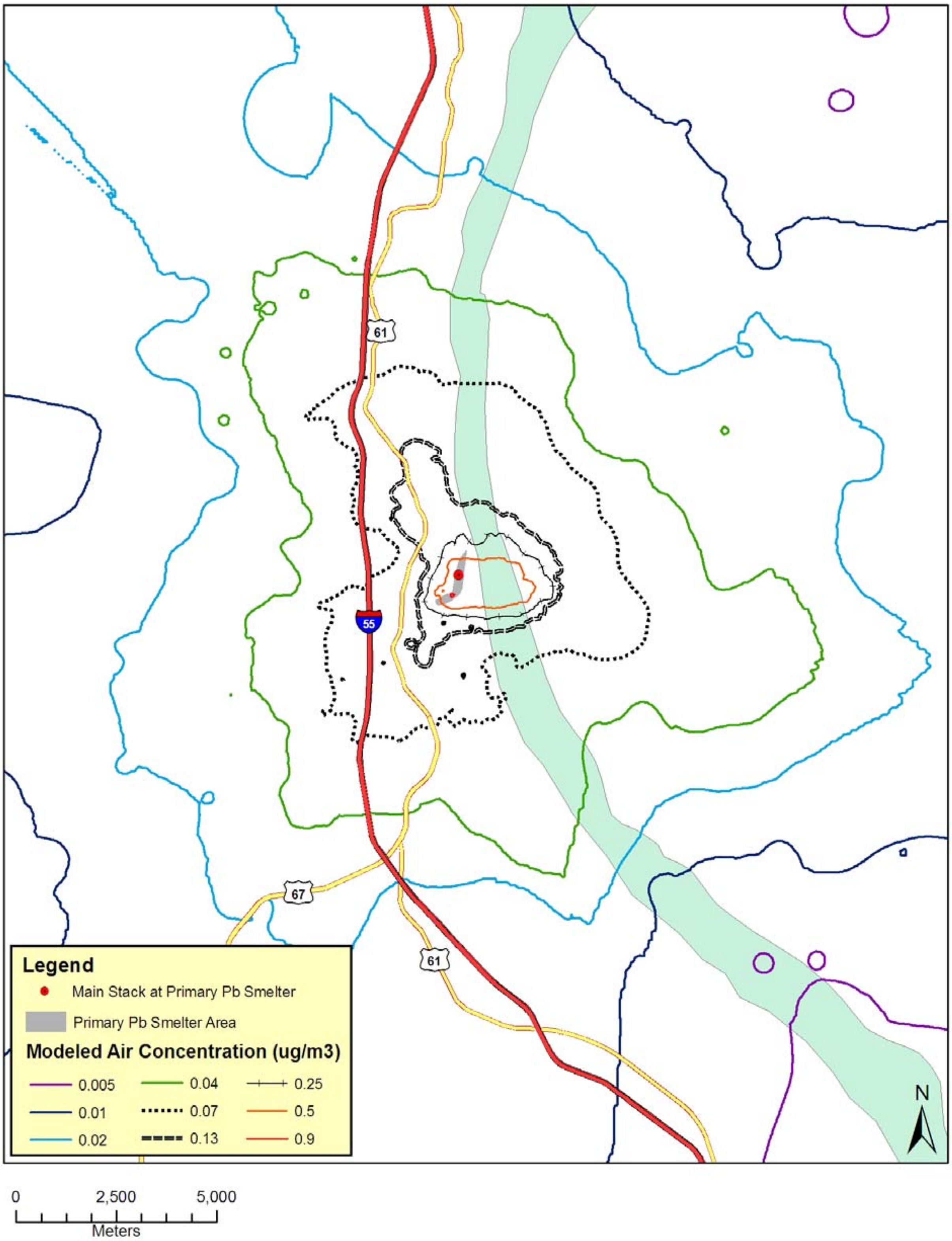
[a] The 137 U.S. Census blocks and block groups with at least one child under the age of seven were used to create this summary.
[b] The statistic (e.g., 95th percentile, median) may not be at the same location for each of the data results presented here.

Exhibit D-4. Wind Rose of Meteorological Data used for Primary Pb Smelter Case Study (Direction from which Wind is Blowing)



Note: Wind rose from 24 consecutive months (April 1, 1997 to March 31, 1999) of on-site meteorological data at the primary Pb smelter (17,520 hours of data).

Exhibit D-5. Annual Average Air Concentration Isopleths for the Current NAAQS Scenario for the Primary Pb Smelter Case Study



D.2.3. Inhalation Exposure Concentrations

Inhalation exposure concentrations of Pb were estimated for the population of interest (young children) from the estimated ambient air concentrations using age group- and location-specific relationships for Pb developed from modeling the U.S. EPA 1999 National-scale Air Toxics Assessment (USEPA, 2006), one of the U.S. EPA's National Air Toxics Assessment (NATA) activities. These relationships account for air concentration differences indoors and outdoors, as well as for mobility or time spent in different locations (e.g., outdoors at home, inside at home, etc.) for the population of interest.

The U.S. EPA 1999 National-scale Air Toxics Assessment produced air concentrations of Pb (and other hazardous air pollutants [HAPs]) for each U.S. Census tract (using the Assessment System for Population Exposure Nationwide model [ASPEN]), and corresponding exposure concentrations of Pb for each of five age-groups at each U.S. Census tract (using the Hazardous Air Pollutant Exposure Model [HAPEM]). The relationships (or ratios) between ambient air Pb concentration and Pb inhalation exposure concentration from the U.S. EPA's 1999 National-scale Air Toxics Assessment for the 0 to 4 age group (the closest age group for which outputs are available to the age group of interest for this assessment) ranged from 0.37 to 0.42 for the U.S. Census tracts within the study area for the primary Pb smelter case study. The ratios are presented in Exhibit D-6. It was assumed that these U.S. Census tract specific ratios provided a reasonable approximation of the ratios for the U.S. Census blocks and block groups contained within each tract. The resulting distribution of annual average inhalation exposure concentrations associated with the five air quality scenarios is presented in Exhibit D-7.

Exhibit D-6. Ratios of Inhalation Exposure Concentrations to Ambient Air Concentrations from the NATA National-scale Air Toxics Assessment

U.S. Census Tract ID	Inhalation Exposure Concentration: Ambient Air Concentration
17133600200	0.40
17133600300	0.39
29099700104	0.40
29099700601	0.42
29099700603	0.40
29099700605	0.38
29099700700	0.41
29099700800	0.40
29099700900	0.37
29099701000	0.39

Use of ratios for the 0 to 4 age group (rather than for 0 to 7) contributes some uncertainty in the estimate of children's inhalation exposure concentrations. In addition, there is some uncertainty in the magnitude of the air concentrations generated using the ASPEN model for the U.S. EPA's 1999 National-scale Air Toxics Assessment (USEPA, 2006). In a comparison to monitoring data across the country, the ASPEN-modeled air concentrations generally underestimated monitored concentrations (USEPA, 2006; Section on Comparison to Monitored Values). However, the relationship between ambient air concentrations and inhalation exposure concentrations (i.e., the comparison used here) is not expected to be affected by underestimated ambient air concentrations from the U.S. EPA's 1999 National-scale Air Toxics Assessment (see Exhibit D-7. In addition, some of the exposure modeling inputs used in the NATA simulations were not specific to Pb and thus may introduce additional uncertainties. For example, the penetration factor, which is used to estimate the fraction of the pollutant in outdoor air that reaches indoor air, used for Pb in the NATA assessment is based on a study that examined the penetration of hexavalent chromium particles, which are generally more reactive than Pb particles (Long et al., 2004).

Exhibit D-7. Annual Average Inhalation Exposure Concentrations for the Primary Pb Smelter Case Study

Statistic [b]	Annual Average Pb Inhalation Exposure Concentration (µg/m³) [a]				
	Current NAAQS Scenario	Alternative NAAQS Scenario			
		1 0.2 µg/m³, Max Quarterly	2 0.5 µg/m³, Max Monthly	3 0.2 µg/m³, Max Monthly	4 0.05 µg/m³, Max Monthly
Maximum	0.3	0.1	0.1	0.1	0.01
95th Percentile	0.2	0.04	0.08	0.03	7.8E-03
Median	0.03	5.9E-03	0.01	4.8E-03	1.2E-03
5th Percentile	5.0E-03	1.1E-03	2.2E-03	8.8E-04	2.2E-04
Minimum	2.3E-03	5.0E-04	1.0E-03	4.1E-04	1.0E-04

[a] The 137 U.S. Census blocks and block groups with at least one child under the age of seven were used to create this summary.
[b] The statistic (e.g., 95th percentile, median) may not be at the same location for each of the data results presented here.

D.2.4. Air Modeling Performance Evaluation

The results from the air Pb modeling performed for the primary Pb smelter case study in this assessment were not compared directly to available monitoring data because they represent facility conditions (e.g., emissions) that do not currently exist (as discussed in Appendix B). Instead, this performance evaluation relied on an "actual value" analysis conducted by the primary Pb smelter case study facility and reviewed by the State of Missouri, which used the 2007 proposed SIP modeling configuration, but replaced the hypothetical facility conditions with “actual values.” This actual value modeling conducted by the primary Pb smelter case study facility included three separate evaluations comparing model predictions to measured Pb concentrations at five monitor sites in the primary Pb smelter case study area. These comparisons included:

- ***Day-to-day evaluation of modeling output compared to monitor values***. The review of the model performance evaluation conducted by the State of Missouri concluded that all sites demonstrated a pattern of overall accuracy for directional prediction (i.e., high modeled days were high monitored days and low modeled days were low monitored days), suggesting that the model was performing well in relating wind direction to Pb transport (MDNR, 2007).
- ***Source contribution analysis***. Significant sources of Pb for each monitor (e.g., in-plant roads and yard dust, blast furnace) were identified using chemical mass balance (CMB) of monitor filter residue. The results of this analysis were compared with relative contributions predicted by the dispersion model for individual modeled sources. The review of the model performance evaluation concluded that there was generally good agreement between the CMB results and the air dispersion results in terms of major sources contributing Pb at each monitor (MDNR, 2007).
- ***Comparison of overall average modeled results with monitored Pb levels***. This performance evaluation involved comparing modeled results (for 247 days simulated for 2005) at six monitor locations with actual measured Pb values for that same period at those locations. Results of this evaluation suggested a slight over-prediction bias (<10 percent) for those sites likely to have the greatest impacts from the primary Pb smelter facility (MDNR, 2007).

This evaluation of model performance for the actual value modeling scenario increases confidence in estimates developed for the current NAAQS scenario using the 2007 proposed SIP revision modeling configuration.

D.3. OUTDOOR SURFACE SOIL

Outdoor surface soil concentrations were estimated from the soil sample measurements in the area for each spatial unit (i.e., U.S. Census blocks and block groups) with at least one child under seven years of age in the study area. The extent and types of soil data sets available for the calculations are described in Appendix B. The two data sets used here are the “pre-excavation” and “recontamination” data sets.

Many of the yards within 1.5 km of the primary Pb smelter facility have been excavated and filled with clean soil in the last 10 years. The U.S. EPA has taken soil samples from 31 of these sites on multiple occasions since 2002. These measurements are called "recontamination" samples. The U.S. EPA database also contains soil samples for more than 900 locations labeled as "pre-excavation." These samples were taken from November 2000 to August 2004 and were the basis for decisions on soil replacement in those locations.[5] The sample depth for both data sets is less than an inch (in) (USEPA, 2001). Depending on the location of the modeled block or block group in the study area (within or outside of the soil cleanup area), the soil concentrations for this assessment were calculated using either the recontamination or pre-excavation data set.

All U.S. Census blocks within the soil cleanup area (approximately 1.5 km) were identified from the Gradient Corporation report (Gradient Corporation, 2004). For these U.S. Census blocks with at least one child under the age of seven, soil concentrations were estimated from the recontamination soil samples taken in 2005. For U.S. Census blocks for which there were one or more soil measurements available, the block soil concentration was set to the average (arithmetic mean) of those measurements. For U.S. Census blocks for which there were no measurements, but for which there were nearby measurements (i.e., across the street), the soil concentration was set to the average of the nearby measurements. For other U.S. Census blocks, the average of all of the recontamination soil measurements within 500 meters (m) was calculated and set as the value for the block.

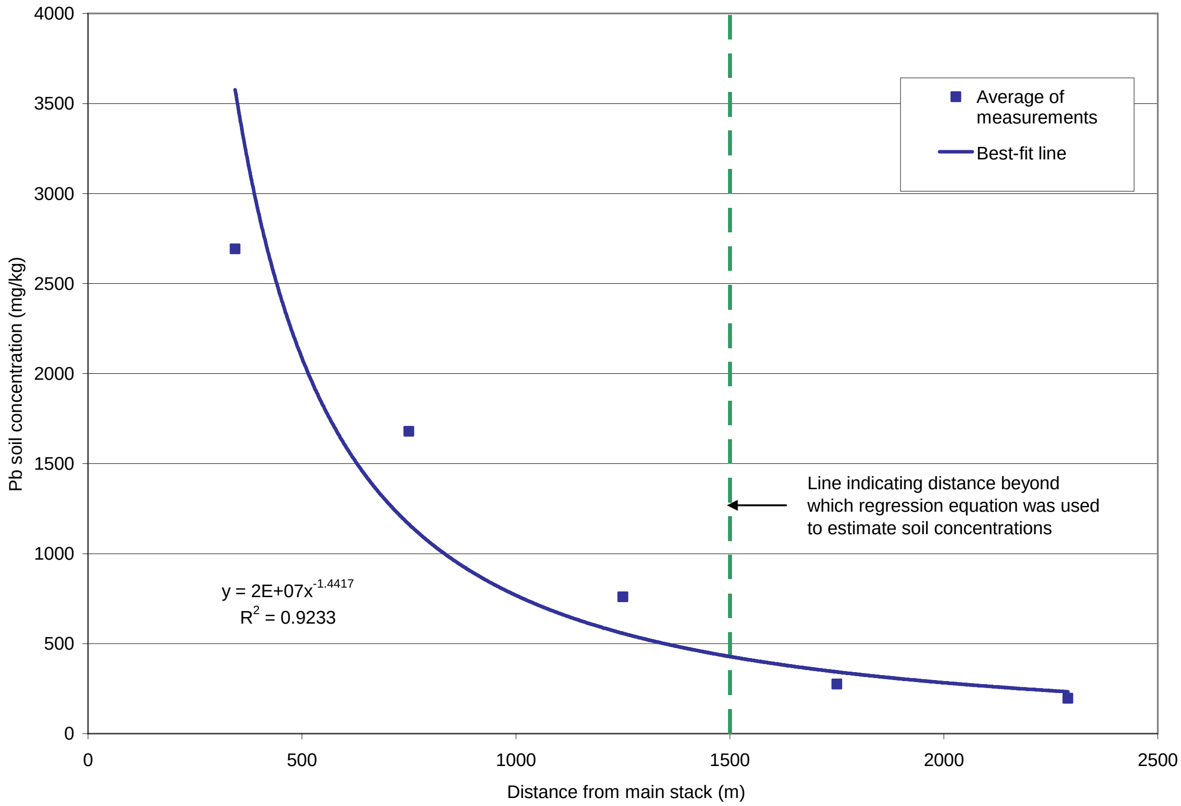
Outside of the soil cleanup area, soil concentrations were estimated using a regression equation of the pre-excavation soil concentrations. The distance of each pre-excavation soil sample to the main stack was measured using a geographical information system (GIS). The measurements were grouped according to distance from the main stack (used as a reference point for distance from the facility and its associated sources), with separate groups for each 500-m increment. The arithmetic mean for each group was calculated, resulting in five arithmetic mean average values for soil concentration, and these values were plotted versus distance from the facility. A regression power equation (R^2 of 0.92) was calculated from the samples (see Exhibit D-8). Note that pre-excavation soil samples taken within 1.5 km of the facility were included to develop the regression equation; however, the equation was not used to estimate soil concentrations at U.S. Census blocks within the 1.5-km soil clean-up area (as indicated in Exhibit D-8). The distance of each U.S. Census block and block group centroid from the main stack was measured in GIS. Soil concentrations for the U.S. Census blocks and block groups

---

[5] Based on these sample results a number of yards in locations within 1.5 km of the facility have been filled with clean soil.

outside the soil cleanup area were then calculated using the regression equations based on distance from the stack.

Exhibit D-8. Average Pre-excavation Soil Measurements and Best-fit Trend Line



All calculated soil concentrations used in the five scenarios for the 137 U.S. Census blocks and block groups with at least one child under seven years of age are summarized in Attachments D-7 through D-11 with an indication of which method was used to calculate the values. Note that due to the soil cleanup within 1.5 km of the stack, the soil Pb concentration estimates (consistent with soil measurements) near the facility are in some cases lower than those in the more distant locations. It is recognized that the estimated Pb concentrations within the remediation zone (i.e., within 1.5 km of the facility) likely underestimate the current contributions of the primary Pb smelter to outdoor soil/dust Pb concentrations as a result of continued recontamination of outdoor soil/dust near the facility. While this is source of uncertainty in the risk results (e.g., underestimating contribution from the outdoor soil/dust pathway close to the primary Pb smelter case study facility), the impact of this limitation on results is reduced by the selection of different indoor dust Pb prediction models for the two different parts of the study area. That is, in the locations within the soil cleanup area, the indoor dust Pb prediction model does not rely on soil Pb concentrations, while in locations outside of the soil cleanup area the indoor dust Pb prediction model does take soil Pb concentrations into account (see Section D.4 and Appendix G for more details).

D.4. INDOOR DUST

For estimating indoor dust concentrations for residences in the primary Pb smelter case study, two dust prediction models were used.

- For locations within 1.5 km of the facility: a site-specific regression model that predicts indoor dust Pb concentration as a function of air concentration (referred to as H6 model in Attachments D-7 through D-11) is used.
- For locations more than 1.5 km away from the facility, a regression model (based on data from communities near various Pb point sources) that predicts Pb dust concentrations given soil and air concentrations (referred to as the air+soil regression-based model) is used (USEPA, 1989).

For a more detailed explanation of these indoor Pb dust concentration prediction models see Appendix G.

Exhibit D-9 presents a summary of the Pb indoor dust concentrations generated in the primary Pb smelter case study for the five different air quality scenarios. Exhibit D-9 also shows the number of children residing in areas associated with different estimates of Pb indoor dust concentration. All estimated indoor dust Pb concentrations for residences with at least one child under seven years of age in the primary Pb smelter case study are presented in Attachments D-7 through D-11.

Exhibit D-9. Modeled Indoor Dust Pb Concentrations for the Primary Pb Smelter Case Study

Indoor Dust Pb Concentration (µg/g)	Number of U.S. Census Blocks/ Block Groups with Indoor Dust Pb Concentrations Greater than Value in First Column [a]					Number of Children Living in Area with Indoor Dust Pb Concentrations Greater than Value in First Column [b]				
	Current NAAQS Scenario	Alternative NAAQS Scenario				Current NAAQS Scenario	Alternative NAAQS Scenario			
		1 0.2 µg/m^3, Max Quarterly	2 0.5 µg/m^3, Max Monthly	3 0.2 µg/m^3, Max Monthly	4 0.05 µg/m^3, Max Monthly		1 0.2 µg/m^3, Max Quarterly	2 0.5 µg/m^3, Max Monthly	3 0.2 µg/m^3, Max Monthly	4 0.05 µg/m^3, Max Monthly
30	137	137	137	137	137	3,880	3,880	3,880	3,880	3,880
50	129	111	122	108	102	3,845	3,481	3,661	2,731	2,672
100	81	56	63	56	52	1,646	884	965	884	876
500	25	13	24	11	0	103	41	98	39	0
1,000	24	4	11	0	0	98	8	39	0	0
3,000	4	0	0	0	0	8	0	0	0	0
5,000	0	0	0	0	0	0	0	0	0	0

[a] The 137 U.S. Census blocks and block groups with children ages 0 to 7 in the 2000 U.S. Census (U.S. Census Bureau, 2005) were used to develop this summary. Note that U.S. Census blocks without children were excluded.

[b] Number of children ages 0 to 7 from the 2000 U.S. Census were used in this analysis (U.S. Census Bureau, 2005).

The Pb indoor dust concentrations estimated for the five scenarios for this primary Pb smelter case study fall within the range presented by the U.S. EPA (1989) but they are not in the high-end of the range. Studies summarized in U.S. EPA (1989) contained measurements of house dust ranging from 10 to 35,000 parts per million (ppm). A high value of 100,000 ppm was measured in one home within 2 km of a Pb smelting facility (USEPA, 1989). In this case study, the maximum dust concentration of Pb predicted at a receptor location is 5,300 ppm at 300 m from the main stack of the primary Pb smelter. Exhibit D-10 presents a summary of the annual average indoor Pb dust exposure concentrations generated in the primary Pb smelter case study for the five different NAAQS scenarios.

In a study of Pb concentrations in household dust near a facility that has operated as a secondary Pb smelter since 1972 and as a primary smelter for the previous 200 years in the Czech Republic, Rieuwerts et al. (1999) measured indoor dust Pb concentrations in houses in a neighborhood adjacent to the facility (the neighborhood ranges from approximately 0 to 500 m away from the facility according to a figure). Measured Pb concentrations in household dust from 14 homes ranged from 861 to 5,890 ppm, with a geometric mean (GM) of 1,668 ppm. Indoor Pb dust concentrations predicted for this case study are similar, ranging from 1,500 to 5,300 ppm out to 500 m from the facility, with a GM of 3,100 ppm. (MDNR, 2007)

Exhibit D-10. Annual Average Indoor Pb Dust Exposure Concentrations for the Primary Pb Smelter Case Study

Statistic [b]	Annual Average Indoor Dust Pb Exposure Concentrations (μg/g) [a]					
	Current NAAQS Scenario	Alternative NAAQS Scenario				
		1 0.2 μg/m^3, Max Quarterly	2 0.5 μg/m^3, Max Monthly	3 0.2 μg/m^3, Max Monthly	4 0.05 μg/m^3, Max Monthly
Maximum	3522.9	1145.1	1925.9	980.8	382.8
95th Percentile	2318.2	753.5	1270.7	645.4	247.0
Median	121.7	83.3	94.9	81.7	76.1
5th Percentile	49.8	43.3	45.2	43.0	41.9
Minimum	41.3	38.3	39.2	38.2	37.7

[a] The 137 U.S. Census blocks and block groups with at least one child under the age of seven were used to create this summary.
[b] The statistic (e.g., 95th percentile, median) may not be at the same location for each of the data results presented here.

REFERENCES

Gradient Corporation. (2004) RAGS Part D Interim Deliverables Report for Community Risk Assessment; Herculaneum, Missouri (Draft). Prepared for the Don Run Company; October.

ICF International. (2006) Lead Human Exposure and Health Risk Assessments and Ecological Risk Assessment for Selected Areas, Pilot Phase. External Review Draft Technical Report. Prepared for the U.S. EPA Office of Air Quality Planning and Standards (OAQPS). December.

Long, T.; Johnson, T.; Laurenson, J.; Rosenbaum, A. (2004) Development of Penetration and Proximity Microenvironment Factor Distributions for the HAPEM5 in Support of the 1999 National-Scale Air Toxics Assessment (NATA). Memorandum prepared for Ted Palma, U.S. EPA, Office of Air Quality Planning and Standards (OAQPS); April 5.

Missouri Department of Natural Resources (MDNR). (2007a) 2007 Revision of the State Implementation Plan for the Herculaneum Lead Nonattainment Area, As Adopted by the Missouri Air Conservation Commission. April 26.

Missouri Department of Natural Resources (MDNR). (2007b) 2007 Revision of the State Implementation Plan for the Herculaneum Lead Nonattainment Area, Public Hearing; March 20, 2007. Emission Source Description on Table 2: 27 of 43. Division of Environmental Quality. Available online at: http://www.dnr.mo.gov/env/apcp/docs/2007revision.pdf.

Missouri Department of Natural Resources (MDNR). (2007c) Doe Run - Herculaneum State Implementation Plan (SIP) Dispersion Modeling Review. Memorandum From Jeffry D. Bennett to John Rustige. February 12. Available online at: http://www.dnr.mo.gov/env/apcp/herculaneumsip.htm.

Rieuwerts, J. S.; Farago, M.; Cikrt, M.; and Bencko, V. (1999) Heavy Metal Concentrations in and Around Households Near a Secondary Lead Smelter. Environmental Monitoring and Assessment. 58: 317-335.

Schulman, L. L.; Stimaitis, D. G.; Scire, J. S. (1997) Addendum to ISC3 User's Guide: The Prime Plume Rise and Building Downwash Model. Earth Tech Document A287. A-99-05, II-A-12. Palo Alto, CA: Electric Power Research Institute; November. Available online at: http://www.epa.gov/scram001/7thconf/iscprime/useguide.pdf.

U.S. Census Bureau. (2005) United States Census 2000: Summary File 1. Public Information Office. Available online at: http://www.census.gov/Press-Release/www/2001/sumfile1.html.

U.S. Department of the Interior U.S. Geological Survey. (1993) USGIS DIGITAL ELEVATION MODELS (DEMs) : User's Guide 5. Reston, Virginia.

U.S. Environmental Protection Agency (USEPA). (1989) Review of National Ambient Air Quality Standard for Lead: Exposure Analysis Methodology and Validation. EPA-450/2-89-011. Research Triangle Park, NC: Office of Air Quality Planning and Standards; June.

U.S. Environmental Protection Agency (USEPA). (1995) User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, Volume 1- User Instructions. Washington, D.C.: Office of Air Quality Planning and Standards (OAQPS). Available online at: http://www.epa.gov/scram001/userg/regmod/isc3v1.pdf#search=%22%22user's%20guide%20for%20the%20industrial%20source%20complex%22%22.

U.S. Environmental Protection Agency (USEPA). (2001) Quality Assurance Project Plan for a Site Characterization at the Herculaneum Lead Smelter. Herculaneum, Missouri, CERCLIS ID No.: MOD 006266373. Prepared for U.S. EPA, Region 7, Superfund Division by U.S. EPA Region 7 Superfund Technical Assessment and Response Team 2; September.

U.S. Environmental Protection Agency (USEPA). (2004) User's Guide for the AERMOD Terrain Preprocessor (AERMAP). EPA-454/B-03-003. RTP, NC: Office of Air Quality Planning and Standards Emissions, Monitoring, and Analysis Division.

U.S. Environmental Protection Agency (USEPA). (2006) 1999 National-Scale Air Toxics Assessment. Available online at: http://www.epa.gov/ttn/atw/nata1999/nsata99.html.

U.S. Environmental Protection Agency (USEPA). (2007) Email From Richard Daye, U.S. EPA Region 7, to Zachary Pekar, Office of Air Quality Planning and Standards. Re: MDNR - Re: Fw: Modeling input/output files? April 26.

Attachment D-1. Emission Parameters for Point Sources for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Hourly Emissions or Emissions Factor?	UTM x (m)	UTM y (m)	Elevation (m)	Source Type (Point, Area or Volume)	Point Emission Releases: Annual Average Emission Rate (g/s) Pb	Stack Height (m)	Stack Gas Exit Temperature (K)	Stack Gas Exit Velocity (m/s)	Stack Diameter (m)
30001	Main stack - GEP stack height (167.67 is actual stack ht)	No	729534	4237767	131.98	Point	4.17	100.75	346.67	5.81	10.31
40004	Dross kettle heat stack	No	729588	4237885	130.76	Point	8.58E-04	21.3	391.5	0.69	0.76
40005	Dross kettle heat stack	No	729587	4237895	130.76	Point	8.58E-04	21.3	391.5	0.69	0.76
50007	New baghouse No. 8 stack (part of 2000 SIP)	No	729596	4237797	131.06	Point	4.31E-02	30.48	285.56	7.13	2.59
50008	New baghouse No. 9 stack (part of 2000 SIP)	No	729596	4237792	131.06	Point	0.297	30.48	276.11	34.57	3.05
50011	Kettle setting heat stack	No	729579	4237787	131.06	Point	1.65E-03	18.8	989.3	5.96	0.61
50012	Kettle setting heat stack	No	729579	4237796	131.06	Point	1.65E-03	18.8	989.3	5.96	0.61
50013	Kettle setting heat stack	No	729579	4237805	131.06	Point	1.65E-03	18.8	989.3	5.96	0.61
50014	Kettle setting heat stack	No	729579	4237813	131.06	Point	1.65E-03	18.8	989.3	5.96	0.61
50015	Kettle setting heat stack	No	729579	4237822	130.76	Point	1.65E-03	18.8	989.3	5.96	0.61
50016	Kettle setting heat stack	No	729579	4237831	130.76	Point	1.65E-03	18.8	989.3	5.96	0.61
50017	Kettle setting heat stack	No	729579	4237840	130.76	Point	1.65E-03	18.8	989.3	5.96	0.61
50018	Kettle setting heat stack	No	729579	4237849	130.76	Point	1.65E-03	18.8	989.3	5.96	0.61
60001	Strip mill heat stack	No	729434	4237560	129.24	Point	1.13E-04	21.3	699.8	2.73	0.56
60002	Strip mill heat stack	No	729475	4237560	130.76	Point	1.13E-04	21.3	699.8	2.73	0.56
60003	Strip mill baghouse	No	729456	4237562	130.76	Point	5.93E-06	7.6	297	7.7	1.08
60004	Low alpha baghouse	No	729477	4237483	128.02	Point	1.80E-03	6.1	327.6	17.5	0.25
60005	Strip mill vent	No	729440	4237549	129.24	Point	1.17E-03	16.8	297	5	0.56
60006	Strip mill vent	No	729450	4237549	129.24	Point	1.17E-03	16.8	297	5	0.56
60007	Strip mill vent	No	729460	4237549	130.76	Point	1.17E-03	16.8	297	5	0.56
60008	Strip mill vent	No	729470	4237549	130.76	Point	1.17E-03	16.8	297	5	0.56

Attachment D-2. Emission Parameters for Volume Sources for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Hourly Emissions or Emissions Factor?	UTM x (m)	UTM y (m)	Elevation (m)	Source Type (Point, Area or Volume)	Volume Emission Releases			
							Annual Average Emission Rate (g/s) Pb	Release Height above ground-level (m)	Lateral Dimension (m)	Vertical Dimension (m)
10001A1	New dump concentrate hopper (Part of 2000 SIP)	yes - Hourly Factors	729460	4237585	131.06	Volume	2.31E-03	0.61	0.28	0.28
10001A2	New dump concentrate storage (Part of 2000 SIP)	yes - Hourly Factors	729520	4237550	129.54	Volume	4.62E-03	4.27	0.21	0.28
10001B1	Load concentrate rail car	yes - Hourly Factors	729520	4237585	129.84	Volume	7.62E-03	4.27	0.57	0.28
10001B2	Dump concentrate and secondary unloader (new location)	yes - Hourly Factors	729547	4238029	132.59	Volume	2.31E-03	6.40	2.33	10.60
20001A	Load sinter railcar/dump sinter	No	729520	4237585	129.84	Volume	3.02E-05	4.27	0.57	0.28
20001B	Load sinter railcar/dump sinter	No	729560	4237920	131.98	Volume	3.02E-05	6.40	2.33	10.60
20002	Sinter unloading (NE corner of sinter building)	No	729520	4237935	132.89	Volume	3.02E-05	3.66	0.57	0.28
20003	Sinter loading/unloading (truck/rail) (at sinter building)	No	729550	4237550	128.63	Volume	3.02E-05	4.27	0.21	0.28
20004	Fume Loading	No	729540	4237980	133.2	Volume	2.41E-04	4.27	0.57	0.28
20004B	New Railcar fume unloading (Part of 2002 SIP-wet vs dry loading)	yes - Hourly Factors	729544	4237424	125	Volume	1.93E-03	0.91	0.57	0.43
20004C	New Railcar fume unloading (Part of 2002 SIP-wet vs dry loading)	yes - Hourly Factors	729538	4237429	125	Volume	7.23E-04	3.66	0.57	0.28
20005A	Sinter mix room	No	729519	4237854	132.28	Volume	3.37E-04	18.30	5.11	8.50
20005B	Sinter mix room	No	729519	4237843	132.28	Volume	3.37E-04	18.30	5.11	8.50
20005C	Sinter mix room	No	729519	4237832	132.28	Volume	3.37E-04	18.30	5.11	8.50
20005D	Sinter mix room	No	729519	4237821	132.28	Volume	3.37E-04	18.30	5.11	8.50
20005E	Sinter mix room	No	729519	4237810	131.98	Volume	3.37E-04	18.30	5.11	8.50
20005F	Sinter mix room	No	729519	4237799	131.98	Volume	3.37E-04	18.30	5.11	8.50
20006	Sinter building fugitives	No	729546	4237904	131.98	Volume	2.31E-03	20.00	0.20	18.00
20007	#3 Baghouse roof vents	No	729540	4237699	131.37	Volume	3.72E-04	21.30	0.30	10.10
30002	Blast furnace	No	729583	4237960	131.37	Volume	1.40E-03	9.30	18.60	8.65
30011	#5 Baghouse roof vent	No	729524	4238016	133.2	Volume	1.93E-04	21.30	0.30	12.70
30012	#5 Baghouse roof vent	No	729524	4237999	133.2	Volume	1.93E-04	21.30	0.30	12.70
30013	#5 Baghouse roof vent	No	729524	4237982	133.2	Volume	1.93E-04	21.30	0.30	12.70
40006	New dross plant fugitives (part of 2000 SIP)	No	729578	4237885	130.76	Volume	4.33E-03	7.62	15.12	7.09
50006	New refinery plant fugitives (part of 2000 SIP w/install BH# 8&9)	No	729578	4237810	131.06	Volume	3.17E-03	5.49	18.60	5.10
70001	Fugitive dross handling	Yes - Hourly Emissions have been averaged	729636	4238220	128.32	Volume	3.67E-04	2.00	2.33	0.00
70007	Fugitive slag handling	Yes - Hourly Emissions have been averaged	729239	4237241	118.57	Volume	4.63E-06	2.00	2.33	0.00
70009	Fugitive secondaries handling	Yes - Hourly Emissions have been averaged	729492	4237630	130.45	Volume	4.76E-05	2.00	2.33	0.00

Attachment D-3. Emission Parameters for Area Sources for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Hourly Emissions or Emissions Factor?	UTM x (m)	UTM y (m)	Elevation (m)	Source Type (Point, Area or Volume)	Release Height (m)	Length of x Side of Area (m)	Length of y Side of Area (m)	Angle (* from N)	Initial Vertical Dimension of the Area Source Plume (m)
70002	Fugitive dross wind erosion	Yes - hourly emissions have been averaged	729620	4238201	130.45	Area	2.00	30.00	40.00	0.00	0.00
70004	Fugitive concentrate wind erosion	Yes - hourly emissions have been averaged	729515	4237391	124.97	Area	2.00	15.00	150.00	0.00	0.00
70006	Fugitive sinter wind erosion	Yes - hourly emissions have been averaged	729537	4237395	124.97	Area	2.00	15.00	150.00	0.00	0.00
70008A	Fugitive slag storage wind erosion	Yes - hourly emissions have been averaged	728878	4237050	128	Area	2.00	166.00	275.00	51.00	0.00
70008B	Fugitive slag storage wind erosion	Yes - hourly emissions have been averaged	729150	4237150	128	Area	2.00	75.00	175.00	51.00	0.00
70010	Fugitive secondaries wind erosion	Yes - hourly emissions have been averaged	729482	4237609	130.45	Area	2.00	20.00	40.00	0.00	0.00
70100	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	727276	4237113	132.59	Area	0	10.00	64.48	90.01	1.40
70101	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	727340	4237103	131.06	Area	0	74.17	10.00	1.24	1.40
70102	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	727415	4237101	128.02	Area	0	74.17	10.00	1.24	1.40
70103	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	727489	4237110	128.93	Area	0	10.00	58.12	86.83	1.40
70104	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	727547	4237113	131.67	Area	0	10.00	58.12	86.83	1.40
70105	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	727605	4237116	132.28	Area	0	10.00	64.48	90.01	1.40
70106	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	727669	4237116	132.89	Area	0	10.00	64.48	90.01	1.40
70107	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	727734	4237106	134.42	Area	0	54.90	10.00	3.36	1.40
70108	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	727788	4237103	138.99	Area	0	54.90	10.00	3.36	1.40
70109	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	727844	4237110	144.17	Area	0	10.00	62.86	90.01	1.40
70110	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	727906	4237110	137.77	Area	0	10.00	62.86	90.01	1.40
70111	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	727969	4237110	124.97	Area	0	10.00	49.97	90.01	1.40

Attachment D-3. Emission Parameters for Area Sources for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Hourly Emissions or Emissions Factor?	UTM x (m)	UTM y (m)	Elevation (m)	Source Type (Point, Area or Volume)	Release Height (m)	Length of x Side of Area (m)	Length of y Side of Area (m)	Angle (* from N)	Initial Vertical Dimension of the Area Source Plume (m)
70112	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	728019	4237110	124.66	Area	0	10.00	49.97	90.01	1.40
70113	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	728069	4237110	124.36	Area	0	10.00	38.69	90.01	1.40
70114	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	728103	4237105	125.58	Area	0	10.00	77.39	2.39	1.40
70115	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	728106	4237182	128.63	Area	0	10.00	51.57	1.79	1.40
70116	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	728108	4237234	130.45	Area	0	10.00	51.57	1.79	1.40
70117	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	728109	4237285	134.72	Area	0	10.00	61.21	0.00	1.40
70118	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	728109	4237348	135.94	Area	0	10.00	86.75	15.08	1.40
70119	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	728132	4237432	132.89	Area	0	10.00	76.58	22.26	1.40
70120	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	728161	4237502	130.15	Area	0	10.00	84.57	17.76	1.40
70121	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	728187	4237583	131.67	Area	0	10.00	72.68	12.81	1.40
70122	New area source input (Hwy 55 to Joachim bridge) segment AB	Yes - hourly factors	728203	4237653	128.63	Area	0	10.00	32.85	11.32	1.40
70150	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728209	4237686	128.63	Area	0	10.00	50.46	13.69	1.40
70151	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728221	4237735	134.42	Area	0	10.00	50.46	13.69	1.40
70152	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728233	4237784	130.45	Area	0	10.00	55.89	12.66	1.40
70153	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728246	4237838	130.45	Area	0	10.00	55.89	12.66	1.40
70154	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728258	4237893	128.63	Area	0	10.00	49.99	11.57	1.40
70155	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728268	4237942	125.88	Area	0	10.00	49.99	11.57	1.40
70156	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728278	4237992	124.97	Area	0	10.00	74.83	22.77	1.40
70157	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728307	4238061	124.05	Area	0	10.00	65.31	29.64	1.40
70158	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728340	4238118	122.22	Area	0	10.00	65.31	29.64	1.40

Attachment D-3. Emission Parameters for Area Sources for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Hourly Emissions or Emissions Factor?	UTM x (m)	UTM y (m)	Elevation (m)	Source Type (Point, Area or Volume)	Release Height (m)	Length of x Side of Area (m)	Length of y Side of Area (m)	Angle (* from N)	Initial Vertical Dimension of the Area Source Plume (m)
70159	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728372	4238175	113.69	Area	0	10.00	63.25	28.39	1.40
70160	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728402	4238230	112.17	Area	0	10.00	63.25	28.39	1.40
70161	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728432	4238286	118.57	Area	0	10.00	94.58	26.58	1.40
70162	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728474	4238370	119.48	Area	0	10.00	50.33	29.14	1.40
70163	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728499	4238414	119.48	Area	0	10.00	50.33	29.14	1.40
70164	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728523	4238458	120.09	Area	0	10.00	52.79	24.96	1.40
70165	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728545	4238506	120.7	Area	0	10.00	52.79	24.96	1.40
70166	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728568	4238554	121.62	Area	0	10.00	50.82	28.83	1.40
70167	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728592	4238599	119.18	Area	0	10.00	50.82	28.83	1.40
70168	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728617	4238643	121.01	Area	0	10.00	65.74	28.32	1.40
70169	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728648	4238700	124.36	Area	0	10.00	52.91	22.26	1.40
70170	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728668	4238749	137.16	Area	0	10.00	43.73	14.75	1.40
70171	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728679	4238790	138.99	Area	0	10.00	75.98	5.05	1.40
70172	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728681	4238963	147.22	Area	0	98.04	10.00	87.40	1.40
70173	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728676	4239030	153.62	Area	0	66.93	10.00	86.18	1.40
70174	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728668	4239120	151.18	Area	0	90.59	10.00	84.36	1.40
70175	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728646	4239176	162.76	Area	0	62.01	10.00	68.95	1.40
70176	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728617	4239239	165.81	Area	0	68.72	10.00	65.08	1.40
70177	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728621	4239236	165.81	Area	0	53.87	10.00	7.11	1.40
70178	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728674	4239229	172.52	Area	0	53.87	10.00	7.11	1.40

Attachment D-3. Emission Parameters for Area Sources for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Hourly Emissions or Emissions Factor?	UTM x (m)	UTM y (m)	Elevation (m)	Source Type (Point, Area or Volume)	Release Height (m)	Length of x Side of Area (m)	Length of y Side of Area (m)	Angle (* from N)	Initial Vertical Dimension of the Area Source Plume (m)
70179	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728727	4239222	174.96	Area	0	97.42	10.00	10.53	1.40
70180	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728823	4239204	173.13	Area	0	54.02	10.00	8.29	1.40
70181	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728877	4239197	171.6	Area	0	54.02	10.00	8.29	1.40
70182	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728929	4239189	165.2	Area	0	65.51	10.00	17.80	1.40
70183	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	728992	4239169	166.42	Area	0	51.82	10.00	8.64	1.40
70184	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729044	4239161	160.32	Area	0	51.82	10.00	8.64	1.40
70185	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729095	4239153	163.07	Area	0	91.32	10.00	12.67	1.40
70186	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729183	4239134	168.25	Area	0	53.37	10.00	23.34	1.40
70187	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729232	4239112	166.73	Area	0	53.37	10.00	23.34	1.40
70188	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729280	4239092	162.15	Area	0	52.18	10.00	39.78	1.40
70189	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729320	4239059	165.51	Area	0	52.18	10.00	39.78	1.40
70190	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729359	4239026	161.54	Area	0	90.62	10.00	47.47	1.40
70191	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729420	4238959	164.9	Area	0	52.17	10.00	50.17	1.40
70192	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729454	4238919	161.85	Area	0	52.17	10.00	50.17	1.40
70193	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729487	4238879	162.46	Area	0	83.81	10.00	50.37	1.40
70194	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729541	4238814	159.11	Area	0	66.20	10.00	47.70	1.40
70195	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729585	4238766	154.23	Area	0	57.75	10.00	62.43	1.40
70196	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729611	4238717	162.46	Area	0	76.20	10.00	83.29	1.40
70197	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729620	4238642	155.45	Area	0	73.49	10.00	88.26	1.40
70198	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729622	4238568	155.14	Area	0	62.33	10.00	90.00	1.40

Attachment D-3. Emission Parameters for Area Sources for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Hourly Emissions or Emissions Factor?	UTM x (m)	UTM y (m)	Elevation (m)	Source Type (Point, Area or Volume)	Release Height (m)	Length of x Side of Area (m)	Length of y Side of Area (m)	Angle (* from N)	Initial Vertical Dimension of the Area Source Plume (m)
70199	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729609	4238447	156.67	Area	0	10.00	61.78	12.49	1.40
70200	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729585	4238400	149.66	Area	0	10.00	53.76	27.11	1.40
70201	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729560	4238352	147.52	Area	0	10.00	53.76	27.11	1.40
70202	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729538	4238289	145.08	Area	0	10.00	66.19	19.67	1.40
70203	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729522	4238227	145.39	Area	0	10.00	64.25	14.05	1.40
70204	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729495	4238145	142.34	Area	0	10.00	86.59	17.98	1.40
70205	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729482	4238084	140.51	Area	0	10.00	61.57	12.54	1.40
70206	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729464	4238029	141.43	Area	0	10.00	58.43	17.76	1.40
70207	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729448	4237982	141.43	Area	0	10.00	49.28	18.45	1.40
70208	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729437	4237926	135.33	Area	0	10.00	56.75	11.32	1.40
70209	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729428	4237881	133.81	Area	0	10.00	45.40	11.32	1.40
70210	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729413	4237815	133.81	Area	0	10.00	68.57	13.14	1.40
70211	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729393	4237764	133.2	Area	0	10.00	54.98	21.39	1.40
70212	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729377	4237717	132.59	Area	0	10.00	49.28	18.45	1.40
70213	New area source input (Joachim bridge exit to plant entrance) segment BC	Yes - hourly factors	729375	4237713	132.59	Area	0	10.00	5.45	26.90	1.40
70250	New area source input (plant entrance to NW corner of Stip Mill Blding/SMB) segment CD	Yes - hourly factors	729367	4237692	132.28	Area	0	10.00	21.62	19.93	1.40
70251	New area source input (plant entrance to NW corner of Stip Mill Blding/SMB) segment CD	Yes - hourly factors	729367	4237689	132.28	Area	0	68.70	10.00	68.35	1.40
70252	New area source input (plant entrance to NW corner of Stip Mill Blding/SMB) segment CD	Yes - hourly factors	729393	4237625	130.76	Area	0	51.46	10.00	68.07	1.40
70300	New area source input (NW corner of SMB to conc. hopper) segment DE	Yes - hourly factors	729416	4237574	129.24	Area	0	46.05	10.00	12.23	1.40
70350	New area source input (conc. hopper to SW corner SMB) segment EF	Yes - hourly factors	729461	4237564	130.76	Area	0	23.47	10.00	9.61	1.40

Attachment D-3. Emission Parameters for Area Sources for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Hourly Emissions or Emissions Factor?	UTM x (m)	UTM y (m)	Elevation (m)	Source Type (Point, Area or Volume)	Release Height (m)	Length of x Side of Area (m)	Length of y Side of Area (m)	Angle (* from N)	Initial Vertical Dimension of the Area Source Plume (m)
70351	New area source input (conc. hopper to SW corner SMB) segment EF	Yes - hourly factors	729482	4237561	130.15	Area	0	17.74	10.00	32.45	1.40
70352	New area source input (conc. hopper to SW corner SMB) segment EF	Yes - hourly factors	729495	4237555	130.15	Area	0	21.78	10.00	77.98	1.40
70353	New area source input (conc. hopper to SW corner SMB) segment EF	Yes - hourly factors	729497	4237493	128.32	Area	0	10.00	41.34	3.78	1.40
70354	New area source input (conc. hopper to SW corner SMB) segment EF	Yes - hourly factors	729497	4237493	128.32	Area	0	29.47	10.00	89.12	1.40
70355	New area source input (conc. hopper to SW corner SMB) segment EF	Yes - hourly factors	729493	4237439	128.02	Area	0	10.00	25.79	10.13	1.40
70356	New area source input (conc. hopper to SW corner SMB) segment EF	Yes - hourly factors	729479	4237432	125.58	Area	0	10.00	18.62	55.95	1.40
70357	New area source input (conc. hopper to SW corner SMB) segment EF	Yes - hourly factors	729459	4237425	125.58	Area	0	10.00	22.52	71.22	1.40
70358	New area source input (conc. hopper to SW corner SMB) segment EF	Yes - hourly factors	729434	4237423	129.24	Area	0	10.00	26.67	83.72	1.40
70400	New area source input (NW corner SMB to SW corner of SMB) segment DF	Yes - hourly factors	729411	4237555	127.71	Area	0	10.00	22.81	2.40	1.40
70401	New area source input (NW corner SMB to SW corner of SMB) segment DF	Yes - hourly factors	729410	4237532	128.02	Area	0	10.00	23.48	2.87	1.40
70402	New area source input (NW corner SMB to SW corner of SMB) segment DF	Yes - hourly factors	729405	4237505	128.32	Area	0	10.00	28.02	9.32	1.40
70403	New area source input (NW corner SMB to SW corner of SMB) segment DF	Yes - hourly factors	729403	4237485	128.32	Area	0	10.00	19.58	5.32	1.40
70404	New area source input (NW corner SMB to SW corner of SMB) segment DF	Yes - hourly factors	729404	4237482	129.84	Area	0	24.35	10.00	65.80	1.40
70405	New area source input (NW corner SMB to SW corner of SMB) segment DF	Yes - hourly factors	729413	4237461	129.84	Area	0	30.68	10.00	71.02	1.40
70406	New area source input (NW corner SMB to SW corner of SMB) segment DF	Yes - hourly factors	729423	4237431	127.71	Area	0	16.78	10.00	68.49	1.40
70450	New area source input (SW corner SMB to North end of Slag Haul Road) segment FG	Yes - hourly factors	729429	4237416	129.24	Area	0	23.40	10.00	68.39	1.40
70451	New area source input (SW corner SMB to North end of Slag Haul Road) segment FG	Yes - hourly factors	729438	4237394	129.24	Area	0	31.73	10.00	59.02	1.40
70452	New area source input (SW corner SMB to North end of Slag Haul Road) segment FG	Yes - hourly factors	729454	4237366	124.97	Area	0	28.05	10.00	55.52	1.40
70453	New area source input (SW corner SMB to North end of Slag Haul Road) segment FG	Yes - hourly factors	729471	4237343	126.19	Area	0	31.66	10.00	51.96	1.40
70454	New area source input (SW corner SMB to North end of Slag Haul Road) segment FG	Yes - hourly factors	729490	4237318	124.97	Area	0	10.98	10.00	51.69	1.40

Attachment D-3. Emission Parameters for Area Sources for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Hourly Emissions or Emissions Factor?	UTM x (m)	UTM y (m)	Elevation (m)	Source Type (Point, Area or Volume)	Release Height (m)	Length of x Side of Area (m)	Length of y Side of Area (m)	Angle (* from N)	Initial Vertical Dimension of the Area Source Plume (m)
70500	New area source input (North end of Slag Haul Road to refinery dock) segment GH	Yes - hourly factors	729587	4237602	127.71	Area	0	29.96	10.00	79.53	1.40
70501	New area source input (North end of Slag Haul Road to refinery dock) segment GH	Yes - hourly factors	729592	4237573	127.71	Area	0	19.13	10.00	84.56	1.40
70502	New area source input (North end of Slag Haul Road to refinery dock) segment GH	Yes - hourly factors	729593	4237528	127.1	Area	0	10.00	27.21	1.91	1.40
70503	New area source input (North end of Slag Haul Road to refinery dock) segment GH	Yes - hourly factors	729592	4237505	125.88	Area	0	10.00	23.16	3.37	1.40
70504	New area source input (North end of Slag Haul Road to refinery dock) segment GH	Yes - hourly factors	729589	4237478	124.36	Area	0	10.00	27.29	4.77	1.40
70505	New area source input (North end of Slag Haul Road to refinery dock) segment GH	Yes - hourly factors	729586	4237453	123.75	Area	0	10.00	25.13	7.26	1.40
70506	New area source input (North end of Slag Haul Road to refinery dock) segment GH	Yes - hourly factors	729583	4237425	123.75	Area	0	10.00	27.67	5.64	1.40
70507	New area source input (North end of Slag Haul Road to refinery dock) segment GH	Yes - hourly factors	729577	4237400	123.14	Area	0	10.00	27.05	13.58	1.40
70508	New area source input (North end of Slag Haul Road to refinery dock) segment GH	Yes - hourly factors	729569	4237384	124.66	Area	0	10.00	18.86	27.20	1.40
70509	New area source input (North end of Slag Haul Road to refinery dock) segment GH	Yes - hourly factors	729552	4237366	124.66	Area	0	10.00	25.99	42.90	1.40
70510	New area source input (North end of Slag Haul Road to refinery dock) segment GH	Yes - hourly factors	729540	4237351	124.97	Area	0	10.00	18.70	39.12	1.40
70511	New area source input (North end of Slag Haul Road to refinery dock) segment GH	Yes - hourly factors	729527	4237337	124.97	Area	0	10.00	19.92	41.33	1.40
70512	New area source input (North end of Slag Haul Road to refinery dock) segment GH	Yes - hourly factors	729514	4237323	121.31	Area	0	10.00	19.24	45.02	1.40
70513	New area source input (North end of Slag Haul Road to refinery dock) segment GH	Yes - hourly factors	729499	4237316	124.97	Area	0	10.00	17.85	62.80	1.40
70550	New area source input (South Slag Haul Road paved) segment GK	Yes - hourly factors	729479	4237311	127.71	Area	0	10.00	20.25	74.42	1.40
70551	New area source input (South Slag Haul Road paved) segment GK	Yes - hourly factors	729460	4237298	125.58	Area	0	10.00	21.51	55.33	1.40
70552	New area source input (South Slag Haul Road paved) segment GK	Yes - hourly factors	729451	4237280	128.02	Area	0	10.00	17.86	23.98	1.40
70553	New area source input (South Slag Haul Road paved) segment GK	Yes - hourly factors	729450	4237278	128.02	Area	0	24.48	10.00	90.00	1.40
70600	New area source input (north end of main building to refinery dock unpaved) segment HL	Yes - hourly factors	729611	4237950	130.15	Area	0	10.00	23.58	1.10	1.40
70601	New area source input (north end of main building to refinery dock unpaved) segment HL	Yes - hourly factors	729611	4237950	130.15	Area	0	35.37	10.00	88.53	1.40

Attachment D-3. Emission Parameters for Area Sources for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Hourly Emissions or Emissions Factor?	UTM x (m)	UTM y (m)	Elevation (m)	Source Type (Point, Area or Volume)	Release Height (m)	Length of x Side of Area (m)	Length of y Side of Area (m)	Angle (* from N)	Initial Vertical Dimension of the Area Source Plume (m)
70602	New area source input (north end of main building to refinery dock unpaved) segment HL	Yes - hourly factors	729612	4237883	128.93	Area	0	10.00	31.74	0.82	1.40
70603	New area source input (north end of main building to refinery dock unpaved) segment HL	Yes - hourly factors	729611	4237846	128.93	Area	0	10.00	37.18	0.70	1.40
70604	New area source input (north end of main building to refinery dock unpaved) segment HL	Yes - hourly factors	729610	4237821	128.63	Area	0	10.00	24.97	3.12	1.40
70605	New area source input (north end of main building to refinery dock unpaved) segment HL	Yes - hourly factors	729606	4237784	128.93	Area	0	10.00	37.80	5.51	1.40
70606	New area source input (north end of main building to refinery dock unpaved) segment HL	Yes - hourly factors	729606	4237753	129.24	Area	0	10.00	29.92	0.87	1.40
70607	New area source input (north end of main building to refinery dock unpaved) segment HL	Yes - hourly factors	729606	4237753	129.24	Area	0	24.48	10.00	90.00	1.40
70608	New area source input (north end of main building to refinery dock unpaved) segment HL	Yes - hourly factors	729605	4237693	127.71	Area	0	10.00	35.82	1.45	1.40
70609	New area source input (north end of main building to refinery dock unpaved) segment HL	Yes - hourly factors	729603	4237661	125.27	Area	0	10.00	32.69	3.18	1.40
70610	New area source input (north end of main building to refinery dock unpaved) segment HL	Yes - hourly factors	729601	4237635	127.71	Area	0	10.00	25.94	5.02	1.40
70611	New area source input (north end of main building to refinery dock unpaved) segment HL	Yes - hourly factors	729598	4237614	127.71	Area	0	10.00	21.09	8.66	1.40
70612	New area source input (north end of main building to refinery dock unpaved) segment HL	Yes - hourly factors	729591	4237604	127.71	Area	0	10.00	14.00	29.07	1.40
70650	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729512	4237946	132.89	Area	0	10.00	17.32	82.58	1.40
70651	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729496	4237936	133.81	Area	0	10.00	16.15	56.33	1.40
70652	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729493	4237904	133.5	Area	0	10.00	28.36	1.51	1.40
70653	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729493	4237902	132.89	Area	0	21.01	10.00	73.48	1.40
70654	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729493	4237859	132.59	Area	0	10.00	26.79	12.88	1.40
70655	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729483	4237846	132.59	Area	0	10.00	18.66	36.89	1.40
70656	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729473	4237826	133.2	Area	0	10.00	21.02	27.49	1.40
70657	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729465	4237795	132.89	Area	0	10.00	31.49	13.72	1.40
70658	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729465	4237792	132.89	Area	0	17.22	10.00	72.34	1.40

Attachment D-3. Emission Parameters for Area Sources for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Hourly Emissions or Emissions Factor?	UTM x (m)	UTM y (m)	Elevation (m)	Source Type (Point, Area or Volume)	Release Height (m)	Length of x Side of Area (m)	Length of y Side of Area (m)	Angle (* from N)	Initial Vertical Dimension of the Area Source Plume (m)
70659	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729470	4237776	132.59	Area	0	23.56	10.00	79.04	1.40
70660	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729474	4237753	132.28	Area	0	28.24	10.00	77.79	1.40
70661	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729480	4237726	132.28	Area	0	24.63	10.00	88.26	1.40
70662	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729481	4237701	131.67	Area	0	20.90	10.00	87.95	1.40
70663	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729480	4237660	131.37	Area	0	10.00	20.94	4.09	1.40
70664	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729480	4237659	131.37	Area	0	19.45	10.00	85.60	1.40
70665	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729482	4237640	130.45	Area	0	13.43	10.00	90.00	1.40
70666	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729482	4237626	130.45	Area	0	19.37	10.00	74.35	1.40
70667	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729488	4237606	130.45	Area	0	19.36	10.00	62.43	1.40
70668	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729497	4237588	130.45	Area	0	20.08	10.00	47.99	1.40
70669	New area source input (sinter plant to sinter storage) segment IJ	Yes - hourly factors	729511	4237572	130.15	Area	0	11.66	10.00	39.78	1.40
70700	New area source input (south Slag Haul Road unpaved) segment KM	Yes - hourly factors	729427	4237243	122.53	Area	0	10.00	29.75	61.04	1.40
70701	New area source input (south Slag Haul Road unpaved) segment KM	Yes - hourly factors	729386	4237233	127.71	Area	0	10.00	43.12	75.53	1.40
70702	New area source input (south Slag Haul Road unpaved) segment KM	Yes - hourly factors	729346	4237218	128.02	Area	0	10.00	42.69	69.94	1.40
70703	New area source input (south Slag Haul Road unpaved) segment KM	Yes - hourly factors	729322	4237208	128.02	Area	0	10.00	25.49	65.68	1.40

Attachment D-4. Hourly Emissions Factors by Emission Point for the Primary Pb Smelter Case Study

Emission	Emissions Factor for Hour of Day																						
Point ID	Hr1	Hr2	Hr3	Hr4	Hr5	Hr6	Hr7	Hr8	Hr9	Hr10	Hr11	Hr12	Hr13	Hr14	Hr15	Hr16	Hr17	Hr18	Hr19	Hr20	Hr21	Hr22	Hr23	Hr24
10001A1	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00
10001A2	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00
10001B1	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00
10001B2	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00
20004B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
20004C	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00
70100	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70101	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70102	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70103	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70104	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70105	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70106	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70107	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70108	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70109	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70110	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70111	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70112	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70113	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70114	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70115	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70116	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70117	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70118	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70119	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70120	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70121	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70122	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70150	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70151	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70152	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70153	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70154	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70155	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70156	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70157	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70158	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70159	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70160	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70161	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70162	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70163	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70164	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70165	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70166	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70167	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70168	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70169	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70170	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70171	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70172	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70173	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70174	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075

Attachment D-4. Hourly Emissions Factors by Emission Point for the Primary Pb Smelter Case Study

Emission Point ID	Emissions Factor for Hour of Day																							
	Hr1	Hr2	Hr3	Hr4	Hr5	Hr6	Hr7	Hr8	Hr9	Hr10	Hr11	Hr12	Hr13	Hr14	Hr15	Hr16	Hr17	Hr18	Hr19	Hr20	Hr21	Hr22	Hr23	Hr24
70175	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70176	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70177	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70178	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70179	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70180	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70181	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70182	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70183	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70184	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70185	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70186	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70187	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70188	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70189	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70190	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70191	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70192	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70193	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70194	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70195	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70196	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70197	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70198	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70199	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70200	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70201	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70202	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70203	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70204	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70205	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70206	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70207	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70208	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70209	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70210	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70211	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70212	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70213	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70250	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70251	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70252	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70300	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70350	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70351	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70352	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70353	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70354	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70355	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70356	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70357	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70358	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70400	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70401	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075

Attachment D-4. Hourly Emissions Factors by Emission Point for the Primary Pb Smelter Case Study

Emission Point ID	Emissions Factor for Hour of Day																							
	Hr1	Hr2	Hr3	Hr4	Hr5	Hr6	Hr7	Hr8	Hr9	Hr10	Hr11	Hr12	Hr13	Hr14	Hr15	Hr16	Hr17	Hr18	Hr19	Hr20	Hr21	Hr22	Hr23	Hr24
70402	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70403	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70404	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70405	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70406	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70450	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70451	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70452	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70453	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70454	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70500	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70501	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70502	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70503	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70504	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70505	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70506	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70507	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70508	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70509	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70510	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70511	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70512	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70513	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70550	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70551	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70552	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70553	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70600	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70601	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70602	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70603	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70604	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70605	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70606	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70607	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70608	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70609	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70610	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70611	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70612	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70650	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70651	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70652	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70653	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70654	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70655	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70656	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70657	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70658	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70659	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70660	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70661	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70662	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075

Attachment D-4. Hourly Emissions Factors by Emission Point for the Primary Pb Smelter Case Study

Emission Point ID	Emissions Factor for Hour of Day																							
	Hr1	Hr2	Hr3	Hr4	Hr5	Hr6	Hr7	Hr8	Hr9	Hr10	Hr11	Hr12	Hr13	Hr14	Hr15	Hr16	Hr17	Hr18	Hr19	Hr20	Hr21	Hr22	Hr23	Hr24
70663	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70664	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70665	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70666	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70667	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70668	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70669	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70700	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70701	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70702	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075
70703	0.05	0.075	0.075	0.075	0.125	0.50	1.25	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	0.50	0.125	0.075	0.075	0.075

Attachment D-5. Particle Size Inputs by Emission Point for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Mass Fraction								Particle Diameter (µm)								Particle Density (g/cm^3)							
		Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8	Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8	Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8
30001	Main stack - GEP stack height (167.67 is actual stack ht)	0.00	0.00	0.11	0.10	0.12	0.21	0.28	0.19	1.57	4.77	7.24	11.94	17.65	24.08	35.09	40.99	4.99	4.99	4.99	4.99	4.99	4.99	4.99	4.99
40004	Dross kettle heat stack	0.00	0.00	0.17	0.19	0.16	0.20	0.27	0.00	1.57	4.76	6.98	12.30	16.98	23.58	34.06	45.01	5.72	5.72	5.72	5.72	5.72	5.72	5.72	5.72
40005	Dross kettle heat stack	0.00	0.00	0.17	0.19	0.16	0.20	0.27	0.00	1.57	4.76	6.98	12.30	16.98	23.58	34.06	45.01	5.72	5.72	5.72	5.72	5.72	5.72	5.72	5.72
50007	New baghouse No. 8 stack (part of 2000 SIP)	0.00	0.00	0.05	0.08	0.13	0.33	0.19	0.22	1.57	4.80	7.04	12.03	17.62	23.93	33.64	42.76	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
50008	New baghouse No. 9 stack (part of 2000 SIP)	0.00	0.00	0.05	0.08	0.13	0.33	0.19	0.22	1.57	4.80	7.04	12.03	17.62	23.93	33.64	42.76	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
50011	Kettle setting heat stack	0.00	0.00	0.05	0.08	0.13	0.33	0.19	0.22	1.57	4.80	7.04	12.03	17.62	23.93	33.64	42.76	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
50012	Kettle setting heat stack	0.00	0.00	0.05	0.08	0.13	0.33	0.19	0.22	1.57	4.80	7.04	12.03	17.62	23.93	33.64	42.76	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
50013	Kettle setting heat stack	0.00	0.00	0.05	0.08	0.13	0.33	0.19	0.22	1.57	4.80	7.04	12.03	17.62	23.93	33.64	42.76	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
50014	Kettle setting heat stack	0.00	0.00	0.05	0.08	0.13	0.33	0.19	0.22	1.57	4.80	7.04	12.03	17.62	23.93	33.64	42.76	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
50015	Kettle setting heat stack	0.00	0.00	0.05	0.08	0.13	0.33	0.19	0.22	1.57	4.80	7.04	12.03	17.62	23.93	33.64	42.76	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
50016	Kettle setting heat stack	0.00	0.00	0.05	0.08	0.13	0.33	0.19	0.22	1.57	4.80	7.04	12.03	17.62	23.93	33.64	42.76	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
50017	Kettle setting heat stack	0.00	0.00	0.05	0.08	0.13	0.33	0.19	0.22	1.57	4.80	7.04	12.03	17.62	23.93	33.64	42.76	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
50018	Kettle setting heat stack	0.00	0.00	0.05	0.08	0.13	0.33	0.19	0.22	1.57	4.80	7.04	12.03	17.62	23.93	33.64	42.76	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
60001	Strip mill heat stack	0.00	0.00	0.05	0.08	0.13	0.33	0.19	0.22	1.57	4.80	7.04	12.03	17.62	23.93	33.64	42.76	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
60002	Strip mill heat stack	0.00	0.00	0.05	0.08	0.13	0.33	0.19	0.22	1.57	4.80	7.04	12.03	17.62	23.93	33.64	42.76	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
60003	Strip mill baghouse	0.00	0.00	0.05	0.08	0.13	0.33	0.19	0.22	1.57	4.80	7.04	12.03	17.62	23.93	33.64	42.76	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
60004	Low alpha baghouse	0.00	0.00	0.05	0.08	0.13	0.33	0.19	0.22	1.57	4.80	7.04	12.03	17.62	23.93	33.64	42.76	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
60005	Strip mill vent	0.00	0.00	0.05	0.08	0.13	0.33	0.19	0.22	1.57	4.80	7.04	12.03	17.62	23.93	33.64	42.76	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
60006	Strip mill vent	0.00	0.00	0.05	0.08	0.13	0.33	0.19	0.22	1.57	4.80	7.04	12.03	17.62	23.93	33.64	42.76	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
60007	Strip mill vent	0.00	0.00	0.05	0.08	0.13	0.33	0.19	0.22	1.57	4.80	7.04	12.03	17.62	23.93	33.64	42.76	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
60008	Strip mill vent	0.00	0.00	0.05	0.08	0.13	0.33	0.19	0.22	1.57	4.80	7.04	12.03	17.62	23.93	33.64	42.76	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
10001A1	New dump concentrate hopper (Part of 2000 SIP) [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
10001A2	New dump concentrate storage (Part of 2000 SIP) [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
10001B1	Load concentrate rail car [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
10001B2	Dump concentrate and secondary unloader (new location) [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
20001A	Load sinter railcar/dump sinter [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
20001B	Load sinter railcar/dump sinter [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
20002	Sinter unloading (NE corner of sinter building) [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
20003	Sinter loading/unloading (truck/rail) (at sinter building) [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
20004	Fume Loading [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
20004B	New Railcar fume unloading (Part of 2002 SIP-wet vs dry loading) [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
20004C	New Railcar fume unloading (Part of 2002 SIP-wet vs dry loading) [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
20005A	Sinter mix room [a]	0.00	0.01	0.12	0.13	0.12	0.28	0.18	0.16	1.57	4.72	7.12	12.08	17.04	23.97	33.86	44.21	5.35	5.35	5.35	5.35	5.35	5.35	5.35	5.35
20005B	Sinter mix room [a]	0.00	0.01	0.12	0.13	0.12	0.28	0.18	0.16	1.57	4.72	7.12	12.08	17.04	23.97	33.86	44.21	5.35	5.35	5.35	5.35	5.35	5.35	5.35	5.35
20005C	Sinter mix room [a]	0.00	0.01	0.12	0.13	0.12	0.28	0.18	0.16	1.57	4.72	7.12	12.08	17.04	23.97	33.86	44.21	5.35	5.35	5.35	5.35	5.35	5.35	5.35	5.35
20005D	Sinter mix room [a]	0.00	0.01	0.12	0.13	0.12	0.28	0.18	0.16	1.57	4.72	7.12	12.08	17.04	23.97	33.86	44.21	5.35	5.35	5.35	5.35	5.35	5.35	5.35	5.35
20005E	Sinter mix room [a]	0.00	0.01	0.12	0.13	0.12	0.28	0.18	0.16	1.57	4.72	7.12	12.08	17.04	23.97	33.86	44.21	5.35	5.35	5.35	5.35	5.35	5.35	5.35	5.35
20005F	Sinter mix room [a]	0.00	0.01	0.12	0.13	0.12	0.28	0.18	0.16	1.57	4.72	7.12	12.08	17.04	23.97	33.86	44.21	5.35	5.35	5.35	5.35	5.35	5.35	5.35	5.35
20006	Sinter building fugitives [a]	0.00	0.01	0.12	0.13	0.12	0.28	0.18	0.16	1.57	4.72	7.12	12.08	17.04	23.97	33.86	44.21	5.35	5.35	5.35	5.35	5.35	5.35	5.35	5.35
20007	#3 Baghouse roof vents [a]	0.00	0.01	0.12	0.13	0.12	0.28	0.18	0.16	1.57	4.72	7.12	12.08	17.04	23.97	33.86	44.21	5.35	5.35	5.35	5.35	5.35	5.35	5.35	5.35
30002	Blast furnace [a]	0.00	0.00	0.11	0.10	0.12	0.21	0.28	0.19	1.57	4.77	7.24	11.94	17.65	24.08	35.09	40.99	4.99	4.99	4.99	4.99	4.99	4.99	4.99	4.99
30011	#5 Baghouse roof vent [a]	0.00	0.00	0.11	0.10	0.12	0.21	0.28	0.19	1.57	4.77	7.24	11.94	17.65	24.08	35.09	40.99	4.99	4.99	4.99	4.99	4.99	4.99	4.99	4.99
30012	#5 Baghouse roof vent [a]	0.00	0.00	0.11	0.10	0.12	0.21	0.28	0.19	1.57	4.77	7.24	11.94	17.65	24.08	35.09	40.99	4.99	4.99	4.99	4.99	4.99	4.99	4.99	4.99
30013	#5 Baghouse roof vent [a]	0.00	0.00	0.11	0.10	0.12	0.21	0.28	0.19	1.57	4.77	7.24	11.94	17.65	24.08	35.09	40.99	4.99	4.99	4.99	4.99	4.99	4.99	4.99	4.99

Attachment D-5. Particle Size Inputs by Emission Point for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Mass Fraction								Particle Diameter (µm)								Particle Density (g/cm^3)							
		Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8	Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8	Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8
40006	New dross plant fugitives (part of 2000 SIP) [a]	0.00	0.00	0.17	0.19	0.16	0.20	0.27	0.00	1.57	4.76	6.98	12.30	16.98	23.58	34.06	45.01	5.72	5.72	5.72	5.72	5.72	5.72	5.72	5.72
50006	New refinery plant fugitives (part of 2000 SIP w/install BH# 8&9) [a]	0.00	0.00	0.05	0.08	0.13	0.33	0.19	0.22	1.57	4.80	7.04	12.03	17.62	23.93	33.64	42.76	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
70001	Fugitive dross handling [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70007	Fugitive slag handling [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70009	Fugitive secondaries handling [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70002	Fugitive dross wind erosion [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70004	Fugitive concentrate wind erosion [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70006	Fugitive sinter wind erosion [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70008A	Fugitive slag storage wind erosion [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70008B	Fugitive slag storage wind erosion [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70010	Fugitive secondaries wind erosion [a]	0.07	0.20	0.20	0.18	0.16	0.19	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70100	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70101	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70102	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70103	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70104	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70105	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70106	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70107	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70108	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70109	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70110	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70111	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70112	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70113	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70114	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70115	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70116	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70117	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-

Attachment D-5. Particle Size Inputs by Emission Point for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Mass Fraction								Particle Diameter (µm)								Particle Density (g/cm^3)							
		Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8	Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8	Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8
70118	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70119	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70120	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70121	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70122	New area source input (Hwy 55 to Joachim bridge) segment AB [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70150	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70151	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70152	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70153	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70154	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70155	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70156	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70157	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70158	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70159	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70160	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70161	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70162	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70163	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70164	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70165	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70166	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70167	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70168	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-

Attachment D-5. Particle Size Inputs by Emission Point for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Mass Fraction								Particle Diameter (µm)								Particle Density (g/cm^3)							
		Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8	Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8	Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8
70169	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70170	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70171	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70172	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70173	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70174	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70175	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70176	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70177	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70178	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70179	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70180	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70181	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70182	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70183	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70184	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70185	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70186	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70187	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70188	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70189	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70190	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70191	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70192	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-

Attachment D-5. Particle Size Inputs by Emission Point for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Mass Fraction								Particle Diameter (µm)								Particle Density (g/cm^3)							
		Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8	Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8	Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8
70193	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70194	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70195	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70196	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70197	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70198	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70199	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70200	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70201	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70202	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70203	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70204	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70205	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70206	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70207	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70208	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70209	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70210	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70211	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70212	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70213	New area source input (Joachim bridge exit to plant entrance) segment BC [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70250	New area source input (plant entrance to NW corner of Stip Mill Blding/SMB) segment CD [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70251	New area source input (plant entrance to NW corner of Stip Mill Blding/SMB) segment CD [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70252	New area source input (plant entrance to NW corner of Stip Mill Blding/SMB) segment CD [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-

Attachment D-5. Particle Size Inputs by Emission Point for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Mass Fraction								Particle Diameter (µm)								Particle Density (g/cm^3)							
		Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8	Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8	Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8
70300	New area source input (NW corner of SMB to conc. hopper) segment DE [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70350	New area source input (conc. hopper to SW corner SMB) segment EF [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70351	New area source input (conc. hopper to SW corner SMB) segment EF [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70352	New area source input (conc. hopper to SW corner SMB) segment EF [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70353	New area source input (conc. hopper to SW corner SMB) segment EF [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70354	New area source input (conc. hopper to SW corner SMB) segment EF [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70355	New area source input (conc. hopper to SW corner SMB) segment EF [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70356	New area source input (conc. hopper to SW corner SMB) segment EF [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70357	New area source input (conc. hopper to SW corner SMB) segment EF [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70358	New area source input (conc. hopper to SW corner SMB) segment EF [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70400	New area source input (NW corner SMB to SW corner of SMB) segment DF [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70401	New area source input (NW corner SMB to SW corner of SMB) segment DF [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70402	New area source input (NW corner SMB to SW corner of SMB) segment DF [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70403	New area source input (NW corner SMB to SW corner of SMB) segment DF [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70404	New area source input (NW corner SMB to SW corner of SMB) segment DF [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70405	New area source input (NW corner SMB to SW corner of SMB) segment DF [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70406	New area source input (NW corner SMB to SW corner of SMB) segment DF [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70450	New area source input (SW corner SMB to North end of Slag Haul Road) segment FG [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70451	New area source input (SW corner SMB to North end of Slag Haul Road) segment FG [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70452	New area source input (SW corner SMB to North end of Slag Haul Road) segment FG [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70453	New area source input (SW corner SMB to North end of Slag Haul Road) segment FG [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70454	New area source input (SW corner SMB to North end of Slag Haul Road) segment FG [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70500	New area source input (North end of Slag Haul Road to refinery dock) segment GH [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70501	New area source input (North end of Slag Haul Road to refinery dock) segment GH [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-

Attachment D-5. Particle Size Inputs by Emission Point for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Mass Fraction								Particle Diameter (µm)								Particle Density (g/cm^3)							
		Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8	Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8	Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8
70502	New area source input (North end of Slag Haul Road to refinery dock) segment GH [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70503	New area source input (North end of Slag Haul Road to refinery dock) segment GH [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70504	New area source input (North end of Slag Haul Road to refinery dock) segment GH [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70505	New area source input (North end of Slag Haul Road to refinery dock) segment GH [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70506	New area source input (North end of Slag Haul Road to refinery dock) segment GH [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-

Attachment D-5. Particle Size Inputs by Emission Point for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Mass Fraction								Particle Diameter (µm)								Particle Density (g/cm^3)							
		Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8	Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8	Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8
70507	New area source input (North end of Slag Haul Road to refinery dock) segment GH [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70508	New area source input (North end of Slag Haul Road to refinery dock) segment GH [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70509	New area source input (North end of Slag Haul Road to refinery dock) segment GH [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70510	New area source input (North end of Slag Haul Road to refinery dock) segment GH [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70511	New area source input (North end of Slag Haul Road to refinery dock) segment GH [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70512	New area source input (North end of Slag Haul Road to refinery dock) segment GH [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70513	New area source input (North end of Slag Haul Road to refinery dock) segment GH [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70550	New area source input (South Slag Haul Road paved) segment GK [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70551	New area source input (South Slag Haul Road paved) segment GK [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70552	New area source input (South Slag Haul Road paved) segment GK [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70553	New area source input (South Slag Haul Road paved) segment GK [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70600	New area source input (north end of main building to refinery dock unpaved) segment HL [a]	0.05	0.10	0.16	0.29	0.20	0.20	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70601	New area source input (north end of main building to refinery dock unpaved) segment HL [a]	0.05	0.10	0.16	0.29	0.20	0.20	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70602	New area source input (north end of main building to refinery dock unpaved) segment HL [a]	0.05	0.10	0.16	0.29	0.20	0.20	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70603	New area source input (north end of main building to refinery dock unpaved) segment HL [a]	0.05	0.10	0.16	0.29	0.20	0.20	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70604	New area source input (north end of main building to refinery dock unpaved) segment HL [a]	0.05	0.10	0.16	0.29	0.20	0.20	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70605	New area source input (north end of main building to refinery dock unpaved) segment HL [a]	0.05	0.10	0.16	0.29	0.20	0.20	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70606	New area source input (north end of main building to refinery dock unpaved) segment HL [a]	0.05	0.10	0.16	0.29	0.20	0.20	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70607	New area source input (north end of main building to refinery dock unpaved) segment HL [a]	0.05	0.10	0.16	0.29	0.20	0.20	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70608	New area source input (north end of main building to refinery dock unpaved) segment HL [a]	0.05	0.10	0.16	0.29	0.20	0.20	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70609	New area source input (north end of main building to refinery dock unpaved) segment HL [a]	0.05	0.10	0.16	0.29	0.20	0.20	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70610	New area source input (north end of main building to refinery dock unpaved) segment HL [a]	0.05	0.10	0.16	0.29	0.20	0.20	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70611	New area source input (north end of main building to refinery dock unpaved) segment HL [a]	0.05	0.10	0.16	0.29	0.20	0.20	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70612	New area source input (north end of main building to refinery dock unpaved) segment HL [a]	0.05	0.10	0.16	0.29	0.20	0.20	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-

Attachment D-5. Particle Size Inputs by Emission Point for the Primary Pb Smelter Case Study

Emission Point ID	Emission Point Description	Mass Fraction								Particle Diameter (µm)								Particle Density (g/cm^3)							
		Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8	Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8	Bin1	Bin2	Bin3	Bin4	Bin5	Bin6	Bin7	Bin8
70650	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70651	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70652	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70653	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70654	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70655	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70656	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70657	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70658	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70659	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70660	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70661	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70662	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70663	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70664	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70665	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70666	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70667	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70668	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70669	New area source input (sinter plant to sinter storage) segment IJ [a]	0.05	0.05	0.10	0.05	0.35	0.41	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70700	New area source input (south Slag Haul Road unpaved) segment KM [a]	0.05	0.10	0.16	0.29	0.20	0.20	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70701	New area source input (south Slag Haul Road unpaved) segment KM [a]	0.05	0.10	0.16	0.29	0.20	0.20	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70702	New area source input (south Slag Haul Road unpaved) segment KM [a]	0.05	0.10	0.16	0.29	0.20	0.20	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-
70703	New area source input (south Slag Haul Road unpaved) segment KM [a]	0.05	0.10	0.16	0.29	0.20	0.20	-	-	1.57	3.88	7.75	12.63	17.57	25.25	-	-	1.00	1.00	1.00	1.00	1.00	1.00	-	-

[a] Emission point description derived from MDNR (2007b).

Attachment D-6. Building Downwash Parameters for the Primary Pb Smelter Case Study

Emission Point ID	Building Parameter	Building Downwash Parameters (categorized in 10's of degrees)																																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
30001	BUILDHGT	27.43	41.10	41.10	22.86	21.30	21.30	21.30	21.30	21.30	21.30	21.30	21.30	21.30	21.30	27.43	41.10	41.10	41.10	41.10	41.10	41.10	27.30	21.30	21.30	21.30	21.30	21.30	21.30	21.30	21.30	21.30	21.30	27.43	41.10	27.43	22.86
	BUILDWID	20.27	45.21	72.28	77.54	39.79	40.68	40.33	38.75	36.00	38.75	40.33	40.68	39.79	37.70	20.95	52.47	43.90	87.00	52.24	45.21	71.64	77.54	39.79	40.68	40.33	38.75	36.00	38.75	40.33	40.68	39.79	37.70	20.95	52.47	20.27	80.00
	BUILDLEN	12.16	74.07	162.98	137.22	37.70	34.45	30.17	24.96	19.00	24.96	30.17	34.45	37.70	39.79	17.29	72.71	71.95	142.00	83.88	74.07	85.92	80.25	37.70	34.45	30.17	24.96	19.00	24.96	30.17	34.45	37.70	39.79	17.29	72.71	12.16	112.00
	XBADJ	-54.05	79.53	71.08	22.93	-32.76	-26.83	-20.09	-12.74	-5.00	-3.36	-1.62	0.17	1.95	3.68	36.47	-152.58	-157.68	-231.00	-239.30	-153.60	-234.05	-160.15	-4.94	-7.62	-10.08	-12.22	-14.00	-21.60	-28.55	-34.62	-39.65	-43.47	-53.77	79.87	-55.61	40.00
	YBADJ	-13.03	42.71	53.25	41.32	-23.58	-25.63	-26.91	-27.37	-27.00	-25.81	-23.83	-21.13	-17.79	-13.91	-20.85	41.90	20.26	24.50	14.45	-42.71	-52.93	-41.32	23.58	25.63	26.91	27.37	27.00	25.81	23.83	21.13	17.79	13.91	20.85	-41.90	4.16	-28.00
40004	BUILDHGT	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10
	BUILDWID	52.24	62.90	71.64	61.97	67.64	71.26	72.71	71.95	69.00	72.64	74.07	73.26	70.21	65.04	59.44	59.91	48.19	87.00	52.24	62.90	71.64	61.97	67.64	71.26	72.71	71.95	69.00	72.64	74.07	73.26	70.21	65.04	59.44	59.91	48.19	87.00
	BUILDLEN	83.88	86.21	85.92	70.21	65.04	59.44	52.47	43.90	34.00	35.62	45.21	54.42	61.97	67.64	71.26	83.22	81.62	142.00	83.88	86.21	85.92	70.21	65.04	59.44	52.47	43.90	34.00	35.62	45.21	54.42	61.97	67.64	71.26	83.22	81.62	142.00
	XBADJ	29.84	24.77	18.94	-64.64	-69.20	-73.22	-75.44	-75.36	-73.00	-72.93	-75.70	-77.16	-76.27	-73.07	-67.64	-110.38	-112.67	-113.00	-113.71	-110.97	-104.86	-5.57	4.16	13.78	22.97	31.46	39.00	37.31	30.49	22.74	14.30	5.42	-3.61	27.16	31.05	-29.00
	YBADJ	18.24	29.92	40.70	45.28	39.25	32.01	23.81	14.88	5.50	-3.70	-12.79	-21.49	-29.53	-36.68	-43.50	21.85	9.32	-29.50	-18.24	-29.92	-40.70	-45.28	-39.25	-32.01	-23.81	-14.88	-5.50	3.70	12.79	21.49	29.53	36.68	43.50	-21.85	-9.32	29.50
40005	BUILDHGT	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10
	BUILDWID	52.24	62.90	54.42	61.97	67.64	71.26	72.71	71.95	69.00	72.64	74.07	73.26	70.21	65.04	59.44	59.91	48.19	87.00	52.24	62.90	54.42	61.97	67.64	71.26	72.71	71.95	69.00	72.64	74.07	73.26	70.21	65.04	59.44	59.91	48.19	87.00
	BUILDLEN	83.88	86.21	73.26	70.21	65.04	59.44	52.47	43.90	34.00	35.62	45.21	54.42	61.97	67.64	71.26	83.22	81.62	142.00	83.88	86.21	73.26	70.21	65.04	59.44	52.47	43.90	34.00	35.62	45.21	54.42	61.97	67.64	71.26	83.22	81.62	142.00
	XBADJ	20.16	15.71	-66.27	-71.66	-74.86	-77.35	-77.92	-76.12	-72.00	-70.21	-71.34	-71.29	-69.08	-64.76	-58.48	-100.64	-102.65	-103.00	-104.04	-101.92	-6.98	1.44	9.83	17.91	25.45	32.21	38.00	34.59	26.13	16.87	7.11	-2.88	-12.78	17.42	21.03	-39.00
	YBADJ	15.52	25.56	44.08	38.09	30.94	22.85	14.07	4.86	-4.50	-13.37	-21.84	-29.65	-36.55	-42.34	-47.63	19.37	8.56	-28.50	-15.52	-25.56	-44.08	-38.09	-30.94	-22.85	-14.07	-4.86	4.50	13.37	21.84	29.65	36.55	42.34	47.63	-19.37	-8.56	28.50
50007	BUILDHGT	41.10	27.30	27.43	27.43	21.30	21.30	18.30	18.30	22.86	22.86	22.86	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	27.30	18.30	18.30	18.30	18.30	18.30	18.30	22.86	22.86	22.86	41.10	41.10	41.10	41.10	41.10	41.10	41.10
	BUILDWID	80.82	65.20	20.95	20.34	39.79	40.68	203.33	79.02	49.00	51.55	52.54	73.26	70.21	65.04	59.44	52.47	48.19	87.00	52.24	65.20	131.44	157.17	178.13	193.67	203.33	206.80	112.00	124.19	132.61	73.26	70.21	65.04	59.44	52.47	108.77	87.00
	BUILDLEN	153.73	78.35	17.29	19.11	37.70	34.45	98.90	29.25	19.00	27.22	34.61	54.42	61.97	67.64	71.26	72.71	81.62	142.00	83.88	78.35	192.17	176.20	154.88	128.85	98.90	65.95	80.00	79.48	100.14	54.42	61.97	67.64	71.26	72.71	133.77	142.00
	XBADJ	44.98	38.16	-106.33	-107.40	-99.42	-95.31	-82.61	-81.30	-73.55	-82.62	-89.17	-127.52	-138.39	-145.05	-147.31	-145.10	-200.29	-200.64	-198.71	-116.51	-46.04	-40.22	-33.17	-25.11	-16.29	-6.98	-6.45	3.14	12.63	73.10	76.42	77.41	76.06	72.39	66.53	58.64
	YBADJ	55.18	45.23	9.48	-7.63	-7.27	-21.15	-37.13	41.09	34.14	22.50	10.17	50.64	32.75	13.87	-6.22	-26.32	17.10	-37.05	-40.89	-45.23	5.02	13.93	22.43	30.24	37.13	42.90	-65.64	-58.82	-50.21	-50.64	-32.75	-13.87	6.22	26.32	13.19	37.05
50008	BUILDHGT	41.10	21.30	27.43	27.43	21.30	21.30	21.30	18.30	18.30	22.86	22.86	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	18.30	18.30	18.30	18.30	18.30	18.30	18.30	18.30	22.86	22.86	41.10	41.10	41.10	41.10	41.10	41.10	41.10
	BUILDWID	80.82	29.14	20.95	20.34	39.79	40.68	40.33	79.02	79.00	51.55	52.54	73.26	70.21	65.04	59.44	52.47	48.19	87.00	52.24	101.72	131.44	157.17	178.13	193.67	203.33	206.80	204.00	124.19	132.61	73.26	70.21	65.04	59.44	52.47	108.77	87.00
	BUILDLEN	153.73	37.51	17.29	19.11	37.70	34.45	30.17	29.25	26.00	27.22	34.61	54.42	61.97	67.64	71.26	72.71	81.62	142.00	83.88	202.30	192.17	176.20	154.88	128.85	98.90	65.95	36.00	79.48	100.14	54.42	61.97	67.64	71.26	72.71	133.77	142.00
	XBADJ	50.69	-127.64	-101.40	-103.09	-95.86	-92.61	-86.55	-80.54	-80.81	-83.89	-91.42	-130.67	-142.35	-149.70	-152.51	-150.68	-206.10	-206.49	-204.43	-55.88	-50.98	-44.53	-36.73	-27.81	-18.05	-7.74	2.81	4.41	14.87	76.25	80.38	82.06	81.25	77.98	72.33	64.49
	YBADJ	56.45	21.36	12.63	-3.67	-2.62	-15.95	-28.80	46.90	33.99	28.22	15.58	55.57	37.06	17.43	-3.52	-24.57	17.86	-37.31	-42.16	-6.30	1.87	9.97	17.78	25.04	31.55	37.09	41.51	-64.53	-55.61	-55.57	-37.06	-17.43	3.52	24.57	12.43	37.31
50011	BUILDHGT	41.10	27.30	27.30	27.43	21.30	21.30	21.30	18.30	18.30	22.86	22.86	22.86	41.10	41.10	41.10	41.10	41.10	41.10	41.10	27.30	27.30	21.30	21.30	21.30	21.30	18.30	18.30	22.86	22.86	22.86	41.10	41.10	41.10	41.10	41.10	41.10
	BUILDWID	80.82	65.20	72.47	20.34	39.79	40.68	40.33	79.02	79.00	51.55	52.54	51.94	70.21	65.04	59.44	52.47	43.90	87.00	52.24	65.20	72.47	37.70	39.79	40.68	40.33	79.02	204.00	51.55	52.54	51.94	70.21	65.04	59.44	52.47	43.90	87.00
	BUILDLEN	153.73	78.35	80.52	19.11	37.70	34.45	30.17	29.25	26.00	27.22	34.61	40.95	61.97	67.64	71.26	72.71	71.95	142.00	83.88	78.35	80.52	39.79	37.70	34.45	30.17	29.25	36.00	27.22	34.61	40.95	61.97	67.64	71.26	72.71	71.95	142.00
	XBADJ	58.05	53.56	45.29	-88.83	-80.08	-75.80	-69.22	-63.20	-64.00	-68.12	-77.16	-83.86	-132.37	-142.35	-148.01	-149.17	-145.80	-211.00	-211.79	-131.91	-125.82	42.14	42.39	41.35	39.05	33.95	-14.00	40.90	42.55	42.91	70.40	74.71	76.76	76.47	73.86	69.00
	YBADJ	40.68	33.22	48.82	-13.65	-9.97	-20.45	-30.31	48.42	38.50	35.58	25.57	14.79	51.32	33.21	13.30	-7.23	-27.53	-20.50	-26.39	-33.22	-48.82	-0.81	9.97	20.45	30.31	-48.42	37.00	-35.58	-25.57	-14.79	-51.32	-33.21	-13.30	7.23	27.53	20.50
50012	BUILDHGT	41.10	41.10	27.30	27.43	21.30	21.30	18.30	18.30	22.86	22.86	22.86	22.86	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	27.30	18.30	18.30	18.30	18.30	18.30	22.86	22.86	22.86	22.86	41.10	41.10	41.10	41.10	41.10	41.10
	BUILDWID	80.82	77.23	72.47	20.34	39.79	40.68	203.33	79.02	49.00	51.55	52.54	51.94	70.21	65.04	59.44	52.47	43.90	87.00	52.24	62.90	72.47	157.17	178.13	193.67	203.33	79.02	49.00	51.55	52.54	51.94	70.21	65.04	59.44	52.47	43.90	87.00
	BUILDLEN	153.73	160.80	80.52	19.11	37.70	34.45	98.90	29.25	19.00	27.22	34.61	40.95	61.97	67.64	71.26	72.71	71.95	142.00	83.88	86.21	80.52	176.20	154.88	128.85	98.90	29.25	19.00	27.22	34.61	40.95	61.97	67.64	71.26	72.71	71.95	142.00
	XBADJ	49.19	36.89	37.50	-95.72	-85.87	-80.30	-66.59	-64.76	-57.00	-66.55	-74.08	-79.36	-126.58	-135.46	-140.22	-140.72	-136.94	-202.00	-202.93	-197.68	-118.02	-51.90	-46.72	-40.12	-32.31	35.51	38.00	39.33	39.47	38.41	64.61	67.82	68.96	68.01	64.99	60.00
	YBADJ	39.12	59.07	44.32	-19.43	-16.87	-28.25	-41.52	39.56	35.50	26.71	17.11	6.99	44.43	27.42	8.80	-10.31	-29.09	-20.50	-24.83	-51.90	-44.32	25.74	32.02	37.34	41.52	-39.56	-35.50	-26.71	-17.11	-6.99	-44.43	-27.42	-8.80	10.31	29.09	20.50
50013	BUILDHGT	41.10	41.10	27.30	27.30	21.30	18.30	18.30	22.86	22.86	22.86	22.86	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	27.30	27.30	18.30	18.30	18.30	22.86	22.86	22.86	22.86	41.10	41.10	41.10	41.10	41.10	41.10	41.10
	BUILDWID	80.82	77.23	72.47	77.54	39.79	193.67	76.63	51.55	49.00	51.55	52.54	73.26	70.21	65.04	59.44	52.47	43.90	87.00	52.24	62.90	72.47	77.54	178.13	193.67	76.63	51.55	49.00	51.55	52.54	73.26	70.21	65.04	59.44	52.47	43.90	87.00
	BUILDLEN	153.73	160.80	80.52	80.25	37.70	128.85	33.60	27.22	19.00	27.22	34.61	54.42	61.97	67.64	71.26	72.71	71.95	142.00	83.88	86.21	80.52	80.25	154.88	128.85	33.60	27.22	19.00	27.22	34.61	54.42	61.97	67.64	71.26	72.71	71.95	142.00
	XBADJ	40.33	28.43	29.70	21.86	-91.65	-93.22	-66.64	-55.79	-57.00	-64.99	-71.01	-109.36	-120.80	-128.56	-132.42	-132.26	-128.07	-193.00	-194.06	-189.23	-110.23	-102.11	-40.94	-35.62	33.04	28.57	38.00	37.77	36.39	54.94	58.83	60.92	61.17	59.55	56.13	51.00
	YBADJ	37.55	55.99	39.82	51.36	-23.76	-45.13	39.96	34.35	26.50	17.85	8.66	52.30	37.54	21.64	4.30	-13.38	-30.66	-20.50	-23.27	-48.83	-39.82	-51.36	38.92	45.13	-39.96	-34.35	-26.50	-17.85	-8.66	-52.30	-37.54	-21.64	-4.30	13.38	30.66	20.50
50014	BUILDHGT	41.10	41.10	27.30	27.30	21.30	18.30	22.86	22.86	22.86	22.86	22.86	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	27.30	27.30	18.30	18.30	22.86	22.86	22.86	22.86	22.86	41.10	41.10	41.10	41.10	41.10	41.10	41.10
	BUILDWID	80.82	77.23	72.47	77.54	39.79	71.92	52.54	51.55	49.00	51.55	52.54	73.26	70.21	65.04	59.44	52.47	43.90	87.00	52.24	62.90	72.47	77.54	178.13	71.92	52.54	51.55	49.00	51.55	52.54	73.26	70.21	65.04	59.44	52.47	43.90	87.00
	BUILDLEN	153.73	160.80	80.52	80.25	37.70	45.56	34.61	27.22	19.00	27.22	34.61	54.42	61.97	67.64	71.26	72.71	71.95	142.00	83.88	86.21	80.52	80.25	154.88	45.56	34.61	27.22	19.00	27.22	34.61	54.42	61.97	67.64	71.26	72.71	71.95	142.00
	XBADJ	32.45	20.91	22.77	15.73	-96.80	-68.93	-55.61	-57.18	-57.00	-63.60	-68.27	-105.36	-115.66	-122.44	-125.49	-124.74	-120.20	-185.00	-186.18	-181.71	-103.30	-95.98	-35.79	23.36	21.00	29.96	38.00	36.38	33.66	50.94	53.69	54.79	54.24	52.04	48.25	43.00
	YBADJ	36.16	53.25	35.82	46.22	-29.89	41.08	33.63	26.47	18.50	9.97	1.14	45.37	31.41	16.49	0.30	-16.12	-32.05	-20.50	-21.88	-46.09	-35.82	-46.22	45.05	-41.08	-33.63	-26.47	-18.50	-9.97	-1.14	-45.37	-31.41	-16.49	-0.30	16.12	32.05	20.50
50015	BUILDHGT	41.10	41.10	27.30	27.30	27.30	22.86	22.86	22.86	22.86	22.86	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	27.30	27.30	27.30	22.86	22.86	22.86	22.86	22.86	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10
	BUILDWID	80.82	77.23	72.47	77.54	80.25	51.94	52.54	51.55	49.00	51.55	74.07	73.26	70.21	65.04	59.44	52.47	43.90	87.00	52.24	62.90	72.47	77.54	80.25	51.94	52.54	51.55	49.00	51.55	74.07	73.26	70.21	65.04	59.44	52.47	43.90	87.00
	BUILDLEN	153.73	160.80	80.52	80.25	77.54	40.95	34.61	27.22	19.00	27.22	45.21	54.42	61.97	67.64	71.26	72.71	71.95	142.00	83.88	86.21	80.52	80.25	77.54	40.95	34.61	27.22	19.00	27.22	45.21	54.42	61.97	67.64	71.26	72.71	71.95	142.00
	XBADJ	23.59	12.45	14.98	8.84	2.43	-56.86	-58.69	-58.74	-57.00	-62.04	-88.79	-100.86	-109.87	-115.54	-117.70	-116.28	-111.33	-176.00	-177.32	-173.25	-95.50	-89.09	-79.97	15.91	24.08	31.52	38.00	34.82	43.58	46.44	47.90	47.90	46.44	43.58	39.39	34.00
	YBADJ	34.60	50.18	31.32	40.43	48.32	31.98	25.17	17.60	9.50	1.11	49.49	37.57	24.51	10.71	-4.20	-19.20	-33.61	-20.50	-20.31	-43.01	-31.32	-40.43	-48.32	-31.98	-25.17	-17.60	-9.50	-1.11	-49.49	-37.57	-24.51	-10.71	4.20	19.20	33.61	20.50
50016	BUILDHGT	41.10	41.10	27.30	27.30	27.30	27.30	27.30	22.86	22.86	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	27.30	27.30	27.30	27.30	27.30	22.86	22.86	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10
	BUILDWID	80.82	62.90	72.47	77.54	80.25	80.52	78.35	51.55	49.00	72.64	74.07	73.26	70.21	65.04	59.44	52.47	43.90	87.00	52.24	62.90	72.47	77.54	80.25	80.52	78.35	51.55	49.00	72.64	74.07	73.26	70.21	65.04	59.44	52.47	43.90	87.00
	BUILDLEN	153.73	86.21	80.52	80.25	77.54	72.47	65.20	27.22	19.00	35.62	45.21	54.42	61.97	67.64	71.26	72.71	71.95	142.00	83.88	86.21	80.52	80.25	77.54	72.47	65.20	27.22	19.00	35.62	45.21	54.42	61.97	67.64	71.26	72.71	71.95	142.00
	XBADJ	14.72	78.59	7.19	1.95	-3.35	-8.55	-13.49	-60.30	-57.00	-73.45	-85.71	-96.36	-104.09	-108.65	-109.91	-107.83	-102.47	-167.00	-168.46	-164.80	-87.71	-82.20	-74.18	-63.92	-51.71	33.08	38.00	37.82	40.50	41.94	42.12	41.01	38.65	35.12	30.52	25.00
	YBADJ	33.04	39.93	26.82	34.65	41.43	46.95	51.04	8.74	0.50	51.04	41.03	29.78	17.62	4.92	-8.70	-22.28	-35.17	-20.50	-18.75	-39.93	-26.82	-34.65	-41.43	-46.95	-51.04	-8.74	-0.50	-51.04	-41.03	-29.78	-17.62	-4.92	8.70	22.28	35.17	20.50
50017	BUILDHGT	41.10	41.10	41.10	27.30	27.30	27.30	27.30	27.30	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	27.30	27.30	27.30	27.30	27.30	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10
	BUILDWID	52.24	62.90	71.64	77.54	80.25	80.52	78.35	73.80	69.00	72.64	74.07	73.26	70.21	65.04	59.44	52.47	43.90	87.00	52.24	62.90	71.64	77.54	80.25	80.52	78.35	73.80	69.00	72.64	74.07	73.26	70.21	65.04	59.44	52.47	43.90	87.00
	BUILDLEN	83.88	86.21	85.92	80.25	77.54	72.47	65.20	55.95	34.00	35.62	45.21	54.42	61.97	67.64	71.26	72.71	71.95	142.00	83.88	86.21	85.92	80.25	77.54	72.47	65.20	55.95	34.00	35.62	45.21	54.42	61.97	67.64	71.26	72.71	71.95	142.00
	XBADJ	75.72	70.13	62.42	-4.95	-9.14	-13.05	-16.57	-19.58	-64.00	-71.88	-82.63	-91.86	-98.30	-101.75	-102.11	-99.37	-93.61	-158.00	-159.59	-156.34	-148.33	-75.30	-68.40	-59.42	-48.63	-36.37	30.00	36.26	37.42	37.44	36.33	34.11	30.86	26.66	21.66	16.00
	YBADJ	17.19	36.86	55.40	28.86	34.53	39.15	42.59	44.72	50.50	42.18	32.58	21.98	10.72	-0.86	-13.20	-25.35	-36.74	-20.50	-17.19	-36.86	-55.40	-28.86	-34.53	-39.15	-42.59	-44.72	-50.50	-42.18	-32.58	-21.98	-10.72	0.86	13.20	25.35	36.74	20.50
50018	BUILDHGT	41.10	41.10	41.10	27.30	27.30	27.30	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	27.30	27.30	27.30	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10	41.10
	BUILDWID	52.24	62.90	71.64	77.54	80.25	80.52	72.71	71.95	69.00	72.64	74.07	73.26	70.21	65.04	59.44	52.47	43.90	87.00	52.24	62.90	71.64	77.54	80.25	80.52	72.71	71.95	69.00	72.64	74.07	73.26	70.21	65.04	59.44	52.47	43.90	87.00
	BUILDLEN	83.88	86.21	85.92	80.25	77.54	72.47	52.47	43.90	34.00	35.62	45.21	54.42	61.97	67.64	71.26	72.71	71.95	142.00	83.88	86.21	85.92	80.25	77.54	72.47	52.47	43.90	34.00	35.62	45.21	54.42	61.97	67.64	71.26	72.71	71.95	142.00
	XBADJ	66.85	61.67	54.62	-11.84	-14.92	-17.55	-54.67	-60.25	-64.00	-70.32	-79.56	-87.36	-92.52	-94.86	-94.32	-90.91	-84.74	-149.00	-150.73	-147.88	-140.54	-68.41	-62.61	-54.92	2.20	16.35	30.00	34.70	34.34	32.94	30.55	27.22	23.06	18.21	12.80	7.00
	YBADJ	15.63	33.78	50.90	23.08	27.64	31.36	54.56	48.77	41.50	33.32	24.12	14.19	3.83	-6.65	-17.70	-28.43	-38.30	-20.50	-15.63	-33.78	-50.90	-23.08	-27.64	-31.36	-54.56	-48.77	-41.50	-33.32	-24.12	-14.19	-3.83	6.65	17.70	28.43	38.30	20.50
60001	BUILDHGT	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24
	BUILDWID	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00
	BUILDLEN	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00
	XBADJ	-20.39	-20.16	-19.32	-17.89	-15.92	-13.46	-10.60	-7.41	-4.00	-3.77	-3.42	-2.96	-2.42	-1.81	-1.13	-0.43	0.29	1.00	-7.00	-14.79	-22.13	-28.80	-34.60	-39.34	-42.88	-45.13	-46.00	-48.77	-50.07	-49.84	-48.09	-44.89	-40.32	-34.53	-27.68	-20.00
	YBADJ	-22.50	-23.32	-23.44	-22.84	-21.54	-19.59	-17.05	-13.99	-10.50	-6.69	-2.68	1.41	5.46	9.34	12.94	16.14	18.86	21.00	22.50	23.32	23.44	22.84	21.54	19.59	17.05	13.99	10.50	6.69	2.68	-1.41	-5.46	-9.34	-12.94	-16.14	-18.86	-21.00
60002	BUILDHGT	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24
	BUILDWID	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00
	BUILDLEN	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00
	XBADJ	-27.51	-34.18	-39.82	-44.25	-47.33	-48.97	-49.13	-47.79	-45.00	-44.14	-41.94	-38.47	-33.83	-28.16	-21.63	-14.45	-6.83	1.00	0.12	-0.77	-1.63	-2.45	-3.19	-3.83	-4.36	-4.75	-5.00	-8.40	-11.54	-14.33	-16.69	-18.53	-19.82	-20.50	-20.56	-20.00
	YBADJ	17.87	15.20	12.07	8.57	4.81	0.91	-3.03	-6.87	-10.50	-13.81	-16.71	-19.09	-20.90	-22.07	-22.57	-22.39	-21.52	-20.00	-17.87	-15.20	-12.07	-8.57	-4.81	-0.91	3.03	6.87	10.50	13.81	16.71	19.09	20.90	22.07	22.57	22.39	21.52	20.00
60003	BUILDHGT	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24
	BUILDWID	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00
	BUILDLEN	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00
	XBADJ	-26.18	-29.57	-32.05	-33.57	-34.06	-33.52	-31.96	-29.43	-26.00	-25.08	-23.41	-21.02	-17.99	-14.41	-10.40	-6.07	-1.56	3.00	-1.21	-5.39	-9.40	-13.13	-16.46	-19.28	-21.53	-23.11	-24.00	-27.46	-30.08	-31.78	-32.53	-32.28	-31.05	-28.88	-25.83	-22.00
	YBADJ	-1.19	-3.34	-5.38	-7.27	-8.93	-10.33	-11.40	-12.14	-12.50	-12.48	-12.09	-11.33	-10.22	-8.80	-7.12	-5.21	-3.16	-1.00	1.19	3.34	5.38	7.27	8.93	10.33	11.40	12.14	12.50	12.48	12.09	11.33	10.22	8.80	7.12	5.21	3.16	1.00
60004	BUILDHGT	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	15.24	15.24	15.24	15.24	15.24	15.24	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71
	BUILDWID	58.62	65.45	70.30	73.01	73.51	71.77	67.84	61.86	54.00	61.86	67.84	71.77	73.51	50.52	52.80	53.48	52.54	50.00	52.54	65.45	70.30	73.01	73.51	71.77	67.84	61.86	54.00	61.86	67.84	71.77	73.51	73.01	70.30	65.45	58.62	50.00
	BUILDLEN	61.86	67.84	71.77	73.51	73.01	70.30	65.45	58.62	50.00	58.62	65.45	70.30	73.01	46.69	41.45	34.96	27.39	19.00	27.39	67.84	71.77	73.51	73.01	70.30	65.45	58.62	50.00	58.62	65.45	70.30	73.01	73.51	71.77	67.84	61.86	54.00
	XBADJ	-5.21	-13.26	-20.90	-27.91	-34.08	-39.20	-43.14	-45.77	-47.00	-56.18	-63.66	-69.20	-72.64	-88.43	-89.32	-87.49	-83.01	-76.00	-75.37	-54.59	-50.86	-45.59	-38.94	-31.10	-22.31	-12.85	-3.00	-2.43	-1.79	-1.10	-0.37	0.37	1.10	1.79	2.43	3.00
	YBADJ	26.88	30.93	34.05	36.14	37.12	36.98	35.72	33.36	30.00	25.72	20.67	14.98	8.84	25.89	14.20	2.07	-10.12	-22.00	-33.21	-30.93	-34.05	-36.14	-37.12	-36.98	-35.72	-33.36	-30.00	-25.72	-20.67	-14.98	-8.84	-2.43	4.05	10.41	16.46	22.00

Attachment D-6. Building Downwash Parameters for the Primary Pb Smelter Case Study

Emission Point ID	Building Parameter	Building Downwash Parameters (categorized in 10's of degrees)																																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
60005	BUILDHGT	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24
	BUILDWID	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00
	BUILDLEN	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00
	XBADJ	-10.60	-11.88	-12.79	-13.32	-13.45	-13.16	-12.48	-11.41	-10.00	-11.58	-12.82	-13.66	-14.09	-14.09	-13.66	-12.82	-11.58	-10.00	-16.79	-23.08	-28.66	-33.37	-37.07	-39.64	-41.01	-41.13	-40.00	-40.96	-40.67	-39.14	-36.43	-32.61	-27.79	-22.14	-15.81	-9.00
	YBADJ	-14.69	-13.92	-12.74	-11.17	-9.26	-7.07	-4.66	-2.11	0.50	3.10	5.60	7.93	10.02	11.81	13.24	14.27	14.86	15.00	14.69	13.92	12.74	11.17	9.26	7.07	4.66	2.11	-0.50	-3.10	-5.60	-7.93	-10.02	-11.81	-13.24	-14.27	-14.86	-15.00
60006	BUILDHGT	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24
	BUILDWID	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00
	BUILDLEN	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00
	XBADJ	-12.34	-15.30	-17.79	-19.75	-21.11	-21.82	-21.87	-21.26	-20.00	-21.43	-22.21	-22.32	-21.75	-20.52	-18.66	-16.24	-13.32	-10.00	-15.06	-19.66	-23.66	-26.94	-29.41	-30.98	-31.61	-31.28	-30.00	-31.11	-31.27	-30.48	-28.77	-26.18	-22.79	-18.72	-14.07	-9.00
	YBADJ	-4.84	-4.53	-4.08	-3.51	-2.83	-2.07	-1.24	-0.38	0.50	1.36	2.18	2.93	3.60	4.15	4.58	4.87	5.01	5.00	4.84	4.53	4.08	3.51	2.83	2.07	1.24	0.38	-0.50	-1.36	-2.18	-2.93	-3.60	-4.15	-4.58	-4.87	-5.01	-5.00
60007	BUILDHGT	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24
	BUILDWID	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00
	BUILDLEN	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00
	XBADJ	-14.07	-18.72	-22.79	-26.18	-28.77	-30.48	-31.27	-31.11	-30.00	-31.28	-31.61	-30.98	-29.41	-26.94	-23.66	-19.66	-15.06	-10.00	-13.32	-16.24	-18.66	-20.52	-21.75	-22.32	-22.21	-21.43	-20.00	-21.26	-21.87	-21.82	-21.11	-19.75	-17.79	-15.30	-12.34	-9.00
	YBADJ	5.01	4.87	4.58	4.15	3.60	2.93	2.18	1.36	0.50	-0.38	-1.24	-2.07	-2.83	-3.51	-4.08	-4.53	-4.84	-5.00	-5.01	-4.87	-4.58	-4.15	-3.60	-2.93	-2.18	-1.36	-0.50	0.38	1.24	2.07	2.83	3.51	4.08	4.53	4.84	5.00
60008	BUILDHGT	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24	15.24
	BUILDWID	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00
	BUILDLEN	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00	27.39	34.96	41.45	46.69	50.52	52.80	53.48	52.54	50.00	52.54	53.48	52.80	50.52	46.69	41.45	34.96	27.39	19.00
	XBADJ	-15.81	-22.14	-27.79	-32.61	-36.43	-39.14	-40.67	-40.96	-40.00	-41.13	-41.01	-39.64	-37.07	-33.37	-28.66	-23.08	-16.79	-10.00	-11.58	-12.82	-13.66	-14.09	-14.09	-13.66	-12.82	-11.58	-10.00	-11.41	-12.48	-13.16	-13.45	-13.32	-12.79	-11.88	-10.60	-9.00
	YBADJ	14.86	14.27	13.24	11.81	10.02	7.93	5.60	3.10	0.50	-2.11	-4.66	-7.07	-9.26	-11.17	-12.74	-13.92	-14.69	-15.00	-14.86	-14.27	-13.24	-11.81	-10.02	-7.93	-5.60	-3.10	-0.50	2.11	4.66	7.07	9.26	11.17	12.74	13.92	14.69	15.00

Attachment D-7. Estimated Media Concentrations in Current NAAQS Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7006031	737	0.032	0.013	40	Regression equation from EPA soil measurements vs. distance	20	46	66	Air+soil regression-based model
7009003	254	0.027	0.010	51	Regression equation from EPA soil measurements vs. distance	17	50	67	Air+soil regression-based model
7008004	197	0.089	0.036	186	Regression equation from EPA soil measurements vs. distance	57	99	156	Air+soil regression-based model
7006052	187	0.015	6.0E-03	51	Regression equation from EPA soil measurements vs. distance	10	50	60	Air+soil regression-based model
7006013	176	0.153	0.064	231	Regression equation from EPA soil measurements vs. distance	97	115	213	Air+soil regression-based model
7001044	164	0.017	7.0E-03	30	Regression equation from EPA soil measurements vs. distance	11	42	53	Air+soil regression-based model
7010001	145	0.019	8.0E-03	37	Regression equation from EPA soil measurements vs. distance	12	45	57	Air+soil regression-based model
7008007	141	0.057	0.023	105	Regression equation from EPA soil measurements vs. distance	36	70	106	Air+soil regression-based model
7006053	139	0.031	0.012	91	Regression equation from EPA soil measurements vs. distance	20	64	84	Air+soil regression-based model
7009001	120	0.046	0.017	85	Regression equation from EPA soil measurements vs. distance	29	62	91	Air+soil regression-based model

Attachment D-7. Estimated Media Concentrations in Current NAAQS Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7008005	104	0.066	0.027	132	Regression equation from EPA soil measurements vs. distance	42	79	122	Air+soil regression-based model
6015002	95	0.134	0.056	282	Regression equation from EPA soil measurements vs. distance	85	134	219	Air+soil regression-based model
7008002	92	0.062	0.025	100	Regression equation from EPA soil measurements vs. distance	39	68	107	Air+soil regression-based model
7009002	86	0.045	0.017	91	Regression equation from EPA soil measurements vs. distance	29	65	93	Air+soil regression-based model
6012052	79	0.093	0.039	107	Regression equation from EPA soil measurements vs. distance	60	70	130	Air+soil regression-based model
7007003	77	0.083	0.034	195	Regression equation from EPA soil measurements vs. distance	53	102	155	Air+soil regression-based model
7007005	74	0.034	0.014	73	Regression equation from EPA soil measurements vs. distance	22	58	80	Air+soil regression-based model
7008003	72	0.047	0.019	83	Regression equation from EPA soil measurements vs. distance	30	62	92	Air+soil regression-based model
7007001	70	0.054	0.022	111	Regression equation from EPA soil measurements vs. distance	35	72	106	Air+soil regression-based model
7006054	63	0.047	0.018	139	Regression equation from EPA soil measurements vs. distance	30	82	112	Air+soil regression-based model

Attachment D-7. Estimated Media Concentrations in Current NAAQS Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7006051	62	0.031	0.012	55	Regression equation from EPA soil measurements vs. distance	20	51	71	Air+soil regression-based model
7008006	58	0.057	0.023	112	Regression equation from EPA soil measurements vs. distance	36	72	108	Air+soil regression-based model
7007004	49	0.065	0.026	146	Regression equation from EPA soil measurements vs. distance	41	84	126	Air+soil regression-based model
7002029	46	0.133	0.054	222	Regression equation from EPA soil measurements vs. distance	85	112	197	Air+soil regression-based model
7006011	45	0.100	0.042	185	Regression equation from EPA soil measurements vs. distance	64	99	162	Air+soil regression-based model
2001044	34	0.026	0.010	44	Regression equation from EPA soil measurements vs. distance	17	47	64	Air+soil regression-based model
7002016	29	0.095	0.039	354	Regression equation from EPA soil measurements vs. distance	61	160	221	Air+soil regression-based model
7002033	23	0.122	0.050	245	Regression equation from EPA soil measurements vs. distance	78	120	199	Air+soil regression-based model
8001017	22	0.059	0.024	120	Regression equation from EPA soil measurements vs. distance	38	75	113	Air+soil regression-based model
6014015	15	0.189	0.079	277	Regression equation from EPA soil measurements vs. distance	121	132	253	Air+soil regression-based model

Attachment D-7. Estimated Media Concentrations in Current NAAQS Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6014027	14	0.449	0.188	223	Re-contamination sample in block	1644	794	2438	H6 model
8001030	14	0.078	0.031	145	Regression equation from EPA soil measurements vs. distance	50	84	134	Air+soil regression-based model
6014025	13	0.223	0.093	116	Re-contamination samples nearby	662	794	1456	H6 model
7002032	13	0.107	0.044	242	Regression equation from EPA soil measurements vs. distance	68	119	187	Air+soil regression-based model
7002021	12	0.101	0.041	211	Regression equation from EPA soil measurements vs. distance	65	108	173	Air+soil regression-based model
6012003	12	0.022	9.0E-03	38	Regression equation from EPA soil measurements vs. distance	14	45	59	Air+soil regression-based model
6015001	11	0.171	0.072	42	Re-contamination sample in block	404	794	1197	H6 model
3001003	11	0.034	0.013	43	Regression equation from EPA soil measurements vs. distance	21	47	68	Air+soil regression-based model
3001000	11	0.012	5.0E-03	27	Regression equation from EPA soil measurements vs. distance	8	41	49	Air+soil regression-based model
8001036	10	0.076	0.031	117	Regression equation from EPA soil measurements vs. distance	48	74	122	Air+soil regression-based model

Attachment D-7. Estimated Media Concentrations in Current NAAQS Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6012053	9	0.090	0.038	97	Regression equation from EPA soil measurements vs. distance	57	67	124	Air+soil regression-based model
2001050	9	0.019	7.0E-03	32	Regression equation from EPA soil measurements vs. distance	12	43	55	Air+soil regression-based model
6015016	8	0.238	0.100	105	Re-contamination sample in block	736	794	1529	H6 model
8001035	8	0.071	0.029	119	Regression equation from EPA soil measurements vs. distance	45	75	120	Air+soil regression-based model
8001031	8	0.068	0.027	144	Regression equation from EPA soil measurements vs. distance	44	84	127	Air+soil regression-based model
8001037	8	0.063	0.025	113	Regression equation from EPA soil measurements vs. distance	40	72	113	Air+soil regression-based model
2001041	8	0.013	5.0E-03	28	Regression equation from EPA soil measurements vs. distance	8	42	50	Air+soil regression-based model
6012016	8	0.026	0.011	42	Regression equation from EPA soil measurements vs. distance	17	46	63	Air+soil regression-based model
7002030	7	0.116	0.047	205	Regression equation from EPA soil measurements vs. distance	74	106	180	Air+soil regression-based model
6012001	7	0.031	0.013	43	Regression equation from EPA soil measurements vs. distance	20	47	67	Air+soil regression-based model

Attachment D-7. Estimated Media Concentrations in Current NAAQS Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6014051	6	0.444	0.186	184	Re-contamination sample in block	1623	794	2417	H6 Model
6014044	6	0.240	0.101	159	Re-contamination samples nearby	744	794	1538	H6 Model
6015017	6	0.222	0.093	153	Re-contamination sample in block	656	794	1450	H6 Model
7002028	6	0.110	0.045	189	Regression equation from EPA soil measurements vs. distance	70	100	170	Air+soil regression-based model
6012021	6	0.042	0.018	53	Regression equation from EPA soil measurements vs. distance	27	50	77	Air+soil regression-based model
6014039	5	0.675	0.282	294	Re-contamination sample in block	2497	794	3291	H6 model
6014046	5	0.458	0.192	129	Re-contamination sample in block	1679	794	2472	H6 model
6015012	5	0.163	0.068	63	Re-contamination sample in block	363	794	1156	H6 model
6015019	5	0.098	0.041	176	Re-contamination sample in block	0	794	794	H6 model
6012051	5	0.094	0.039	89	Regression equation from EPA soil measurements vs. distance	60	64	123	Air+soil regression-based model
2001058	5	0.023	9.0E-03	34	Regression equation from EPA soil measurements vs. distance	15	44	59	Air+soil regression-based model

Attachment D-7. Estimated Media Concentrations in Current NAAQS Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6012013	5	0.028	0.012	42	Regression equation from EPA soil measurements vs. distance	18	46	64	Air+soil regression-based model
8001006	5	0.038	0.015	87	Regression equation from EPA soil measurements vs. distance	25	63	87	Air+soil regression-based model
8001049	4	0.088	0.035	585	Regression equation from EPA soil measurements vs. distance	56	244	300	Air+soil regression-based model
8001045	4	0.084	0.034	376	Regression equation from EPA soil measurements vs. distance	54	168	222	Air+soil regression-based model
7002031	4	0.110	0.045	237	Regression equation from EPA soil measurements vs. distance	70	117	187	Air+soil regression-based model
6012014	4	0.024	0.010	39	Regression equation from EPA soil measurements vs. distance	16	45	61	Air+soil regression-based model
2001029	4	0.016	6.0E-03	38	Regression equation from EPA soil measurements vs. distance	10	45	55	Air+soil regression-based model
2001015	4	0.010	4.0E-03	26	Regression equation from EPA soil measurements vs. distance	7	41	48	Air+soil regression-based model
3001065	4	0.012	5.0E-03	28	Regression equation from EPA soil measurements vs. distance	8	42	49	Air+soil regression-based model
2001023	4	6.0E-03	2.0E-03	20	Regression equation from EPA soil measurements vs. distance	4	39	42	Air+soil regression-based model

Attachment D-7. Estimated Media Concentrations in Current NAAQS Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7002011	3	0.097	0.040	556	Regression equation from EPA soil measurements vs. distance	62	234	296	Air+soil regression-based model
7002012	3	0.130	0.053	519	Regression equation from EPA soil measurements vs. distance	83	220	303	Air+soil regression-based model
6014018	3	0.158	0.066	400	Regression equation from EPA soil measurements vs. distance	101	177	278	Air+soil regression-based model
8001000	3	0.067	0.027	461	Regression equation from EPA soil measurements vs. distance	43	199	242	Air+soil regression-based model
8001044	3	0.081	0.033	373	Regression equation from EPA soil measurements vs. distance	52	167	219	Air+soil regression-based model l
6012057	3	0.089	0.037	124	Regression equation from EPA soil measurements vs. distance	57	76	133	Air+soil regression-based model
2001059	3	0.037	0.015	36	Regression equation from EPA soil measurements vs. distance	24	44	68	Air+soil regression-based model
6012049	3	0.076	0.032	84	Regression equation from EPA soil measurements vs. distance	49	62	111	Air+soil regression-based model
2001056	3	0.021	8.0E-03	35	Regression equation from EPA soil measurements vs. distance	13	44	58	Air+soil regression-based model
8001034	3	0.076	0.030	112	Regression equation from EPA soil measurements vs. distance	48	72	120	Air+soil regression-based model

Attachment D-7. Estimated Media Concentrations in Current NAAQS Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
8001032	3	0.067	0.027	141	Regression equation from EPA soil measurements vs. distance	42	83	125	Air+soil regression-based model
8001029	3	0.069	0.028	129	Regression equation from EPA soil measurements vs. distance	44	78	123	Air+soil regression-based model l
2001057	3	0.022	9.0E-03	35	Regression equation from EPA soil measurements vs. distance	14	44	58	Air+soil regression-based model
6012044	3	0.054	0.022	68	Regression equation from EPA soil measurements vs. distance	34	56	90	Air+soil regression-based model
6012030	3	0.046	0.019	62	Regression equation from EPA soil measurements vs. distance	29	54	83	Air+soil regression-based model
6012019	3	0.032	0.014	46	Regression equation from EPA soil measurements vs. distance	21	48	69	Air+soil regression-based model
8001042	3	0.045	0.018	106	Regression equation from EPA soil measurements vs. distance	29	70	99	Air+soil regression-based model
6012022	3	0.031	0.013	51	Regression equation from EPA soil measurements vs. distance	20	50	70	Air+soil regression-based model
2001030	3	0.024	9.0E-03	48	Regression equation from EPA soil measurements vs. distance	15	49	64	Air+soil regression-based model
6014043	2	0.386	0.162	150	Re-contamination samples nearby	1387	794	2181	H6 model

Attachment D-7. Estimated Media Concentrations in Current NAAQS Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6014028	2	0.413	0.173	179	Re-contamination samples nearby	1500	794	2294	H6 model
6015015	2	0.231	0.097	98	Re-contamination samples nearby	703	794	1496	H6 model
6014021	2	0.224	0.094	95	Re-contamination sample in block	669	794	1462	H6 model
6015018	2	0.152	0.064	160	Re-contamination samples nearby	304	794	1097	H6 model
8001047	2	0.092	0.037	447	Regression equation from EPA soil measurements vs. distance	59	194	252	Air+soil regression-based model
6012065	2	0.126	0.053	136	Regression equation from EPA soil measurements vs. distance	80	81	161	Air+soil regression-based model
7002014	2	0.110	0.045	276	Regression equation from EPA soil measurements vs. distance	70	132	202	Air+soil regression-based model
8001019	2	0.088	0.036	230	Regression equation from EPA soil measurements vs. distance	56	115	171	Air+soil regression-based model
6012062	2	0.075	0.031	108	Regression equation from EPA soil measurements vs. distance	48	70	118	Air+soil regression-based model
8001023	2	0.077	0.031	158	Regression equation from EPA soil measurements vs. distance	49	89	138	Air+soil regression-based model
2001051	2	0.017	7.0E-03	32	Regression equation from EPA soil measurements vs. distance	11	43	54	Air+soil regression-based model

Attachment D-7. Estimated Media Concentrations in Current NAAQS Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6012041	2	0.046	0.019	60	Regression equation from EPA soil measurements vs. distance	30	53	83	Air+soil regression-based model
2001060	2	0.019	8.0E-03	37	Regression equation from EPA soil measurements vs. distance	12	45	57	Air+soil regression-based model
6012005	2	0.024	0.010	38	Regression equation from EPA soil measurements vs. distance	15	45	61	Air+soil regression-based model
6012006	2	0.024	0.010	38	Regression equation from EPA soil measurements vs. distance	15	45	60	Air+soil regression-based model
3001017	2	0.042	0.016	87	Regression equation from EPA soil measurements vs. distance	27	63	90	Air+soil regression-based model
3001055	2	0.010	4.0E-03	24	Regression equation from EPA soil measurements vs. distance	6	40	46	Air+soil regression-based model
6014042	1	0.740	0.310	129	Re-contamination samples nearby	2729	794	3523	H6 model
6014052	1	0.283	0.118	216	Re-contamination sample in block	941	794	1734	H6 model
6014032	1	0.669	0.280	162	Re-contamination samples nearby	2476	794	3270	H6 model
6014033	1	0.708	0.296	162	Re-contamination samples nearby	2614	794	3407	H6 model
6014049	1	0.333	0.139	167	Re-contamination sample in block	1162	794	1955	H6 model

Attachment D-7. Estimated Media Concentrations in Current NAAQS Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6014029	1	0.380	0.159	135	Re-contamination sample in block	1360	794	2154	H6 model
6014050	1	0.274	0.115	171	Re-contamination sample in block	903	794	1696	H6 model
6015013	1	0.173	0.072	53	Re-contamination samples nearby	414	794	1208	H6 model
6015011	1	0.137	0.057	123	Re-contamination samples nearby	225	794	1019	H6 model
7002006	1	0.128	0.052	703	Regression equation from EPA soil measurements vs. distance	82	287	369	Air+soil regression-based model
7002009	1	0.099	0.040	958	Regression equation from EPA soil measurements vs. distance	63	380	443	Air+soil regression-based model
6014006	1	0.154	0.065	153	Regression equation from EPA soil measurements vs. distance	98	87	185	Air+soil regression-based model
7002017	1	0.126	0.051	323	Regression equation from EPA soil measurements vs. distance	80	149	229	Air+soil regression-based model
6014007	1	0.160	0.067	200	Regression equation from EPA soil measurements vs. distance	102	104	207	Air+soil regression-based model
3001019	1	0.102	0.040	169	Regression equation from EPA soil measurements vs. distance	65	93	158	Air+soil regression-based model
2001066	1	0.028	0.011	41	Regression equation from EPA soil measurements vs. distance	18	46	64	Air+soil regression-based model

Attachment D-7. Estimated Media Concentrations in Current NAAQS Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration ($\mu g/m^3$)	Annual Average Inhalation Exposure Concentration ($\mu g/m^3$)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7002025	1	0.070	0.028	179	Regression equation from EPA soil measurements vs. distance	44	97	141	Air+soil regression-based model
6012031	1	0.044	0.018	60	Regression equation from EPA soil measurements vs. distance	28	53	81	Air+soil regression-based model
8001003	1	0.046	0.019	109	Regression equation from EPA soil measurements vs. distance	30	71	101	Air+soil regression-based model
6012018	1	0.028	0.012	43	Regression equation from EPA soil measurements vs. distance	18	47	65	Air+soil regression-based model
6012004	1	0.023	0.010	38	Regression equation from EPA soil measurements vs. distance	15	45	60	Air+soil regression-based model
3001015	1	0.027	0.010	70	Regression equation from EPA soil measurements vs. distance	17	57	74	Air+soil regression-based model
2001003	1	6.0E-03	2.0E-03	17	Regression equation from EPA soil measurements vs. distance	4	37	41	Air+soil regression-based model
3001063	1	0.014	6.0E-03	30	Regression equation from EPA soil measurements vs. distance	9	42	51	Air+soil regression-based model
3001009	1	0.027	0.011	60	Regression equation from EPA soil measurements vs. distance	17	53	70	Air+soil regression-based model
3001066	1	0.013	5.0E-03	30	Regression equation from EPA soil measurements vs. distance	8	42	50	Air+soil regression-based model

Attachment D-7. Estimated Media Concentrations in Current NAAQS Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration ($\mu g/m^3$)	Annual Average Inhalation Exposure Concentration ($\mu g/m^3$)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
2001104	1	0.023	9.0E-03	56	Regression equation from EPA soil measurements vs. distance	15	52	67	Air+soil regression-based model
2001101	1	0.023	9.0E-03	58	Regression equation from EPA soil measurements vs. distance	15	52	67	Air+soil regression-based model
2001022	1	7.0E-03	3.0E-03	22	Regression equation from EPA soil measurements vs. distance	5	39	44	Air+soil regression-based model

[a] "Other" refers to contributions from indoor paint, outdoor soil/dust and additional sources (including historical air) and "recent air" refers to contributions associated with outdoor ambient air.

Attachment D-8. Estimated Media Concentrations in Alternative NAAQS (0.5 $\mu g/m^3$ max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration ($\mu g/m^3$)	Annual Average Inhalation Exposure Concentration ($\mu g/m^3$)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7006031	737	0.014	6.0E-03	40	Regression equation from EPA soil measurements vs. distance	9	46	55	Air+soil regression-based model
7009003	254	0.012	4.0E-03	51	Regression equation from EPA soil measurements vs. distance	8	50	58	Air+soil regression-based model

Attachment D-8. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m³ max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7008004	197	0.039	0.016	186	Regression equation from EPA soil measurements vs. distance	25	99	124	Air+soil regression-based model
7006052	187	7.0E-03	3.0E-03	51	Regression equation from EPA soil measurements vs. distance	4	50	54	Air+soil regression-based model
7006013	176	0.067	0.028	231	Regression equation from EPA soil measurements vs. distance	43	115	158	Air+soil regression-based model
7001044	164	8.0E-03	3.0E-03	30	Regression equation from EPA soil measurements vs. distance	5	42	47	Air+soil regression-based model
7010001	145	9.0E-03	3.0E-03	37	Regression equation from EPA soil measurements vs. distance	5	45	50	Air+soil regression-based model
7008007	141	0.025	0.010	105	Regression equation from EPA soil measurements vs. distance	16	70	86	Air+soil regression-based model
7006053	139	0.014	5.0E-03	91	Regression equation from EPA soil measurements vs. distance	9	64	73	Air+soil regression-based model
7009001	120	0.020	8.0E-03	85	Regression equation from EPA soil measurements vs. distance	13	62	75	Air+soil regression-based model
7008005	104	0.029	0.012	132	Regression equation from EPA soil measurements vs. distance	19	79	98	Air+soil regression-based model
6015002	95	0.059	0.025	282	Regression equation from EPA soil measurements vs. distance	38	134	172	Air+soil regression-based model

Attachment D-8. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7008002	92	0.027	0.011	100	Regression equation from EPA soil measurements vs. distance	17	68	85	Air+soil regression-based model
7009002	86	0.020	7.0E-03	91	Regression equation from EPA soil measurements vs. distance	13	65	77	Air+soil regression-based model
6012052	79	0.041	0.017	107	Regression equation from EPA soil measurements vs. distance	26	70	96	Air+soil regression-based model
7007003	77	0.037	0.015	195	Regression equation from EPA soil measurements vs. distance	23	102	126	Air+soil regression-based model
7007005	74	0.015	6.0E-03	73	Regression equation from EPA soil measurements vs. distance	10	58	68	Air+soil regression-based model
7008003	72	0.021	8.0E-03	83	Regression equation from EPA soil measurements vs. distance	13	62	75	Air+soil regression-based model
7007001	70	0.024	0.010	111	Regression equation from EPA soil measurements vs. distance	15	72	87	Air+soil regression-based model
7006054	63	0.021	8.0E-03	139	Regression equation from EPA soil measurements vs. distance	13	82	95	Air+soil regression-based model
7006051	62	0.014	5.0E-03	55	Regression equation from EPA soil measurements vs. distance	9	51	60	Air+soil regression-based model
7008006	58	0.025	0.010	112	Regression equation from EPA soil measurements vs. distance	16	72	88	Air+soil regression-based model

Attachment D-8. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m³ max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7007004	49	0.029	0.012	146	Regression equation from EPA soil measurements vs. distance	18	84	103	Air+soil regression-based model
7002029	46	0.059	0.024	222	Regression equation from EPA soil measurements vs. distance	37	112	149	Air+soil regression-based model
7006011	45	0.044	0.018	185	Regression equation from EPA soil measurements vs. distance	28	99	127	Air+soil regression-based model
2001044	34	0.012	5.0E-03	44	Regression equation from EPA soil measurements vs. distance	7	47	54	Air+soil regression-based model
7002016	29	0.042	0.017	354	Regression equation from EPA soil measurements vs. distance	27	160	187	Air+soil regression-based model
7002033	23	0.054	0.022	245	Regression equation from EPA soil measurements vs. distance	34	120	155	Air+soil regression-based model
8001017	22	0.026	0.011	120	Regression equation from EPA soil measurements vs. distance	17	75	92	Air+soil regression-based model
6014015	15	0.083	0.035	277	Regression equation from EPA soil measurements vs. distance	53	132	185	Air+soil regression-based model
6014027	14	0.198	0.083	223	Re-contamination sample in block	899	434	1333	H6 model
8001030	14	0.034	0.014	145	Regression equation from EPA soil measurements vs. distance	22	84	106	Air+soil regression-based model
6014025	13	0.098	0.041	116	Re-contamination samples nearby	362	434	796	H6 model

Attachment D-8. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7002032	13	0.047	0.019	242	Regression equation from EPA soil measurements vs. distance	30	119	149	Air+soil regression-based model
7002021	12	0.045	0.018	211	Regression equation from EPA soil measurements vs. distance	29	108	137	Air+soil regression-based model
6012003	12	0.010	4.0E-03	38	Regression equation from EPA soil measurements vs. distance	6	45	51	Air+soil regression-based model
6015001	11	0.075	0.032	42	Re-contamination sample in block	221	434	654	H6 model
3001003	11	0.015	6.0E-03	43	Regression equation from EPA soil measurements vs. distance	9	47	56	Air+soil regression-based model
3001000	11	5.0E-03	2.0E-03	27	Regression equation from EPA soil measurements vs. distance	3	41	45	Air+soil regression-based model
8001036	10	0.033	0.013	117	Regression equation from EPA soil measurements vs. distance	21	74	95	Air+soil regression-based model
6012053	9	0.040	0.017	97	Regression equation from EPA soil measurements vs. distance	25	67	92	Air+soil regression-based model
2001050	9	8.0E-03	3.0E-03	32	Regression equation from EPA soil measurements vs. distance	5	43	48	Air+soil regression-based model
6015016	8	0.105	0.044	105	Re-contamination sample in block	402	434	836	H6 model
8001035	8	0.031	0.013	119	Regression equation from EPA soil measurements vs. distance	20	75	95	Air+soil regression-based model

Attachment D-8. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
8001031	8	0.030	0.012	144	Regression equation from EPA soil measurements vs. distance	19	84	103	Air+soil regression-based model
8001037	8	0.028	0.011	113	Regression equation from EPA soil measurements vs. distance	18	72	90	Air+soil regression-based model
2001041	8	6.0E-03	2.0E-03	28	Regression equation from EPA soil measurements vs. distance	4	42	45	Air+soil regression-based model
6012016	8	0.012	5.0E-03	42	Regression equation from EPA soil measurements vs. distance	7	46	54	Air+soil regression-based model
7002030	7	0.051	0.021	205	Regression equation from EPA soil measurements vs. distance	33	106	139	Air+soil regression-based model
6012001	7	0.014	6.0E-03	43	Regression equation from EPA soil measurements vs. distance	9	47	56	Air+soil regression-based model
6014051	6	0.195	0.082	184	Re-contamination sample in block	887	434	1321	H6 model
6014044	6	0.106	0.044	159	Re-contamination samples nearby	407	434	841	H6 model
6015017	6	0.098	0.041	153	Re-contamination sample in block	359	434	793	H6 model
7002028	6	0.049	0.020	189	Regression equation from EPA soil measurements vs. distance	31	100	131	Air+soil regression-based model
6012021	6	0.019	8.0E-03	53	Regression equation from EPA soil measurements vs. distance	12	50	62	Air+soil regression-based model

Attachment D-8. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6014039	5	0.297	0.124	294	Re-contamination sample in block	1365	434	1799	H6 model
6014046	5	0.202	0.084	129	Re-contamination sample in block	918	434	1352	H6 model
6015012	5	0.072	0.030	63	Re-contamination sample in block	198	434	632	H6 model
6015019	5	0.043	0.018	176	Re-contamination sample in block	0	434	434	H6 model
6012051	5	0.041	0.017	89	Regression equation from EPA soil measurements vs. distance	26	64	90	Air+soil regression-based model
2001058	5	0.010	4.0E-03	34	Regression equation from EPA soil measurements vs. distance	7	44	50	Air+soil regression-based model
6012013	5	0.012	5.0E-03	42	Regression equation from EPA soil measurements vs. distance	8	46	54	Air+soil regression-based model
8001006	5	0.017	7.0E-03	87	Regression equation from EPA soil measurements vs. distance	11	63	74	Air+soil regression-based model
8001049	4	0.039	0.016	585	Regression equation from EPA soil measurements vs. distance	25	244	269	Air+soil regression-based model
8001045	4	0.037	0.015	376	Regression equation from EPA soil measurements vs. distance	24	168	192	Air+soil regression-based model
7002031	4	0.048	0.020	237	Regression equation from EPA soil measurements vs. distance	31	117	148	Air+soil regression-based model

Attachment D-8. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6012014	4	0.011	4.0E-03	39	Regression equation from EPA soil measurements vs. distance	7	45	52	Air+soil regression-based model
2001029	4	7.0E-03	3.0E-03	38	Regression equation from EPA soil measurements vs. distance	4	45	50	Air+soil regression-based model
2001015	4	5.0E-03	2.0E-03	26	Regression equation from EPA soil measurements vs. distance	3	41	44	Air+soil regression-based model
3001065	4	5.0E-03	2.0E-03	28	Regression equation from EPA soil measurements vs. distance	3	42	45	Air+soil regression-based model
2001023	4	3.0E-03	1.0E-03	20	Regression equation from EPA soil measurements vs. distance	2	39	40	Air+soil regression-based model
7002011	3	0.043	0.017	556	Regression equation from EPA soil measurements vs. distance	27	234	261	Air+soil regression-based model
7002012	3	0.057	0.023	519	Regression equation from EPA soil measurements vs. distance	37	220	257	Air+soil regression-based model
6014018	3	0.070	0.029	400	Regression equation from EPA soil measurements vs. distance	45	177	221	Air+soil regression-based model
8001000	3	0.030	0.012	461	Regression equation from EPA soil measurements vs. distance	19	199	218	Air+soil regression-based model
8001044	3	0.036	0.014	373	Regression equation from EPA soil measurements vs. distance	23	167	190	Air+soil regression-based model

Attachment D-8. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m³ max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6012057	3	0.039	0.016	124	Regression equation from EPA soil measurements vs. distance	25	76	102	Air+soil regression-based model
2001059	3	0.016	6.0E-03	36	Regression equation from EPA soil measurements vs. distance	10	44	55	Air+soil regression-based model
6012049	3	0.034	0.014	84	Regression equation from EPA soil measurements vs. distance	21	62	83	Air+soil regression-based model
2001056	3	9.0E-03	4.0E-03	35	Regression equation from EPA soil measurements vs. distance	6	44	50	Air+soil regression-based model
8001034	3	0.033	0.013	112	Regression equation from EPA soil measurements vs. distance	21	72	93	Air+soil regression-based model
8001032	3	0.029	0.012	141	Regression equation from EPA soil measurements vs. distance	19	83	101	Air+soil regression-based model
8001029	3	0.030	0.012	129	Regression equation from EPA soil measurements vs. distance	19	78	98	Air+soil regression-based model
2001057	3	9.0E-03	4.0e-03	35	Regression equation from EPA soil measurements vs. distance	6	44	50	Air+soil regression-based model
6012044	3	0.024	0.010	68	Regression equation from EPA soil measurements vs. distance	15	56	71	Air+soil regression-based model
6012030	3	0.020	9.0E-03	62	Regression equation from EPA soil measurements vs. distance	13	54	67	Air+soil regression-based model

Attachment D-8. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6012019	3	0.014	6.0E-03	46	Regression equation from EPA soil measurements vs. distance	9	48	57	Air+soil regression-based model
8001042	3	0.020	8.0E-03	106	Regression equation from EPA soil measurements vs. distance	13	70	83	Air+soil regression-based model
6012022	3	0.014	6.0E-03	51	Regression equation from EPA soil measurements vs. distance	9	50	59	Air+soil regression-based model
2001030	3	0.010	4.0E-03	48	Regression equation from EPA soil measurements vs. distance	7	49	55	Air+soil regression-based model
6014043	2	0.170	0.071	150	Re-contamination samples nearby	758	434	1192	H6 model
6014028	2	0.182	0.076	179	Re-contamination samples nearby	820	434	1254	H6 model
6015015	2	0.102	0.043	98	Re-contamination samples nearby	384	434	818	H6 model
6014021	2	0.099	0.041	95	Re-contamination sample in block	366	434	799	H6 model
6015018	2	0.067	0.028	160	Re-contamination samples nearby	166	434	600	H6 model
8001047	2	0.040	0.016	447	Regression equation from EPA soil measurements vs. distance	26	194	220	Air+soil regression-based model
6012065	2	0.055	0.023	136	Regression equation from EPA soil measurements vs. distance	35	81	116	Air+soil regression-based model

Attachment D-8. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7002014	2	0.048	0.020	276	Regression equation from EPA soil measurements vs. distance	31	132	163	Air+soil regression-based model
8001019	2	0.039	0.016	230	Regression equation from EPA soil measurements vs. distance	25	115	140	Air+soil regression-based model
6012062	2	0.033	0.014	108	Regression equation from EPA soil measurements vs. distance	21	70	92	Air+soil regression-based model
8001023	2	0.034	0.014	158	Regression equation from EPA soil measurements vs. distance	22	89	111	Air+soil regression-based model
2001051	2	8.0E-03	3.0E-03	32	Regression equation from EPA soil measurements vs. distance	5	43	48	Air+soil regression-based model
6012041	2	0.020	9.0E-03	60	Regression equation from EPA soil measurements vs. distance	13	53	66	Air+soil regression-based model
2001060	2	9.0E-03	3.0E-03	37	Regression equation from EPA soil measurements vs. distance	5	45	50	Air+soil regression-based model
6012005	2	0.011	4.0E-03	38	Regression equation from EPA soil measurements vs. distance	7	45	52	Air+soil regression-based model
6012006	2	0.010	4.0E-03	38	Regression equation from EPA soil measurements vs. distance	7	45	52	Air+soil regression-based model
3001017	2	0.018	7.0E-03	87	Regression equation from EPA soil measurements vs. distance	12	63	75	Air+soil regression-based model

Attachment D-8. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
3001055	2	4.0E-03	2.0E-03	24	Regression equation from EPA soil measurements vs. distance	3	40	43	Air+soil regression-based model
6014042	1	0.326	0.136	129	Re-contamination samples nearby	1492	434	1926	H6 model
6014052	1	0.125	0.052	216	Re-contamination sample in block	514	434	948	H6 model
6014032	1	0.295	0.123	162	Re-contamination samples nearby	1354	434	1788	H6 model
6014033	1	0.312	0.130	162	Re-contamination samples nearby	1429	434	1863	H6 model
6014049	1	0.147	0.061	167	Re-contamination sample in block	635	434	1069	H6 model
6014029	1	0.167	0.070	135	Re-contamination sample in block	744	434	1178	H6 model
6014050	1	0.121	0.051	171	Re-contamination sample in block	494	434	927	H6 model
6015013	1	0.076	0.032	53	Re-contamination samples nearby	227	434	660	H6 model
6015011	1	0.060	0.025	123	Re-contamination samples nearby	123	434	557	H6 model
7002006	1	0.056	0.023	703	Regression equation from EPA soil measurements vs. distance	36	287	323	Air+soil regression-based model
7002009	1	0.044	0.018	958	Regression equation from EPA soil measurements vs. distance	28	380	408	Air+soil regression-based model

Attachment D-8. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6014006	1	0.068	0.028	153	Regression equation from EPA soil measurements vs. distance	43	87	130	Air+soil regression-based model
7002017	1	0.056	0.023	323	Regression equation from EPA soil measurements vs. distance	35	149	184	Air+soil regression-based model
6014007	1	0.071	0.030	200	Regression equation from EPA soil measurements vs. distance	45	104	149	Air+soil regression-based model
3001019	1	0.045	0.018	169	Regression equation from EPA soil measurements vs. distance	29	93	122	Air+soil regression-based model
2001066	1	0.012	5.0E-03	41	Regression equation from EPA soil measurements vs. distance	8	46	54	Air+soil regression-based model
7002025	1	0.031	0.012	179	Regression equation from EPA soil measurements vs. distance	20	97	116	Air+soil regression-based model
6012031	1	0.019	8.0E-03	60	Regression equation from EPA soil measurements vs. distance	12	53	66	Air+soil regression-based model
8001003	1	0.020	8.0E-03	109	Regression equation from EPA soil measurements vs. distance	13	71	84	Air+soil regression-based model
6012018	1	0.012	5.0E-03	43	Regression equation from EPA soil measurements vs. distance	8	47	55	Air+soil regression-based model
6012004	1	0.010	4.0E-03	38	Regression equation from EPA soil measurements vs. distance	7	45	52	Air+soil regression-based model

Attachment D-8. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m³ max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
3001015	1	0.012	5.0E-03	70	Regression equation from EPA soil measurements vs. distance	7	57	64	Air+soil regression-based model
2001003	1	3.0E-03	1.0E-03	17	Regression equation from EPA soil measurements vs. distance	2	37	39	Air+soil regression-based model
3001063	1	6.0E-03	2.0E-03	30	Regression equation from EPA soil measurements vs. distance	4	42	46	Air+soil regression-based model
3001009	1	0.012	5.0E-03	60	Regression equation from EPA soil measurements vs. distance	8	53	61	Air+soil regression-based model
3001066	1	6.0E-03	2.0E-03	30	Regression equation from EPA soil measurements vs. distance	4	42	46	Air+soil regression-based model
2001104	1	0.010	4.0E-03	56	Regression equation from EPA soil measurements vs. distance	7	52	58	Air+soil regression-based model
2001101	1	0.010	4.0E-03	58	Regression equation from EPA soil measurements vs. distance	6	52	59	Air+soil regression-based model
2001022	1	3.0E-03	1E-03	22	Regression equation from EPA soil measurements vs. distance	2	39	41	Air+soil regression-based model

[a] "Other" refers to contributions from indoor paint, outdoor soil/dust and additional sources (including historical air) and "recent air" refers to contributions associated with outdoor ambient air.

Attachment D-9. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7006031	737	6.0E-03	2.2E-03	40	Regression equation from EPA soil measurements vs. distance	4	46	49	Air+soil regression-based model
7009003	254	5E-03	1.8E-03	51	Regression equation from EPA soil measurements vs. distance	3	50	53	Air+soil regression-based model
7008004	197	0.016	6.3E-03	186	Regression equation from EPA soil measurements vs. distance	10	99	109	Air+soil regression-based model
7006052	187	3.0E-03	1.0E-03	51	Regression equation from EPA soil measurements vs. distance	2	50	52	Air+soil regression-based model
7006013	176	0.027	0.0112	231	Regression equation from EPA soil measurements vs. distance	17	115	133	Air+soil regression-based model
7001044	164	3.0E-03	1.2E-03	30	Regression equation from EPA soil measurements vs. distance	2	42	44	Air+soil regression-based model
7010001	145	3.0E-03	1.3E-03	37	Regression equation from EPA soil measurements vs. distance	2	45	47	Air+soil regression-based model
7008007	141	0.010	4.1E-03	105	Regression equation from EPA soil measurements vs. distance	6	70	76	Air+soil regression-based model
7006053	139	6.0E-03	2.1E-03	91	Regression equation from EPA soil measurements vs. distance	4	64	68	Air+soil regression-based model
7009001	120	8.0E-03	3.0E-03	85	Regression equation from EPA soil measurements vs. distance	5	62	67	Air+soil regression-based model

Attachment D-9. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7008005	104	0.012	4.7E-03	132	Regression equation from EPA soil measurements vs. distance	7	79	87	Air+soil regression-based model
6015002	95	0.024	9.9E-03	282	Regression equation from EPA soil measurements vs. distance	15	134	149	Air+soil regression-based model
7008002	92	0.011	4.4E-03	100	Regression equation from EPA soil measurements vs. distance	7	68	75	Air+soil regression-based model
7009002	86	8.0E-03	3.0E-03	91	Regression equation from EPA soil measurements vs. distance	5	65	70	Air+soil regression-based model
6012052	79	0.016	6.9E-03	107	Regression equation from EPA soil measurements vs. distance	10	70	81	Air+soil regression-based model
7007003	77	0.015	6.0E-03	195	Regression equation from EPA soil measurements vs. distance	9	102	112	Air+soil regression-based model
7007005	74	6.0E-03	2.5E-03	73	Regression equation from EPA soil measurements vs. distance	4	58	62	Air+soil regression-based model
7008003	72	8.0E-03	3.3E-03	83	Regression equation from EPA soil measurements vs. distance	5	62	67	Air+soil regression-based model
7007001	70	0.010	3.9E-03	111	Regression equation from EPA soil measurements vs. distance	6	72	78	Air+soil regression-based model
7006054	63	8.0E-03	3.1E-03	139	Regression equation from EPA soil measurements vs. distance	5	82	87	Air+soil regression-based model

Attachment D-9. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7006051	62	6.0E-03	2.1E-03	55	Regression equation from EPA soil measurements vs. distance	4	51	55	Air+soil regression-based model
7008006	58	0.010	4.0E-03	112	Regression equation from EPA soil measurements vs. distance	6	72	78	Air+soil regression-based model
7007004	49	0.011	4.7E-03	146	Regression equation from EPA soil measurements vs. distance	7	84	92	Air+soil regression-based model
7002029	46	0.023	9.6E-03	222	Regression equation from EPA soil measurements vs. distance	15	112	127	Air+soil regression-based model
7006011	45	0.018	7.4E-03	185	Regression equation from EPA soil measurements vs. distance	11	99	110	Air+soil regression-based model
2001044	34	5.0E-03	1.8E-03	44	Regression equation from EPA soil measurements vs. distance	3	47	50	Air+soil regression-based model
7002016	29	0.017	6.8E-03	354	Regression equation from EPA soil measurements vs. distance	11	160	171	Air+soil regression-based model
7002033	23	0.022	8.8E-03	245	Regression equation from EPA soil measurements vs. distance	14	120	134	Air+soil regression-based model
8001017	22	0.010	4.2E-03	120	Regression equation from EPA soil measurements vs. distance	7	75	82	Air+soil regression-based model
6014015	15	0.033	0.0139	277	Regression equation from EPA soil measurements vs. distance	21	132	154	Air+soil regression-based model
6014027	14	0.079	0.0331	223	Re-contamination sample in	458	221	679	H6 model

Attachment D-9. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
					block				
8001030	14	0.014	5.5E-03	145	Regression equation from EPA soil measurements vs. distance	9	84	93	Air+soil regression-based model
6014025	13	0.039	0.0164	116	Re-contamination samples nearby	184	221	405	H6 model
7002032	13	0.019	7.7E-03	242	Regression equation from EPA soil measurements vs. distance	12	119	131	Air+soil regression-based model
7002021	12	0.018	7.3E-03	211	Regression equation from EPA soil measurements vs. distance	11	108	119	Air+soil regression-based model
6012003	12	4.0E-03	1.6E-03	38	Regression equation from EPA soil measurements vs. distance	2	45	48	Air+soil regression-based model
6015001	11	0.030	0.0126	42	Re-contamination sample in block	112	221	333	H6 model
3001003	11	6.0E-03	2.3E-03	43	Regression equation from EPA soil measurements vs. distance	4	47	51	Air+soil regression-based model
3001000	11	2.0E-03	8.0E-04	27	Regression equation from EPA soil measurements vs. distance	1	41	43	Air+soil regression-based model
8001036	10	0.013	5.4E-03	117	Regression equation from EPA soil measurements vs. distance	9	74	82	Air+soil regression-based model
6012053	9	0.016	6.6E-03	97	Regression equation from EPA soil measurements vs. distance	10	67	77	Air+soil regression-based model

Attachment D-9. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
2001050	9	3.0E-03	1.3E-03	32	Regression equation from EPA soil measurements vs. distance	2	43	45	Air+soil regression-based model
6015016	8	0.042	0.0176	105	Re-contamination sample in block	205	221	426	H6 model
8001035	8	0.013	5.0E-03	119	Regression equation from EPA soil measurements vs. distance	8	75	83	Air+soil regression-based model
8001031	8	0.012	4.8E-03	144	Regression equation from EPA soil measurements vs. distance	8	84	91	Air+soil regression-based model
8001037	8	0.011	4.5E-03	113	Regression equation from EPA soil measurements vs. distance	7	72	79	Air+soil regression-based model
2001041	8	2.0E-0E	9.0e-04	28	Regression equation from EPA soil measurements vs. distance	1	42	43	Air+soil regression-based model
6012016	8	5.0E-03	1.9E-03	42	Regression equation from EPA soil measurements vs. distance	3	46	49	Air+soil regression-based model
7002030	7	0.020	8.3E-03	205	Regression equation from EPA soil measurements vs. distance	13	106	119	Air+soil regression-based model
6012001	7	6.0E-03	2.3E-03	43	Regression equation from EPA soil measurements vs. distance	4	47	50	Air+soil regression-based model
6014051	6	0.078	0.0327	184	Re-contamination sample in block	452	221	673	H6 model
6014044	6	0.042	0.0177	159	Re-contamination samples nearby	207	221	428	H6 model

Attachment D-9. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6015017	6	0.039	0.0163	153	Re-contamination sample in block	183	221	404	H6 model
7002028	6	0.019	7.9E-03	189	Regression equation from EPA soil measurements vs. distance	12	100	112	Air+soil regression-based model
6012021	6	7.0E-03	3.1E-03	53	Regression equation from EPA soil measurements vs. distance	5	50	55	Air+soil regression-based model
6014039	5	0.119	0.0498	294	Re-contamination sample in block	695	221	916	H6 model
6014046	5	0.081	0.0338	129	Re-contamination sample in block	467	221	688	H6 model
6015012	5	0.029	0.0120	63	Re-contamination sample in block	101	221	322	H6 model
6015019	5	0.017	7.2E-03	176	Re-contamination sample in block	0	221	221	H6 model
6012051	5	0.017	6.9E-03	89	Regression equation from EPA soil measurements vs. distance	11	64	74	Air+soil regression-based model
2001058	5	4.0E-03	1.6E-03	34	Regression equation from EPA soil measurements vs. distance	3	44	46	Air+soil regression-based model
6012013	5	5.0E-03	2.1E-03	42	Regression equation from EPA soil measurements vs. distance	3	46	50	Air+soil regression-based model
8001006	5	7.0E-03	2.7E-03	87	Regression equation from EPA soil measurements vs. distance	4	63	67	Air+soil regression-based model

Attachment D-9. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
8001049	4	0.015	6.2E-03	585	Regression equation from EPA soil measurements vs. distance	10	244	254	Air+soil regression-based model
8001045	4	0.015	6.0E-03	376	Regression equation from EPA soil measurements vs. distance	9	168	178	Air+soil regression-based model
7002031	4	0.019	7.9E-03	237	Regression equation from EPA soil measurements vs. distance	12	117	130	Air+soil regression-based model
6012014	4	4.0E-03	1.8E-03	39	Regression equation from EPA soil measurements vs. distance	3	45	48	Air+soil regression-based model
2001029	4	3.0E-03	1.1E-03	38	Regression equation from EPA soil measurements vs. distance	2	45	47	Air+soil regression-based model
2001015	4	2.0E-03	7.0E-04	26	Regression equation from EPA soil measurements vs. distance	1	41	42	Air+soil regression-based model
3001065	4	2.0E-03	8.0E-04	28	Regression equation from EPA soil measurements vs. distance	1	42	43	Air+soil regression-based model
2001023	4	1.0E-03	4.0E-04	20	Regression equation from EPA soil measurements vs. distance	1	39	39	Air+soil regression-based model
7002011	3	0.017	7.0E-03	556	Regression equation from EPA soil measurements vs. distance	11	234	245	Air+soil regression-based model
7002012	3	0.023	9.3E-03	519	Regression equation from EPA soil measurements vs. distance	15	220	235	Air+soil regression-based model

Attachment D-9. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6014018	3	0.028	0.0117	400	Regression equation from EPA soil measurements vs. distance	18	177	195	Air+soil regression-based model
8001000	3	0.012	4.8E-03	461	Regression equation from EPA soil measurements vs. distance	8	199	207	Air+soil regression-based model
8001044	3	0.014	5.8E-03	373	Regression equation from EPA soil measurements vs. distance	9	167	176	Air+soil regression-based model
6012057	3	0.016	6.6E-03	124	Regression equation from EPA soil measurements vs. distance	10	76	87	Air+soil regression-based model
2001059	3	7.0E-03	2.6E-03	36	Regression equation from EPA soil measurements vs. distance	4	44	49	Air+soil regression-based model
6012049	3	0.013	5.6E-03	84	Regression equation from EPA soil measurements vs. distance	9	62	70	Air+soil regression-based model
2001056	3	4.0E-03	1.5E-03	35	Regression equation from EPA soil measurements vs. distance	2	44	46	Air+soil regression-based model
8001034	3	0.013	5.4E-03	112	Regression equation from EPA soil measurements vs. distance	9	72	81	Air+soil regression-based model
8001032	3	0.012	4.7E-03	141	Regression equation from EPA soil measurements vs. distance	7	83	90	Air+soil regression-based model
8001029	3	0.012	4.9E-03	129	Regression equation from EPA soil measurements vs. distance	8	78	86	Air+soil regression-based model

Attachment D-9. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
2001057	3	4.0E-03	1.5E-03	35	Regression equation from EPA soil measurements vs. distance	2	44	47	Air+soil regression-based model
6012044	3	9.0E-03	4.0E-03	68	Regression equation from EPA soil measurements vs. distance	6	56	62	Air+soil regression-based model
6012030	3	8.0E-03	3.4E-03	62	Regression equation from EPA soil measurements vs. distance	5	54	59	Air+soil regression-based model
6012019	3	6.0E-03	2.4E-03	46	Regression equation from EPA soil measurements vs. distance	4	48	52	Air+soil regression-based model
8001042	3	8.0E-03	3.2E-03	106	Regression equation from EPA soil measurements vs. distance	5	70	75	Air+soil regression-based model
6012022	3	6.0E-03	2.3E-03	51	Regression equation from EPA soil measurements vs. distance	4	50	54	Air+soil regression-based model
2001030	3	4.0E-03	1.6E-03	48	Regression equation from EPA soil measurements vs. distance	3	49	51	Air+soil regression-based model
6014043	2	0.068	0.0285	150	Re-contamination samples nearby	386	221	607	H6 model
6014028	2	0.073	0.0305	179	Re-contamination samples nearby	418	221	639	H6 model
6015015	2	0.041	0.0171	98	Re-contamination samples nearby	196	221	417	H6 model
6014021	2	0.040	0.0165	95	Re-contamination sample in block	186	221	407	H6 model

Attachment D-9. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6015018	2	0.027	0.0112	160	Re-contamination samples nearby	85	221	306	H6 model
8001047	2	0.016	6.5E-03	447	Regression equation from EPA soil measurements vs. distance	10	194	204	Air+soil regression-based model
6012065	2	0.022	9.3E-03	136	Regression equation from EPA soil measurements vs. distance	14	81	95	Air+soil regression-based model
7002014	2	0.019	7.9E-03	276	Regression equation from EPA soil measurements vs. distance	12	132	144	Air+soil regression-based model
8001019	2	0.016	6.3E-03	230	Regression equation from EPA soil measurements vs. distance	10	115	125	Air+soil regression-based model
6012062	2	0.013	5.5E-03	108	Regression equation from EPA soil measurements vs. distance	8	70	79	Air+soil regression-based model
8001023	2	0.014	5.5E-03	158	Regression equation from EPA soil measurements vs. distance	9	89	98	Air+soil regression-based model
2001051	2	3.0E-03	1.2E-03	32	Regression equation from EPA soil measurements vs. distance	2	43	45	Air+soil regression-based model
6012041	2	8.0E-03	3.4E-03	60	Regression equation from EPA soil measurements vs. distance	5	53	58	Air+soil regression-based model
2001060	2	3.0E--03	1.4E-03	37	Regression equation from EPA soil measurements vs. distance	2	45	47	Air+soil regression-based model

Attachment D-9. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6012005	2	4.0E-03	1.8E-03	38	Regression equation from EPA soil measurements vs. distance	3	45	48	Air+soil regression-based model
6012006	2	4.0E-03	1.7E-03	38	Regression equation from EPA soil measurements vs. distance	3	45	48	Air+soil regression-based model
3001017	2	7.0E-03	2.9E-03	87	Regression equation from EPA soil measurements vs. distance	5	63	68	Air+soil regression-based model
3001055	2	2.0E-03	7.0E-04	24	Regression equation from EPA soil measurements vs. distance	1	40	41	Air+soil regression-based model
6014042	1	0.130	0.0546	129	Re-contamination samples nearby	760	221	981	H6 model
6014052	1	0.050	0.0208	216	Re-contamination sample in block	262	221	483	H6 model
6014032	1	0.118	0.0493	162	Re-contamination samples nearby	689	221	910	H6 model
6014033	1	0.125	0.0522	162	Re-contamination samples nearby	728	221	949	H6 model
6014049	1	0.059	0.0245	167	Re-contamination sample in block	323	221	544	H6 model
6014029	1	0.067	0.0280	135	Re-contamination sample in block	379	221	600	H6 model
6014050	1	0.048	0.0202	171	Re-contamination sample in block	251	221	472	H6 model
6015013	1	0.030	0.0128	53	Re-contamination samples nearby	115	221	336	H6 model

Attachment D-9. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6015011	1	0.024	0.0101	123	Re-contamination samples nearby	63	221	284	H6 model
7002006	1	0.023	9.2E-03	703	Regression equation from EPA soil measurements vs. distance	14	287	302	Air+soil regression-based model
7002009	1	0.017	7.1E-03	958	Regression equation from EPA soil measurements vs. distance	11	380	391	Air+soil regression-based model
6014006	1	0.027	0.0114	153	Regression equation from EPA soil measurements vs. distance	17	87	104	Air+soil regression-based model
7002017	1	0.022	9.1E-03	323	Regression equation from EPA soil measurements vs. distance	14	149	163	Air+soil regression-based model
6014007	1	0.028	0.0118	200	Regression equation from EPA soil measurements vs. distance	18	104	122	Air+soil regression-based model
3001019	1	0.018	7.0E-03	169	Regression equation from EPA soil measurements vs. distance	12	93	104	Air+soil regression-based model
2001066	1	5.0E-03	2.0E-03	41	Regression equation from EPA soil measurements vs. distance	3	46	49	Air+soil regression-based model
7002025	1	0.012	5.0E-03	179	Regression equation from EPA soil measurements vs. distance	8	97	104	Air+soil regression-based model
6012031	1	8.0E-03	3.2E-03	60	Regression equation from EPA soil measurements vs. distance	5	53	58	Air+soil regression-based model

Attachment D-9. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m³ max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
8001003	1	8.0E-03	3.3E-03	109	Regression equation from EPA soil measurements vs. distance	5	71	76	Air+soil regression-based model
6012018	1	5.0E-03	2.1E-03	43	Regression equation from EPA soil measurements vs. distance	3	47	50	Air+soil regression-based model
6012004	1	4.0E-03	1.7E-03	38	Regression equation from EPA soil measurements vs. distance	3	45	48	Air+soil regression-based model
3001015	1	5.0E-03	1.8E-03	70	Regression equation from EPA soil measurements vs. distance	3	57	60	Air+soil regression-based model
2001003	1	1.0E-03	4.0E-04	17	Regression equation from EPA soil measurements vs. distance	1	37	38	Air+soil regression-based model
3001063	1	3.0E-03	1.0e-03	30	Regression equation from EPA soil measurements vs. distance	2	42	44	Air+soil regression-based model
3001009	1	5.0E-03	1.9E-03	60	Regression equation from EPA soil measurements vs. distance	3	53	56	Air+soil regression-based model
3001066	1	2.0E-03	9.0E-04	30	Regression equation from EPA soil measurements vs. distance	1	42	44	Air+soil regression-based model
2001104	1	4.0E-03	1.6E-03	56	Regression equation from EPA soil measurements vs. distance	3	52	54	Air+soil regression-based model

Attachment D-9. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
2001101	1	4.0E-03	1.6E-03	58	Regression equation from EPA soil measurements vs. distance	3	52	55	Air+soil regression-based model
2001022	1	1.0E-03	5.0E-04	22	Regression equation from EPA soil measurements vs. distance	1	39	40	Air+soil regression-based model

[a] "Other" refers to contributions from indoor paint, outdoor soil/dust and additional sources (including historical air) and "recent air" refers to contributions associated with outdoor ambient air.

Attachment D-10. Estimated Media Concentrations in Alternative NAAQS (0.05 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7006031	737	1.4E-03	6.0E-04	40	Regression equation from EPA soil measurements vs. distance	1	46	47	Air+soil regression-based model
7009003	254	1.2E-03	4.0E-04	51	Regression equation from EPA soil measurements vs. distance	1	50	51	Air+soil regression-based model
7008004	197	3.9E-03	1.6E-03	186	Regression equation from EPA soil measurements vs. distance	2	99	102	Air+soil regression-based model
7006052	187	7.0E-04	3.0E-04	51	Regression equation from EPA soil measurements vs. distance	0	50	50	Air+soil regression-based model
7006013	176	6.7E-03	2.8E-03	231	Regression equation from EPA soil measurements vs. distance	4	115	120	Air+soil regression-based model
7001044	164	8.0E-04	3.0E-04	30	Regression equation from EPA soil measurements vs. distance	0	42	43	Air+soil regression-based model
7010001	145	9.0E-04	3.0E-04	37	Regression equation from EPA soil measurements vs. distance	1	45	45	Air+soil regression-based model
7008007	141	2.5E-03	1.0E-03	105	Regression equation from EPA soil measurements vs. distance	2	70	71	Air+soil regression-based model
7006053	139	1.4E-03	5.0E-04	91	Regression equation from EPA soil measurements vs. distance	1	64	65	Air+soil regression-based model
7009001	120	2.0E-03	8.0E-04	85	Regression equation from EPA soil measurements vs. distance	1	62	63	Air+soil regression-based model

Attachment D-10. Estimated Media Concentrations in Alternative NAAQS (0.05 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7008005	104	2.9E-03	1.2E-03	132	Regression equation from EPA soil measurements vs. distance	2	79	81	Air+soil regression-based model
6015002	95	5.9E-03	2.5E-03	282	Regression equation from EPA soil measurements vs. distance	4	134	138	Air+soil regression-based model
7008002	92	2.7E-03	1.1E-03	100	Regression equation from EPA soil measurements vs. distance	2	68	70	Air+soil regression-based model
7009002	86	2.0E-03	7.0E-04	91	Regression equation from EPA soil measurements vs. distance	1	65	66	Air+soil regression-based model
6012052	79	4.1E-03	1.7E-03	107	Regression equation from EPA soil measurements vs. distance	3	70	73	Air+soil regression-based model
7007003	77	3.7E-03	1.5E-03	195	Regression equation from EPA soil measurements vs. distance	2	102	105	Air+soil regression-based model
7007005	74	1.5E-03	6.0E-04	73	Regression equation from EPA soil measurements vs. distance	1	58	59	Air+soil regression-based model
7008003	72	2.1E-03	8.0E-04	83	Regression equation from EPA soil measurements vs. distance	1	62	63	Air+soil regression-based model
7007001	70	2.4E-03	1.0E-03	111	Regression equation from EPA soil measurements vs. distance	2	72	73	Air+soil regression-based model
7006054	63	2.1E-03	8.0E-04	139	Regression equation from EPA soil measurements vs. distance	1	82	83	Air+soil regression-based model

Attachment D-10. Estimated Media Concentrations in Alternative NAAQS (0.05 µg/m³ max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7006051	62	1.4E-03	5.0E-04	55	Regression equation from EPA soil measurements vs. distance	1	51	52	Air+soil regression-based model
7008006	58	2.5E-03	1.0E-03	112	Regression equation from EPA soil measurements vs. distance	2	72	74	Air+soil regression-based model
7007004	49	2.9E-03	1.2E-03	146	Regression equation from EPA soil measurements vs. distance	2	84	86	Air+soil regression-based model
7002029	46	5.9E-03	2.4E-03	222	Regression equation from EPA soil measurements vs. distance	4	112	116	Air+soil regression-based model
7006011	45	4.4E-03	1.8E-03	185	Regression equation from EPA soil measurements vs. distance	3	99	101	Air+soil regression-based model
2001044	34	1.2E-03	5.0E-04	44	Regression equation from EPA soil measurements vs. distance	1	47	48	Air+soil regression-based model
7002016	29	4.2E-03	1.7E-03	354	Regression equation from EPA soil measurements vs. distance	3	160	163	Air+soil regression-based model
7002033	23	5.4E-03	2.2E-03	245	Regression equation from EPA soil measurements vs. distance	3	120	124	Air+soil regression-based model
8001017	22	2.6E-03	1.1E-03	120	Regression equation from EPA soil measurements vs. distance	2	75	77	Air+soil regression-based model
6014015	15	8.3E-03	3.5E-03	277	Regression equation from EPA soil measurements vs. distance	5	132	138	Air+soil regression-based model
6014027	14	0.0198	8.3E-03	223	Re-contamination sample in	165	80	245	H6 model

Attachment D-10. Estimated Media Concentrations in Alternative NAAQS (0.05 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
					block				
8001030	14	3.4E-03	1.4E-03	145	Regression equation from EPA soil measurements vs. distance	2	84	86	Air+soil regression-based model
6014025	13	9.8E-03	4.1E-03	116	Re-contamination samples nearby	66	80	146	H6 model
7002032	13	4.7E-03	1.9E-03	242	Regression equation from EPA soil measurements vs. distance	3	119	122	Air+soil regression-based model
7002021	12	4.5E-03	1.8E-03	211	Regression equation from EPA soil measurements vs. distance	3	108	111	Air+soil regression-based model
6012003	12	1.0E-03	4.0E-04	38	Regression equation from EPA soil measurements vs. distance	1	45	46	Air+soil regression-based model
6015001	11	7.5E-03	3.2E-03	42	Re-contamination sample in block	40	80	120	H6 model
3001003	11	1.5E-03	6.0E-04	43	Regression equation from EPA soil measurements vs. distance	1	47	48	Air+soil regression-based model
3001000	11	5E-04	2.0E-04	27	Regression equation from EPA soil measurements vs. distance	0	41	42	Air+soil regression-based model
8001036	10	3.3E-03	1.3E-03	117	Regression equation from EPA soil measurements vs. distance	2	74	76	Air+soil regression-based model
6012053	9	4.0E-03	1.7E-03	97	Regression equation from EPA soil measurements vs. distance	3	67	69	Air+soil regression-based model

Attachment D-10. Estimated Media Concentrations in Alternative NAAQS (0.05 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
2001050	9	8.0E-04	3.0E-04	32	Regression equation from EPA soil measurements vs. distance	1	43	44	Air+soil regression-based model
6015016	8	0.0105	4.4E-03	105	Re-contamination sample in block	74	80	153	H6 model
8001035	8	3.1E-03	1.3E-03	119	Regression equation from EPA soil measurements vs. distance	2	75	77	Air+soil regression-based model
8001031	8	3.0E-03	1.2E-03	144	Regression equation from EPA soil measurements vs. distance	2	84	86	Air+soil regression-based model
8001037	8	2.8E-03	1.1E-03	113	Regression equation from EPA soil measurements vs. distance	2	72	74	Air+soil regression-based model
2001041	8	6.0E-04	2.0E-04	28	Regression equation from EPA soil measurements vs. distance	0	42	42	Air+soil regression-based model
6012016	8	1.2E-03	5.0E-04	42	Regression equation from EPA soil measurements vs. distance	1	46	47	Air+soil regression-based model
7002030	7	5.1E-03	2.1E-03	205	Regression equation from EPA soil measurements vs. distance	3	106	109	Air+soil regression-based model
6012001	7	1.4E-03	6.0E-04	43	Regression equation from EPA soil measurements vs. distance	1	47	48	Air+soil regression-based model
6014051	6	0.0195	8.2E-03	184	Re-contamination sample in block	163	80	242	H6 model
6014044	6	0.0106	4.4E-03	159	Re-contamination samples nearby	75	80	154	H6 model

Attachment D-10. Estimated Media Concentrations in Alternative NAAQS (0.05 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6015017	6	9.8E-03	4.1E-03	153	Re-contamination sample in block	66	80	145	H6 model
7002028	6	4.9E-03	2.0E-03	189	Regression equation from EPA soil measurements vs. distance	3	100	103	Air+soil regression-based model
6012021	6	1.9E-03	8.0E-04	53	Regression equation from EPA soil measurements vs. distance	1	50	52	Air+soil regression-based model
6014039	5	0.0297	0.0124	294	Re-contamination sample in block	251	80	330	H6 model
6014046	5	0.0202	8.4E-03	129	Re-contamination sample in block	168	80	248	H6 model
6015012	5	7.2E-03	3.0E-03	63	Re-contamination sample in block	36	80	116	H6 model
6015019	5	4.3E-03	1.8E-03	176	Re-contamination sample in block	0	80	80	H6 model
6012051	5	4.1E-03	1.7E-03	89	Regression equation from EPA soil measurements vs. distance	3	64	66	Air+soil regression-based model
2001058	5	1.0E-03	4.0E-04	34	Regression equation from EPA soil measurements vs. distance	1	44	44	Air+soil regression-based model
6012013	5	1.2E-03	5.0E-04	42	Regression equation from EPA soil measurements vs. distance	1	46	47	Air+soil regression-based model
8001006	5	1.7E-03	7.0E-04	87	Regression equation from EPA soil measurements vs. distance	1	63	64	Air+soil regression-based model

Attachment D-10. Estimated Media Concentrations in Alternative NAAQS (0.05 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
8001049	4	3.9E-03	1.6E-03	585	Regression equation from EPA soil measurements vs. distance	2	244	247	Air+soil regression-based model
8001045	4	3.7E-03	1.5E-03	376	Regression equation from EPA soil measurements vs. distance	2	168	171	Air+soil regression-based model
7002031	4	4.8E-03	2.0E-03	237	Regression equation from EPA soil measurements vs. distance	3	117	120	Air+soil regression-based model
6012014	4	1.1E-03	4.0E-04	39	Regression equation from EPA soil measurements vs. distance	1	45	46	Air+soil regression-based model
2001029	4	7.0E-04	3.0E-04	38	Regression equation from EPA soil measurements vs. distance	0	45	46	Air+soil regression-based model
2001015	4	5.0E-04	2.0E-04	26	Regression equation from EPA soil measurements vs. distance	0	41	41	Air+soil regression-based model
3001065	4	5.0E-04	2.0E-04	28	Regression equation from EPA soil measurements vs. distance	0	42	42	Air+soil regression-based model
2001023	4	3.0E-04	1.0E-04	20	Regression equation from EPA soil measurements vs. distance	0	39	39	Air+soil regression-based model
7002011	3	4.3E-03	1.7E-03	556	Regression equation from EPA soil measurements vs. distance	3	234	236	Air+soil regression-based model
7002012	3	5.7E-03	2.3E-03	519	Regression equation from EPA soil measurements vs. distance	4	220	224	Air+soil regression-based model

Attachment D-10. Estimated Media Concentrations in Alternative NAAQS (0.05 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6014018	3	7.0E-03	2.9E-03	400	Regression equation from EPA soil measurements vs. distance	4	177	181	Air+soil regression-based model
8001000	3	3.0E-03	1.2E-03	461	Regression equation from EPA soil measurements vs. distance	2	199	201	Air+soil regression-based model
8001044	3	3.6E-03	1.4E-03	373	Regression equation from EPA soil measurements vs. distance	2	167	169	Air+soil regression-based model
6012057	3	3.9E-03	1.6E-03	124	Regression equation from EPA soil measurements vs. distance	3	76	79	Air+soil regression-based model
2001059	3	1.6E-03	6.0E-04	36	Regression equation from EPA soil measurements vs. distance	1	44	45	Air+soil regression-based model
6012049	3	3.4E-03	1.4E-03	84	Regression equation from EPA soil measurements vs. distance	2	62	64	Air+soil regression-based model
2001056	3	9.0E-04	4.0E-04	35	Regression equation from EPA soil measurements vs. distance	1	44	45	Air+soil regression-based model
8001034	3	3.3E-03	1.3E-03	112	Regression equation from EPA soil measurements vs. distance	2	72	74	Air+soil regression-based model
8001032	3	2.9E-03	1.2E-03	141	Regression equation from EPA soil measurements vs. distance	2	83	85	Air+soil regression-based model
8001029	3	3.0E-03	1.2E-03	129	Regression equation from EPA soil measurements vs. distance	2	78	80	Air+soil regression-based model

Attachment D-10. Estimated Media Concentrations in Alternative NAAQS (0.05 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
2001057	3	9.0E-04	4.0E-04	35	Regression equation from EPA soil measurements vs. distance	1	44	45	Air+soil regression-based model
6012044	3	2.4E-03	1.0E-03	68	Regression equation from EPA soil measurements vs. distance	2	56	57	Air+soil regression-based model
6012030	3	2.0E-03	9.0E-04	62	Regression equation from EPA soil measurements vs. distance	1	54	55	Air+soil regression-based model
6012019	3	1.4E-03	6.0E-04	46	Regression equation from EPA soil measurements vs. distance	1	48	49	Air+soil regression-based model
8001042	3	2.0E-03	8.0E-04	106	Regression equation from EPA soil measurements vs. distance	1	70	71	Air+soil regression-based model
6012022	3	1.4E-03	6.0E-04	51	Regression equation from EPA soil measurements vs. distance	1	50	51	Air+soil regression-based model
2001030	3	1.0E-03	4.0E-04	48	Regression equation from EPA soil measurements vs. distance	1	49	49	Air+soil regression-based model
6014043	2	0.0170	7.1E-03	150	Re-contamination samples nearby	139	80	219	H6 model
6014028	2	0.0182	7.6E-03	179	Re-contamination samples nearby	150	80	230	H6 model
6015015	2	0.0102	4.3E-03	98	Re-contamination samples nearby	70	80	150	H6 model
6014021	2	9.9E-03	4.1E-03	95	Re-contamination sample in block	67	80	147	H6 model

Attachment D-10. Estimated Media Concentrations in Alternative NAAQS (0.05 µg/m³ max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6015018	2	6.7E-03	2.8E-03	160	Re-contamination samples nearby	30	80	110	H6 model
8001047	2	4.0E-03	1.6E-03	447	Regression equation from EPA soil measurements vs. distance	3	194	196	Air+soil regression-based model
6012065	2	5.5E-03	2.3E-03	136	Regression equation from EPA soil measurements vs. distance	4	81	84	Air+soil regression-based model
7002014	2	4.8E-03	2.0E-03	276	Regression equation from EPA soil measurements vs. distance	3	132	135	Air+soil regression-based model
8001019	2	3.9E-03	1.6E-03	230	Regression equation from EPA soil measurements vs. distance	2	115	117	Air+soil regression-based model
6012062	2	3.3E-03	1.4E-03	108	Regression equation from EPA soil measurements vs. distance	2	70	73	Air+soil regression-based model
8001023	2	3.4E-03	1.4E-03	158	Regression equation from EPA soil measurements vs. distance	2	89	91	Air+soil regression-based model
2001051	2	8.0E-04	3.0E-04	32	Regression equation from EPA soil measurements vs. distance	0	43	44	Air+soil regression-based model
6012041	2	2.0E-03	9.0E-04	60	Regression equation from EPA soil measurements vs. distance	1	53	54	Air+soil regression-based model
2001060	2	9.0E-04	3.0E-04	37	Regression equation from EPA soil measurements vs. distance	1	45	45	Air+soil regression-based model

Attachment D-10. Estimated Media Concentrations in Alternative NAAQS (0.05 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6012005	2	1.1E-03	4.0E-04	38	Regression equation from EPA soil measurements vs. distance	1	45	46	Air+soil regression-based model
6012006	2	1.0E-03	4.0E-04	38	Regression equation from EPA soil measurements vs. distance	1	45	46	Air+soil regression-based model
3001017	2	1.8E-03	7.0E-04	87	Regression equation from EPA soil measurements vs. distance	1	63	64	Air+soil regression-based model
3001055	2	4.0E-04	2.0E-04	24	Regression equation from EPA soil measurements vs. distance	0	40	40	Air+soil regression-based model
6014042	1	0.0326	0.0136	129	Re-contamination samples nearby	274	80	353	H6 model
6014052	1	0.0125	5.2E-03	216	Re-contamination sample in block	94	80	174	H6 model
6014032	1	0.0295	0.0123	162	Re-contamination samples nearby	248	80	328	H6 model
6014033	1	0.0312	0.0130	162	Re-contamination samples nearby	262	80	342	H6 model
6014049	1	0.0147	6.1E-03	167	Re-contamination sample in block	117	80	196	H6 model
6014029	1	0.0167	7.0E-03	135	Re-contamination sample in block	136	80	216	H6 model
6014050	1	0.0121	5.1E-03	171	Re-contamination sample in block	91	80	170	H6 model
6015013	1	7.6E-03	3.2E-03	53	Re-contamination samples nearby	42	80	121	H6 model

Attachment D-10. Estimated Media Concentrations in Alternative NAAQS (0.05 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6015011	1	6.0E-03	2.5E-03	123	Re-contamination samples nearby	23	80	102	H6 model
7002006	1	5.6E-03	2.3E-03	703	Regression equation from EPA soil measurements vs. distance	4	287	291	Air+soil regression-based model
7002009	1	4.4E-03	1.8E-03	958	Regression equation from EPA soil measurements vs. distance	3	380	383	Air+soil regression-based model
6014006	1	6.8E-03	2.8E-03	153	Regression equation from EPA soil measurements vs. distance	4	87	91	Air+soil regression-based model
7002017	1	5.6E-03	2.3E-03	323	Regression equation from EPA soil measurements vs. distance	4	149	153	Air+soil regression-based model
6014007	1	7.1E-03	3.0E-03	200	Regression equation from EPA soil measurements vs. distance	5	104	109	Air+soil regression-based model
3001019	1	4.5E-03	1.8E-03	169	Regression equation from EPA soil measurements vs. distance	3	93	96	Air+soil regression-based model
2001066	1	1.2E-03	5.0E-04	41	Regression equation from EPA soil measurements vs. distance	1	46	47	Air+soil regression-based model
7002025	1	3.1E-03	1.2E-03	179	Regression equation from EPA soil measurements vs. distance	2	97	99	Air+soil regression-based model
6012031	1	1.9E-03	8.0E-04	60	Regression equation from EPA soil measurements vs. distance	1	53	54	Air+soil regression-based model

Attachment D-10. Estimated Media Concentrations in Alternative NAAQS (0.05 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
8001003	1	2.0E-03	8.0E-04	109	Regression equation from EPA soil measurements vs. distance	1	71	72	Air+soil regression-based model
6012018	1	1.2E-03	5.0E-04	43	Regression equation from EPA soil measurements vs. distance	1	47	48	Air+soil regression-based model
6012004	1	1.0E-03	4.0E-04	38	Regression equation from EPA soil measurements vs. distance	1	45	46	Air+soil regression-based model
3001015	1	1.2E-03	5.0E-04	70	Regression equation from EPA soil measurements vs. distance	1	57	57	Air+soil regression-based model
2001003	1	3.0E-04	1.0E-04	17	Regression equation from EPA soil measurements vs. distance	0	37	38	Air+soil regression-based model
3001063	1	6.0E-04	2.0E-04	30	Regression equation from EPA soil measurements vs. distance	0	42	43	Air+soil regression-based model
3001009	1	1.2E-03	5.0E-04	60	Regression equation from EPA soil measurements vs. distance	1	53	54	Air+soil regression-based model
3001066	1	6.0E-04	2.0E-04	30	Regression equation from EPA soil measurements vs. distance	0	42	43	Air+soil regression-based model
2001104	1	1.0E-03	4.0E-04	56	Regression equation from EPA soil measurements vs. distance	1	52	52	Air+soil regression-based model
2001101	1	1.0E-03	4.0E-04	58	Regression equation from EPA soil measurements vs. distance	1	52	53	Air+soil regression-based model

Attachment D-10. Estimated Media Concentrations in Alternative NAAQS (0.05 µg/m^3 max-monthly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
2001022	1	3.0E-04	1.0E-04	22	Regression equation from EPA soil measurements vs. distance	0	39	40	Air+soil regression-based model

[a] "Other" refers to contributions from indoor paint, outdoor soil/dust and additional sources (including historical air) and "recent air" refers to contributions associated with outdoor ambient air.

1

Attachment D-11. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m³ max-quarterly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7006031	737	7.0E-03	2.7E-03	40	Regression equation from EPA soil measurements vs. distance	4	46	50	Air+soil regression-based model
7009003	254	6.0E-03	2.2E-03	51	Regression equation from EPA soil measurements vs. distance	4	50	54	Air+soil regression-based model
7008004	197	0.019	7.8E-03	186	Regression equation from EPA soil measurements vs. distance	12	99	111	Air+soil regression-based model
7006052	187	3.0E-03	1.3E-03	51	Regression equation from EPA soil measurements vs. distance	2	50	52	Air+soil regression-based model
7006013	176	0.033	0.0139	231	Regression equation from EPA soil measurements vs. distance	21	115	137	Air+soil regression-based model
7001044	164	4.0E-03	1.5E-03	30	Regression equation from EPA soil measurements vs. distance	2	42	45	Air+soil regression-based model
7010001	145	4.0E-03	1.6E-03	37	Regression equation from EPA soil measurements vs. distance	3	45	47	Air+soil regression-based model
7008007	141	0.012	5.0E-03	105	Regression equation from EPA soil measurements vs. distance	8	70	77	Air+soil regression-based model
7006053	139	7.0E-03	2.6E-03	91	Regression equation from EPA soil measurements vs. distance	4	64	69	Air+soil regression-based model
7009001	120	0.01	3.7E-03	85	Regression equation from EPA soil measurements vs. distance	6	62	68	Air+soil regression-based model

Attachment D-11. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-quarterly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7008005	104	0.014	5.8E-03	132	Regression equation from EPA soil measurements vs. distance	9	79	89	Air+soil regression-based model
6015002	95	0.029	0.0122	282	Regression equation from EPA soil measurements vs. distance	19	134	152	Air+soil regression-based model
7008002	92	0.013	5.4E-03	100	Regression equation from EPA soil measurements vs. distance	9	68	76	Air+soil regression-based model
7009002	86	0.01	3.6E-03	91	Regression equation from EPA soil measurements vs. distance	6	65	71	Air+soil regression-based model
6012052	79	0.02	8.5E-03	107	Regression equation from EPA soil measurements vs. distance	13	70	83	Air+soil regression-based model
7007003	77	0.018	7.3E-03	195	Regression equation from EPA soil measurements vs. distance	11	102	114	Air+soil regression-based model
7007005	74	7.0E-03	3.0E-03	73	Regression equation from EPA soil measurements vs. distance	5	58	63	Air+soil regression-based model
7008003	72	0.01	4.1E-03	83	Regression equation from EPA soil measurements vs. distance	7	62	68	Air+soil regression-based model
7007001	70	0.012	4.8E-03	111	Regression equation from EPA soil measurements vs. distance	8	72	79	Air+soil regression-based model
7006054	63	0.01	3.9E-03	139	Regression equation from EPA soil measurements vs. distance	7	82	88	Air+soil regression-based model

Attachment D-11. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-quarterly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7006051	62	7.0E-03	2.6E-03	55	Regression equation from EPA soil measurements vs. distance	4	51	56	Air+soil regression-based model
7008006	58	0.012	5.0E-03	112	Regression equation from EPA soil measurements vs. distance	8	72	80	Air+soil regression-based model
7007004	49	0.014	5.8E-03	146	Regression equation from EPA soil measurements vs. distance	9	84	93	Air+soil regression-based model
7002029	46	0.029	0.0118	222	Regression equation from EPA soil measurements vs. distance	18	112	130	Air+soil regression-based model
7006011	45	0.022	9.1E-03	185	Regression equation from EPA soil measurements vs. distance	14	99	112	Air+soil regression-based model
2001044	34	6.0E-03	2.3E-03	44	Regression equation from EPA soil measurements vs. distance	4	47	51	Air+soil regression-based model
7002016	29	0.021	8.4E-03	354	Regression equation from EPA soil measurements vs. distance	13	160	173	Air+soil regression-based model
7002033	23	0.027	0.0108	245	Regression equation from EPA soil measurements vs. distance	17	120	137	Air+soil regression-based model
8001017	22	0.013	5.2E-03	120	Regression equation from EPA soil measurements vs. distance	8	75	83	Air+soil regression-based model
6014015	15	0.041	0.0172	277	Regression equation from EPA soil measurements vs. distance	26	132	158	Air+soil regression-based model
6014027	14	0.098	0.0409	223	Re-contamination sample in block	534	258	792	Air+soil regression-based

Attachment D-11. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-quarterly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
									model
8001030	14	0.017	6.8E-03	145	Regression equation from EPA soil measurements vs. distance	11	84	95	Air+soil regression-based model
6014025	13	0.048	0.0203	116	Re-contamination samples nearby	215	258	473	Air+soil regression-based model
7002032	13	0.023	9.5E-03	242	Regression equation from EPA soil measurements vs. distance	15	119	134	Air+soil regression-based model
7002021	12	0.022	9.0E-03	211	Regression equation from EPA soil measurements vs. distance	14	108	122	Air+soil regression-based model
6012003	12	5.0E-03	2.0E-03	38	Regression equation from EPA soil measurements vs. distance	3	45	48	Air+soil regression-based model
6015001	11	0.037	0.0156	42	Re-contamination sample in block	131	258	389	H6 Model
3001003	11	7.0E-03	2.8E-03	43	Regression equation from EPA soil measurements vs. distance	5	47	51	Air+soil regression-based model
3001000	11	3.0E-03	1.0E-03	27	Regression equation from EPA soil measurements vs. distance	2	41	43	Air+soil regression-based model
8001036	10	0.017	6.6E-03	117	Regression equation from EPA soil measurements vs. distance	11	74	84	Air+soil regression-based model
6012053	9	0.02	8.2E-03	97	Regression equation from EPA soil measurements vs. distance	12	67	79	Air+soil regression-based model

Attachment D-11. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-quarterly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
2001050	9	4.0E-03	1.6E-03	32	Regression equation from EPA soil measurements vs. distance	3	43	46	Air+soil regression-based model
6015016	8	0.052	0.0217	105	Re-contamination sample in block	239	258	497	H6 model
8001035	8	0.015	6.2E-03	119	Regression equation from EPA soil measurements vs. distance	10	75	85	Air+soil regression-based model
8001031	8	0.015	6.0E-03	144	Regression equation from EPA soil measurements vs. distance	9	84	93	Air+soil regression-based model
8001037	8	0.014	5.5E-03	113	Regression equation from EPA soil measurements vs. distance	9	72	81	Air+soil regression-based model
2001041	8	3.0E-03	1.1E-03	28	Regression equation from EPA soil measurements vs. distance	2	42	43	Air+soil regression-based model
6012016	8	6.0E-03	2.4E-03	42	Regression equation from EPA soil measurements vs. distance	4	46	50	Air+soil regression-based model
7002030	7	0.025	0.0103	205	Regression equation from EPA soil measurements vs. distance	16	106	122	Air+soil regression-based model
6012001	7	7.0E-03	2.8E-03	43	Regression equation from EPA soil measurements vs. distance	4	47	51	Air+soil regression-based model
6014051	6	0.096	0.0404	184	Re-contamination sample in block	528	258	785	H6 model
6014044	6	0.052	0.0219	159	Re-contamination samples nearby	242	258	500	H6 model
6015017	6	0.048	0.0202	153	Re-contamination sample in block	213	258	471	H6 model

Attachment D-11. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-quarterly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7002028	6	0.024	9.8E-03	189	Regression equation from EPA soil measurements vs. distance	15	100	115	Air+soil regression-based model
6012021	6	9.0E-03	3.8E-03	53	Regression equation from EPA soil measurements vs. distance	6	50	56	Air+soil regression-based model
6014039	5	0.147	0.0614	294	Re-contamination sample in block	812	258	1070	H6 model
6014046	5	0.10	0.0416	129	Re-contamination sample in block	546	258	804	H6 model
6015012	5	0.035	0.0148	63	Re-contamination sample in block	118	258	376	H6 model
6015019	5	0.021	8.9E-03	176	Re-contamination sample in block	0	258	258	H6 model
6012051	5	0.02	8.5E-03	89	Regression equation from EPA soil measurements vs. distance	13	64	77	Air+soil regression-based model
2001058	5	5.0E-03	2.0E-03	34	Regression equation from EPA soil measurements vs. distance	3	44	47	Air+soil regression-based model
6012013	5	6.0E-03	2.5E-03	42	Regression equation from EPA soil measurements vs. distance	4	46	50	Air+soil regression-based model
8001006	5	8.0E-03	3.4E-03	87	Regression equation from EPA soil measurements vs. distance	5	63	68	Air+soil regression-based model
8001049	4	0.019	7.7E-03	585	Regression equation from EPA soil measurements vs. distance	12	244	256	Air+soil regression-based model
8001045	4	0.018	7.4E-03	376	Regression equation from EPA soil measurements vs. distance	12	168	180	Air+soil regression-based model

Attachment D-11. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-quarterly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7002031	4	0.024	9.7E-03	237	Regression equation from EPA soil measurements vs. distance	15	117	133	Air+soil regression-based model
6012014	4	5.0E-03	2.2E-03	39	Regression equation from EPA soil measurements vs. distance	3	45	49	Air+soil regression-based model
2001029	4	3.0E-03	1.4E-03	38	Regression equation from EPA soil measurements vs. distance	2	45	48	Air+soil regression-based model
2001015	4	2.0E-03	9.0E-04	26	Regression equation from EPA soil measurements vs. distance	1	41	42	Air+soil regression-based model
3001065	4	3.0E-03	1.0E-03	28	Regression equation from EPA soil measurements vs. distance	2	42	43	Air+soil regression-based model
2001023	4	1.0E-03	5.0E-04	20	Regression equation from EPA soil measurements vs. distance	1	39	39	Air+soil regression-based model
7002011	3	0.021	8.6E-03	556	Regression equation from EPA soil measurements vs. distance	13	234	247	Air+soil regression-based model
7002012	3	0.028	0.0115	519	Regression equation from EPA soil measurements vs. distance	18	220	238	Air+soil regression-based model
6014018	3	0.034	0.0144	400	Regression equation from EPA soil measurements vs. distance	22	177	199	Air+soil regression-based model
8001000	3	0.015	5.9E-03	461	Regression equation from EPA soil measurements vs. distance	9	199	208	Air+soil regression-based model

Attachment D-11. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-quarterly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
8001044	3	0.018	7.1E-03	373	Regression equation from EPA soil measurements vs. distance	11	167	178	Air+soil regression-based model
6012057	3	0.019	8.1E-03	124	Regression equation from EPA soil measurements vs. distance	12	76	89	Air+soil regression-based model
2001059	3	8.0E-03	3.2E-03	36	Regression equation from EPA soil measurements vs. distance	5	44	50	Air+soil regression-based model
6012049	3	0.017	6.9E-03	84	Regression equation from EPA soil measurements vs. distance	11	62	72	Air+soil regression-based model
2001056	3	5.0E-03	1.8E-03	35	Regression equation from EPA soil measurements vs. distance	3	44	47	Air+soil regression-based model
8001034	3	0.016	6.6E-03	112	Regression equation from EPA soil measurements vs. distance	11	72	83	Air+soil regression-based model
8001032	3	0.014	5.8E-03	141	Regression equation from EPA soil measurements vs. distance	9	83	92	Air+soil regression-based model
8001029	3	0.015	6.1E-02	129	Regression equation from EPA soil measurements vs. distance	10	78	88	Air+soil regression-based model
2001057	3	5.0E-03	1.9E-03	35	Regression equation from EPA soil measurements vs. distance	3	44	47	Air+soil regression-based model
6012044	3	0.012	4.9E-03	68	Regression equation from EPA soil measurements vs. distance	7	56	63	Air+soil regression-based model

Attachment D-11. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m³ max-quarterly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6012030	3	0.01	4.2E-03	62	Regression equation from EPA soil measurements vs. distance	6	54	60	Air+soil regression-based model
6012019	3	7.0E-03	2.9E-03	46	Regression equation from EPA soil measurements vs. distance	4	48	53	Air+soil regression-based model
8001042	3	0.01	3.9E-03	106	Regression equation from EPA soil measurements vs. distance	6	70	76	Air+soil regression-based model
6012022	3	7.0E-03	2.9E-03	51	Regression equation from EPA soil measurements vs. distance	4	50	54	Air+soil regression-based model
2001030	3	5.0E-03	2.0E-03	48	Regression equation from EPA soil measurements vs. distance	3	49	52	Air+soil regression-based model
6014043	2	0.084	0.0351	150	Re-contamination samples nearby	451	258	709	H6 model
6014028	2	0.09	0.0376	179	Re-contamination samples nearby	488	258	746	H6 model
6015015	2	0.05	0.0211	98	Re-contamination samples nearby	228	258	486	H6 model
6014021	2	0.049	0.0204	95	Re-contamination sample in block	217	258	475	H6 model
6015018	2	0.033	0.0138	160	Re-contamination samples nearby	99	258	357	H6 model
8001047	2	0.02	8.0E-03	447	Regression equation from EPA soil measurements vs. distance	13	194	207	Air+soil regression-based model
6012065	2	0.027	0.0115	136	Regression equation from EPA soil measurements vs. distance	17	81	98	Air+soil regression-based model

Attachment D-11. Estimated Media Concentrations in Alternative NAAQS (0.2 μg/m^3 max-quarterly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (μg/m^3)	Annual Average Inhalation Exposure Concentration (μg/m^3)	Soil Concentration (μg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (μg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
7002014	2	0.024	9.7E-03	276	Regression equation from EPA soil measurements vs. distance	15	132	147	Air+soil regression-based model
8001019	2	0.019	7.7E-03	230	Regression equation from EPA soil measurements vs. distance	12	115	127	Air+soil regression-based model
6012062	2	0.016	6.8E-03	108	Regression equation from EPA soil measurements vs. distance	10	70	81	Air+soil regression-based model
8001023	2	0.017	6.8E-03	158	Regression equation from EPA soil measurements vs. distance	11	89	100	Air+soil regression-based model
2001051	2	4.0E-03	1.5E-03	32	Regression equation from EPA soil measurements vs. distance	2	43	46	Air+soil regression-based model
6012041	2	0.01	4.2E-03	60	Regression equation from EPA soil measurements vs. distance	6	53	59	Air+soil regression-based model
2001060	2	4.0E-03	1.7E-03	37	Regression equation from EPA soil measurements vs. distance	3	45	48	Air+soil regression-based model
6012005	2	5.0E-03	2.2E-03	38	Regression equation from EPA soil measurements vs. distance	3	45	49	Air+soil regression-based model
6012006	2	5.0E-03	2.2E-03	38	Regression equation from EPA soil measurements vs. distance	3	45	48	Air+soil regression-based model
3001017	2	9.0E-03	3.5E-03	87	Regression equation from EPA soil measurements vs. distance	6	63	69	Air+soil regression-based model

Attachment D-11. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-quarterly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
3001055	2	2.0E-03	8.0E-04	24	Regression equation from EPA soil measurements vs. distance	1	40	41	Air+soil regression-based model
6014042	1	0.161	0.0674	129	Re-contamination samples nearby	887	258	1145	H6 model
6014052	1	0.061	0.0257	216	Re-contamination sample in block	306	258	564	H6 model
6014032	1	0.145	0.0609	162	Re-contamination samples nearby	805	258	1063	H6 model
6014033	1	0.154	0.0644	162	Re-contamination samples nearby	850	258	1108	H6 model
6014049	1	0.072	0.0303	167	Re-contamination sample in block	378	258	635	H6 model
6014029	1	0.083	0.0345	135	Re-contamination sample in block	442	258	700	H6 model
6014050	1	0.06	0.025	171	Re-contamination sample in block	293	258	551	H6 model
6015013	1	0.038	0.0157	53	Re-contamination samples nearby	135	258	393	H6 model
6015011	1	0.03	0.0125	123	Re-contamination samples nearby	73	258	331	H6 model
7002006	1	0.028	0.0113	703	Regression equation from EPA soil measurements vs. distance	18	287	305	Air+soil regression-based model
7002009	1	0.022	8.8E-03	958	Regression equation from EPA soil measurements vs. distance	14	380	394	Air+soil regression-based model
6014006	1	0.034	0.014	153	Regression equation from EPA soil measurements vs. distance	21	87	108	Air+soil regression-based model
7002017	1	0.027	0.0112	323	Regression equation from EPA soil measurements vs. distance	17	149	166	Air+soil regression-based model

Attachment D-11. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-quarterly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
6014007	1	0.035	0.0146	200	Regression equation from EPA soil measurements vs. distance	22	104	126	Air+soil regression-based model
3001019	1	0.022	8.7E-03	169	Regression equation from EPA soil measurements vs. distance	14	93	107	Air+soil regression-based model
2001066	1	6.0E-03	2.4E-03	41	Regression equation from EPA soil measurements vs. distance	4	46	50	Air+soil regression-based model
7002025	1	0.015	6.2E-03	179	Regression equation from EPA soil measurements vs. distance	10	97	106	Air+soil regression-based model
6012031	1	0.01	4.0E-03	60	Regression equation from EPA soil measurements vs. distance	6	53	59	Air+soil regression-based model
8001003	1	0.01	4.1E-03	109	Regression equation from EPA soil measurements vs. distance	6	71	78	Air+soil regression-based model
6012018	1	6.0E-03	2.5E-03	43	Regression equation from EPA soil measurements vs. distance	4	47	51	Air+soil regression-based model
6012004	1	5.0E-03	2.1E-03	38	Regression equation from EPA soil measurements vs. distance	3	45	48	Air+soil regression-based model
3001015	1	6.0E-03	2.2E-03	70	Regression equation from EPA soil measurements vs. distance	4	57	60	Air+soil regression-based model
2001003	1	1.0E-03	5.0E-03	17	Regression equation from EPA soil measurements vs. distance	1	37	38	Air+soil regression-based model

Attachment D-11. Estimated Media Concentrations in Alternative NAAQS (0.2 µg/m^3 max-quarterly) Scenario for the Primary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Soil Concentration (µg/g)	Method of Estimating Soil Concentrations	Predicted Indoor Dust Concentrations (µg/g)			Method of Estimating Indoor Dust Concentrations
						From Recent Air	From Other [a]	Total	
3001063	1	3.0E-03	1.2E-03	30	Regression equation from EPA soil measurements vs. distance	2	42	44	Air+soil regression-based model
3001009	1	6.0E-03	2.3E-03	60	Regression equation from EPA soil measurements vs. distance	4	53	57	Air+soil regression-based model
3001066	1	3.0E-03	1.1E-03	30	Regression equation from EPA soil measurements vs. distance	2	42	44	Air+soil regression-based model
2001104	1	5.0E-03	2.0E-03	56	Regression equation from EPA soil measurements vs. distance	3	52	55	Air+soil regression-based model
2001101	1	5.0E-03	2.0E-03	58	Regression equation from EPA soil measurements vs. distance	3	52	55	Air+soil regression-based model
2001022	1	2.0E-03	6.0E-04	22	Regression equation from EPA soil measurements vs. distance	1	39	40	Air+soil regression-based model

[a] "Other" refers to contributions from indoor paint, outdoor soil/dust and additional sources (including historical air) and "recent air" refers to contributions associated with outdoor ambient air.

July 25, 2007

Appendix E: Media Concentrations for the Secondary Pb Smelter Case Study

Prepared by:

ICF International
Research Triangle Park, NC

Prepared for:

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina

Contract No. EP-D-06-115
Work Assignment No. 0-4

Table of Contents

List of Exhibits

List of Attachments

E. MEDIA CONCENTRATIONS FOR THE SECONDARY PB SMELTER CASE STUDY

This appendix discusses methods, results, limitations, and uncertainties associated with the estimation of environmental media concentrations for the secondary lead (Pb) smelter case study included in the human exposure and health risk assessments. These media concentrations were estimated using a combination of modeling approaches and the estimated concentrations for the current conditions scenario were compared to available measurement data to evaluate the performance of the approaches. Estimates presented in this appendix are specified with regard to number of decimal places, which results in various numbers of implied significant figures. This is not intended to convey greater precision for some estimates than others; it is simply an expedient and initial result of the software used for the calculation. Greater attention is given to significant figures in the presentation of estimates in the main body of the report.

- For this analysis, five air quality scenarios were evaluated, including current conditions, in which the current National Ambient Air Quality Standard (NAAQS) is attained and four possible alternative NAAQS, as described below:
- Attainment of air concentration of 0.2 µg/m^3, based on a maximum calendar quarter averaging period;
- Attainment of air concentration of 0.5 µg/m^3, based on a maximum monthly averaging period;
- Attainment of air concentration of 0.2 µg/m^3, based on a maximum monthly averaging period; and
- Attainment of air concentration of 0.05 µg/m^3, based on a maximum monthly averaging period.

This analysis focused on three primary environmental media and their exposure concentrations: ambient air, indoor dust, and outdoor surface soil/dust. Estimated inhalation and indoor dust exposure concentrations differed for the five air quality scenarios because they each were based, at least in part, on the estimated ambient air concentrations, which varied across scenarios. The outdoor surface soil/dust exposure concentrations estimated for the current conditions scenario were also used for the alternative NAAQS scenarios (i.e., it was assumed that reductions in ambient air concentrations associated with the alternative NAAQS scenarios did not have a significant impact on soil concentrations).[1] The approaches used and the estimated exposure concentrations for air, outdoor soil, and indoor dust are described in the remainder of this appendix.

E.1. SPATIAL TEMPLATE

The study area extent was defined using geographic information system (GIS) software to identify U.S. Census block groups that fall predominantly within 10 kilometers (km) of the facility; 12 U.S. Census block groups were identified. Because of the irregular shape of U.S. Census block groups, not all of the U.S. Census block groups with area within 10 km were included, and some that were included have area outside 10 km. Block groups falling along the 10 km radius from the source were generally included if most of their area fell within the radius. Model receptors were placed at all U.S. Census block centroids within the 12 U.S. Census block groups of interest. This resulted in 665 U.S. Census block centroid points being modeled. The U.S. Census blocks with no children under age seven were included in the modeling simulations to aid in understanding the patterns of air concentrations in the study area. These locations were not included in this assessment and are not included in exhibits summarizing modeling results (with the exception of isopleths diagrams), because this assessment focuses on the health risk for Pb in children under age seven. The remaining 298 U.S. Census blocks with children under the age of seven as of the 2000 U.S. Census were included in the exposure assessment and are the basis for all of the exhibits (with the exception of isopleths diagrams) in this appendix.

[1] Derivation of the outdoor surface soil/dust estimates for the current conditions scenario is further discussed in Section E.3.

The spatial template for this case study was developed in the pilot assessment and includes all U.S. Census blocks within the extent of the study area. As was done for the primary Pb smelter case study, an analysis was performed to investigate whether it would be appropriate to reduce the number of individual locations within the template to gain modeling efficiency by replacing some sets of individual blocks with the corresponding block group. This analysis involved comparing the maximum U.S. Census block level modeled air concentration to the mean annual average air concentration for the U.S. Census block group to identify occurrences where this difference was less than a factor of two, and the U.S. Census block group might be substituted for the individual U.S. Census blocks. For this case study, although five U.S. Census block groups had maximum-to-average ratios less than 2.0, the individual U.S. Census blocks within these five U.S. Census block groups were included in the spatial template because of the small size of the U.S. Census block groups and their proximity to the facility (see Exhibit E-1). That is, based on the analysis performed for the pilot assessment, the spatial template for this assessment also included all individual U.S. Census blocks within the study area (see Exhibit E-2).

In addition, two air Pb-TSP monitors from the U.S. EPA Air Quality System (AQS) database were identified between 400 and 700 meters (m) of the facility (USEPA, 2007). The locations of these two monitors were modeled as discrete receptors and the results at these locations were used to directly compare estimated concentrations from the current conditions scenario modeling to the available monitoring data.

Exhibit E-1. Ratios of the Maximum-to-Mean Block-level Annual Average Air Concentrations in each Block Group

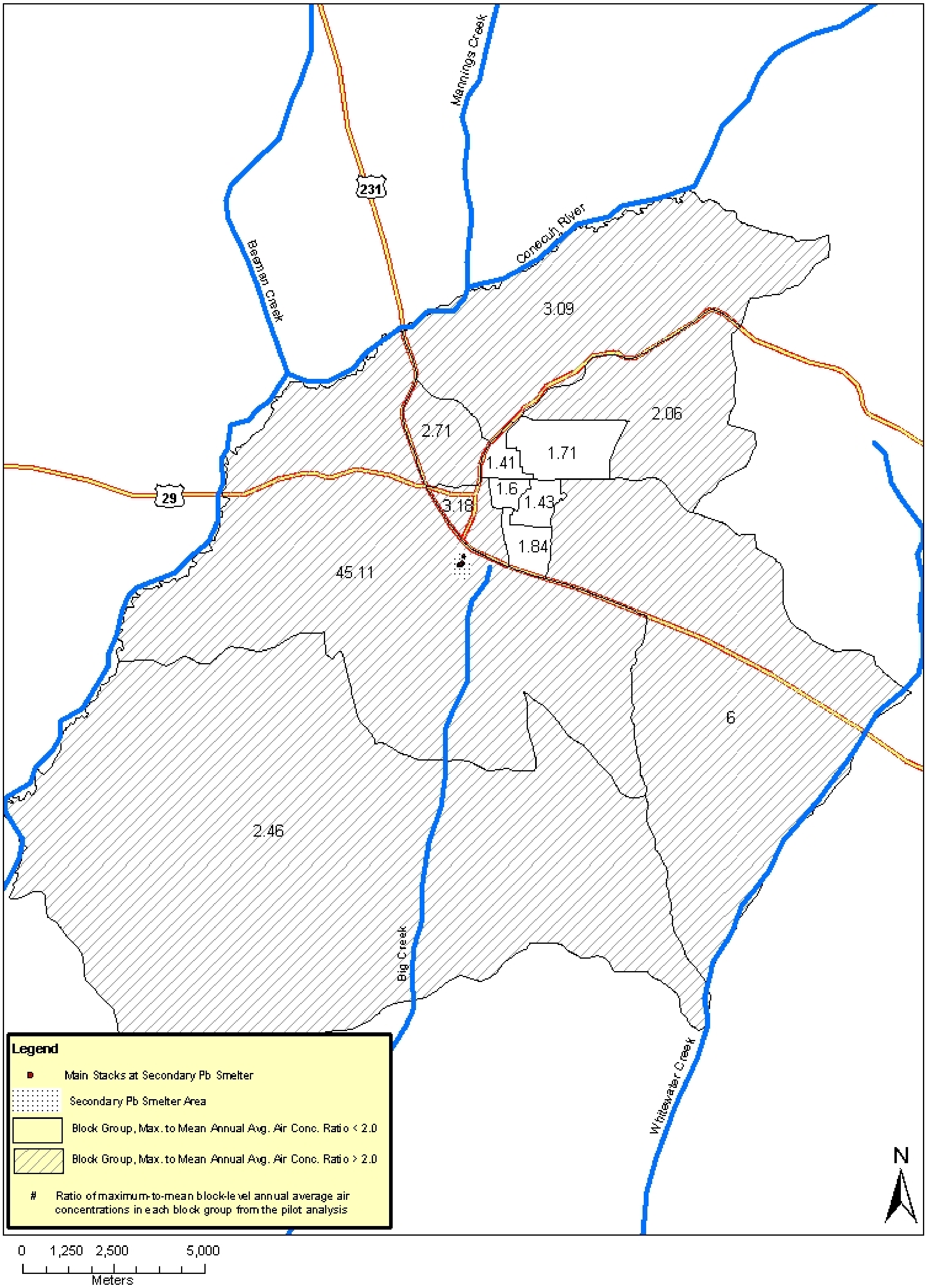
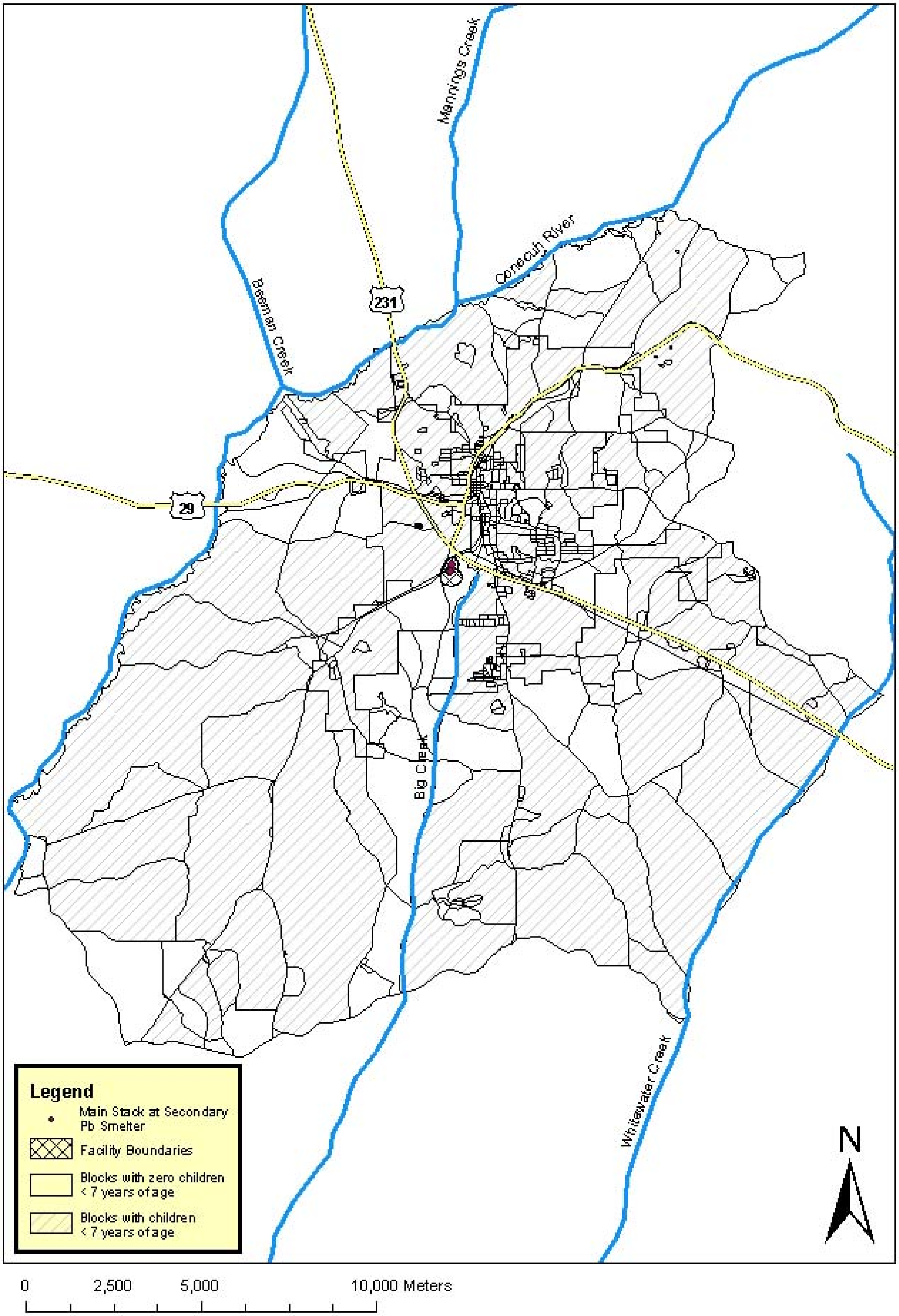


Exhibit E-2. Spatial Template for the Secondary Pb Smelter Case Study (Including U.S. Census Blocks with Children under the Age of Seven)



E.2. AIR

The air concentrations and total (dry + wet) deposition fluxes of Pb for the secondary Pb smelter case study were modeled using the AERMOD 07026 air dispersion model, and the air concentrations were compared to the air concentrations from nearby monitors (USEPA, 2004; 2004). The emissions used for the air quality modeling are described in Appendix B.

E.2.1. Air Dispersion Modeling

The meteorological data used for the AERMOD air dispersion model includes five consecutive years (1998 to 2002) of nearby measurements. Surface-level and upper air meteorological data were obtained for weather stations located in Montgomery, Alabama, and Centerville, Alabama (National Oceanic and Atmospheric Administration (NOAA), 1997; 1997), respectively, and processed using the meteorological pre-processor, AERMET 06341 (USEPA, 2002). These stations represent locations close in proximity and geography to Troy, Alabama, and for which five consecutive years of surface and upper air meteorological data were available. Obtaining five consecutive years of weather observations for use in AERMOD was desirable because it allowed for the natural variability in weather conditions to be captured in the air modeling.

All five years of meteorological data (1998 to 2002) were simulated individually using AERMOD with the same emissions. There were no modeled differences in emissions between the different simulation years because the available emissions data were not necessarily representative of any particular year. Instead, they were compiled to represent current conditions, given the available emissions data. The estimates for process emissions for the secondary Pb smelter analyzed in this assessment were calculated from Pb emissions measured during stack tests performed in 2005 and 2006 (URS Corporation, 2005; 2005; 2006). Fugitive emissions for four fugitive sources (associated with the smelter building, materials handling, loader traffic, and truck traffic) were estimated based on 1987 Prevention of Significant Deterioration (PSD) data (URS Corporation, 2006), which were the most recent available data on fugitive emissions from the facility. Due to the relatively flat terrain in the study area, terrain calculations were not included in this application. All of the inputs for these modeling simulations are provided in Attachments E-1 and E-2. Monthly average air concentrations and total deposition fluxes for each simulation year and receptor location (i.e., U.S. Census blocks and monitor locations) were output from the air dispersion model at each receptor (i.e., U.S. Census block) and monitor location, as described in Section E.1.

E.2.2. Air Concentration and Total Deposition Results

The monthly average air concentration model results for the current conditions scenario were calculated at the centroid of each U.S. Census block and monitor receptor point as described in Section E.2.1. The concentrations were also averaged quarterly and compared to the current NAAQS (1.5 $\mu g/m^3$) to confirm that the estimated air concentrations for this current conditions scenario were at or below the current NAAQS. This comparison indicated that none of the U.S. Census block-level air concentrations exceeded the current NAAQS. The monthly averages were then averaged over each year of the modeling period to generate annual averages. To take into account variations in meteorological data, the annual average concentrations and total depositions for each of the five years were averaged to generate one set of representative annual average concentration estimates for the current conditions scenario.

Monthly and quarterly averages were also compared to four alternative NAAQS scenarios including: monthly maximum NAAQS scenarios of 0.5 $\mu g/m^3$, 0.2 $\mu g/m^3$, and 0.05 $\mu g/m^3$; and one quarterly maximum NAAQS scenario of 0.2 $\mu g/m^3$. For these alternative scenarios there were several modeled U.S. Census blocks which did not meet the alternative NAAQS, in which case a ratio was developed from the maximum monthly or quarterly averaged value and the alternative NAAQS level. This roll-back factor was then applied to scale down the concentrations at each of the locations and a new combined annual average was calculated from the scaled data set (i.e., a proportional rollback of all modeled locations was implemented).

Attachments E-3 to E-7 present the annual average air Pb concentration estimates for the 298 U.S. Census blocks with at least one child under seven years of age for all scenarios. Exhibit E-3 presents a summary of these data for the 298 U.S. Census blocks with at least one child under seven years of age for the current conditions scenario and the four alternative NAAQS scenarios.

Exhibit E-3. Annual Average Air Concentrations for the Secondary Pb Smelter Case Study

Statistic [b]	Annual Average Pb Air Concentration (μg/m^3) [a]				
	Current Conditions	Alternative NAAQS Scenario			
		1 0.2 μg/m^3, Max Quarterly	2 0.5 μg/m^3, Max Monthly	3 0.2 μg/m^3, Max Monthly	4 0.05 μg/m^3, Max Monthly
Maximum	0.1	0.03	0.07	0.03	7.1E-03
95th Percentile	0.02	4.1E-03	8.6E-03	3.4E-03	8.6E-04
Median	3.3E-03	8.8E-04	1.8E-03	7.3E-04	1.8E-04
5th Percentile	5.2E-04	1.4E-04	2.9E-04	1.2E-04	5.0E-05
Minimum	2.7E-04	7.2E-05	1.5E-04	6.0E-05	5.0E-05

[a] The 298 U.S. Census blocks with children under the age of seven selected for analysis were used to create this summary.
[b] The statistic (e.g., 95th percentile, median) may not be at the same location for each of the data results presented here.

As described in Section E.2.1, wet and dry Pb deposition was also modeled and a summary of the total deposition flux estimates are presented in Exhibit E-4.

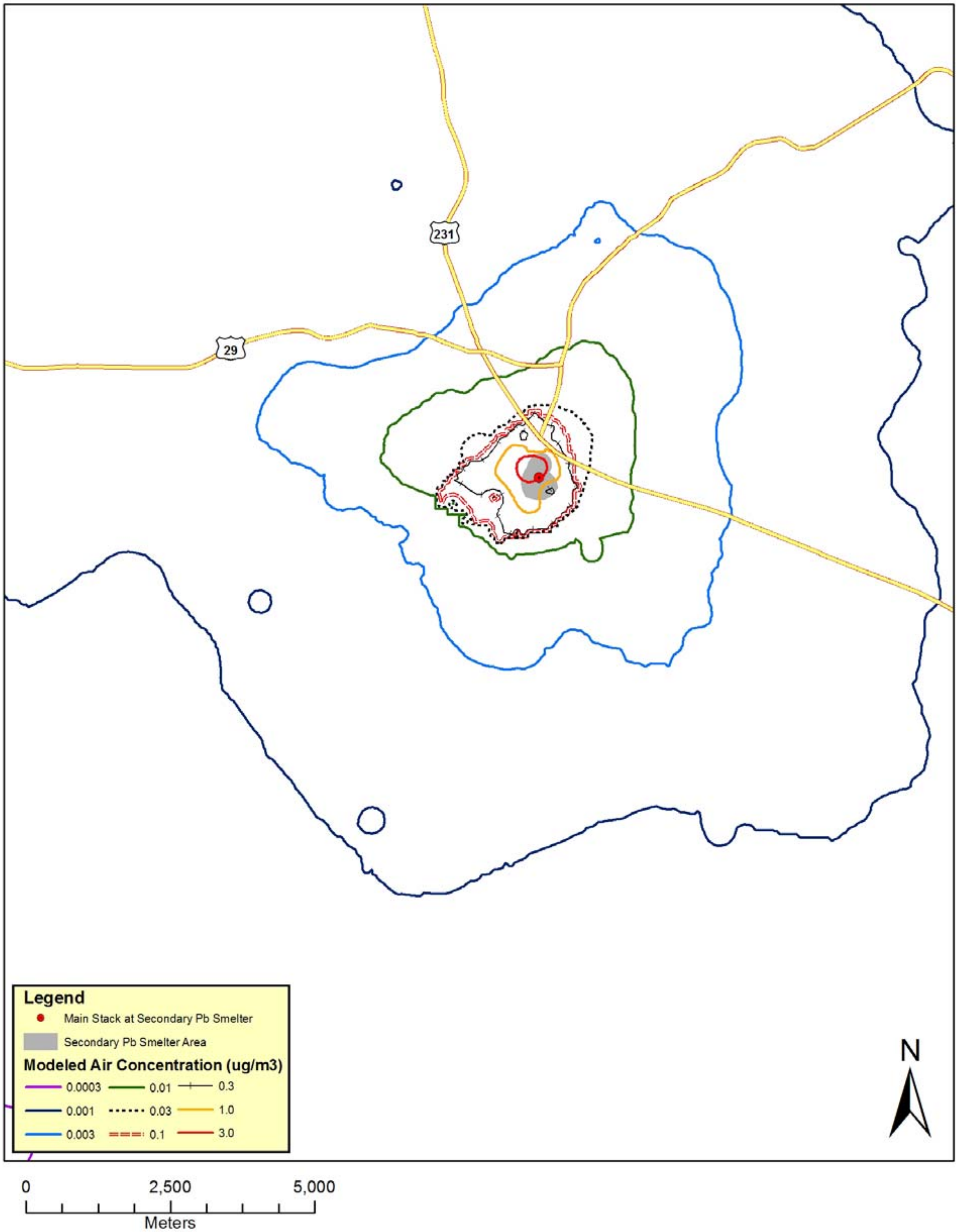
Exhibit E-4. Annual Average Total Deposition of Pb across the Study Area for the Current Conditions Scenario

Statistic [a]	Annual Average Total Deposition of Pb (g/m^2/year)
Maximum	0.05
95th Percentile	5.4E-03
Median	1.0E-03
5th Percentile	1.3E-04
Minimum	3.8E-05

[a] The statistic (e.g., 95th percentile, median) may not be at the same location for each of the data results presented here.

Exhibit E-5 shows the isopleths of the U.S. Census block-level modeled annual average air concentration results for the current conditions scenario.

Exhibit E-5. Annual Average Air Concentration Isopleths for the Current Conditions Scenario for the Secondary Pb Smelter Case Study



E.2.3. Inhalation Exposure Concentrations

Inhalation exposure concentrations of Pb were estimated for the population of interest (young children) from the estimated annual average ambient air concentrations using age group- and location-specific relationships for Pb developed from modeling performed for the U.S. EPA 1999 National-scale Air Toxics Assessment (USEPA, 2006), one of the U.S. EPA's National Air Toxics Assessment (NATA) activities. These relationships account for air concentration differences indoors and outdoors, as well as for mobility or time spent in different locations (e.g., outdoors at home, inside at home) for the population of interest.

The NATA national-scale assessment produced air concentrations of Pb (and other hazardous air pollutants [HAPs]) for each U.S. Census tract (using the Assessment System for Population Exposure Nationwide model [ASPEN]), and corresponding exposure concentrations of Pb for each of five age groups at each U.S. Census tract (using the Hazardous Air Pollutant Exposure Model [HAPEM]). The relationships (or ratios) between the Pb inhalation exposure concentrations and the ambient Pb air concentrations from the NATA national-scale assessment for the 0 to 4 age group (the closest age group to the age group of interest for this assessment for which ASPEN and HAPEM outputs were available) ranged from 0.44 to 0.46 for the U.S. Census tracts in the study area for the secondary Pb smelter case study. The ratios are presented in Exhibit E-6. It was assumed that these U.S. Census tract-specific ratios provided a reasonable approximation of the ratios for the U.S. Census blocks and block groups contained within each tract.

The resulting inhalation exposure estimates for each scenario and U.S. Census block with at least one child under the age of seven are provided in Attachments E-3 to E-7.

Exhibit E-6. Ratios of Inhalation Exposure Concentrations to Ambient Air Concentrations from the NATA National-scale Air Toxics Assessment

U.S. Census Tract ID	Ratio of Inhalation Exposure Concentration: Ambient Air Concentration
01109988900	0.46
01109989100	0.45
01109989200	0.45
01109989000	0.44

Use of ratios for the 0 to 4 age group (rather than for 0 to 7) contributes some uncertainty in the estimate of children's inhalation exposure concentrations. In addition, there is some uncertainty in the magnitude of the air concentrations generated using the ASPEN model for the NATA national-scale assessment (USEPA, 2006). In a comparison to monitoring data across the country, the ASPEN-modeled air concentrations generally underestimated monitored concentrations (USEPA, 2006; Section on Comparison to Monitored Values). However, the relationship between ambient air concentrations and inhalation exposure concentrations (i.e., the comparison used here) is not expected to be affected by underestimated ambient air concentrations from the NATA national-scale assessment (see Exhibit E-7). In addition, some of the exposure modeling inputs used in the NATA simulations were not specific to Pb and thus may introduce additional uncertainties. For example, the penetration factor, which is used to estimate the fraction of the pollutant in outdoor air that reaches indoor air, used for Pb in the NATA assessment, is based on a study that examined the penetration of hexavalent chromium particles, which are generally more reactive than Pb particles (Long et al., 2004).

Exhibit E-7. Annual Average Inhalation Exposure Concentrations for the Secondary Pb Smelter Case Study

Statistic [b]	Annual Average Pb Inhalation Exposure Concentration (µg/m³) [a]					
	Current Conditions Scenario	Alternative NAAQS Scenario				
		1 0.2 µg/m³, Max Quarterly	2 0.5 µg/m³, Max Monthly	3 0.2 µg/m³, Max Monthly	4 0.05 µg/m³, Max Monthly	
Maximum	0.06	0.01	0.03	0.01	3.1E-03	
95th Percentile	6.7E-03	1.8E-03	3.8E-03	1.5E-03	3.8E-04	
Median	1.4E-03	3.9E-04	8.1E-04	3.2E-04	8.1E-05	
5th Percentile	2.3E-04	6.2E-05	1.3E-04	5.2E-05	2.3E-05	
Minimum	1.2E-04	3.2E-05	6.7E-05	2.7E-05	2.3E-05	

[a] The 298 U.S. Census blocks/block groups with at least one child under seven years of age were used to create this summary.
[b] The statistic (e.g., 95th percentile, median) may not be at the same location for each of the data results presented here.

E.2.4. Air Modeling Performance Assessment

The monitoring data at the two air monitor locations near the facility were compared to modeled concentrations at the same locations (see Exhibit E-8). For this comparison, air monitoring measurements from 1998 through 2002 were compared to the modeled air concentrations. These years of monitoring data were selected to correspond to the years of meteorological data used in the air modeling.[2] Overall, the modeled combined annual average concentrations at the monitor locations (located to the northwest of the facility) are slightly lower than the weighted annual average values at the monitor[3] closest to the facility and approximately a factor of two to three lower at the monitor slightly farther from the facility. Because the meteorological data used for the modeling were not site-specific, there is likely some uncertainty with use of these data to estimate air concentrations at specific points. It is possible that the local predominant wind direction is different from that of the meteorological data. Therefore, the weighted annual average monitored air concentrations were also compared to the combined annual average modeled air concentrations within similar distances to the facility, in all directions modeled on a radial grid (see Exhibit E-8). When compared to concentrations in all directions, the monitored values fall within the range of modeled results. A more detailed comparison is presented in Attachment E-8.

---

[2] Note that the emissions data used in this modeling represent stack testing performed in 2005 and 2006 and fugitive emission estimates from 1987 (Alabama Department of Environmental Management (ADEM), 2007). Given that these emissions data, when used together, are not clearly representative of any specific time period, the decision was made to use monitoring data corresponding to the years of meteorological data used in the modeling (i.e., 1998 to 2002).

[3] Annual averages were calculated from the monthly composite data from the U.S. EPA AQS database and weighted by the number of days in a month (USEPA, 2007).

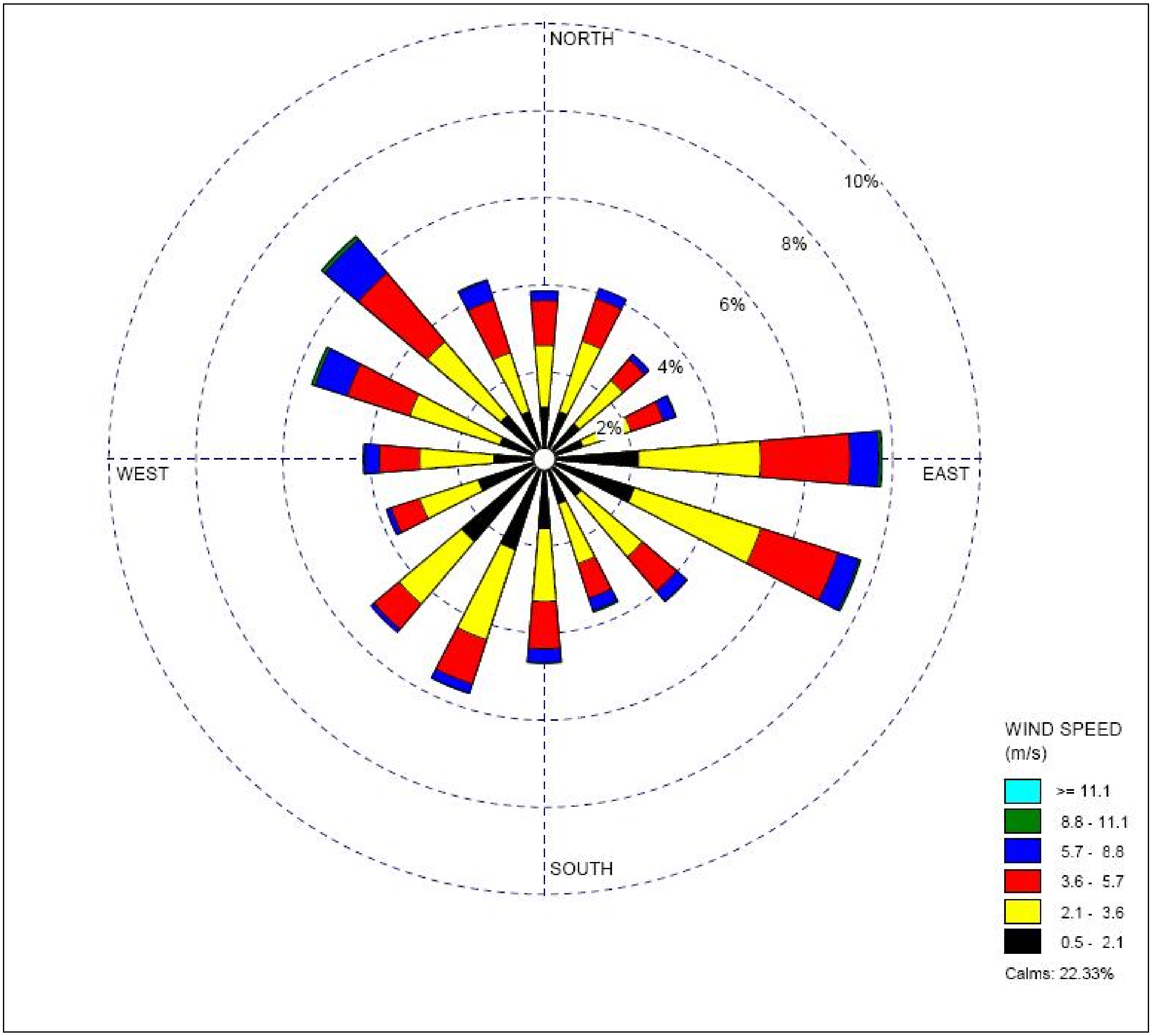
Exhibit E-8. Modeled Annual Average Air Pb Concentrations Compared to Monitored Annual Average Air Pb Concentrations

Monitor Values [a]			Modeled Results [b]		
U.S. EPA AQS Monitor	Distance from Midpoint of Facility (m)	Range of Annual Average Monitor Air Concentrations from the U.S. EPA AQS Database from 1998 to 2002 (μg/m³)	Range of Modeled Distances for Comparison	Range of Annual Average Modeled Concentrations (μg/m³)	Annual Average Modeled Concentration at Monitor Location (μg/m³) [c]
11090003	400	0.275 to 0.467	300 to 500 m (108 Points)	0.04 to 2.5	0.260
11090006	680	0.139 to 0.204	600 to 800 m (108 Points)	0.02 to 0.2	0.059

[a] Annual average monitor air concentrations were created from the monthly composite data from the U.S. EPA AQS database (USEPA, 2007). Each average was weighted based on the number of days in the month.
[b] The modeled concentrations presented here were generated from a model run with a radial receptor grid. This summary is not from U.S. Census block centroid results.
[c] These values are the annual average concentrations for the specific receptor location from the model run.

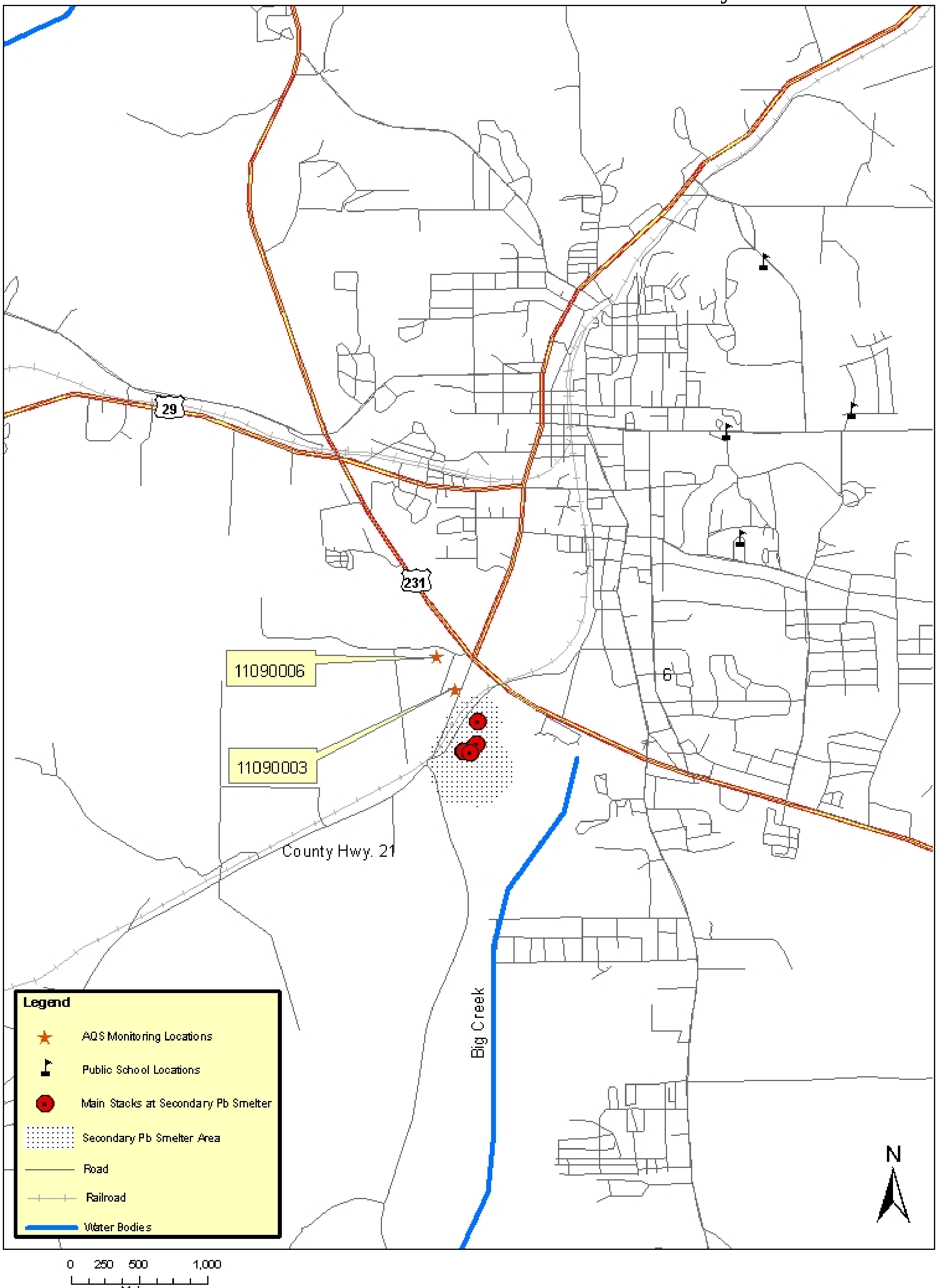
A wind rose created from five years of Montgomery, Alabama, wind data (see Exhibit E-9) shows that the predominant directions from which the wind is blowing are east, east south-east, and northwest. Both monitors are located northwest of the facility. The potential difference between actual site meteorological data and the meteorological data used in the modeling may help explain why the modeled concentrations are not closer to the monitored concentrations at the exact monitor locations, but modeled concentrations in all directions are within the range of monitored concentrations at similar distances. Because the monitors are both located northwest of the facility (see Exhibit E-10), it cannot be determined from the available data whether all modeled air concentrations and deposition rates could potentially be underestimated or the degree of over- or under-prediction by the model is dependent on direction (or neither or both). A directional difference between modeled and actual air concentrations can impact risk results (either under- or over-predicting) because the number of modeled children varies spatially for the U.S. Census blocks located near the facility.

Exhibit E-9. Wind Rose of Meteorological Data Used for Secondary Pb Smelter Case Study (Direction from which Wind is Blowing)



1 Note: Wind rose derived from five years (1998 to 2002) of meteorological data (41,766 hours of data).

Exhibit E-10. Air Monitor Locations near the Secondary Pb Smelter



No local measurements of Pb deposition (dry, wet, or total) were found for comparison to the model predicted deposition results. In the U.S. EPA Pb Criteria Document (2006), the U.S. EPA summarized studies that provided ranges of Pb total deposition fluxes in various locations across the United States. None of these studies were specifically for total deposition near a secondary Pb smelter, but they provided a range of total deposition values for comparison. Exhibit E-11 summarizes this range of total deposition values.

The ranges of annual average deposition fluxes from the secondary Pb smelter emissions modeled at a nearby U.S. Census block centroid with children under seven years of age are 3.8E-05 to 4.9E-02 gram per square meter per year ($g/m^2/yr$) and 0 to 5.7E-04 $g/m^2/yr$ for dry and wet deposition, respectively. These ranges are slightly larger than those deposition fluxes presented in the studies in Exhibit E-11, which is expected because none of the studies presented in Exhibit E-11 measured deposition directly next to a secondary Pb smelter facility. The lower modeled dry deposition fluxes are comparable to those at the low end of the majority of the measured ranges from the studies in Exhibit E-11, which is expected given that the locations of those deposition fluxes could be described as urban background. The lower modeled fluxes for wet deposition (median: 2.4E-05) may also be explained by urban background not included in the modeling. The median modeled dry deposition flux (1.03E-03 $g/m^2/year$) falls within the range of some of the measurements presented in Exhibit E-11 (i.e., New York City, Detroit, and sites near Lake Michigan). Comparison of the modeled total deposition fluxes to the study measurements throughout the United States provides some confidence that the modeled total deposition is within the expected range.

Exhibit E-11. Pb Deposition Fluxes from Studies in the United States

Location	Mean Value or Range (g Pb/m^2/year)	Source
Total Deposition Fluxes		
New York City, building exterior plate collecting total deposition (weekly values from 2003 to 2005 averaged)	9.8E-03	(Caravanos et al., 2006)
Dry Deposition Fluxes		
Two sites on Chesapeake Bay in 1990 to 1991	3.7E-04 to 1E-03	(Wu et al., 1994)
New York-New Jersey Harbor Bight area	1.5E-04 to 7.6E-04	(Gao et al., 2002)
Urban site in metropolitan Detroit 1982 to 1991	4E-04 to 4E-03	(Pirrone et al., 1995)
Sites near Lake Michigan 1993 to 1995	8.4E-03 to 1.4E-02	(Yi et al., 2001)
Lake Michigan	9.5E-04	(Sweet et al., 1998)
Lake Superior	9.2E-04	(Sweet et al., 1998)
Lake Erie	7.8E-04	(Sweet et al., 1998)
Wet Deposition Fluxes		
Reston, Virginia	4.4E-04	(Conko et al., 2004)
Delaware Bay and Chesapeake Bay	3.9E-04 to 5.1E-04	(Kim et al., 2000)
Western Maryland	6.4E-04	(Lawson and Mason, 2001)
North-central Maryland	3.0E-04 to 6.0E-04	(Scudlark et al., 2005)
Great Lakes Region	5.5E-04 to 1.0E-03	(Sweet et al., 1998)

E.3. OUTDOOR SURFACE SOIL/DUST

Outdoor surface soil/dust concentrations of Pb were estimated by defining the spatial pattern of surface soil/dust concentrations around the secondary Pb smelter facility using air and surface soil/dust model results and then adjusting the magnitude of the concentrations based on measured concentrations from a different secondary Pb smelter facility for which there were soil/dust Pb measurements.

The spatial pattern of the outdoor soil/dust concentrations were estimated using the AERMOD total deposition estimates and the U.S. EPA's Multiple Pathways of Exposure (MPE) methodology (USEPA, 1998). The MPE methodology represents the update of the Indirect Exposure Methodology (IEM) (USEPA, 1990) and consists of a set of multimedia fate and transport algorithms developed by the U.S. EPA's Office of Research and Development (ORD), including a soil mixing model. In the MPE soil mixing model algorithms, cumulative soil concentrations were calculated as a function of total particle deposition, soil mixing depth, bulk density, and a soil loss constant. The soil loss constant (in this case) was defined as a function of loss due to leaching, erosion, and runoff processes. Concentration in the soil was calculated in the top 1 centimeter (cm) of soil assuming constant total deposition of Pb for the entire operating period of the facility (37 years). All input parameters used for the soil mixing model are listed in Attachment E-9. Site-specific input parameters were used when feasible, but assumptions were made for some parameters, in many cases based on suggested values in the database of input parameters included with the U.S. EPA's Human Health Risk Assessment Protocol (HHRAP) (2005).

As the total deposition rate estimates used in the soil mixing model were those derived from the AERMOD simulations using current emissions estimates, without additional historical emissions, it is recognized that the resultant cumulative deposition and associated estimate of soil concentration will be an underestimate of current soil concentrations (and this is supported by comparison to concentrations near other secondary Pb smelters). Consequently, the AERMOD-MPE generated results were only used to produce a spatial pattern for the soil concentrations. This base pattern of concentrations was then scaled up using soil measurements available for another secondary Pb smelter facility. The measurements of Pb in surface soil samples located 100 to 1000 m from the other secondary Pb smelter facility (Kimbrough and Suffet, 1995) were up to 13 times higher than the AERMOD-MPE generated base concentrations, depending on the distance from the facility. Distance-specific scaling factors, presented in Exhibit E-12, were developed by averaging the concentrations from the Kimbrough and Suffet (1995) data within different distance rings around the facility and comparing these average concentrations to the averages within the same distance rings from the modeled soil concentrations. This scaling preserves the overall pattern of soil concentrations estimated using the modeling approach (which takes into account site-specific inputs such as meteorological data and facility characteristics) and adjusts the magnitude of the concentrations to better correspond with measured values at a surrogate location.

The surface soil concentrations estimated for the current conditions scenario using this approach for each U.S. Census block are summarized in Exhibit E-13 and provided in Attachment E-3. These surface soil concentrations for the current conditions scenario were also used for the alternative NAAQS scenarios (i.e., it was assumed that reductions in ambient air concentrations associated with the alternative NAAQS scenarios did not have a significant impact on soil concentrations). The individual U.S. Census block surface soil concentrations for the alternative NAAQS scenarios are presented in Attachments E-4 to E-7.

Exhibit E-12. Summary of Soil Pb Concentration Factors with Distance

Distance (m)	Factor
0 to 200	1
200 to 400	2
400 to 600	4
600 to 800	6
800+	13

Exhibit E-13. Summary of Surface Soil Pb Concentrations for the Current Conditions Scenario

Statistic	Average Surface Soil Pb Concentration: Model Output (mg/kg) [a]	Average Soil Pb Concentration: Scaled (mg/kg) [a]	Distance from Main Stack (m) [b]
Maximum	52.5	315.3	680
95th Percentile	5.0	65.6	1,600
Median	0.9	12.0	3,300
5th Percentile	0.1	1.4	8,500
Minimum	0.03	0.4	16,000

[a] Surface soil concentrations were calculated to a depth of 1 cm.
[b] Some U.S. Census blocks greater than 10 km from the facility were included in the spatial template because of the irregular shape of U.S. Census block groups (see Section E.1).

E.4. INDOOR DUST

Indoor dust Pb sampling data were not available for the secondary Pb smelter case study, necessitating the use of modeling to characterize indoor dust Pb levels within the study area. A version of the air-only regression-based model (USEPA, 1989) that uses ambient air Pb levels for predicting dust levels was chosen. This is a similar model as used for the primary Pb smelter case study at distances greater than 1.5 km from the source; however, in the case of the secondary Pb smelter, an “air-only” version of the model was employed reflecting the reduced overall confidence associated with soil characterization for this case study. For a more detailed explanation of the air-only regression-based model see Appendix G.

Exhibit E-14 shows the number of U.S. Census blocks associated with different estimates of indoor dust Pbconcentration. Exhibit E-14 also shows the number of children ages 0 to 7 residing in areas associated with different estimates of indoor dust Pb concentration.

Exhibit E-14. Number of U.S. Census Blocks and Number of Children Ages 0 to 7 Residing in Areas Associated with Different Estimates of Indoor Dust Pb Concentrations

Indoor Dust Pb Concentration (µg/g)	Number of U.S. Census Blocks with Indoor Dust Pb Concentrations Greater than Value in First Column [a]					Number of Children Living in Area with Indoor Dust Pb Concentrations Greater than Value in First Column [b]				
	Current Conditions Scenario	Alternative NAAQS Scenario				Current Conditions Scenario	Alternative NAAQS Scenario			
		1 0.2 µg/m^3, Max Quarterly	2 0.5 µg/m^3, Max Monthly	3 0.2 µg/m^3, Max Monthly	4 0.05 µg/m^3, Max Monthly		1 0.2 µg/m^3, Max Quarterly	2 0.5 µg/m^3, Max Monthly	3 0.2 µg/m^3, Max Monthly	4 0.05 µg/m^3, Max Monthly
60	298	298	298	298	298	1698	1698	1698	1698	1698
70	27	3	6	1	0	121	8	17	1	0
80	4	1	3	1	0	9	1	8	1	0
100	3	0	1	0	0	8	0	1	0	0
120	1	0	0	0	0	1	0	0	0	0

[a] The 298 U.S. Census blocks with children ages 0 to 7 in the 2000 U.S. Census (U.S. Census Bureau, 2005) were used to develop this summary. Note that blocks without children were excluded.
[b] Number of children ages 0 to 7 from the 2000 U.S. Census were used in this analysis (U.S. Census Bureau, 2005).

Exhibit E-15 presents a summary of the Pb indoor dust concentrations generated in the secondary Pb smelter case study for the 298 U.S. Census blocks/block groups with at least one child under seven years of age for the current conditions scenario and the four alternative NAAQS scenarios. All estimated indoor dust Pb concentrations for residences with at least one child under seven years of age in the secondary Pb smelter case study are presented in Attachments E-3 to E-7.

Exhibit E-15. Annual Average Indoor Dust Pb Exposure Concentrations for the Secondary Pb Smelter Case Study

Statistic [b]	Annual Average Indoor Dust Pb Exposure Concentrations (μg/g) [a]				
	Current Conditions Scenario	Alternative NAAQS Scenario			
		1 0.2 μg/m^3, Max Quarterly	2 0.5 μg/m^3, Max Monthly	3 0.2 μg/m^3, Max Monthly	4 0.05 μg/m^3, Max Monthly
Maximum	166.2	88.6	119.8	83.9	66.0
95th Percentile	72.9	63.5	67.3	62.9	60.7
Median	62.7	60.7	61.5	60.6	60.2
5th Percentile	60.4	60.1	60.2	60.1	60.0
Minimum	60.2	60.1	60.1	60.1	60.0

[a] The 298 U.S. Census blocks/block groups with at least one child under seven years of age were used to create this summary.
[b] The statistic (e.g., 95th percentile, median) may not be at the same location for each of the data results presented here.

Studies summarized in the 1990 review of the Pb NAAQS contained measurements of indoor house dust ranging from 10 to 35,000 parts per million (ppm), and a high value of 100,000 ppm for one home within 2 km of a Pb smelting facility (USEPA, 1989). The indoor dust Pbconcentrations for the secondary Pb smelter case study fall within the range presented by the U.S. EPA (1989), although at the low-end of the range. The fact that this facility is a secondary Pb smelter and the summarized literature was inclusive of primary Pb smelters may explain some of the difference.

REFERENCES

Alabama Department of Environmental Management (ADEM). (2006) Personal Communication (Via Email) From Charles Killebrew, Alabama Department of Environmental Management (ADEM) to Rebecca Murphy, ICF International. Re: Sander's Lead. September 6.

Alabama Department of Environmental Management (ADEM). (2007) Personal Communication (Via Fax) From Charles Killebrew, Alabama Department of Environmental Management (ADEM) to Zack Pekar, Ambient Standards Group, Office of Air and Radiation, U.S. EPA. 10 pages. May 4.

Alabama National Resources Conservation Service (NRCS). (2006) Soil Survey Geographic (SSURGO) Database for Pike County. Fort Worth, TX: U.S. Department of Agriculture (USDA). Available online at: http://soildatamart.nrcs.usda.gov/Survey.aspx?County=AL109.

California Office of Environmental Health Hazard Assessment. (2000) Air Toxics "Hot Spots" Program Risk Assessment Guidelines Part IV: Technical Support Document for Exposure Assessment and Stochastic Analysis . September. Available online at: http://www.oehha.org/air/hot_spots/finalStoc.html#download .

Caravanos, J.; Weiss, A. L.; Jaeger, R. J. (2006) An Exterior and Interior Leaded Dust Deposition Survey in New York City: Results of a 2-Year Study. Environmental Research. 100: 159-164.

Conko, K. M.; Rice, K. C.; Kennedy, M. M. (2004) Atmospheric Wet Deposition of Trace Elements to a Suburban Environment. Atmos. Environ. 38: 4025-4033.

Gao, Y.; Nelson, E. D.; Field, M. P.; Ding, Q.; Li, H.; Sherrell, R. M.; Gigliotti, C. L.; Van Ry, D. A.; Glenn, T. R.; Eisenreich, S. J. (2002) Characterization of Atmospheric Trace Elements on PM2.5 Particulate Matter Over the New York-New Jersey Harbor Estuary. Atmospheric Environment. 36: 1077-1086. (as cited in EPA 2006, criteria document).

Hanson, R. L. (1991) Evapotranspiration and Drought. USGS Water-Supply Paper 2375: 99-104. U.S. Geological Survey.

Kim, G.; Scudlark, J. R.; Church, T. M. (2000) Atmospheric Wet Deposition of Trace Elements to Chesapeake and Delaware Bays. Atmos. Environ. 34: 3437-3444.

Kimbrough, D. E.and Suffet, I. H. (1995) Off-Site Forensic Determination of Airborne Elemental Emissions by Multi-Media Analysis: A Case Study at Two Secondary Lead Smelters. <Vo. > 30. 29: 2217-2221.

Lawson, N. M.and Mason, R. P. (2001) Concentration of Mercury, Methylmercury, Cadmium, Lead, Arsenic, and Selenium in the Rain and Stream Water of Two Contrasting Watersheds in Western Maryland. Water Res. 35: 4039-4052.

Long, T.; Johnson, T.; Laurenson, J.; Rosenbaum, A. (2004) Development of Penetration and Proximity Microenvironment Factor Distributions for the HAPEM5 in Support of the 1999 National-Scale Air Toxics Assessment (NATA). Memorandum prepared for Ted Palma, U.S. EPA, Office of Air Quality Planning and Standards (OAQPS); April 5.

McKone, T. E. and Bodnar, A. B. (2001) Development and Evaluation of State-Specific Landscape Data Sets for Multimedia Source-to-Dose Models. LBNL-43722. Ernesto Orlando Lawrence Berkley National Laboratory; July.

National Climatic Data Center (NCDC). (2002) Climatography of the United States. No. 81, Volumes 1 and 23. Available online at: http://www.ncdc.noaa.gov/oa/mpp/freedata.html.

Pirrone, N.; Keeler, G. J.; Warner, P. O. (1995) Trends of Ambient Concentrations and Deposition Fluxes of Particulate Trace Metals in Detroit From 1982 to 1992. Science of Total Environment. 162(43): 61. (as cited in EPA 2006, criteria document)

Schwab, G. O.; Fangmeier, D. D.; Elliot, W. J.; Frevert, R. K. (1993) Soil and Water Conservation Engineering. New York: Wiley.

Scudlark, J. R.; Rice, K. C.; Conko, K. M.; Bricker, O. P.; Church, T. M. (2005) Transmission of Atmospherically Derived Trace Elements Through an Undeveloped, Forested Maryland Watershed. Water Air Soil Pollut. 163: 53-79.

Sweet, C. W.; Weiss, A.; Vermette, S. J. (1998) Atmospheric Deposition of Trace Metals at Three Sites Near the Great Lakes. Water, Air, and Soil Pollution. 103: 423-439. (as cited in EPA 2006, criteria document).

URS Corporation. (2005a) Periodic NESHAP-Required Inorganic Lead Source Emissions Testing Program Conducted February 15, 2005 on Stack No. 10.

URS Corporation. (2005b) Periodic NESHAP-Required Inorganic Lead Source Emissions Testing Program Conducted October 18, 2005 on Stack No. 4.

URS Corporation. (2006a) Memorandum From Billy R. Nichols at URS Corporation to Ronald W. Gore at Alabama Department of Environmental Management (ADEM) Regarding 2005 Annual Emission Estimates for the Secondary Pb Smelter. April 26, 2006.

URS Corporation. (2006b) Periodic NESHAP-Required Inorganic Lead Source Emissions Testing Program Conducted February 7 and 8, 2006 on Stack No. 1 and Stack No. 5.

U.S. Census Bureau. (2005) United States Census 2000: Summary File 1. Public Information Office. Available online at: http://www.census.gov/Press-Release/www/2001/sumfile1.html.

U.S. Environmental Protection Agency (USEPA). (1989) Review of National Ambient Air Quality Standard for Lead: Exposure Analysis Methodology and Validation. EPA-450/2-89-011. Research Triangle Park, NC: Office of Air Quality Planning and Standards; June.

U.S. Environmental Protection Agency (USEPA). (1990) Methodology for Assessing Health Risks Associated With Multiple Pathways of Exposure to Combustor Emissions. EPA 600/6-90/003. Office of Health and Environmental Assessment. Available online at: Available at http://www.ntis.gov/help/ordermethods.asp?loc=7-4-0.

U.S. Environmental Protection Agency (USEPA). (1998) Methodology for Assessing Health Risks Associated With Multiple Pathways of Exposure to Combustor Emissions. Update to EPA/600/6-90/003, EPA/NCEA (EPA 600/R-98/137). Cincinnati, OH: National Center for Environmental Assessment (NCEA). Available online at: oaspub.epa.gov/eims/eimscomm.getfile?p_download_id=427339.

U.S. Environmental Protection Agency (USEPA). (2002) Addendum to User's Guide for the AERMOD Meteorological Preprocessor. EPA-454/B-02-002b. Research Triangle Park, NC: Office of Air Quality Planning and Standards (OAQPS); Emissions, Monitoring and Analysis Division.

U.S. Environmental Protection Agency (USEPA). (2004a) Addendum User's Guide for the AMS/EPA Regulatory Mode - AERMOD. Office of Air Quality Planning and Standards. Available online at: Available at http://www.epa.gov/ttn/scram/7thconf/aermod/aerguide_addm.pdf.

U.S. Environmental Protection Agency (USEPA). (2004b) User's Guide for the AMS/EPA Regulatory Model - AERMOD. EPA-454/B-03-001. Office of Air Quality Planning and Standards; September.

U.S. Environmental Protection Agency (USEPA). (2005) Human Health Risk Assessment Protocol (HHRAP) for Hazardous Waste Combustion Facilities. EPA530-R-05-006. Office of Solid Waste and Emergency Response; September. Available online at: http://www.epa.gov/epaoswer/hazwaste/combust/risk.htm.

U.S. Environmental Protection Agency (USEPA). (2006a) 1999 National-Scale Air Toxics Assessment. Available online at: http://www.epa.gov/ttn/atw/nata1999/nsata99.html.

U.S. Environmental Protection Agency (USEPA). (2006b) Air Quality Criteria for Lead (Final). Volume I and II. Research Triangle Park, NC: National Center for Environmental Assessment; EPA/600/R-05/144aF-bF. Available online at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=158823.

U.S. Environmental Protection Agency (USEPA). (2007) Air Quality System (AQS) Database. Available online at: http://www.epa.gov/ttn/airs/airsaqs/aqsweb/aqswebwarning.htm.

Wu, Z. Y.; Han, M.; Lin, Z. C.; Ondov, J. M. (1994) Chesapeake Bay Atmospheric Deposition Study, Year 1: Sources and Dry Deposition of Selected Elements in Aerosol Particles. Atmospheric Environment. 28: 1471-1486. (as cited in EPA 2006, criteria document).

Yi, S. M.; Shahin, U.; Sivadechathep, J.; Sofuoglu, S. C.; Holsen, T. M. (2001) Overall Elemental Dry Deposition Velocities Measured Around Lake Michigan. Atmospheric Environment. 35: 1133-1140. (as cited in EPA 2006, criteria document).

Attachment E-1. Emission Parameters for All Sources for the Secondary Pb Smelter Case Study

Emission Point ID	Location			Source Type (point,area)	Point Source					Area Source					
	UTMx (m)	UTMy (m)	Elevation (m)		Actual Annual Average Emission Rate (g/s)	Release Height (m)	Stack Gas Exit Temperature (K)	Stack Gas Exit Veolcity (m/s)	Stack Diameter (m)	Actual Annual Average Emission Rate (g/(s*m2)	Release Height (m)	Length of x-side of area (m)	Length of y-side of area (m)	Angle (from North)	Initial vertical dimension of the area source plume (m)
Stack1	596705	3517220	0	POINT	1.22E-02	54.9	360	37.5	1.2	-	-	-	-	-	-
Stack4	596810	3517275	0	POINT	1.07E-02	27.4	340	30.4	0.9	-	-	-	-	-	-
Stack5	596715	3517220	0	POINT	2.02E-02	54.9	356	29.9	1.2	-	-	-	-	-	-
Stack10	596766	3517210	0	POINT	6.93E-04	9.1	304	18.3	1.1	-	-	-	-	-	-
Area1	596647	3517376	0	AREAPOLY	-	-	-	-	-	3.93E-06	0	7		0	0
Area2	596831	3517404	0	AREA	-	-	-	-	-	1.00E-05	0	27	46	0	0
Area3	596742	3517510	0	AREAPOLY	-	-	-	-	-	1.34E-06	0	8		0	0

Attachment E-2. Building Downwash Parameters for the Secondary Pb Smelter Case Study

Emission Point ID	Building Parameter	Building Downwash Parameters (categorized in 10's of degrees)																																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Stack1	BUILDHGT	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00
	BUILDWID	80.41	73.38	65.23	67.63	74.66	79.42	81.76	81.62	79.00	73.98	66.71	118.46	123.69	128.49	83.11	86.37	87.01	85.00	80.41	73.38	65.23	67.63	74.66	79.42	81.76	81.62	79.00	73.98	66.71	118.46	123.69	128.49	83.11	86.37	87.01	85.00
	BUILDLEN	73.98	66.71	60.44	69.19	77.33	83.11	86.37	87.01	85.00	80.41	73.38	65.23	67.63	74.66	79.42	81.76	81.62	79.00	73.98	66.71	60.44	69.19	77.33	83.11	86.37	87.01	85.00	80.41	73.38	65.23	67.63	74.66	79.42	81.76	81.62	79.00
	XBADJ	-1.92	8.22	15.09	13.15	10.80	8.13	5.22	2.14	-1.00	-4.11	-7.10	-9.87	-16.26	-28.83	-40.52	-50.99	-59.90	-67.00	-72.06	-74.93	-75.52	-82.34	-88.13	-91.25	-91.59	-89.15	-84.00	-76.30	-66.28	-55.36	-51.38	-45.83	-38.89	-30.77	-21.72	-12.00
	YBADJ	-36.09	-29.59	-22.75	-17.56	-8.50	0.82	10.11	19.09	27.50	35.07	41.57	16.29	20.49	23.88	49.69	48.40	45.64	41.50	36.09	29.59	22.75	17.56	8.50	-0.82	-10.11	-19.09	-27.50	-35.07	-41.57	-16.29	-20.49	-23.88	-49.69	-48.40	-45.64	-41.50
Stack4	BUILDHGT	14.00	14.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00
	BUILDWID	111.64	88.90	65.23	67.63	74.66	79.42	81.76	81.62	79.00	73.98	170.27	168.20	164.18	164.63	163.45	157.30	146.37	131.00	111.64	88.90	65.23	67.63	74.66	79.42	81.76	81.62	79.00	73.98	170.27	168.20	164.18	164.63	163.45	157.30	146.37	131.00
	BUILDLEN	167.18	170.27	60.44	69.19	77.33	83.11	86.37	87.01	85.00	80.41	88.90	68.16	76.12	91.53	107.20	128.55	145.99	159.00	167.18	170.27	60.44	69.19	77.33	83.11	86.37	87.01	85.00	80.41	88.90	68.16	76.12	91.53	107.20	128.55	145.99	159.00
	XBADJ	-120.83	-133.98	-85.04	-96.48	-104.98	-110.30	-112.26	-110.81	-106.00	-97.96	-92.06	-73.30	-69.83	-71.06	-70.13	-67.07	-61.98	-55.00	-46.35	-36.29	24.61	27.29	27.66	27.19	25.89	23.81	21.00	17.56	3.16	5.13	-6.30	-20.47	-37.07	-61.47	-84.01	-104.00
	YBADJ	56.92	47.61	40.68	27.52	16.86	5.68	-5.66	-16.84	-27.50	-37.33	-48.85	-58.97	-68.88	-73.84	-74.86	-73.61	-70.12	-64.50	-56.92	-47.61	-40.68	-27.52	-16.86	-5.68	5.66	16.84	27.50	37.33	48.85	58.97	68.88	73.84	74.86	73.61	70.12	64.50
Stack5	BUILDHGT	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00
	BUILDWID	80.41	73.38	65.23	67.63	74.66	79.42	81.76	81.62	79.00	73.98	66.71	118.46	69.19	77.33	83.11	86.37	87.01	85.00	80.41	73.38	65.23	67.63	74.66	79.42	81.76	81.62	79.00	73.98	66.71	118.46	69.19	77.33	83.11	86.37	87.01	85.00
	BUILDLEN	73.98	66.71	60.44	69.19	77.33	83.11	86.37	87.01	85.00	80.41	73.38	65.23	67.63	74.66	79.42	81.76	81.62	79.00	73.98	66.71	60.44	69.19	77.33	83.11	86.37	87.01	85.00	80.41	73.38	65.23	67.63	74.66	79.42	81.76	81.62	79.00
	XBADJ	-3.66	4.80	10.09	6.72	3.14	-0.53	-4.18	-7.71	-11.00	-13.96	-16.49	-18.53	-23.92	-35.26	-45.52	-54.41	-61.64	-67.00	-70.32	-71.51	-70.52	-75.91	-80.47	-82.59	-82.19	-79.30	-74.00	-66.45	-56.88	-46.70	-43.72	-39.40	-33.89	-27.35	-19.98	-12.00
	YBADJ	-26.25	-20.19	-14.09	-9.90	-2.07	5.82	13.53	20.83	27.50	33.33	38.15	11.29	41.31	41.81	41.03	39.01	35.80	31.50	26.25	20.19	14.09	9.90	2.07	-5.82	-13.53	-20.83	-27.50	-33.33	-38.15	-11.29	-41.31	-41.81	-41.03	-39.01	-35.80	-31.50
Stack10	BUILDHGT	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00
	BUILDWID	80.41	73.38	65.23	67.63	74.66	79.42	81.76	81.62	79.00	73.98	66.71	60.44	69.19	77.33	83.11	86.37	87.01	85.00	80.41	73.38	65.23	67.63	74.66	79.42	81.76	81.62	79.00	73.98	66.71	60.44	69.19	77.33	83.11	86.37	87.01	85.00
	BUILDLEN	73.98	66.71	60.44	69.19	77.33	83.11	86.37	87.01	85.00	80.41	73.38	65.23	67.63	74.66	79.42	81.76	81.62	79.00	73.98	66.71	60.44	69.19	77.33	83.11	86.37	87.01	85.00	80.41	73.38	65.23	67.63	74.66	79.42	81.76	81.62	79.00
	XBADJ	-2.66	-3.25	-6.75	-18.40	-29.50	-39.69	-48.68	-56.20	-62.00	-65.92	-67.84	-67.69	-69.41	-75.70	-79.68	-81.25	-80.35	-77.00	-71.32	-63.46	-53.68	-50.79	-47.83	-43.42	-37.69	-30.81	-23.00	-14.49	-5.54	2.46	1.78	1.04	0.27	-0.51	-1.28	-2.00
	YBADJ	25.72	31.15	35.08	35.60	38.37	39.98	40.37	39.54	37.50	34.33	30.11	23.47	16.19	9.17	1.86	-5.50	-12.69	-19.50	-25.72	-31.15	-35.08	-35.60	-38.37	-39.98	-40.37	-39.54	-37.50	-34.33	-30.11	-23.47	-16.19	-9.17	-1.86	5.50	12.69	19.50

Attachment E-3. Estimated Media Pb Concentrations in the Current Conditions Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
9003026	71	2.1E-03	1.0E-03	7.1	1.8	60	61.8
9001004	63	4.6E-03	2.1E-03	14.9	3.9	60	63.9
0003048	53	4.2E-03	1.9E-03	17.8	3.6	60	63.6
2001012	42	5.8E-04	2.6E-04	1.3	0.5	60	60.5
1004004	38	6.7E-04	3.0E-04	2.7	0.6	60	60.6
1002001	35	7.9E-03	3.6E-03	28.2	6.7	60	66.7
9001007	35	4.0E-03	1.9E-03	14.4	3.4	60	63.4
0003040	31	6.8E-03	3.0E-03	29.7	5.7	60	65.7
2001009	31	4.9E-04	2.2E-04	1.4	0.4	60	60.4
0001002	30	3.0E-03	1.3E-03	11.4	2.5	60	62.5
0002023	29	0.02	6.8E-03	79.6	12.9	60	72.9
9003043	26	3.0E-03	1.4E-03	11.1	2.5	60	62.5
9004000	24	8.8E-04	4.1E-04	1.4	0.7	60	60.7
2001037	22	5.2E-04	2.3E-04	1.4	0.4	60	60.4
9003012	21	1.4E-03	6.4E-04	5.1	1.2	60	61.2
1004092	21	8.1E-04	3.6E-04	3.7	0.7	60	60.7
1004014	21	7.2E-04	3.3E-04	3.0	0.6	60	60.6
0003121	19	1.4E-03	6.4E-04	6.0	1.2	60	61.2
2001005	19	7.5E-04	3.4E-04	2.2	0.6	60	60.6
9001011	18	4.4E-03	2.1E-03	16.2	3.7	60	63.7
0003061	18	3.3E-03	1.4E-03	14.8	2.7	60	62.7
2001004	17	7.3E-04	3.3E-04	2.0	0.6	60	60.6
0001023	16	5.4E-03	2.4E-03	25.4	4.6	60	64.6
1004031	16	3.1E-03	1.4E-03	10.7	2.6	60	62.6
0003080	16	3.0E-03	1.3E-03	14.1	2.5	60	62.5
9003051	16	2.9E-03	1.3E-03	11.5	2.4	60	62.4
2001039	16	4.4E-04	1.9E-04	1.0	0.4	60	60.4
2001001	15	9.8E-04	4.4E-04	2.8	0.8	60	60.8
9002026	14	8.1E-03	3.7E-03	25.2	6.8	60	66.8

Attachment E-3. Estimated Media Pb Concentrations in the Current Conditions Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0001000	14	3.0E-03	1.3E-03	10.5	2.6	60	62.6
0002024	12	0.01	5.9E-03	66.2	11.3	60	71.3
0001015	12	5.1E-03	2.3E-03	22.2	4.3	60	64.3
2001068	12	9.1E-04	4.0E-04	2.6	0.8	60	60.8
1004068	11	4.6E-03	2.1E-03	25.8	3.9	60	63.9
0002027	10	0.01	6.0E-03	58.0	11.3	60	71.3
1002015	10	9.0E-03	4.1E-03	28.1	7.6	60	67.6
0001029	10	5.2E-03	2.3E-03	19.9	4.4	60	64.4
1004041	10	3.5E-03	1.6E-03	12.9	3.0	60	63.0
2001026	10	5.9E-04	2.6E-04	1.8	0.5	60	60.5
1002014	9	0.01	4.7E-03	34.1	8.8	60	68.8
1003025	9	8.2E-03	3.7E-03	40.5	6.9	60	66.9
0003051	9	2.8E-03	1.3E-03	9.7	2.4	60	62.4
9003023	9	2.0E-03	9.5E-04	5.3	1.7	60	61.7
2001010	9	6.4E-04	2.9E-04	1.7	0.5	60	60.5
0002038	8	0.02	8.5E-03	65.5	16.2	60	76.2
0001026	8	7.0E-03	3.1E-03	26.4	5.9	60	65.9
1003000	8	6.9E-03	3.1E-03	23.7	5.8	60	65.8
1003006	8	6.1E-03	2.7E-03	27.0	5.1	60	65.1
0001009	8	4.2E-03	1.9E-03	14.7	3.5	60	63.5
9003041	8	3.9E-03	1.8E-03	13.4	3.3	60	63.3
1004050	8	3.6E-03	1.6E-03	15.4	3.1	60	63.1
1004036	8	3.1E-03	1.4E-03	10.8	2.7	60	62.7
0003068	8	2.8E-03	1.2E-03	12.8	2.3	60	62.3
0003007	8	1.3E-03	5.6E-04	4.8	1.1	60	61.1
1004025	8	1.0E-03	4.7E-04	4.3	0.9	60	60.9
9003003	8	8.3E-04	3.8E-04	2.0	0.7	60	60.7
1004098	8	6.9E-04	3.1E-04	2.3	0.6	60	60.6
0003089	7	9.5E-03	4.2E-03	41.7	8.0	60	68.0

Attachment E-3. Estimated Media Pb Concentrations in the Current Conditions Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
1003008	7	8.1E-03	3.6E-03	36.1	6.8	60	66.8
9002023	7	5.9E-03	2.8E-03	19.1	5.0	60	65.0
9002015	7	5.6E-03	2.6E-03	21.7	4.7	60	64.7
9001010	7	5.5E-03	2.6E-03	15.5	4.7	60	64.7
9001005	7	4.7E-03	2.2E-03	17.5	4.0	60	64.0
1004059	7	3.4E-03	1.5E-03	16.0	2.8	60	62.8
0003114	7	2.9E-03	1.3E-03	10.1	2.4	60	62.4
0003037	7	2.5E-03	1.1E-03	10.1	2.1	60	62.1
0003042	6	0.05	2.3E-02	256.0	44.1	60	104.1
9003027	6	2.9E-03	1.4E-03	9.7	2.5	60	62.5
0003155	6	2.7E-03	1.2E-03	11.5	2.3	60	62.3
1004058	6	2.4E-03	1.1E-03	11.2	2.1	60	62.1
1004096	6	6.0E-04	2.7E-04	2.4	0.5	60	60.5
1004007	6	5.6E-04	2.5E-04	2.0	0.5	60	60.5
2001051	6	3.1E-04	1.4E-04	0.6	0.3	60	60.3
0002050	5	0.02	1.0E-02	101.5	18.9	60	78.9
0002036	5	0.02	8.1E-03	65.1	15.3	60	75.3
1003013	5	0.02	7.9E-03	57.6	14.7	60	74.7
0002026	5	0.02	7.7E-03	91.1	14.6	60	74.6
1003016	5	0.01	6.2E-03	45.1	11.7	60	71.7
0003138	5	0.01	5.0E-03	69.5	9.5	60	69.5
1002003	5	0.01	4.9E-03	35.3	9.1	60	69.1
0003140	5	8.5E-03	3.8E-03	53.5	7.2	60	67.2
0003083	5	8.5E-03	3.8E-03	49.0	7.2	60	67.2
1003007	5	5.4E-03	2.4E-03	23.8	4.5	60	64.5
1004047	5	4.1E-03	1.9E-03	15.6	3.5	60	63.5
0001006	5	3.3E-03	1.5E-03	11.9	2.8	60	62.8
1004037	5	2.6E-03	1.2E-03	9.0	2.2	60	62.2
0003071	5	2.5E-03	1.1E-03	11.3	2.1	60	62.1

Attachment E-3. Estimated Media Pb Concentrations in the Current Conditions Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
9004022	5	1.4E-03	6.6E-04	3.8	1.2	60	61.2
0003004	5	1.2E-03	5.2E-04	4.5	1.0	60	61.0
1004028	5	1.1E-03	4.9E-04	3.7	0.9	60	60.9
1004019	5	9.3E-04	4.2E-04	3.3	0.8	60	60.8
1004013	5	8.6E-04	3.9E-04	3.5	0.7	60	60.7
9003002	5	8.2E-04	3.8E-04	1.9	0.7	60	60.7
2001006	5	6.2E-04	2.8E-04	1.6	0.5	60	60.5
2001007	5	5.9E-04	2.6E-04	1.4	0.5	60	60.5
1002018	4	0.02	6.8E-03	51.9	12.7	60	72.7
0002018	4	0.01	5.0E-03	47.6	9.4	60	69.4
1002012	4	0.01	4.6E-03	34.9	8.6	60	68.6
0002022	4	9.1E-03	4.1E-03	36.4	7.7	60	67.7
1003023	4	8.7E-03	3.9E-03	49.5	7.3	60	67.3
1002016	4	8.6E-03	3.9E-03	26.7	7.2	60	67.2
9002021	4	7.2E-03	3.4E-03	25.6	6.1	60	66.1
9002030	4	7.0E-03	3.2E-03	27.8	5.9	60	65.9
1003028	4	5.5E-03	2.5E-03	28.8	4.7	60	64.7
0003144	4	5.2E-03	2.3E-03	27.7	4.4	60	64.4
9002000	4	4.6E-03	2.1E-03	14.5	3.9	60	63.9
0001012	4	4.3E-03	1.9E-03	15.6	3.6	60	63.6
9002006	4	4.3E-03	2.0E-03	15.0	3.6	60	63.6
0003060	4	4.0E-03	1.8E-03	16.3	3.4	60	63.4
0003079	4	3.9E-03	1.7E-03	17.7	3.3	60	63.3
1004051	4	3.6E-03	1.6E-03	13.4	3.0	60	63.0
1004048	4	3.4E-03	1.5E-03	12.9	2.9	60	62.9
9001013	4	3.4E-03	1.6E-03	8.3	2.8	60	62.8
9001002	4	3.3E-03	1.5E-03	9.8	2.8	60	62.8
0003107	4	3.3E-03	1.5E-03	10.6	2.8	60	62.8
1004049	4	3.1E-03	1.4E-03	12.8	2.6	60	62.6

Attachment E-3. Estimated Media Pb Concentrations in the Current Conditions Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
1004054	4	2.3E-03	1.0E-03	8.0	1.9	60	61.9
1004057	4	2.3E-03	1.0E-03	9.1	1.9	60	61.9
9003044	4	2.1E-03	9.8E-04	7.6	1.8	60	61.8
1004055	4	2.1E-03	9.3E-04	7.6	1.7	60	61.7
0003128	4	2.0E-03	8.7E-04	7.5	1.7	60	61.7
2001028	4	1.3E-03	5.9E-04	4.3	1.1	60	61.1
1004011	4	7.0E-04	3.1E-04	2.5	0.6	60	60.6
0002047	3	0.02	1.0E-02	76.6	19.2	60	79.2
0002039	3	0.02	9.2E-03	73.6	17.4	60	77.4
0002028	3	0.02	7.3E-03	77.2	13.9	60	73.9
1002020	3	0.01	6.5E-03	50.6	12.2	60	72.2
1002002	3	8.8E-03	4.0E-03	35.2	7.4	60	67.4
0003093	3	8.2E-03	3.7E-03	34.2	7.0	60	67.0
0003082	3	7.7E-03	3.4E-03	42.4	6.5	60	66.5
0002017	3	6.9E-03	3.1E-03	29.4	5.8	60	65.8
9002011	3	6.7E-03	3.1E-03	27.1	5.7	60	65.7
1003004	3	6.6E-03	3.0E-03	27.1	5.5	60	65.5
0001032	3	6.6E-03	2.9E-03	24.9	5.5	60	65.5
0001027	3	6.1E-03	2.7E-03	25.2	5.2	60	65.2
9002001	3	4.9E-03	2.3E-03	18.2	4.2	60	64.2
0003078	3	4.9E-03	2.2E-03	21.0	4.2	60	64.2
1003001	3	4.5E-03	2.0E-03	15.9	3.8	60	63.8
1004060	3	4.4E-03	2.0E-03	20.1	3.7	60	63.7
1004046	3	4.1E-03	1.8E-03	15.0	3.5	60	63.5
0001013	3	4.0E-03	1.8E-03	14.5	3.3	60	63.3
9001012	3	3.5E-03	1.6E-03	8.8	3.0	60	63.0
1004052	3	3.3E-03	1.5E-03	14.8	2.8	60	62.8
9001014	3	3.1E-03	1.5E-03	8.9	2.7	60	62.7
0003070	3	2.9E-03	1.3E-03	9.9	2.5	60	62.5

Attachment E-3. Estimated Media Pb Concentrations in the Current Conditions Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0003036	3	2.9E-03	1.3E-03	12.1	2.4	60	62.4
9004015	3	2.6E-03	1.2E-03	6.5	2.2	60	62.2
9004014	3	2.5E-03	1.2E-03	7.1	2.1	60	62.1
0003073	3	2.5E-03	1.1E-03	11.3	2.1	60	62.1
0001003	3	2.4E-03	1.1E-03	8.0	2.1	60	62.1
0003115	3	2.2E-03	9.8E-04	7.5	1.9	60	61.9
9004016	3	2.0E-03	9.2E-04	5.4	1.7	60	61.7
1004072	3	2.0E-03	8.9E-04	5.1	1.7	60	61.7
1004056	3	1.8E-03	8.3E-04	7.1	1.6	60	61.6
9003017	3	1.4E-03	6.7E-04	4.5	1.2	60	61.2
9004017	3	1.4E-03	6.4E-04	3.7	1.2	60	61.2
9004006	3	1.3E-03	5.9E-04	3.2	1.1	60	61.1
0003020	3	1.3E-03	5.6E-04	5.1	1.1	60	61.1
9003013	3	1.2E-03	5.7E-04	4.2	1.0	60	61.0
0003006	3	1.2E-03	5.3E-04	4.8	1.0	60	61.0
9004008	3	1.2E-03	5.6E-04	3.0	1.0	60	61.0
1004089	3	1.1E-03	4.8E-04	4.8	0.9	60	60.9
2001011	3	6.5E-04	2.9E-04	1.9	0.6	60	60.6
1004100	3	5.7E-04	2.6E-04	1.5	0.5	60	60.5
2001008	3	5.6E-04	2.5E-04	1.8	0.5	60	60.5
2001013	3	4.7E-04	2.1E-04	1.0	0.4	60	60.4
1003012	2	0.01	6.8E-03	59.6	12.6	60	72.6
1002019	2	0.01	6.3E-03	50.2	11.7	60	71.7
0002025	2	0.01	6.0E-03	71.9	11.4	60	71.4
0003087	2	0.01	5.1E-03	56.2	9.7	60	69.7
1003009	2	0.01	4.8E-03	50.4	9.0	60	69.0
0003088	2	9.6E-03	4.3E-03	43.5	8.1	60	68.1
0002019	2	9.4E-03	4.2E-03	39.7	7.9	60	67.9
9002029	2	8.2E-03	3.8E-03	28.4	6.9	60	66.9

Attachment E-3. Estimated Media Pb Concentrations in the Current Conditions Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0001035	2	7.8E-03	3.5E-03	30.3	6.6	60	66.6
0003085	2	7.2E-03	3.2E-03	47.3	6.1	60	66.1
0001025	2	6.8E-03	3.0E-03	27.5	5.7	60	65.7
9002012	2	6.1E-03	2.8E-03	23.2	5.1	60	65.1
0001031	2	5.9E-03	2.6E-03	23.0	5.0	60	65.0
9002017	2	5.8E-03	2.7E-03	19.7	4.9	60	64.9
0003142	2	5.2E-03	2.3E-03	29.5	4.4	60	64.4
0003077	2	4.8E-03	2.1E-03	19.8	4.0	60	64.0
0001024	2	4.7E-03	2.1E-03	19.4	4.0	60	64.0
0003055	2	4.1E-03	1.8E-03	14.3	3.5	60	63.5
0003056	2	4.0E-03	1.8E-03	16.0	3.4	60	63.4
9003042	2	3.8E-03	1.8E-03	14.2	3.2	60	63.2
9003050	2	3.8E-03	1.8E-03	14.0	3.2	60	63.2
0001008	2	3.7E-03	1.6E-03	13.9	3.1	60	63.1
1004045	2	3.6E-03	1.6E-03	12.8	3.0	60	63.0
0003065	2	3.5E-03	1.6E-03	11.9	3.0	60	63.0
0003052	2	3.3E-03	1.5E-03	11.3	2.8	60	62.8
1004033	2	3.1E-03	1.4E-03	10.3	2.6	60	62.6
1004040	2	2.9E-03	1.3E-03	10.2	2.4	60	62.4
0003050	2	2.7E-03	1.2E-03	9.4	2.3	60	62.3
1004038	2	2.7E-03	1.2E-03	9.1	2.2	60	62.2
0003069	2	2.6E-03	1.2E-03	11.9	2.2	60	62.2
0003049	2	2.6E-03	1.1E-03	10.9	2.2	60	62.2
0003031	2	2.5E-03	1.1E-03	10.5	2.1	60	62.1
9001001	2	2.1E-03	9.9E-04	5.5	1.8	60	61.8
9004018	2	1.9E-03	8.8E-04	4.9	1.6	60	61.6
0003122	2	1.9E-03	8.3E-04	5.9	1.6	60	61.6
0003123	2	1.8E-03	7.9E-04	5.6	1.5	60	61.5
0003160	2	1.7E-03	7.7E-04	8.6	1.5	60	61.5

Attachment E-3. Estimated Media Pb Concentrations in the Current Conditions Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m[3])	Annual Average Inhalation Exposure Concentration (µg/m[3])	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
1004030	2	1.7E-03	7.7E-04	5.5	1.4	60	61.4
9003033	2	1.6E-03	7.3E-04	4.1	1.3	60	61.3
0003110	2	1.5E-03	6.8E-04	5.8	1.3	60	61.3
2001031	2	1.5E-03	6.5E-04	4.7	1.2	60	61.2
2001027	2	1.2E-03	5.3E-04	4.3	1.0	60	61.0
9004023	2	1.2E-03	5.4E-04	3.3	1.0	60	61.0
0003127	2	1.2E-03	5.1E-04	5.5	1.0	60	61.0
0003001	2	9.1E-04	4.1E-04	2.8	0.8	60	60.8
2001002	2	8.8E-04	3.9E-04	2.5	0.7	60	60.7
1004094	2	8.1E-04	3.6E-04	3.4	0.7	60	60.7
1004018	2	8.0E-04	3.6E-04	2.5	0.7	60	60.7
1004010	2	6.0E-04	2.7E-04	2.0	0.5	60	60.5
2001038	2	5.8E-04	2.6E-04	1.7	0.5	60	60.5
2001036	2	5.6E-04	2.5E-04	1.4	0.5	60	60.5
1004000	2	5.0E-04	2.2E-04	1.5	0.4	60	60.4
1004003	2	4.8E-04	2.2E-04	1.4	0.4	60	60.4
2001042	2	3.8E-04	1.7E-04	1.1	0.3	60	60.3
2001053	2	3.5E-04	1.6E-04	0.8	0.3	60	60.3
2001047	2	3.5E-04	1.6E-04	0.9	0.3	60	60.3
2001059	2	3.0E-04	1.3E-04	0.5	0.3	60	60.3
0002042	1	0.13	5.6E-02	315.3	106.2	60	166.2
0003046	1	0.05	2.3E-02	141.9	44.3	60	104.3
0002041	1	0.03	1.4E-02	141.8	26.4	60	86.4
0002029	1	0.02	8.2E-03	66.9	15.5	60	75.5
0002037	1	0.02	7.3E-03	57.0	13.9	60	73.9
1003014	1	0.02	7.0E-03	49.5	13.2	60	73.2
0003137	1	0.01	6.7E-03	99.0	12.7	60	72.7
1003011	1	0.01	6.6E-03	64.2	12.3	60	72.3
1002007	1	0.01	5.9E-03	45.2	11.1	60	71.1

Attachment E-3. Estimated Media Pb Concentrations in the Current Conditions Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
1002013	1	0.01	5.2E-03	39.4	9.7	60	69.7
1002017	1	0.01	5.1E-03	36.0	9.6	60	69.6
1003010	1	0.01	5.1E-03	49.7	9.6	60	69.6
0003090	1	9.6E-03	4.3E-03	42.0	8.1	60	68.1
0003091	1	9.5E-03	4.2E-03	36.9	8.0	60	68.0
1003022	1	9.2E-03	4.1E-03	51.0	7.7	60	67.7
0002015	1	9.0E-03	4.0E-03	45.4	7.6	60	67.6
0003094	1	8.1E-03	3.6E-03	33.4	6.8	60	66.8
1001017	1	7.2E-03	3.3E-03	24.1	6.1	60	66.1
9002031	1	6.6E-03	3.0E-03	25.3	5.5	60	65.5
1003005	1	6.5E-03	2.9E-03	29.5	5.5	60	65.5
9002022	1	6.0E-03	2.8E-03	22.2	5.0	60	65.0
9002014	1	5.8E-03	2.7E-03	22.5	4.9	60	64.9
9002013	1	5.7E-03	2.6E-03	21.3	4.8	60	64.8
9002020	1	5.6E-03	2.6E-03	20.5	4.7	60	64.7
9002016	1	5.3E-03	2.4E-03	19.1	4.4	60	64.4
1003003	1	5.2E-03	2.4E-03	23.1	4.4	60	64.4
9001009	1	5.0E-03	2.3E-03	11.6	4.2	60	64.2
1001016	1	4.9E-03	2.2E-03	16.1	4.1	60	64.1
0003058	1	4.5E-03	2.0E-03	18.5	3.8	60	63.8
9002007	1	4.5E-03	2.1E-03	18.6	3.8	60	63.8
1004043	1	4.0E-03	1.8E-03	14.5	3.4	60	63.4
0001010	1	4.0E-03	1.8E-03	13.7	3.3	60	63.3
0003054	1	3.9E-03	1.7E-03	13.5	3.3	60	63.3
0003053	1	3.9E-03	1.7E-03	13.1	3.3	60	63.3
0003064	1	3.5E-03	1.6E-03	13.2	3.0	60	63.0
0001011	1	3.5E-03	1.6E-03	12.9	3.0	60	63.0
0001018	1	3.4E-03	1.5E-03	14.7	2.9	60	62.9
9001015	1	3.4E-03	1.6E-03	8.2	2.8	60	62.8

Attachment E-3. Estimated Media Pb Concentrations in the Current Conditions Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0001007	1	3.3E-03	1.4E-03	12.7	2.8	60	62.8
0003063	1	3.2E-03	1.4E-03	10.8	2.7	60	62.7
0003066	1	3.2E-03	1.4E-03	10.9	2.7	60	62.7
0001020	1	3.1E-03	1.4E-03	14.7	2.7	60	62.7
0003067	1	3.0E-03	1.3E-03	10.3	2.6	60	62.6
0003109	1	3.0E-03	1.3E-03	15.2	2.5	60	62.5
0003076	1	3.0E-03	1.3E-03	12.5	2.5	60	62.5
0001019	1	2.6E-03	1.2E-03	12.9	2.2	60	62.2
1004039	1	2.5E-03	1.1E-03	8.8	2.1	60	62.1
0003072	1	2.4E-03	1.0E-03	10.6	2.0	60	62.0
0001005	1	2.1E-03	9.4E-04	8.2	1.8	60	61.8
0003152	1	1.7E-03	7.6E-04	8.0	1.4	60	61.4
0003159	1	1.7E-03	7.5E-04	6.5	1.4	60	61.4
9004021	1	1.6E-03	7.2E-04	5.1	1.3	60	61.3
2001029	1	1.3E-03	5.7E-04	4.6	1.1	60	61.1
0003015	1	1.3E-03	5.6E-04	3.9	1.1	60	61.1
0003112	1	1.2E-03	5.6E-04	4.8	1.1	60	61.1
9003020	1	1.2E-03	5.8E-04	2.8	1.1	60	61.1
9003016	1	1.2E-03	5.5E-04	2.7	1.0	60	61.0
0003002	1	1.1E-03	4.8E-04	4.4	0.9	60	60.9
9003021	1	1.1E-03	5.0E-04	2.6	0.9	60	60.9
0003003	1	1.1E-03	4.7E-04	4.3	0.9	60	60.9
9003010	1	1.0E-03	4.7E-04	3.0	0.9	60	60.9
2001000	1	9.5E-04	4.2E-04	3.6	0.8	60	60.8
1004081	1	9.1E-04	4.1E-04	4.1	0.8	60	60.8
1004024	1	9.1E-04	4.1E-04	3.1	0.8	60	60.8
1004091	1	8.4E-04	3.8E-04	3.7	0.7	60	60.7
0003129	1	8.2E-04	3.6E-04	2.3	0.7	60	60.7
1004093	1	8.1E-04	3.7E-04	3.4	0.7	60	60.7

Attachment E-3. Estimated Media Pb Concentrations in the Current Conditions Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
1004017	1	7.1E-04	3.2E-04	2.4	0.6	60	60.6
1004015	1	6.9E-04	3.1E-04	2.7	0.6	60	60.6
1004005	1	5.2E-04	2.3E-04	1.7	0.4	60	60.4
1004006	1	4.9E-04	2.2E-04	1.4	0.4	60	60.4
2001070	1	4.3E-04	1.9E-04	1.3	0.4	60	60.4

Attachment E-3. Estimated Media Pb Concentrations in the Current Conditions Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
2001052	1	3.4E-04	1.5E-04	0.7	0.3	60	60.3
2001062	1	3.3E-04	1.5E-04	0.6	0.3	60	60.3
2001058	1	2.7E-04	1.2E-04	0.4	0.2	60	60.2

[a] Recent air refers to contributions associated with recent outdoor ambient air.

[b] Other refers to contributions from indoor paint, outdoor soil/dust and additional sources (including historical air).

Attachment E-4. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
9003026	71	1.2E-03	5.6E-04	7.1	1.0	60	61.0
9001004	63	2.6E-03	1.2E-03	14.9	2.2	60	62.2
0003048	53	2.4E-03	1.1E-03	17.8	2.0	60	62.0
2001012	42	3.3E-04	1.5E-04	1.3	0.3	60	60.3
1004004	38	3.8E-04	1.7E-04	2.7	0.3	60	60.3
1002001	35	4.4E-03	2.0E-03	28.2	3.7	60	63.7
9001007	35	2.2E-03	1.0E-03	14.4	1.9	60	61.9
0003040	31	3.8E-03	1.7E-03	29.7	3.2	60	63.2
2001009	31	2.8E-04	1.2E-04	1.4	0.2	60	60.2
0001002	30	1.7E-03	7.4E-04	11.4	1.4	60	61.4
0002023	29	8.6E-03	3.8E-03	79.6	7.2	60	67.2
9003043	26	1.7E-03	7.7E-04	11.1	1.4	60	61.4
9004000	24	4.9E-04	2.3E-04	1.4	0.4	60	60.4
2001037	22	2.9E-04	1.3E-04	1.4	0.2	60	60.2
9003012	21	7.7E-04	3.6E-04	5.1	0.7	60	60.7
1004092	21	4.5E-04	2.0E-04	3.7	0.4	60	60.4
1004014	21	4.1E-04	1.8E-04	3.0	0.3	60	60.3
0003121	19	8.1E-04	3.6E-04	6.0	0.7	60	60.7
2001005	19	4.2E-04	1.9E-04	2.2	0.4	60	60.4
9001011	18	2.5E-03	1.2E-03	16.2	2.1	60	62.1
0003061	18	1.8E-03	8.1E-04	14.8	1.5	60	61.5
2001004	17	4.1E-04	1.8E-04	2.0	0.3	60	60.3
0001023	16	3.0E-03	1.4E-03	25.4	2.6	60	62.6
1004031	16	1.8E-03	8.0E-04	10.7	1.5	60	61.5
0003080	16	1.7E-03	7.5E-04	14.1	1.4	60	61.4
9003051	16	1.6E-03	7.6E-04	11.5	1.4	60	61.4
2001039	16	2.5E-04	1.1E-04	1.0	0.2	60	60.2
2001001	15	5.5E-04	2.5E-04	2.8	0.5	60	60.5

Attachment E-4. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
9002026	14	4.5E-03	2.1E-03	25.2	3.8	60	63.8
0001000	14	1.7E-03	7.6E-04	10.5	1.4	60	61.4
0002024	12	7.5E-03	3.3E-03	66.2	6.3	60	66.3
0001015	12	2.9E-03	1.3E-03	22.2	2.4	60	62.4
2001068	12	5.1E-04	2.3E-04	2.6	0.4	60	60.4
1004068	11	2.6E-03	1.2E-03	25.8	2.2	60	62.2
0002027	10	7.5E-03	3.4E-03	58.0	6.4	60	66.4
1002015	10	5.1E-03	2.3E-03	28.1	4.3	60	64.3
0001029	10	2.9E-03	1.3E-03	19.9	2.5	60	62.5
1004041	10	2.0E-03	9.0E-04	12.9	1.7	60	61.7
2001026	10	3.3E-04	1.5E-04	1.8	0.3	60	60.3
1002014	9	5.9E-03	2.7E-03	34.1	5.0	60	65.0
1003025	9	4.6E-03	2.1E-03	40.5	3.9	60	63.9
0003051	9	1.6E-03	7.0E-04	9.7	1.3	60	61.3
9003023	9	1.2E-03	5.3E-04	5.3	1.0	60	61.0
2001010	9	3.6E-04	1.6E-04	1.7	0.3	60	60.3
0002038	8	0.01	4.8E-03	65.5	9.1	60	69.1
0001026	8	3.9E-03	1.7E-03	26.4	3.3	60	63.3
1003000	8	3.9E-03	1.7E-03	23.7	3.3	60	63.3
1003006	8	3.4E-03	1.5E-03	27.0	2.9	60	62.9
0001009	8	2.4E-03	1.0E-03	14.7	2.0	60	62.0
9003041	8	2.2E-03	1.0E-03	13.4	1.8	60	61.8
1004050	8	2.0E-03	9.2E-04	15.4	1.7	60	61.7
1004036	8	1.8E-03	8.0E-04	10.8	1.5	60	61.5
0003068	8	1.5E-03	6.9E-04	12.8	1.3	60	61.3
0003007	8	7.1E-04	3.2E-04	4.8	0.6	60	60.6
1004025	8	5.8E-04	2.6E-04	4.3	0.5	60	60.5
9003003	8	4.6E-04	2.2E-04	2.0	0.4	60	60.4

Attachment E-4. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
1004098	8	3.9E-04	1.8E-04	2.3	0.3	60	60.3
0003089	7	5.4E-03	2.4E-03	41.7	4.5	60	64.5
1003008	7	4.5E-03	2.1E-03	36.1	3.8	60	63.8
9002023	7	3.3E-03	1.5E-03	19.1	2.8	60	62.8
9002015	7	3.1E-03	1.5E-03	21.7	2.6	60	62.6
9001010	7	3.1E-03	1.4E-03	15.5	2.6	60	62.6
9001005	7	2.6E-03	1.2E-03	17.5	2.2	60	62.2
1004059	7	1.9E-03	8.5E-04	16.0	1.6	60	61.6
0003114	7	1.6E-03	7.2E-04	10.1	1.4	60	61.4
0003037	7	1.4E-03	6.3E-04	10.1	1.2	60	61.2
0003042	6	0.03	1.3E-02	256.0	24.8	60	84.8
9003027	6	1.6E-03	7.6E-04	9.7	1.4	60	61.4
0003155	6	1.5E-03	6.9E-04	11.5	1.3	60	61.3
1004058	6	1.4E-03	6.2E-04	11.2	1.2	60	61.2
1004096	6	3.4E-04	1.5E-04	2.4	0.3	60	60.3
1004007	6	3.2E-04	1.4E-04	2.0	0.3	60	60.3
2001051	6	1.8E-04	7.8E-05	0.6	0.1	60	60.1
0002050	5	0.01	5.6E-03	101.5	10.6	60	70.6
0002036	5	0.01	4.5E-03	65.1	8.6	60	68.6
1003013	5	9.8E-03	4.4E-03	57.6	8.3	60	68.3
0002026	5	9.7E-03	4.3E-03	91.1	8.2	60	68.2
1003016	5	7.8E-03	3.5E-03	45.1	6.6	60	66.6
0003138	5	6.4E-03	2.8E-03	69.5	5.4	60	65.4
1002003	5	6.1E-03	2.8E-03	35.3	5.1	60	65.1
0003140	5	4.8E-03	2.1E-03	53.5	4.1	60	64.1
0003083	5	4.8E-03	2.1E-03	49.0	4.0	60	64.0
1003007	5	3.0E-03	1.4E-03	23.8	2.6	60	62.6
1004047	5	2.3E-03	1.0E-03	15.6	2.0	60	62.0

Attachment E-4. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0001006	5	1.9E-03	8.3E-04	11.9	1.6	60	61.6
1004037	5	1.5E-03	6.6E-04	9.0	1.2	60	61.2
0003071	5	1.4E-03	6.2E-04	11.3	1.2	60	61.2
9004022	5	8.0E-04	3.7E-04	3.8	0.7	60	60.7
0003004	5	6.6E-04	2.9E-04	4.5	0.6	60	60.6
1004028	5	6.1E-04	2.8E-04	3.7	0.5	60	60.5
1004019	5	5.2E-04	2.4E-04	3.3	0.4	60	60.4
1004013	5	4.8E-04	2.2E-04	3.5	0.4	60	60.4
9003002	5	4.6E-04	2.2E-04	1.9	0.4	60	60.4
2001006	5	3.5E-04	1.6E-04	1.6	0.3	60	60.3
2001007	5	3.3E-04	1.5E-04	1.4	0.3	60	60.3
1002018	4	8.5E-03	3.8E-03	51.9	7.2	60	67.2
0002018	4	6.3E-03	2.8E-03	47.6	5.3	60	65.3
1002012	4	5.7E-03	2.6E-03	34.9	4.8	60	64.8
0002022	4	5.1E-03	2.3E-03	36.4	4.3	60	64.3
1003023	4	4.9E-03	2.2E-03	49.5	4.1	60	64.1
1002016	4	4.8E-03	2.2E-03	26.7	4.1	60	64.1
9002021	4	4.1E-03	1.9E-03	25.6	3.4	60	63.4
9002030	4	3.9E-03	1.8E-03	27.8	3.3	60	63.3
1003028	4	3.1E-03	1.4E-03	28.8	2.6	60	62.6
0003144	4	2.9E-03	1.3E-03	27.7	2.5	60	62.5
9002000	4	2.6E-03	1.2E-03	14.5	2.2	60	62.2
0001012	4	2.4E-03	1.1E-03	15.6	2.0	60	62.0
9002006	4	2.4E-03	1.1E-03	15.0	2.0	60	62.0
0003060	4	2.2E-03	1.0E-03	16.3	1.9	60	61.9
0003079	4	2.2E-03	9.8E-04	17.7	1.9	60	61.9
1004051	4	2.0E-03	9.1E-04	13.4	1.7	60	61.7
1004048	4	1.9E-03	8.6E-04	12.9	1.6	60	61.6

Attachment E-4. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
9001013	4	1.9E-03	8.8E-04	8.3	1.6	60	61.6
9001002	4	1.9E-03	8.7E-04	9.8	1.6	60	61.6
0003107	4	1.9E-03	8.3E-04	10.6	1.6	60	61.6
1004049	4	1.7E-03	7.8E-04	12.8	1.5	60	61.5
1004054	4	1.3E-03	5.8E-04	8.0	1.1	60	61.1
1004057	4	1.3E-03	5.8E-04	9.1	1.1	60	61.1
9003044	4	1.2E-03	5.5E-04	7.6	1.0	60	61.0
1004055	4	1.2E-03	5.2E-04	7.6	1.0	60	61.0
0003128	4	1.1E-03	4.9E-04	7.5	0.9	60	60.9
2001028	4	7.4E-04	3.3E-04	4.3	0.6	60	60.6
1004011	4	3.9E-04	1.8E-04	2.5	0.3	60	60.3
0002047	3	0.01	5.7E-03	76.6	10.8	60	70.8
0002039	3	0.01	5.2E-03	73.6	9.8	60	69.8
0002028	3	9.3E-03	4.1E-03	77.2	7.8	60	67.8
1002020	3	8.1E-03	3.7E-03	50.6	6.9	60	66.9
1002002	3	5.0E-03	2.2E-03	35.2	4.2	60	64.2
0003093	3	4.6E-03	2.1E-03	34.2	3.9	60	63.9
0003082	3	4.3E-03	1.9E-03	42.4	3.7	60	63.7
0002017	3	3.9E-03	1.7E-03	29.4	3.3	60	63.3
9002011	3	3.8E-03	1.8E-03	27.1	3.2	60	63.2
1003004	3	3.7E-03	1.7E-03	27.1	3.1	60	63.1
0001032	3	3.7E-03	1.6E-03	24.9	3.1	60	63.1
0001027	3	3.5E-03	1.5E-03	25.2	2.9	60	62.9
9002001	3	2.8E-03	1.3E-03	18.2	2.3	60	62.3
0003078	3	2.8E-03	1.2E-03	21.0	2.3	60	62.3
1003001	3	2.5E-03	1.1E-03	15.9	2.1	60	62.1
1004060	3	2.5E-03	1.1E-03	20.1	2.1	60	62.1
1004046	3	2.3E-03	1.0E-03	15.0	1.9	60	61.9

Attachment E-4. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0001013	3	2.2E-03	9.9E-04	14.5	1.9	60	61.9
9001012	3	2.0E-03	9.2E-04	8.8	1.7	60	61.7
1004052	3	1.9E-03	8.4E-04	14.8	1.6	60	61.6
9001014	3	1.8E-03	8.2E-04	8.9	1.5	60	61.5
0003070	3	1.6E-03	7.3E-04	9.9	1.4	60	61.4
0003036	3	1.6E-03	7.2E-04	12.1	1.4	60	61.4
9004015	3	1.5E-03	6.8E-04	6.5	1.2	60	61.2
9004014	3	1.4E-03	6.6E-04	7.1	1.2	60	61.2
0003073	3	1.4E-03	6.1E-04	11.3	1.2	60	61.2
0001003	3	1.4E-03	6.1E-04	8.0	1.2	60	61.2
0003115	3	1.2E-03	5.5E-04	7.5	1.0	60	61.0
9004016	3	1.1E-03	5.2E-04	5.4	0.9	60	60.9
1004072	3	1.1E-03	5.0E-04	5.1	0.9	60	60.9
1004056	3	1.0E-03	4.7E-04	7.1	0.9	60	60.9
9003017	3	8.1E-04	3.8E-04	4.5	0.7	60	60.7
9004017	3	7.8E-04	3.6E-04	3.7	0.7	60	60.7
9004006	3	7.1E-04	3.3E-04	3.2	0.6	60	60.6
0003020	3	7.1E-04	3.2E-04	5.1	0.6	60	60.6
9003013	3	7.0E-04	3.2E-04	4.2	0.6	60	60.6
0003006	3	6.7E-04	3.0E-04	4.8	0.6	60	60.6
9004008	3	6.7E-04	3.1E-04	3.0	0.6	60	60.6
1004089	3	6.0E-04	2.7E-04	4.8	0.5	60	60.5
2001011	3	3.7E-04	1.6E-04	1.9	0.3	60	60.3
1004100	3	3.2E-04	1.5E-04	1.5	0.3	60	60.3
2001008	3	3.1E-04	1.4E-04	1.8	0.3	60	60.3
2001013	3	2.7E-04	1.2E-04	1.0	0.2	60	60.2
1003012	2	8.4E-03	3.8E-03	59.6	7.1	60	67.1
1002019	2	7.8E-03	3.5E-03	50.2	6.6	60	66.6

Attachment E-4. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m³ Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0002025	2	7.6E-03	3.4E-03	71.9	6.4	60	66.4
0003087	2	6.5E-03	2.9E-03	56.2	5.5	60	65.5
1003009	2	6.0E-03	2.7E-03	50.4	5.1	60	65.1
0003088	2	5.4E-03	2.4E-03	43.5	4.6	60	64.6
0002019	2	5.3E-03	2.4E-03	39.7	4.5	60	64.5
9002029	2	4.6E-03	2.1E-03	28.4	3.9	60	63.9
0001035	2	4.4E-03	1.9E-03	30.3	3.7	60	63.7
0003085	2	4.0E-03	1.8E-03	47.3	3.4	60	63.4
0001025	2	3.8E-03	1.7E-03	27.5	3.2	60	63.2
9002012	2	3.4E-03	1.6E-03	23.2	2.9	60	62.9
0001031	2	3.3E-03	1.5E-03	23.0	2.8	60	62.8
9002017	2	3.3E-03	1.5E-03	19.7	2.8	60	62.8
0003142	2	2.9E-03	1.3E-03	29.5	2.5	60	62.5
0003077	2	2.7E-03	1.2E-03	19.8	2.3	60	62.3
0001024	2	2.7E-03	1.2E-03	19.4	2.2	60	62.2
0003055	2	2.3E-03	1.0E-03	14.3	2.0	60	62.0
0003056	2	2.3E-03	1.0E-03	16.0	1.9	60	61.9
9003042	2	2.1E-03	9.9E-04	14.2	1.8	60	61.8
9003050	2	2.1E-03	9.9E-04	14.0	1.8	60	61.8
0001008	2	2.1E-03	9.3E-04	13.9	1.8	60	61.8
1004045	2	2.0E-03	9.1E-04	12.8	1.7	60	61.7
0003065	2	2.0E-03	8.8E-04	11.9	1.7	60	61.7
0003052	2	1.9E-03	8.4E-04	11.3	1.6	60	61.6
1004033	2	1.7E-03	7.8E-04	10.3	1.5	60	61.5
1004040	2	1.6E-03	7.3E-04	10.2	1.4	60	61.4
0003050	2	1.5E-03	6.8E-04	9.4	1.3	60	61.3
1004038	2	1.5E-03	6.7E-04	9.1	1.3	60	61.3
0003069	2	1.5E-03	6.5E-04	11.9	1.2	60	61.2

Attachment E-4. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0003049	2	1.4E-03	6.4E-04	10.9	1.2	60	61.2
0003031	2	1.4E-03	6.3E-04	10.5	1.2	60	61.2
9001001	2	1.2E-03	5.6E-04	5.5	1.0	60	61.0
9004018	2	1.1E-03	4.9E-04	4.9	0.9	60	60.9
0003122	2	1.0E-03	4.7E-04	5.9	0.9	60	60.9
0003123	2	1.0E-03	4.4E-04	5.6	0.8	60	60.8
0003160	2	9.7E-04	4.3E-04	8.6	0.8	60	60.8
1004030	2	9.6E-04	4.3E-04	5.5	0.8	60	60.8
9003033	2	8.8E-04	4.1E-04	4.1	0.7	60	60.7
0003110	2	8.6E-04	3.8E-04	5.8	0.7	60	60.7
2001031	2	8.2E-04	3.7E-04	4.7	0.7	60	60.7
2001027	2	6.7E-04	3.0E-04	4.3	0.6	60	60.6
9004023	2	6.6E-04	3.1E-04	3.3	0.6	60	60.6
0003127	2	6.5E-04	2.9E-04	5.5	0.5	60	60.5
0003001	2	5.1E-04	2.3E-04	2.8	0.4	60	60.4
2001002	2	4.9E-04	2.2E-04	2.5	0.4	60	60.4
1004094	2	4.5E-04	2.0E-04	3.4	0.4	60	60.4
1004018	2	4.5E-04	2.0E-04	2.5	0.4	60	60.4
1004010	2	3.4E-04	1.5E-04	2.0	0.3	60	60.3
2001038	2	3.2E-04	1.4E-04	1.7	0.3	60	60.3
2001036	2	3.2E-04	1.4E-04	1.4	0.3	60	60.3
1004000	2	2.8E-04	1.3E-04	1.5	0.2	60	60.2
1004003	2	2.7E-04	1.2E-04	1.4	0.2	60	60.2
2001042	2	2.1E-04	9.5E-05	1.1	0.2	60	60.2
2001053	2	2.0E-04	8.8E-05	0.8	0.2	60	60.2
2001047	2	2.0E-04	8.8E-05	0.9	0.2	60	60.2
2001059	2	1.7E-04	7.6E-05	0.5	0.1	60	60.1
0002042	1	0.07	3.1E-02	315.3	59.8	60	119.8

Attachment E-4. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m³ Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0003046	1	0.03	1.3E-02	141.9	24.9	60	84.9
0002041	1	0.02	7.8E-03	141.8	14.9	60	74.9
0002029	1	0.01	4.6E-03	66.9	8.7	60	68.7
0002037	1	9.3E-03	4.1E-03	57.0	7.8	60	67.8
1003014	1	8.8E-03	4.0E-03	49.5	7.4	60	67.4
0003137	1	8.4E-03	3.8E-03	99.0	7.1	60	67.1
1003011	1	8.2E-03	3.7E-03	64.2	6.9	60	66.9
1002007	1	7.4E-03	3.3E-03	45.2	6.2	60	66.2
1002013	1	6.5E-03	2.9E-03	39.4	5.5	60	65.5
1002017	1	6.4E-03	2.9E-03	36.0	5.4	60	65.4
1003010	1	6.4E-03	2.9E-03	49.7	5.4	60	65.4
0003090	1	5.4E-03	2.4E-03	42.0	4.6	60	64.6
0003091	1	5.3E-03	2.4E-03	36.9	4.5	60	64.5
1003022	1	5.2E-03	2.3E-03	51.0	4.4	60	64.4
0002015	1	5.1E-03	2.3E-03	45.4	4.3	60	64.3
0003094	1	4.6E-03	2.0E-03	33.4	3.9	60	63.9
1001017	1	4.1E-03	1.8E-03	24.1	3.4	60	63.4
9002031	1	3.7E-03	1.7E-03	25.3	3.1	60	63.1
1003005	1	3.6E-03	1.6E-03	29.5	3.1	60	63.1
9002022	1	3.4E-03	1.6E-03	22.2	2.8	60	62.8
9002014	1	3.3E-03	1.5E-03	22.5	2.8	60	62.8
9002013	1	3.2E-03	1.5E-03	21.3	2.7	60	62.7
9002020	1	3.2E-03	1.5E-03	20.5	2.7	60	62.7
9002016	1	3.0E-03	1.4E-03	19.1	2.5	60	62.5
1003003	1	2.9E-03	1.3E-03	23.1	2.5	60	62.5
9001009	1	2.8E-03	1.3E-03	11.6	2.4	60	62.4
1001016	1	2.7E-03	1.2E-03	16.1	2.3	60	62.3
0003058	1	2.5E-03	1.1E-03	18.5	2.1	60	62.1

Attachment E-4. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
9002007	1	2.5E-03	1.2E-03	18.6	2.1	60	62.1
1004043	1	2.2E-03	1.0E-03	14.5	1.9	60	61.9
0001010	1	2.2E-03	9.9E-04	13.7	1.9	60	61.9
0003054	1	2.2E-03	9.8E-04	13.5	1.9	60	61.9
0003053	1	2.2E-03	9.7E-04	13.1	1.8	60	61.8
0003064	1	2.0E-03	8.9E-04	13.2	1.7	60	61.7
0001011	1	2.0E-03	8.8E-04	12.9	1.7	60	61.7
0001018	1	1.9E-03	8.5E-04	14.7	1.6	60	61.6
9001015	1	1.9E-03	8.8E-04	8.2	1.6	60	61.6
0001007	1	1.8E-03	8.2E-04	12.7	1.5	60	61.5
0003063	1	1.8E-03	8.1E-04	10.8	1.5	60	61.5
0003066	1	1.8E-03	7.9E-04	10.9	1.5	60	61.5
0001020	1	1.8E-03	7.9E-04	14.7	1.5	60	61.5
0003067	1	1.7E-03	7.6E-04	10.3	1.4	60	61.4
0003109	1	1.7E-03	7.5E-04	15.2	1.4	60	61.4
0003076	1	1.7E-03	7.4E-04	12.5	1.4	60	61.4
0001019	1	1.5E-03	6.5E-04	12.9	1.2	60	61.2
1004039	1	1.4E-03	6.2E-04	8.8	1.2	60	61.2
0003072	1	1.3E-03	5.9E-04	10.6	1.1	60	61.1
0001005	1	1.2E-03	5.3E-04	8.2	1.0	60	61.0
0003152	1	9.6E-04	4.3E-04	8.0	0.8	60	60.8
0003159	1	9.5E-04	4.2E-04	6.5	0.8	60	60.8
9004021	1	8.8E-04	4.1E-04	5.1	0.7	60	60.7
2001029	1	7.2E-04	3.2E-04	4.6	0.6	60	60.6
0003015	1	7.1E-04	3.2E-04	3.9	0.6	60	60.6
0003112	1	7.0E-04	3.1E-04	4.8	0.6	60	60.6
9003020	1	7.0E-04	3.3E-04	2.8	0.6	60	60.6
9003016	1	6.7E-04	3.1E-04	2.7	0.6	60	60.6

Attachment E-4. Estimated Media Concentrations in Alternative NAAQS (0.5 µg/m³ Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0003002	1	6.0E-04	2.7E-04	4.4	0.5	60	60.5
9003021	1	6.0E-04	2.8E-04	2.6	0.5	60	60.5
0003003	1	6.0E-04	2.7E-04	4.3	0.5	60	60.5
9003010	1	5.7E-04	2.6E-04	3.0	0.5	60	60.5
2001000	1	5.3E-04	2.4E-04	3.6	0.4	60	60.4
1004081	1	5.1E-04	2.3E-04	4.1	0.4	60	60.4
1004024	1	5.1E-04	2.3E-04	3.1	0.4	60	60.4
1004091	1	4.7E-04	2.1E-04	3.7	0.4	60	60.4
0003129	1	4.6E-04	2.1E-04	2.3	0.4	60	60.4
1004093	1	4.6E-04	2.1E-04	3.4	0.4	60	60.4
1004017	1	4.0E-04	1.8E-04	2.4	0.3	60	60.3
1004015	1	3.9E-04	1.7E-04	2.7	0.3	60	60.3
1004005	1	2.9E-04	1.3E-04	1.7	0.2	60	60.2
1004006	1	2.8E-04	1.3E-04	1.4	0.2	60	60.2
2001070	1	2.4E-04	1.1E-04	1.3	0.2	60	60.2
2001052	1	1.9E-04	8.5E-05	0.7	0.2	60	60.2
2001062	1	1.8E-04	8.2E-05	0.6	0.2	60	60.2
2001058	1	1.5E-04	6.7E-05	0.4	0.1	60	60.1

[a] Recent air refers to contributions associated with recent outdoor ambient air.

[b] Other refers to contributions from indoor paint, outdoor soil/dust and additional sources (including historical air).

Attachment E-5. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
9003026	71	4.8E-04	2.2E-04	7.1	0.4	60	60.4
9001004	63	1.0E-03	4.8E-04	14.9	0.9	60	60.9
0003048	53	9.5E-04	4.2E-04	17.8	0.8	60	60.8
2001012	42	1.3E-04	5.8E-05	1.3	0.1	60	60.1
1004004	38	1.5E-04	6.9E-05	2.7	0.1	60	60.1
1002001	35	1.8E-03	8.0E-04	28.2	1.5	60	61.5
9001007	35	9.0E-04	4.2E-04	14.4	0.8	60	60.8
0003040	31	1.5E-03	6.8E-04	29.7	1.3	60	61.3
2001009	31	1.1E-04	4.9E-05	1.4	0.1	60	60.1
0001002	30	6.7E-04	3.0E-04	11.4	0.6	60	60.6
0002023	29	3.4E-03	1.5E-03	79.6	2.9	60	62.9
9003043	26	6.7E-04	3.1E-04	11.1	0.6	60	60.6
9004000	24	2.0E-04	9.2E-05	1.4	0.2	60	60.2
2001037	22	1.2E-04	5.3E-05	1.4	0.1	60	60.1
9003012	21	3.1E-04	1.4E-04	5.1	0.3	60	60.3
1004092	21	1.8E-04	8.2E-05	3.7	0.2	60	60.2
1004014	21	1.6E-04	7.4E-05	3.0	0.1	60	60.1
0003121	19	3.2E-04	1.4E-04	6.0	0.3	60	60.3
2001005	19	1.7E-04	7.6E-05	2.2	0.1	60	60.1
9001011	18	1.0E-03	4.6E-04	16.2	0.8	60	60.8
0003061	18	7.3E-04	3.3E-04	14.8	0.6	60	60.6
2001004	17	1.6E-04	7.4E-05	2.0	0.1	60	60.1
0001023	16	1.2E-03	5.4E-04	25.4	1.0	60	61.0
1004031	16	7.1E-04	3.2E-04	10.7	0.6	60	60.6
0003080	16	6.7E-04	3.0E-04	14.1	0.6	60	60.6
9003051	16	6.5E-04	3.0E-04	11.5	0.5	60	60.5
2001039	16	9.8E-05	4.4E-05	1.0	0.1	60	60.1
2001001	15	2.2E-04	9.9E-05	2.8	0.2	60	60.2
9002026	14	1.8E-03	8.4E-04	25.2	1.5	60	61.5

Attachment E-5. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0001000	14	6.8E-04	3.0E-04	10.5	0.6	60	60.6
0002024	12	3.0E-03	1.3E-03	66.2	2.5	60	62.5
0001015	12	1.2E-03	5.1E-04	22.2	1.0	60	61.0
2001068	12	2.0E-04	9.1E-05	2.6	0.2	60	60.2
1004068	11	1.0E-03	4.7E-04	25.8	0.9	60	60.9
0002027	10	3.0E-03	1.3E-03	58.0	2.5	60	62.5
1002015	10	2.0E-03	9.2E-04	28.1	1.7	60	61.7
0001029	10	1.2E-03	5.2E-04	19.9	1.0	60	61.0
1004041	10	8.0E-04	3.6E-04	12.9	0.7	60	60.7
2001026	10	1.3E-04	6.0E-05	1.8	0.1	60	60.1
1002014	9	2.4E-03	1.1E-03	34.1	2.0	60	62.0
1003025	9	1.8E-03	8.3E-04	40.5	1.6	60	61.6
0003051	9	6.3E-04	2.8E-04	9.7	0.5	60	60.5
9003023	9	4.6E-04	2.1E-04	5.3	0.4	60	60.4
2001010	9	1.4E-04	6.4E-05	1.7	0.1	60	60.1
0002038	8	4.3E-03	1.9E-03	65.5	3.6	60	63.6
0001026	8	1.6E-03	7.0E-04	26.4	1.3	60	61.3
1003000	8	1.6E-03	7.0E-04	23.7	1.3	60	61.3
1003006	8	1.4E-03	6.2E-04	27.0	1.2	60	61.2
0001009	8	9.4E-04	4.2E-04	14.7	0.8	60	60.8
9003041	8	8.7E-04	4.1E-04	13.4	0.7	60	60.7
1004050	8	8.2E-04	3.7E-04	15.4	0.7	60	60.7
1004036	8	7.1E-04	3.2E-04	10.8	0.6	60	60.6
0003068	8	6.2E-04	2.8E-04	12.8	0.5	60	60.5
0003007	8	2.8E-04	1.3E-04	4.8	0.2	60	60.2
1004025	8	2.3E-04	1.1E-04	4.3	0.2	60	60.2
9003003	8	1.9E-04	8.6E-05	2.0	0.2	60	60.2
1004098	8	1.6E-04	7.0E-05	2.3	0.1	60	60.1
0003089	7	2.1E-03	9.5E-04	41.7	1.8	60	61.8

Attachment E-5. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
1003008	7	1.8E-03	8.2E-04	36.1	1.5	60	61.5
9002023	7	1.3E-03	6.2E-04	19.1	1.1	60	61.1
9002015	7	1.3E-03	5.8E-04	21.7	1.1	60	61.1
9001010	7	1.2E-03	5.8E-04	15.5	1.1	60	61.1
9001005	7	1.1E-03	4.9E-04	17.5	0.9	60	60.9
1004059	7	7.6E-04	3.4E-04	16.0	0.6	60	60.6
0003114	7	6.5E-04	2.9E-04	10.1	0.6	60	60.6
0003037	7	5.7E-04	2.5E-04	10.1	0.5	60	60.5
0003042	6	0.01	5.2E-03	256.0	9.9	60	69.9
9003027	6	6.6E-04	3.1E-04	9.7	0.6	60	60.6
0003155	6	6.2E-04	2.7E-04	11.5	0.5	60	60.5
1004058	6	5.5E-04	2.5E-04	11.2	0.5	60	60.5
1004096	6	1.3E-04	6.1E-05	2.4	0.1	60	60.1
1004007	6	1.3E-04	5.7E-05	2.0	0.1	60	60.1
2001051	6	7.0E-05	3.1E-05	0.6	0.1	60	60.1
0002050	5	5.0E-03	2.2E-03	101.5	4.3	60	64.3
0002036	5	4.1E-03	1.8E-03	65.1	3.4	60	63.4
1003013	5	3.9E-03	1.8E-03	57.6	3.3	60	63.3
0002026	5	3.9E-03	1.7E-03	91.1	3.3	60	63.3
1003016	5	3.1E-03	1.4E-03	45.1	2.6	60	62.6
0003138	5	2.5E-03	1.1E-03	69.5	2.1	60	62.1
1002003	5	2.4E-03	1.1E-03	35.3	2.1	60	62.1
0003140	5	1.9E-03	8.5E-04	53.5	1.6	60	61.6
0003083	5	1.9E-03	8.5E-04	49.0	1.6	60	61.6
1003007	5	1.2E-03	5.5E-04	23.8	1.0	60	61.0
1004047	5	9.3E-04	4.2E-04	15.6	0.8	60	60.8
0001006	5	7.5E-04	3.3E-04	11.9	0.6	60	60.6
1004037	5	5.9E-04	2.7E-04	9.0	0.5	60	60.5
0003071	5	5.5E-04	2.5E-04	11.3	0.5	60	60.5

Attachment E-5. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
9004022	5	3.2E-04	1.5E-04	3.8	0.3	60	60.3
0003004	5	2.6E-04	1.2E-04	4.5	0.2	60	60.2
1004028	5	2.4E-04	1.1E-04	3.7	0.2	60	60.2
1004019	5	2.1E-04	9.4E-05	3.3	0.2	60	60.2
1004013	5	1.9E-04	8.7E-05	3.5	0.2	60	60.2
9003002	5	1.9E-04	8.6E-05	1.9	0.2	60	60.2
2001006	5	1.4E-04	6.3E-05	1.6	0.1	60	60.1
2001007	5	1.3E-04	5.9E-05	1.4	0.1	60	60.1
1002018	4	3.4E-03	1.5E-03	51.9	2.9	60	62.9
0002018	4	2.5E-03	1.1E-03	47.6	2.1	60	62.1
1002012	4	2.3E-03	1.0E-03	34.9	1.9	60	61.9
0002022	4	2.1E-03	9.1E-04	36.4	1.7	60	61.7
1003023	4	2.0E-03	8.8E-04	49.5	1.7	60	61.7
1002016	4	1.9E-03	8.7E-04	26.7	1.6	60	61.6
9002021	4	1.6E-03	7.6E-04	25.6	1.4	60	61.4
9002030	4	1.6E-03	7.3E-04	27.8	1.3	60	61.3
1003028	4	1.2E-03	5.6E-04	28.8	1.1	60	61.1
0003144	4	1.2E-03	5.2E-04	27.7	1.0	60	61.0
9002000	4	1.0E-03	4.8E-04	14.5	0.9	60	60.9
0001012	4	9.7E-04	4.3E-04	15.6	0.8	60	60.8
9002006	4	9.7E-04	4.5E-04	15.0	0.8	60	60.8
0003060	4	9.0E-04	4.0E-04	16.3	0.8	60	60.8
0003079	4	8.9E-04	3.9E-04	17.7	0.7	60	60.7
1004051	4	8.1E-04	3.6E-04	13.4	0.7	60	60.7
1004048	4	7.6E-04	3.4E-04	12.9	0.6	60	60.6
9001013	4	7.6E-04	3.5E-04	8.3	0.6	60	60.6
9001002	4	7.5E-04	3.5E-04	9.8	0.6	60	60.6
0003107	4	7.4E-04	3.3E-04	10.6	0.6	60	60.6
1004049	4	7.0E-04	3.1E-04	12.8	0.6	60	60.6

Attachment E-5. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 μg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (μg/m^3)	Annual Average Inhalation Exposure Concentration (μg/m^3)	Scaled Soil Concentration (μg/g)	Predicted Indoor Dust Pb Concentrations (μg/g)		
					From Recent Air [a]	From Other [b]	Total
1004054	4	5.2E-04	2.3E-04	8.0	0.4	60	60.4
1004057	4	5.1E-04	2.3E-04	9.1	0.4	60	60.4
9003044	4	4.7E-04	2.2E-04	7.6	0.4	60	60.4
1004055	4	4.6E-04	2.1E-04	7.6	0.4	60	60.4
0003128	4	4.4E-04	2.0E-04	7.5	0.4	60	60.4
2001028	4	3.0E-04	1.3E-04	4.3	0.3	60	60.3
1004011	4	1.6E-04	7.1E-05	2.5	0.1	60	60.1
0002047	3	5.1E-03	2.3E-03	76.6	4.3	60	64.3
0002039	3	4.6E-03	2.1E-03	73.6	3.9	60	63.9
0002028	3	3.7E-03	1.7E-03	77.2	3.1	60	63.1
1002020	3	3.3E-03	1.5E-03	50.6	2.7	60	62.7
1002002	3	2.0E-03	8.9E-04	35.2	1.7	60	61.7
0003093	3	1.9E-03	8.2E-04	34.2	1.6	60	61.6
0003082	3	1.7E-03	7.7E-04	42.4	1.5	60	61.5
0002017	3	1.6E-03	6.9E-04	29.4	1.3	60	61.3
9002011	3	1.5E-03	7.0E-04	27.1	1.3	60	61.3
1003004	3	1.5E-03	6.7E-04	27.1	1.2	60	61.2
0001032	3	1.5E-03	6.6E-04	24.9	1.2	60	61.2
0001027	3	1.4E-03	6.2E-04	25.2	1.2	60	61.2
9002001	3	1.1E-03	5.2E-04	18.2	0.9	60	60.9
0003078	3	1.1E-03	4.9E-04	21.0	0.9	60	60.9
1003001	3	1.0E-03	4.6E-04	15.9	0.9	60	60.9
1004060	3	1.0E-03	4.5E-04	20.1	0.8	60	60.8
1004046	3	9.2E-04	4.2E-04	15.0	0.8	60	60.8
0001013	3	8.9E-04	4.0E-04	14.5	0.8	60	60.8
9001012	3	7.9E-04	3.7E-04	8.8	0.7	60	60.7
1004052	3	7.5E-04	3.4E-04	14.8	0.6	60	60.6
9001014	3	7.1E-04	3.3E-04	8.9	0.6	60	60.6
0003070	3	6.6E-04	2.9E-04	9.9	0.6	60	60.6

Attachment E-5. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0003036	3	6.5E-04	2.9E-04	12.1	0.5	60	60.5
9004015	3	5.8E-04	2.7E-04	6.5	0.5	60	60.5
9004014	3	5.7E-04	2.6E-04	7.1	0.5	60	60.5
0003073	3	5.5E-04	2.5E-04	11.3	0.5	60	60.5
0001003	3	5.5E-04	2.4E-04	8.0	0.5	60	60.5
0003115	3	4.9E-04	2.2E-04	7.5	0.4	60	60.4
9004016	3	4.4E-04	2.1E-04	5.4	0.4	60	60.4
1004072	3	4.4E-04	2.0E-04	5.1	0.4	60	60.4
1004056	3	4.1E-04	1.9E-04	7.1	0.3	60	60.3
9003017	3	3.3E-04	1.5E-04	4.5	0.3	60	60.3
9004017	3	3.1E-04	1.4E-04	3.7	0.3	60	60.3
9004006	3	2.9E-04	1.3E-04	3.2	0.2	60	60.2
0003020	3	2.8E-04	1.3E-04	5.1	0.2	60	60.2
9003013	3	2.8E-04	1.3E-04	4.2	0.2	60	60.2
0003006	3	2.7E-04	1.2E-04	4.8	0.2	60	60.2
9004008	3	2.7E-04	1.3E-04	3.0	0.2	60	60.2
1004089	3	2.4E-04	1.1E-04	4.8	0.2	60	60.2
2001011	3	1.5E-04	6.6E-05	1.9	0.1	60	60.1
1004100	3	1.3E-04	5.8E-05	1.5	0.1	60	60.1
2001008	3	1.3E-04	5.6E-05	1.8	0.1	60	60.1
2001013	3	1.1E-04	4.7E-05	1.0	0.1	60	60.1
1003012	2	3.4E-03	1.5E-03	59.6	2.8	60	62.8
1002019	2	3.1E-03	1.4E-03	50.2	2.6	60	62.6
0002025	2	3.0E-03	1.4E-03	71.9	2.6	60	62.6
0003087	2	2.6E-03	1.2E-03	56.2	2.2	60	62.2
1003009	2	2.4E-03	1.1E-03	50.4	2.0	60	62.0
0003088	2	2.2E-03	9.6E-04	43.5	1.8	60	61.8
0002019	2	2.1E-03	9.4E-04	39.7	1.8	60	61.8
9002029	2	1.8E-03	8.5E-04	28.4	1.6	60	61.6

Attachment E-5. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0001035	2	1.8E-03	7.8E-04	30.3	1.5	60	61.5
0003085	2	1.6E-03	7.2E-04	47.3	1.4	60	61.4
0001025	2	1.5E-03	6.8E-04	27.5	1.3	60	61.3
9002012	2	1.4E-03	6.4E-04	23.2	1.2	60	61.2
0001031	2	1.3E-03	5.9E-04	23.0	1.1	60	61.1
9002017	2	1.3E-03	6.1E-04	19.7	1.1	60	61.1
0003142	2	1.2E-03	5.2E-04	29.5	1.0	60	61.0
0003077	2	1.1E-03	4.8E-04	19.8	0.9	60	60.9
0001024	2	1.1E-03	4.7E-04	19.4	0.9	60	60.9
0003055	2	9.3E-04	4.1E-04	14.3	0.8	60	60.8
0003056	2	9.0E-04	4.0E-04	16.0	0.8	60	60.8
9003042	2	8.6E-04	4.0E-04	14.2	0.7	60	60.7
9003050	2	8.5E-04	4.0E-04	14.0	0.7	60	60.7
0001008	2	8.3E-04	3.7E-04	13.9	0.7	60	60.7
1004045	2	8.1E-04	3.6E-04	12.8	0.7	60	60.7
0003065	2	7.9E-04	3.5E-04	11.9	0.7	60	60.7
0003052	2	7.5E-04	3.3E-04	11.3	0.6	60	60.6
1004033	2	6.9E-04	3.1E-04	10.3	0.6	60	60.6
1004040	2	6.5E-04	2.9E-04	10.2	0.5	60	60.5
0003050	2	6.1E-04	2.7E-04	9.4	0.5	60	60.5
1004038	2	6.0E-04	2.7E-04	9.1	0.5	60	60.5
0003069	2	5.9E-04	2.6E-04	11.9	0.5	60	60.5
0003049	2	5.8E-04	2.6E-04	10.9	0.5	60	60.5
0003031	2	5.7E-04	2.5E-04	10.5	0.5	60	60.5
9001001	2	4.8E-04	2.2E-04	5.5	0.4	60	60.4
9004018	2	4.3E-04	2.0E-04	4.9	0.4	60	60.4
0003122	2	4.2E-04	1.9E-04	5.9	0.4	60	60.4
0003123	2	4.0E-04	1.8E-04	5.6	0.3	60	60.3
0003160	2	3.9E-04	1.7E-04	8.6	0.3	60	60.3

Attachment E-5. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
1004030	2	3.8E-04	1.7E-04	5.5	0.3	60	60.3
9003033	2	3.5E-04	1.6E-04	4.1	0.3	60	60.3
0003110	2	3.4E-04	1.5E-04	5.8	0.3	60	60.3
2001031	2	3.3E-04	1.5E-04	4.7	0.3	60	60.3
2001027	2	2.7E-04	1.2E-04	4.3	0.2	60	60.2
9004023	2	2.6E-04	1.2E-04	3.3	0.2	60	60.2
0003127	2	2.6E-04	1.2E-04	5.5	0.2	60	60.2
0003001	2	2.1E-04	9.1E-05	2.8	0.2	60	60.2
2001002	2	2.0E-04	8.8E-05	2.5	0.2	60	60.2
1004094	2	1.8E-04	8.2E-05	3.4	0.2	60	60.2
1004018	2	1.8E-04	8.1E-05	2.5	0.2	60	60.2
1004010	2	1.4E-04	6.1E-05	2.0	0.1	60	60.1
2001038	2	1.3E-04	5.8E-05	1.7	0.1	60	60.1
2001036	2	1.3E-04	5.7E-05	1.4	0.1	60	60.1
1004000	2	1.1E-04	5.0E-05	1.5	0.1	60	60.1
1004003	2	1.1E-04	4.9E-05	1.4	0.1	60	60.1
2001042	2	8.5E-05	3.8E-05	1.1	0.1	60	60.1
2001053	2	7.9E-05	3.5E-05	0.8	0.1	60	60.1
2001047	2	7.9E-05	3.5E-05	0.9	0.1	60	60.1
2001059	2	6.8E-05	3.0E-05	0.5	0.1	60	60.1
0002042	1	0.03	1.3E-02	315.3	23.9	60	83.9
0003046	1	0.01	5.2E-03	141.9	10.0	60	70.0
0002041	1	7.0E-03	3.1E-03	141.8	5.9	60	65.9
0002029	1	4.1E-03	1.8E-03	66.9	3.5	60	63.5
0002037	1	3.7E-03	1.7E-03	57.0	3.1	60	63.1
1003014	1	3.5E-03	1.6E-03	49.5	3.0	60	63.0
0003137	1	3.4E-03	1.5E-03	99.0	2.8	60	62.8
1003011	1	3.3E-03	1.5E-03	64.2	2.8	60	62.8
1002007	1	3.0E-03	1.3E-03	45.2	2.5	60	62.5

Attachment E-5. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
1002013	1	2.6E-03	1.2E-03	39.4	2.2	60	62.2
1002017	1	2.6E-03	1.2E-03	36.0	2.2	60	62.2
1003010	1	2.6E-03	1.2E-03	49.7	2.2	60	62.2
0003090	1	2.2E-03	9.6E-04	42.0	1.8	60	61.8
0003091	1	2.1E-03	9.5E-04	36.9	1.8	60	61.8
1003022	1	2.1E-03	9.3E-04	51.0	1.7	60	61.7
0002015	1	2.0E-03	9.0E-04	45.4	1.7	60	61.7
0003094	1	1.8E-03	8.1E-04	33.4	1.5	60	61.5
1001017	1	1.6E-03	7.4E-04	24.1	1.4	60	61.4
9002031	1	1.5E-03	6.9E-04	25.3	1.2	60	61.2
1003005	1	1.5E-03	6.6E-04	29.5	1.2	60	61.2
9002022	1	1.3E-03	6.2E-04	22.2	1.1	60	61.1
9002014	1	1.3E-03	6.1E-04	22.5	1.1	60	61.1
9002013	1	1.3E-03	5.9E-04	21.3	1.1	60	61.1
9002020	1	1.3E-03	5.9E-04	20.5	1.1	60	61.1
9002016	1	1.2E-03	5.5E-04	19.1	1.0	60	61.0
1003003	1	1.2E-03	5.3E-04	23.1	1.0	60	61.0
9001009	1	1.1E-03	5.3E-04	11.6	1.0	60	61.0
1001016	1	1.1E-03	5.0E-04	16.1	0.9	60	60.9
0003058	1	1.0E-03	4.5E-04	18.5	0.9	60	60.9
9002007	1	1.0E-03	4.7E-04	18.6	0.9	60	60.9
1004043	1	9.0E-04	4.1E-04	14.5	0.8	60	60.8
0001010	1	8.9E-04	4.0E-04	13.7	0.8	60	60.8
0003054	1	8.8E-04	3.9E-04	13.5	0.7	60	60.7
0003053	1	8.7E-04	3.9E-04	13.1	0.7	60	60.7
0003064	1	8.0E-04	3.5E-04	13.2	0.7	60	60.7
0001011	1	8.0E-04	3.5E-04	12.9	0.7	60	60.7
0001018	1	7.6E-04	3.4E-04	14.7	0.6	60	60.6
9001015	1	7.6E-04	3.5E-04	8.2	0.6	60	60.6

Attachment E-5. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0001007	1	7.3E-04	3.3E-04	12.7	0.6	60	60.6
0003063	1	7.3E-04	3.2E-04	10.8	0.6	60	60.6
0003066	1	7.1E-04	3.2E-04	10.9	0.6	60	60.6
0001020	1	7.1E-04	3.1E-04	14.7	0.6	60	60.6
0003067	1	6.8E-04	3.0E-04	10.3	0.6	60	60.6
0003109	1	6.8E-04	3.0E-04	15.2	0.6	60	60.6
0003076	1	6.7E-04	3.0E-04	12.5	0.6	60	60.6
0001019	1	5.8E-04	2.6E-04	12.9	0.5	60	60.5
1004039	1	5.5E-04	2.5E-04	8.8	0.5	60	60.5
0003072	1	5.3E-04	2.4E-04	10.6	0.4	60	60.4
0001005	1	4.8E-04	2.1E-04	8.2	0.4	60	60.4
0003152	1	3.8E-04	1.7E-04	8.0	0.3	60	60.3
0003159	1	3.8E-04	1.7E-04	6.5	0.3	60	60.3
9004021	1	3.5E-04	1.6E-04	5.1	0.3	60	60.3
2001029	1	2.9E-04	1.3E-04	4.6	0.2	60	60.2
0003015	1	2.9E-04	1.3E-04	3.9	0.2	60	60.2
0003112	1	2.8E-04	1.2E-04	4.8	0.2	60	60.2
9003020	1	2.8E-04	1.3E-04	2.8	0.2	60	60.2
9003016	1	2.7E-04	1.2E-04	2.7	0.2	60	60.2
0003002	1	2.4E-04	1.1E-04	4.4	0.2	60	60.2
9003021	1	2.4E-04	1.1E-04	2.6	0.2	60	60.2
0003003	1	2.4E-04	1.1E-04	4.3	0.2	60	60.2
9003010	1	2.3E-04	1.1E-04	3.0	0.2	60	60.2
2001000	1	2.1E-04	9.5E-05	3.6	0.2	60	60.2
1004081	1	2.1E-04	9.3E-05	4.1	0.2	60	60.2
1004024	1	2.1E-04	9.3E-05	3.1	0.2	60	60.2
1004091	1	1.9E-04	8.5E-05	3.7	0.2	60	60.2
0003129	1	1.8E-04	8.2E-05	2.3	0.2	60	60.2
1004093	1	1.8E-04	8.3E-05	3.4	0.2	60	60.2

Attachment E-5. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
1004017	1	1.6E-04	7.2E-05	2.4	0.1	60	60.1
1004015	1	1.5E-04	7.0E-05	2.7	0.1	60	60.1
1004005	1	1.2E-04	5.3E-05	1.7	0.1	60	60.1
1004006	1	1.1E-04	5.0E-05	1.4	0.1	60	60.1
2001070	1	9.8E-05	4.4E-05	1.3	0.1	60	60.1
2001052	1	7.6E-05	3.4E-05	0.7	0.1	60	60.1
2001062	1	7.4E-05	3.3E-05	0.6	0.1	60	60.1
2001058	1	6.0E-05	2.7E-05	0.4	0.1	60	60.1

[a] Recent air refers to contributions associated with recent outdoor ambient air.

[b] Other refers to contributions from indoor paint, outdoor soil/dust and additional sources (including historical air).

Attachment E-6. Estimated Media Pb Concentrations in Alternative NAAQS (0.05 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
9003026	71	1.2E-04	5.6E-05	7.1	0.1	60	60.1
9001004	63	2.6E-04	1.2E-04	14.9	0.2	60	60.2
0003048	53	2.4E-04	1.1E-04	17.8	0.2	60	60.2
2001012	42	5.0E-05	2.2E-05	1.3	0.0	60	60.0
1004004	38	5.0E-05	2.3E-05	2.7	0.0	60	60.0
1002001	35	4.4E-04	2.0E-04	28.2	0.4	60	60.4
9001007	35	2.2E-04	1.0E-04	14.4	0.2	60	60.2
0003040	31	3.8E-04	1.7E-04	29.7	0.3	60	60.3
2001009	31	5.0E-05	2.2E-05	1.4	0.0	60	60.0
0001002	30	1.7E-04	7.4E-05	11.4	0.1	60	60.1
0002023	29	8.6E-04	3.8E-04	79.6	0.7	60	60.7
9003043	26	1.7E-04	7.7E-05	11.1	0.1	60	60.1
9004000	24	5.0E-05	2.3E-05	1.4	0.04	60	60.0
2001037	22	5.0E-05	2.2E-05	1.4	0.04	60	60.0
9003012	21	7.7E-05	3.6E-05	5.1	0.1	60	60.1
1004092	21	5.0E-05	2.3E-05	3.7	0.0	60	60.0
1004014	21	5.0E-05	2.3E-05	3.0	0.0	60	60.0
0003121	19	8.1E-05	3.6E-05	6.0	0.1	60	60.1
2001005	19	5.0E-05	2.2E-05	2.2	0.04	60	60.0
9001011	18	2.5E-04	1.2E-04	16.2	0.2	60	60.2
0003061	18	1.8E-04	8.1E-05	14.8	0.2	60	60.2
2001004	17	5.0E-05	2.2E-05	2.0	0.04	60	60.0
0001023	16	3.0E-04	1.4E-04	25.4	0.3	60	60.3
1004031	16	1.8E-04	8.0E-05	10.7	0.1	60	60.1
0003080	16	1.7E-04	7.5E-05	14.1	0.1	60	60.1
9003051	16	1.6E-04	7.6E-05	11.5	0.1	60	60.1
2001039	16	5.0E-05	2.2E-05	1.0	0.04	60	60.0
2001001	15	5.5E-05	2.5E-05	2.8	0.05	60	60.0
9002026	14	4.5E-04	2.1E-04	25.2	0.4	60	60.4
0001000	14	1.7E-04	7.6E-05	10.5	0.1	60	60.1

Attachment E-6. Estimated Media Pb Concentrations in Alternative NAAQS (0.05 µg/m³ Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0002024	12	7.5E-04	3.3E-04	66.2	0.6	60	60.6
0001015	12	2.9E-04	1.3E-04	22.2	0.2	60	60.2
2001068	12	5.1E-05	2.3E-05	2.6	0.04	60	60.0
1004068	11	2.6E-04	1.2E-04	25.8	0.2	60	60.2
0002027	10	7.5E-04	3.4E-04	58.0	0.6	60	60.6
1002015	10	5.1E-04	2.3E-04	28.1	0.4	60	60.4
0001029	10	2.9E-04	1.3E-04	19.9	0.2	60	60.2
1004041	10	2.0E-04	9.0E-05	12.9	0.2	60	60.2
2001026	10	5.0E-05	2.2E-05	1.8	0.04	60	60.0
1002014	9	5.9E-04	2.7E-04	34.1	0.5	60	60.5
1003025	9	4.6E-04	2.1E-04	40.5	0.4	60	60.4
0003051	9	1.6E-04	7.0E-05	9.7	0.1	60	60.1
9003023	9	1.2E-04	5.3E-05	5.3	0.1	60	60.1
2001010	9	5.0E-05	2.2E-05	1.7	0.04	60	60.0
0002038	8	1.1E-03	4.8E-04	65.5	0.9	60	60.9
0001026	8	3.9E-04	1.7E-04	26.4	0.3	60	60.3
1003000	8	3.9E-04	1.7E-04	23.7	0.3	60	60.3
1003006	8	3.4E-04	1.5E-04	27.0	0.3	60	60.3
0001009	8	2.4E-04	1.0E-04	14.7	0.2	60	60.2
9003041	8	2.2E-04	1.0E-04	13.4	0.2	60	60.2
1004050	8	2.0E-04	9.2E-05	15.4	0.2	60	60.2
1004036	8	1.8E-04	8.0E-05	10.8	0.1	60	60.1
0003068	8	1.5E-04	6.9E-05	12.8	0.1	60	60.1
0003007	8	7.1E-05	3.2E-05	4.8	0.1	60	60.1
1004025	8	5.8E-05	2.6E-05	4.3	0.05	60	60.0
1004098	8	5.0E-05	2.3E-05	2.3	0.04	60	60.0
9003003	8	5.0E-05	2.3E-05	2.0	0.04	60	60.0
0003089	7	5.4E-04	2.4E-04	41.7	0.5	60	60.5
1003008	7	4.5E-04	2.1E-04	36.1	0.4	60	60.4
9002023	7	3.3E-04	1.5E-04	19.1	0.3	60	60.3

Attachment E-6. Estimated Media Pb Concentrations in Alternative NAAQS (0.05 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
9002015	7	3.1E-04	1.5E-04	21.7	0.3	60	60.3
9001010	7	3.1E-04	1.4E-04	15.5	0.3	60	60.3
9001005	7	2.6E-04	1.2E-04	17.5	0.2	60	60.2
1004059	7	1.9E-04	8.5E-05	16.0	0.2	60	60.2
0003114	7	1.6E-04	7.2E-05	10.1	0.1	60	60.1
0003037	7	1.4E-04	6.3E-05	10.1	0.1	60	60.1
0003042	6	2.9E-03	1.3E-03	256.0	2.5	60	62.5
9003027	6	1.6E-04	7.6E-05	9.7	0.1	60	60.1
0003155	6	1.5E-04	6.9E-05	11.5	0.1	60	60.1
1004058	6	1.4E-04	6.2E-05	11.2	0.1	60	60.1
1004096	6	5.0E-05	2.3E-05	2.4	0.04	60	60.0
1004007	6	5.0E-05	2.3E-05	2.0	0.04	60	60.0
2001051	6	5.0E-05	2.2E-05	0.6	0.04	60	60.0
0002050	5	1.3E-03	5.6E-04	101.5	1.1	60	61.1
0002036	5	1.0E-03	4.5E-04	65.1	0.9	60	60.9
1003013	5	9.8E-04	4.4E-04	57.6	0.8	60	60.8
0002026	5	9.7E-04	4.3E-04	91.1	0.8	60	60.8
1003016	5	7.8E-04	3.5E-04	45.1	0.7	60	60.7
0003138	5	6.4E-04	2.8E-04	69.5	0.5	60	60.5
1002003	5	6.1E-04	2.8E-04	35.3	0.5	60	60.5
0003140	5	4.8E-04	2.1E-04	53.5	0.4	60	60.4
0003083	5	4.8E-04	2.1E-04	49.0	0.4	60	60.4
1003007	5	3.0E-04	1.4E-04	23.8	0.3	60	60.3
1004047	5	2.3E-04	1.0E-04	15.6	0.2	60	60.2
0001006	5	1.9E-04	8.3E-05	11.9	0.2	60	60.2
1004037	5	1.5E-04	6.6E-05	9.0	0.1	60	60.1
0003071	5	1.4E-04	6.2E-05	11.3	0.1	60	60.1
9004022	5	8.0E-05	3.7E-05	3.8	0.1	60	60.1
0003004	5	6.6E-05	2.9E-05	4.5	0.1	60	60.1
1004028	5	6.1E-05	2.8E-05	3.7	0.1	60	60.1

Attachment E-6. Estimated Media Pb Concentrations in Alternative NAAQS (0.05 μg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (μg/m^3)	Annual Average Inhalation Exposure Concentration (μg/m^3)	Scaled Soil Concentration (μg/g)	Predicted Indoor Dust Pb Concentrations (μg/g)		
					From Recent Air [a]	From Other [b]	Total
1004019	5	5.2E-05	2.4E-05	3.3	0.04	60	60.0
1004013	5	5.0E-05	2.3E-05	3.5	0.04	60	60.0
9003002	5	5.0E-05	2.3E-05	1.9	0.04	60	60.0
2001006	5	5.0E-05	2.2E-05	1.6	0.04	60	60.0
2001007	5	5.0E-05	2.2E-05	1.4	0.04	60	60.0
1002018	4	8.5E-04	3.8E-04	51.9	0.7	60	60.7
0002018	4	6.3E-04	2.8E-04	47.6	0.5	60	60.5
1002012	4	5.7E-04	2.6E-04	34.9	0.5	60	60.5
0002022	4	5.1E-04	2.3E-04	36.4	0.4	60	60.4
1003023	4	4.9E-04	2.2E-04	49.5	0.4	60	60.4
1002016	4	4.8E-04	2.2E-04	26.7	0.4	60	60.4
9002021	4	4.1E-04	1.9E-04	25.6	0.3	60	60.3
9002030	4	3.9E-04	1.8E-04	27.8	0.3	60	60.3
1003028	4	3.1E-04	1.4E-04	28.8	0.3	60	60.3
0003144	4	2.9E-04	1.3E-04	27.7	0.2	60	60.2
9002000	4	2.6E-04	1.2E-04	14.5	0.2	60	60.2
0001012	4	2.4E-04	1.1E-04	15.6	0.2	60	60.2
9002006	4	2.4E-04	1.1E-04	15.0	0.2	60	60.2
0003060	4	2.2E-04	1.0E-04	16.3	0.2	60	60.2
0003079	4	2.2E-04	9.8E-05	17.7	0.2	60	60.2
1004051	4	2.0E-04	9.1E-05	13.4	0.2	60	60.2
1004048	4	1.9E-04	8.6E-05	12.9	0.2	60	60.2
9001013	4	1.9E-04	8.8E-05	8.3	0.2	60	60.2
9001002	4	1.9E-04	8.7E-05	9.8	0.2	60	60.2
0003107	4	1.9E-04	8.3E-05	10.6	0.2	60	60.2
1004049	4	1.7E-04	7.8E-05	12.8	0.1	60	60.1
1004054	4	1.3E-04	5.8E-05	8.0	0.1	60	60.1
1004057	4	1.3E-04	5.8E-05	9.1	0.1	60	60.1
9003044	4	1.2E-04	5.5E-05	7.6	0.1	60	60.1
1004055	4	1.2E-04	5.2E-05	7.6	0.1	60	60.1

Attachment E-6. Estimated Media Pb Concentrations in Alternative NAAQS (0.05 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0003128	4	1.1E-04	4.9E-05	7.5	0.1	60	60.1
2001028	4	7.4E-05	3.3E-05	4.3	0.1	60	60.1
1004011	4	5.0E-05	2.3E-05	2.5	0.04	60	60.0
0002047	3	1.3E-03	5.7E-04	76.6	1.1	60	61.1
0002039	3	1.2E-03	5.2E-04	73.6	1.0	60	61.0
0002028	3	9.3E-04	4.1E-04	77.2	0.8	60	60.8
1002020	3	8.1E-04	3.7E-04	50.6	0.7	60	60.7
1002002	3	5.0E-04	2.2E-04	35.2	0.4	60	60.4
0003093	3	4.6E-04	2.1E-04	34.2	0.4	60	60.4
0003082	3	4.3E-04	1.9E-04	42.4	0.4	60	60.4
0002017	3	3.9E-04	1.7E-04	29.4	0.3	60	60.3
9002011	3	3.8E-04	1.8E-04	27.1	0.3	60	60.3
1003004	3	3.7E-04	1.7E-04	27.1	0.3	60	60.3
0001032	3	3.7E-04	1.6E-04	24.9	0.3	60	60.3
0001027	3	3.5E-04	1.5E-04	25.2	0.3	60	60.3
9002001	3	2.8E-04	1.3E-04	18.2	0.2	60	60.2
0003078	3	2.8E-04	1.2E-04	21.0	0.2	60	60.2
1003001	3	2.5E-04	1.1E-04	15.9	0.2	60	60.2
1004060	3	2.5E-04	1.1E-04	20.1	0.2	60	60.2
1004046	3	2.3E-04	1.0E-04	15.0	0.2	60	60.2
0001013	3	2.2E-04	9.9E-05	14.5	0.2	60	60.2
9001012	3	2.0E-04	9.2E-05	8.8	0.2	60	60.2
1004052	3	1.9E-04	8.4E-05	14.8	0.2	60	60.2
9001014	3	1.8E-04	8.2E-05	8.9	0.1	60	60.1
0003070	3	1.6E-04	7.3E-05	9.9	0.1	60	60.1
0003036	3	1.6E-04	7.2E-05	12.1	0.1	60	60.1
9004015	3	1.5E-04	6.8E-05	6.5	0.1	60	60.1
9004014	3	1.4E-04	6.6E-05	7.1	0.1	60	60.1
0003073	3	1.4E-04	6.1E-05	11.3	0.1	60	60.1
0001003	3	1.4E-04	6.1E-05	8.0	0.1	60	60.1

Attachment E-6. Estimated Media Pb Concentrations in Alternative NAAQS (0.05 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0003115	3	1.2E-04	5.5E-05	7.5	0.1	60	60.1
9004016	3	1.1E-04	5.2E-05	5.4	0.1	60	60.1
1004072	3	1.1E-04	5.0E-05	5.1	0.1	60	60.1
1004056	3	1.0E-04	4.7E-05	7.1	0.1	60	60.1
9003017	3	8.1E-05	3.8E-05	4.5	0.1	60	60.1
9004017	3	7.8E-05	3.6E-05	3.7	0.1	60	60.1
9004006	3	7.1E-05	3.3E-05	3.2	0.1	60	60.1
0003020	3	7.1E-05	3.2E-05	5.1	0.1	60	60.1
9003013	3	7.0E-05	3.2E-05	4.2	0.1	60	60.1
0003006	3	6.7E-05	3.0E-05	4.8	0.1	60	60.1
9004008	3	6.7E-05	3.1E-05	3.0	0.1	60	60.1
1004089	3	6.0E-05	2.7E-05	4.8	0.1	60	60.1
2001011	3	5.0E-05	2.2E-05	1.9	0.04	60	60.0
2001008	3	5.0E-05	2.2E-05	1.8	0.04	60	60.0
1004100	3	5.0E-05	2.3E-05	1.5	0.04	60	60.0
2001013	3	5.0E-05	2.2E-05	1.0	0.04	60	60.0
1003012	2	8.4E-04	3.8E-04	59.6	0.7	60	60.7
1002019	2	7.8E-04	3.5E-04	50.2	0.7	60	60.7
0002025	2	7.6E-04	3.4E-04	71.9	0.6	60	60.6
0003087	2	6.5E-04	2.9E-04	56.2	0.5	60	60.5
1003009	2	6.0E-04	2.7E-04	50.4	0.5	60	60.5
0003088	2	5.4E-04	2.4E-04	43.5	0.5	60	60.5
0002019	2	5.3E-04	2.4E-04	39.7	0.4	60	60.4
9002029	2	4.6E-04	2.1E-04	28.4	0.4	60	60.4
0001035	2	4.4E-04	1.9E-04	30.3	0.4	60	60.4
0003085	2	4.0E-04	1.8E-04	47.3	0.3	60	60.3
0001025	2	3.8E-04	1.7E-04	27.5	0.3	60	60.3
9002012	2	3.4E-04	1.6E-04	23.2	0.3	60	60.3
0001031	2	3.3E-04	1.5E-04	23.0	0.3	60	60.3
9002017	2	3.3E-04	1.5E-04	19.7	0.3	60	60.3

Attachment E-6. Estimated Media Pb Concentrations in Alternative NAAQS (0.05 µg/m³ Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0003142	2	2.9E-04	1.3E-04	29.5	0.2	60	60.2
0003077	2	2.7E-04	1.2E-04	19.8	0.2	60	60.2
0001024	2	2.7E-04	1.2E-04	19.4	0.2	60	60.2
0003055	2	2.3E-04	1.0E-04	14.3	0.2	60	60.2
0003056	2	2.3E-04	1.0E-04	16.0	0.2	60	60.2
9003042	2	2.1E-04	9.9E-05	14.2	0.2	60	60.2
9003050	2	2.1E-04	9.9E-05	14.0	0.2	60	60.2
0001008	2	2.1E-04	9.3E-05	13.9	0.2	60	60.2
1004045	2	2.0E-04	9.1E-05	12.8	0.2	60	60.2
0003065	2	2.0E-04	8.8E-05	11.9	0.2	60	60.2
0003052	2	1.9E-04	8.4E-05	11.3	0.2	60	60.2
1004033	2	1.7E-04	7.8E-05	10.3	0.1	60	60.1
1004040	2	1.6E-04	7.3E-05	10.2	0.1	60	60.1
0003050	2	1.5E-04	6.8E-05	9.4	0.1	60	60.1
1004038	2	1.5E-04	6.7E-05	9.1	0.1	60	60.1
0003069	2	1.5E-04	6.5E-05	11.9	0.1	60	60.1
0003049	2	1.4E-04	6.4E-05	10.9	0.1	60	60.1
0003031	2	1.4E-04	6.3E-05	10.5	0.1	60	60.1
9001001	2	1.2E-04	5.6E-05	5.5	0.1	60	60.1
9004018	2	1.1E-04	4.9E-05	4.9	0.1	60	60.1
0003122	2	1.0E-04	4.7E-05	5.9	0.1	60	60.1
0003123	2	1.0E-04	4.4E-05	5.6	0.1	60	60.1
0003160	2	9.7E-05	4.3E-05	8.6	0.1	60	60.1
1004030	2	9.6E-05	4.3E-05	5.5	0.1	60	60.1
9003033	2	8.8E-05	4.1E-05	4.1	0.1	60	60.1
0003110	2	8.6E-05	3.8E-05	5.8	0.1	60	60.1
2001031	2	8.2E-05	3.7E-05	4.7	0.1	60	60.1
2001027	2	6.7E-05	3.0E-05	4.3	0.1	60	60.1
9004023	2	6.6E-05	3.1E-05	3.3	0.1	60	60.1
0003127	2	6.5E-05	2.9E-05	5.5	0.1	60	60.1

Attachment E-6. Estimated Media Pb Concentrations in Alternative NAAQS (0.05 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0003001	2	5.1E-05	2.3E-05	2.8	0.04	60	60.0
1004094	2	5.0E-05	2.3E-05	3.4	0.04	60	60.0
1004018	2	5.0E-05	2.3E-05	2.5	0.04	60	60.0
2001002	2	5.0E-05	2.2E-05	2.5	0.04	60	60.0
1004010	2	5.0E-05	2.3E-05	2.0	0.04	60	60.0
2001038	2	5.0E-05	2.2E-05	1.7	0.04	60	60.0
1004000	2	5.0E-05	2.3E-05	1.5	0.04	60	60.0
1004003	2	5.0E-05	2.3E-05	1.4	0.04	60	60.0
2001036	2	5.0E-05	2.2E-05	1.4	0.04	60	60.0
2001042	2	5.0E-05	2.2E-05	1.1	0.04	60	60.0
2001047	2	5.0E-05	2.2E-05	0.9	0.04	60	60.0
2001053	2	5.0E-05	2.2E-05	0.8	0.04	60	60.0
2001059	2	5.0E-05	2.2E-05	0.5	0.04	60	60.0
0002042	1	7.1E-03	3.1E-03	315.3	6.0	60	66.0
0003046	1	3.0E-03	1.3E-03	141.9	2.5	60	62.5
0002041	1	1.8E-03	7.8E-04	141.8	1.5	60	61.5
0002029	1	1.0E-03	4.6E-04	66.9	0.9	60	60.9
0002037	1	9.3E-04	4.1E-04	57.0	0.8	60	60.8
1003014	1	8.8E-04	4.0E-04	49.5	0.7	60	60.7
0003137	1	8.4E-04	3.8E-04	99.0	0.7	60	60.7
1003011	1	8.2E-04	3.7E-04	64.2	0.7	60	60.7
1002007	1	7.4E-04	3.3E-04	45.2	0.6	60	60.6
1002013	1	6.5E-04	2.9E-04	39.4	0.5	60	60.5
1002017	1	6.4E-04	2.9E-04	36.0	0.5	60	60.5
1003010	1	6.4E-04	2.9E-04	49.7	0.5	60	60.5
0003090	1	5.4E-04	2.4E-04	42.0	0.5	60	60.5
0003091	1	5.3E-04	2.4E-04	36.9	0.5	60	60.5
1003022	1	5.2E-04	2.3E-04	51.0	0.4	60	60.4
0002015	1	5.1E-04	2.3E-04	45.4	0.4	60	60.4
0003094	1	4.6E-04	2.0E-04	33.4	0.4	60	60.4

Attachment E-6. Estimated Media Pb Concentrations in Alternative NAAQS (0.05 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
1001017	1	4.1E-04	1.8E-04	24.1	0.3	60	60.3
9002031	1	3.7E-04	1.7E-04	25.3	0.3	60	60.3
1003005	1	3.6E-04	1.6E-04	29.5	0.3	60	60.3
9002022	1	3.4E-04	1.6E-04	22.2	0.3	60	60.3
9002014	1	3.3E-04	1.5E-04	22.5	0.3	60	60.3
9002013	1	3.2E-04	1.5E-04	21.3	0.3	60	60.3
9002020	1	3.2E-04	1.5E-04	20.5	0.3	60	60.3
9002016	1	3.0E-04	1.4E-04	19.1	0.3	60	60.3
1003003	1	2.9E-04	1.3E-04	23.1	0.2	60	60.2
9001009	1	2.8E-04	1.3E-04	11.6	0.2	60	60.2
1001016	1	2.7E-04	1.2E-04	16.1	0.2	60	60.2
0003058	1	2.5E-04	1.1E-04	18.5	0.2	60	60.2
9002007	1	2.5E-04	1.2E-04	18.6	0.2	60	60.2
1004043	1	2.2E-04	1.0E-04	14.5	0.2	60	60.2
0001010	1	2.2E-04	9.9E-05	13.7	0.2	60	60.2
0003054	1	2.2E-04	9.8E-05	13.5	0.2	60	60.2
0003053	1	2.2E-04	9.7E-05	13.1	0.2	60	60.2
0003064	1	2.0E-04	8.9E-05	13.2	0.2	60	60.2
0001011	1	2.0E-04	8.8E-05	12.9	0.2	60	60.2
0001018	1	1.9E-04	8.5E-05	14.7	0.2	60	60.2
9001015	1	1.9E-04	8.8E-05	8.2	0.2	60	60.2
0001007	1	1.8E-04	8.2E-05	12.7	0.2	60	60.2
0003063	1	1.8E-04	8.1E-05	10.8	0.2	60	60.2
0003066	1	1.8E-04	7.9E-05	10.9	0.2	60	60.2
0001020	1	1.8E-04	7.9E-05	14.7	0.1	60	60.1
0003067	1	1.7E-04	7.6E-05	10.3	0.1	60	60.1
0003109	1	1.7E-04	7.5E-05	15.2	0.1	60	60.1

Attachment E-6. Estimated Media Pb Concentrations in Alternative NAAQS (0.05 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0003076	1	1.7E-04	7.4E-05	12.5	0.1	60	60.1
0001019	1	1.5E-04	6.5E-05	12.9	0.1	60	60.1
1004039	1	1.4E-04	6.2E-05	8.8	0.1	60	60.1
0003072	1	1.3E-04	5.9E-05	10.6	0.1	60	60.1
0001005	1	1.2E-04	5.3E-05	8.2	0.1	60	60.1
0003152	1	9.6E-05	4.3E-05	8.0	0.1	60	60.1
0003159	1	9.5E-05	4.2E-05	6.5	0.1	60	60.1
9004021	1	8.8E-05	4.1E-05	5.1	0.1	60	60.1
2001029	1	7.2E-05	3.2E-05	4.6	0.1	60	60.1
0003015	1	7.1E-05	3.2E-05	3.9	0.1	60	60.1
0003112	1	7.0E-05	3.1E-05	4.8	0.1	60	60.1
9003020	1	7.0E-05	3.3E-05	2.8	0.1	60	60.1
9003016	1	6.7E-05	3.1E-05	2.7	0.1	60	60.1
0003002	1	6.0E-05	2.7E-05	4.4	0.1	60	60.1
9003021	1	6.0E-05	2.8E-05	2.6	0.1	60	60.1
0003003	1	6.0E-05	2.7E-05	4.3	0.1	60	60.1
9003010	1	5.7E-05	2.6E-05	3.0	0.05	60	60.0
2001000	1	5.3E-05	2.4E-05	3.6	0.04	60	60.0
1004081	1	5.1E-05	2.3E-05	4.1	0.04	60	60.0
1004024	1	5.1E-05	2.3E-05	3.1	0.04	60	60.0
1004091	1	5.0E-05	2.3E-05	3.7	0.04	60	60.0
1004093	1	5.0E-05	2.3E-05	3.4	0.04	60	60.0
1004015	1	5.0E-05	2.3E-05	2.7	0.04	60	60.0
1004017	1	5.0E-05	2.3E-05	2.4	0.04	60	60.0
0003129	1	5.0E-05	2.2E-05	2.3	0.04	60	60.0
1004005	1	5.0E-05	2.3E-05	1.7	0.04	60	60.0
1004006	1	5.0E-05	2.3E-05	1.4	0.04	60	60.0
2001070	1	5.0E-05	2.2E-05	1.3	0.04	60	60.0

Attachment E-6. Estimated Media Pb Concentrations in Alternative NAAQS (0.05 µg/m^3 Max-Monthly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
2001052	1	5.0E-05	2.2E-05	0.7	0.04	60	60.0
2001062	1	5.0E-05	2.2E-05	0.6	0.04	60	60.0
2001058	1	5.0E-05	2.2E-05	0.4	0.04	60	60.0

[a] Recent air refers to contributions associated with recent outdoor ambient air.

[b] Other refers to contributions from indoor paint, outdoor soil/dust and additional sources (including historical air).

Attachment E-7. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m³ Max-Quarterly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
9003026	71	5.8E-04	2.7E-04	7.1	0.5	60	60.5
9001004	63	1.2E-03	5.8E-04	14.9	1.0	60	61.0
0003048	53	1.1E-03	5.0E-04	17.8	1.0	60	61.0
2001012	42	1.6E-04	7.0E-05	1.3	0.1	60	60.1
1004004	38	1.8E-04	8.2E-05	2.7	0.2	60	60.2
1002001	35	2.1E-03	9.6E-04	28.2	1.8	60	61.8
9001007	35	1.1E-03	5.0E-04	14.4	0.9	60	60.9
0003040	31	1.8E-03	8.1E-04	29.7	1.5	60	61.5
2001009	31	1.3E-04	5.9E-05	1.4	0.1	60	60.1
0001002	30	8.0E-04	3.6E-04	11.4	0.7	60	60.7
0002023	29	4.1E-03	1.8E-03	79.6	3.5	60	63.5
9003043	26	8.0E-04	3.7E-04	11.1	0.7	60	60.7
9004000	24	2.4E-04	1.1E-04	1.4	0.2	60	60.2
2001037	22	1.4E-04	6.3E-05	1.4	0.1	60	60.1
9003012	21	3.7E-04	1.7E-04	5.1	0.3	60	60.3
1004092	21	2.2E-04	9.8E-05	3.7	0.2	60	60.2
1004014	21	1.9E-04	8.8E-05	3.0	0.2	60	60.2
0003121	19	3.9E-04	1.7E-04	6.0	0.3	60	60.3
2001005	19	2.0E-04	9.1E-05	2.2	0.2	60	60.2
9001011	18	1.2E-03	5.5E-04	16.2	1.0	60	61.0
0003061	18	8.8E-04	3.9E-04	14.8	0.7	60	60.7
2001004	17	2.0E-04	8.8E-05	2.0	0.2	60	60.2
0001023	16	1.5E-03	6.5E-04	25.4	1.2	60	61.2
1004031	16	8.4E-04	3.8E-04	10.7	0.7	60	60.7
0003080	16	8.1E-04	3.6E-04	14.1	0.7	60	60.7
9003051	16	7.8E-04	3.6E-04	11.5	0.7	60	60.7
2001039	16	1.2E-04	5.2E-05	1.0	0.1	60	60.1
2001001	15	2.6E-04	1.2E-04	2.8	0.2	60	60.2
9002026	14	2.2E-03	1.0E-03	25.2	1.8	60	61.8

Attachment E-7. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m^3 Max-Quarterly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0001000	14	8.1E-04	3.6E-04	10.5	0.7	60	60.7
0002024	12	3.6E-03	1.6E-03	66.2	3.0	60	63.0
0001015	12	1.4E-03	6.1E-04	22.2	1.2	60	61.2
2001068	12	2.4E-04	1.1E-04	2.6	0.2	60	60.2
1004068	11	1.2E-03	5.6E-04	25.8	1.1	60	61.1
0002027	10	3.6E-03	1.6E-03	58.0	3.0	60	63.0
1002015	10	2.4E-03	1.1E-03	28.1	2.1	60	62.1
0001029	10	1.4E-03	6.2E-04	19.9	1.2	60	61.2
1004041	10	9.5E-04	4.3E-04	12.9	0.8	60	60.8
2001026	10	1.6E-04	7.1E-05	1.8	0.1	60	60.1
1002014	9	2.8E-03	1.3E-03	34.1	2.4	60	62.4
1003025	9	2.2E-03	9.9E-04	40.5	1.9	60	61.9
0003051	9	7.6E-04	3.4E-04	9.7	0.6	60	60.6
9003023	9	5.5E-04	2.6E-04	5.3	0.5	60	60.5
2001010	9	1.7E-04	7.7E-05	1.7	0.1	60	60.1
0002038	8	5.2E-03	2.3E-03	65.5	4.4	60	64.4
0001026	8	1.9E-03	8.3E-04	26.4	1.6	60	61.6
1003000	8	1.9E-03	8.4E-04	23.7	1.6	60	61.6
1003006	8	1.6E-03	7.4E-04	27.0	1.4	60	61.4
0001009	8	1.1E-03	5.0E-04	14.7	1.0	60	61.0
9003041	8	1.0E-03	4.9E-04	13.4	0.9	60	60.9
1004050	8	9.7E-04	4.4E-04	15.4	0.8	60	60.8
1004036	8	8.5E-04	3.8E-04	10.8	0.7	60	60.7
0003068	8	7.4E-04	3.3E-04	12.8	0.6	60	60.6
0003007	8	3.4E-04	1.5E-04	4.8	0.3	60	60.3
1004025	8	2.8E-04	1.3E-04	4.3	0.2	60	60.2
9003003	8	2.2E-04	1.0E-04	2.0	0.2	60	60.2
1004098	8	1.9E-04	8.4E-05	2.3	0.2	60	60.2
0003089	7	2.6E-03	1.1E-03	41.7	2.2	60	62.2

Attachment E-7. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m^3 Max-Quarterly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
1003008	7	2.2E-03	9.8E-04	36.1	1.8	60	61.8
9002023	7	1.6E-03	7.4E-04	19.1	1.3	60	61.3
9002015	7	1.5E-03	7.0E-04	21.7	1.3	60	61.3
9001010	7	1.5E-03	6.9E-04	15.5	1.3	60	61.3
9001005	7	1.3E-03	5.9E-04	17.5	1.1	60	61.1
1004059	7	9.0E-04	4.1E-04	16.0	0.8	60	60.8
0003114	7	7.8E-04	3.5E-04	10.1	0.7	60	60.7
0003037	7	6.8E-04	3.0E-04	10.1	0.6	60	60.6
0003042	6	0.01	6.2E-03	256.0	11.9	60	71.9
9003027	6	7.9E-04	3.7E-04	9.7	0.7	60	60.7
0003155	6	7.4E-04	3.3E-04	11.5	0.6	60	60.6
1004058	6	6.6E-04	3.0E-04	11.2	0.6	60	60.6
1004096	6	1.6E-04	7.2E-05	2.4	0.1	60	60.1
1004007	6	1.5E-04	6.8E-05	2.0	0.1	60	60.1
2001051	6	8.4E-05	3.7E-05	0.6	0.1	60	60.1
0002050	5	6.0E-03	2.7E-03	101.5	5.1	60	65.1
0002036	5	4.9E-03	2.2E-03	65.1	4.1	60	64.1
1003013	5	4.7E-03	2.1E-03	57.6	4.0	60	64.0
0002026	5	4.7E-03	2.1E-03	91.1	3.9	60	63.9
1003016	5	3.7E-03	1.7E-03	45.1	3.1	60	63.1
0003138	5	3.0E-03	1.4E-03	69.5	2.6	60	62.6
1002003	5	2.9E-03	1.3E-03	35.3	2.5	60	62.5
0003140	5	2.3E-03	1.0E-03	53.5	1.9	60	61.9
0003083	5	2.3E-03	1.0E-03	49.0	1.9	60	61.9
1003007	5	1.4E-03	6.5E-04	23.8	1.2	60	61.2
1004047	5	1.1E-03	5.0E-04	15.6	0.9	60	60.9
0001006	5	8.9E-04	4.0E-04	11.9	0.8	60	60.8
1004037	5	7.0E-04	3.2E-04	9.0	0.6	60	60.6
0003071	5	6.6E-04	2.9E-04	11.3	0.6	60	60.6

Attachment E-7. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m^3 Max-Quarterly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
9004022	5	3.8E-04	1.8E-04	3.8	0.3	60	60.3
0003004	5	3.2E-04	1.4E-04	4.5	0.3	60	60.3
1004028	5	2.9E-04	1.3E-04	3.7	0.2	60	60.2
1004019	5	2.5E-04	1.1E-04	3.3	0.2	60	60.2
1004013	5	2.3E-04	1.0E-04	3.5	0.2	60	60.2
9003002	5	2.2E-04	1.0E-04	1.9	0.2	60	60.2
2001006	5	1.7E-04	7.5E-05	1.6	0.1	60	60.1
2001007	5	1.6E-04	7.1E-05	1.4	0.1	60	60.1
1002018	4	4.1E-03	1.8E-03	51.9	3.4	60	63.4
0002018	4	3.0E-03	1.3E-03	47.6	2.5	60	62.5
1002012	4	2.7E-03	1.2E-03	34.9	2.3	60	62.3
0002022	4	2.5E-03	1.1E-03	36.4	2.1	60	62.1
1003023	4	2.3E-03	1.1E-03	49.5	2.0	60	62.0
1002016	4	2.3E-03	1.0E-03	26.7	1.9	60	61.9
9002021	4	1.9E-03	9.0E-04	25.6	1.6	60	61.6
9002030	4	1.9E-03	8.7E-04	27.8	1.6	60	61.6
1003028	4	1.5E-03	6.7E-04	28.8	1.3	60	61.3
0003144	4	1.4E-03	6.2E-04	27.7	1.2	60	61.2
9002000	4	1.2E-03	5.7E-04	14.5	1.0	60	61.0
0001012	4	1.2E-03	5.2E-04	15.6	1.0	60	61.0
9002006	4	1.2E-03	5.4E-04	15.0	1.0	60	61.0
0003060	4	1.1E-03	4.8E-04	16.3	0.9	60	60.9
0003079	4	1.1E-03	4.7E-04	17.7	0.9	60	60.9
1004051	4	9.6E-04	4.3E-04	13.4	0.8	60	60.8
1004048	4	9.1E-04	4.1E-04	12.9	0.8	60	60.8
9001013	4	9.1E-04	4.2E-04	8.3	0.8	60	60.8
9001002	4	8.9E-04	4.1E-04	9.8	0.8	60	60.8
0003107	4	8.9E-04	3.9E-04	10.6	0.8	60	60.8
1004049	4	8.3E-04	3.8E-04	12.8	0.7	60	60.7

Attachment E-7. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m^3 Max-Quarterly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
1004054	4	6.2E-04	2.8E-04	8.0	0.5	60	60.5
1004057	4	6.1E-04	2.8E-04	9.1	0.5	60	60.5
9003044	4	5.7E-04	2.6E-04	7.6	0.5	60	60.5
1004055	4	5.6E-04	2.5E-04	7.6	0.5	60	60.5
0003128	4	5.3E-04	2.3E-04	7.5	0.4	60	60.4
2001028	4	3.5E-04	1.6E-04	4.3	0.3	60	60.3
1004011	4	1.9E-04	8.5E-05	2.5	0.2	60	60.2
0002047	3	6.1E-03	2.7E-03	76.6	5.2	60	65.2
0002039	3	5.5E-03	2.5E-03	73.6	4.7	60	64.7
0002028	3	4.4E-03	2.0E-03	77.2	3.8	60	63.8
1002020	3	3.9E-03	1.8E-03	50.6	3.3	60	63.3
1002002	3	2.4E-03	1.1E-03	35.2	2.0	60	62.0
0003093	3	2.2E-03	9.9E-04	34.2	1.9	60	61.9
0003082	3	2.1E-03	9.2E-04	42.4	1.8	60	61.8
0002017	3	1.9E-03	8.3E-04	29.4	1.6	60	61.6
9002011	3	1.8E-03	8.4E-04	27.1	1.5	60	61.5
1003004	3	1.8E-03	8.0E-04	27.1	1.5	60	61.5
0001032	3	1.8E-03	7.8E-04	24.9	1.5	60	61.5
0001027	3	1.7E-03	7.4E-04	25.2	1.4	60	61.4
9002001	3	1.3E-03	6.2E-04	18.2	1.1	60	61.1
0003078	3	1.3E-03	5.9E-04	21.0	1.1	60	61.1
1003001	3	1.2E-03	5.5E-04	15.9	1.0	60	61.0
1004060	3	1.2E-03	5.4E-04	20.1	1.0	60	61.0
1004046	3	1.1E-03	5.0E-04	15.0	0.9	60	60.9
0001013	3	1.1E-03	4.7E-04	14.5	0.9	60	60.9
9001012	3	9.5E-04	4.4E-04	8.8	0.8	60	60.8
1004052	3	8.9E-04	4.0E-04	14.8	0.8	60	60.8
9001014	3	8.5E-04	3.9E-04	8.9	0.7	60	60.7
0003070	3	7.9E-04	3.5E-04	9.9	0.7	60	60.7

Attachment E-7. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m^3 Max-Quarterly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0003036	3	7.7E-04	3.4E-04	12.1	0.7	60	60.7
9004015	3	7.0E-04	3.2E-04	6.5	0.6	60	60.6
9004014	3	6.8E-04	3.1E-04	7.1	0.6	60	60.6
0003073	3	6.6E-04	2.9E-04	11.3	0.6	60	60.6
0001003	3	6.6E-04	2.9E-04	8.0	0.6	60	60.6
0003115	3	5.9E-04	2.6E-04	7.5	0.5	60	60.5
9004016	3	5.3E-04	2.5E-04	5.4	0.4	60	60.4
1004072	3	5.3E-04	2.4E-04	5.1	0.4	60	60.4
1004056	3	4.9E-04	2.2E-04	7.1	0.4	60	60.4
9003017	3	3.9E-04	1.8E-04	4.5	0.3	60	60.3
9004017	3	3.7E-04	1.7E-04	3.7	0.3	60	60.3
9004006	3	3.4E-04	1.6E-04	3.2	0.3	60	60.3
0003020	3	3.4E-04	1.5E-04	5.1	0.3	60	60.3
9003013	3	3.3E-04	1.5E-04	4.2	0.3	60	60.3
0003006	3	3.2E-04	1.4E-04	4.8	0.3	60	60.3
9004008	3	3.2E-04	1.5E-04	3.0	0.3	60	60.3
1004089	3	2.9E-04	1.3E-04	4.8	0.2	60	60.2
2001011	3	1.8E-04	7.9E-05	1.9	0.1	60	60.1
1004100	3	1.5E-04	7.0E-05	1.5	0.1	60	60.1
2001008	3	1.5E-04	6.7E-05	1.8	0.1	60	60.1
2001013	3	1.3E-04	5.7E-05	1.0	0.1	60	60.1
1003012	2	4.0E-03	1.8E-03	59.6	3.4	60	63.4
1002019	2	3.7E-03	1.7E-03	50.2	3.1	60	63.1
0002025	2	3.6E-03	1.6E-03	71.9	3.1	60	63.1
0003087	2	3.1E-03	1.4E-03	56.2	2.6	60	62.6
1003009	2	2.9E-03	1.3E-03	50.4	2.4	60	62.4
0003088	2	2.6E-03	1.2E-03	43.5	2.2	60	62.2
0002019	2	2.5E-03	1.1E-03	39.7	2.1	60	62.1
9002029	2	2.2E-03	1.0E-03	28.4	1.9	60	61.9

Attachment E-7. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m^3 Max-Quarterly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0001035	2	2.1E-03	9.3E-04	30.3	1.8	60	61.8
0003085	2	1.9E-03	8.6E-04	47.3	1.6	60	61.6
0001025	2	1.8E-03	8.1E-04	27.5	1.5	60	61.5
9002012	2	1.6E-03	7.6E-04	23.2	1.4	60	61.4
0001031	2	1.6E-03	7.1E-04	23.0	1.4	60	61.4
9002017	2	1.6E-03	7.3E-04	19.7	1.3	60	61.3
0003142	2	1.4E-03	6.2E-04	29.5	1.2	60	61.2
0003077	2	1.3E-03	5.7E-04	19.8	1.1	60	61.1
0001024	2	1.3E-03	5.6E-04	19.4	1.1	60	61.1
0003055	2	1.1E-03	4.9E-04	14.3	0.9	60	60.9
0003056	2	1.1E-03	4.8E-04	16.0	0.9	60	60.9
9003042	2	1.0E-03	4.8E-04	14.2	0.9	60	60.9
9003050	2	1.0E-03	4.7E-04	14.0	0.9	60	60.9
0001008	2	1.0E-03	4.4E-04	13.9	0.8	60	60.8
1004045	2	9.6E-04	4.4E-04	12.8	0.8	60	60.8
0003065	2	9.5E-04	4.2E-04	11.9	0.8	60	60.8
0003052	2	9.0E-04	4.0E-04	11.3	0.8	60	60.8
1004033	2	8.3E-04	3.7E-04	10.3	0.7	60	60.7
1004040	2	7.8E-04	3.5E-04	10.2	0.7	60	60.7
0003050	2	7.3E-04	3.3E-04	9.4	0.6	60	60.6
1004038	2	7.1E-04	3.2E-04	9.1	0.6	60	60.6
0003069	2	7.0E-04	3.1E-04	11.9	0.6	60	60.6
0003049	2	6.9E-04	3.1E-04	10.9	0.6	60	60.6
0003031	2	6.8E-04	3.0E-04	10.5	0.6	60	60.6
9001001	2	5.7E-04	2.7E-04	5.5	0.5	60	60.5
9004018	2	5.1E-04	2.4E-04	4.9	0.4	60	60.4
0003122	2	5.0E-04	2.2E-04	5.9	0.4	60	60.4
0003123	2	4.8E-04	2.1E-04	5.6	0.4	60	60.4
0003160	2	4.6E-04	2.1E-04	8.6	0.4	60	60.4

Attachment E-7. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m^3 Max-Quarterly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
1004030	2	4.6E-04	2.1E-04	5.5	0.4	60	60.4
9003033	2	4.2E-04	2.0E-04	4.1	0.4	60	60.4
0003110	2	4.1E-04	1.8E-04	5.8	0.3	60	60.3
2001031	2	3.9E-04	1.8E-04	4.7	0.3	60	60.3
2001027	2	3.2E-04	1.4E-04	4.3	0.3	60	60.3
9004023	2	3.2E-04	1.5E-04	3.3	0.3	60	60.3
0003127	2	3.1E-04	1.4E-04	5.5	0.3	60	60.3
0003001	2	2.5E-04	1.1E-04	2.8	0.2	60	60.2
2001002	2	2.4E-04	1.1E-04	2.5	0.2	60	60.2
1004094	2	2.2E-04	9.8E-05	3.4	0.2	60	60.2
1004018	2	2.1E-04	9.7E-05	2.5	0.2	60	60.2
1004010	2	1.6E-04	7.3E-05	2.0	0.1	60	60.1
2001038	2	1.6E-04	6.9E-05	1.7	0.1	60	60.1
2001036	2	1.5E-04	6.8E-05	1.4	0.1	60	60.1
1004000	2	1.3E-04	6.0E-05	1.5	0.1	60	60.1
1004003	2	1.3E-04	5.9E-05	1.4	0.1	60	60.1
2001042	2	1.0E-04	4.5E-05	1.1	0.1	60	60.1
2001053	2	9.5E-05	4.2E-05	0.8	0.1	60	60.1
2001047	2	9.4E-05	4.2E-05	0.9	0.1	60	60.1
2001059	2	8.1E-05	3.6E-05	0.5	0.1	60	60.1
0002042	1	0.03	1.5E-02	315.3	28.6	60	88.6
0003046	1	0.01	6.3E-03	141.9	11.9	60	71.9
0002041	1	8.4E-03	3.7E-03	141.8	7.1	60	67.1
0002029	1	5.0E-03	2.2E-03	66.9	4.2	60	64.2
0002037	1	4.4E-03	2.0E-03	57.0	3.8	60	63.8
1003014	1	4.2E-03	1.9E-03	49.5	3.5	60	63.5
0003137	1	4.0E-03	1.8E-03	99.0	3.4	60	63.4
1003011	1	3.9E-03	1.8E-03	64.2	3.3	60	63.3
1002007	1	3.5E-03	1.6E-03	45.2	3.0	60	63.0

Attachment E-7. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m^3 Max-Quarterly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
1002013	1	3.1E-03	1.4E-03	39.4	2.6	60	62.6
1002017	1	3.1E-03	1.4E-03	36.0	2.6	60	62.6
1003010	1	3.1E-03	1.4E-03	49.7	2.6	60	62.6
0003090	1	2.6E-03	1.2E-03	42.0	2.2	60	62.2
0003091	1	2.5E-03	1.1E-03	36.9	2.2	60	62.2
1003022	1	2.5E-03	1.1E-03	51.0	2.1	60	62.1
0002015	1	2.4E-03	1.1E-03	45.4	2.0	60	62.0
0003094	1	2.2E-03	9.7E-04	33.4	1.8	60	61.8
1001017	1	1.9E-03	8.8E-04	24.1	1.6	60	61.6
9002031	1	1.8E-03	8.2E-04	25.3	1.5	60	61.5
1003005	1	1.7E-03	7.8E-04	29.5	1.5	60	61.5
9002022	1	1.6E-03	7.4E-04	22.2	1.4	60	61.4
9002014	1	1.6E-03	7.3E-04	22.5	1.3	60	61.3
9002013	1	1.5E-03	7.1E-04	21.3	1.3	60	61.3
9002020	1	1.5E-03	7.0E-04	20.5	1.3	60	61.3
9002016	1	1.4E-03	6.6E-04	19.1	1.2	60	61.2
1003003	1	1.4E-03	6.4E-04	23.1	1.2	60	61.2
9001009	1	1.4E-03	6.3E-04	11.6	1.1	60	61.1
1001016	1	1.3E-03	5.9E-04	16.1	1.1	60	61.1
0003058	1	1.2E-03	5.4E-04	18.5	1.0	60	61.0
9002007	1	1.2E-03	5.6E-04	18.6	1.0	60	61.0
1004043	1	1.1E-03	4.8E-04	14.5	0.9	60	60.9
0001010	1	1.1E-03	4.7E-04	13.7	0.9	60	60.9
0003054	1	1.1E-03	4.7E-04	13.5	0.9	60	60.9
0003053	1	1.0E-03	4.6E-04	13.1	0.9	60	60.9
0003064	1	9.5E-04	4.2E-04	13.2	0.8	60	60.8
0001011	1	9.5E-04	4.2E-04	12.9	0.8	60	60.8
0001018	1	9.1E-04	4.0E-04	14.7	0.8	60	60.8
9001015	1	9.1E-04	4.2E-04	8.2	0.8	60	60.8

Attachment E-7. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m³ Max-Quarterly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m³)	Annual Average Inhalation Exposure Concentration (µg/m³)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
0001007	1	8.8E-04	3.9E-04	12.7	0.7	60	60.7
0003063	1	8.7E-04	3.9E-04	10.8	0.7	60	60.7
0003066	1	8.5E-04	3.8E-04	10.9	0.7	60	60.7
0001020	1	8.5E-04	3.8E-04	14.7	0.7	60	60.7
0003067	1	8.2E-04	3.6E-04	10.3	0.7	60	60.7
0003109	1	8.1E-04	3.6E-04	15.2	0.7	60	60.7
0003076	1	8.0E-04	3.5E-04	12.5	0.7	60	60.7
0001019	1	7.0E-04	3.1E-04	12.9	0.6	60	60.6
1004039	1	6.6E-04	3.0E-04	8.8	0.6	60	60.6
0003072	1	6.3E-04	2.8E-04	10.6	0.5	60	60.5
0001005	1	5.7E-04	2.5E-04	8.2	0.5	60	60.5
0003152	1	4.6E-04	2.0E-04	8.0	0.4	60	60.4
0003159	1	4.6E-04	2.0E-04	6.5	0.4	60	60.4
9004021	1	4.2E-04	1.9E-04	5.1	0.4	60	60.4
2001029	1	3.5E-04	1.5E-04	4.6	0.3	60	60.3
0003015	1	3.4E-04	1.5E-04	3.9	0.3	60	60.3
0003112	1	3.4E-04	1.5E-04	4.8	0.3	60	60.3
9003020	1	3.4E-04	1.6E-04	2.8	0.3	60	60.3
9003016	1	3.2E-04	1.5E-04	2.7	0.3	60	60.3
0003002	1	2.9E-04	1.3E-04	4.4	0.2	60	60.2
9003021	1	2.9E-04	1.3E-04	2.6	0.2	60	60.2
0003003	1	2.9E-04	1.3E-04	4.3	0.2	60	60.2
9003010	1	2.7E-04	1.3E-04	3.0	0.2	60	60.2
2001000	1	2.5E-04	1.1E-04	3.6	0.2	60	60.2
1004081	1	2.5E-04	1.1E-04	4.1	0.2	60	60.2
1004024	1	2.5E-04	1.1E-04	3.1	0.2	60	60.2
1004091	1	2.3E-04	1.0E-04	3.7	0.2	60	60.2
0003129	1	2.2E-04	9.8E-05	2.3	0.2	60	60.2
1004093	1	2.2E-04	9.9E-05	3.4	0.2	60	60.2

Attachment E-7. Estimated Media Pb Concentrations in Alternative NAAQS (0.2 µg/m^3 Max-Quarterly) Scenario for the Secondary Pb Smelter Case Study

Block ID	Children Ages 0 to 7	Annual Average Air Concentration (µg/m^3)	Annual Average Inhalation Exposure Concentration (µg/m^3)	Scaled Soil Concentration (µg/g)	Predicted Indoor Dust Pb Concentrations (µg/g)		
					From Recent Air [a]	From Other [b]	Total
1004017	1	1.9E-04	8.6E-05	2.4	0.2	60	60.2
1004015	1	1.8E-04	8.4E-05	2.7	0.2	60	60.2
1004005	1	1.4E-04	6.3E-05	1.7	0.1	60	60.1
1004006	1	1.3E-04	6.0E-05	1.4	0.1	60	60.1
2001070	1	1.2E-04	5.2E-05	1.3	0.1	60	60.1
2001052	1	9.1E-05	4.1E-05	0.7	0.1	60	60.1
2001062	1	8.8E-05	3.9E-05	0.6	0.1	60	60.1
2001058	1	7.2E-05	3.2E-05	0.4	0.1	60	60.1

[a] Recent air refers to contributions associated with recent outdoor ambient air.

[b] Other refers to contributions from indoor paint, outdoor soil/dust and additional sources (including historical air).

Attachment E-8. Comparison of Monitored to Modeled Air Pb Concentrations for the Secondary Pb Smelter Case Study

Monitor ID	Distance from Main Stack (km)	Five Year Average Modeled Air Pb Conc (µg/m³)	Average Monitored Pb Concentrations [a]											
			1997		1998		1999		2000		2001		2002	
			Mean Conc (µg/m³)	Ratio Monitor to Model	Mean Conc (µg/m³)	Ratio Monitor to Model	Mean Conc (µg/m³)	Ratio Monitor to Model	Mean Conc (µg/m³)	Ratio Monitor to Model	Mean Conc (µg/m³)	Ratio Monitor to Model	Mean Conc (µg/m³)	Ratio Monitor to Model
Sanders Pb Data														
11090003	400	0.26	0.40	1.5	0.47	1.8	0.47	1.8	0.38	1.5	0.44	1.7	0.28	1.1
11090006	680	0.06	0.13	2.2	0.16	2.7	0.18	3.0	0.19	3.3	0.20	3.5	0.14	2.4

[a] Annual averages were calculated from monthly composite U.S. AQS data and weighted by the number of days in a month.

Attachment E-9. Input Parameters for Secondary Pb Smelter Case Study Soil Model Calculations

Use in Model	Parameter	Description	Value Used	Source and Reason [a]
Mixing equation parameters	Tyd [b]	Yearly total deposition rate of contaminant	Varies by block (g/m^2-yr) See Attachment E-3 to E-7	AERMOD results – deposition at each block was assumed constant for modeling period.
	tD	Total time period over which deposition occurs	37 years	Lifetime of the facility (1969 to present, according to Alabama Department of Environmental Management (ADEM) (2006).
	Zs	Soil mixing depth	1 cm	Human Health Risk Assessment Protocol (HHRAP)(USEPA, 2005); California Office of Environmental Health Hazard Assessment (2000); and for consistency with primary Pb smelter soil samples.
	BD	Bulk density of soil	Varies (g/cm^3) (Average 1.47)	From soil survey for Pike county (Alabama National Resources Conservation Service (NRCS), 2006) Soil type at each block centroid was identified.
Loss equation meteorological parameters	My	Rainfall	136.7 cm/year	Annual normal precipitation from 1971 to 2000 for Troy, AL (National Climatic Data Center (NCDC), 2002).
	I	Irrigation	0	Assumption.
	Ev	Evapotranspiration	82.5 cm/yr	Midpoint of estimated evapotranspiration for Alabama based on hydrologic budget of the state (Hanson, 1991).
Loss equation soil and contaminant properties	RO	Average annual surface runoff	51.1 cm/yr	Value for the south east central United States (McKone and Bodnar, 2001).
	esw	Volumetric soil water content	0.2 milliliter (mL/)cm^3	HHRAP default midpoint value.
	Kds	Soil-water partitioning coefficient	900 mL/g	HHRAP default for Pb.
	SD	Sediment delivery ratio	0.18	MPE default.
	ER	Contaminant enrichment ratio	1	HHRAP default.

Attachment E-9. Input Parameters for Secondary Pb Smelter Case Study Soil Model Calculations

Use in Model	Parameter	Description	Value Used	Source and Reason [a]
Loss equation Universal Soil Loss Equation (USLE) additional parameters	R	Erosivity factor	350 yr^{-1}	Estimated from U.S. Soil Conservation Service Map in Schwab et al. (1993).
	K	Erodibility factor	Varies (ton/acre) (Average 0.18)	From soil survey for Pike county (NRCS, 2006). Soil type at each block centroid was identified.
	LS	Topographical or slope-length factor	1.5	HHRAP default that represents a variety of distance and slope conditions. Default was selected because of the large area used relative to the intended design of USLE.
	C	Cover management factor	0.1	HHRAP value for grass and agricultural crops.
	P	Supporting practice factor	0	HHRAP conservative assumption that no erosion prevention methods are in place.

[a] HHRAP refers to the U.S. EPA (2005) and MPE refers to the U.S. EPA (1998).
[b] Dyd (annual dry deposition) and Dyw (annual wet deposition) were pooled to create Tyd (annual total deposition).

July 25, 2007

Appendix F: Pb in Outdoor Soil and Dust near Roadways

Prepared by:

ICF International
Research Triangle Park, NC

Prepared for:

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina

Contract No. EP-D-06-115
Work Assignment No. 0-4

Table of Contents

List of Exhibits

F. PB IN OUTDOOR SOIL AND DUST NEAR ROADWAYS

This appendix describes data on concentrations of lead (Pb) in outdoor soil and dust near roadways. Section F.1 briefly introduces this topic. Section F.2 summarizes measured Pb concentrations in outdoor soil and dust near roadways, as reported in recent literature. Section F.3 provides a summary of trends in Pb concentrations in outdoor soil and dust near roadways based on this literature review.

Although dust was not an explicit search term in identifying publications for discussion in this appendix, generally speaking, the surface layer of outdoor soil is sometimes referred to as outdoor dust. Specifically, the phrase "outdoor dust" refers to particles deposited on any outdoor surface, including, for example, roadways (as well as soil). That said, in summarizing literature findings in Section F.2, the terms used are consistent with those used in the corresponding publication.

F.1. INTRODUCTION

Elevated levels of Pb have been observed in roadside soils throughout the United States. Although Pb concentrations in air decreased dramatically with the phase-out of Pb in gasoline, the persistence and relative immobility of Pb in soils has resulted in elevated concentrations of Pb in soils adjacent to roadways. Because the Pb in near-roadway soils is not easily transported by erosion, runoff, or other advective processes, it can remain there for relatively long time periods (USEPA, 2006). Correlations between current soil concentrations of Pb and air concentrations of Pb from periods when leaded gasoline was in use have been observed (Sheets et al., 2001). Studies in several cities in the late 1980s and 1990s found high concentrations in central sections of each city where traffic and population density are greatest (USEPA, 2006).

The resuspension of Pb in near-roadway soil and dust is a potential source of airborne Pb in some locations (USEPA, 2006). Young et al. (2001; 2002), for example, evaluated Pb levels in roadside soils and surface soil samples near facilities to estimate the "potential suspension yield" (i.e., the amount of Pb sorbed to particulate matter (PM) less than 10 micrometers (µm) that is likely to be subject to resuspension due to wind erosion) and the enrichment ratio of suspended Pb (i.e., concentration of Pb in suspended PM versus the measured Pb concentration in surface soil). Based on their results, Pb-contaminated soils were found to be a potential source of airborne Pb.

Mass-balance studies performed on urban and metropolitan scales support the hypothesis that resuspension of Pb in soil is a source of current levels of airborne Pb. For example, in two studies described in the Criteria Document (USEPA, 2006), mass-balance calculations were conducted for the air emissions of Pb in the California South Coast Air Basin near Los Angeles. Lankey et al. (1998) estimated that 40 percent of Pb emitted to air was generated by the resuspension of Pb previously deposited on roadways. This mass balance was calculated for 1989, when some leaded gas was still in use (the authors estimated that direct Pb emitted in car exhaust also accounted for 40 percent of the total airborne Pb). Using data collected in 2001, Harris and Davidson (2005) estimated that soil contamination subject to resuspension is the source of 90 percent of the Pb emitted to air in southern California near Los Angeles. Although these studies are based on generalized, mass-balance assumptions and the contribution of near-roadway soils is uncertain, resuspension of soil-bound Pb particles and contaminated road dust is considered to be a significant source of airborne Pb (USEPA, 2006).

F.2. PB CONCENTRATIONS IN SOIL AND DUST NEAR ROADWAYS

Exhibit F-1 presents a summary of published accounts ordered alphabetically by primary author of measured Pb concentrations in outdoor soil and dust near roadways. This summary is based on a literature search intended to identify recent studies of Pb in surface soil and dust adjacent to roads. Only recent studies that conducted outdoor soil or dust measurements are included here, with a focus on those published within the past decade. In many instances, additional measurements were collected or investigators completed other analyses using the results; these details are not included in this summary.

This snapshot of the literature reveals that concentrations of Pb in soils or dust near roadways have been measured at a wide range of locations. For these studies, Pb levels range from typical urban background levels to hundreds or thousands of milligrams per kilogram (mg/kg) (Shinn et al., 2000; Sutherland et al., 2000; Turer and Maynard, 2003). Exhibit F-2 presents the general range of Pb concentrations reported in this subset of the literature for surface soil and dust samples taken near United States and Canadian roadways. Note that this chart is intended to convey only general information on the levels of total Pb reported in the literature in soil and dust near roadways; it should not be interpreted as a representative or comprehensive summary of surface soil data for the entire United States nor Canada.

Exhibit F-1. Selected Data – Pb in Surface Soil and Dust Near Roadways and Related Urban Measurements

Study Citation	Location and Sampling Scheme	Reported Pb Concentration(s) (total Pb unless otherwise specified)	Other Relevant Information
Chirenje et al., 2004	• Gainesville, Florida (relatively undeveloped, low population/traffic density) and Miami, Florida (developed, high population/traffic density) • Locations sampled according to land use characterization as residential, commercial, public parks, or public buildings • Sampling depths: 0 to 20 cm (centimeters) in Gainesville; 0 to 10 cm in Miami • In Miami, analyses showed concentrations from 0 to 10 cm were no different than concentrations from 10 to 20 cm	• Miami: median 98 parts per million (ppm); 55 percent of samples were 51 to 200 ppm • Gainesville: median 15 ppm; 87 percent of samples <50 ppm	• Concluded lower Pb in Gainesville was due to lower inputs (low industrial activity, less traffic) but also increased Pb mobility/low retention (lower pH, organic carbon content, and clay content versus Miami soils) • Pb patterns with land use slightly differed between Gainesville and Miami • Residential and commercial areas generally had higher levels of Pb
Fakayode and Olu-Owolabi, 2003	• Osogbo, Orun, Nigeria • Samples taken at depths of 0 to 5 cm at distances of 5, 15, 30, and 50 meters (m) from edge of roads • 39 sampling locations; divided into high, medium, and low density traffic regions	• For high traffic density roads: average 92±21 ppm at 5 m from road; reductions in Pb with distance: 37 percent at 10 m, 62 percent at 30 m, 81 percent at 50 m • For medium traffic density roads: 64, 42, 27, and 13 ppm, respectively, at distance of 5, 10, 30, and 50 m	• Authors concluded that vehicle Pb-based emissions and gasoline-related sources are major contributors to elevated levels of Pb relative to controls
Filippelli et al., 2005	• Indianapolis, Indiana • Sampled at several locations on transects along urban and suburban roadways; 10 to 40 m from road • Sampling depth: 0 to 5 cm	• Urban roadways: 400 to >900 ppm • Suburban roadways: 100 to <200 ppm	• Concentrations diminished with increasing distance from roadside • Also sampled at various urban locations to investigate Pb from diffuse (non-specific) sources • Conducted predictive blood-Pb (PbB) modeling using soil measurements

Exhibit F-1. Selected Data – Pb in Surface Soil and Dust Near Roadways and Related Urban Measurements

Study Citation	Location and Sampling Scheme	Reported Pb Concentration(s) (total Pb unless otherwise specified)	Other Relevant Information
Gillies et al., 1999	• Urban locations near Reno, Nevada, and surrounding non-urban areas • Sampled dust at surface of soil or paved road • Sampling locations included playas (dry lake bed/salt flat), paved roads, and construction sites • Sampling depth: ~ top 1 cm of soil	• Reported relative abundance of Pb in PM 2.5 by weight percent: playa and construction site 0.001 to 0.01 percent; paved road 0.01 to 0.1 percent • Approximate enrichment factors of Pb in PM2.5: playa ~1 to 10; paved road ~30; construction site ~5 to 10 • Pb enrichment factors slightly lower for particles in between PM10 and PM2.5 for playa and paved road; approximately same for construction site	• Results were used in source apportionment analysis for resuspended PM
Hafen and Brinkmann, 1996	• Tampa, Florida • Sampled 32 transects at roadways, 7 samples per transect; 3 cm to 220 cm from road; sampling depth: 0 to 3 cm • 224 samples total, 7 samples per transect	• Range: 40 to 3,360 ppm • Mean Pb concentrations by distance from road were relatively tightly clustered; means ranged from 200 ppm (>0.8 m) to 440 ppm (0.24 m)	• Looked for trends in concentration with distance and other factors on a near-term scale (within 2.2 m of road); weak negative correlation with distance from roadway observed
Lejano and Ericson, 2005	• Pacoima, California, (near Los Angeles) • 210 samples at transects along freeways spaced about 1 kilometer (km) apart; sampling depth: 0 to 2.54 cm; samples collected from within 150 m of the roadway	• Total range not presented; mean concentrations of five roadways range from 43 to 112 ppm (mean for one road up to 232 ppm if one outlier included)	• Mean concentrations for three “non-vehicular” sample sites: 52, 67, and 111 ppm • Concluded that historical vehicular emissions appear to be primary and most bioavailable source of Pb in soil
Li, 2006	• Burnaby, Canada • Three transects across highway; samples at 0.1 m intervals from road • 139 samples from 17 borehole locations; sampling depth: 0 to 10 cm	• Results for three transects: 7 to 1020 ppm (lower traffic/speed); 25 to 925 ppm; 303 to 1650 ppm	• Sequential extractions were also performed to check sorption/bioavailability
Li and Preciado, 2004	• British Columbia, Canada, Highway 17 • Two transects along highway; 0 to 10 m from road; 1 m intervals • Sampling depth: 0 to 5 cm • Also sampled on-road dust and measured Pb deposition rates adjacent to roadway	• Roadside soil results: ~100 ppm for samples 0 m from roadside; <50 ppm for all samples 1 to 10 m from roadside • On-road dust: Pb content ranged from 51 to 181 mg/kg	• PM deposition adjacent to road decreases by ~1/2 within 10 m of roadway • Pb deposition rates on soils within 12 m of roadway range from 1.5 to 5 micrograms per square meter per day (μg/m^2-day); no clear pattern versus distance

Exhibit F-1. Selected Data – Pb in Surface Soil and Dust Near Roadways and Related Urban Measurements

Study Citation	Location and Sampling Scheme	Reported Pb Concentration(s) (total Pb unless otherwise specified)	Other Relevant Information
Sanchez-Martin et al., 2000	• Two medium-sized Spanish cities (Salamanca and Valladolid) • Samples taken at near-roadway, median, urban, suburban, park, and natural settings • Sampling depth: 1 to 10 cm	• Salamanca: 1 to 3 m from road: 33 to 353 ppm (mean 122 ppm); 10 m from road: 18 to 90 ppm (mean 48 ppm); median strip 87 to 1480 ppm (mean 580 ppm) • Valladodid: median strip 51 to 1117 ppm (mean 96 ppm)	• Statistically significant correlation observed between Pb concentrations and mean daily traffic intensity traffic in samples from Salamanca • Also measured soluble fraction
Sheets et al., 2001	• Springfield, Missouri • Multiple sampling locations, including three near heavy-traffic streets and two more than 30 m from residential street • Sampling depth: 0 to 1 cm	• Averages for surface samples at five roadside locations ranged from 18 to 179 ppm	• Correlation was observed between soil measurements taken in 1999 and airborne Pb monitoring from 1979 to 1984 (when gasoline was leaded)
Shinn et al., 2000	• Chicago, Illinois • Sampled bare soil in four-block urban residential area and measured Pb • Developed surface plots of Pb levels via kriging; analyzed patterns by reviewing historical data for potential sources • Sampling depth not specified	• Mean soil Pb: 2180 ppm; median: 1775 ppm; range: 175 to 7935 ppm	• Pb distribution in soil indicates non-random distribution of Pb sources • Pb surface soil patterns linked to existing and previous potential sources within study area. as well as nearby street with high-traffic volume
Speiran, 1998	• Interstate 95 (I-95) north of Richmond, Virginia (Exit 86 to a moderately traveled, two-lane road) • 59 soil samples from 19 sites • Varying distances from interstate and exit ramp • Sampling depth: 0 to 7.6 cm	• Range: 46 to 1200 ppm	• Spatial variations in concentrations indicate that highway lanes were a source of metals, including Pb • Concentrations decrease with increasing distance from roadside

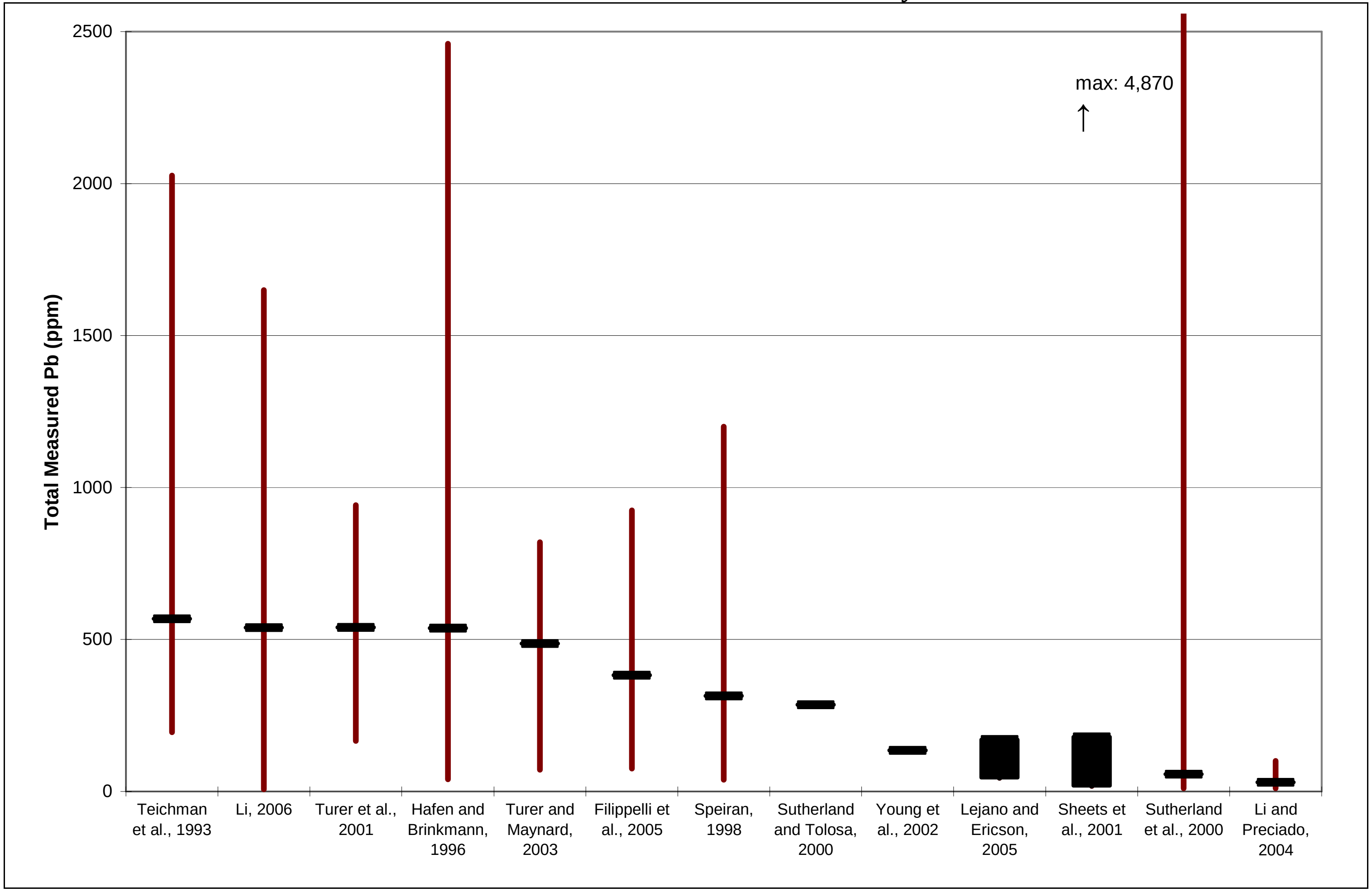
Exhibit F-1. Selected Data – Pb in Surface Soil and Dust Near Roadways and Related Urban Measurements

Study Citation	Location and Sampling Scheme	Reported Pb Concentration(s) (total Pb unless otherwise specified)	Other Relevant Information
Sutherland and Tolosa, 2001	• Manoa basin, Oahu, Hawaii • Sampled two transects at low speed roadways (near park and school) out to 50 m from road • First sample (0 m) from "road deposited sediment (RDS)" – curbside area at edge of road • Sampling depth: 0 to 2.5 cm	• Park transect: max of 375 ppm (5 m from road); RDS 285 ppm • School transect: max of 200 ppm in RDS; all soil samples 25 to 50 ppm, out to 50 m • Measurements for both transects drop to <50 ppm within 5 to 10 m • Local background soil concentrations reported as 12 to 13 ppm	• Concluded that "urban architecture" (sidewalks, grass, topography) impacts Pb concentrations • Pb concentration versus distance plotted using data from 10 studies from the 1970s to 1980s; relationship generally linear when log of concentration and distance are used • Five supplemental soil samples collected from grass-covered recreational field >100 m from roadway; 10 "control" locations sampled from relatively undisturbed areas
Sutherland et al., 2000	• Manoa watershed, Oahu, Hawaii • Sampled road deposited sediment (in curb at roadside) and roadside soils within 2 m of road surface; 78 samples • Daily traffic volumes: <3200 to 45,200 vehicles/day • Sampling depth: 0 to 2.5 cm	• Range of total Pb in roadside soil 10 to 4870 ppm • Median Pb concentration 56 ppm (includes road deposited sediment, but highest levels seen in roadside soil)	• Enrichment ratios were calculated based on the degree of anthropogenic influence on Pb levels; Pb was the most significantly enhanced metal versus aluminum (Al), copper (Cu), and zinc (Zn) • Enrichment ratio for roadside Pb was four to five times higher than in background soils

Exhibit F-1. Selected Data – Pb in Surface Soil and Dust Near Roadways and Related Urban Measurements

Study Citation	Location and Sampling Scheme	Reported Pb Concentration(s) (total Pb unless otherwise specified)	Other Relevant Information
Teichman et al., 1993	• Alameda County, California, adjacent to Interstate 880 (I-880) • ~200 samples were taken in residential yards and parks/playgrounds in communities adjacent to I-880 and within 1-mile radius of I-880 • Sampling depth: ranged from surface to 1.27 to 1.91 cm deep	• Residential soil measurements: average 567.7 ppm; range 195 to 2026 ppm • Parks and playgrounds measurements: average 136.5 ppm; range 6 to 565 ppm	• "Gasoline emissions" cited as a likely urban source
Turer and Maynard, 2003	• Corpus Christi, Texas; two sampling sites; one transect per site • Site 1: city center (heavy traffic); 12 samples; 2 to 12 m from road; 12 m from road; sampling depth: 0 to 32.5 cm • Site 2: near oil refinery; 10 samples; 0.5 to 4 m from road; sampling depth: 0 and 0 to 2.5 cm	• Site 1: 210 to 770 ppm; Site 2: 140 to 390 ppm • Highest concentrations at both sites were observed closest to roadway (within 3.5 m)	• Results were compared to Cincinnati , Ohio metal contamination in near-highway soils, and organic matter was determined to be the key to Pb mobility
Turer et al., 2001	• Cincinnati, Ohio Interstate 75 (I-75) through city; 58 samples • Sampling conducted adjacent to highways on median between lanes (within ~50 m of road) • Sampling depth: 0 to 1 cm; also sampled 1 to 5 cm	• Range for 0- to 1-cm samples: 166 to 942 ppm; range for 1- to 5-cm samples: 59 to 1073 ppm • Some samples taken at depth of 10 to15 cm contained total Pb between 1000 and 2000 ppm	• Performed mass balance analysis to determine fate of Pb (total emitted historically in exhaust versus Pb currently in soil); results suggest 60 percent of Pb has been lost from study area (roadsides) • Removal via wind-blown dust was proposed as most likely remobilization mechanism; surface runoff may be lesser removal mechanism
Young et al., 2001	• California highways; three locations (not identified) • Samples taken 1.5 m from roadway • Sampling depth not specified	• Pb concentration reported to be 38, 46, and 322 ppm	• Pb content, potential PM10 yield, and Pb emission potential via resuspension measured for all samples

Exhibit F-2. Pb Concentrations Measured in Outdoor Soil and Dust Adjacent to United States and Canadian Roadways



Note: This chart is intended to convey the range of total Pb measured in roadside soils in the United States and Canada in the cited studies. For each study, the vertical line represents the approximate range of total Pb reported in surface soil samples taken from roadside locations; surface sampling depth varies by study. The horizontal hash mark or box represents the "average" total Pb for all samples in that study; this average may be either reported in the study or calculated based on reported data. In some cases, only the average or median concentrations for selected study locations or sample categories were reported; these cases are represented by a black box with no vertical line. Refer to cited publications for details on individual studies.

F.3. TRENDS IN PB LEVELS NEAR ROADWAYS

Pb concentrations are typically higher in roadside soils located in highly developed urban areas than in non-urban environments (Chirenje et al., 2004; Shinn et al., 2000; Turer and Maynard, 2003). Generalizing beyond this observation, however, is difficult. Although Pb concentrations in soils have been positively correlated with traffic volume on adjacent roadways in some cases (see, e.g., Sanchez-Martin et al. [2000] and Fakayode and Olu-Owolabi [2003]), other analyses have suggested that that relationship may be confounded by variables such as microclimate turbulence, near-roadway topography, and human construction and landscaping activities (Hafen and Brinkmann, 1996). Although Pb is generally higher in soils near heavily-traveled roadways, determining the specific relationship with traffic volume can be difficult, in part because traffic density for previous time periods can be difficult to determine. Also, other site-specific factors can affect Pb mobility; for example, lower soil pH and organic carbon and clay content have been correlated with increased Pb mobility (i.e., lower retention rates) in roadside soils (Chirenje et al., 2004). Pb concentrations tend to be highest in the upper-most layer of soil (i.e., first several cm). Some exceptions have been reported; for example, Turer et al. (2001) observed concentrations of total Pb in soil adjacent to an interstate highway in Cincinnati, Ohio of 1,000 to 2,000 mg/kg at a depth 10 to 15 cm (compared to concentrations up to about 1,000 mg/kg in the top 5 cm of soil).

Substantial evidence indicates that Pb concentrations in surface soil decrease rapidly with distance from the roadway. Sutherland and Tolosa (2001) reported that the relationship for measurements taken adjacent to roadways (out to 50 m) in Hawaii is approximately linear when the log of concentration is plotted against the log of distance from the roadway. Similarly, Filippelli et al. (2005) have reported an exponential decay in Pb concentration with increasing distance from the roadside based on transects at 10 and 40 m from roadways in Indianapolis, Indiana. Hafen and Brinkmann (1996) surveyed results from several studies and observed a generally exponential decrease in Pb concentration with distance from the road. Other investigators have observed an overall decrease in Pb in surface soil but were unable to determine a mathematical relationship (Li and Preciado, 2004; Shinn et al., 2000). In general, however, based on the conclusions of these studies, Pb concentrations adjacent to roads appear to decrease to local background levels within 50 m of the roadway.

REFERENCES

Chirenje, T.; Ma, L. Q.; Reeves, M.; Szulczewski, M. (2004) Lead Distribution in Near-Surface Soils of Two Florida Cities: Gainesville and Miami. *Geoderma.* 119(2): 113-120.

Fakayode, S. O.and Olu-Owolabi, B. I. (2003) Heavy Metal Contamination of Roadside Topsoil in Osogbo, Nigeria: Its Relationship to Traffic Density and Proximity to Highways. *Environmental Geology.* 44: 150-157.

Filippelli, G. M.; Laidlaw, M. A.; Latimer, J. C.; Raftis, R. (2005) Urban Lead Poisoning and Medical Geology: An Unfinished Story. *GSA Today.* 15(1): 4-11.

Gillies, J. A.; O'Connor, C. M.; Mamane, Y.; Gerler, A. W. (1999) Chemical Profiles for Characterizing Dust Sources in an Urban Area, Western Nevada, USA. In: Livingstone, I., Ed. Aeolian Geomorphology: Papers From the 4th International Conference on Aeolian Research 1998, Oxford, UK. *Zeitschrift fuer Geomorphologie.* 116(S): 19-44.

Hafen, M. R. and Brinkmann, R. (1996) Analysis of Lead in Soils Adjacent to an Interstate Highway in Tampa, Florida. *Environmental Geochemistry and Health.* 18(4): 171-179.

Harris, A. R.and Davidson, C. I. (2005) The Role of Resuspension in Lead Flows in the California South Coast Air Basin. *Environ Sci Technol.* 39: 7410-7415.

Lankey, R. L.; Davidson, C. I.; McMichael, F. C. (1998) Mass Balance for Lead in the California South Coast Air Basin: an Update. *Environmental Research.* A 78: 86-93.

Lejano, R. P.and Ericson, J. E. (2005) Tragedy of the Temporal Commons: Soil-Bound Lead and the Anachronicity of Risk. *Journal of Environmental Planning and Management.* 48(2): 301-320.

Li, L. Y. and Preciado, H. (2004) Air, Runoff and Soil Monitoring of Highway Pollution by Metals Along Highway Corridors. In Brebbia, C.A., ed. Air Pollution XII (Air Pollution 2004). United Kingdom: Wessex Institute of Technology.

Li, L. Y. (2006) Retention Capacity and Environmental Mobility of Pb in Soils Along Highway Corridor. *Water, Air, and Soil Pollution.* 170: 211-227.

Sanchez-Martin, M. J.; Sanchez-Camazano, M.; Lorenzo, L. F. (2000) Cadmium and Lead Contents in Suburban and Urban Soils From Two Medium-Sized Cites of Spain: Influence of Traffic Intensity. *Bulletin of Environmental Contamination and Toxicology.* 64: 250-257.

Sheets, R. W.; Kryger, J. R.; Biagioni, R. N.; Probst, S.; Boyer, R.; Barke, K. (2001) Relationship Between Soil Lead and Airborne Lead Concentrations at Springfield, Missouri, USA. *Science of Total Environment.* 271: 79-85.

Shinn, N. J.; Bing-Canar, J.; Cailas, M.; Peneff, N.; Binns, H. J. (2000) Determination of Spatial Continuity of Soil Lead Levels in an Urban Residential Neighborhood. *Environmental Research.* 82 (Section A): 46-52.

Speiran, G. K. (1998) Selected Heavy Metals and Other Constituents in Soil and Stormwater Runoff at the Interstate 95 Interchange Near Atlee, Virginia, April 1993-May 1997. Water-Resources Investigations Report 98-4115, 39p. U.S. Geological Survey.

Sutherland, R. A.; Tolosa, C. A.; Tack, F. M. G.; Verloo, M. G. (2000) Characterization of Selected Element Concentrations and Enrichment Ratios in Background and Anthropogenically Impacted Roadside Areas. *Archives of Environmental Contamination and Toxicology.* 38: 428-438.

Sutherland, R. A.and Tolosa, C. A. (2001) Variation in Total and Extractable Elements With Distance From Roads in an Urban Watershed, Honolulu, Hawaii. *Water, Air, and Soil Pollution.* 127(4): 315-338.

Tiechman, J.; Coltrin, D.; Prouty, K.; Bir, W. A. (1993) A Survey of Lead Contamination in Soil Along Interstate 880, Alameda County, CA. *American Industrial Hygiene Association Journal.* 54(9): 557-559.

Turer, D.; Maynard, J. B.; Sansalone, J. J. (2001) Heavy Metal Contamination in Soils of Urban Highways: Comparison Between Runoff and Soil Concentrations at Cincinnati, Ohio. *Water, Air, and Soil Pollution.* 132: 293-314.

Turer, D. G. and Maynard, J. B. (2003) Heavy Metal Contamination in Highway Soils. Comparison of Corpus Christi, Texas and Cincinnati, Ohio Shows Organic Matter Is Key to Mobility. *Clean Technologies and Environmental Policy.* 4(4): 235-245.

U.S. Environmental Protection Agency (USEPA). (2006) Air Quality Criteria for Lead (Final). Volume I and II. Research Triangle Park, NC: National Center for Environmental Assessment; EPA/600/R-05/144aF-bF. Available online at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=158823.

Young, T. M.; Heeraman, G.; Sirin, G.; Ashbaugh, L. (2001) Resuspension of Soil As a Source of Airborne Lead. Contract No. 97-325. Final Project Report from Air Quality Group, Crocker Nuclear Lab to the Research Division of the Air Resources Board; August.

Young, T. M.; Heeraman, G.; Sirin, G.; Ashbaugh, L. (2002) Resuspension of Soil As a Source of Airborne Lead Near Industrial Facilities and Highways. *Sci. Technol.* 36: 2484-2490.

July 25, 2007

Appendix G: Approaches for Estimating Indoor Dust Pb Concentrations

Prepared by:

ICF International
Research Triangle Park, NC

Prepared for:

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina

Contract No. EP-D-06-115
Work Assignment No. 0-4

Table of Contents

List of Exhibits

List of Attachments

G. APPROACHES FOR ESTIMATING INDOOR DUST PB CONCENTRATIONS

Indoor dust concentrations of Pb were estimated using empirically derived relationships between indoor dust and other media concentrations, mechanistic models that directly model the accumulation of indoor dust due to physical processes, or a combination of the two. The following sections present an overview of the algorithms used to calculate indoor dust Pb concentrations in each case study followed by a more detailed discussion of the development and selection of the algorithms.

G.1. INDOOR DUST PB CONCENTRATION ALGORITHMS FOR DIFFERENT CASE STUDIES

Different approaches were used to calculate indoor dust concentrations of Pb for different case studies. This section provides an overview of the equations used to calculate the indoor dust concentrations in each case study. Justification for using these equations appears in the subsequent sections.

G.1.1. General Urban Case Study

In recognition of the model uncertainty associated with this key analytical step of the risk assessment, the general urban case study uses two different models to estimate indoor dust Pb concentration given an ambient air concentration. The first is a hybrid model that relies on the steady state solution for a mechanistic model to determine the ambient air-derived indoor dust Pb loading and an empirical value for the indoor dust Pb loading from other sources (e.g, indoor paint, outdoor soil/dust and additional sources including historical air). The mechanistic model was developed using a mass-balance equation relating outdoor ambient air Pb to indoor air Pb and deposition of Pb to indoor surfaces in typical residences. The indoor dust Pb loading from other sources was derived using the U.S. Department of Housing and Urban Development (HUD) National Survey of Lead-Based Paint in Housing (USEPA, 1995) average indoor dust Pb loadings and subtracting out the air-related indoor dust from the mechanistic model. Both pieces of this hybrid model are described more fully in Section G.3. The equation for this model is:

$$PbDUST = \mathrm{EXP}[4.92 + 0.52 \times \ln\left(0.185 \times (104.2 \times PbAIR + 1.15)^{0.931}\right)]$$

where:

$PbDUST$	=	concentration of Pb in indoor dust (microgram [µg] per gram [g])
$PbAIR$	=	concentration of Pb in the ambient air (µg/cubic meter [m^3])

The second indoor dust estimation algorithm for this case study uses a U.S. EPA developed regression model (USEPA, 1989). For the general urban case study, the air-only regression-based model is used:

$$PbDUST = 60 + (844 \times PbAIR)$$

where:

$PbDUST$ = concentration of Pb in indoor dust (μg/g),
$PbAIR$ = concentration of in the ambient air (μg/m^3)

G.1.2. Point Source Case Studies

G.1.2.1. Primary Pb Smelter Case Study

The primary Pb smelter case study included a remediated zone, where measurements of site-specific outdoor soil/dust and indoor dust Pb concentrations were available, and an unremediated zone, where no Pb measurements were available. To best capture the outdoor soil/dust and indoor dust Pb concentrations at this particular site, a site-specific regression equation was developed for all U.S. Census blocks within 1.5 kilometer (km) of the facility (the remediated zone):

$$\ln(PbDUST) = 8.3884 + 0.73639 \text{ x } \ln(PbAIR)$$

where:

$PbDUST$ = concentration of Pb in indoor dust (μg/g)
$PbAIR$ = concentration of Pb in the ambient air (μg/m^3)

For the remainder of the U.S. Census blocks, a U.S. EPA air+soil regression-based model was used to estimate indoor dust Pb concentrations (USEPA, 1989). This equation was developed using data from primary smelters, including the primary smelter included in this assessment. The relationship specifies that:

$$PbDUST = 31.3 + (638 \text{ x } PbAIR) + (0.364 \text{ x } PbSOIL)$$

where:

$PbDUST$ = concentration of Pb in indoor dust (μg/g)
$PbAIR$ = concentration of Pb in the ambient air (μg/m^3)
$PbSOIL$ = concentration of Pb in outdoor soil/dust (mg/kg)

For a more complete discussion of the development and selection of these models, see Section G.4.

G.1.2.2. Secondary Pb Smelter Case Study

Unlike the primary Pb smelter case study, no site-specific indoor dust concentration observations were available for the secondary Pb smelter case study area. As a result, the following air-only regression-based model was used to characterize indoor dust concentrations:

$$PbDUST = 60 + (844 \times PbAIR)$$

where:

$PbDUST$ = concentration of Pb in indoor dust (μg/g),
$PbAIR$ = concentration of Pb in the ambient air (μg/m^3)

This model is further described in Section G.5.

G.2. BACKGROUND INFORMATION ON RELATIONSHIPS BETWEEN INDOOR DUST PB AND AIR AND OTHER VARIABLES

Pb in indoor dust, which collects on surfaces and may be ingested by children, typically has three major sources: (1) outdoor ambient air-suspended particles, which infiltrate the indoor environment and become deposited as indoor dust; (2) outdoor soil/dust, which is tracked into the home from the yard or from the wider community; and (3) interior Pb paints, which chip or chalk and contribute to indoor dust (e.g., Adgate et al., 1998). Many literature studies have examined one or more of these contributors to determine their absolute or relative contribution to indoor dust Pb levels. However, this analysis is confounded by the fact that the outdoor ambient air contains resuspended outdoor soil/dust that may have been transported over significant distances, and that outdoor soil/dust contains signatures of other numerous sources, including exterior Pb paint. Thus, determining the exact sources of Pb in indoor dust at a single location is a complex exercise.

Published studies have examined indoor dust Pb loadings or concentrations in both point-source and urban environments. In general, exposure to Pb near point sources includes both a current component due to active emissions and a historical component due to the accumulation in outdoor soil/dust of previously emitted Pb and Pb from Pb paint (Hilts, 2003). In point-source environments where emission controls have been imposed, current emissions may be reduced, but these environments will retain a higher signal of Pb in indoor dust relative to background locations away from point sources due to the presence of previously contaminated outdoor soil/dust (von Lindern et al., 2003). In a generalized urban environment away from any historic Pb point-source emission source, increased Pb exposure is dominated by historical sources of Pb only, including the past deposition of Pb in outdoor soil/dust from leaded gasoline, which was available until the 1980s, and by historic use of Pb paint (Mielke et al., 1997). Because of the deposition of Pb from leaded gasoline, urban locations near historically congested roadways tend to have higher outdoor soil/dust concentrations than those away from major roadways (see Appendix F). In both urban and point-source locations, the residence time of Pb in outdoor soil/dust can be up to 700 years in the absence of remediation (Laidlaw et al., 2005), indicating that accumulated Pb in outdoor soil/dust can have a long temporal footprint on indoor dust.

Several studies have attempted to determine the relative contributions of ambient air, outdoor soil/dust, and Pb paint to indoor dust Pb levels. Using an isotopic analysis of various elements in particulate matter, Adgate et al. (1998) found that air contributed approximately 17 percent, Pb paint contributed approximately 34 percent, and outdoor soil/road dust contributed approximately 49 percent to indoor dust Pb levels by mass. This study was conducted in an urban environment in Jersey City, New Jersey. However, the homes in the study were all built before 1960, and most of the homes were built prior to 1940 (Adgate et al., 1998); thus, the portion of dust arising from Pb paint may be high compared with homes of a younger vintage where Pb paint is not as prevalent. A similar study in Christchurch, New Zealand, found that 45 percent of indoor dust came from paint, three to five percent came from outdoor soil, 15 to 20 percent came from outdoor road dust, and 15 to 25 percent came from air-related sources (Fergusson and Schroeder, 1985). Gwiazda and Smith (2000) found that, in children with the highest blood Pb (PbB) levels in Santa Cruz county (> 15 μg/deciliter [dL]), indoor dust exposure was usually due to paint ingestion or past exposure due to residing outside the United States. Thus, while these studies are useful in suggesting that outdoor soil/dust and Pb paint are the strongest contributors to indoor dust, the relative contributions are highly dependent on the underlying media concentrations themselves; these factors can be applied only to an urban or point-source environment if the underlying media concentrations are similar to those encountered in the original study. In addition, because the ambient air may contain resuspended outdoor soil/dust particles, the high outdoor soil/dust contribution may actually be delivered via the ambient air infiltration, rather than during direct outdoor soil/dust-tracking events.

Other studies have attempted to develop direct regression relationships between indoor dust and one or more of the underlying contributing media. For example, von Lindern et al. (2003) developed a structured equation model relating the log-transformed indoor dust Pb and outdoor soil/dust (community-wide and neighborhood-wide averages) and air concentrations. While the resulting correlations were highly significant, outdoor soil/dust and air contributions only accounted for approximately 20 percent of the indoor dust Pb variance. This result suggests high house-to-house variability that is related to other confounding variables (cleaning habits, carpet versus hard floor, parental occupation, etc.) rather than the media concentrations themselves. In the absence of regression relationships, other studies have provided measurements of a combination of indoor dust, outdoor soil/dust, and air central tendencies in urban or point-source environments. Again, both the regression study and the relative indoor dust-outdoor soil/dust-air measurements provide a framework for understanding the contributions of the underlying sources to Pb in indoor dust, but these data can be applied only within the parameter space they define.

Physically-based mechanistic models offer a potential advantage over regression models or empirical observations because they potentially can be used across a wider range of parameter values, provided the inputs are selected carefully. No studies were identified that have attempted to build a fully mechanistic Pb indoor dust model that simultaneously simulates the contribution to Pb indoor dust from ambient air, outdoor soil/dust, and paint to indoor air and indoor floor dust Pb levels. However, mass-balance models are available that model the infiltration of ambient air into the indoor environment, including the loss of particles through deposition (e.g., Ferro et al., 2004; Nazaroff, 2004; Thatcher and Layton, 1995). These mass-balance models have been used to infer air exchange rates (the rate at which outdoor air infiltrates the indoor environment), penetration efficiencies (the fraction of particulate material that enters the indoor environment in a given size class), deposition rates, and resuspension rates for generic particles of given size ranges from measured indoor and ambient concentrations. These models may be applied to Pb indoor dust in so far as the assumptions made in the modeling studies are relevant to particles containing Pb.

Typically, authors have measured outdoor soil/dust, indoor dust, and ambient air contaminant concentrations at a single home, assuming that the dominant influences on indoor dust derive from the media in the immediate vicinity. However, some attempts have been made to explore the spatial footprint across which media may influence indoor dust. For example, von Lindern et al. (2003) calculated correlation coefficients between indoor dust and outdoor soil/dust concentrations of Pb averaged over the yard, averaged over the neighborhood (defined as within 200 foot [ft]), and averaged over the community (an entire town) in a remediation zone near the Bunker Hill Superfund site. In general, indoor dust was most strongly correlated with community-level outdoor soil/dust averages, indicating that outdoor soil/dust from a wide spatial footprint affects indoor dust levels at a single location. This observation may reflect the fact that outdoor soil/dust is tracked from wider areas than those adjacent to a home or that transport of airborne outdoor soil/dust particles occurs across large distances.

In addition to spatial variations in indoor dust concentrations, Pb in indoor dust will also vary temporally, particularly when remediation practices are used to reduce media (outdoor soil/dust or indoor dust) concentrations or when intervention occurs to educate home owners of the dangers of Pb exposure. Hilts (2003) measured the changes in air, outdoor soil/dust, and indoor dust concentrations after emissions reduction efforts at a Pb smelter in Trail, British Columbia. Air and outdoor soil Pb concentrations both decreased (air from 1.1 $\mu g/m^3$ to 0.03 $\mu g/m^3$ and soil from 844 parts per million [ppm] to 750 ppm), and indoor dust concentrations were observed to decrease as well (758 ppm to 580 ppm) from 1996 to 1999. In addition, von Lindern (2003) traced the changes in soil and the concurrent changes in indoor dust after soil remediation at the Bunker Hill smelter site. Geometric mean (GM) outdoor soil/dust concentrations decreased from 1715 to 1507 ppm, and GM indoor dust concentrations also decreased from 1435 to 897 ppm. In addition to changes in indoor dust due to intervention, normal seasonal fluctuations in indoor dust are expected; Laidlaw et al. (2005) showed that fluctuations in humidity and wind speed can be associated with changes in the mobilization of Pb-containing outdoor soil/dust into the air. These changes were subsequently found to be associated with changes in PbB concentrations. Thus, climatic variables may affect the amount of Pb contained in the ambient air environment and the amount of Pb that subsequently infiltrates the indoor environment.

Although indoor dust Pb concentrations are known to depend on ambient air, outdoor soil/dust, and Pb paints, a high degree of uncertainty surrounds the physical processes that govern this dependence. In particular, the importance of tracking outdoor soil/dust into a home as a source of Pb contamination is poorly constrained by lack of studies in the literature. The accumulation of outdoor soil/dust particles on doormats has been measured in several studies (Thatcher and Layton, 1995; von Lindern et al., 2003), and these studies found similar overall particulate matter accumulation rates in very different environments (urban versus rural). However, little information is available about the relative amount that collects on a doormat versus the amount that is subsequently tracked throughout the house. Also, the amount of tracked dirt highly depends on the type of floor (hard floor or carpet), with carpeted sources collecting more tracked material. The contribution of paint flaking is also poorly characterized. Pb paints can have widely variable Pb concentrations, and in general the relative contribution of paint to indoor dust Pb loading is the most variable among outdoor soil/dust, air, and paint (Adgate et al., 1998). Finally, other practices in the home (e.g., cleaning practices), occupation, socio-economic status, and other climatic variables (e.g., humidity, wind speed) tend to confound the relationship between these media concentrations and the total Pb indoor dust, implying that indoor dust concentrations will vary substantially in homes exposed to the exact same media concentrations.

Because of the complex relationship among Pb in air, outdoor soil/dust, paint, and indoor dust, regression models based on observed simultaneous measurements are useful tools in predicting indoor dust Pb concentrations. However, these models will be relevant only if the underlying study from which they were developed included homes similar to those for which indoor dust Pb concentrations need to be modeled. Also, mechanistic models may be useful tools in modeling the accumulation of dust in the indoor environment; in particular, the air component has been relatively well-explored. However, as noted above, the processes governing the contribution of paint and outdoor soil/dust to indoor dust have not been extensively studied in the literature. Also, mechanistic models based on central tendency household and exposure concentration values will not capture any household to household dust concentration variability stemming from atypical household practices or exposure concentrations. For these reasons, the various case studies rely on different indoor dust prediction techniques, depending on the underlying data available in the literature and the extent to which a mechanistic model can be reasonably applied. The following sections describe efforts to build indoor dust prediction models for each case study.

G.3. FOUNDATION FOR THE GENERAL URBAN CASE STUDY INDOOR DUST ALGORITHMS

G.3.1. Investigation of an Empirical Model for the General Urban Case Study

Attempts were made to generate an empirical model relating indoor dust Pb concentrations or loadings to measurements of ambient air Pb concentrations, outdoor soil/dust concentrations, and indoor paint concentrations for the general urban case study. Two data sets were identified as candidates for this activity. The first was a study conducted by Lanphear et al. (1996) in Rochester, New York. Data were provided for 205 children with simultaneous measurements of indoor dust Pb loadings (in multiple areas of the house), indoor dust concentrations (in multiple areas of the house), outdoor soil/dust concentrations (in both the play yard and the dripline), and interior paint concentrations (in the form of X-ray fluorescence [XRF] measurements), along with PbB measurements and potentially confounding socioeconomic and other variables. The second data set included data from the HUD National Survey of Lead-Based Paint in Housing (USEPA, 1995), which provided indoor dust Pb concentrations and loadings and measurements of outdoor soil/dust and Pb paint for a sample of homes chosen to be representative of the national population.

G.3.1.1. Lanphear et al. 1996 Data Set for Rochester, New York

The Lanphear et al. (1996) study data (hereafter referred to as the “Rochester data”) were collected in an urban environment and contain nearly all the primary variables of interest except for site-specific ambient air Pb concentrations, which are an integral part of the risk assessment. Attempts were made to find an appropriate spatial distribution of ambient air concentrations to use with this data set to generate relationships between ambient air, outdoor soil/dust, exterior or interior paint, and indoor dust, as described below. Unfortunately, no such appropriate spatial distribution could be identified. While this data gap handicapped the ability to develop an empirical model relating indoor dust Pb levels to ambient air Pb levels, the data set was analyzed to examine relationships between indoor dust Pb and the other key variables that could be applied to the general urban case study.

The data set was prepared to include both arithmetic and GM values for the entire house (i.e., averaging across the different sampling rooms in the house: living room, bedroom, play yard, and entry way) to provide single indoor dust Pb loading and concentration estimates for each child's residence (205 children in all). The play yard and perimeter outdoor soil concentrations, which typically differed by an order of magnitude, were analyzed separately to determine which was most strongly correlated with the indoor dust concentrations.

To approximate the air Pb concentrations, data from three U.S. EPA Air Quality System (AQS) air monitors were available that were within 50 km of the study homes (USEPA, 2007). The first monitor, monitor 360550014 (Monitor 1), measured Pb in total suspended particles (TSP) and is an average of 37 km from the homes included in the study. The other two monitors, monitors 360556001 (Monitor 2) and 360551007 (Monitor 3), are $PM_{2.5}$ monitors (for which the Pb concentration is available) and are located an average of 2.8 km and 4.5 km from the homes in the study, respectively. In general, the Pb measurements from the TSP monitors are an order of magnitude higher than those from the $PM_{2.5}$ monitors. Data provided for Monitor 1 spanned January 1993 to June 1996, which includes the time the Rochester data were collected. Monitor 2 data spanned May 2004 to November 2006 and Monitor 3 data spanned January 2001 to March 2004. All three monitors have distinct latitude and longitude coordinates.

Because the TSP and $PM_{2.5}$ monitors measure the Pb content in different particle size ranges, all three monitors could not be combined. Indoor dust Pb concentrations likely reflect the total Pb content of atmospheric particles, rather than a specific size range, since all size ranges appear to penetrate at least to some degree into the indoor environment ((e.g., Layton and Thatcher, 1995). However, in order to create a spatial distribution of air Pb concentrations that correspond to the study homes, at least two monitors were needed, implying the $PM_{2.5}$ monitors had to be used as a proxy for total Pb content in the ambient air. To create this spatial distribution, the air concentrations at each of the $PM_{2.5}$ monitor locations were averaged over the longest possible measuring time that included full annual cycles (the data were averaged only over full years to avoid any artificial variations due to seasonal cycles). The Rochester data included zip code information, and these zip codes were converted to latitudes and longitudes using the centroid for each zip code area. Then, the distances between the two $PM_{2.5}$ monitors and the zip code of the home in question were calculated, and the two monitor concentrations were distance-weighted-averaged. Unfortunately, the two monitors did not take measurements during overlapping time periods, so this analysis implicitly assumes that no major emission or climatological shifts occurred between the two time periods. These air data were then combined with the indoor dust and outdoor soil/dust data in the Rochester data to build a regression model. In doing this, however, it was recognized that there were limitations of the spatial coverage for this measurement and that the $PM_{2.5}$-Pb underestimates Pb that may contribute to indoor dust Pb.

To investigate the correlations among the different study variables, correlation coefficients between both the arithmetic and GM of indoor dust concentrations measured on the floor and other variables in the data set were calculated. The following variables were explored: the exterior XRF paint concentrations, the interior XRF paint concentrations, the play yard soil concentrations, the house perimeter soil concentrations, the first-draw water concentrations, exterior dust concentrations, porch concentrations, arithmetic and GM window sill concentrations, arithmetic and GM window well concentrations, two hand-wipe samples from each child, air concentrations, and housing vintage.

Of these variables, only those shown in Exhibit G-1 were significantly correlated with the GM indoor floor dust concentrations, where significance was set at $p<0.05$. The number of points used in each correlation (N) is different for each variable due to missing values. In general, the arithmetic means tended to have weaker correlations, so the GM across rooms in each house was selected as the primary indoor dust metric. Play yard outdoor soil/dust is weakly correlated with indoor dust, although house perimeter soil is not significantly correlated. All correlation coefficients are weak, suggesting that variability in other house-to-house practices significantly influence the indoor dust load. Correlations (r) between the natural log (ln) of the dust concentrations and each of these variables were also calculated, along with correlations between the dust concentrations and the natural log of each variable. These calculations were designed to identify non-linear relationships between the variables, but the correlations did not significantly improve under either of these efforts.

Exhibit G-1. Correlation Coefficients, Number of Samples, and p Values for Variables Significantly Correlated with Indoor Dust

GM of Window Sill Pb Concentration (µg/g)	Exterior Paint XRF Reading (milligram [mg] per square foot [ft^2])	Average Interior Paint XRF Reading (mg/ft^2)	Average Play Yard Soil Concentration, ppm	Exterior Dust Concentration (µg/g)
r=0.314	r=0.2498	r=0.2808	r=0.252	r=0.1724
N=194	N=200	N=204	N=86	N=143
p=<0.0005	p=<0.0005	P=<0.0005	p=.019	p=.040

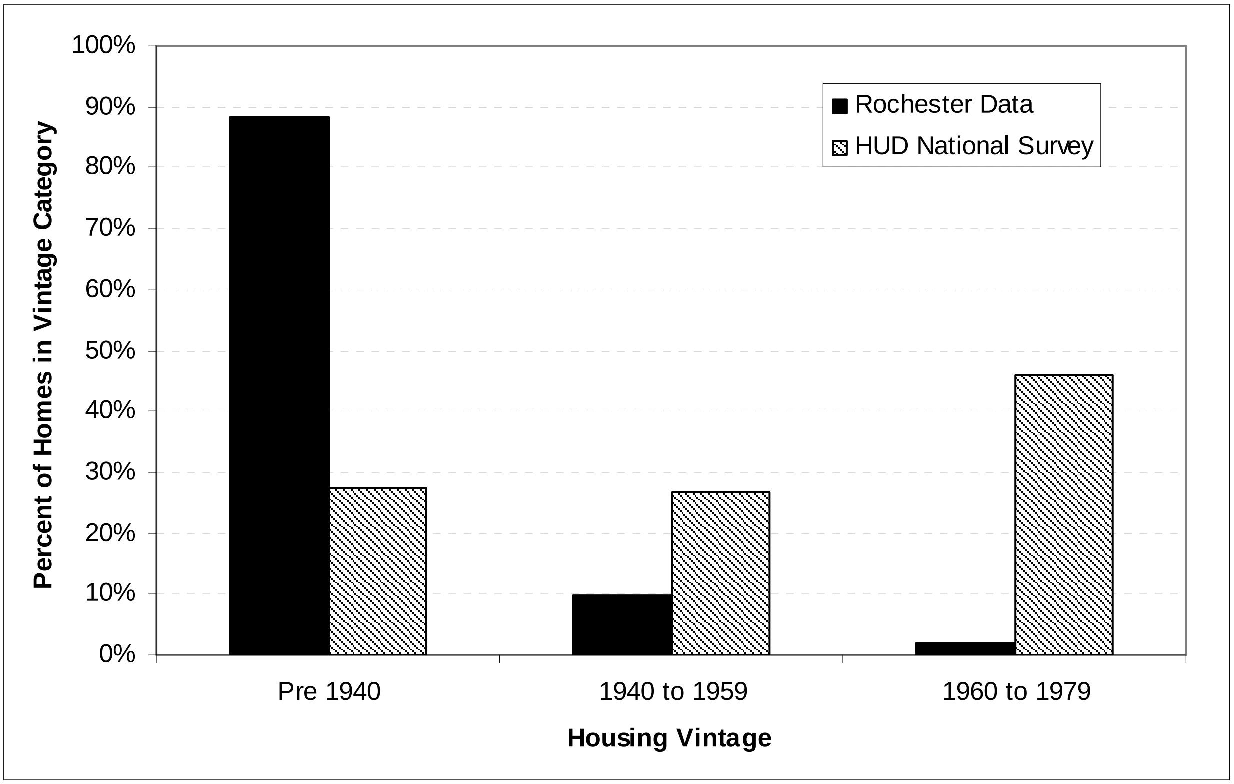
Porch Dust Concentration (µg/g)	Window Well Dust Concentration (µg/g)	Hand Wipe 1 (µg)	Hand Wipe 2 (µg)	Housing Vintage (year)
r=0.1944	r=0.1698	r=0.2199	r=0.1703	r=-0.1566
N=122	N=187	N=196	N=195	N=204
p=.032	p=.020	p=.002	p=.017	p=.025

As expected given the inadequate characterization of airborne Pb near the study residences, no correlation was found between air Pb concentrations and indoor dust Pb concentrations.

The most significant correlations were found between the window sill Pb concentrations, which likely have similar sources to the indoor dust concentrations, and the exterior and interior paint XRF measurements. Outdoor soil is also significantly correlated with indoor dust concentration, although the low correlation coefficient suggests limited predictive power. The fact that paint correlations with indoor dust Pb concentration are significant suggests that paint is playing a major role in determining indoor dust concentrations.

To understand why paint may be contributing so strongly to indoor dust, Exhibit G-2 compares the percentage of study homes in each housing vintage in the Rochester data compared with the HUD National Survey. More than 85 percent of the homes are in the oldest vintage in the Rochester data, compared with only 27 percent in the HUD survey. These older homes have a higher tendency to contain Pb paint and the indoor dust Pb loadings may retain a larger paint-derived fraction than in a typical urban environment. Because (1) Pb in ambient air near study residences could not be adequately characterized; (2) the correlations among outdoor soil/dust, paint, and indoor dust are weak; and (3) because the Rochester data are likely influenced more strongly by the presence of Pb paint than in typical urban environments, no empirically derived model was obtained from this data set.

Exhibit G-2. Comparison of Housing Vintage Percentages in the Rochester Data and the HUD National Survey



G.3.1.2. HUD National Survey Data Set

Data from the HUD National Survey of Lead in Housing (USEPA, 1995) were also evaluated to examine relationships among ambient air Pb concentrations, outdoor soil/dust and indoor dust Pb concentrations, and indoor dust Pb loading. The methods and results of this analysis are described in detail in Attachment G-1 and are not discussed further here.

G.3.2. Development of a Mechanistic Air Model for the General Urban Case Study

G.3.2.1. Physical Processes and Derivation of an Equation for Steady-state Pb Floor Loading

The mechanistic model captures the physical transfer of Pb from one medium to another, rather than capturing the interaction between the media in a statistical relationship. As discussed in Section G.2, the accumulation of indoor dust depends on the relative contributions of outdoor ambient air, outdoor soil/dust, and Pb paint to the interior environment. The tracking of outdoor soil/dust and the flaking/chipping of interior Pb paint are both highly variable and poorly studied processes. However, the infiltration of outdoor ambient air into the indoor environment and the subsequent settling of particles have been extensively studied and have been characterized in mass-balance physical models (e.g., Ferro et al., 2004; Nazaroff, 2004; Thatcher and Layton, 1995). For this reason, a mechanistic model was derived for the contribution of Pb in outdoor ambient air to Pb in dust in the interior environment; then, a non-air component was empirically derived, as described in Section G.3.3.

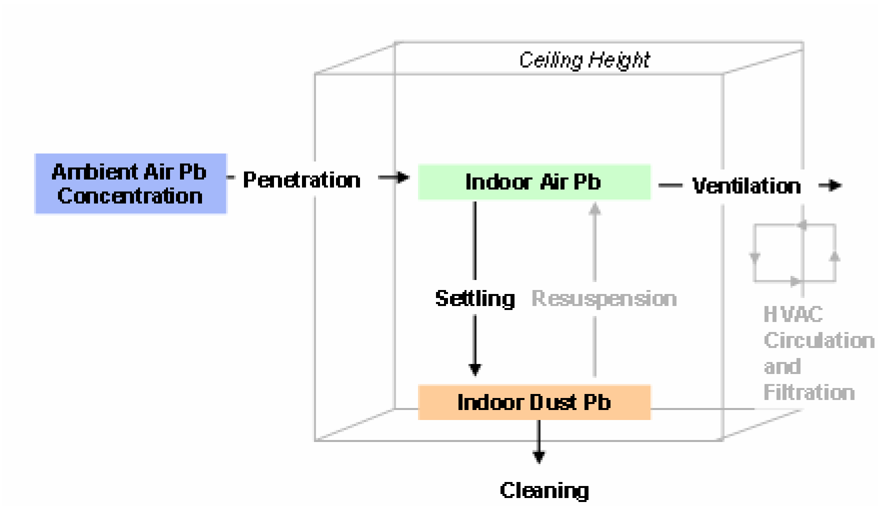
Exhibit G-3 shows a schematic of the mechanistic indoor dust model. Two separate Pb "compartments" accumulate Pb over time: the indoor air Pb compartment and the indoor dust Pb compartment. Mass balance dictates that in both of these compartments, the change in Pb mass over time depends on the flux of Pb mass into the compartment minus the flux of Pb out of the compartment:

$$\frac{d[Mass]}{dt} = Flux\ of\ Mass\ In - Flux\ of\ Mass\ Out$$

where:

d[Mass]/dt	= change over time of the Pb mass (µg/hour [h])
Flux of Mass In	= flux of Pb into the compartment (µg/h)
Flux of Mass Out	= flux of Pb out of the compartment (µg/h)

Exhibit G-3. Mechanistic Indoor Dust Model Schematic



For the indoor air compartment (*INAIR*), the fluxes include penetration of air and particles from outdoors, ventilation of indoor air back to the outdoor environment, deposition of Pb out of the air, resuspension of accumulated Pb on the floor back into the air, and filtration associated with re-circulating air due to the presence of an HVAC system:

$$\frac{dINAIR}{dt} = Penetration\ Flux - Ventilation\ Flux - Deposition\ Flux + Re\text{-}suspension\ Flux - Filtration\ Flux$$

where:

dINAIR/dt	= change in time of the indoor air Pb mass (μg/h)
Penetration Flux	= penetration of air containing particles from outdoors (μg/h)
Ventilation Flux	= ventilation of indoor air back to the outdoor environment (μg/h)
Deposition Flux	= deposition of Pb out of the air (μg/h)
Resuspension Flux	= resuspension of accumulated Pb on the floor back into the air (μg/h)
Filtration Flux	= filtration associated with re-circulating air due to the presence of an HVAC system (μg/h)

Each flux is parameterized as the mass of the "donor" compartment multiplied by the rate (expressed in reciprocal time) of the physical exchange process. In some cases, an efficiency factor is also included to account for any filtration of Pb associated with the process:

$$Penetration\ Flux = AER \times P \times PbAIR \times V$$

where:

Penetration Flux	= penetration of air containing particles from outdoors (μg/h)
AER	= air exchange rate (h^{-1})
P	= penetration efficiency (unitless)
PbAIR	= concentration of Pb in ambient air ($\mu g/m^3$)
V	= volume of the house (m^3)

Because the air exchange rate (*AER*) specifies the number of times the indoor air is replaced by outdoor air in a given hour, it represents both the rate of penetration in and ventilation out. The ventilation flux out of the house is equal to the *AER* multiplied by the indoor mass of Pb in air (*INAIR*):

$$Ventilation\ Flux = AER \times INAIR$$

where:

Ventilation Flux	= ventilation of indoor air back to the outdoor environment (μg/h)
AER	= air exchange rate (h^{-1})
INAIR	= indoor mass of Pb in air (μg)

The deposition flux (*Deposition Flux*) is defined as the amount of Pb in the air times a deposition rate:

$$Deposition\ Flux = D \times INAIR$$

where:

Deposition Flux	= deposition of Pb out of the air (μg/h)
D	= deposition rate (h^{-1})
INAIR	= indoor mass of Pb in air (μg)

For resuspension, the amount of resuspended material depends on the total available mass of Pb on the floor. Because the current model only traces air-derived floor Pb (and other sources of Pb not transported via outdoor to indoor air), resuspension cannot be accurately modeled. In addition, resuspension rates have not been extensively studied in field studies. Thus, similar to other mass balance models, resuspension is neglected in the current mechanistic model (Riley et al., 2002); this assumption will tend to underestimate the Pb in the air compartment and overestimate the Pb in the floor compartment.

Finally, the presence of an HVAC system will tend to re-circulate indoor air, passing the air through a filter with each circulation. This system will tend to remove Pb from the indoor environment (both in the air and on the floor). Because many urban families do not have HVAC systems and because the circulation rate and filtration efficiency of such systems has not been comprehensively described in the literature, removal of Pb during recirculation is not included in the mechanistic model.

So, using the penetration, ventilation, and deposition fluxes, the equation for the change in time of the indoor air Pb mass is:

$$\frac{dINAIR}{dt} = AER \times P \times PbAIR \times V - AER \times INAIR - D \times INAIR \qquad \textbf{(Equation 1)}$$

where:

dINAIR/dt	= change in time of the indoor air Pb mass (μg/h)
AER	= air exchange rate ($hour^{1}$)
P	= penetration efficiency (unitless)
PbAIR	= concentration of Pb in ambient air ($\mu g/m^3$)
V	= volume of the house (m^3)
D	= deposition rate (h^{-1})
INAIR	= indoor mass of Pb in air (μg)

For the indoor floor dust compartment (*FLOOR*), the fluxes include deposition of Pb from the air onto the floor, resuspension of Pb from the floor into the air, and removal of Pb due to routine cleaning:

$$\frac{dFLOOR}{dt} = Deposition\ Flux - Resuspension\ Flux - Cleaning\ Flux$$

where:

dFLOOR/dt	= change in time of the indoor floor dust Pb mass (μg/h)
Deposition Flux	= deposition of Pb out of the air onto the floor (μg/h)
Resuspension Flux	= resuspension of Pb from the floor into the air (μg/h)
Cleaning Flux	= removal of Pb due to routine cleaning (μg/h)

The deposition flux (*Deposition Flux*) retains the same form as in the *INAIR* equation, and the resuspension flux (*Resuspension Flux*) is again neglected. The cleaning flux (*Cleaning Flux*) is parameterized assuming a cleaning efficiency (*CE*) and cleaning frequency (*CF*) and multiplying these by the mass of Pb on the floor (*FLOOR*):

$$Cleaning\ Flux = CE \times CF \times FLOOR$$

where:

Cleaning Flux	= removal of Pb due to routine cleaning (μg/h)
CE	= cleaning efficiency (unitless)
CF	= cleaning frequency (cleanings/h)
FLOOR	= mass of Pb on the floor (μg)

In this parameterization, discrete cleaning episodes occurring with a given frequency are assumed to be captured by assuming continuous cleaning with the same frequency (rate) and efficiency. Combining the floor fluxes then gives:

$$\frac{dFLOOR}{dt} = D \times INAIR - CE \times CF \times FLOOR \qquad \textbf{(Equation 2)}$$

where:

dFLOOR/dt = change in time of the indoor floor dust Pb mass (μg/h)
D = deposition rate (h^{-1})
INAIR = indoor mass of Pb in air (μg)
CE = cleaning efficiency (unitless)
CF = cleaning frequency (cleanings/h)

FLOOR = mass of Pb on the floor (μg)

To obtain the steady-state solution for each compartment, the derivative terms are set to zero, so that nothing is changing in time. Using equations (1) and (2) and rearranging gives:

$$(D + AER) \times INAIR = AER \times P \times PbAIR \times V$$
$$CE \times CF \times FLOOR = D \times INAIR$$

The ambient air concentration (*PbAIR)*, is known, so the upper equation can be solved for *INAIR* to give:

$$INAIR = \frac{AER \times P \times V}{(D + AER)} \times PbAIR$$

Then, substituting into the second equation gives:

$$FLOOR = \frac{D \times AER \times P \times V}{CE \times CF \times (D + AER)} \times PbAIR$$

Thus, this equation yields the mass of Pb on the floor, and the Pb loading can be found by dividing by the floor area and noting that the house volume divided by the floor area is the ceiling height (*H*):

$$FLOOR\ LOADING = \frac{D \times AER \times P \times H}{CE \times CF \times (D + AER)} \times 0.09 \times PbAIR \qquad \textbf{(Equation 3)}$$

where:

FLOOR LOADING	= Pb loading on the floor (μg/ft^2)
D	= deposition rate (h^{-1})
AER	= air exchange rate (h^{-1})
P	= penetration efficiency unitless)
H	= ceiling height (meter [m])
CE	= cleaning efficiency (unitless)
CF	= cleaning frequency (cleanings/h)
PbAIR	= concentration of Pb in the ambient air (μg/m^3)

The 0.09 term is included in the equation to change the loading units from μg/m^2 to μg/ft^2 (where *PbAIR* is in μg/m^3). This final equation gives the floor Pb loading accumulated under steady-state conditions from air-derived sources, assuming that none of the underlying ambient air concentrations or process rates varies over time. In reality, the *AER* will vary seasonally (especially if windows are open), cleaning rates likely are not constant, and other rates may vary; in addition, several of the parameters (e.g., deposition rate and penetration efficiency) may vary by particle size. Thus, the steady-state solution represents the average floor loading if the inputs are selected to be representative of time-averaged and particle-size-averaged rates and concentrations.

G.3.2.2. Input Values for the Mechanistic Model

To implement the mechanistic model for the general urban case study, representative input parameters applicable to urban environments had to be specified. Exhibit G-4 gives the input parameter values chosen and the source of the values.

Exhibit G-4. Input Parameters Selected for the Mechanistic Model for Urban Environments

Variable	Variable Name	Units	Value	Source
D	Deposition Rate	h^{-1}	1.11	(Layton and Thatcher, 1995)
AER	Air Exchange Rate	h^{-1}	0.5	(USEPA, 1997; Riley et al., 2002; Vette et al., 2001)
P	Penetration Efficiency	unitless	1	(Layton and Thatcher, 1995)
H	Ceiling Height	m	2.44	(USEPA, 1997)
CE	Cleaning Efficiency	unitless	0.25	(Battelle Memorial Institute, 1997)
CF	Cleaning Frequency	cleanings/h	0.003	Professional Judgement

The deposition rate (*D*) was set to 1.11 h^{-1}. This value was derived from the only Pb-specific estimate of deposition velocity that was found in the literature, obtained from a mass-balance modeling analysis of homes near a Pb smelter in Arnhem, Netherlands (Layton and Thatcher, 1995). The deposition velocity was converted to a deposition rate by dividing the velocity by the assumed ceiling height (8 ft, or 2.44 m). This value tended to be within the range of literature values reported for generic particles of differing size distributions (e.g., Riley et al. (2002) Figure 3]: 0.04 to 7.2 h^{-1} for 0.1 to 10 micrometer [μm]; Vette et al. (2001) Figure 7: 0.5 to 4 h^{-1} for 0.01 to 2 μm).

The *AER* values were consistently reported to have central tendency values near 0.5 exchanges per h (USEPA, 1997; Riley et al., 2002; Vette et al., 2001). For example, Table 17-10 of the Exposure Factors Handbook (USEPA, 1997) indicates a GM near 0.5 for all regions of the country, with only the north central region having a somewhat lower *AER* (0.39).

The penetration efficiency (*P*) has been modeled for particles of various size classes and has been measured in a few field studies to be less than one (e.g., Dockery D.W. and Spengler J.D., 1981; Freed et al., 1983; Liu and Nazaroff, 2001). However, unlike the above studies, in a field study that simultaneously controlled for penetration and deposition, the penetration efficiency (*P*) was found to be near 1 for all size classes (Thatcher and Layton, 1995); a similar result was also reported for $PM_{2.5}$ for homes in California (Ozkaynak et al., 1996). Thus, the penetration efficiency (*P*) was set to 1 for the mechanistic model. The ceiling height (*H*) was set to 8 ft (2.44 m) based on the typical ceiling height in the United States (USEPA, 1997).

The two cleaning variables (efficiency and frequency) likely represent the most poorly characterized parameters. Cleaning efficiency (*CE*) has been found to vary according to the type of flooring (carpeting versus hard floor) and the total amount of Pb on the floor (lower efficiencies for very low Pb loadings, due to electrostatic forces attracting the particles to the floor or burial of Pb deep into carpet, and higher efficiencies for higher Pb loadings). The Environmental Field Sampling Study (EFSS), Volume I: Table 8D-3 (Battelle Memorial Institute, 1997) provides pre- and post-cleaning Pb loading estimates from a house with hard floors that was subject to a renovation activity and post-activity cleaning. Thus, these estimates likely are higher than routine cleaning efficiencies in a house where no renovation (and no associated elevated Pb loading) has occurred. The selected value for *CE* (25 percent removal with each cleaning) is typical of the cases in the lowest Pb loading range in the study. These values are similar to values found by Ewers et al. (1994) and Clemson Environmental Technologies Laboratory (2001) for cleaning efficiencies on a carpeted floor after a renovation activity and after three previous cleaning iterations (so that much of the renovation-related Pb loading had already been removed and the cleaning was similar to a routine cleaning).

The cleaning frequency (*CF*) is expected to be highly variable from household to household, and no information could be located in the literature for urban houses. A representative value of one cleaning every two weeks (0.003 cleanings per h) was selected using professional judgment.

Based on these inputs, the final equation for the steady-state air-derived indoor dust Pb loading is:

$$FLOOR\ LOADING = 104.2 \times PbAIR$$ **(Equation 4)**

where:

FLOOR LOADING = Pb loading on the floor (µg/ft^2)
PbAIR = concentration of Pb in the ambient air (µg/m^3)

This equation is meant to capture all Pb mass that falls on the floor from air-derived sources, so it is more consistent with wipe-based Pb loading measurements rather than vacuum-based Pb loading measurements. This steady-state answer applies to the extent to which the inputs can be assumed to represent time averages. With the given inputs, solving this equation dynamically indicates that the modeled system will require one year to reach steady-state conditions (although the modeled floor Pb loading is within 90 percent of the steady-state solution after 129 days).

G.3.3. Combining the Mechanistic Air Model with Empirical Data to Derive an Indoor Dust Pb Loading Estimate from Other Sources

Equation (4) gives the estimated steady-state indoor dust Pb loading from recent air-derived sources. This value must be combined with another estimate of indoor dust Pb loading that incorporates all other sources of Pb to indoor dust (e.g, indoor paint, outdoor soil/dust and additional sources including historical air). To do so, the median indoor dust Pb loading value from the HUD National Survey of Lead-Based Paint in Housing (USEPA, 1995) was selected as a representative total indoor dust Pb loading. The HUD survey selected study homes such that the overall survey estimates are weighed by population to be nationally representative. Although the survey does not focus on urban homes, these homes are likely dominating the signal because urban areas represent the population centers in the country. The median wipe indoor dust Pb loading in the survey was 5.32 μg/ft^2.

In order to derive the “other” component from the HUD median Pb loading value, the associated recent air component was estimated using an air Pb concentration derived to correspond to the HUD survey indoor dust survey. The HUD survey was conducted during late 1989 and early 1990. To derive a representative air Pb concentration, data for all U.S. EPA AQS air monitors operating in 1989 and 1990 were averaged into a single air concentration estimate of 0.04 μg/m^3 (USEPA, 2007). This average was calculated separately using all monitors and using only those monitors in urban locations, but the differences in the concentrations estimated by the two methods was minimal; so the all monitors value was used. This air value was then substituted into the mechanistic model to give a recent air-derived Pb loading of 4.17 μg/ft^2. By subtracting this recent air-derived portion from the total background Pb loading, a Pb indoor dust loading estimate of 1.15 μg/ft^2 was derived for other source contributions. Thus, the final hybrid mechanistic-empirical model equation is:

$$TOTAL\ FLOOR\ LOADING = 104.2 \times PbAIR + 1.15$$ **(Equation 5)**

where:

TOTAL FLOOR LOADING = total Pb loading on the floor (μg/ft^2)

PbAIR = concentration of Pb in the ambient air (μg/m^3)

The HUD survey was selected because it is the same data set that was used to derive the indoor dust Pb loading to indoor dust Pb concentration conversion equation (see Section G.3.4). Because the HUD survey was conducted in 1989 and 1990, it has the potential to introduce an upward bias in estimating contributions from sources other than recent air to indoor dust Pb levels for the current housing stock. Reductions in Pb paint and outdoor soil/dust Pb concentrations may have occurred since 1990, due to education about the dangers of indoor Pb exposure and because some of the more heavily contaminated older homes have been demolished. Furthermore, household habits may have changed (e.g., cleaning behavior) due to increased education.

The picture is less clear for Pb in outdoor soil/dust. As discussed above, in the absence of direct remediation, the half-life of Pb in outdoor soil may be up to 700 years (Laidlaw et al., 2005), suggesting that the outdoor soil levels probably have not dropped significantly since the HUD survey. One last limitation of the HUD survey is that it focuses on homes built before 1980 and does not include any built between 1990 and the present. However, because the focus of the hybrid model is on urban homes that tend to be of earlier vintage, using the HUD survey data as the basis for estimating background indoor dust loading allows for reasonable estimates of overall indoor dust Pb loading to be generated that are typical of current urban housing stock. This indoor dust estimate is applicable in "typical" urban environments with outdoor soil and paint contributions to indoor dust Pb loading which do not differ strongly from those observed in the HUD survey data. For situations with high paint or outdoor soil signals, or atypical household habits, the model may not adequately capture the total indoor dust Pb loadings.

G.3.4. Converting Indoor Dust Pb Loadings to Indoor Dust Pb Concentrations

Once the indoor dust Pb loadings are calculated, indoor dust concentrations must be estimated from these loadings for input into the PbB model. To do so, a regression equation was developed based on empirical data. Data on the relationship between indoor dust Pb loading and concentration were gathered as part of the HUD National Survey of Lead-Based Paint in Housing (USEPA, 1995).

The equation for the concentration to loading regression was found to be:

$$\ln(PbCONC) = 4.92 + 0.52 \times \ln(PbVAC)$$

where:

$PbCONC$ = indoor dust concentration (µg/g)
$PbVAC$ = vacuum indoor dust Pb loading (µg/ft^2)

For more information on the derivation of this equation, see Attachment G-1. Because this model was derived using log-transformed variables, small changes in the slope or intercept transfer to large changes in the predicted dust concentration; thus, this conversion introduces considerable uncertainty into the dust model.

G.3.4.1. Estimating Vacuum Pb Loadings from Wipe Pb Loadings

The equation that converts dust Pb loading to dust Pb concentration (see Section G.3.4) requires that the dust Pb loading estimates be for vacuum Pb loading . This section describes the equation used to convert wipe Pb loadings (from the hybrid model) to vacuum Pb loadings. To do so, the following equation developed to convert wipe samples to blue nozzle vacuum samples for hard floors is used (USEPA, 1997):

$$PbVAC = 0.185 \times PbWIPE^{0.921}$$

where:

$PbVAC$ = vacuum indoor dust Pb loading (μg/ft^2)
$PbWIPE$ = indoor wipe Pb loading (μg/ft^2)

G.3.5. Specification of the General Urban Case Study Indoor Dust Algorithms

Converting the hybrid model wipe Pb loading to vacuum Pb loadings and using the conversion equation to convert from Pb loading to concentration gives the final form of the hybrid model for the general urban case study:

$$PbDUST = EXP[4.92 + 0.52 \times \ln\left(0.185 \times (104.2 \times PbAIR + 1.15)^{0.931}\right)]$$ **(Equation 6)**

where:

$PbDUST$ = indoor dust Pb loading (μg/ft^2)
$PbAIR$ = concentration of Pb in the ambient air (μg/m^3)

In contrast, the air-only regression-based model is:

$$PbDUST = 60 + 844 \times PbAIR$$ **(Equation 7)**

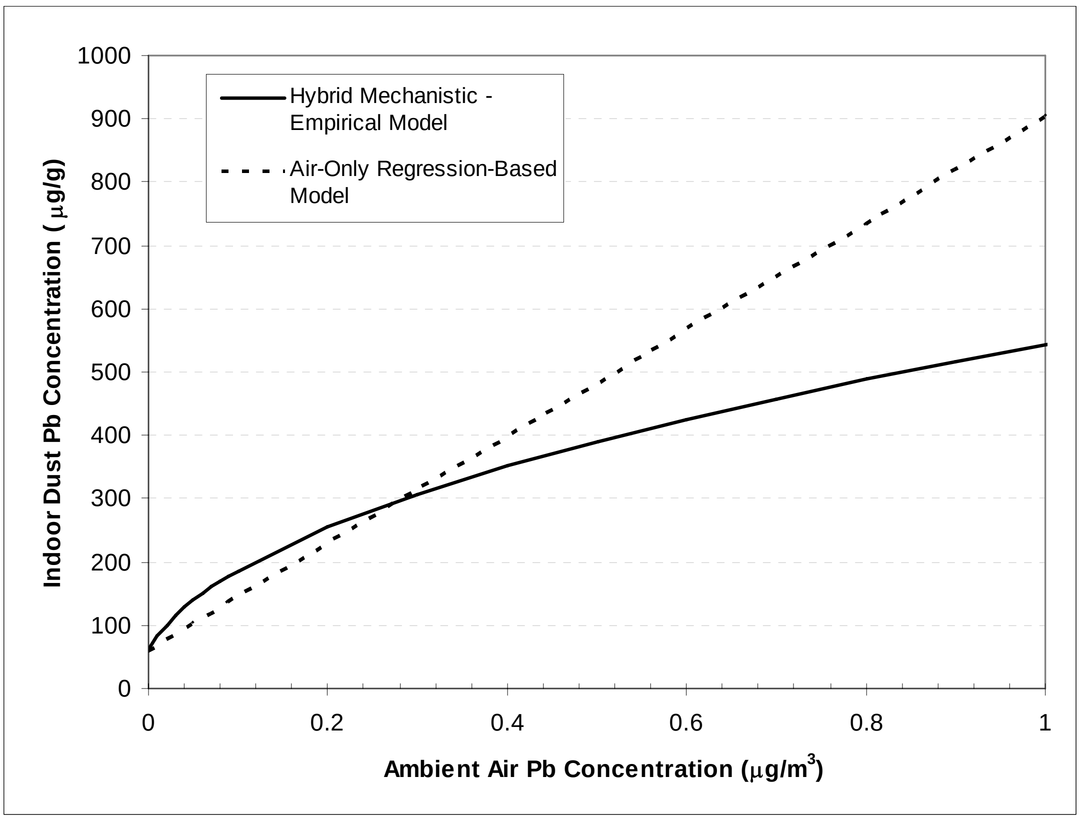
where:

$PbDUST$ = indoor dust Pb loading (μg/ft^2)
$PbAIR$ = concentration of Pb in the ambient air (μg/m^3)

Exhibit G-5 shows a comparison of indoor dust Pb concentrations estimated using the hybrid model and the air-only regression based model for a given ambient air Pb concentration. The two models have similar intercepts at zero air Pb concentrations. The air-only regression-based model is linear and tends to predict higher indoor dust Pb concentration than the hybrid model for air Pb concentrations between 0 and 0.3 μg/m^3. The average difference between the models in this range of air concentrations is 20 percent. Above 0.3 μg/m^3, the slope of the hybrid model decreases, and the air-only regression-based model then predicts higher indoor dust Pb concentrations for a given ambient air level (with an average difference of 61 percent between 0.3 and 1.5 μg/m^3).

The hybrid mechanistic-empirical model and the air-only regression-based model represent two distinct options for converting ambient air concentrations to indoor dust concentrations, one that is strictly empirical and one that combines empirical background measurement with a mechanistic air-dust model. Indoor dust calculations are performed using both models for the general urban case study to allow for the characterization of uncertainty associated with the selection of the indoor dust modeling approach.

Exhibit G-5. Comparison of the Hybrid Mechanistic-empirical Model and the Air-only Regression-based Model Indoor Dust Pb Concentration Predictions for a Given Ambient Air Pb Concentration



G.3.6. Performance Evaluation of the General Urban Case Study Indoor Dust Models

Various data sources are available to evaluate the performance of the mechanistic portion of the model, the full hybrid model, and the air-only regression-based model in urban or smelter environments. Evaluations that have been performed are shown in Exhibit G-6. In general, no data set provides the ideal set of data for performance evaluation, which would include simultaneous measurements of ambient air concentrations, indoor air concentrations, indoor dust wipe Pb loadings, indoor dust vacuum Pb loadings, and indoor dust Pb concentrations in multiple houses in multiple urban environments. However, the available data do provide insights into the performance of the models in specific urban environments.

Exhibit G-6. Summary of Performance Evaluation Performed on General Urban Case Study Models

Study	Location and Year of Study	Study Parameters Relevant to Model Evaluation	Evaluation Performed	Results of Evaluation	Conclusions
Air-only Regression-based Model Deposition Fluxes					
Caravanos et al., 2006	Manhattan, New York City, New York; 2003 to 2005	Median Pb deposition flux on a glass plate near a window open 1 inch (in); Upper limit of deposition flux on a glass plate near a closed window. Glass plates were located in a stairwell with no Pb paint and no foot traffic, so the deposition is due to air contributions only.	Compare Pb deposition fluxes to weekly deposition flux in the mechanistic air-only model; mechanistic model is run without cleaning and at an air exchange rate of 0.5 exchanges per h (appropriate for a closed-window environment); ambient air is assumed to be consistent with the 2005 national value of 0.025 $\mu g/m^3$.	Caravanos, window open 1 in: 4.8 $\mu g/ft^2$/week; Caravanos, window closed: < 1.6 $\mu g/ft^2$/week; Mechanistic model: 0.35 $\mu g/ft^2$/week.	The mechanistic model gives deposition fluxes lower than the measured rate with the window open but is consistent with the case with a window closed.
Ratio of Indoor Air and Ambient Air Pb Concentrations					
Roy et al., 2003	NHEXAS Region 5: Minnesota, Wisconsin, Michigan, Illinois, Indiana, and Ohio	25th Percentile, Median, and 75th Percentile indoor and ambient air Pb concentrations.	Compare the ratio of indoor to ambient air concentrations in each percentile to the ratio in the air-only mechanistic model run with an air exchange rate of 0.5.	Roy, 0.62, 0.73, 0.93 (25th, Median, 75th Percentile); Mechanistic Model: 0.31.	Assuming that the 25th percentile indoor and ambient concentrations correspond to the same house (and similarly for the median and 75th Percentile), the Roy study indicates that the indoor to outdoor ratio increases for increasing ambient air concentrations. In the mechanistic model, this ratio is constant with increasing ambient air concentrations. The mechanistic model gives lower ratios, potentially due to the absence of resuspension. Also, the ventilation pattern in each of the study homes is unknown; open windows increase the air exchange rate and increase the indoor to ambient air concentration ratio.

Exhibit G-6. Summary of Performance Evaluation Performed on General Urban Case Study Models

Study	Location and Year of Study	Study Parameters Relevant to Model Evaluation	Evaluation Performed	Results of Evaluation	Conclusions
Riley et al., 2002	Modeled	Modeled indoor air to ambient air concentrations created by combining empirical data and a mass balance model.	Compare the range of predicted ratios with the air-only mechanistic model, where both models use the same air exchange rate.	Riley: 0.2 to 0.8 for urban scenarios with typical ventilation (the range is for different particle size classes); Mechanistic Model: 0.31.	The modeled indoor/outdoor ratio is consistent with the range for other urban mass balance models; the 0.31 value is closer to the modeled value for the coarse mode particles (2.5 µm to 10 µm). Particles less than 2.5 µm and greater than 10 µm tend to have higher ratios in the Riley study.
Percent Contribution of Air Pb to Indoor Dust Pb					
Adgate et al., 1998	Jersey City, New Jersey; 1992 to 1994	Mean percent contribution from air, paint, and crustal materials to indoor dust; these are ascertained using isotopic ratios of multiple elements and assuming the indoor dust is comprised of Pb from these three sources only.	Compare the percent contribution from air in the study to the percent contribution in the hybrid mechanistic-empirical model and in the air-only regression-based model, assuming an air concentration of 0.04 µg/m^3 (consistent with national air values in 1990).	Adgate: 17.2 percent from air; Hybrid Model: 78 percent from air; Air-only Regression-based Model: 36 percent from air.	Both the hybrid model and the air-only regression-based model predict higher percentage air contributions at the assumed air concentration than were seen in the Adgate study; these percentages tend to decrease with decreasing ambient air concentrations in both the air-only regression-based model and hybrid model The Adgate study estimate of air contribution is likely biased low since the homes tend to be largely < 1940 homes with strong Pb paint dust contributions. This air contribution is also highly dependent on the outdoor soil/dust concentrations, which may also be elevated due to the historical presence of exterior Pb paint in these older homes.
Loading to Concentration Regression					
Tang et al., 2004	Manhattan, New York City; 2002	Mean vacuum Pb loadings and concentrations, assuming the non-detects are 0 (ND=0) and the non-detects are the detection limit (ND=DL).	Compare the actual concentrations with the concentrations predicted using the loading to concentration regression equation with the mean Pb loadings.	Vacuum Loadings: 0.5 and 3 µg/ft^2; Measured Indoor Dust Pb Concentrations: 130 and 130 µg/g; Predicted Concentrations: 96 and 243 µg/g (ND=0 and ND=DL).	The indoor dust Pb concentrations predicted with the hybrid model (upper and lower bounds, assuming Pb loading non-detects are either zero or the detection limit) bound the actual measured mean concentration.

Exhibit G-6. Summary of Performance Evaluation Performed on General Urban Case Study Models

Study	Location and Year of Study	Study Parameters Relevant to Model Evaluation	Evaluation Performed	Results of Evaluation	Conclusions
Roy et al., 2003	NHEXAS Region 5: Minnesota, Wisconsin, Michigan, Illinois, Indiana, and Ohio	25th Percentile, Median, and 75th Percentile vacuum Pb loadings and wipe Pb concentrations.	Compare the actual concentrations with the concentrations predicted using the Pb loading to concentration regression equation for each percentile.	Vacuum Loadings: 4.77, 10.44, 22.86 µg/ft^2; Measured Concentrations: 68, 129, 303 µg/g; Predicted Concentrations: 309, 464, 697 µg/g (25th, Median, and 75th Percentile).	In general, the Pb loading to concentration equation predicts higher indoor dust concentrations than the measured values at all percentiles (where the assumption is made that the 25th percentile Pb loading corresponds to the 25th percentile concentration, and similarly for the median and 75th percentile). This result suggests that the exposure media concentrations and/or the relative importance of the contributing media (outdoor soil/dust, air, and paint) are different in the NHEXAS study compared to the HUD survey, from which the regression was derived.
Predicted Indoor Dust Pb Loadings in the Hybrid Mechanistic-empirical Model					
Tang et al., 2004	Manhattan, New York City, New York; 2002	Mean wipe and vacuum Pb loadings and mean indoor air Pb concentrations.	Compare the predicted total Pb loadings from the hybrid model with the mean wipe and vacuum Pb loadings; the empirical model is run using indoor air concentrations provided in the study. Thus, the model equations are altered to solve for the floor Pb loading as a function of indoor air instead of ambient air. Two cases are analyzed: one assuming the Pb loading and indoor air Pb concentration non-detects are zero (ND=0) and one assuming the Pb loading and indoor air Pb concentration non-detects are the detection limits (ND=DL).	Tang Indoor Air Concentrations: 0.002 and 0.05; Tang Wipe Loadings: 0.5 and 1.0 µg/ft^2; Tang Vacuum Loadings: 0.9 and 3.0 µg/ft^2; Hybrid Model Loading: 1.8 and 17.8 µg/ft^2 (ND=0 and ND=DL).	The hybrid model gives estimates that should be consistent with wipe Pb loadings. The hybrid model predicts higher indoor dust Pb loading than observed in both the ND=0 and ND=DL cases, although the predicted value is close the actual value when comparing wipe Pb loadings and predicted Pb loadings for the ND=0 case. The study likely includes high-rise buildings where outdoor soil/dust tracking and ambient air Pb levels may be lower than those in ground-floor homes. Also, the measured vacuum Pb loadings are higher than the wipe Pb loadings, contrary to expectations.

Exhibit G-6. Summary of Performance Evaluation Performed on General Urban Case Study Models

Study	Location and Year of Study	Study Parameters Relevant to Model Evaluation	Evaluation Performed	Results of Evaluation	Conclusions
Roy et al., 2003	NHEXAS Region 5: Minnesota, Wisconsin, Michigan, Illinois, Indiana, and Ohio	25th Percentile, Median, and 75th Percentile wipe Pb loadings and ambient air concentrations.	Compare the hybrid model Pb loadings using the measured ambient air concentrations to the measured wipe Pb loadings.	Roy Ambient Air: 0.00599, 0.00863 0.0123 µg/m^3; Roy Wipe Loading: 1.5, 5.35, 17.73 µg/ft^2; Predicted Loading: 1.77, 2.05, 2.43 µg/ft^2 (25th, Median, 75th Percentile).	The hybrid model overpredicts the Pb loading at low air concentrations and underpredicts the Pb loading at higher air concentrations, assuming that the 25th percentile air measurements correspond to the 25th percentile Pb loadings (and similarly for the median and 75th percentiles). The higher Pb loading percentiles likely contain higher than average outdoor soil/dust, paint, and/or household-specific contributions to indoor dust, which are not captured in the empirical portion of the hybrid model (which assumes median conditions from the HUD survey).
Lanphear et al., 1996	Rochester, New York; 1993	GM indoor dust Pb loadings (wipe) averaged over all surfaces.	Compare the predicted total Pb loadings from the hybrid model with the measured indoor dust Pb loading, assuming an ambient air Pb concentration of 0.04 (nationally representative 1990 value)	Lanphear indoor Pb dust loading; 106 µg/ft^2; hybrid model loading: 5.3 µg/ft^2.	The hybrid model gives a very low indoor dust Pb level compared with the measured Pb loading; however, over 85 percent of the study homes in Rochester were constructed before 1940, suggesting a very strong paint signal that is not captured in the hybrid model. The Lanphear value is higher than typical urban indoor dust Pb loadings seen in other data sources, such as the HUD survey.

Exhibit G-6. Summary of Performance Evaluation Performed on General Urban Case Study Models

Study	Location and Year of Study	Study Parameters Relevant to Model Evaluation	Evaluation Performed	Results of Evaluation	Conclusions
Predicted Concentrations in the Hybrid Mechanistic-Empirical Model and Air-only Regression-based Model					
Tang et al., 2004	Manhattan, New York City, New York; 2002	Mean Pb indoor dust concentrations and mean indoor air Pb concentrations.	Compare the predicted concentrations using the hybrid model with the measured indoor air concentrations to the actual indoor dust concentrations; compare the air-only regression-based model predicted concentrations assuming that ambient air = indoor air to the measured indoor dust concentrations. Cases using the air concentrations assuming the non-detects are zero (ND=0) and the non-detects are the detection limit (ND=DL) are both analyzed.	Tang Indoor Air Concentrations: 0.002 and 0.05 µg/m^3; Tang Indoor Dust Concentrations: 130 and 130 µg/g; Hybrid Model Indoor Dust Concentrations: 76 and 226 µg/g; Air-only Regression-based Model Indoor Dust Concentrations: 62 and 102 µg/g (ND=0 and ND=DL).	The hybrid model indoor dust concentrations using the ND=0 and ND=DL cases bound the actual measured concentration of 130 µg/g; the air-only regression-based model cases both predict lower indoor dust Pb concentrations than the measured value. The ambient air concentrations are set equal to indoor air concentrations for the air-only regression-based model, so the ambient air concentrations are lower than likely actual values introducing a low bias to the air-only regression-based model predictions in this case.
Rasmussen et al., 2001	Ottawa, Canada; 1993	Arithmetic mean, GM, median, minimum, maximum, 90th percentile and 95th percentile indoor dust concentrations.	Compare the hybrid model indoor dust concentrations and the air-only regression-based model concentrations using an ambient air concentration consistent with national values in the United States in 1990 with the measured indoor dust concentrations.	Rasmussen Indoor Dust Concentrations: 406, 233, 222, 50, 3226, 969, 1312 µg/g (arithmetic mean, GM, median, minimum, maximum, 90th percentile, 95th percentile); Hybrid Model Indoor Dust Concentration: 128 µg/g; Air-only Regression-based Model Indoor Dust Concentration: 94 µg/g.	Assuming the ambient air concentration is representative of Ottawa in 1993, the hybrid model and the air-only regression-based model both tend to under predict the mean and median indoor dust concentration. This result suggests that the background United States concentration used to derive the empirical portion of the model does not adequately capture the indoor dust concentrations in Ottawa.

Exhibit G-6. Summary of Performance Evaluation Performed on General Urban Case Study Models

Study	Location and Year of Study	Study Parameters Relevant to Model Evaluation	Evaluation Performed	Results of Evaluation	Conclusions
Hilts 2003	Trail, British Columbia (smelter site); 1996 to 1999	GM ambient air concentrations and indoor dust concentrations in 1999 (after the opening of a new Pb smelter, which reduced ambient air levels in the community).	Compare the hybrid model indoor dust concentrations and the air-only regression-based model concentrations using the measured ambient air concentrations to the measured Pb concentrations.	Hilts Ambient Air Concentration: 0.3 $\mu g/m^3$; Hilts Measured Indoor Dust Concentration: 583 µg/g; Hybrid Model Indoor Dust Concentration: 301 µg/g; Air-only Regression-based Model Indoor Dust Concentration: 313 µg/g.	The ambient air concentration used in this study is close to the air concentration where the hybrid model and the air-only regression-based model cross, so they give very similar estimates of indoor dust concentration. Both of these estimates tend to somewhat underpredict the indoor dust concentrations; this is likely due to the fact that elevated outdoor soil/dust concentrations in the vicinity of the smelter are playing a larger role in determining the indoor dust concentrations than in a typical urban environment.
Adgate et al. 1998	Jersey City, New Jersey; 1992 to 1994	Mean Pb indoor dust concentration for the coarse size fraction (particle size of 2.5 µm to 10 µm).	Compare the indoor dust concentration in the hybrid model and in the air-only regression-based model, assuming an air concentration of 0.04 $\mu g/m^3$ (consistent with national air values in 1990).	Adgate: 857 µg/g; Hybrid Model: 128 µg/g; Air-only Regression-based Model: 94 µg/g.	Both the hybrid model and the air-only regression-based model under predict the actual mean indoor dust concentration. This may be due to the fact that the Jersey City homes included in the Adgate study tend to be of older vintage and include a strong paint signal that was not captured in the HUD survey empirical data or in the data from which the air-only regression-based model was derived.

The different studies mentioned above allow testing of various portions of the hybrid mechanistic-empirical model and the air-only regression-based model. Comparison of the ratio of ambient air Pb concentrations to indoor Pb concentrations in the mechanistic portion of the hybrid model indicate that the hybrid model ratios are lower than those in the Roy et al. (2003) study; however, this ratio will vary depending on whether windows are open or closed, and no such information is available for the Roy et al. (2003) study. In addition, the portion of indoor dust Pb arising from ambient air contributions is lower in the hybrid model than in the Adgate et al. (1998) study. However, most of the Adgate et al. (1998) study homes were built before 1940, indicating that Pb paint likely plays a larger role in setting the dust Pb loading than in an urban environment including homes from a later vintage. The equation for converting Pb loadings to Pb concentrations was tested using both the Tang et al. (2004) study and the Roy et al. (2003) study. In general, the Pb concentrations estimated from the Pb loadings were within range for the Tang et al. (2004) study, but biased high for the Roy et al. (2003) study, indicating the Roy et al. (2003) study may include data that differs significantly from the HUD study from which the conversion equation was derived. The final predicted concentrations from the hybrid model were compared with the Pb concentrations measured in Manhattan, New York City, New York in the Tang et al. (2004) study, and the predicted values bounded the measured mean value. The hybrid values underpredicted the indoor dust Pb concentrations in the Hilts (2003) study and the Adgate et al. (1998) study. However, the Hilts (2003) study was performed at a Pb smelter site and the Adgate et al. (1998) study included homes built before 1940, both of which suggest these homes are different from a typical urban home. In general, the hybrid model predicts Pb concentrations within the wide range of values available in the literature for urban (and Pb smelter) environments.

G.3.7. Separating Pb Indoor Dust Concentrations into Recent Air and Other Portions

Once the Pb indoor dust concentrations have been estimated using both the hybrid model and the air-only regression-based model, these estimates are also separated into the portion of Pb in indoor dust derived from recent air and the portion derived from other sources (e.g, indoor paint, outdoor soil/dust and additional sources including historical air). For the air-only regression-based model, the concentration equation is linear with respect to the air Pb concentration. Thus, the recent air-derived portion of Pb in indoor dust is the air slope multiplied by the air concentration, and the proportion of indoor dust Pb from the "other sources" portion is equal to the intercept.

For the hybrid model, the Pb indoor dust concentration equation is non-linear with respect to the air concentration. Conversely, the loading equation (including both recent air-derived and other sources) is linear with respect to the air concentration and has the format:

$$PbDustLoading = a + b * PbAir$$

The fraction of total indoor dust from recent air-derived sources is then equal to

$$Air - Dust\ Loading = \frac{b * PbAir}{a + b * PbAir}$$

This fraction is then applied to the total Pb indoor dust concentration to give the recent air-derived portion of total indoor dust. The "other sources" portion is then the remaining Pb indoor dust concentration after subtracting the recent air portion.

G.4. FOUNDATION FOR THE PRIMARY PB SMELTER CASE STUDY INDOOR DUST ALGORITHMS

For estimating indoor dust concentrations for residences in the primary Pb smelter case study, two indoor dust prediction models were used:

- For locations within 1.5 km of the facility: a site-specific regression model; and
- For receptors more than 1.5 km away from the facility: a pooled analysis model (referred to as the air+soil regression-based model) identified from the literature, which predicts Pb indoor dust concentrations given outdoor soil/dust and ambient air Pb levels based on data from a variety of industrial and urban studies (USEPA, 1989).

The site-specific model is based on data collected within the residential remediation zone characterizing yard outdoor soil/dust Pb levels (post-remediation) and indoor dust levels. The air+soil regression-based model, or non-site-specific model, was selected for zones outside of the remediation area because available outdoor soil/dust and indoor dust Pb data did not extend to these more distant areas and the site-specific model derived for the remediated zone was deemed not representative for the non-remediated zone.

G.4.1. Site-specific Regression Model

The objective of the indoor dust analysis for the primary Pb smelter case study was to derive a statistical model that could be used to estimate Pb concentrations in indoor dust from Pb concentrations in other media at locations where the media concentrations had not been directly measured. The models derived were used to estimate indoor dust Pb concentrations for the U.S. Census blocks closest to the primary Pb smelter.

G.4.1.1. Overview of Methods

The primary approach taken in this analysis was to derive regression-type models that describe the relationships among the environmental media concentrations at the primary Pb smelter case study location. This approach was informed by previous analysis completed by EPA and other researchers with similar data. More complex approaches (e.g., structural equation modeling) might also be used to explore and/or confirm the relationships among the variables examined. Based on preliminary analyses of the data, however, the regression analyses were best justified by the quality and quantity of available data.

G.4.1.2. Data Sources

All data used in the analyses were obtained electronically from the U.S. EPA Region 7 (USEPA, 2006) and are presented in Appendix B. Pb concentrations in residential outdoor soil and indoor and road dust were obtained from samples taken by EPA contractors as part of Superfund investigations conducted in the area around the primary Pb smelter from March 2003 to May 2006 (see Exhibit G-7). The data set also contained Pb loading information related to indoor floor dust, dust obtained from wipe samples, and total dust.

Universal Transverse Mercator (UTM) coordinates were provided for all of the samples and were used in the analysis of the spatial patterns of soil and dust contamination. From March 2002 to May 2006, concentrations of Pb in both indoor dust and residential soil were measured at only 17 locations (homes) near the primary Pb smelter. Pb concentrations in residential soil only were measured at 12 other residential locations, for which no accompanying Pb indoor dust measurements were available (see Exhibit G-7). Note that the soil measurements were taken post-remediation; thus, the effect of the historic facility operations on soil Pb concentrations (from stack emissions or road dust) are expected to be greatly attenuated compared to the soil Pb concentrations that existed prior to remediation.

Exhibit G-7. Primary Pb Smelter Case Study: Summary of Pb Concentrations in Residential Soil and House and Road Dust

Data Field	Sampling Locations [a]	Sampling Dates	Samples per Location Mean (Range)	Total Samples	Distances to Main Stack Mean (Range) (m) [b]	Pb Concentration Mean (Range) mg/kg
Indoor Dust	17	March 2002 to May 2006	9 (3 to 20)	159	898 (395 to 1,594)	1,544 (348 to 3,812)
Residential Outdoor Soil	17	March 2002 to May 2006	13 (4 to 23)	215	898 (395 to 1,594)	81 (31 to 139)
Road Dust	21 [c]	May 2002 to April 2006	42 (14 to 139)	891	609 (161 to 1,693)	28,300 (1,570 to 111,000)

[a] Number of locations includes both indoor dust and residential outdoor soil Pb data.
[b] The main stack location is included as a point of reference only (not intended to imply it is the main contributor to the observed Pb concentrations).
[c] Sampling locations with the same UTM coordinates were combined.

Anecdotal evidence suggested that road dust may be a major source of Pb in the air and in indoor dust at residences around the primary Pb smelter; therefore, an analysis was performed to identify the relationships between road dust Pb concentrations and indoor dust Pb concentrations. EPA contractors analyzed almost 900 road dust samples from May 2002 to April 2006. The road dust samples were taken from 21 locations ranging from 161 to about 1,700 m from the main stack. Pb sampling locations for road dust differed from the residential outdoor soil and indoor dust sample locations; the distance between road dust sampling locations and the 17 residential soil and indoor dust sampling locations ranged from 52 to 1328 m (average 280 m).

In the absence of residence-specific ambient air Pb concentration monitoring data, the indoor dust Pb levels were fit to modeled air concentrations developed as part of the pilot assessment. Long-term average air Pb concentrations predicted in the Industrial Source Complex (ISC-PRIME) current NAAQS scenario runs for U.S. Census block and block group centroids located near the residential indoor dust sampling locations were used (ICF, 2006). The centroids were not precisely co-located with any of the indoor dust sampling locations.

G.4.1.3. Data Manipulation

Developing indoor dust prediction models for the primary Pb smelter case study presented a number of challenges. Primary among these challenges was that the indoor dust, residential outdoor soil, and road dust measurements were not taken at the same time. Also, as noted above, the road dust and air modeling input data were spatially removed from the residential indoor dust sampling locations. For these reasons, two approaches were taken to develop data sets for the regression analyses.

G.4.1.3.1. Data Set Based on Spatial-temporal "Windows"

The first approach involved identifying observations from each of the various environmental media that were "close" together in time and space, and using these data to create composite data points. Each data point represented the arithmetic or GM value of all observations in each medium within defined spatial and temporal "windows" of the nearest residential indoor dust observation. The indoor dust observations were used as the centers of the "windows" because fewer observations were available for indoor dust than for any other medium (and because indoor dust was the "dependent" variable for which values were being predicted). The dimensions of the windows were defined for two purposes:

- Maintain, to the extent possible, the temporal and spatial relationships between the indoor dust measurements and the measured/estimated concentrations in the other media; and
- Include as many input data points as possible per window.

After looking at a number of possible approaches to stratify the data, window "dimensions" were chosen with the following spatial and temporal boundaries:

- Indoor dust measurements from the same location occurring within ± 30 days of each other.
- Residential soil measurements within ± 30 days of the nearest indoor dust sampling date for the same residence (soil and indoor dust measurements were taken from the same locations, so no spatial window was necessary).
- Road dust Pb measurements from all of the sampling locations within 300 m, or the closest road dust sampling location, taken within ± 60 days of the indoor dust sample. If no road dust sampling location within 300 m was available, the measurements from the nearest road dust sampling locations were used. For five homes, no road dust samples were taken within approximately 60 days of any indoor dust sampling events. In these cases, all road dust results from within 300 m, or from the closest road dust sampling location, were averaged as above, and associated with the indoor dust sampling dates in the database.
- Average long-term air Pb concentrations estimated for U.S. Census block centroids within 200 m of each indoor dust Pb measurement (ICF, 2006). Most indoor dust sampling locations had several centroids less than 200 m away, but averaging the air Pb levels within 200 m produced the highest correlations with the indoor dust samples. Because no specific date is associated with the estimated air Pb concentrations, the same air concentration values were used for all "windows" for each indoor dust location.

The resulting data set contained 125 records comprised of ambient air, residential outdoor soil, and indoor and road dust data, along with several other auxiliary variables relating to location, distance from the main stack (as a surrogate location for the facility), and sampling dates.

G.4.1.3.2. Data Set Based on Indoor Dust Sampling Locations

The number of samples (and therefore the amount of information) combined into the observations for the individual "windows" varied greatly. The "house" data set, which combines all data for each indoor dust sampling location, was developed to avoid giving undue weight to points with few observational data. The "house" data set includes 17 values for each variable. Each value corresponds to the arithmetic mean or geometric mean of all values for that variable for all "windows" associated with a given indoor dust sampling location. As described below, the modeling results obtained using the "windows" and the "house" data sets are quite similar.

G.4.1.4. Results of the Statistical Analysis

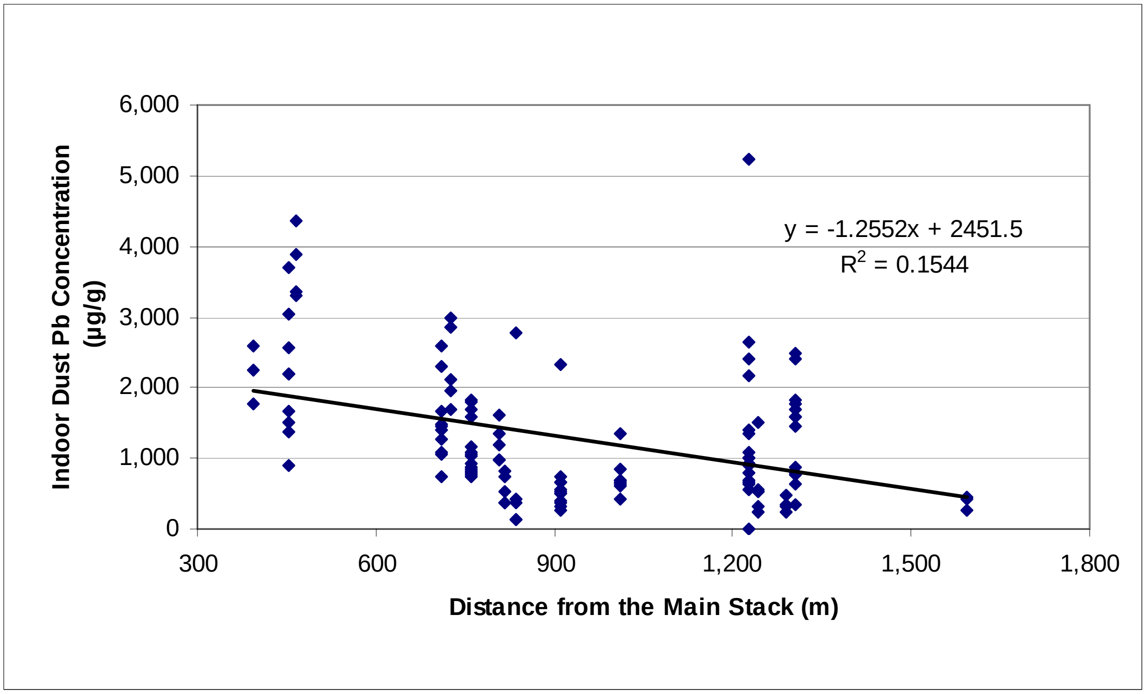
G.4.1.4.1. Exploratory Analysis

Several exploratory analyses were conducted to confirm the general relationships within the data set, and to rule out the potential for omitted variables to affect the regression analysis results. The exploratory analyses included graphical summaries and calculation of simple correlation coefficients among the variables and their log-transformed values.

For House 3, two indoor dust Pb measurements (5,230 and 23,640 milligram per kilogram [mg/kg]) differed markedly from other measurements taken at that house (mean = 1,190 mg/kg, 15 samples). The two measurements were the last two samples taken at House 3 (in April and October 2005). The two measurements were omitted from the analysis on the grounds that some factor maybe have been affecting indoor dust Pb concentrations during this period that had not been operating previously. After removing these two data points, the indoor dust Pb concentrations in the "windows" data set were well-represented by a lognormal distribution, and thus both the untransformed and log-transformed indoor dust Pb values were included in the regression analyses, as discussed below.

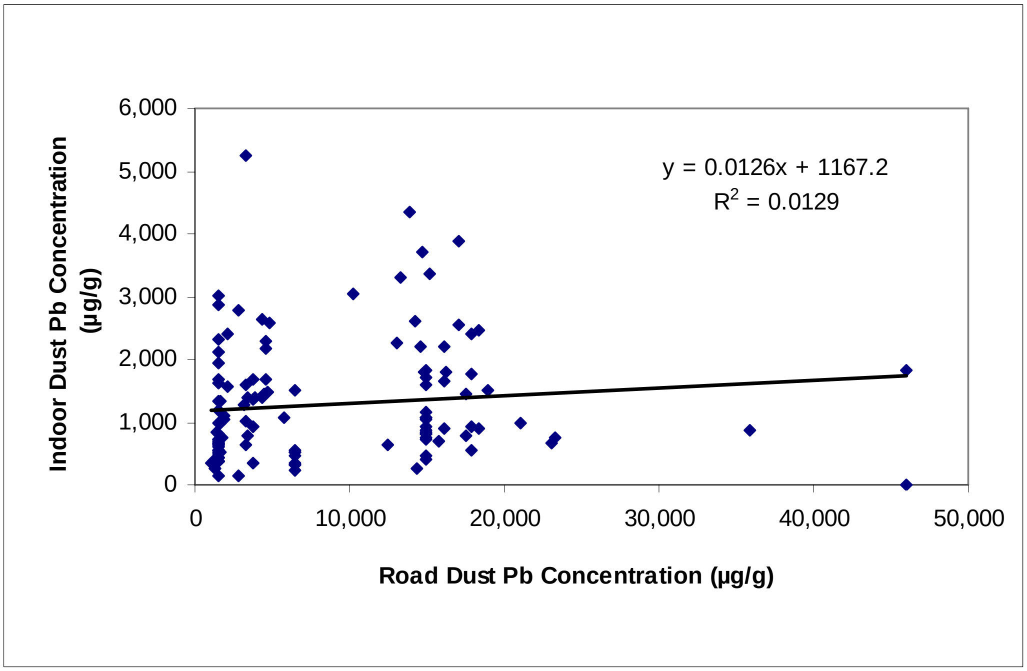
As expected, average indoor dust Pb concentrations were found to be highly (inversely) correlated with distance to the main stack, when the "windows" data set was used (see Exhibit G-8). Pb in air is believed to be a major contributor to indoor dust Pb levels, and thus these results are to be expected. A weak, but significant, inverse correlation between indoor dust Pb concentrations and residential soil Pb was found. The reason for this correlation was not clear, and the significance of the correlation declines in some, but not all, regression models when measures of air Pb are also included. Average and log-transformed road dust Pb concentrations were weakly correlated with similarly expressed indoor dust Pb statistics, but the correlations lost significance when residential soil and air Pb were included in the models (see Exhibit G-9).

Exhibit G-8. Primary Pb Smelter Case Study: Relationship between Indoor Dust Pb Concentrations and Distance from Facility



Note: The main stack location is included as a point of reference only (not intended to imply it is the main contributor to the observed Pb concentrations).

Exhibit G-9. Primary Pb Smelter Case Study: Relationship between Road Dust Pb Concentrations and Nearby Indoor Dust Pb Concentrations



G.4.1.4.2. Regression Modeling of Indoor Dust Pb Concentrations

A systematic search for multiple regression models was conducted to maximize the proportion of explained variance (R^2) in indoor dust (*DustPb*) and the log-transformed indoor dust (*lnDustPb*) values. Forwards and backwards stepwise regression methods were used, with contribution to the F-statistic as the inclusion/removal criterion for untransformed and log-transformed variables. Residential soil and road dust Pb were "forced" back into well-fitted models to determine their effects on R^2 and on the coefficients for other variables. Probability plots of residuals and other diagnostics were used to evaluate the quality of the fit and to determine failures in assumptions required to produce unbiased estimates. Results of the best regressions derived from the "windows" data set are summarized Exhibit G-10.

Exhibit G-10. Indoor Dust Regression Models Tested and Summary of Regression Analysis Results for the "Windows" Data Set

Model [a]	Independent Variable [b]	Dependent Variable(s)	Estimated Values (m)	Coefficient p-Value(s)	Adjusted R^2
W1	DustPb	Intercept	685.7	0.000	0.322
		AIR_200	1625.2	0.000	
W2	DustPb	Intercept	1012.5	0.000	0.367
		SoilAvg	-4.699	0.002	
		AIR_200	1687.2	0.000	
W3	DustPb	Intercept	2285.6	0.000	0.343
		lnAIR200	791.0	0.000	
W4	DustPb	Intercept	2863.2	0.000	0.426
		SoilAvg	-6.317	0.000	
		lnAIR200	874.7	0.000	
W5	LnDustPb	Intercept	6.4540	0.000	0.268
		AIR_200	1.2361	0.000	
W6	LnDustPb	Intercept	6.6725	0.000	0.294
		SoilAvg	-0.0031	0.020	
		AIR_200	1.2777	0.000	
W7	LnDustPb	Intercept	7.7366	0.000	0.336
		lnAIR200	0.6520	0.000	
W8	LnDustPb	Intercept	8.1506	0.000	0.395
		SoilAvg	-0.0045	0.000	
		lnAIR200	0.7120	0.000	

[a] Models labeled "W" were developed considering media concentrations within a particular spatial distance and temporal period of the nearest indoor dust observation.
[b] Abbreviations: *DustPb* = Pb concentration in indoor dust; *LnDustPb* = log-transformed value; *AIR_200* = ambient air concentration within 200 m of indoor dust sampling locations; *lnAIR200* = log-transformed concentration; and *SoilAvg* = average residential soil Pb concentration.

For all of the regressions, variables representing ambient air Pb concentrations at monitors within 200 m of indoor dust sampling locations (*AIR200*, *lnAIR200*) accounted for the bulk of explained variance in indoor dust Pb levels (see Exhibit G-10). The only other variable related to environmental concentrations that retained significance and/or resulted in increases in explained variance was the average residential soil Pb (*SoilAvg*). Surprisingly, the sign of the coefficient for residential soil Pb was consistently negative in those regressions where it was statistically significant. When the natural log of indoor dust Pb concentration (*LnDustPb*) was used as the "independent" variable, the R^2 values for regressions including air and residential soil Pb levels were reduced slightly compared to the results obtained for the analogous regressions using the untransformed *DustPb* values. However, the pattern of regression residuals was considerably improved (more nearly normal) when the log-transformed (as opposed to untransformed) indoor dust values were fit. No variables representing road dust Pb concentration were found to retain statistical significance when air-related variables were included in the regression models.

Similar results were found when regressions were fit using the "house" data set, as shown in Exhibit G-11. Similar coefficient values are observed for analogous regressions based on the two data sets. One difference from the results obtained using the "windows" data was that, when *Air200* was included in the regression, *SoilAvg* became statistically insignificant. Residential soil was significant in the other variants of the model shown in Exhibit G-11. As with the "windows" data set, the road dust Pb was never a significant predictor of indoor dust Pb levels. Also, patterns of residuals were again superior when the models were fit to *LnDustPb,* rather than *DustPb*. The results (coefficients and significance) did not significantly change when regressions were conducted that were weighted by the numbers of observations at each house, rather than uniformly weighted.

Exhibit G-11. Summary of Regression Analysis Results for the "House" Data Set

Model [a]	Independent Variable [b]	Dependent Variable(s)	Estimated Values (m)	Coefficient p-Value(s)	Adjusted R^2
H1	DustPb	Intercept	701.2	0.008	0.489
		Air200	1573.1	0.001	
H2	DustPb	Intercept	2447.1	0.000	0.609
		LnAir200	883.4	0.000	
H3	DustPb	Intercept	3313.2	0.000	0.722
		SoilAvg	-11.349	0.019	
		LnAir200	946.9	0.000	
H4	LnDustPb	Intercept	6.3928	0.000	0.447
		Air200	1.2185	0.002	
H5	LnDustPb	Intercept	7.7892	0.000	0.625
		LnAir200	0.7200	0.000	
H6	LnDustPb	Intercept	8.3884	0.000	0.701
		SoilAvg	-0.0079	0.045	
		LnAir200	0.7639	0.000	

[a] Models labeled "H" were created considering all of the data for each indoor dust sampling location.
[b] Abbreviations: *DustPb* = Pb concentration in indoor dust; *LnDustP*b = log-transformed value; *AIR_200* = ambient air concentration within 200 meters (m) of indoor dust sampling locations; *LnAIR200* = log-transformed concentration; and *SoilAvg* = average residential soil Pb concentration.

G.4.1.4.3. Comparison of Predicted to Observed Indoor Dust Pb Concentrations in Primary Pb Smelter Case Study

To evaluate potential approaches for estimating indoor dust Pb levels in the primary Pb smelter case study, the estimated indoor dust Pb concentrations derived using several of the better fitting models (as judged by adjusted R^2 values) were compared based on the "windows" data (see Exhibit G-12).

Exhibit G-12. Comparison of Three Best "Windows" Models with EPA Air+Soil Regression-based Model and "Windows" Data

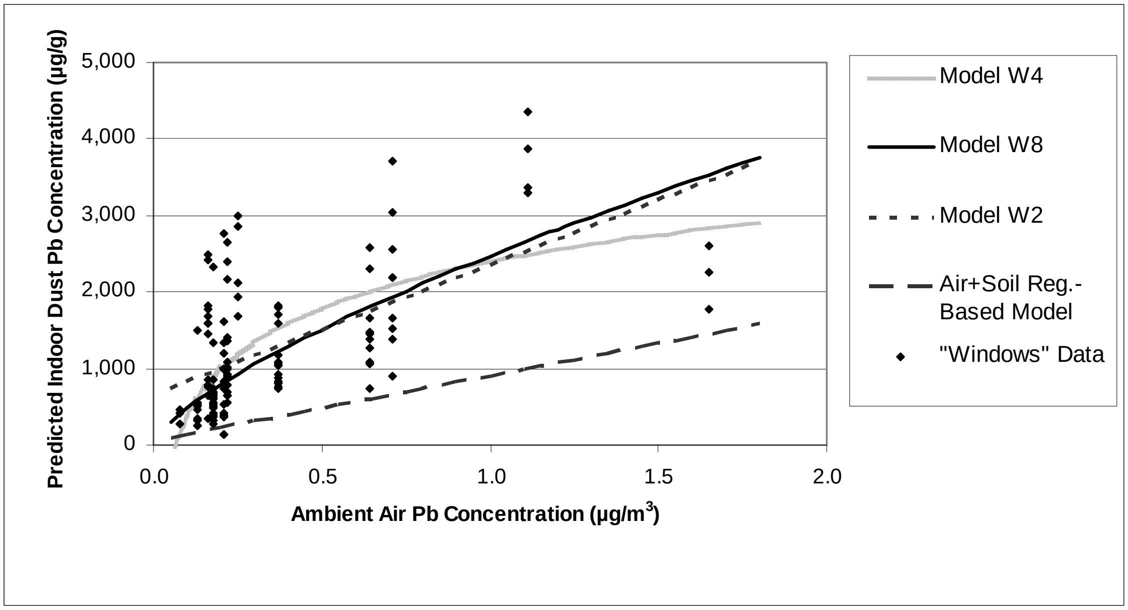
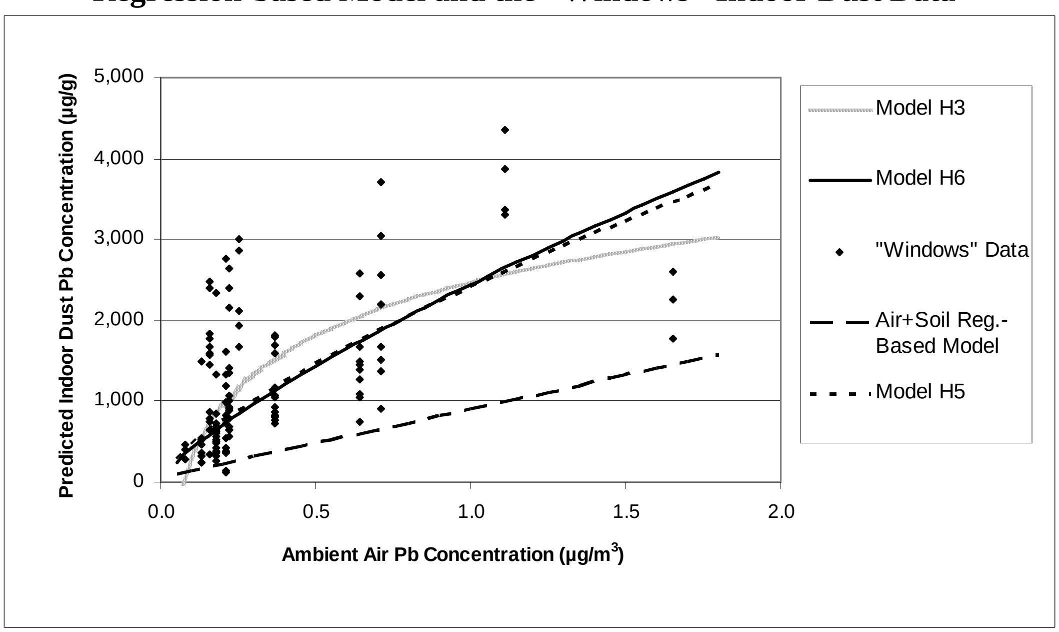


Exhibit G-13 shows the indoor dust concentrations predicted by the three best fitting models derived using the "house" data. For models that included coefficients for residential soil Pb (all except H5), the assumed residential soil Pb concentration was held constant at its mean value. In both cases, the predictions are compared to those derived using EPA's air+soil regression-based model (USEPA, 1989).

Exhibit G-13. Comparison of Best-fitting "House" Models with the EPA Air+Soil Regression-based Model and the "Windows" Indoor Dust Data



The models derived from the "windows" and "house" data sets have generally the same form. The relationships were highly curved, and negative indoor dust values were predicted at low air concentrations, when the models were fit to untransformed indoor dust data (W4, H3). For the "windows" models, predicted indoor dust Pb concentration values were very similar when the model was fit using untransformed air concentrations (W2) or log-transformed values (W8.) Also, predicted indoor dust Pb levels were very similar for the two log-log "house" models when soil concentration was included (H6) or excluded (H5) from the model.

All models predicted substantially higher indoor dust Pb concentrations than the air+soil regression-based model. Also, the air+soil regression-based model predicts indoor dust levels that are far below the observed values.

G.4.1.5. Primary Pb Smelter Case Study: Indoor Dust Modeling Approach Used Near Facility

The availability of site-specific indoor dust and residential soil concentration data from the primary Pb smelter case study location led to the development of a site-specific model as described above. Soil and indoor dust samples from which the site-specific models were developed were available only to a distance of about 1,600 m from the facility's main stack, leading to greater uncertainty associated with use of the site-specific model to predict indoor dust Pb concentrations at greater distances. Thus, the site-specific H6 model was used to predict indoor dust Pb concentrations at centroids to a distance of 1.5 km from the site, and the air+soil regression-based model was used to predict indoor dust Pb levels for centroids at greater distances. The format for the H6 model is:

$$\ln(\mathit{PbDUST}) = 8.3884 + 0.73639 \times \ln(\mathit{PbAIR})$$

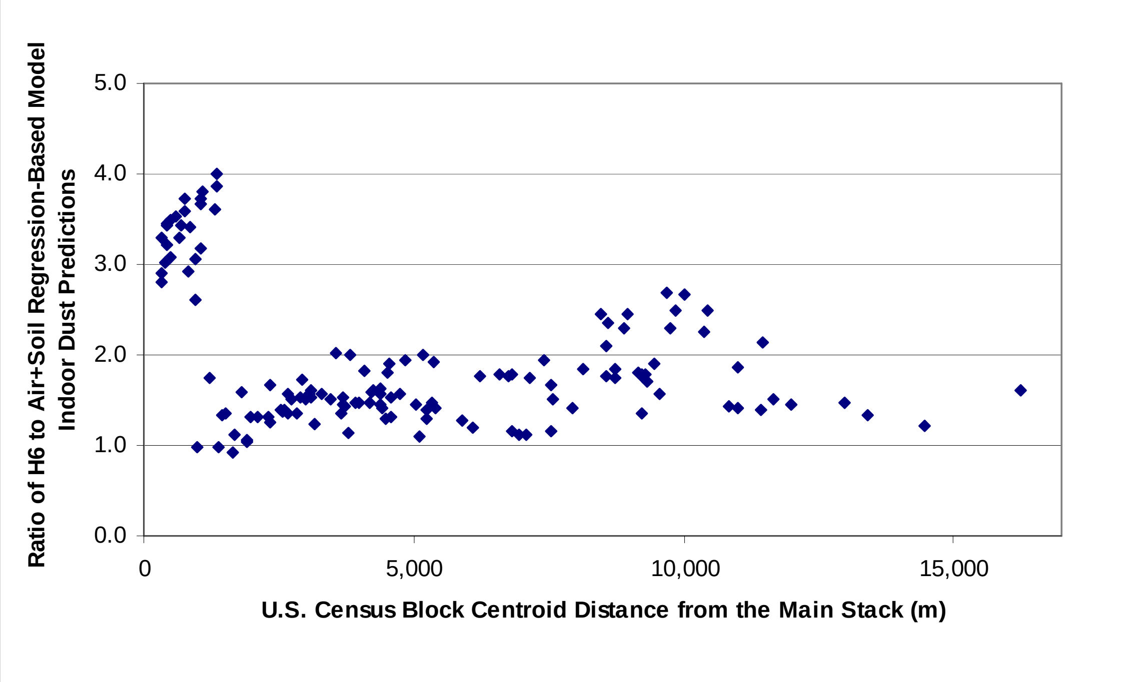
where:

$$\mathit{PbDUST} = \text{concentration of Pb in indoor dust } (\mu g/g)$$

$$\mathit{PbAIR} = \text{concentration of Pb modeled in the ambient air } (\mu g/m^3)$$

As shown in Exhibit G-14, the H6 model predicted much higher indoor dust concentrations at centroids closer to the facility than the air+soil regression-based model, but at longer distances, the predictions became more similar. For centroids around 1,500 m (1.5 km) from the facility, the average H6 model predicted indoor dust Pb concentrations of 310 µg/g, while the average air + soil regression-based model prediction was approximately 270 µg/g. At 5,000 m (5 km), the average predictions from the two models were 120 µg/g and 80 µg/g, respectively.

Exhibit G-14. Ratio of Indoor Dust Pb Concentrations Predicted by the H6 and Air+Soil Regression-based Models versus Distance from the Facility



Note: The main stack location is included as a point of reference only (not intended to imply it is the main contributor to the observed Pb concentrations).

G.4.2. Primary Pb Smelter Case Study: Indoor Dust Modeling Approach Used at Distance from Facility

For the portion of the study area outside the 1.5 km radius from the primary Pb smelter, the pooled analysis air+soil regression-based model based on data collected in the past at several active primary Pb smelters, including the primary smelter analyzed here, was used (USEPA, 1989). The air+soil regression-based model predicts indoor dust Pb based on both outdoor soil/dust and ambient air Pb levels. The model is appropriate for the non-remediation portion of the primary Pb smelter case study area because this area has not been subjected to extensive remediation and is therefore likely to resemble the locations included in the pooled analysis used in deriving this model (i.e., areas not having undergone extensive outdoor soil remediation). Furthermore, because the non-remediation portion of the study area is likely to have outdoor surface soil Pb gradients reflecting long-term atmospheric deposition of Pb, indoor dust would likely be partially dependent on outdoor soil Pb. Therefore, the air+soil regression-based model presented here was selected for this portion of the study area:

$$PbDUST = 31.3 + (638 \text{ x } PbAIR) + (0.364 \text{ x } PbSOIL)$$

where:

$PbDUST$ = concentration of Pb in indoor dust (µg/g)
$PbAIR$ = concentration of Pb in ambient air (µg/m^3)
$PbSOIL$ = concentration of Pb in outdoor surface soil (mg/kg).

G.4.3. Separating Indoor Dust Pb Concentrations into Recent Air and Other Portions

As in the general urban case study, the total indoor dust concentrations were separated into the component associated with recent air and that associated with other sources (e.g, indoor paint, outdoor soil/dust and additional sources including historical air). For the air+soil regression-based model (used for blocks and block groups more than 1.5 km from the facility), the equation is linear with respect to the air concentration; thus, the recent air-derived indoor dust Pb portion is simply that outdoor ambient air concentration multiplied by the outdoor ambient air slope, and the portion assigned to other sources is the remainder (outdoor soil/dust and intercept contributions) of the Pb indoor dust concentration. However, the site-specific H6 model is nonlinear with respect to outdoor ambient air concentration. In the general urban case study hybrid model, the loadings fractions (which are linear with respect to outdoor ambient air concentrations) were used to derive the outdoor ambient air Pb contribution, and this fraction was applied to the concentration. However, for the H6 model, no such loading information is available. In addition, the equation is log-log and has the general format:

$$PbDust = \exp[a + b * \ln(PbAir)]$$

To approximate the contribution from "other sources," the Pb indoor dust concentration is calculated for all sites in the remediation zone using the above equation for each NAAQS scenario. In each of the air quality scenarios, the block or block group with the lowest resulting indoor dust Pb concentration is assumed to have zero contribution from outdoor ambient air, so the indoor dust concentration is completely composed of the "other sources" fraction. This concentration is then used as the "other sources indoor dust concentration" for all the blocks in the remediation zone, and the recent air-derived component is found by subtracting this concentration from the total concentration. This method likely underestimates the outdoor ambient air contribution for the blocks and block groups in the remediation zone, since in reality the lowest indoor dust concentration includes both recent air-derived and "other sources" of indoor dust, rather than merely the "other sources" as assumed.

G.5. FOUNDATION FOR THE SECONDARY PB SMELTER CASE STUDY INDOOR DUST ALGORITHMS

Indoor dust sampling data were not available for the secondary Pb smelter case study, necessitating the use of modeling to characterize indoor dust Pb levels within the study area. The air+soil regression based model (USEPA, 1989) that uses ambient air Pb levels for predicting indoor dust levels was chosen. This model is similar to the one used for the primary Pb smelter case study at distances greater than 1.5 km from the source; however, in the case of the secondary Pb smelter, an "air-only" version of the model was used reflecting the reduced overall confidence associated with soil characterization for this case study.

The air-only regression-based model does reflect (implicitly) some consideration for the soil-to-indoor dust mechanism in the air signal. Specifically, the larger air factor for the air-only model (relative to the air+soil regression model's air factor) reflects the fact that, in this version of the model, air measurements are used to represent both the direct loading of indoor dust Pb from air and the loading of outdoor soil/dust Pb by air with subsequent impacts of that outdoor soil/dust on indoor dust through other mechanisms (USEPA, 1989). The air-only regression-based model used for the secondary Pb smelter was based on a number of studies focusing mainly on primary Pb smelters. This introduces uncertainty into the indoor dust predictions generated using this model associated with potential differences between primary and secondary Pb smelters that may affect indoor dust Pb loading (e.g., particle size profiles and nature of the entrained Pb compounds). The air-only regression-based model used in this analysis is presented below:

$$PbDUST = 60 + (844 \times PbAIR)$$

where:

PbDUST	=	concentration of Pb in indoor dust (μg/g)
PbAIR	=	concentration of Pb in the ambient air (μg/m^3)

G.5.1. Separating Pb Indoor Dust Concentrations into Recent Air and Other Portions

The total Pb indoor dust concentration was separated into the component associated with recent air and that associated with other sources (e.g, indoor paint, outdoor soil/dust and additional sources including historical air). The Pb indoor dust concentration equation is linear with respect to air Pb concentration, so the recent air contribution to indoor dust Pb concentration is the slope multiplied by the air concentration, and the other sources contribution is the intercept.

REFERENCES

Adgate, J. L.; Willis, R. D.; Buckley, T. J.; Chow, J. C.; Watson, J. G.; Rhoads, G. G.; Lioy, P. J. (1998) Chemical Mass Balance Source Apportionment of Lead in House Dust. Environ. Sci. Technol. 32(1): 108-114.

Battelle Memorial Institute. (1997) Lead Exposure Associated With Renovation and Remodeling Activities: Environmental Field Sampling Study Volume I: Technical Report. EPA 747-R-96-007: 1-204. Washington, DC: prepared for US Environmental Protection Agency (USEPA).

Caravanos, J.; Weiss, A. L.; Jaeger, R. J. (2006) An Exterior and Interior Leaded Dust Deposition Survey in New York City: Results of a 2-Year Study. Environmental Research. 100: 159-164.

Clemson Environmental Technologies Laboratory (CETL). (2001) A Comparison of Post-Renovation and Remodeling Surface Cleaning Techniques. USEPA Office of Pollution, Prevention, and Toxics; December 14.

Dockery D.W.and Spengler J.D. (1981) Indoor-Outdoor Relationships of Respirable Sulfates and Particles. Atmospheric Environment. 15: 335-343.

Ewers, L.; Clark, S.; Menrath, W.; Succop, P.; Bornschein, R. (1994) Clean-Up of Lead in Household Carpet and Floor Dust. Am. Ind. Hyg. Assoc. J. 55(7): 650-657.

Fergusson, J. E.and Schroeder, R. J. (1985) Lead in House Dust of Christchurch, New Zealand: Sampling, Levels and Sources. Sci. Total Environ. 46: 61-72.

Ferro, A. R.; Kopperud, R. J.; Hildemann, L. M. (2004) Source Strengths for Indoor Human Activities That Resuspend Particulate Matter. Environ. Sci. Technol. 38(6): 1759-1764.

Freed, J. R.; , C. T.; Christie, W. N.; Carpenter, C. E. (1983) Methods for Assessing Exposure to Chemical Substance (Volume 2). EPA 560/5-1;3-015: 70-73. USEPA, Office of Toxic Substances.

Gwiazda, R. H.and Smith, D. R. (2000) Lead Isotopes As a Supplementary Tool in the Routine Evaluation of Household Lead Hazards. Environ. Health Perspect. 108(11): 1091-1097.

Hilts, S. R. (2003) Effect of Smelter Emission Reductions on Children's Blood Lead Levels. Sci. Total Environ. 303(1-2): 51-58.

ICF International. (2006) Lead Human Exposure and Health Risk Assessments and Ecological Risk Assessment for Selected Areas, Pilot Phase. External Review Draft Technical Report. Prepared for the U.S. EPA Office of Air Quality Planning and Standards (OAQPS). December.

Kleinbaum D.G.; Kupper K.L.; Muller K.E.; and Nizam N. 1998. Applied Regression Methods and Other Multivariate Methods. Duxbury Press, Pacific Grove California, 3rd ed.

Laidlaw, M. A.; Mielke, H. W.; Filippelli, G. M.; Johnson, D. L.; Gonzales, C. R. (2005) Seasonality and Children's Blood Lead Levels: Developing a Predictive Model Using Climatic Variables and Blood Lead Data From Indianapolis, Indiana, Syracuse, New York, and New Orleans, Louisiana (USA). Environ. Health Perspect. 113(6): 793-800.

Lanphear, B. P.; Weitzman, M.; Winter, N. L.; Eberly, S.; Yakir, B.; Tanner, M.; Emond, M.; Matte, T. D. (1996) Lead-Contaminated House Dust and Urban Children's Blood Lead Levels. Am. J. Public Health. 86(10): 1416-1421.

Layton, D. W. and Thatcher, T. L. (1995) Movement of Outdoor Particles to the Indoor Environment: An Analysis of the Arnhem Lead Study. 95-MP4.02. San Antonio, TX: prepared for The Annual Meeting of the Air and Waste Management Association; June.

Liu, D. L.and Nazaroff, W. W. (2001) Modeling Pollutant Penetration Across Building Envelopes. Atmospheric Environment. 35: 4451-4462.

Mielke, H. W.; Dugas, D.; Mielke, P. W., Jr.; Smith, K. S.; Gonzales, C. R. (1997) Associations Between Soil Lead and Childhood Blood Lead in Urban New Orleans and Rural Lafourche Parish of Louisiana. Environ. Health Perspect. 105(9): 950-954.

Nazaroff, W. W. (2004) Indoor Particle Dynamics. Indoor. Air. 14 Suppl 7: 175-183.

Ozkaynak, H.; Xue, J.; Spengler, J.; Wallace, L.; Pellizzari, E.; Jenkins, P. (1996) Personal Exposure to Airborne Particles and Metals: Results From the Particle TEAM Study in Riverside, California. J. Expo. Anal. Environ. Epidemiol. 6(1): 57-78.

Rasmussen, P. E.; Subramanian, K. S.; Jessiman, B. J. (2001) A Multi-Element Profile of Housedust in Relation to Exterior Dust and Soils in the City of Ottawa, Canada. Sci. Total Environ. 267(1-3): 125-140.

Riley, W. J.; McKone, T. E.; Lai, A. C.; Nazaroff, W. W. (2002) Indoor Particulate Matter of Outdoor Origin: Importance of Size-Dependent Removal Mechanisms. Environ. Sci. Technol. 36(2): 200-207.

Roy, A.; Georgopoulos, P. G.; Ouyang, M.; Freeman, N.; Lioy, P. J. (2003) Environmental, Dietary, Demographic, and Activity Variables Associated With Biomarkers of Exposure for Benzene and Lead. J. Expo. Anal. Environ. Epidemiol. 13(6): 417-426.

Tang, K. M.; Nace, C. G., Jr.; Lynes, C. L.; Maddaloni, M. A.; LaPosta, D.; Callahan, K. C. (2004) Characterization of Background Concentrations in Upper Manhattan, New York Apartments for Select Contaminants Identified in World Trade Center Dust. Environ. Sci. Technol. 38(24): 6482-6490.

Thatcher, T. L.and Layton, D. W. (1995) Deposition, Resuspension, and Penetration of Particles Within a Residence. Atmospheric Environment. 29(13): 1487-1497.

U.S. Environmental Protection Agency (USEPA). (1989) Review of National Ambient Air Quality Standard for Lead: Exposure Analysis Methodology and Validation. EPA-450/2-89-011. Research Triangle Park, NC: Office of Air Quality Planning and Standards; June.

U.S. Environmental Protection Agency (USEPA). (1995) Report on the National Survey of Lead-Based Paint in Housing: Appendix I: Design and Methodology. EPA 747-R95-004. Office of Pollution Prevention and Toxics.

U.S. Environmental Protection Agency (USEPA). 1996. Adjustments to the HUD National Survey Dust Data for Section 403 Analyses. Office of Pollution, Prevention, and Toxics. EPA 747-R-96-011.

U.S. Environmental Protection Agency (USEPA). (1997a) Conversion Equations for Use in Section 403 Rulemaking. EPA 747-R-96-012. Office of Pollution, Prevention, and Toxics. Available online at: http://www.epa.gov/oppt/lead/pubs/es_con.htm.

U.S. Environmental Protection Agency (USEPA). (1997b) Exposure Factors Handbook Vol. III: Activity Factors. 1-74. USEPA; August.

U.S. Environmental Protection Agency (USEPA). (1998) Risk Analysis to Support Standards for Lead in Paint, Dust, and Soil. Office of Pollution, Prevention, and Toxics. EPA 747-R-97-006.

U.S. Environmental Protection Agency (USEPA). (2007) Air Quality System (AQS) Database. Available online at: http://www.epa.gov/ttn/airs/airsaqs/aqsweb/aqswebwarning.htm.

Vette, A. F.; Rea, A. W.; Lawless, P. A.; Rodes, C. E.; Evans, G.; Highsmith, V. R.; Sheldon, L. (2001) Characterization of Indoor-Outdoor Aerosol Concentration Relationships During the Fresno PM Exposure Studies. Aerosol Science and Technology. 34(1): 118-126.

von Lindern, I.; Spalinger, S. M.; Bero, B. N.; Petrosyan, V.; von Braun, M. C. (2003) The Influence of Soil Remediation on Lead in House Dust. Sci. Total Environ. 303(1-2): 59-78.

ATTACHMENT G-1. METHOD USED TO CONVERT INDOOR PB LOADINGS TO CONCENTRATIONS

This attachment describes the method used to convert Pb loadings to concentrations for the hybrid mechanistic-empirical model in the general urban case study. Section G-1.1 describes the data used to derive the indoor dust loading-indoor dust concentration models. Sections G-1.2 and G-1.3 describe data and correlation analyses. Section G-1.4 discusses the types and design of the regression models, and Section G-1.5 discusses the limitations of the data set used and uncertainties in the indoor dust Pb concentration models. Section G-1.6 provides detailed regression results.

G-1.1. SOURCE OF INDOOR DUST PB LOADING AND INDOOR DUST CONCENTRATION DATA

Data on the relationship between indoor dust Pb loading and concentration were gathered as part of the HUD National Survey of Lead-Based Paint in Housing conducted between November 1989 and 1990 (USEPA, 1995). This survey provides the largest data set the document's authors are aware of that contains simultaneous measurements of indoor dust loading and indoor dust concentration from the same households. In addition, the survey was designed to include a nationally representative sample of houses of varying age, and thus could be used to evaluate temporal trends in Pb occurrence and concentration.

The goal of the survey was to obtain information on the presence and condition of Pb-based paint, Pb in soil, indoor dust Pb loadings, and concentrations as well as other household data, from a representative national sample of 300 private homes and 100 public housing facilities (USEPA, 1995). The data used to derive relationships between indoor dust loading and Pb concentration in this approach came from the 284 private households that were ultimately sampled during the survey. The data are tabulated in Appendix C of EPA's 1998 "Section 403" risk analysis (USEPA, 1998). The data elements include:

- Building construction date (vintage) in three ranges (<1940, 1940 to 1959, and 1960 to 1979);
- Vacuum [Blue Nozzle (BN)] floor indoor dust Pb loading, micrograms (µg) per square feet (ft^2);
- Blue nozzle indoor dust Pb concentration, µg per gram (g);
- Vacuum window sill indoor dust loading, µg/ft^2;
- Average yard outdoor soil/dust Pb concentration, µg/g; and
- Maximum interior and exterior X-ray fluorescence (XRF) Pb concentration, milligrams (mg) per square centimeter (cm^2).

The data set also included a set of sampling weights developed by EPA designed for extrapolation of the survey sample results to United States private residences as a whole. Floor indoor dust Pb loading and concentration values were household averages, generally of three samples taken at different locations in the sampled household. The Pb concentration values in samples with low tap weights (indoor dust loading derived using sampling weights) were corrected for systematic bias (USEPA, 1995); this correction affected relatively few samples.

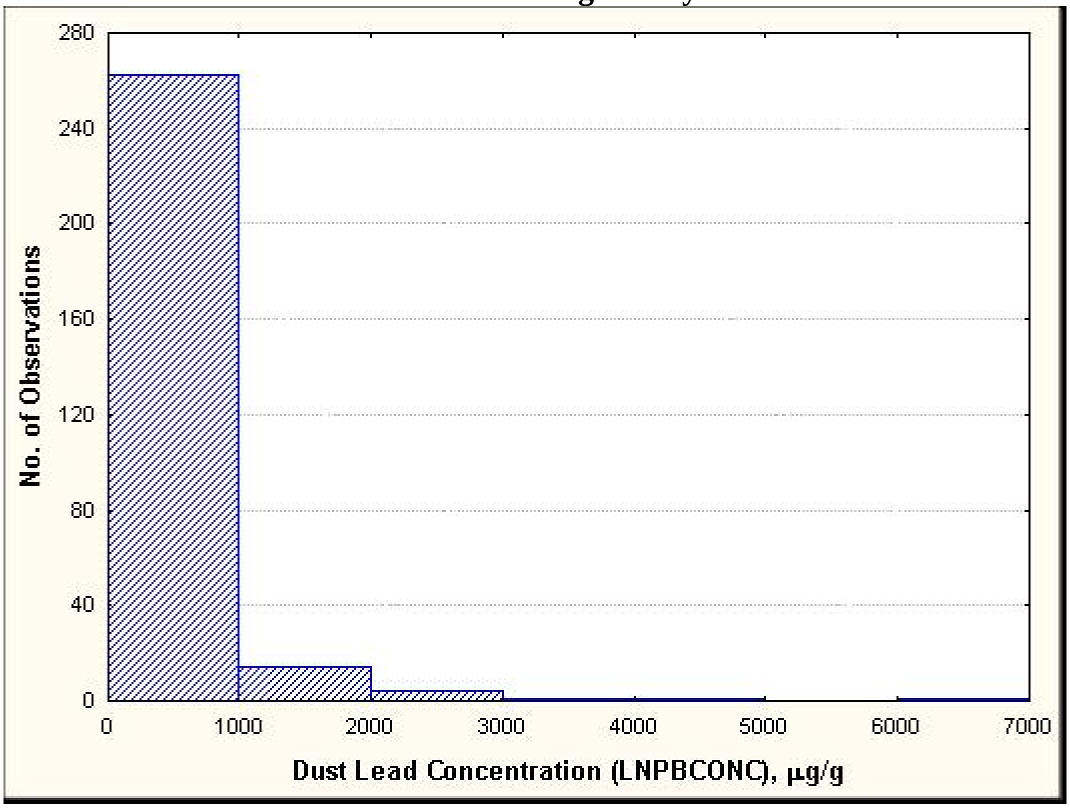
Because wipe samples have become the preferred technique to measure Pb indoor dust loading, EPA also calculated equivalent wipe sample loading estimates for each household based on the vacuum sample results. The conversion was accomplished using regression results derived from several previous studies of relative sampling method performance (USEPA, 1997a). Owing to the added level of uncertainty introduced by the vacuum-wipe sample conversion, the wipe sample results were not used in this analysis. Instead, as described below, regression models were developed that related the vacuum indoor dust loading results from the HUD National Survey to indoor dust Pb concentrations.

G-1.2. PRELIMINARY DATA ANALYSIS

Data analyses were focused primarily on vacuum indoor dust Pb loading and Pb concentration data, but other variables were also examined for possible correlations with indoor dust Pb concentration. Data from the 1998 Risk Analysis were imported into Excel 2003™ and Statistica™ Version 7. Reported values for individual variables were examined graphically (e.g., histograms, stem-and-leaf plots) for outliers and discrepant values. Probability plots and goodness-of-fit tests were used to test individual variable distributions for normality.

As is commonly the case with environmental sampling data, the distributions of indoor dust Pb loading and Pb concentrations were both highly skewed (Attachment G-1-1 and Attachment G-1-2). Normal probability plots of the log-transformed data appeared to be approximately normal (Attachment G-1-3 and Attachment G-1-4), except that there appeared to be outliers in both the low and high "tails" of the log-transformed indoor dust Pb concentration data (Attachment G-1-3). As discussed below, the majority of observations in the tails came from houses constructed between 1960 and 1979.

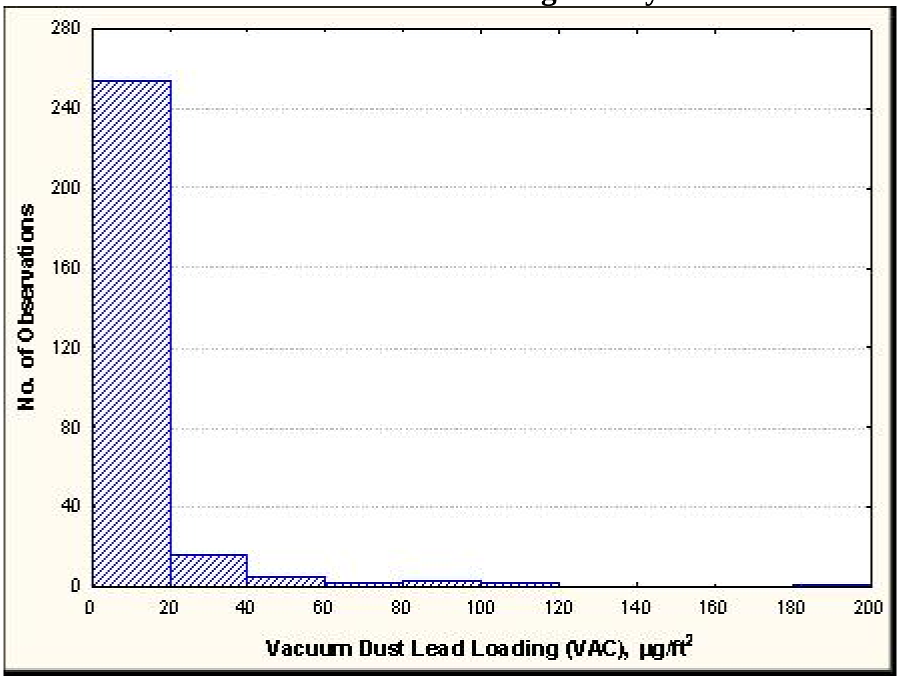
Attachment G-1-1. Distribution of Pb Concentration Data, HUD National Housing Survey



Note: One data point was omitted at 50,400 µg/g.
Source: USEPA, 1995

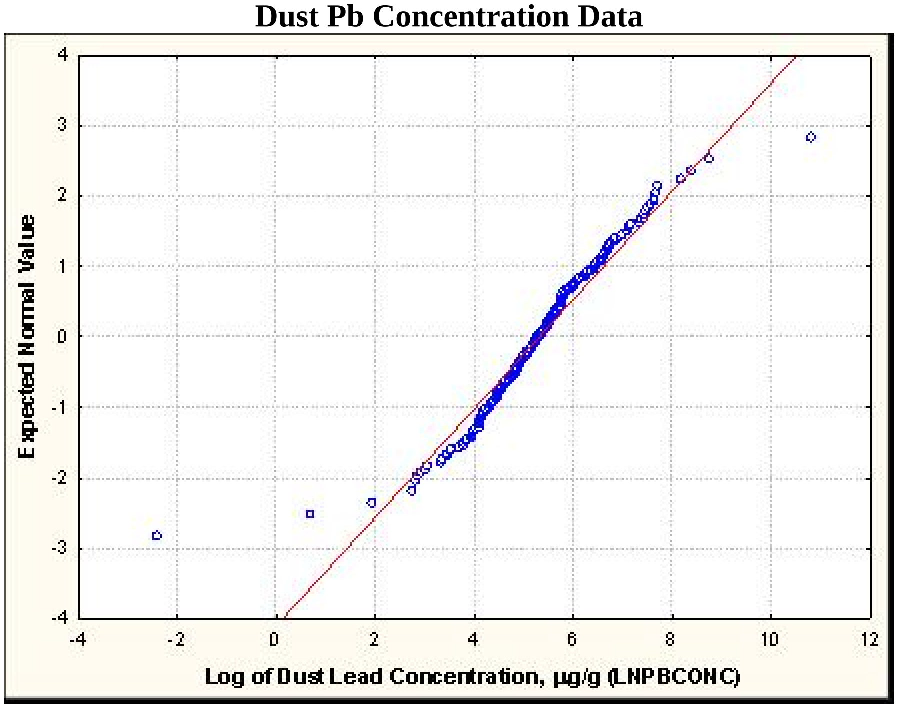
Goodness-of-fit tests suggested that the log-transformed Pb loading and concentration data from the data set taken as a whole were nearly, but not perfectly, lognormal. The relatively less sensitive single-sample Kolgmorgorov-Smirnov (K-S) test tended to give p-values indicating consistency with the normal distribution of the log-transformed indoor dust loading and Pb concentration data; however, the more sensitive Lilliefors and Shapiro-Wilks W tests gave low p-values, indicating the lack of a good "fit" to the normal distribution (Attachment G-1-5, top panels).

Attachment G-1-2. Distribution of Vacuum Dust Pb Loading, HUD National Housing Survey

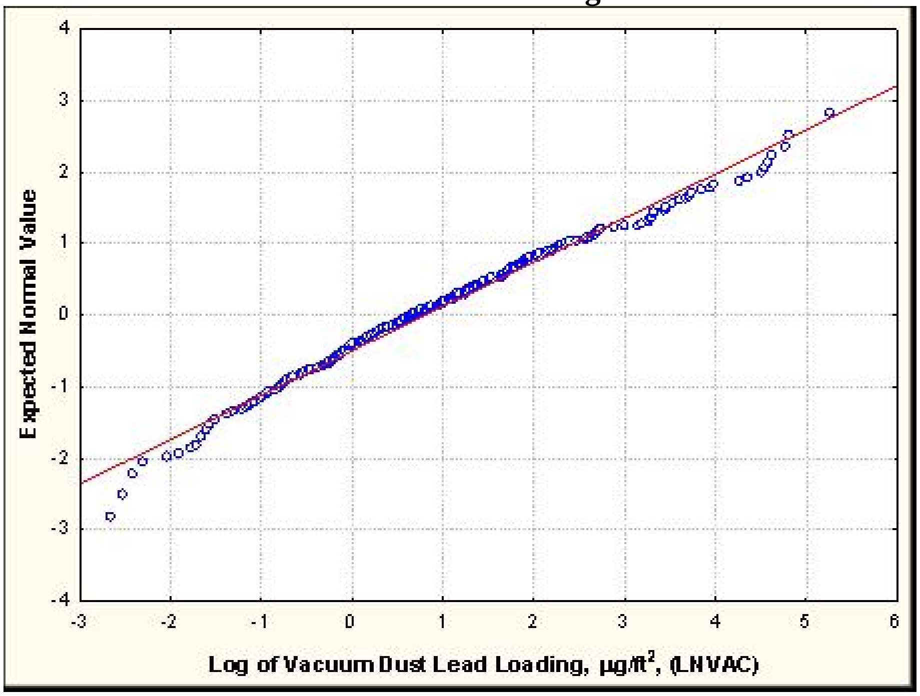


Source: USEPA, 1995

Attachment G-1-3. Normal Probability Plot of Log-Transformed Dust Pb Concentration Data



Attachment G-1-4. Normal Probability Plot of Log-Transformed Vacuum Dust Pb Loading Data



The distributions of the indoor dust loading and indoor dust concentration data were also evaluated separately by vintage because of the possible differences in the distributions of indoor dust loading and indoor dust concentration data across the three building vintage strata. Of the 284 valid observations, 77 were obtained from houses constructed prior to 1940, 87 came from houses constructed between 1940 and 1959, and 120 came from houses constructed between 1960 and 1979.

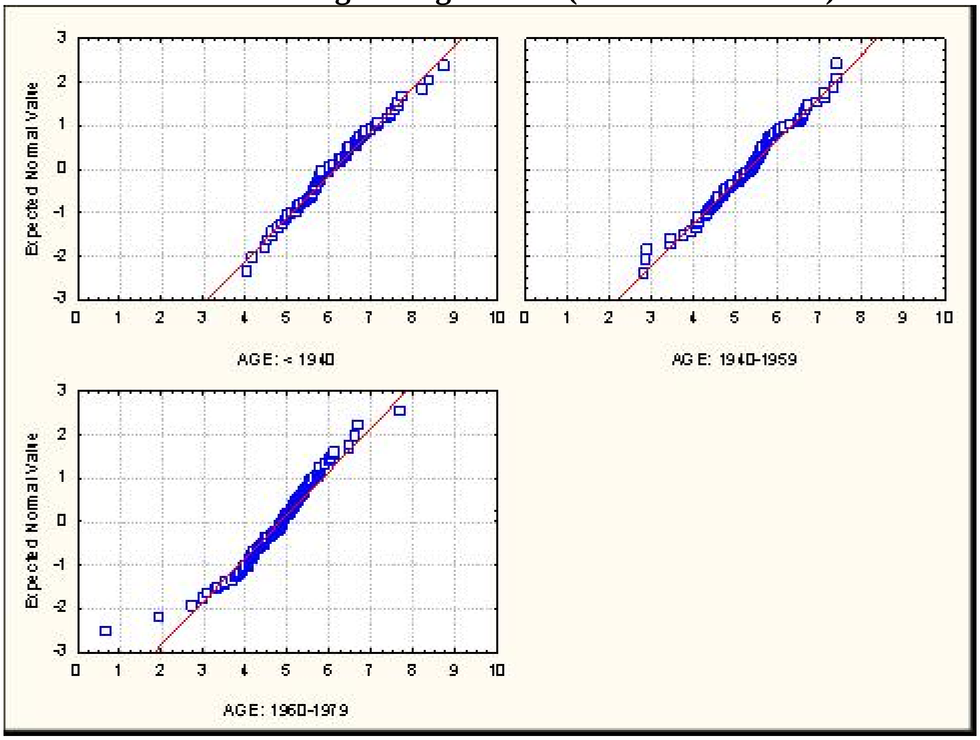
It can be seen from the goodness-of fit test results in the lower panels of Attachment G-1-5 that stratifying the data resulted in more normal distributions of both log-transformed indoor dust Pb concentration and indoor dust loading. Some of the apparent improvement is due to the smaller number of observations in the stratified data sets. However, the improvement in normality is also apparent in the increased linearity of the probability plots of the two variables. Removal of the two extreme (outlying) values from the Pb concentration data sets (the very low value from the prior to 1940 data and the very high value from the 1960 to 1979 stratum) also resulted in additional improvements to the normality of the data (see Attachment G-1-6). These values were, however, retained in the following evaluation of multivariate correlations.

Attachment G-1-5. Goodness-of-Fit Test Results (p-values) for Log-Transformed Dust Loading and Dust Concentration Data

Variable	K-S	Lilliefors	Shapiro-Wilks W
Combined Data			
LNVAC	> 0.20	> 0.20	0.01
LNPBCONC	< 0.10	< 0.01	0.000
Combined Data (minus outlying values)			
LNVAC	> 0.20	> 0.20	0.03
LNPBCONC	< 0.20	< 0.01	0.02
<1940			
LNVAC	> 0.20	> 0.20	0.66
LNPBCONC	< 0.20	< 0.01	0.000
<1940 (minus outlying value)			
LNVAC	> 0.20	> 0.20	0.69
LNPBCONC	> 0.20	> 0.20	0.71
1940 - 1959			
LNVAC	> 0.20	> 0.20	0.75
LNPBCONC	> 0.20	> 0.20	0.35
1960 to 1979			
LNVAC	> 0.20	> 0.20	0.04
LNPBCONC	> 0.20	< 0.01	0.000
1960 to 1979 (minus outlying value)			
LNVAC	> 0.20	> 0.20	0.17
LNPBCONC	> 0.20	< 0.15	0.000

Note: Low p-values indicate poor fit to the normal (Gaussian) distribution.

Attachment G-1-6. Probability Plots of Log-Transformed Pb Concentration Data for the Three Building Vintage Strata (Outliers Removed)



Observations on other variables (window sill vacuum indoor dust loading, outdoor soil Pb concentration, and interior and exterior XRF results) also tended to be skewed, and were therefore log-transformed prior to exploration of multivariate correlations.

G-1.3. CORRELATION ANALYSIS

In preparation for model building, correlations between potential explanatory variables and indoor dust Pb concentration were examined. While the intent was to construct a model that predicts indoor dust Pb concentrations from indoor dust loading, it is important to know if any other variables in the data are also highly correlated with indoor dust concentration or loading. Attachment G-1-7 summarizes the simple product moment correlation coefficients seen in the combined data set with indoor dust Pb concentration and log-transformed indoor dust Pb concentration.

Attachment G-1-7. Correlations Between Potential Explanatory Variables, Dust Pb Concentration (PBCONC), and Log-Transformed Dust Concentration (LNPBCONC)

Variable	PBCONC	LNPBCONC
AGEGRP	0.00	-0.34*
Pb paint	0.05	0.24*
VACLOAD	0.49*	0.54*
LNVAC	0.26*	0.66*
SILLVAC	0.03	0.15*
LNSVAC	0.04	0.32*
YARD	0.03	0.32*
LNYARD	0.03	0.45*
INTXRF	0.02	0.34*
LNINTXRF	-0.02	0.36*
EXTXRF	0.02	0.28*

Note: A* indicates simple correlation coefficients significant at $p < 0.05$. See text for explanations of variable names.

It is clear that a number of variables, in addition to vacuum indoor dust loading (VACLOAD), are highly correlated with indoor dust Pb concentration when the data set is examined as a whole. The correlations are generally much higher when the log-transformed variables are used. This is to be expected, since log-transformation reduces the impact of the skew in the variables as described earlier, and allows underlying relationships to be more clearly seen.

It is important to note that building vintage (AGEGRP) is negatively correlated with indoor dust Pb concentration, as would be expected if the extent of Pb paint usage decreased, and the overall state of repair improved, with more recent construction. A dummy variable for the observed presence of Pb paint, log-transformed sill vacuum indoor dust Pb loading (LNSVAC), log-transformed average yard soil Pb concentration (LNYARD), and interior and exterior XRF readings were also found to be correlated with house indoor dust Pb concentration. These latter variables were also highly correlated with housing vintage, raising the question as to whether there was actually an independent effect of building age that was not already captured by differences in sill indoor dust loadings, soil Pb concentrations, and XRF readings.

Omitting the extreme high and low indoor dust Pb concentration values from the data set resulted in a substantial increase in the magnitude of the correlation coefficient between the log-transformed Pb indoor dust concentration (LNPBCONC) and building vintage (AGE GRP) from -0.34 to -0.47. Omitting these outlying values also slightly increased the magnitude of the correlations between LNPBCONC and most of the other variables in Attachment G-1-7. The correlation between LNPBCONC and log-transformed vacuum indoor dust loading (LNVAC) remains strong within each of the individual building vintage strata (Attachment G-1-8). Most of the other variables retain their significant correlations to the log-transformed Pb concentration within the individual vintage strata, but the magnitude of the correlations varies. Correlations with LNPBCONC are generally weaker in the 1960 to 1979 data than in the other strata.

Attachment G-1-8. Correlations with Log-Transformed Pb Concentration (LNPBCONC) Within Individual Building Vintage Strata

Variable	<1940	1940 to 1959	1960 to 1979
Pb paint	0.04	0.24*	0.20*
VAC LOAD	0.45*	0.54*	0.58*
LNVAC	0.62*	0.70*	0.57*
SILLVAC	0.16	-0.12	0.08
LNSVAC	0.30*	0.23*	0.25*
YARD	0.24	0.36*	0.15
LNYARD	0.41*	0.45*	0.16
INT XRF	0.30*	0.36*	0.13
LNINTXRF	0.35*	0.27*	0.13
EXT XRF	0.15	0.42*	0.14

Note: A * indicates simple correlation coefficients significant at $p < 0.05$.

Removing the low value from the <1940 Pb indoor dust concentration data increases the magnitude of the correlation between LNVAC and LNPBCONC (from 0.62 to 0.73). Removing the high Pb concentration value from the 1960 to 1979 data, in contrast, reduces this correlation from 0.57 to 0.49.

G-1.4. REGRESSION MODELING

Correlation coefficients between log-transformed indoor dust Pb concentration and log-transformed vacuum indoor dust loading (Attachment G-1-9) suggested that a linear regression model (in this case, log-log) might provide a good fit to the data. Data for the three building vintage strata cluster fairly tightly, with data from newer age strata having slightly lower values of both LNPBCONC and LNVAC than the data from <1940 houses. Pb concentration values from the newer houses (1960 to 1979) also appear to be somewhat more variable than the values for the other age strata.

Attachment G-1-9. Correlation Coefficients between Log-Transformed Dust Pb Concentration and Log-Transformed Vacuum Dust Pb Loading

Variable	<1940	1940 to 1959	1960 to 1979
Pb paint	0.04	0.24*	0.20*
VAC LOAD	0.45*	0.54*	0.58*
LNVAC	0.62*	0.70*	0.57*
SILLVAC	0.16	-0.12	0.08
LNSVAC	0.30*	0.23*	0.25*
YARD	0.24	0.36*	0.15
LNYARD	0.41*	0.45*	0.16
INT XRF	0.30*	0.36*	0.13
LNINTXRF	0.35*	0.27*	0.13
EXT XRF	0.15	0.42*	0.14

Note: A * indicates simple correlation coefficients significant at $p < 0.05$.

As noted above, it has already been demonstrated that two values in the Pb concentration data set (at the upper right and lower left corners of Attachment G-1-9) appear to be "outliers," that is, they seem to fall outside the distribution of the other Pb concentration values. As part of the model development, these (and other) data points were tested to determine if these would be disproportionately influential in determining the results of a linear regression.

In a univariate regression of LNPBCONC on LNVAC, the two outlying data points appeared to be quite influential; Cook's distances for these data points were 0.20 and 0.19, respectively, more than three times the next highest value, compared to a median value across the data points of 0.003. However, these values are not extreme in and of themselves; Cook's distances greater than 1.0 are generally considered to be an indication of undue influence of single data points (Kleinbaum et al., 1998).

When the data are stratified, however, the low and high outlying points are found to be very influential in determining regression results. In a LNPBCONC – LNVAC linear regression for the <1940 data, the Cook's distance for the lowest Pb indoor dust concentration value was 1.05, compared to a next highest value of 0.05. In the univariate regression on the 1960 to 1979 data, the calculated Cook's distance for the highest indoor dust Pb concentration data point was 1.19, compared to a next highest value of 0.19. These results indicate that in both cases the overall result of the regression is being strongly influenced by the outlying values. Thus, these data points are omitted from the regressions discussed below.

G-4.1.1 Univariate Models

Log-log regression models were first run in which LNPBCONC was fit to LNVAC only. Models were run for the combined data set and for the stratified data sets. Results of the models are summarized in Attachment G-1-10. Detailed regression outputs are provided in Section G-1.6.

Attachment G-1-10. Univariate Regression Results: LNPBCONC as a Function of LNVAC

Model Data Set	Variable	Coefficient	SE Coefficient	t-statistic	p-value	F-Statistic, p-level	Adjusted R^2
All Vintages Combined	Intercept	5.37	0.05	111.2	0.000	F(1,272)=230.40 p<0.000	0.46
	LNVAC	0.49	0.03	15.2	0.000		
<1940	Intercept	6.34	0.05	127.4	0.000	F(1,187)=210.06 p<0.000	0.53
	LNVAC	0.45	0.03	14.5	0.000		
1940 to 1959	Intercept	5.30	0.05	104.2	0.000	F(1,189)=175.82 p<0.000	0.48
	LNVAC	0.44	0.03	13.3	0.000		
1960 to 1979	Intercept	4.74	0.05	102.6	0.000	F(1,344)=87.771 p<.000	0.20
	LNVAC	0.35	0.04	9.37	0.000		

Note: Regressions were performed using the national weight values from the HUD survey data (USEPA 1998); LNVAC (log-transformed vacuum Pb loading) values were centered at their means.

In all cases, the regression results (F-statistics) are highly significant. The LNVAC coefficients are likewise significant. Both the intercept and LNVAC coefficients decrease with newer building vintages. The 1960 to 1979 model explains a considerably smaller proportion of the variance in LNPBCONC (R^2 of 0.20) than the models derived from older houses and from the data set as a whole (R^2 on order of 0.5). This suggests a weaker and less consistent relationship between indoor dust loading and concentration in newer houses, perhaps because of a decreased contribution from interior Pb paint and higher contributions from exterior sources.

G-4.2.1 Multivariate Models

A number of multivariate models were also tested to determine which, if any, of the other variables in the data set might also explain significant proportions of the variance in the log-transformed indoor dust Pb concentration data. Forward and backward stepwise procedures were used to identify variables for which regression coefficients retained significance in the presence of other covariates, and which appeared to explain appreciable proportions of the variance in LNPBCONC in multivariate models. The results of these analyses are summarized in Attachment G-1-11.

Attachment G-1-11. Multivariate Regression Results: LNPBCONC as a Function of LNVAC and Other Variables

Model/Data Set	Variable[b]	Coefficient	SE of Coefficient	t-statistic	p-value	F-Statistic, p-level	Adjusted R^2
All Vintages Combined	Intercept	4.43	0.17	26.6	0.00	F(3,257)=108.17 p<0.0000	0.55
	LNALL CNT	0.39	0.03	11.9	0.00		
	LNYARD	0.20	0.04	5.71	0.00		
	LNINTXRF	0.12	0.05	2.30	0.02		
<1940	Intercept	5.00	0.25	20.1	0.00	F(3,177)=132.13 p<0.0000	0.69
	LNV1 CNT	0.45	0.03	17.3	0.00		
	LNYARD	0.19	0.04	4.92	0.00		
	LNINTXRF	0.22	0.03	6.59	0.00		
1940 to 1959	Intercept	4.03	0.19	21.0	0.00	F(2,180)=134.08 p<0.0000	0.59
	LNV2 CNT	0.39	0.03	12.3	0.00		
	LNYARD	0.28	0.04	6.84	0.00		
1960 to 1979	Intercept	4.24	0.17	24.34	0.00	F(2,343)=49.323 p<0.0000	0.22
	LNV3 CNT	0.34	0.04	9.15	0.00		
	LNYARD	0.14	0.05	2.98	0.00		

Note: Regressions were performed using the national weight values from the HUD survey data (USEPA 1998).
[a] Variables: LNALL CNT = centered LNVAC for combined data set, LNYARD = log-transformed average yard soil Pb concentration (µg/g); LNINTXRF = log-transformed interior paint XRF Pb concentration (mg/cm^2); LNV1(2,3) CNT = centered LNVAC for each building vintage stratum.

When analyzing the combined data set, the inclusion of two additional variables (log-transformed yard soil Pb and log-transformed interior XRF Pb concentration) results in an increase in R^2 to 0.55, compared to 0.46 for the model containing vacuum indoor dust loading alone. Similar increases in R^2 are achieved with the inclusion of additional variables into the models for the stratified data. The R^2 value for the <1940 model increases from 0.53 to 0.69 when log-transformed soil Pb and interior XRF readings are included. In the 1940 to 1959 regression, only log-transformed outdoor soil retains significance when LNVAC is also included, resulting in an increase in R^2 from 0.48 to 0.59. Including LNYARD in the regression on the 1960 to 1979 data increases R^2 only from 0.20 to 0.22, and no other variable retains significance in this model.

These results are consistent with a situation where both outdoor soil Pb levels and indoor Pb paint concentrations influence the observed indoor dust Pb concentrations in the HUD survey data, where the influence of indoor Pb paint concentration is weaker in homes built more recently. As always, however, care should be taken in drawing causal inferences from this type of analysis. The physical mechanisms responsible for the observed correlations cannot be inferred with any degree of certainty based on the regression analysis alone.

G-4.3.1 Selection of Models for the Prediction of Dust Pb Concentrations

The preceding analyses provide the basis for selecting indoor dust Pb concentration model(s). The question arises as to whether the univariate (indoor dust loading only) or multivariate models should be used. Arguably, the multivariate models explain a larger proportion of the variance in Pb concentration, and could thus, in theory, provide more reliable and precise predictions. However, to use the multivariate models, it is necessary to have information not only on the indoor dust Pb loading levels, but also to have values for the other variates (soil Pb concentrations and, for the two older strata, maximum interior XRF readings). Estimates of these values are not available from the data sources used to derive indoor dust loading estimates in the approach. While it would be defensible to use the mean values of the missing variates (from the HUD survey data) when generating predictions, doing so might (1) introduce additional bias into the indoor dust concentration estimates and/or (2) provide a deceptively precise estimate of indoor dust Pb concentration, since the statistical prediction limits for the multivariate models are narrower than those for the univariate models.

G-4.4.1 Dust Pb Concentration Model Equations and Prediction Limits

Attachment G-1-12 summarizes the prediction equations and their coefficients derived from the HUD National Survey data. The models predict LNPBCONC based solely on LNVAC. For each data set (combined, <1940, 1940 to 1959, and 1959-1970), coefficients are provided for predicting the geometric mean indoor dust Pb concentration and for estimating the upper and lower 95 percent statistical prediction limits. The prediction limits provide an estimate of the expected precision of the predicted indoor dust Pb concentrations, given the assumptions embodied in the regression models. Note that the coefficients in Attachment G-1-12 are different from those in Attachment G-1-10 because the regressions in Attachment G-1-10 were conducted using centered Pb loading data.

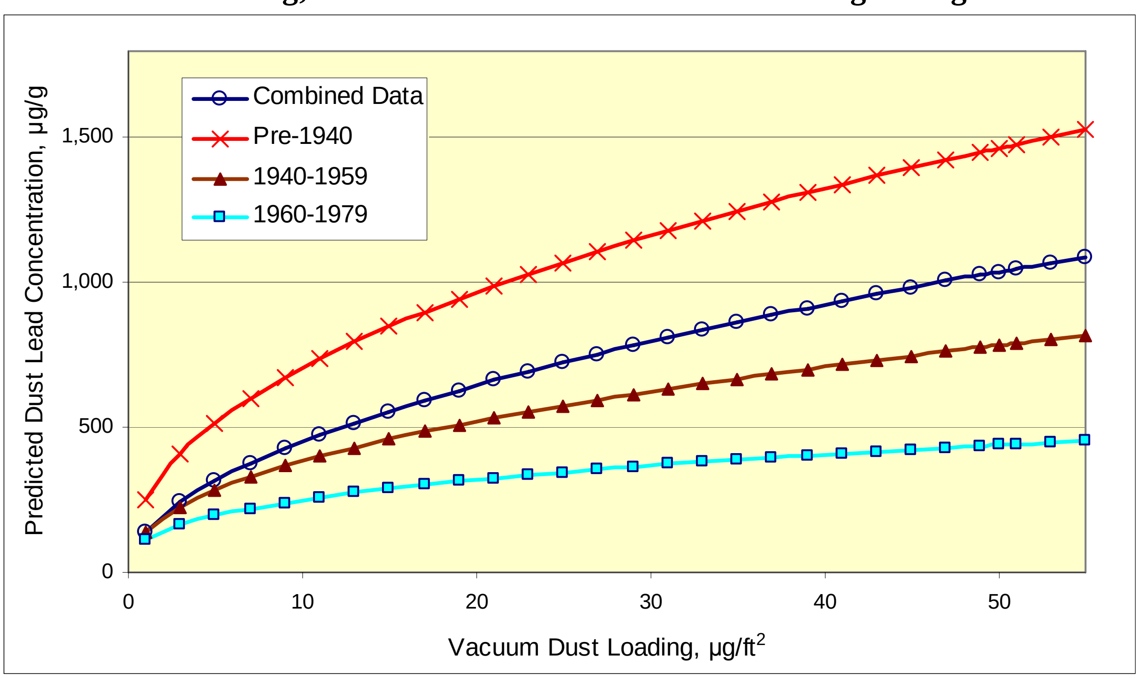
Attachment G-1-12. Dust Pb Concentration Prediction Equations and Prediction Limits

Building Vintage	Estimate	Model Coefficients[a]	
		Intercept	Slope
Combined Data Set	Predicted Dust Concentration	4.92	0.52
	95% Upper Prediction Limit	6.58	0.52
	95% Lower Prediction Limit	3.26	0.52
Pre - 1940	Predicted Dust Concentration	5.51	0.45
	95% Upper Prediction Limit	6.87	0.45
	95% Lower Prediction Limit	4.16	0.45
1940 - 1959	Predicted Dust Concentration	4.93	0.44
	95% Upper Prediction Limit	6.33	0.44
	95% Lower Prediction Limit	3.54	0.44
1960 - 1979	Predicted Dust Concentration	4.70	0.35
	95% Upper Prediction Limit	6.40	0.35
	95% Lower Prediction Limit	3.01	0.35

[a] Prediction equation: LNPBCONC, µg/g = Intercept + Slope * LNVAC, $\mu g/ft^2$.

While the prediction equations are linear in "log-space," they are not linear in terms of the predicted concentration of indoor dust Pb as a function of indoor dust Pb loading. Attachment G-1-13 shows the prediction equations derived from the combined data and from each age stratum.

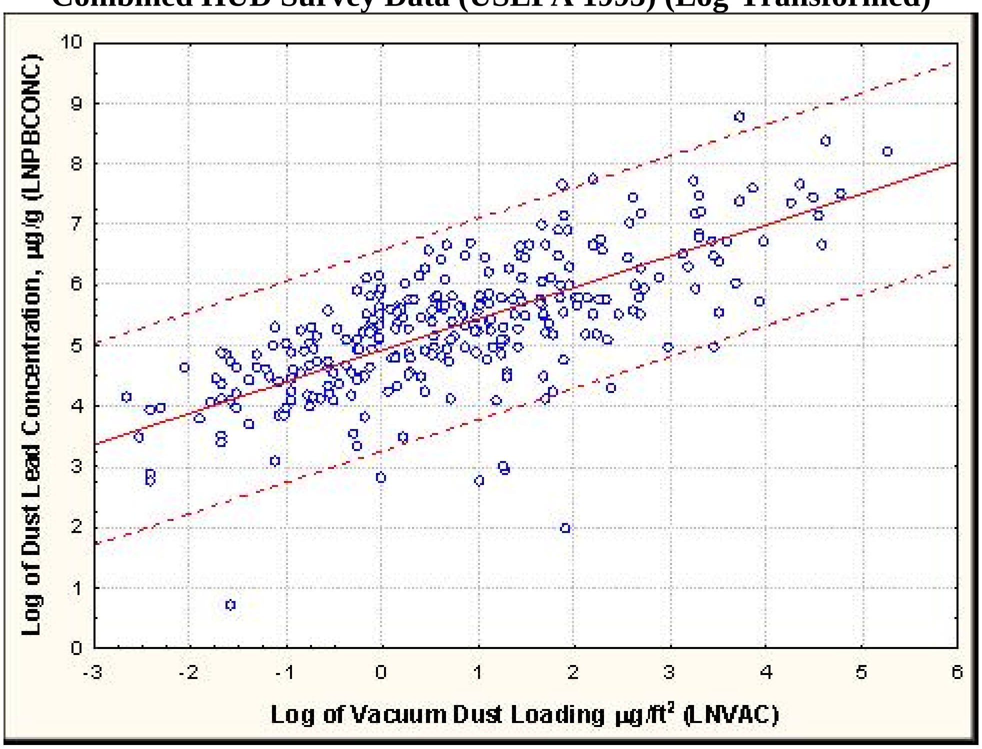
Attachment G-1-13. Predicted Geometric Mean Dust Pb Concentrations as a Function of Dust Pb Loading; Models Derived from Different Building Vintage Strata



It can be seen that the range of indoor dust Pb concentration predictions generated by the different models becomes increasingly divergent with increasing indoor dust Pb loading. For an indoor dust loading of 5 µg/ft^2, the predicted indoor dust concentrations range from 195 µg/g (1960 to 1979 data) to 515 µg/g (<1940 data). For an indoor dust loading input of 55 µg/ft^2, the range of predicted indoor dust concentrations is 440 to 1450 µg/g, with the models derived from the newest and oldest subsets of the data again generating the lowest and highest predictions, respectively.

Statistical prediction limits provide another indication of the expected degree of uncertainty associated with the indoor dust Pb concentration estimates. Note that in all cases (Attachment G-1-12) the log-transformed models and their prediction limit equations have the same slope, and differ only in their intercepts. That is, the width of the log-transformed prediction limits is constant, as shown in Attachment G-1-14. This is equivalent to saying that the ratio of the upper to lower prediction limits remains constant across the range of indoor dust loading inputs.

Attachment G-1-14. Prediction Equation and Prediction Limits Derived from the Combined HUD Survey Data (USEPA 1995) (Log-Transformed)



Because of the log-transformation of the data, the width of the prediction limits (upper minus lower limit) varies with the input indoor dust loading concentrations. At low indoor dust loading, the indoor dust Pb concentration limits are relatively narrow, increasing at higher indoor dust loading (Attachment G-1-15).

Attachment G-1-15. Dust Concentration Prediction Limits As a Function of Dust Loading (µg/g)

Data Set	Prediction Limit	Dust Loading, µg/ft^2						
		0.14	0.37	1.0	2.7	7.4	20.1	54.6
All Vintages Combined	Upper	257	416	674	1,096	1,786	2,918	4,780
	Lower	11	18	29	47	76	123	199
<1940	Upper	NA[a]	617	965	1,515	2,384	3,763	5,955
	Lower	NA[a]	40	64	101	159	250	392
1940 to 1959	Upper	232	358	556	866	1,351	2,116	3,325
	Lower	14	22	34	54	84	129	200
1960 to 1979	Upper	298	423	601	858	1,229	1,766	NA[a]
	Lower	10	14	20	29	41	58	NA[a]

These values provide a rough guide for judging the uncertainty associated with estimates of indoor dust concentrations from indoor dust loading. Ratios of the upper to lower prediction limits range from about 15 (<1940 vintage) to approximately 30 (1960 to 1979 vintage), reflecting the varying level of variability in the data used to derive the models. Another way of expressing the width of the prediction limits is to say that the upper and lower limits are within approximately 3.9- to 5.4-fold of the predicted geometric mean indoor dust concentrations depending upon which subset of data are included.

Note that the prediction limits do not capture all of the uncertain in the indoor dust loading-concentration models. As discussed below, the overall uncertainty in the indoor dust Pb concentration predictions also depends on assumptions regarding the quality and representativeness of the data.

G-1.5. LIMITATIONS AND UNCERTAINTY IN DUST PB CONCENTRATION MODELS

G-5.1.1 Limitations of the Data Set

As noted at the beginning of this appendix, the HUD National Survey provides the largest publicly available data set containing simultaneous measurements of vacuum indoor dust loading and indoor dust Pb concentration, along with other environmental Pb measurements, from a nationally representative sample of private residences. There are enough (284) observations to support the development of indoor dust loading-concentration models both for the data set as a whole and for the individual building vintage strata <1940, 1940 to 1959, and 1960 to 1979 (77, 87, and 120, respectively). Sample collection and analysis techniques were consistent across the survey, and laboratory quality assurance procedures were stringent and fully documented. Potential biases in indoor dust Pb concentration measurements in "low tap weight" samples were identified and suspect samples were eliminated from the data set (USEPA, 1996). Nonetheless, the data set has some limitations as the basis for predicting indoor dust Pb concentrations.

Potential uncertainties associated with the representativeness of the data cannot be quantified, but may be substantial. There is no guarantee that the Pb hazard characteristics of current urban houses will necessarily be the same as those in the HUD survey. For example, the HUD survey was conducted in 1989 to 1990, and the physical characteristics of houses with Pb paint hazards surviving to the present may be different from those surveyed 18 years ago (perhaps a result of better upkeep and maintenance). In addition, there may be other (unknown) reasons why the characteristics of current urban houses are systematically different from those in the 30 counties sampled by HUD. On the other hand, there is no reason to suspect that such differences would substantially bias the relationship between indoor dust Pb loading and concentration.

As noted above, the technical quality of the data set appears to be quite good. The data on the whole are reasonably "well-behaved," in that log-transformation results in symmetric, near-Gaussian distributions for most variables. Two observations, one with a very low indoor dust Pb concentration (0.1 μg/g) and one with a very high value (50,400 μg/kg) were identified as "outliers" and were found to be unduly influential in the regression models for the <1940 and 1960 to 1979 data sets, respectively. These observations were omitted from the regression models, which had the effect (in both cases) of reducing the estimated regression coefficients for LNVAC by about 10 percent, while improving the regularity of the regression residuals.

The issue of potential errors in the measurements of indoor dust loading has been raised in past analyses of indoor dust Pb sampling studies (USEPA, 1997a). If measurement errors are significant, there is the potential that the estimated regression coefficients and standard errors may be biased and inaccurate. While there are a number of approaches that can be used to address errors in variables, it was not necessary to employ any special methods in this approach. The major justification for not doing so is the assumption that the indoor dust loading for the general urban case study will be subject to roughly the same errors as the loading estimates on which the regression models were based. To the extent that the errors in these two sets of measurements are systematically different, then the regression coefficients may be biased.

G-5.2.1 Limitations and Uncertainties in Dust Pb Models

The most important choices with regard to model design were the decisions to log-transform the variables and employ log-log regression as the primary analytical technique. As noted above, log-transformation resulted in much more symmetrical, nearly Gaussian distributions for all (non-categorical) variables. The least well-behaved of the important explanatory variables was LNPBCONC, where there appeared to still be a slight deviation from (log) normality in the extreme "tails" of the data.

No other simple model form was found that provided better qualitative or quantitative fits to the indoor dust loading-concentration data than the log-log multiple regression approach. Plots of regression residuals (Section G-1.6) showed little evidence of deviations from linearity or heteroscedasticity (non-uniformity of residual variance). The coefficient of determination (R^2) values were quite high (>0.46) for all of the univariate regressions, except that derived from the 1960 to 1979 subset of the data (0.20).

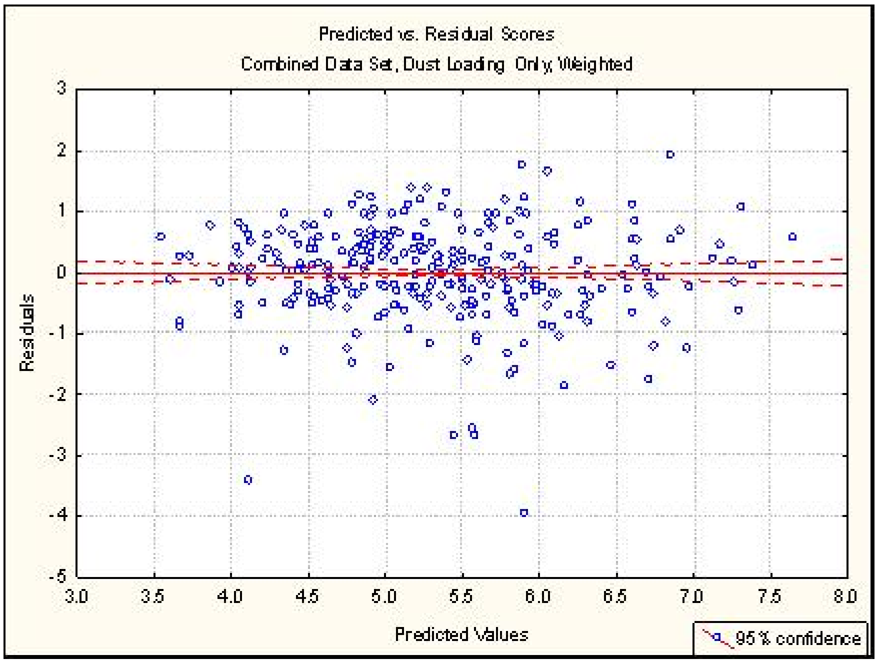
All of the models are sufficient to develop reasonably reliable estimates of indoor dust concentration from indoor dust loading inputs, although the statistical confidence limits for these predictions are quite wide. A higher degree of scatter in the data from buildings built between 1960 and 1979 is reflected in broader prediction limits for that regression. Also, the statistical confidence limits do not capture the full extent of uncertainty associated with potential non-representativeness of data or other data limitations.

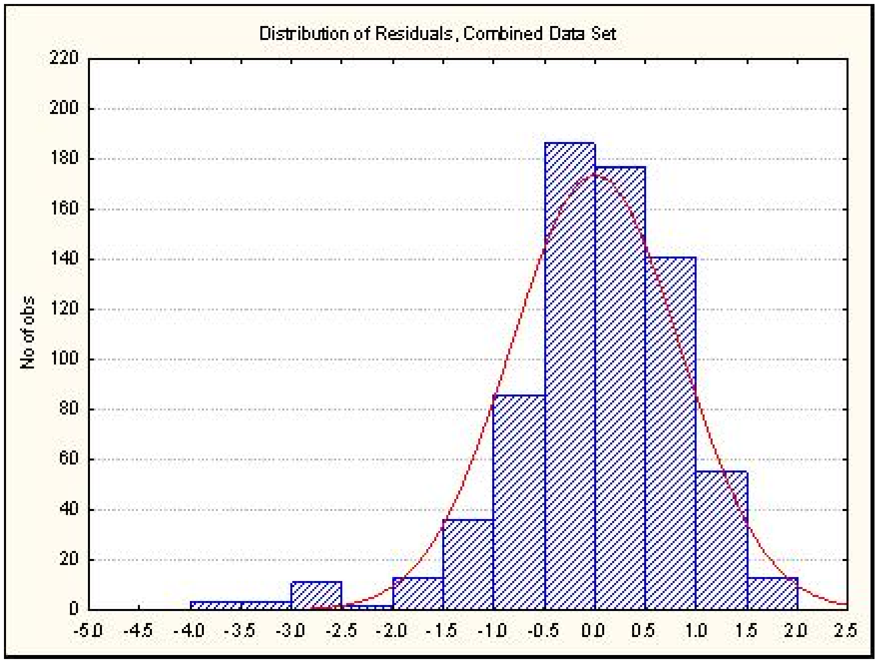
Detailed model outputs and residuals plots are provided in Attachment G-1-16 through G-1-19 in Section G-1.6.

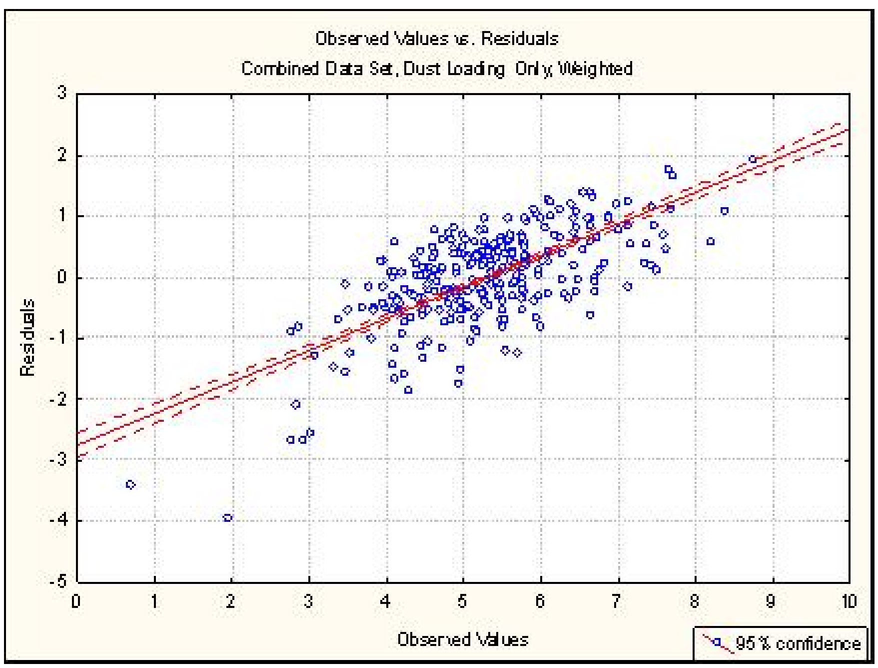
G-1.6. DETAILED REGRESSION RESULTS

Attachment G-1-16. Regression Results for Combined Data Set

Combined Data Set Dust Loading Only, Weighted						
Regression Summary for Dependent Variable: LNPBCONC (New HUD Data With Weights.sta) R = 0.69437119 R²= 0.48215135 Adjusted R² = 0.48143609 F(1,724)=674.09 p<0.0000 SE of estimate: 0.84431						
	Beta	***SE of Beta***	***B***	***SE of B***	***t(280)***	***p-level***
Intercept			4.920573	0.034640	142.0480	0.00
LNVAC	0.694371	0.026744	0.517568	0.019935	25.9633	0.00

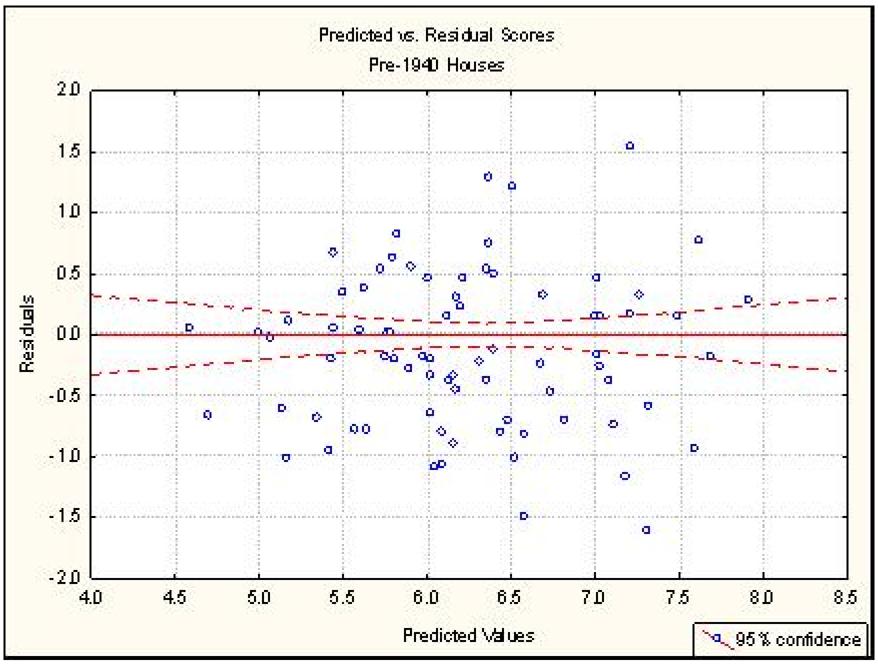


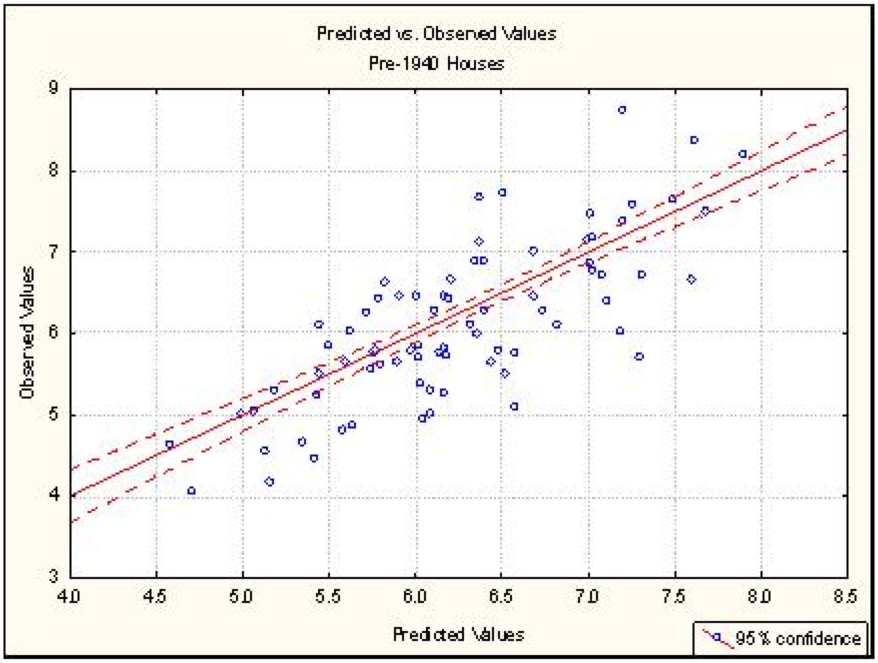

Distribution of Residuals, Combined Data Set
No of obs
220
200
180
160
140
120
100
80
60
40
20
0
-5.0 -4.5 -4.0 -3.5 -3.0 -2.5 -2.0 -1.5 -1.0 -0.5 0.0 0.5 1.0 1.5 2.0 2.5


Observed Values vs. Residuals
Combined Data Set, Dust Loading Only, Weighted
Residuals
3
2
1
0
-1
-2
-3
-4
-5
0 1 2 3 4 5 6 7 8 9 10
Observed Values
95 % confidence

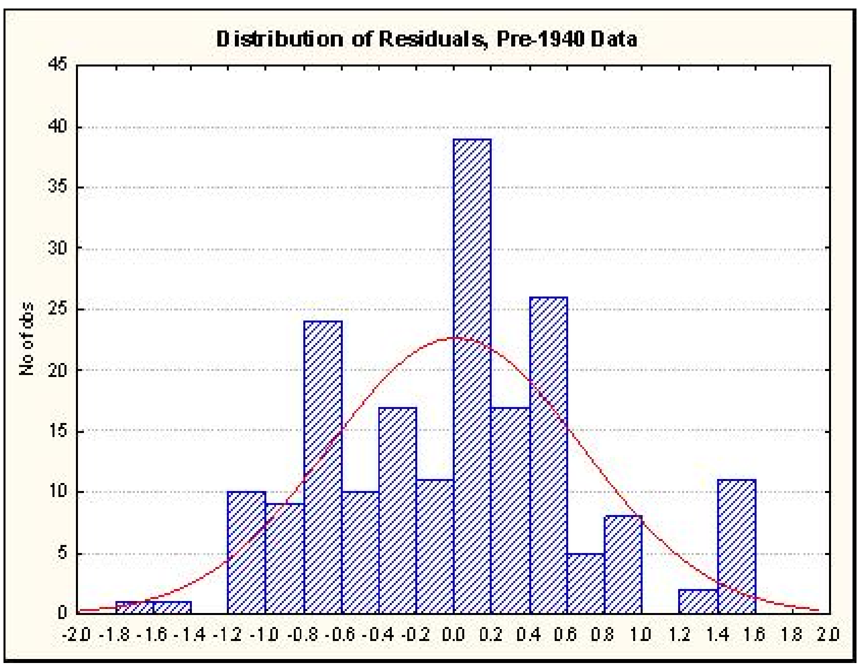
Attachment G-1-17. Regression Results for <1940 Data

<1940 Data, Weighted						
Regression Summary for Dependent Variable: LNPBCONC (New HUD Data With Weights.sta) R = 0.72734822 R² = 0.52903543 Adjusted R² = .52651690 F(1,187) = 210.06 p<0.0000 SE of estimate: 0.68462 Include condition: v2 = 1						
	Beta	***SE of Beta***	***B***	***SE of B***	***t(187)***	***p-level***
Intercept			5.513770	0.075486	73.04334	0.000000
LNVAC	0.727348	0.050185	0.454319	0.031347	14.49336	0.000000





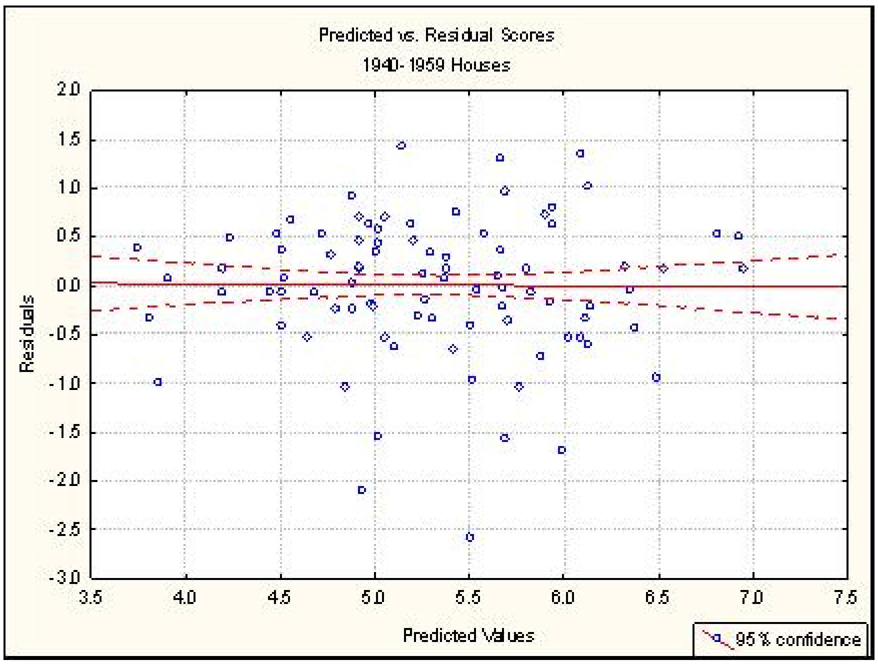
Predicted vs. Observed Values
Pre-1940 Houses
Observed Values
Predicted Values
95% confidence
9
8
7
6
5
4
3
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5

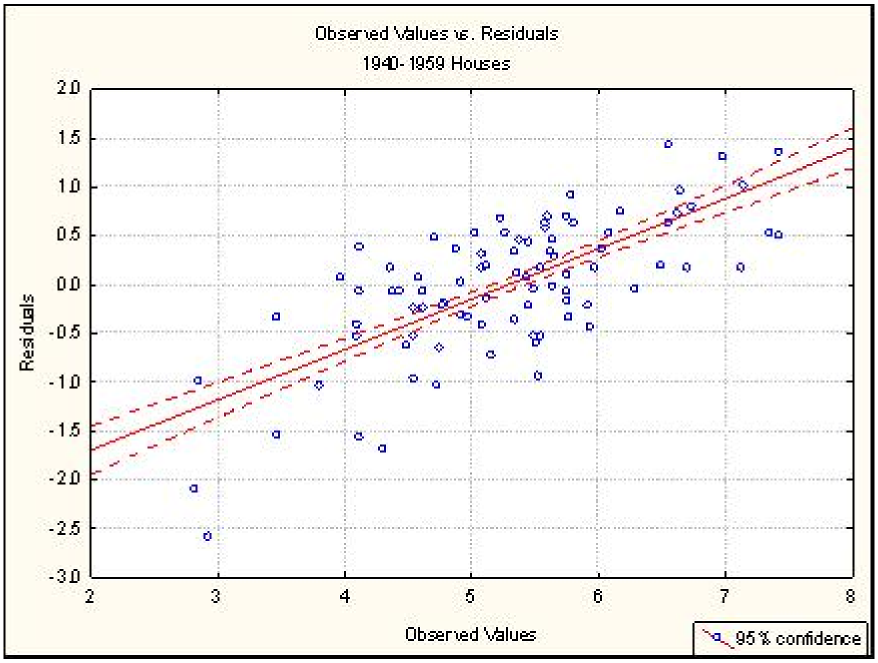


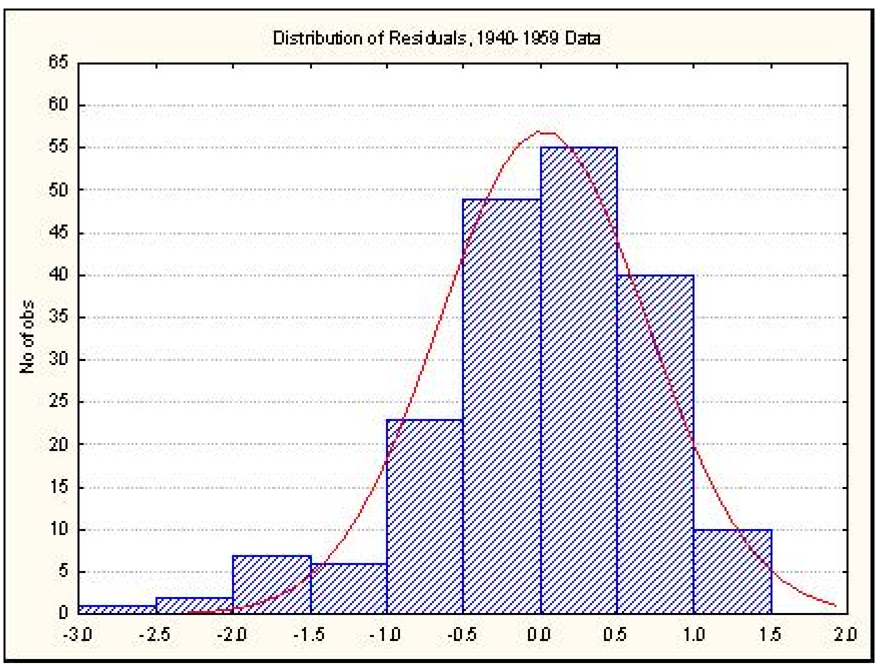
Distribution of Residuals, Pre-1940 Data
No of obs
45
40
35
30
25
20
15
10
5
0
-2.0 -1.8 -1.6 -1.4 -1.2 -1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0

Attachment G-1-18. Regression Results for Data from 1940 to 1959

1940 to 1959 Data, Weighted						
Regression Summary for Dependent Variable: LNPBCONC (New HUD Data With Weights.sta) R = 0.69421417 R^2 = 0.48193331 Adjusted R^2 = 0.47919222 F(1,189) = 175.82 p<0.0000 SE of estimate: 0.70271 Include condition: v2 = 2						
	Beta	***SE of Beta***	***B***	***SE of B***	***t(189)***	***p-level***
Intercept			4.930233	0.058076	84.89214	0.000000
LNVAC	0.694214	0.052355	0.443382	0.033438	13.25963	8.49E-29

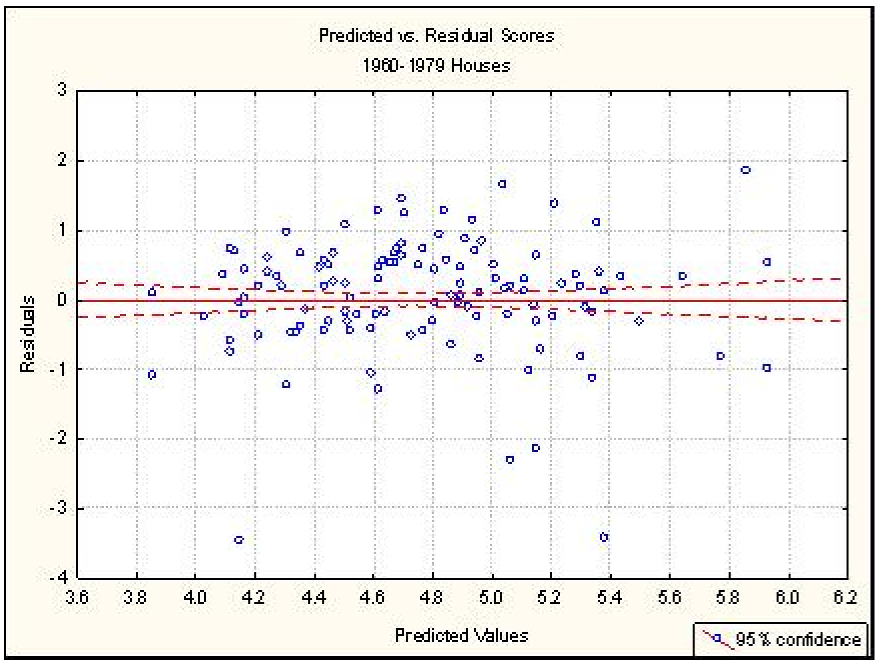


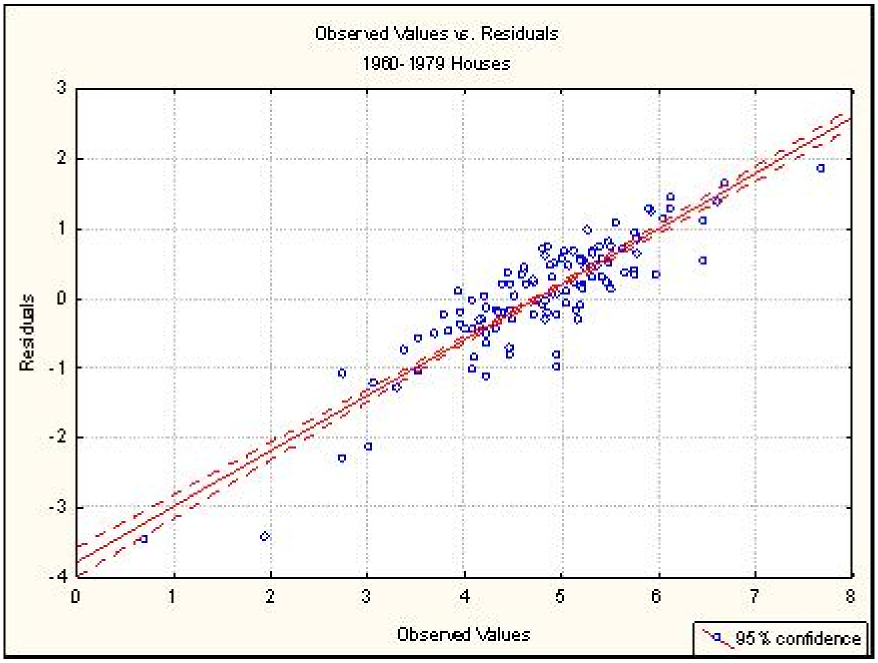

Observed Values vs. Residuals
1940-1959 Houses
Residuals
Observed Values
95 % confidence
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
2
3
4
5
6
7
8

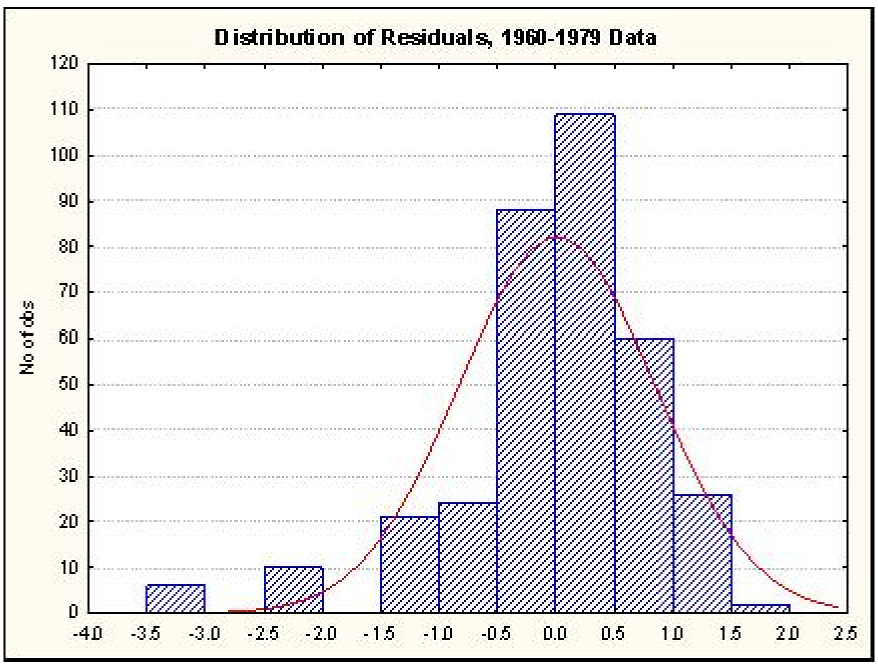

Distribution of Residuals, 1940-1959 Data
No of obs
65
60
55
50
45
40
35
30
25
20
15
10
5
0
-3.0
-2.5
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0

Attachment G-1-19. Regression Results from 1960 to 1979 Data

1960 to 1979 Data, Weighted						
Regression Summary for Dependent Variable: LNPBCONC (New HUD Data With Weights.sta) R = 0.45086819 R^2 = 0.20328213 Adjusted R^2 = 0.20096609 F(1,344) = 87.771 p<.00000 SE of estimate: 0.86020 Include condition: v2 = 3						
	Beta	***SE of Beta***	***B***	***SE of B***	***t(344)***	***p-level***
Intercept			4.704796	0.046407	101.3816	0.000000
LNVAC	0.450868	0.048125	0.354631	0.037853	9.3686	0.000000




Observed Values vs. Residuals
1960-1979 Houses
Residuals
Observed Values
95% confidence


Distribution of Residuals, 1960-1979 Data
No of obs

July 25, 2007

Appendix H: Blood Lead (PbB) Prediction Methods, Models, and Inputs

Prepared by:

ICF International
Research Triangle Park, NC

Prepared for:

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina

Contract No. EP-D-06-115
Work Assignment No. 0-4

Table of Contents

List of Exhibits

List of Attachments

H. BLOOD PB PREDICTION METHODS, MODELS, AND INPUTS

This appendix describes the approaches and methods that were used to predict the changes in individual children's blood lead (PbB) levels and population PbB distributions associated with air, outdoor soil/dust, indoor dust, diet, and drinking water exposures.

H.1. OVERVIEW OF BLOOD PB ESTIMATION APPROACH

As discussed in Appendices C through E, exposure concentrations of lead (Pb) in air, outdoor soil/dust, and indoor dust have been estimated for each of the case studies. For the two point source case studies, these estimates are provided for each of the U.S. Census blocks or block groups in the assessment. For the general urban case study, a single estimate for each of the media is provided to capture the entire urban area. In addition to these exposure media, physiological and behavioral inputs are generated for each case study, as described below in Section H.4.3. These exposure concentrations and other variables related to exposure patterns, and pathway-specific absorption serve as inputs to the Integrated Exposure Uptake Biokinetic (IEUBK) Model for Children (hereafter referred to as the "IEUBK model") to generate PbB estimates. Outputs from the IEUBK model take the form of PbB profiles (from 6 to 84 months of age) of a child receiving that combination of exposures for the entire exposure period. Two PbB metrics have been derived from this lifetime PbB profile. The first metric is the "lifetime" average, where "lifetime" is defined as the period from 6 to 84 months. The second metric is an estimate of "concurrent" PbB concentration, which has been defined as the average at ages 75 and 81 months of age in the seventh year of life.[1]

The PbB models yield central tendency estimates of a child's PbB concentrations for specified simulation periods (with the temporal precision varying depending on the specific model) and for specific patterns of exposure. Unless the graphing option of the IEUBK is used, these estimates for a typical child (representing central tendency exposure) do not provide information about how individual responses to Pb exposure might vary among the exposed children or how changes in an individual's PbB levels would affect the population's levels for a given case study. Thus, a probabilistic approach has been implemented to capture both the effects of inter-individual variability in PbB levels and the population distribution of exposures on the resultant population distribution of PbB statistics.

[1] The rationale for defining the average PbB at 75 and 81 months of age in the seventh year of life as concurrent reflects the fact that the average age of the intelligence quotient (IQ) testing in the Lanphear et al. (2005) study of PbB-IQ relationships was approximately seven years (see Appendix K for a more detailed discussion).

For the two point source case studies, development of population distributions of PbB levels involved the following steps:

Step 1. PbB models were used to generate central tendency estimates of PbB per U.S. Census block or block group.

Step 2. The number of children (birth to seven years of age) residing in each block and block group was determined from U.S. Census Bureau data (2005).

Step 3. Population-weighted random sampling was used to select a PbB level from the results of Step 1. The probability for sampling each U.S. Census block or block group was set proportional to the number of young children (birth to seven years of age) residing in each block (obtained from Step 2). The data set generated in Step 1 was sampled 50,000 times in this way.

Step 4. For the central tendency estimate corresponding to a specific U.S. Census block or block group chosen in each iteration of Step 3, a lognormal distribution reflecting inter-individual variability in both behavior and biokinetics related to Pb exposure was developed using a geometric standard deviation (GSD) obtained from the literature. A random number was generated for each of the 50,000 iterations; this number corresponded to a cumulative probability value of the cumulative distribution function for the lognormal distribution defined by the chosen central tendency and the GSD. The Excel function LOGINV was then used to find the specific PbB value corresponding to that cumulative distribution function value. In this way, the central tendency values were adjusted to reflect specific patterns of behavior and biokinetics in children related to Pb exposure. Data related to the selection of the GSD values were provided in Section H.4.

Step 5. These 50,000 simulated child PbB levels were then used to characterize (via percentiles) the distribution of PbB levels in the population.

Steps (3) through (5) result in a distribution of predicted PbB levels in the exposed population that reflects variability contributed by both the population-weighted distributions of exposure concentrations and by the inter-individual variations in response to Pb exposures.

For the general urban case study, no population-specific differences in central tendency PbB levels were available, since only a single representative PbB was generated for the entire urban area. Thus Steps (2) and (3) were skipped, and the same central tendency value was always used to generate a lognormal distribution with the specified GSD in Step (4). However, as in the other case studies, 50,000 PbB values were selected to reflect the inter-individual variability associated with the GSD.

The following sections discuss in detail the PbB models used for this assessment to generate the central tendency estimates, the selected model inputs, and how the models were implemented to estimate case study-specific PbB levels for children (6 to 84 months of age).

H.2. DESCRIPTION OF BLOOD PB MODELS

Two biokinetic models and one empirical (regression-based) model were considered for use in this assessment. The two biokinetic models are the IEUBK model described in Section H.2.1 and the International Commission for Radiation Protection (ICRP) model (hereafter referred to as the "Leggett model"), described in Section H.2.2. Both are well-documented, are widely used, and have been subject to a range of testing and calibration exercises (see Section 4.4 of USEPA (2006a)]). The empirical model was developed by Lanphear et al. (1998) (hereafter referred to as the "Lanphear model") and is described in Section H.2.3.

Based on the performance evaluation described in Appendix J, the IEUBK model was selected for use in this assessment. However, PbB predictions generated using the Leggett biokinetic model are included in the sensitivity analysis for comparison purposes (see Appendix L for more details).

H.2.1. The IEUBK Model

The U.S. EPA IEUBK model (USEPA, 2005) consists of three main modules: the exposure module, the uptake module, and the biokinetic module (see Exhibit H-1). The IEUBK model also has a graphing module that estimates a plausible distribution of PbB concentrations for a given GSD. The distribution is centered on the geometric mean (GM) PbB concentration calculated by the biokinetic module. Each of the main modules is described below. Full documentation of the IEUBK module structure and the basis for the suggested default parameter values can be found in U.S. EPA (1994b; 2002b).

H.2.1.1. Exposure and Uptake Modules of the IEUBK Model

The exposure module accepts inputs related to six exposure media: air, diet (excluding drinking water), drinking water, outdoor soil/dust, indoor dust, and other. The IEUBK model provides default values for the various model input parameters, which the user can adjust for specific applications. These parameters include those used by the model to estimate Pb uptake, including absorption fraction and inhalation rate, water intake, dietary intakes of specific food classes, and outdoor soil/dust and indoor dust ingestion rates. The selection of model input parameter values for this assessment is discussed in more detail in Section H.4.

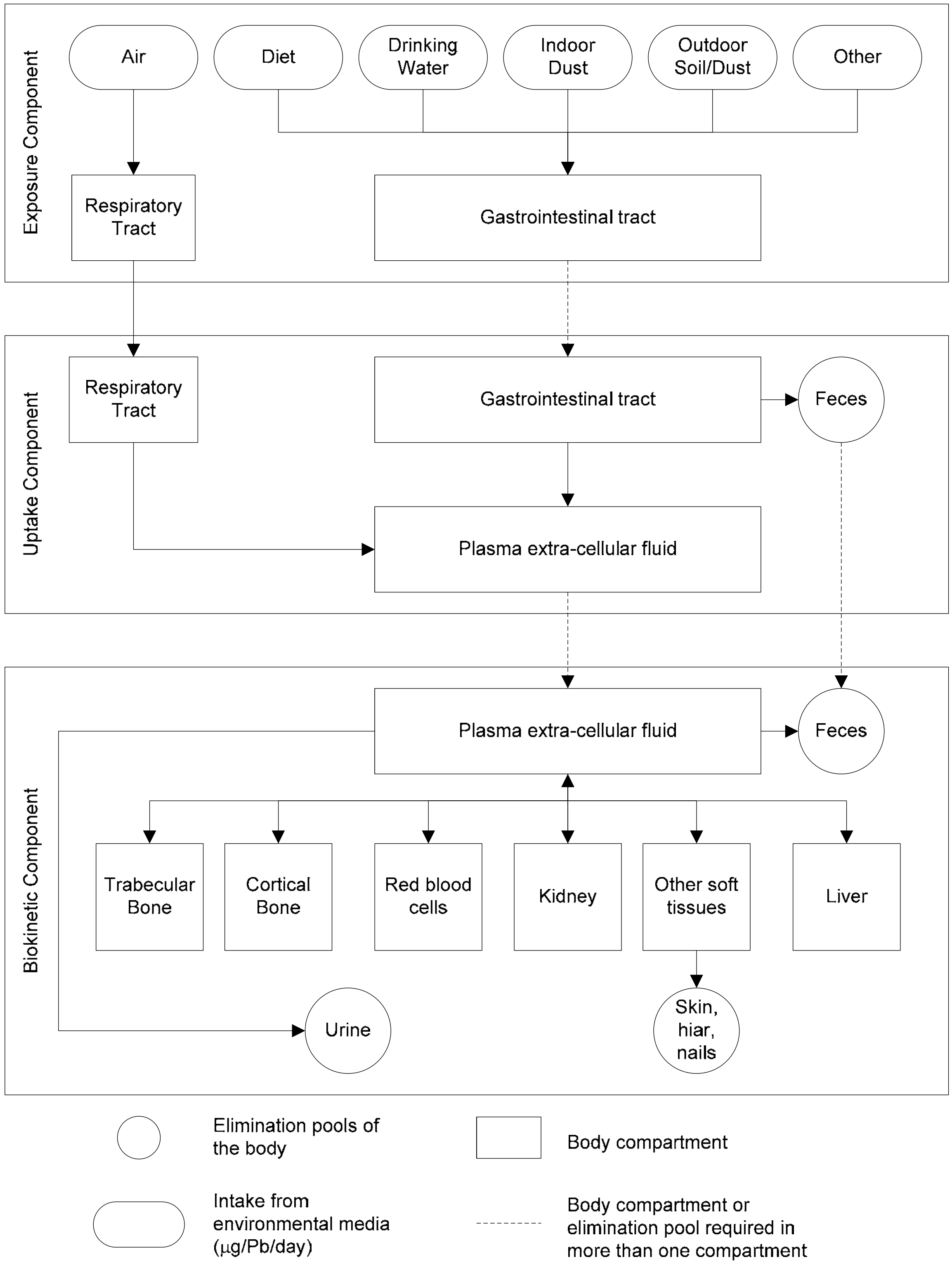
The exposure module also includes default age-specific estimates of time spent outdoors, as well as estimates of outdoor and indoor air Pb concentrations, age-specific inhalation rate, and respiratory tract absorption fraction, all of which are used to estimate age-specific Pb inhalation uptakes. The respiratory tract absorption fraction implicitly reflects both deposition of inhaled Pb in the respiratory tract and absorption of deposited Pb, either from the respiratory tract or from the gastrointestinal (GI) tract. The model also contains an option for calculating indoor dust Pb concentrations based on an empirical relationship among air, outdoor soil/dust, and indoor dust Pb levels (a variation of the air and outdoor soil/dust regression based models discussed in Appendix G). Ingestion uptake is calculated using absorption fractions that are specific to the ingested medium (diet, drinking water, outdoor soil/dust, or indoor dust).

In the uptake module, total GI Pb uptake is modeled as being composed of a saturable and an unsaturable component using the IEUBK default parameters describing the relative importance of these two pathways as a function of Pb intake. The outputs of the uptake module are estimates of the masses of Pb absorbed into the body over time as a function of concentrations in the various exposure media.

H.2.1.2. Biokinetic Module of the IEUBK Model

In the biokinetic module of the model, absorbed Pb (from ingestion and inhalation) is assumed to appear immediately in the plasma-extracellular fluid (ECF) compartment. The plasma-ECF compartment constitutes the central compartment in the biokinetic model from which exchange to all other compartments occurs. Trabecular and cortical bone (which are not directly coupled in the IEUBK model) constitute the main long-term storage compartments, with the estimated turnover in other compartments being more rapid. The binding capacity of the red blood cell (RBC) compartment is modeled as being saturable, simulating the limited capacity of aminolevulinate dehydratase (ALAD) and other Pb-binding proteins. Pb excretion occurs through a urine pathway (distinct from the kidney compartment); hepatobiliary secretion is coupled with the liver compartment, with a minor component of excretion from “other soft tissues” (i.e., skin, hair, and nails). A more complete description of the derivation and structure of the IEUBK model can be found in U.S. EPA (2006a) and White et al. (1998).

Exhibit H-1. Structure of the IEUBK Model



Source: Adapted from (USEPA, 2006a).

H.2.2. Leggett Model

The Leggett model (Leggett, 1993) differs from the IEUBK model in that data from short-term studies (on the time-scale of hours to days) are used to estimate parameter values for the most rapid uptake and exchange processes, and thus the time resolution of the Leggett model is much finer than that of the IEUBK model. The user may specify step length, depending on the degree of time resolution required in the PbB predictions. Unlike in the IEUBK model, Pb absorption is a linear function of Pb intake, and the known nonlinearity of PbB responses is modeled through concentration-dependent variation in Pb binding by RBCs.

The biokinetic component of the Leggett model is more technically sophisticated than the IEUBK model, but the model lacks a built-in facility to convert exposure concentrations to Pb uptake and to integrate uptakes from multiple exposure media.

Other key differences between the structures of the Leggett model and the IEUBK model include (Pounds and Leggett, 1998; USEPA, 2006a):

- The published version of the Leggett model lacks the multipathway exposure module of the IEUBK model. The Leggett model accepts total respiratory and ingestion intakes (administered doses) as inputs and calculates Pb uptake using age-specific absorption factors.
- The Leggett model lacks a "probabilistic" component; all predictions are deterministic for a single individual receiving a given set of exposures, with no capability for generating graphical outputs.
- The central exchange compartment in the Leggett model is "diffusible plasma," rather than the plasma-ECF compartment used in the IEUBK model. Extra-vascular fluid, RBCs, and a bound plasma fraction are the other blood/fluid compartments that exchange directly with plasma in the Leggett model, with different transfer rates reflecting differences in estimated exchange rates.
- The trabecular and cortical bone compartments in the Leggett model are each divided into three subcompartments, bone surface and exchangeable and "non-exchangeable" bone volume. Pb in the "non-exchangeable" compartments of both types of bone can be remobilized, but only relatively slowly as a result of bone remodeling, whereas in the IEUBK model bone Pb stores are represented by only two (trabecular and cortical) compartments.
- Another major difference between the models in the turn-over of Pb in bone. In the IEUBK model, the half-time for transfer from bone to plasma is 8.5 days (at 2 years of age). In the Leggett model, approximately 98 percent of bone Pb resides in exchangeable and non-exchangeable bone volume, with half-times out of these compartments being approximately 40 and 300 days, respectively (at age 2 years). This difference in bone retention while not evident from quasi-steady state bone or blood estimates of the two

models, yields very different bone Pb kinetics in response to change in exposure (Leggett, 1993; USEPA, 1994a; 2006a: Section 4.4).

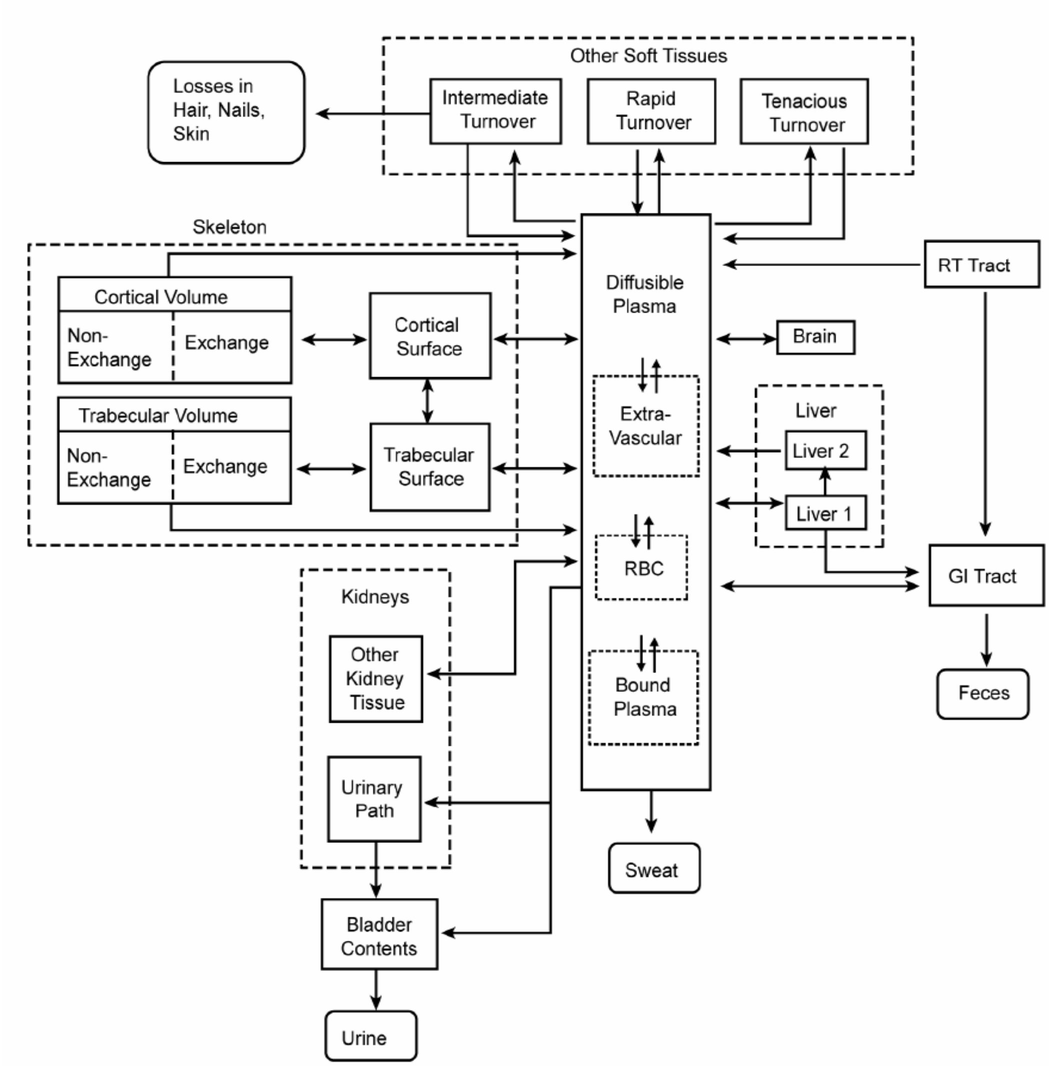
- Urinary excretion is modeled in the Leggett model as part of a kidney subcompartment that receives Pb from blood plasma and rapidly transfers it to urine, rather than as a distinct compartment as in the IEUBK model.

- In the Leggett model, the liver is modeled as two compartments one with rapid and one with moderately rapid Pb exchange. Other soft tissues are modeled as having three compartments with differing exchange rates. Pb in brain tissue is explicitly modeled in the Leggett model. The IEUBK model, in contrast, simulates three soft tissue compartments (kidney, liver and other), and does not specifically model Pb levels in the brain.

The Leggett model predictions have been compared with the deterministic predictions of PbB levels generated by the IEUBK model, using the IEUBK default inputs (Pounds and Leggett, 1998). In that comparison, the Leggett model predictions were substantially higher than those from the IEUBK model.

Like the IEUBK model, the Leggett model is biokinetic, and exchange among compartments is modeled using first-order transfer coefficients (equivalent to first-order rate constants). The Leggett model implements values for the transfer rates that are based on a range of data from adult human radioactive tracer studies, autopsy data from adults and children, and data from animal studies related to the absorption, deposition, and excretion of Pb and chemically similar elements (Leggett, 1993). Exhibit H-2 depicts the compartmental structure of the Leggett model. These transfer coefficients were estimated during the development of the Leggett model and provided as default values for six age categories: newborn (birth to 100 days), 1 year, 5 years, 10 years, 15 years, and 25 years and older, with age-specific transfer parameters for children estimated by interpolation between the nearest values. Transfer factors for children were adjusted to take into account the more rapid bone turnover (calcium [Ca] and Pb addition and resorption) in children compared with adults. All of the Leggett model’s default transfer factors were used without modification in the performance evaluation described in Appendix J.

Exhibit H-2. Structure of the Leggett Model



Source: Leggett (1993).

H.2.3. Lanphear Model

Lanphear et al. (1998) reported the results of an analysis of the relationship among residential outdoor soil Pb levels, indoor dust Pb, Pb paint hazards, and PbB levels in 12 cohorts of urban children in the United States. The study controlled for socioeconomic and family variables and exposure to Pb in drinking water. A major result of that effort was a model that predicted PbB concentrations as a function of indoor dust Pb loading (the amount of Pb per unit area of flooring) and residential outdoor soil Pb concentrations. It is important to reiterate that the Lanphear model estimates PbB concentrations for children 16 months of age, so the results from this model cannot be directly compared to the lifetime average and concurrent PbB predictions developed from outputs of the IEUBK and Leggett models.

H.3. APPLICATION OF BLOOD PB MODELS

H.3.1. Adaptation of the IEUBK Model

The IEUBK model was used in batch mode to generate PbB estimates at different ages for children exposed from 6 to 84 months of age in each block or block group for each case study. Inputs to the IEUBK model included exposure parameters and intake and uptake factor values (see Section H.4) and the inhalation, outdoor soil/dust and indoor dust exposure concentrations of Pb for each block or block group. The input data also included age-specific Pb exposure concentrations for policy-relevant background pathways (e.g., drinking water and diet), which were assumed to be the same for all children.

As described in Section H.1, lifetime average and concurrent PbB estimates were derived for each (hypothetical) exposed child. Lifetime average is defined as the average PbB level of model outputs for the exposure interval 6 to 84 months, and concurrent PbB is defined as the average PbB level at 75 and 81 months in the seventh year of life. To derive these metrics, IEUBK PbB estimates were first generated for nine specific age ranges (see Exhibit H-3) for each block or block group (point source case studies) or for the case study as a whole (the general urban case study); these estimates represented the central-tendency PbB levels experienced by children of those ages in each block or block group or the general urban environment. The lifetime average PbB metric was derived as the time-weighted average of the PbB values for the nine ages. The concurrent PbB metric was derived as the average of the last two ages (75 and 81 months).

Exhibit H-3. Ages for the IEUBK-Derived PbB Estimates

Mid-point of IEUBK Age Ranges (Months)	Age Range Represented by IEUBK PbB Estimates (Months)
9	7 to 12
15	13 to 18
21	19 to 24
31	25 to 36
43	37 to 48
55	49 to 60
67	61 to 72
76	73 to 78
82	79 to 84

Note: Modeling periods run from the first day of the first month to the last day of the last month.

The nine age periods for which the point estimates were obtained using the IEUBK model were selected to capture those periods of childhood exposure expected to produce significant variability in PbB (i.e., exposures occurring under 2 years of age). Consequently, exposure intervals covering the first two years of life (i.e., 7 to 12 months, 13 to 18 months, and 19 to 24 months) were six months long, while the remainder of the simulation periods (up to the last year) were simulated with year-long exposure intervals.

The lifetime average and concurrent estimates were stored in Microsoft Excel® spreadsheets to serve as inputs to the probabilistic population PbB model (see Sections H.1 and H.4). Each time the Monte Carlo sampling algorithm chose a particular U.S. Census block or block group, the appropriate lifetime average and concurrent PbB levels served as the GM values for the block or block group from which the individual PbB estimates were derived.

H.3.2. Adaptation of the Leggett Model

To evaluate its potential use in these assessments, two adaptations were made to the Leggett model code, which Dr. Joel Pounds provided (Pounds, 2005). First, an external spreadsheet model (hereafter referred to as the "Leggett uptake calculation model") was developed for converting multimedia exposure concentrations to age-specific Pb uptake estimates. This model was constructed using the same exposure factors and absorption fraction values for the air, drinking water, diet, outdoor soil/dust, and indoor dust exposure pathways as were used in the IEUBK model runs. This approach ensured that the age-specific masses of Pb entering the biokinetic module of the Leggett model would be identical to those entering the IEUBK model at the same exposure Pb concentrations for a child of the same age. Input values for the PbB modeling are provided in Exhibit H-6 in Section H.4.3.

In addition to the Leggett uptake calculation model, a FORTRAN "wrapper" was developed that allowed the model to be run in the batch mode (hereafter referred to as the "batch Leggett model"), generating PbB profiles for multiple children based on the Leggett uptake calculation model estimates described above. The outputs of the batch Leggett model were daily age profiles of PbB estimates for each exposed child, from which the concurrent and lifetime PbB metrics were derived by averaging over the same age ranges as described in Section H.3.1 for the IEUBK model.

PbB predictions from the Leggett uptake calculation model and the batch Leggett model were compared to results obtained by the U.S. EPA and other investigators for the same exposure scenarios. Predicted PbB levels were found to be very similar (nearly identical) to the results obtained in earlier model comparisons (USEPA, 2007b).

The Leggett model iteration time step was set at 0.1 day throughout the modeling period. Test runs indicated that modeled daily, concurrent, and lifetime average PbB concentrations from six months of age and older were identical to those obtained using much shorter time steps. Just as was described in Section H.3.1 for the IEUBK model, outputs from the PbB modeling (lifetime average and concurrent PbB estimates for each U.S. Census block or block group) were saved and stored in Microsoft Excel® spreadsheets to serve as inputs to the probabilistic population PbB model described in Section H.1.

H.3.3. Adaptation of the Lanphear Model

Two technical issues needed to be addressed in order to apply the Lanphear model to estimate PbB levels in this type of assessment. First, because the Lanphear model accepts dust Pb loading rather than dust Pb concentration as its input, a method was needed to develop a model describing the relationship between the indoor dust concentration estimates generated in the primary Pb smelter case study and estimates of indoor dust loading. The second problem was how to apply the Lanphear model to the specific combinations of indoor dust and outdoor soil Pb exposures in each case study block or block group. Sections H.3.3.1 and H.3.3.2 explain how these two issues were addressed.

H.3.3.1. Development of a Dust Pb Loading-Dust Pb Concentration Regression Model

The biokinetic models used to predict PbB concentrations use as their inputs the concentrations of Pb in outdoor soil/dust and indoor dust. However, the Lanphear model used to estimate PbB levels generates outputs from inputs of indoor dust Pb loading. Thus, developing approaches for estimating dust Pb concentration based on dust Pb loading is necessary. The relationship between indoor dust loading and Pb concentration was investigated using a data set developed as part of the U.S. Department of Housing and Urban Development's (HUD's) 1997 National Survey. The data set was used because it appeared to be the largest, most nationally representative source of both indoor dust loading and concentration data taken simultaneously from the same households. To the extent that these data do not reflect the dust loading-dust concentration relationship in the primary Pb smelter case study, the PbB estimates will be biased. See Attachment G-1 for a more detailed discussion of the dust Pb loading-dust Pb concentration Regression Model.

The HUD data comprises 307 wipe sample and dust concentration measurements taken from 284 households (USEPA, 1998; Appendix C). The data were stratified into four vintage ranges from pre-1940 to post-1979. The data from all four ranges were pooled for the analysis. Log-log regression provided the best fit and regression diagnostics. Two dust concentration data points, one with a value about five-fold below the next lowest and one with a value more than

10-fold above the next highest concentration, were excluded from the analysis. The dust concentration model derived in this manner was as follows:

$$LnHouseDustPb = 4.920573 + 0.517568 \times LnDustPbLoading$$

where:

LnHouseDustPb	=	log-transformed indoor dust Pb concentration (micrograms per grams [μg/g])
LnDustPbLoading	=	log-transformed dust Pb loading (vacuum samples) (μg/square feet [ft^2])

Details of the derivation of the dust Pb loading-dust Pb concentration regression model can be found in Attachment G-1.

H.3.3.2. Estimation of Equivalent Dust Pb Concentrations and a Bivariate PbB Model

In the second part of the analysis, linear regression was again used to estimate PbB concentrations from the dust loading measurements in the Lanphear et al. (1998) analysis. Exhibit H-4 reproduces Table 4 from Lanphear et al. (1998) with an added column of estimated dust Pb concentrations. The table entries contain covariate-adjusted estimates of PbB for 16-month-old children associated with specified combinations of indoor dust loading and outdoor soil/dust Pb concentrations. In Exhibit H-4, the relationship is also specified for indoor dust Pb concentrations.

To estimate PbB values for individual U.S. Census blocks or in general urban environments, data from Exhibit H-4 were used to derive a bivariate model for predicting PbB as a continuous function of outdoor soil/dust and indoor dust Pb concentrations. The REGRESS module from Mathematica® version 5.2 was used to fit a nonlinear model to the natural log of outdoor soil/dust and indoor dust Pb concentrations, as follows:

$$BloodPb = -9.1138 + 2.03554 \times LnDustPb + 0.66657 \times LnSoilPb$$

where:

BloodPb	=	concentration of Pb in blood (μg/deciliter [dL])
LnDustPb	=	log-transformed indoor dust Pb concentration (μg/g)
LnSoilPb	=	log-transformed outdoor soil/dust Pb concentration (μg/g)

All the coefficients were significant at $p < 10^{-6}$ and the F Ratio for the fit model was 960.3. To test the model, the fitted coefficients were used to reproduce the estimated PbB values in Exhibit H-4. The resulting PbB values matched those in the table within an average of 0.4 percent. The maximum difference between any of the values in Exhibit H-4 and those in Lanphear's original Table 4 was 1.6 percent.

Exhibit H-4. Predicted PbB Levels Associated with Combinations of Outdoor Soil/Dust and Indoor Dust Pb Loading and Indoor Pb Concentration

Indoor Dust Pb Loading (µg/ft^2)	Estimated Equivalent Indoor Dust Concentration (mg/kg)	Outdoor Soil/Dust Pb (mg/kg) [a]							
		10	72	100	500	1000	1500	2000	4000
1	56	2.3	2.8	2.9	3.5	3.8	4	4.1	4.4
5	150	3.2	4	4.1	4.9	5.3	5.5	5.7	6.1
10	228	3.7	4.6	4.7	5.6	6.1	6.3	6.5	7.1
15	292	4	5	5.1	6.1	6.6	6.9	7.1	7.7
20	348	4.2	5.3	5.4	6.5	7	7.3	7.6	8.1
25	398	4.4	5.5	5.7	6.8	7.3	7.7	7.9	8.5
40	530	4.9	6.1	6.3	7.5	8.1	8.4	8.7	9.4
55	643	5.2	6.5	6.7	8	8.6	9	9.3	10
70	745	5.5	6.8	7	8.4	9.1	9.5	9.8	10.5
100	925	5.9	7.3	7.6	9	9.7	10.2	10.5	11.3

[a] Table adapted from Table 4 in Lanphear et al. (1998).

Note that for equivalent indoor dust Pb concentrations outside of the range of the model (greater than 925 µg/g), the same degree of model fit cannot be expected. However, only 17 U.S. Census blocks/block groups in the primary Pb smelter case study, with less than two percent of the exposed child population, have predicted indoor dust Pb concentrations above this value.

H.3.3.3. Estimation of PbB from Indoor Dust Loadings

The adapted version of Table 4 from the Lanphear model (see Exhibit H-4) predicts the PbB concentrations in young children as a function of outdoor soil/dust Pb concentration and indoor dust Pb loading. Thus, a log-log model of PbB concentration based on these variables can be derived directly from the values given in Exhibit H-4. Multiple regression of *LnBloodPb* on *LnSoilPb* and *LnDustPbLoading* [2] yields the following:

[2] The Lanphear et al. (1998) model is based on wipe loading measurements.

$$LnBloodPb = 0.578371 + .205290 \times LnDustPbLoading + 0.108972 \times LnSoilPb$$

where:

LnBloodPb	= log-transformed concentration of Pb in blood (µg/dL)
LnDustPbLoading	= log-transformed indoor dust Pb loading (wipe samples) (µg/ft^2)
LnSoilPb	= log-transformed outdoor soil/dust Pb concentration (µg/g)
adjusted R^2	= adjusted variance, set to 0.9997

Like the model based on indoor dust Pb concentration, the model fit the data within rounding error ($R^2 = 0.9997$, the F Ratio = 1691, and $p< 10^{-6}$). When the indoor dust estimation models were used, which provided indoor dust Pb loading as their outputs, the above equation was used to predict PbB levels based on the Lanphear model.

H.4. INPUTS TO THE BLOOD PB MODELS

H.4.1. Exposure Concentration Estimates for Inhalation, Outdoor Soil/Dust and Indoor Dust

Exposure concentrations for inhalation, outdoor soil/dust and indoor dust were estimated for each U.S. Census block or block group in each case study as described in Appendices C, D and E. The values used for each air quality scenario modeled are presented in Appendix C for the general urban case study, in Appendix D for the primary Pb smelter case study, and in Appendix E for the secondary Pb smelter case study.

H.4.2. Policy-Relevant Background Exposure Pathway Concentrations and Pb Intake Estimates

As noted above, the exposure Pb concentrations and Pb intake from policy-relevant background pathways (drinking water and diet) were also parameter inputs to the PbB models. All exposed populations were assigned the same Pb concentration in drinking water. While the literature contains abundant data, in many cases the data are from “first-draw” samples, non-random (“priority”) samples, or from communities where Pb levels were known to be elevated. After reviewing the literature, the average drinking water concentration was estimated to be 4.61 µg/liter (L), based on data from two recent studies of residential water concentrations in homes and apartments in the United States and Canada (Clayton et al., 1999; Moir et al., 1996). The range of values seen in these studies (0.84 to 16 µg/L) was considered to be representative of randomly sampled residential water in houses constructed since Pb pipe and solder were banned from residential use. The selected value is close to the “default” value (4.0 µg/L) provided with the IEUBK model (USEPA, 1994b). Much higher values have been encountered in homes with

Pb piping and/or very corrosive water. Lower average drinking water Pb concentrations (on the order of 0.9 µg/L) have been reported in some recent studies (Ryan et al., 2000).

In addition to drinking water, young children are expected to be exposed to Pb in the foods they consume. In this assessment, all exposed children were assumed to receive the age-specific estimates of dietary Pb intake developed by the U.S. EPA Office of Solid Waste and Emergency Response (USEPA, 2006c). The U.S. EPA developed these estimates by analyzing food consumption data from the third National Health and Nutrition Examination Survey (NHANES III), conducted by the National Center for Health Statistics (CDC, 1997), and food residue data from the U.S. Food and Drug Administration's (FDA) Total Dietary Study (USFDA, 2001). The daily intake values shown in Exhibit H-5 are considerably lower than those developed using the same methodology in the 1980s and 1990s. Pb concentrations in food have decreased dramatically since the prohibition of Pb solder in food containers in 1982 (USEPA, 2006a, Section 3.4).

Exhibit H-5. Summary of Non-Water Dietary Pb Intake Estimates

Age Category (months)	Updated Dietary Pb Intake Estimates (µg/day)
0 to 11	3.16
12 to 23	2.6
24 to 35	2.87
36 to 47	2.74
48 to 59	2.61
60 to 71	2.74
72 to 84	2.99

The potential exists for double-counting of drinking water and dietary Pb intake because some diet categories (e.g., baby formula, soup) may be prepared using domestic drinking water. Such double counting is likely to be minimal because the Total Dietary Survey data are limited to "direct" drinking water intake (USFDA, 2001).

The assumption that all children in all exposed populations experience the same background exposure concentrations may result in a substantial underestimation of the overall variation in Pb uptake in these populations.

H.4.3. Behavioral, Physical, and Chemicals Factors Affecting Pb Exposure, Intake, and Uptake

As discussed previously, a number of model inputs govern how absorbed dose (uptake) estimates are calculated from exposure concentrations. These factors represent the physiological and behavioral characteristics of the exposed population and the chemical and physical properties of the exposure media that govern exposure and absorption by inhalation and ingestion.

Because substantial data have become available since the IEUBK default values were last updated, a literature review was conducted to identify and evaluate recent information related to Pb exposures, absorption, and bioavailability (USEPA, 2006b). Experts in the U.S. EPA were also consulted in an effort to derive exposure, intake, and uptake values for this assessment. Exhibit H-6 presents the parameter values that were selected as inputs to the PbB prediction models used in this assessment. The same (or equivalent) values were used, as described above, to calculate Pb inputs to the Leggett model during the sensitivity analysis

Several values in Exhibit H-6 differ from the suggested default values in the most current version of the IEUBK model (USEPA, 2005). Children's daily ventilation rate estimates were derived from values in the International Commission on Radiological Protection (ICRP) report (2002). The child respiratory absorption fraction values used in this assessment were 0.27 for the primary and secondary Pb smelter case studies and 0.24 for the general urban case study. OAQPS staff estimated these values based on multiple analyses of respiratory particulate deposition and Pb absorption, assuming a mass median particle diameter (MMPD) of 4.8 micrometers (μM), with a GSD of 8.29, for areas affected by point sources and 0.5 μM, with GSD of 3.94, for urban areas not affected by specific point sources (USEPA, 2007a). See Attachment H-1 for more details.

Exhibit H-6. Input Parameter Values for the PbB Modeling

Parameter	Parameter Name [a]	Parameter Value: IEUBK Default Age Ranges (Years) 0.5 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	Basis/Derivation [a]
Inhalation									
Daily ventilation rate (cubic meters [m^3]/day)	Ventilation rate	4	5.1	6	6.8	7.8	8.8	10	ICRP (2002), with interpolation for intermediate ages.
Absolute inhalation absorption fraction (unitless)	• Lung absorption (IEUBK) • Absolute respiratory absorption fraction (Leggett)	0.27 (Primary, secondary Pb smelter case studies), 0.24 (general urban case study)							U.S. EPA analysis of multiple studies of particulate deposition and Pb absorption (USEPA, 2007a).
Indoor air Pb concentration	Indoor air Pb concentration (percentage of outdoor)	100 percent							Time spent indoors/outdoors was not considered when using either the IEUBK or Leggett model because the input air concentrations were already long-term weighted averages of indoor and outdoor concentrations (see Appendices C, D and E).
Time spent outdoors	Time spent outdoors (hours/day)	Not used							
Drinking Water Ingestion									
Water consumption (L/day)	Water consumption (L/day)	0.34	0.31	0.31	0.33	0.36	0.39	0.42	Based on value for infants, 1- to 3-year olds, 1-to10-year olds (with trend lines used to interpolate intermediate age ranges) (USEPA, 2002a).
Water Pb concentration (µg/L)	Pb concentration in drinking water (µg/L)	4.61							GM of values reported in studies of United States and Canadian populations (residential water) (Clayton et al., 1999; Moir et al., 1996; as cited in USEPA, 2006a, Section 3.3 Table 3-10).

Exhibit H-6. Input Parameter Values for the PbB Modeling

Parameter	Parameter Name [a]	Parameter Value: IEUBK Default Age Ranges (Years) 0.5 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	Basis/Derivation [a]
Absolute absorption (unitless)	• Total percent accessible (IEUBK) • Absolute GI absorption fraction (Leggett)	50 percent (Single value used across all age ranges)							Assumed similar to dietary absorption (see "Total percent accessible" under Diet below).
Diet									
Dietary Pb intake (µg/day)	Daily Pb intake (µg/day)	3.16	2.6	2.87	2.74	2.61	2.74	2.99	Estimates based on the following: • Pb food residue data from U.S. Food and Drug Administration (U.S. FDA) Total Diet Study (USFDA, 2001); and • food consumption data from NHANES III (CDC, 1997).
Absolute absorption (unitless)	• Total percent accessible (IEUBK) • Absolute GI absorption fraction (Leggett)	50 percent							Alexander et al. (1974) and Ziegler et al. (1978) as cited in U.S. EPA (2006a, Section 4.2.1). These two dietary balance studies suggest that 40 to 50 percent of ingested Pb is absorbed by children (2 weeks to 8 years of age).
Outdoor Soil/Dust and Indoor Dust Ingestion									
Outdoor soil/dust and indoor dust weighting factor (unitless)	• Outdoor soil/dust and indoor dust ingestion weighting factor (percent outdoor soil/dust) (IEUBK) • Outdoor soil/dust and indoor dust ingestion rates calculated separately using same proportion of outdoor soil/dust ingestion (Leggett)	45 percent							This is the percent of total ingestion that is outdoor soil/dust. Value reflects best judgment and consideration (results published by van Wijnen et al. (1990), as cited in (USEPA, 1989). The van Wijnen et al. study examined at tracer studies of ingestion rates for rainy days and non–rainy days. It was assumed that rainy days were associated with all outdoor soil/dust ingestion and non-rainy days were associated with a combination of outdoor soil/dust and indoor dust with the delta representing outdoor soil/dust.

Exhibit H-6. Input Parameter Values for the PbB Modeling

Parameter	Parameter Name [a]	Parameter Value							Basis/Derivation [a]
		IEUBK Default Age Ranges (Years)							
		0.5 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	
Total indoor dust + outdoor soil/dust ingestion (mg/day)	Amount of outdoor soil/dust and indoor dust ingested daily (mg)	85	135	135	135	100	90	85	U.S. EPA (1989), which was based on multiple studies focusing on children.
Absolute gastrointestinal absorption (outdoor soil/dust and indoor dust) (unitless)	Total percent accessible(IEUBK) Absolute GI absorption fraction (Leggett)	Primary Pb smelter case study: 0.48 for outdoor soil/dust and 0.26 for indoor dust Secondary Pb smelter and general urban case study: 0.30 for both outdoor soil/dust and indoor dust							Site-specific absorption factors for outdoor soil/dust and indoor dust were derived for the primary Pb smelter case study using relative bioavailability (RBA) estimates generated based on swine studies involving outdoor soil/dust and indoor dust samples collected in the study area (Casteel et al., 2005). These RBAs were converted to absolute bioavailability factors (i.e., total percent accessible values) by applying the absolute bioavailability factor for the control material (Pb acetate water solution also fed to the animals). Secondary Pb smelter and the general urban case study values: (USEPA, 1989) reflects evidence that Pb in indoor dust and outdoor soil/dust is as accessible as dietary Pb and that indoor dust and outdoor soil/dust ingestion may occur away from mealtimes (resulting in enhanced absorption relative to exposure during meal events).
Other									
Maternal PbB (µg/dL)	Maternal PbB concentration at childbirth, µg/dL	1.94							NHANES IV, national GM for adult women – all nationalities (CDC, 2004).

[a] Where variable names or interpretations differ between the two models, it is specified within the Exhibit.

Estimates of children's direct water ingestion were interpolated from values in the U.S. EPA Children-Specific Exposure Factors Handbook (USEPA, 2002a); the GI absorption fraction of Pb from water (and diet) was retained at the IEUBK default value of 50 percent, and is consistent with the U.S. EPA OAQPS previous analyses of Pb uptake (USEPA, 1989). As noted above, age-specific dietary intake values for Pb were revised to reflect the latest analyses of the U.S. FDA and NHANES III data on food consumption pattern and Pb residue levels (USEPA, 2006c).

Age-specific outdoor soil/dust and indoor dust ingestion rates for the PbB models were left at the IEUBK default values. Similarly, the weighting factor for outdoor soil/dust and indoor dust ingestion was also left at 45 percent outdoor soil/dust, despite limited data supporting this specific value (USEPA, 1989; 1994b). The impacts of changes in the weighting factor and other variables related to outdoor soil/dust and indoor dust ingestion were investigated through the sensitivity analysis, which is discussed in more detail in Appendix L.

Casteel et al. (2005) evaluated the GI absorption of Pb and other metals from outdoor soil/dust samples taken from the primary Pb smelter study area in juvenile swine. Results of these experiments (relative bioavailability estimates) were used to derive estimates of absolute GI absorption fractions (the IEUBK inputs are called "Percent Available") of 0.48 (48 percent) for outdoor soil/dust and 0.26 (26 percent) for indoor dust. Note that these values, based on site-specific data, should not be considered representative of patterns of Pb uptake at other Pb smelter sites. For the other case studies, the IEUBK generic default value for GI absorption of Pb from outdoor soil/dust and indoor dust (0.30, or 30 percent) was used. This value is generally consistent with more recently reported values, although estimates vary widely. As was the case with the outdoor soil/dust-indoor dust weighting factor, the impacts of changes in absorption fractions for outdoor soil/dust and indoor dust were investigated in the sensitivity analyses, which is discussed in more detail in Appendix L.

For the case study PbB modeling, the IEUBK default value for maternal PbB level was updated using data from the most recent NHANES survey. NHANES III data from 1988 to 1994 indicate that the GM PbB value for women of reproductive age has dropped to about 1.94 μg/deciliter (dL) (Maddaloni et al., 2005).

H.4.4 Inter-Individual Variability

The final major input to the probabilistic PbB model that needs to be defined is the estimated GSD. The GSD is a measure of the extent to which an individual's simulated PbB level varies from the mean of the PbB levels for all individuals within a defined area.[3] The selected GSD value determines the shapes of the population distributions of PbB levels generated by the probabilistic model within each of the defined areas. Larger GSD estimates will stretch the upper "tails" of the distribution, resulting in a larger proportion of children having higher estimated PbB values for a given set of exposures. As part designing this analysis, a review was conducted of recent literature characterizing variability in populations of Pb-exposed children to support the GSD values selected for each case study.

Note that the appropriateness of using the GSD as an indicator of PbB inter-variability presupposes that the population distributions of PbB levels are, or are close to, lognormal. With a few exceptions, numerous studies of PbB distributions in moderate to large populations have shown that lognormal models generally provide a good fit to the data. As discussed below, this appears to be the case even in populations where Pb exposures are relatively homogeneous.

Many PbB studies are available, dating to the 1970s, which report PbB GSD values or present data from which GSD values can be estimated. These studies include large population surveys (such as the NHANES), as well as studies of smaller populations, often in limited geographic areas. A substantial proportion of the smaller studies are of children residing near smelting or mining operations where point source emissions and/or historical outdoor soil/dust contamination are dominant sources of exposure. Two objectives of the literature review were to (1) identify trends in GSD values over time in both the large population surveys and the smaller cohort studies, and (2) determine whether any systematic differences were evident between the PbB GSD values for the large and the small studies, and between the smelter and other small cohort analyses. The expectation was that the variability in studies of large populations with

---

[3] These defined areas are designed to delineate portions of the study area expected to have relatively uniform Pb media concentrations (for the two point source case studies, these areas are U.S. Census blocks and/or block groups). Consequently, the GSD used to cover inter-individual variability in PbB levels within each of these defined areas reflects primarily differences in behavior and biokinetics related to Pb exposure (i.e., delineation of these areas to include portions of the study area with similar Pb media concentrations has controlled for significant differences in Pb exposure concentrations, although some variability within these areas is still likely and is covered by the GSD). Note, that the GSD is applied to the entire urban case study area because this is a single exposure zone assumed to have uniform Pb media concentrations (and is not further differentiated as is the case with the two point source case studies).

very heterogeneous exposure patterns should be greater than the variability in studies of small populations, where exposures are less variable.

Exhibit H-7 lists the studies that were reviewed, and provides details related to the study methodologies, populations, and dates of blood sampling.

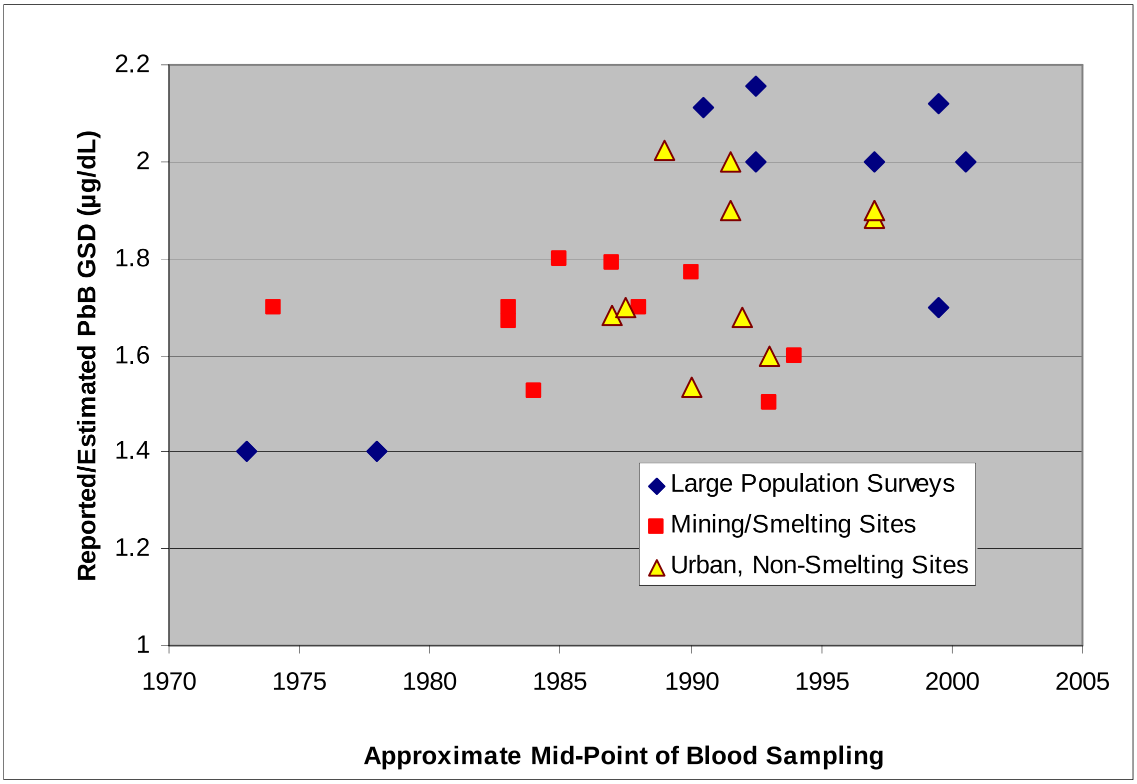
Exhibit H-7. Summary of Children's PbB Studies

Study, Authors	Study Population	Age (months)	Dates of PbB Measurement	GM PbB (µg/dL)	GSD (µg/dL)
New York Screening Study (Billick et al., 1979)	New York State	NA	1970 to 1976	18 to 25	1.41
NHANES II (Marcus, 1990)	National, 6 to 60	6 to 60	1976 to 1980	12.8	1.4
(White et al., 1998) review (see article for full references)	Midvale, Utah (smelter)	NA	1980s	NA	1.8
	Baltimore, Maryland Urban Soil Pb Abatement Demonstration Project	NA	NA	NA	1.6
	Butte, Montana (smelter)	NA	NA	NA	1.5
	Kellogg, Idaho (smelter)	NA	1974, 1983	14.8, 8.0	1.7, 1.7
	E. Helena, Montana (smelter)	NA	1983	8.8	1.7
	Leadville, Colorado (smelter)	NA	1987	8.7	1.8
	Telluride, Colorado (smelter)	NA	1988	6.1	1.7
	Midvale, Utah (smelter)	NA	1990	5.1	1.8
(Griffin et al., 1999)	Bingham Creek, Utah (smelter)	NA	1993	3.1	1.6
	Sandy, Utah (smelter)	NA	1994	NA	1.6
(Lanphear et al., 1998)	Five urban studies	12 to 30	1985 to 1998	5.1	2.0 [a]
	Seven Pb smelter studies	12 to 30	1989 to 1994	4	1.9 [a]
(Lanphear et al., 2005)	Seven cohort studies (one smelter, three foreign)	6 to 60	1979 to 2000	11.70	1.6 (median lifetime) [b]
				7.50	1.7 (median concurrent) [b]
(Pirkle et al., 1998) NHANES III	Males	12 to 60	1991 to 1994	2.7	2.0 [a]
	Females			2.8	2.2 [a]
	Urban			2.8	2.2 [a]
	Non-Urban			2.7	2.0 [a]
	13 Socioeconomic groups			--	2.0 (median)
NHANES III, IV (CDC, 2007)	National	12 to 60	1988 to 1991	3.6	2.1 [a]
			1991 to 1994	2.7	2.2 [a]
			1999 to 2000	2.2	2.1 [a]
NHEXAS, Age 12 to 60 months (USEPA, 2004)	Arizona	12 to 60	1997	1.8	1.9
	Baltimore, Maryland			2.3	1.9
	Region 5			1.8	2
New York Seasonality (Haley and Talbot, 2004)	New York State	12 to 24	1994 to 1997	4	1.7
NHANES IV, Age 12 through 24 months (CDC, 2004)	National males	12 to 24	1999 to 2000	2.3	2
	National females	12 to 24		2.4	2

[a] GSD values were estimated from reported GM values and proportions of PbB measurements above 10 µg/dL.
[b] GSD values were estimated from reported GM, 5th and 95th percentiles.

These studies illustrate the decline in children's PbB levels over the past three decades. They also suggest that the level of inter-individual variability in PbB levels, as indicated by GSDs, has increased. Exhibit H-8 shows the temporal trend in reported and calculated GSD values from the studies listed in Exhibit H-7, with midpoint dates assigned to studies where sampling took place over more than one year.

Exhibit H-8. Time Trend in Children's PbB GSD Values



Large-scale and national studies, in particular, show a dramatic increase in children's PbB GSDs. GSD estimates from the two pre-1980 studies are both approximately 1.4 µg/dL for New York State and National populations. In contrast, children's PbB GSDs in all post-1990 large population surveys were greater than 1.7 µg/dL. All studies based on the NHANES from 1991 onward estimate PbB GSDs of between 2.0 and 2.2 µg/dL for children ages 6 to 60 months or subgroups of that population.

Potential time trends in GSD estimates from studies of smaller populations are more difficult to discern from data presented in Exhibit H-8. Studies of populations living near smelting and mining sites, most of which were conducted between 1970 and the mid-1990s, show relatively constant GSDs of between 1.5 and 1.8 µg/dL across this time period. However, the non-smelter studies, most of which were conducted more recently (1985 to 2000), indicate that PbB GSD values increased over this period, although the trend is less pronounced than for the large-population survey data. Uncertainties about the exact dates when PbB levels were sampled, differences in sampling and averaging methods, and differences in the populations studied prevent concluding that this apparent increase in GSD values is “real,” even though such a trend would be consistent with that shown by in the national survey data.

Collectively, the mean GSD value estimated from all the small studies (smelter and non-smelter) is 1.73 µg/dL. The average GSD derived from studies of smelter populations is 1.67 µg/dL; the average GSD for studies of non-smelter populations is 1.80 µg/dL. The average GSD for all of the small-population studies where blood sampling occurred after 1990 is 1.76 µg/dL. For large-population surveys where sampling was conducted during the same period the average GSD is 2.01 µg/dL. These results generally support the idea that PbB variability in small populations with relatively homogeneous exposure patterns is, in fact, less than that for the United States population as a whole, where exposure is much less homogeneous. Because of methodological differences among these various studies, however, the differences in variability should be interpreted cautiously.

One major difficulty in comparing GSD estimates from the various populations in Exhibit H-8 is that the PbB data were collected and interpreted differently from study to study. The number of samples taken from each child can strongly affect the overall inter-individual variability in PbB levels. Also, the timing and numbers of multiple samples, and how they are combined to generate PbB metrics, can strongly influence the reported “GSD” values. As noted above, different levels of variability in exposures will also affect the observed variability in PbB levels. Differences in analytical methods and levels of detection may also play a role in differences in GSD.

In this assessment, these issues were addressed by basing risk estimates on two different PbB metrics, which capture PbB variability over different time periods (i.e., “concurrent” and “lifetime” PbB metrics as defined by Lanphear et al. (2005)]). The PbB-IQ model Lanphear et al. (2005) was developed based on PbB data from seven cohort studies of Pb-exposed children, where multiple PbB measurements had been taken over the age range of 6 months to at least 60 months. The data from these studies was also helpful in estimating appropriate GSD values for use in this assessment; using similar assumptions about PbB variability helped to ensure that the risk estimates evaluated were consistent with those that might be derived for the populations from which the risk model was developed.

Exhibit H-9 summarizes the data Lanphear et al. (2005) used in the development of their PbB-IQ models. GSD values for each of the seven studies were estimated based on the GM, 5th, and 95th percentile values presented in Lanphear et al.’s Table 2 (2005), assuming log normality.

In the exhibit, concurrent PbB refers to the PbB measurement closest to the age at which IQ testing was performed, which was six to seven years for the bulk of the cohorts studied. Lifetime PbB levels refer to the average of all PbB samples taken between six months of age and the concurrent sample. Because lifetime PbB levels are estimated based on many measurements per child, the average GSD value (1.58 µg/dL) for lifetime average PbB levels is lower than the average GSD for concurrent PbB (1.72 µg/dL) across the seven studies. The pattern is very consistent; the estimated concurrent GSDs are greater than the estimated lifetime GSDs for all of the studies evaluated.

Exhibit H-9. GSD Estimates from Seven Studies Used to Derive the Lanphear et al. (2005) PbB-IQ Model

Study	Location	Lifetime PbB (µg/dL) [a]		Concurrent PbB (µg/dL) [b]	
		GM	GSD [c]	GM	GSD [c]
(Bellinger et al., 1992)	Boston, Massachusetts	7.6	1.55	5.4	1.68
(Dietrich et al., 1993)	Cincinnati, Ohio	11.7	1.56	7.5	1.70
(Ernhart et al., 1989)	Cleveland, Ohio	14.5	1.41	14.2	1.53
(Schnaas et al., 2000)	Mexico	10.6	1.60	7.0	1.68
(Baghurst et al., 1992)	Port Pirie, South Australia	18.6	1.37	13.0	1.52
(Canfield et al., 2003)	Rochester, New York	5.5	1.66	4.0	1.88
(Wasserman et al., 1997)	Yugoslavia	15.8	1.94	15.9	2.02
Mean of All Studies		12.04	1.58	9.57	1.72
Median of All Studies		11.70	1.56	7.50	1.68

[a] Lifetime PbB levels refer to the average of all PbB samples taken between six months of age and the "concurrent" sample.
[b] Concurrent PbB refers to the PbB measurement closest to the age at which IQ testing was performed, which was six to seven years of age for all of the cohorts studied, except the Boston and Cleveland cohorts. Blood samples taken at the age of five years and an average age of 4.8 years were used to estimate "concurrent" PbB levels in the Boston and Cleveland cohorts, respectively.
[c] GSD values were calculated from GM, 5th, and 95th percentile in Lanphear et al. (2005).

The values in Exhibit H-9, along with those in Exhibit H-7 and Exhibit H-8, helped provide the basis for selecting appropriate GSD values for this assessment. The IEUBK default GSD value (intended to represent variability for children across the 7 year age range) was 1.6 µg/dL.

H.5. LIMITATIONS AND UNCERTAINTIES IN THIS ASSESSMENT AND BLOOD PB MODELING

A number of factors affect the degree of uncertainty associated with this assessment and PbB modeling. These factors include the estimated exposure Pb concentrations associated with policy-relevant sources and policy-relevant background; the exposure, intake, and uptake factor values; the differences in the PbB models themselves; the approach used to characterize inter-individual variability; and the demographics of the exposed population. The relative impacts of these factors on PbB estimates and health impacts are discussed in Appendix M.

REFERENCES

Alexander, F. W.; Clayton, B. E.; Delves, H. T. (1974) Mineral and Trace-Metal Balances in Children Receiving Normal and Synthetic Diets. *Q. J. Med.* 43: 89-111.

Asgharian, B.; Menache, M. G.; Miller, F. J. (2004) Modeling Age-Related Particle Deposition in Humans. *J. Aerosol Med.* 17(3): 213-224.

Baghurst, P. A.; McMichael, A. J.; Wigg, N. R.; Vimpani, G. V.; Robertson, E. F.; Roberts, R. J.; Tong, S. L. (1992) Environmental Exposure to Lead and Children's Intelligence at the Age of Seven Years. The Port Pirie Cohort Study. *N. Engl. J. Med.* 327(18): 1279-1284.

Bellinger, D. C.; Stiles, K. M.; Needleman, H. L. (1992) Low-Level Lead Exposure, Intelligence and Academic Achievement: a Long-Term Follow-Up Study. *Pediatrics.* 90(6): 855-861.

Billick, I. H.; Curran, A. S.; Shier, D. R. (1979) Analysis of Pediatric Blood Lead Levels in New York City for 1970-1976. *Environ. Health Perspect.* 31: 183-190.

Canfield, R. L.; Henderson, C. R., Jr.; Cory-Slechta, D. A.; Cox, C.; Jusko, T. A.; Lanphear, B. P. (2003) Intellectual Impairment in Children With Blood Lead Concentrations Below 10 Microg Per Deciliter. *N. Engl. J. Med.* 348(16): 1517-1526.

Casteel, S. W.; Tessman R.; Brattin W.J.; Wahlquist A.M. (2005) Relative Bioavailability of Lead in House Dust and Soil From the Herculaneum Lead Smelter Site in Herculaneum, Missouri. Prepared for Black & Veatch Special Projects Corporation; May.

Centers for Disease Control and Prevention (CDC). (1997) Third National Health and Nutrition Examination Survey (NHANES III), 1988-1994, Dietary Recall. Available online at: http://www.cdc.gov/nchs/products/elec_prods/subject/nhanes3.htm.

Centers for Disease Control and Prevention (CDC). (2004) Children's Blood Lead Levels in the United States. Childhood Lead Poisoning Prevention Branch, National Center for Environmental Health. Available online at: http://www.cdc.gov/nceh/lead/research/kidsBLL.htm#National%20surveys.

Centers for Disease Control and Prevention (CDC). (2007) Children's Blood Lead Levels in the United States. Available online at: http://www.cdc.gov/nceh/lead/research/kidsBLL.htm#National%20surveys.

Centers for Health Research (CIIT) and Dutch National Institute for Public Health and the Environment (RIVM). (2002) Multiple Path Particle Dosimetry Model (MPPD): A Model for Human and Rat Airway Particle Dosimetry. 2.0. Available online at: http://www.rivm.nl/bibliotheek/rapporten/650010030.html.

Clayton, C. A.; Pellizzari, E. D.; Whitmore, R. W.; Perritt, R. L.; Quackenboss, J. J. (1999) National Human Exposure Assessment Survey (NHEXAS): Distributions and Associations of Lead, Arsenic, and Volatile Organic Compounds in EPA Region 5. *J. Exposure Anal. Environ. Epidemiol.* 9: 381-392.

Cohen, J. (1987) Respiratory Deposition and Absorption of Lead Particles (Memorandum to Fred Miller and Ted Martonen, Inhalation Toxicology Division). Durham, NC: USEPA, Office of Air Quality Planning and Standards, Ambient Standards Branch; October 7.

Dietrich, K. N.; Berger, O. G.; Succop, P. A.; Hammond, P. B.; Bornschein, R. L. (1993) The Developmental Consequences of Low to Moderate Prenatal and Postnatal Lead Exposure: Intellectual Attainment in the Cincinnati Lead Study Cohort Following School Entry. *Neurotoxicol. Teratol.* 15(1): 37-44.

Ernhart, C. B.; Morrow-Tlucak, M.; Wolf, A. W.; Super, D.; Drotar, D. (1989) Low Level Lead Exposure in the Prenatal and Early Preschool Periods: Intelligence Prior to School Entry. *Neurotoxicol. Teratol.* 11(2): 161-170.

Griffin, S.; Marcus, A.; Schulz, T.; Walker, S. (1999) Calculating the Interindividual Geometric Standard Deviation for Use in the Integrated Exposure Uptake Biokinetic Model for Lead in Children. *Environ. Health Perspect.* 107(6): 481-487.

Haley, V. B.and Talbot, T. O. (2004) Geographic Analysis of Blood Lead Levels in New York State Children Born 1994-1997. *Environ. Health Perspect.* 112(15): 1577-1582.

International Commission on Radiological Protection (ICRP). (1994) LUDEP 2.07: Personal Computer Program for Calculating Internal Doses Using the ICRP Publication 66 Respiratory Tract Model.

International Commission on Radiological Protection (ICRP). (2002) ICRP Publication 89: Basic Anatomical and Physiological Data for Use in Radiological Protection. *Annals of the ICRP.* 32(3-4): 100

Lanphear, B. P.; Hornung, R.; Khoury, J.; Yolton, K.; Baghurst, P.; Bellinger, D. C.; Canfield, R. L.; Dietrich, K. N.; Bornschein, R.; Greene, T.; Rothenberg, S. J.; Needleman, H. L.; Schnaas, L.; Wasserman, G.; Graziano, J.; Robe, R. (2005) Low-Level Environmental Lead Exposure and Children's Intellectual Function: An International Pooled Analysis. *Environmental Health Perspectives.* 113(7)

Lanphear, B. P.; Matte, T. D.; Rogers, J.; Clickner, R. P.; Dietz, B.; Bornschein, R. L.; Succop, P.; Mahaffey, K. R.; Dixon, S.; Galke, W.; Rabinowitz, M.; Farfel, M.; Rohde, C.; Schwartz, J.; Ashley, P.; Jacobs, D. E. (1998) The Contribution of Lead-Contaminated House Dust and Residential Soil to Children's Blood Lead Levels: A Pooled Analysis of 12 Epidemiologic Studies. *Environmental Research.* 79: 51-68.

Leggett, R. W. (1993) An Age-Specific Kinetic Model of Lead Metabolism in Humans. *Environ Health Perspect.* 101: 598-616.

Maddaloni, M.; Bellew, M.; Diamond, G.; Follansbee, M.; Gefell, D.; Goodrum, P.; Johnson, M.; Koporec, K.; Khoury, G.; Luey, J.; Odin, M.; Troast, R.; Van, L. P.; Zaragoza, L. (2005) Assessing Lead Risks at Non-Residential Hazardous Waste Sites. *Human and Ecological Risk Assessment.* 11: 967-1005.

Marcus, A. H. (1990) Contributions to a Risk Assessment for Lead in Drinking Water (Report to the U.S. Environmental Protection Agency Office of Drinking Water/Office of Toxic Substances). 68-D8-0115. Batelle Memorial Institute.

Menache, M. G.; Miller, F. J.; Raabe, O. G. (1995) Particle Inhalability Curves for Humans and Small Laboratory Animals. *Ann. Occup. Hyg.* 39(3): 317-328.

Moir, C. M.; Freedman, B.; McCurdy, R. (1996) Metal Mobilization From Water-Distribution Systems of Buildings Serviced by Lead-Pipe Mains. *Can. Water Resour. J.* 21: 45-52.

Phalen, R. F.and Oldham, M. J. (2001) Methods for Modeling Particle Deposition As a Function of Age. *Respir. Physiol.* 128(1): 119-130.

Pirkle, J. L.; Kaufmann, R. B.; Brody, D. J.; Hickman, T.; Gunter, E. W.; Paschal, D. C. (1998) Exposure of the U.S. Population to Lead, 1991-1994. *Environ. Health Perspect.* 106(11): 745-750.

Pounds, J. G. (2005) Personal Communication With William Mendez, ICF International. Including the ICRP (Leggett) Model FORTRAN Code and User's Manual.

Pounds, J. G.and Leggett, R. W. (1998) The ICRP Age-Specific Biokinetic Model for Lead: Validations, Empirical Comparisons, and Explorations. *Environ Health Perspect.* 106 Suppl 6: 1505-1511.

Ryan, B.; Huet, N.; MacIntosh, D. L. (2000) Longitudinal Investigation of Exposure to Arsenic, Cadmium, and Lead in Drinking Water. *Environmental Health Perspect.* 108(731): 735

Schnaas, L.; Rothenberg, S. J.; Perroni, E.; Martinez, S.; Hernandez, C.; Hernandez, R. M. (2000) Temporal Pattern in the Effect of Postnatal Blood Lead Level on Intellectual Development of Young Children. *Neurotoxicol. Teratol.* 22(6): 805-810.

Singh, M.; Jaques, P. A.; Sioutas, C. (2006) Size Distribution and Diurnal Characteristics of Particle-Bound Metals in Source and Receptor Sites of the Los Angeles Basin. *Atmospheric Environment.* 36: 1675-1689.

U.S. Census Bureau. (2005) United States Census 2000: Summary File 1. Public Information Office. Available online at: http://www.census.gov/Press-Release/www/2001/sumfile1.html.

U.S. Environmental Protection Agency (USEPA). (1989) Review of National Ambient Air Quality Standard for Lead: Exposure Analysis Methodology and Validation. EPA-450/2-89-011. Research Triangle Park, NC: Office of Air Quality Planning and Standards; June.

U.S. Environmental Protection Agency (USEPA). (1990) Review of National Ambient Air Quality Standard for Lead:Assessment of Scientific and Technical Information. EPA-450/2-89-022. Research Triangle Park, NC: Office of Air Quality Planning and Standards; December.

U.S. Environmental Protection Agency (USEPA). (1994a) Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children. PB93-963510. Washington, DC: Office of Solid Waste and Emergency Response.

U.S. Environmental Protection Agency (USEPA). (1994b) Technical Support Document: Parameters and Equations Used in the Integrated Exposure Uptake Biokinetic Model for Lead in Children (v.099d). EPA 540/R-94/040. Office of Solid Waste.

U.S. Environmental Protection Agency (USEPA). (1998) Risk Analysis to Support Standards for Lead in Paint, Dust, and Soil. EPA 747-R-97-006. Office of Pollution Prevention and Toxics.

U.S. Environmental Protection Agency (USEPA). (2002a) Children-Specific Exposure Factors Handbook Interim Draft. EPA-600-P-00-002B. National Center for Environmental Assessment, Office of Research and Development.

U.S. Environmental Protection Agency (USEPA). (2002b) User's Guide for the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) Windows Version – 32 Bit Version. EPA 540-K-01-005. Washington, DC: Office of Solid Waste and Emergency Response.

U.S. Environmental Protection Agency (USEPA). (2004) Exposure Measurements: The National Human Exposure Assessment Survey (NEXAS). Available online at: http://www.epa.gov/heasd/edrb/nhexas.htm.

U.S. Environmental Protection Agency (USEPA). (2005) Integrated Exposure Uptake Biokinetic Model for Lead in Children, Windows® Version (IEUBKwin V1.0 Build 263). Available online at: http://www.epa.gov/superfund/lead/products.htm.

U.S. Environmental Protection Agency (USEPA). (2006a) Air Quality Criteria for Lead (Final). Volume I and II. Research Triangle Park, NC: National Center for Environmental Assessment; EPA/600/R-05/144aF-bF. Available online at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=158823.

U.S. Environmental Protection Agency (USEPA). (2006b) Predicted Lead Deposition, Herculaneum, Missouri (April 1, 1997 Through March 21, 1999). Memorandum from Richard L. Daye to Gene Gunn; January.

U.S. Environmental Protection Agency (USEPA). (2006c) Specific Estimates of Dietary Pb Intake Developed by EPA's Office of Solid Waste and Emergency Response. Available online at: http://www.epa.gov/superfund/lead/ieubkfaq.htm#FDA .

U.S. Environmental Protection Agency (USEPA). (2007a) Analysis of Respiratory Particulate Deposition and Lead Absorption Studies in Children. Office of Air Quality Planning and Standards; May 14.

U.S. Environmental Protection Agency (USEPA). (2007b) Correction to Errors Identified in Leggett-Based Blood Lead Modeling Completed for the Pilot Analysis. Memorandum from Zachary Pekar, Office of Air Quality Planning and Standards to NAAQS Docket; January 26.

U.S. Food and Drug Administration (USFDA). (2001) Total Diet Study. Center for Food Safety and Applied Nutrition, Office of Plant and Dairy Foods and Beverages; June. Available online at: http://www.cfsan.fda.gov/~comm/tds-toc.html.

van Wijnen J.H.; Clausing P.; Brunekreef, B. (1990) Estimated Soil Ingestion by Children. *Environ Res.* 51(2): 147-162.

Wasserman, G. A.; Liu, X.; Lolacono, N. J.; Factor-Litvak, P.; Kline, J. K.; Popovac, D.; Morina, N.; Musabegovic, A.; Vrenezi, N.; Capuni-Paracka, S.; Lekic, V.; Preteni-Redjepi, E.; Hadzialjevic, S.; Slavkovich, V.; Graziano, J. H. (1997) Lead Exposure and Intelligence in 7-Year-Old Children: the Yugoslavia Prospective Study. *Environ. Health Perspect.* 105(9): 956-962.

White, P. D.; Van Leeuwen, P.; Davis, B. D.; Maddaloni, M.; Hogan, K. A.; Marcus, A. H. (1998) The Conceptual Structure of the Integrated Exposure Uptake Biokinetic Model for Lead in Children. *Environmental Health Perspectives.* 106(S6): 1513-1530.

Yeh, H. C.and Schum, G. M. (1980) Models of Human Lung Airways and Their Application to Inhaled Particle Deposition. *Bull. Math. Biol.* 42(3): 461-480.

Ziegler, E. E.; Edwards, B. B.; Jensen, R. L.; Mahaffey, K. R.; Fomon, S. J. (1978) Absorption and Retention of Lead by Infants. *Pediatr. Res.* 12: 29-34.

ATTACHMENT H-1. RESPIRATORY DEPOSITION AND ABSORPTION FRACTION – INPUT FOR THE IEUBK MODEL

One of the inputs to the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK model) is an estimate of the fraction of lead (Pb) in air that deposits in the respiratory system and is absorbed into the blood (either from the respiratory tract or from the gastrointestinal tract following mucocilliary clearance from the respiratory system).[4] Throughout this discussion, this parameter is termed respiratory deposition-absorption fraction.

To estimate appropriate values for the respiratory deposition-absorption fraction for use in the case studies for this assessment, the basis for previously used values (i.e., those developed for the 1990 U.S. EPA Staff Paper (USEPA, 1990)]) and currently available information and methodologies were considered. The bases for the value used in the case study assessments described in the 1990 Staff Paper and the default value used in the IEUBK model were described by Cohen (1987). The value for the 1990 case study assessments was considered ambient air near Pb point sources,[5] while the value used as the IEUBK model default was for "general atmospheres." Different analyses, with some commonality, underlie these two values. The analyses differ in derivation of the estimates of fractional deposition in the respiratory tract regions, due to different aerosol size distributions for the Pb particles in the ambient air in the two types of environments (i.e., near point source or general populations). Subsequent steps for both analyses relied on estimates of fractional absorption associated with the different regions of the respiratory tract, and estimated differences in particle deposition between an adult and a 2-year-old child.

Consistent with the 1987 analysis, and given the two types of case studies included in this assessment (i.e., point sources and the general urban case study), two estimates of the respiratory deposition-absorption fraction pertaining to the two different environments were developed again. In addition to the aspects considered in the 1987 analysis, this assessment involved the use of publicly available particle dosimetry models and explicitly considered particle inhalability. Addressing inhalability, which was not done in the 1987 analysis, has a larger effect on the estimate for the point source environment due to a greater preponderance of larger particles.

---

[4] Among the model parameters for the IEUBK model (windows based version), this is termed "lung absorption" and is entered as a percentage (USEPA, 2002b).

In the current analysis, the Pb-laden aerosol size distributions for the two types of environments were described in terms of their mass median aerodynamic diameter (MMAD) and GSD based on information on Pb particle size distributions described in the U.S. EPA Criteria Document for Pb (USEPA, 2006a) and other available information (Cohen, 1987; Singh et al., 2006).[6,7] Regional deposition (with consideration to inhalability) for the aerosols was estimated using two publicly available mathematical models: 1) the Multiple Path Particle Dosimetry (MPPD) model, Version 2.0, and 2) the Lung Dose Evaluation Program (LUDEP), Version 2.07, software. The MPPD model was developed by the CIIT Centers for Health Research (CIIT), USA, in collaboration with the National Institute of Public Health and the Environment (RIVM), the Netherlands, and the Ministry of Housing, Spatial Planning and the Environment, the Netherlands (Asgharian et al., 2004; CIIT and RIVM, 2002). The LUDEP model is an implementation of the Human Respiratory Tract Model for Radiological Protection model developed by the International Commission on Radiological Protection (ICRP, 1994). LUDEP (Version 2.07) only allows simulations for adult males, and not for females or children.

For the adult simulations, the MPPD was run using the (Yeh and Schum, 1980) airway model. The adult simulations used the normal augmenter breathing route and similar values for functional residual capacity (FRC) (3,300 milliliters [ml]) and head volume (50 ml). Tidal volume and breathing frequency values for each activity level were those from (ICRP, 2002), as were hours associated with each activity level used in deriving daily regional deposition estimates. For the child simulations, the MPPD symmetric airway model (Asgharian et al., 2004) for age 23 months was run. The FRC, head volume, and activity-dependent values of tidal volume and breathing frequency were obtained by a curve fit to the data for three or more ages e.g., 0.25, 1, and 5 years of age (see Table 15 [(ICRP, 1994)).

To create the average daily estimates needed for the IEUBK model, a daily respiratory volume-weighted average was derived for each region of the respiratory tract[8] using estimates of

---

[5] The case studies included in the 1990 U.S. EPA Staff Paper analysis were populations living near two secondary Pb smelters, a primary Pb smelter, and a battery recycling plant (USEPA, 1990).
[6] The particle size distribution presented for the smelter environments was collapsed into a lognormal distribution with MMAD of 4.8 μm and GSD of 8.29.
[7] The particle size distribution presented for the downtown urban site was collapsed into a lognormal distribution with MMAD of 0.5 μm and GSD of 3.94.
[8] The MPPD model truncates calculations at MMAD values above 20 μm. For the point source scenario, assuming a lognormal distribution; approximately 30 percent of the particle mass falls into this part of the distribution. Deposition of these particles, assumed to occur in the head, was estimated based on their inhalability (Menache et al., 1995).

daily time spent at each activity level and the associated cumulative ventilation volume. The estimates of average daily fractional deposition were then combined with estimates of absorption. Estimates of fractional absorption of Pb associated with deposition in different regions of the respiratory tract used in this analysis were the same as in the Cohen (1987) analysis, which are consistent with information presented in the U.S. EPA Criteria Document for Pb (USEPA, 2006a). Absorption was estimated to be complete (100 percent) for particles depositing in the alveolar region, while absorption was estimated at 40 percent for particles depositing in the head or tracheobronchial region and were assumed to clear to the GI tract for absorption.

The adult estimates of total and regional average daily respiratory tract deposition derived using the two different models are generally similar (see Attachment H-1-1). The adult estimates of total deposition are not that dissimilar from those for children. However, the regional deposition values for children relative to adults were lower for the pulmonary region and higher for the tracheobronchial and head regions. This finding is consistent with observations in the current literature (Phalen and Oldham, 2001; USEPA, 2006a; pages 4-4 and 4-5). Consistent with Cohen (1987), the current analysis for the general urban environment showed greater deposition in the tracheobronchial and head regions of children as compared to adults. The relatively lesser pulmonary deposition of children in both environments, while similar to observations in the literature, differs from Cohen (1987), in which factors of 1.3 to 1.5 were assigned to calculate estimates of pulmonary deposition for children from estimates for adults.

Attachment H-1-1. Estimates of Average Daily Respiratory Deposition Fraction – Current Analysis

Body Region	2-year Old Child (MPPD)	Adult (MPPD)	Adult (LUDEP)
General Urban Case Study			
Alveolar Region	0.038	0.119	0.122
Tracheobronchial Region	0.020	0.026	0.014
Head Region	0.122	0.109	0.093
Total	0.170	0.254	0.230
Point Sources/Smelters			
Alveolar Region	0.015	0.053	0.065
Tracheobronchial Region	0.012	0.012	0.010
Head Region	0.225	0.230	0.207
Total	0.252	0.295	0.282

All estimates of respiratory deposition-absorption fraction (i.e., the IEUBK "lung absorption" parameter) derived in the current analysis are lower than the previous estimates (see Attachment H-1-2) indicating the influence of the newly considered inhalability.

The regional deposition differences between children and adults discussed above were amplified when they were multiplied by the regional Pb absorption estimates of 100 percent for the pulmonary region (where deposition is greater for adults) and 40 percent for tracheobronchial and head regions (where deposition is greater for children), such that the resultant estimates of respiratory deposition-absorption fraction were slightly lower for children than adults. However, observations on particle deposition in the different regions of the human respiratory tract are less available for children (the target population for this risk assessment) as compared to adults, more greatly limiting our ability to evaluate the child-specific deposition estimates and accordingly contributing to greater uncertainty. Consequently, rather than assigning a lower respiratory deposition-absorption fraction estimate to the target population than the estimates obtained from the adult modeling, the estimates chosen for IEUBK modeling were the averages of the values obtained from the MPPD and ICRP adult model simulations. That is, 0.27 was selected as the respiratory deposition-absorption fraction estimate for the smelter case studies and 0.24 was selected as the estimate for the general urban case study. The same values were adopted as absolute total absorption fractions in the sensitivity analysis conducted using the Leggett model. The Leggett model regional deposition fractions (which determine the rate at which Pb is released to the blood stream from the various lung compartments) were not changed from the default values.

Attachment H-1-2. Estimates of Respiratory Deposition-Absorption Fraction – Previous and Current Analyses

Source	2-Year Old Child	Adult
General Urban		
Cohen, 1987	0.25 to 0.45	0.15 to 0.30
MPPD (this analysis)	0.17	0.25
ICRP-LUDEP (this analysis)		0.23
Point Sources/Smelters		
Cohen, 1987	0.42	0.38
Cohen, 1987 (adjusted for inhalability)	0.32 [a]	0.27 to 0.28 [a]
MPPD (this analysis)	0.22	0.26
ICRP-LUDEP (this analysis)		0.28

[a] This value was derived by adjusting the Cohen (1987) estimated fractional deposition for larger particles based on inhalability (ICRP, 1994; Menache et al., 1995). Per ICRP (1994), the same adjustment was made for child as adults.

July 25, 2007

Appendix I: Blood Lead (PbB) Modeling Estimates

Prepared by:

ICF International
Research Triangle Park, NC

Prepared for:

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina

Contract No. EP-D-06-115
Work Assignment No. 0-4

Table of Contents

List of Exhibits

I. BLOOD LEAD MODELING ESTIMATES

This appendix presents the blood lead (PbB) estimates for each case study and for all National Ambient Air Quality Standards (NAAQS) scenarios considered in this analysis. Section I.2 contains the results for the general urban case study, including an overview of the scenarios evaluated (see Section I.2.1), the PbB estimates for several percentiles of the PbB distribution (see Section I.2.2), and the ambient air Pb concentration to PbB ratios (see Section I.2.3). Similarly, Section I.3 provides the results for the primary Pb smelter case study, including an overview of the scenarios evaluated (see Section I.3.1), the PbB results for several percentiles (see Section I.3.2), and the ambient air Pb concentration to PbB ratios (see Section I.3.3). Finally, Section I.4 presents the results for the secondary Pb smelter case study, including an overview of the scenarios evaluated (see Section I.4.1), the PbB results for several percentiles (see Section I.4.2), and the ambient air Pb concentration to PbB ratios (see Section I.4.3).

Estimates presented in this appendix are specified with regard to number of decimal places, which results in various numbers of implied significant figures. This is not intended to convey greater precision for some estimates than others; it is simply an expedient and initial result of the software used for the calculation. Greater attention is given to significant figures in the presentation of estimates in the main body of the report.

I.1. CALCULATION OF PATHWAY CONTRIBUTIONS TO BLOOD PB

In the subsequent sections of this appendix, the PbB estimates are separated into contributions from diet, drinking water, outdoor soil/dust, indoor dust from “other” sources, indoor dust from “recent air” sources, and the inhalation of recent air. These contributions are estimated by calculating the percentage of uptake from each pathway and applying the same percentage to the total PbB estimate. To calculate the percentage of total Pb uptake arising from the different exposure pathways, the intake for each medium is calculated as the total amount consumed of the given medium multiplied by the concentration of Pb in that medium. The uptake is then calculated as the intake multiplied by the fraction of Pb that is absorbed for that medium. All the relevant input parameters needed for this calculation are discussed in Appendix H. For indoor dust and outdoor soil/dust, the total ingestion of both media is divided into separate indoor dust and outdoor soil/dust contributions by multiplying by the percentage of the total ingestion which arises from outdoor soil/dust (as discussed in Appendix H). The intakes are calculated for all seven years of the child’s life and then a lifetime average intake is calculated for each medium. Finally, these are summed to get the total average yearly uptake, and the percentage arising from each pathway is calculated as the uptake in a given medium divided by the total.

The separation of indoor dust Pb into two portions is described for each case study in Appendix G. These are: (1) that derived from "recent air" contributions and 2) "other." The PbB contributions arising from these different portions of indoor dust Pb ingestion are derived by applying the percentage of the dust Pb concentration arising from each of these two sources to the total dust intake percentage. As described in Appendix G, how these portions, and their corresponding percentages of total dust Pb concentration, are estimated varies with the model used to estimate dust Pb concentration. For the hybrid mechanistic-empirical model, the "recent air" percentages of total dust Pb is the percent contribution of dust Pb loading from the mechanistic portion of the model and the percent from "other" is the percent contribution from the empirical portion. For the regression-based models, these percentages are estimated as the air slope multiplied by the air concentration ("recent air") and the intercept ("other" sources) relative to the total estimated indoor dust Pb concentration. For the site-specific model used for the primary Pb smelter case study, the "other" portion is assigned the dust Pb concentration at the modeled receptor with the lowest air Pb concentration. Then, the percent from "other" sources is calculated as this constant contribution to dust Pb concentration divided by the total dust Pb concentration at each receptor. The "recent air" portion is the remainder after subtracting "other" from the total dust Pb.

I.2. GENERAL URBAN CASE STUDY

I.2.1. PbB Model Scenarios Run for the General Urban Case Study

Exhibit I-1 lists the major elements of the modeling approach used in estimating PbB distributions in each general urban case study scenario. PbB model inputs for the general urban case study were single estimates of the exposure concentrations representing the geometric mean (GM) exposure concentrations for the entire child population of the simulated urban environment. These concentrations were assumed to remain constant throughout the seven years of exposure modeled in the biokinetic model. As discussed in Appendix G, two distinct dust models (the air-only regression-based model and the hybrid mechanistic-empirical model [“hybrid model” for short]) were used to generate PbB estimates. Both concurrent (average of the results at 75 and 81 months of age in the seventh year of life) and lifetime (average of the results between age six and 84 months) PbB metrics are reported. The estimated inter-individual variability (i.e., geometric standard deviation [GSD] values) used to generate PbB distributions are also shown in Exhibit I-1.

The age-specific outdoor soil/dust, indoor dust, inhalation exposure, and drinking water concentrations and dietary Pb intakes discussed in Appendix H were used to generate PbB estimates using the Integrated Exposure Uptake Biokinetic (IEUBK) Model for Children (hereafter referred to as the "IEUBK model") for each dust model and each PbB metric. The IEUBK model has been well-documented, is widely used, and has been subject to a range of testing and calibration exercises (see Section 4.4 of USEPA (2006)]). These estimates represented the GM PbB estimates for each scenario in the general urban case study. To capture the inter-individual variability within the urban environment, the GSD values were then applied to the GM values for each NAAQS scenario-dust model-PbB metric combination. The lognormal distributions created by the GM and GSD were sampled 50,000 times to generate PbB distributions, from which percentile estimates were derived, as described in Appendix H. For the general urban case study, two GSD values were chosen for each PbB metric to represent high and low variability cases, as shown in Exhibit I-1. Data supporting the selection of values for the GSDs are provided in Appendix H.

Exhibit I-1. PbB Model Scenarios Run for the General Urban Case Study

NAAQS Scenario	Dust Model (see Appendix G)	GSD (microgram per deciliter [μg/dL])	PbB Metric
Current conditions (95th percentile)	Air-only regression-based model	2.1	Concurrent
		2.0	Lifetime
		1.7	Concurrent
		1.6	Lifetime
	Hybrid model	2.1	Concurrent
		2.0	Lifetime
		1.7	Concurrent
		1.6	Lifetime
Current conditions (mean)	Air-only regression-based model	2.1	Concurrent
		2.0	Lifetime
		1.7	Concurrent
		1.6	Lifetime
	Hybrid model	2.1	Concurrent
		2.0	Lifetime
		1.7	Concurrent
		1.6	Lifetime
Current NAAQS (1.5 microgram per cubic meter ($\mu g/m^3$), max quarterly average)	Air-only regression-based model	2.1	Concurrent
		2.0	Lifetime
		1.7	Concurrent
		1.6	Lifetime
	Hybrid model	2.1	Concurrent
		2.0	Lifetime
		1.7	Concurrent
		1.6	Lifetime
Alternative NAAQS 1 (0.2 $\mu g/m^3$, max quarterly average)	Air-only regression-based model	2.1	Concurrent
		2.0	Lifetime
		1.7	Concurrent
		1.6	Lifetime
	Hybrid model	2.1	Concurrent
		2.0	Lifetime
		1.7	Concurrent
		1.6	Lifetime
Alternative NAAQS 2 (0.5 $\mu g/m^3$, max monthly average)	Air-only regression-based model	2.1	Concurrent
		2.0	Lifetime
		1.7	Concurrent
		1.6	Lifetime
	Hybrid model	2.1	Concurrent
		2.0	Lifetime
		1.7	Concurrent
		1.6	Lifetime

Exhibit I-1 Continued. PbB Model Scenarios Run for the General Urban Case Study

NAAQS Scenario	Dust Model	GSD (microgram per deciliter [μg/dL])	PbB Metric
Alternative NAAQS 3 (0.2 μg/m^3, max monthly average)	Air-only regression-based model	2.1	Concurrent
		2.0	Lifetime
		1.7	Concurrent
		1.6	Lifetime
	Hybrid model	2.1	Concurrent
		2.0	Lifetime
		1.7	Concurrent
		1.6	Lifetime
Alternative NAAQS 4 (0.05 μg/m^3, max monthly average)	Air-only regression-based model	2.1	Concurrent
		2.0	Lifetime
		1.7	Concurrent
		1.6	Lifetime
	Hybrid model	2.1	Concurrent
		2.0	Lifetime
		1.7	Concurrent
		1.6	Lifetime

I.2.2. PbB Results for the General Urban Case Study

Exhibit I-2 through Exhibit I-8 summarize the predicted PbB percentiles for scenarios in the general urban case study. The exhibits also provide estimated contributions from each pathway to total Pb uptake, expressed as percentages. Because there is no specific population in the general urban case study (unlike in the two point source case studies), these percentages do not vary by PbB percentile. The contribution from the ingestion of indoor dust is separated into the contribution derived from recent ambient air and that from other sources (e.g., indoor paint, outdoor soil/dust, and additional sources including historical air), as described in Appendix G.

In general, the concurrent PbB values are lower than the lifetime PbB values for all percentiles and in all scenarios. Because the age-specific outdoor soil/dust and indoor dust ingestion input parameters are highest for children ages two, three, and four, PbB tends to be higher during these years and lower at ages one, five, six, and seven. Therefore, the lifetime average PbB value, which includes all ages, is higher than the concurrent PbB value, which is the average PbB at 75 and 81 months during the seventh year of life.

The hybrid mechanistic-empirical dust model predicts higher indoor dust Pb concentrations for ambient air Pb concentrations less than 0.28 μg/m^3 than those predicted by the air-only regression-based model. In contrast, the hybrid model predicts lower indoor dust Pb concentrations for ambient air Pb concentrations greater than 0.28 μg/m^3. Only the current

NAAQS scenario has an annual-average ambient air Pb concentration above 0.28 μg/m^3 (i.e., 0.6 μg/m^3). Thus in this scenario, the air-only regression-based model predicts higher PbB levels than the hybrid model. In all other scenarios, the median PbB values are higher when the hybrid model is used to predict indoor dust concentrations, as expected. In general, the higher PbB percentiles also follow this trend. However, in the second alternative NAAQS (0.5 μg/m^3, maximum monthly average) scenario, the PbB values obtained using the higher GSD (2.1 μg/dL) for the concurrent PbB metric are higher for the 95th, 99th, 99.5th, and 99.9th percentiles when the air-only regression-based model is used than when the hybrid model is used. This unexpected trend is likely due to sampling error in the "tails" of the distribution, particularly because it occurs with higher GSDs, but not with lower GSDs.

Exhibit I-2. General Urban Case Study: Current Conditions (95th Percentile) – Estimated PbB Levels

PbB Percentile	Predicted PbB (µg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent)							
99.9th	10.0	17.1%	10.0%	36.5%	13.5%	21.8%	1.0%
99.5th	7.6						
99th	6.7						
95th	4.7						
90th	3.9						
75th	2.8						
Median	2.0						
25th	1.4						
1st	0.6						
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime)							
99.9th	11.9	17.1%	10.0%	36.5%	13.5%	21.8%	1.0%
99.5th	9.4						
99th	8.4						
95th	6.1						
90th	5.2						
75th	3.9						
Median	2.8						
25th	2.1						
1st	1.0						

Exhibit I-2 Continued. General Urban Case Study: Current Conditions (95th Percentile) – Estimated PbB Levels

PbB Percentile	Predicted PbB (µg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent)							
99.9th	10.8						
99.5th	8.2						
99th	7.3						
95th	5.1						
90th	4.2	15.7%	9.1%	33.4%	3.6%	37.2%	0.9%
75th	3.1						
Median	2.1						
25th	1.5						
1st	0.6						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime)							
99.9th	13.0						
99.5th	10.2						
99th	9.1						
95th	6.7						
90th	5.6	15.7%	9.1%	33.4%	3.6%	37.2%	0.9%
75th	4.2						
Median	3.1						
25th	2.2						
1st	1.0						

Exhibit I-2 Continued. General Urban Case Study: Current Conditions (95th Percentile) – Estimated PbB Levels

PbB Percentile	Predicted PbB (µg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent)							
99.9th	19.9	17.1%	10.0%	36.5%	13.5%	21.8%	1.0%
99.5th	13.1						
99th	11.1						
95th	6.7						
90th	5.1						
75th	3.3						
Median	2.0						
25th	1.2						
1st	0.4						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime)							
99.9th	24.6	17.1%	10.0%	36.5%	13.5%	21.8%	1.0%
99.5th	16.7						
99th	14.3						
95th	8.9						
90th	6.9						
75th	4.5						
Median	2.8						
25th	1.8						
1st	0.6						

Exhibit I-2 Continued. General Urban Case Study: Current Conditions (95th Percentile) – Estimated PbB Levels

PbB Percentile	Predicted PbB (µg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent)							
99.9th	21.5	15.7%	9.1%	33.4%	3.6%	37.2%	0.9%
99.5th	14.2						
99th	12.0						
95th	7.2						
90th	5.5						
75th	3.5						
Median	2.1						
25th	1.3						
1st	0.4						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime)							
99.9th	26.7	15.7%	9.1%	33.4%	3.6%	37.2%	0.9%
99.5th	18.1						
99th	15.5						
95th	9.6						
90th	7.5						
75th	4.9						
Median	3.1						
25th	1.9						
1st	0.6						

[a] Pathway contributions apply to all percentiles. See text for further discussion.
[b] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-3. General Urban Case Study: Current Conditions (Mean) – Estimated PbB Levels

<table>
<tr><th rowspan="4">PbB Percentile</th><th rowspan="4">Predicted PbB (μg/dL)</th><th colspan="6">Pathway Contribution [a]</th></tr>
<tr><th colspan="5">Ingestion</th><th rowspan="3">Inhalation (Recent Air)</th></tr>
<tr><th rowspan="2">Diet</th><th rowspan="2">Drinking Water</th><th rowspan="2">Outdoor Soil/Dust</th><th colspan="2">Indoor Dust</th></tr>
<tr><th>Other [b]</th><th>Recent Air</th></tr>
<tr><td colspan="8">Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent)</td></tr>
<tr><td>99.9th</td><td>9.0</td><td rowspan="9">19.4%</td><td rowspan="9">11.3%</td><td rowspan="9">41.3%</td><td rowspan="9">15.3%</td><td rowspan="9">12.1%</td><td rowspan="9">0.6%</td></tr>
<tr><td>99.5th</td><td>6.8</td></tr>
<tr><td>99th</td><td>6.0</td></tr>
<tr><td>95th</td><td>4.2</td></tr>
<tr><td>90th</td><td>3.5</td></tr>
<tr><td>75th</td><td>2.5</td></tr>
<tr><td>Median</td><td>1.8</td></tr>
<tr><td>25th</td><td>1.2</td></tr>
<tr><td>1st</td><td>0.5</td></tr>
<tr><td colspan="8">Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime)</td></tr>
<tr><td>99.9th</td><td>10.7</td><td rowspan="9">19.4%</td><td rowspan="9">11.3%</td><td rowspan="9">41.3%</td><td rowspan="9">15.3%</td><td rowspan="9">12.1%</td><td rowspan="9">0.6%</td></tr>
<tr><td>99.5th</td><td>8.3</td></tr>
<tr><td>99th</td><td>7.4</td></tr>
<tr><td>95th</td><td>5.5</td></tr>
<tr><td>90th</td><td>4.6</td></tr>
<tr><td>75th</td><td>3.5</td></tr>
<tr><td>Median</td><td>2.5</td></tr>
<tr><td>25th</td><td>1.8</td></tr>
<tr><td>1st</td><td>0.8</td></tr>
</table>

1 **Exhibit I-3 Continued. General Urban Case Study: Current Conditions (Mean) –**
2 **Estimated PbB Levels**

PbB Percentile	Predicted PbB (µg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent)							
99.9th	9.8	17.7%	10.3%	37.6%	5.6%	28.3%	0.5%
99.5th	7.6						
99th	6.6						
95th	4.6						
90th	3.8						
75th	2.8						
Median	1.9						
25th	1.3						
1st	0.6						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime)							
99.9th	11.7	17.7%	10.3%	37.6%	5.6%	28.3%	0.5%
99.5th	9.4						
99th	8.3						
95th	6.0						
90th	5.1						
75th	3.8						
Median	2.8						
25th	2.0						
1st	0.9						

Exhibit I-3 Continued. General Urban Case Study: Current Conditions (Mean) – Estimated PbB Levels

PbB Percentile	Predicted PbB (μg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent)							
99.9th	16.4						
99.5th	11.7						
99th	9.9						
95th	6.0						
90th	4.5	19.4%	11.3%	41.3%	15.3%	12.1%	0.6%
75th	2.9						
Median	1.8						
25th	1.1						
1st	0.3						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime)							
99.9th	20.2						
99.5th	14.8						
99th	12.6						
95th	7.8						
90th	6.1	19.4%	11.3%	41.3%	15.3%	12.1%	0.6%
75th	4.0						
Median	2.5						
25th	1.6						
1st	0.5						

Exhibit I-3 Continued. General Urban Case Study: Current Conditions (Mean) – Estimated PbB Levels

<table>
<tr><th rowspan="4">PbB Percentile</th><th rowspan="4">Predicted PbB (µg/dL)</th><th colspan="6">Pathway Contribution [a]</th></tr>
<tr><th colspan="5">Ingestion</th><th rowspan="3">Inhalation (Recent Air)</th></tr>
<tr><th rowspan="2">Diet</th><th rowspan="2">Drinking Water</th><th rowspan="2">Outdoor Soil/Dust</th><th colspan="2">Indoor Dust</th></tr>
<tr><th>Other [b]</th><th>Recent Air</th></tr>
<tr><td colspan="8">Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent)</td></tr>
<tr><td>99.9th</td><td>17.9</td><td rowspan="9">17.7%</td><td rowspan="9">10.3%</td><td rowspan="9">37.6%</td><td rowspan="9">5.6%</td><td rowspan="9">28.3%</td><td rowspan="9">0.5%</td></tr>
<tr><td>99.5th</td><td>12.9</td></tr>
<tr><td>99th</td><td>10.8</td></tr>
<tr><td>95th</td><td>6.5</td></tr>
<tr><td>90th</td><td>5.0</td></tr>
<tr><td>75th</td><td>3.1</td></tr>
<tr><td>Median</td><td>1.9</td></tr>
<tr><td>25th</td><td>1.2</td></tr>
<tr><td>1st</td><td>0.3</td></tr>
<tr><td colspan="8">Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime)</td></tr>
<tr><td>99.9th</td><td>22.2</td><td rowspan="9">17.7%</td><td rowspan="9">10.3%</td><td rowspan="9">37.6%</td><td rowspan="9">5.6%</td><td rowspan="9">28.3%</td><td rowspan="9">0.5%</td></tr>
<tr><td>99.5th</td><td>16.4</td></tr>
<tr><td>99th</td><td>13.9</td></tr>
<tr><td>95th</td><td>8.6</td></tr>
<tr><td>90th</td><td>6.7</td></tr>
<tr><td>75th</td><td>4.4</td></tr>
<tr><td>Median</td><td>2.8</td></tr>
<tr><td>25th</td><td>1.7</td></tr>
<tr><td>1st</td><td>0.5</td></tr>
</table>

[a] Pathway contributions apply to all percentiles. See text for further discussion.
[b] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-4. General Urban Case Study: Current NAAQS (1.5 µg/m^3, Maximum Quarterly Average) – Estimated PbB Levels

PbB Percentile	Predicted PbB (µg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent)							
99.9th	18.4	8.7%	5.1%	18.6%	6.9%	58.0%	2.8%
99.5th	14.2						
99th	12.6						
95th	8.7						
90th	7.2						
75th	5.2						
Median	3.7						
25th	2.6						
1st	1.1						
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime)							
99.9th	22.2	8.7%	5.1%	18.6%	6.9%	58.0%	2.8%
99.5th	17.7						
99th	15.8						
95th	11.5						
90th	9.7						
75th	7.3						
Median	5.3						
25th	3.9						
1st	1.8						

Exhibit I-4 Continued. General Urban Case Study: Current NAAQS (1.5 µg/m^3, Maximum Quarterly Average) – Estimated PbB Levels

PbB Percentile	Predicted PbB (µg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent)							
99.9th	16.5						
99.5th	12.6						
99th	11.0						
95th	7.6						
90th	6.2	10.4%	6.0%	22.1%	1.1%	57.1%	3.3%
75th	4.5						
Median	3.1						
25th	2.2						
1st	0.9						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime)							
99.9th	19.7						
99.5th	15.5						
99th	13.7						
95th	9.9						
90th	8.3	10.4%	6.0%	22.1%	1.1%	57.1%	3.3%
75th	6.2						
Median	4.5						
25th	3.3						
1st	1.5						

Exhibit I-4 Continued. General Urban Case Study: Current NAAQS (1.5 µg/m^3, Maximum Quarterly Average) – Estimated PbB Levels

PbB Percentile	Predicted PbB (µg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent)							
99.9th	35.1						
99.5th	25.0						
99th	20.9						
95th	12.3						
90th	9.4	8.7%	5.1%	18.6%	6.9%	58.0%	2.8%
75th	6.0						
Median	3.6						
25th	2.2						
1st	0.6						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime)							
99.9th	43.9						
99.5th	32.0						
99th	27.1						
95th	16.5						
90th	12.8	8.7%	5.1%	18.6%	6.9%	58.0%	2.8%
75th	8.4						
Median	5.3						
25th	3.3						
1st	1.0						

Exhibit I-4 Continued. General Urban Case Study: Current NAAQS (1.5 $\mu g/m^3$, Maximum Quarterly Average) – Estimated PbB Levels

PbB Percentile	Predicted PbB (μg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent)							
99.9th	28.5	10.4%	6.0%	22.1%	1.1%	57.1%	3.3%
99.5th	21.0						
99th	17.3						
95th	10.6						
90th	8.1						
75th	5.1						
Median	3.1						
25th	1.9						
1st	0.6						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime)							
99.9th	35.6	10.4%	6.0%	22.1%	1.1%	57.1%	3.3%
99.5th	26.7						
99th	22.3						
95th	14.1						
90th	10.9						
75th	7.2						
Median	4.5						
25th	2.8						
1st	0.9						

[a] Pathway contributions apply to all percentiles. See text for further discussion.
[b] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-5. General Urban Case Study: Alternative NAAQS 1 (0.2 $\mu g/m^3$, Maximum Quarterly Average) – Estimated PbB Levels

PbB Percentile	Predicted PbB (μg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent)							
99.9th	9.4						
99.5th	7.3						
99th	6.4						
95th	4.4						
90th	3.6	18.4%	10.7%	39.2%	14.5%	16.3%	0.8%
75th	2.7						
Median	1.9						
25th	1.3						
1st	0.5						
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime)							
99.9th	11.1						
99.5th	8.9						
99th	7.9						
95th	5.7						
90th	4.8	18.4%	10.7%	39.2%	14.5%	16.3%	0.8%
75th	3.7						
Median	2.7						
25th	1.9						
1st	0.9						

Exhibit I-5 Continued. General Urban Case Study: Alternative NAAQS 1 (0.2 μg/m^3, Maximum Quarterly Average) – Estimated PbB Levels

PbB Percentile	Predicted PbB (μg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent)							
99.9th	10.2	16.7%	9.7%	35.6%	4.5%	32.7%	0.7%
99.5th	7.8						
99th	6.9						
95th	4.8						
90th	4.0						
75th	2.9						
Median	2.0						
25th	1.4						
1st	0.6						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime)							
99.9th	12.2	16.7%	9.7%	35.6%	4.5%	32.7%	0.7%
99.5th	9.6						
99th	8.6						
95th	6.3						
90th	5.3						
75th	4.0						
Median	2.9						
25th	2.1						
1st	1.0						

Exhibit I-5 Continued. General Urban Case Study: Alternative NAAQS 1 (0.2 μg/m^3, Maximum Quarterly Average) – Estimated PbB Levels

<table>
<tr><th rowspan="4">PbB Percentile</th><th rowspan="4">Predicted PbB (μg/dL)</th><th colspan="6">Pathway Contribution [a]</th></tr>
<tr><th colspan="5">Ingestion</th><th rowspan="3">Inhalation (Recent Air)</th></tr>
<tr><th rowspan="2">Diet</th><th rowspan="2">Drinking Water</th><th rowspan="2">Outdoor Soil/Dust</th><th colspan="2">Indoor Dust</th></tr>
<tr><th>Other [b]</th><th>Recent Air</th></tr>
<tr><td colspan="8">Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent)</td></tr>
<tr><td>99.9th</td><td>18.1</td><td rowspan="9">18.4%</td><td rowspan="9">10.7%</td><td rowspan="9">39.2%</td><td rowspan="9">14.5%</td><td rowspan="9">16.3%</td><td rowspan="9">0.8%</td></tr>
<tr><td>99.5th</td><td>12.4</td></tr>
<tr><td>99th</td><td>10.4</td></tr>
<tr><td>95th</td><td>6.2</td></tr>
<tr><td>90th</td><td>4.8</td></tr>
<tr><td>75th</td><td>3.1</td></tr>
<tr><td>Median</td><td>1.9</td></tr>
<tr><td>25th</td><td>1.1</td></tr>
<tr><td>1st</td><td>0.3</td></tr>
<tr><td colspan="8">Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime)</td></tr>
<tr><td>99.9th</td><td>22.3</td><td rowspan="9">18.4%</td><td rowspan="9">10.7%</td><td rowspan="9">39.2%</td><td rowspan="9">14.5%</td><td rowspan="9">16.3%</td><td rowspan="9">0.8%</td></tr>
<tr><td>99.5th</td><td>15.6</td></tr>
<tr><td>99th</td><td>13.3</td></tr>
<tr><td>95th</td><td>8.2</td></tr>
<tr><td>90th</td><td>6.4</td></tr>
<tr><td>75th</td><td>4.3</td></tr>
<tr><td>Median</td><td>2.7</td></tr>
<tr><td>25th</td><td>1.7</td></tr>
<tr><td>1st</td><td>0.5</td></tr>
</table>

Exhibit I-5 Continued. General Urban Case Study: Alternative NAAQS 1 (0.2 $\mu g/m^3$, Maximum Quarterly Average) – Estimated PbB Levels

PbB Percentile	Predicted PbB (μg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent)							
99.9th	20.3						
99.5th	14.1						
99th	11.5						
95th	6.9						
90th	5.3	16.7%	9.7%	35.6%	4.5%	32.7%	0.7%
75th	3.3						
Median	2.0						
25th	1.2						
1st	0.4						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime)							
99.9th	25.1						
99.5th	17.9						
99th	14.7						
95th	9.2						
90th	7.1	16.7%	9.7%	35.6%	4.5%	32.7%	0.7%
75th	4.7						
Median	2.9						
25th	1.8						
1st	0.6						

[a] Pathway contributions apply to all percentiles. See text for further discussion.
[b] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-6. General Urban Case Study: Alternative NAAQS 2 (0.5 µg/m^3, Maximum Monthly Average) – Estimated PbB Levels

<table>
<tr><th rowspan="4">PbB Percentile</th><th rowspan="4">Predicted PbB (µg/dL)</th><th colspan="6">Pathway Contribution [a]</th></tr>
<tr><th colspan="5">Ingestion</th><th rowspan="3">Inhalation (Recent Air)</th></tr>
<tr><th rowspan="2">Diet</th><th rowspan="2">Drinking Water</th><th rowspan="2">Outdoor Soil/Dust</th><th colspan="2">Indoor Dust</th></tr>
<tr><th>Other [b]</th><th>Recent Air</th></tr>
<tr><td colspan="8">Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent)</td></tr>
<tr><td>99.9th</td><td>10.0</td><td rowspan="9">16.8%</td><td rowspan="9">9.8%</td><td rowspan="9">35.8%</td><td rowspan="9">13.2%</td><td rowspan="9">23.3%</td><td rowspan="9">1.1%</td></tr>
<tr><td>99.5th</td><td>7.7</td></tr>
<tr><td>99th</td><td>6.8</td></tr>
<tr><td>95th</td><td>4.8</td></tr>
<tr><td>90th</td><td>3.9</td></tr>
<tr><td>75th</td><td>2.9</td></tr>
<tr><td>Median</td><td>2.0</td></tr>
<tr><td>25th</td><td>1.4</td></tr>
<tr><td>1st</td><td>0.6</td></tr>
<tr><td colspan="8">Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime)</td></tr>
<tr><td>99.9th</td><td>12.0</td><td rowspan="9">16.8%</td><td rowspan="9">9.8%</td><td rowspan="9">35.8%</td><td rowspan="9">13.2%</td><td rowspan="9">23.3%</td><td rowspan="9">1.1%</td></tr>
<tr><td>99.5th</td><td>9.5</td></tr>
<tr><td>99th</td><td>8.5</td></tr>
<tr><td>95th</td><td>6.2</td></tr>
<tr><td>90th</td><td>5.3</td></tr>
<tr><td>75th</td><td>4.0</td></tr>
<tr><td>Median</td><td>2.9</td></tr>
<tr><td>25th</td><td>2.1</td></tr>
<tr><td>1st</td><td>1.0</td></tr>
</table>

Exhibit I-6 Continued. General Urban Case Study: Alternative NAAQS 2 (0.5 µg/m^3, Maximum Monthly Average) – Estimated PbB Levels

PbB Percentile	Predicted PbB (µg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent)							
99.9th	10.9						
99.5th	8.5						
99th	7.5						
95th	5.2						
90th	4.3	15.4%	9.0%	32.9%	3.4%	38.3%	1.0%
75th	3.1						
Median	2.2						
25th	1.5						
1st	0.6						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime)							
99.9th	13.1						
99.5th	10.5						
99th	9.4						
95th	6.8						
90th	5.7	15.4%	9.0%	32.9%	3.4%	38.3%	1.0%
75th	4.3						
Median	3.2						
25th	2.3						
1st	1.1						

Exhibit I-6 Continued. General Urban Case Study: Alternative NAAQS 2 (0.5 µg/m^3, Maximum Monthly Average) – Estimated PbB Levels

PbB Percentile	Predicted PbB (µg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent)							
99.9th	20.3						
99.5th	13.5						
99th	11.2						
95th	6.8						
90th	5.2	16.8%	9.8%	35.8%	13.2%	23.3%	1.1%
75th	3.3						
Median	2.0						
25th	1.2						
1st	0.4						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime)							
99.9th	25.1						
99.5th	17.2						
99th	14.5						
95th	9.1						
90th	7.0	16.8%	9.8%	35.8%	13.2%	23.3%	1.1%
75th	4.6						
Median	2.9						
25th	1.8						
1st	0.6						

Exhibit I-6 Continued. General Urban Case Study: Alternative NAAQS 2 (0.5 µg/m^3, Maximum Monthly Average) – Estimated PbB Levels

PbB Percentile	Predicted PbB (µg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust: Other [b]	Indoor Dust: Recent Air	
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent)							
99.9th	18.6						
99.5th	12.7						
99th	10.6						
95th	6.7						
90th	5.2	15.4%	9.0%	32.9%	3.4%	38.3%	1.0%
75th	3.4						
Median	2.2						
25th	1.4						
1st	0.4						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime)							
99.9th	31.4						
99.5th	20.9						
99th	17.2						
95th	10.5						
90th	8.0	15.4%	9.0%	32.9%	3.4%	38.3%	1.0%
75th	5.1						
Median	3.1						
25th	1.9						
1st	0.6						

[a] Pathway contributions apply to all percentiles. See text for further discussion.
[b] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-7. General Urban Case Study: Alternative NAAQS 3 (0.2 $\mu g/m^3$, Maximum Monthly Average) – Estimated PbB Levels

PbB Percentile	Predicted PbB (μg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent)							
99.9th	9.1						
99.5th	6.8						
99th	6.0						
95th	4.2						
90th	3.5	19.7%	11.5%	41.9%	15.5%	10.9%	0.5%
75th	2.5						
Median	1.7						
25th	1.2						
1st	0.5						
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime)							
99.9th	10.8						
99.5th	8.3						
99th	7.5						
95th	5.4						
90th	4.6	19.7%	11.5%	41.9%	15.5%	10.9%	0.5%
75th	3.4						
Median	2.5						
25th	1.8						
1st	0.8						

Exhibit I-7 Continued. General Urban Case Study: Alternative NAAQS 3 (0.2 μg/m^3, Maximum Monthly Average) – Estimated PbB Levels

PbB Percentile	Predicted PbB (μg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent)							
99.9th	9.9						
99.5th	7.5						
99th	6.5						
95th	4.5						
90th	3.7	17.9%	10.4%	38.2%	6.0%	27.0%	0.5%
75th	2.7						
Median	1.9						
25th	1.3						
1st	0.6						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime)							
99.9th	11.8						
99.5th	9.3						
99th	8.2						
95th	5.9						
90th	5.0	17.9%	10.4%	38.2%	6.0%	27.0%	0.5%
75th	3.7						
Median	2.7						
25th	2.0						
1st	0.9						

Exhibit I-7 Continued. General Urban Case Study: Alternative NAAQS 3 (0.2 µg/m³, Maximum Monthly Average) – Estimated PbB Levels

PbB Percentile	Predicted PbB (µg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent)							
99.9th	17.0						
99.5th	11.7						
99th	9.9						
95th	5.9						
90th	4.5	19.7%	11.5%	41.9%	15.5%	10.9%	0.5%
75th	2.9						
Median	1.8						
25th	1.1						
1st	0.3						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime)							
99.9th	20.9						
99.5th	14.8						
99th	12.6						
95th	7.8						
90th	6.0	19.7%	11.5%	41.9%	15.5%	10.9%	0.5%
75th	4.0						
Median	2.5						
25th	1.6						
1st	0.5						

Exhibit I-7 Continued. General Urban Case Study: Alternative NAAQS 3 (0.2 $\mu g/m^3$, Maximum Monthly Average) – Estimated PbB Levels

PbB Percentile	Predicted PbB (μg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent)							
99.9th	18.3						
99.5th	12.6						
99th	10.6						
95th	6.4						
90th	4.9	17.9%	10.4%	38.2%	6.0%	27.0%	0.5%
75th	3.1						
Median	1.9						
25th	1.1						
1st	0.3						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime)							
99.9th	22.6						
99.5th	16.0						
99th	13.6						
95th	8.5						
90th	6.6	17.9%	10.4%	38.2%	6.0%	27.0%	0.5%
75th	4.3						
Median	2.7						
25th	1.7						
1st	0.5						

[a] Pathway contributions apply to all percentiles. See text for further discussion.
[b] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-8. General Urban Case Study: Alternative NAAQS 4 (0.05 $\mu g/m^3$, Maximum Monthly Average) – Estimated PbB Levels

PbB Percentile	Predicted PbB (µg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent)							
99.9th	7.9						
99.5th	6.3						
99th	5.5						
95th	3.9						
90th	3.2	21.5%	12.5%	45.8%	17.0%	3.0%	0.1%
75th	2.3						
Median	1.6						
25th	1.1						
1st	0.5						
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime)							
99.9th	9.4						
99.5th	7.6						
99th	6.8						
95th	5.0						
90th	4.2	21.5%	12.5%	45.8%	17.0%	3.0%	0.1%
75th	3.1						
Median	2.3						
25th	1.7						
1st	0.8						

Exhibit I-8 Continued. General Urban Case Study: Alternative NAAQS 4 (0.05 µg/m³, Maximum Monthly Average) – Estimated PbB Levels

<table>
<tr><th rowspan="4">PbB Percentile</th><th rowspan="4">Predicted PbB (µg/dL)</th><th colspan="6">Pathway Contribution [a]</th></tr>
<tr><th colspan="5">Ingestion</th><th rowspan="3">Inhalation (Recent Air)</th></tr>
<tr><th rowspan="2">Diet</th><th rowspan="2">Drinking Water</th><th rowspan="2">Outdoor Soil/Dust</th><th colspan="2">Indoor Dust</th></tr>
<tr><th>Other [b]</th><th>Recent Air</th></tr>
<tr><td colspan="8">Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent)</td></tr>
<tr><td>99.9th</td><td>8.5</td><td rowspan="9">20.5%</td><td rowspan="9">11.9%</td><td rowspan="9">43.7%</td><td rowspan="9">11.1%</td><td rowspan="9">12.6%</td><td rowspan="9">0.1%</td></tr>
<tr><td>99.5th</td><td>6.7</td></tr>
<tr><td>99th</td><td>5.9</td></tr>
<tr><td>95th</td><td>4.1</td></tr>
<tr><td>90th</td><td>3.4</td></tr>
<tr><td>75th</td><td>2.4</td></tr>
<tr><td>Median</td><td>1.7</td></tr>
<tr><td>25th</td><td>1.2</td></tr>
<tr><td>1st</td><td>0.5</td></tr>
<tr><td colspan="8">Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime)</td></tr>
<tr><td>99.9th</td><td>10.0</td><td rowspan="9">20.5%</td><td rowspan="9">11.9%</td><td rowspan="9">43.7%</td><td rowspan="9">11.1%</td><td rowspan="9">12.6%</td><td rowspan="9">0.1%</td></tr>
<tr><td>99.5th</td><td>8.1</td></tr>
<tr><td>99th</td><td>7.2</td></tr>
<tr><td>95th</td><td>5.2</td></tr>
<tr><td>90th</td><td>4.4</td></tr>
<tr><td>75th</td><td>3.3</td></tr>
<tr><td>Median</td><td>2.4</td></tr>
<tr><td>25th</td><td>1.7</td></tr>
<tr><td>1st</td><td>0.8</td></tr>
</table>

Exhibit I-8 Continued. General Urban Case Study: Alternative NAAQS 4 (0.05 μg/m³, Maximum Monthly Average) – Estimated PbB Levels

PbB Percentile	Predicted PbB (μg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent)							
99.9th	15.8	21.5%	12.5%	45.8%	17.0%	3.0%	0.1%
99.5th	11.2						
99th	9.2						
95th	5.5						
90th	4.2						
75th	2.7						
Median	1.6						
25th	1.0						
1st	0.3						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime)							
99.9th	19.3	21.5%	12.5%	45.8%	17.0%	3.0%	0.1%
99.5th	14.0						
99th	11.7						
95th	7.2						
90th	5.6						
75th	3.7						
Median	2.3						
25th	1.4						
1st	0.5						

Exhibit I-8 Continued. General Urban Case Study: Alternative NAAQS 4 (0.05 µg/m^3, Maximum Monthly Average) – Estimated PbB Levels

PbB Percentile	Predicted PbB (µg/dL)	Pathway Contribution [a]					
		Ingestion					Inhalation (Recent Air)
		Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
					Other [b]	Recent Air	
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent)							
99.9th	16.2	20.5%	11.9%	43.7%	11.1%	12.6%	0.1%
99.5th	11.5						
99th	9.5						
95th	5.7						
90th	4.4						
75th	2.8						
Median	1.7						
25th	1.0						
1st	0.3						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime)							
99.9th	19.9	20.5%	11.9%	43.7%	11.1%	12.6%	0.1%
99.5th	14.4						
99th	12.1						
95th	7.5						
90th	5.9						
75th	3.8						
Median	2.4						
25th	1.5						
1st	0.5						

[a] Pathway contributions apply to all percentiles. See text for further discussion.
[b] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

I.2.3. Ambient Air to PbB Ratios for the General Urban Case Study

Exhibit I-9 through Exhibit I-15 show the ratio of the annual average ambient air Pb concentration to the PbB estimate (where a ratio of 1:2.0 indicates that the PbB, estimated in µg/dL, is twice the ambient air concentration, estimated in µg/m^3). The ratios in this section were calculated before the application of the GSD to the PbB values to account for inter-individual variability. That is, the GM PbB estimates for each NAAQS scenario (i.e., the unadjusted IEUBK outputs) are used to determine the ratios. All ratios are presented to one decimal place, which results in various numbers of implied significant figures (e.g., 1 to 5).[1] This is not intended to convey greater precision for some ratios than others; it is simply an expedient and initial result of the software used for the calculation. Greater attention is given to significant figures in the presentation of ratios in the main body of the report.

For each NAAQS scenario, ratios are provided for different portions of the estimated PbB. The first ratio (inhalation [recent air]) is for that portion of PbB estimated to be derived from inhalation of ambient air. The second (inhalation+ingestion [recent air]) is for the aggregate PbB estimated to result from inhalation of ambient air plus ingestion of the Pb in indoor dust that is predicted to be associated with ambient air Pb levels. The third (inhalation+ingestion [recent and past air]) is the aggregate PbB resulting from the inhalation of ambient air, the ingestion of indoor dust, and the ingestion of outdoor soil/dust.

As a result of the dust equations used for the general urban case study, the indoor dust Pb contributions other than that associated with recent ambient air Pb levels cannot be distinguished. This is because indoor paint, outdoor soil/dust or other sources (e.g., historical ambient air contributions) are all represented by a single constant intercept in the indoor dust loading equation (for the hybrid model) or indoor dust concentration equation (for the air-only regression-based model). Therefore, the third ratio includes contributions to PbB from indoor paint, as well as recent ambient air Pb levels and past deposition of ambient air Pb to outdoor soil/dust. Accordingly, this ratio may be an overestimate of the relationship of ambient air Pb concentration to the portion of PbB derived from ambient air Pb.

---

[1] Similarly, the ambient air annual average Pb concentration estimates are presented to three decimal places, resulting in various numbers of implied significant figures (e.g., 1 to 3). No difference in precision is intended to be conveyed; this is simply an expedient and initial result of the software used for presentation.

Exhibit I-9. General Urban Case Study: Current Conditions (95th Percentile) – Ambient Air Pb to PbB Ratios

Dust Model	Ambient Air Annual Average Pb Concentration (µg/m³)	Air to PbB Ratios (µg/m³ : µg/dL) with PbB Contribution from:		
		Inhalation (Recent Air) [a]	Inhalation +Ingestion (Recent Air) [a]	Inhalation +Ingestion (Recent and Past Air) [a,b]
Concurrent PbB Metric				
Air-only regression-based	0.114	1 : 0.2	1 : 3.9	1 : 12.6
Lifetime PbB Metric				
Air-only regression-based	0.114	1 : 0.3	1 : 5.7	1 : 18.1
Concurrent PbB Metric				
Hybrid	0.114	1 : 0.2	1 : 7.1	1 : 14.0
Lifetime PbB Metric				
Hybrid	0.114	1 : 0.3	1 : 10.3	1 : 20.3

[a] These results exclude application of the GSD reflecting inter-individual variability in Pb exposure and biokinetics.
[b] "Past air" includes contributions from outdoor soil/dust contribution to indoor dust, historical air contribution to indoor dust, and outdoor soil/dust pathways, and "recent air" refers to contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-10. General Urban Case Study: Current Conditions (Mean) – Ambient Air Pb to PbB Ratios

Dust Model	Ambient Air Annual Average Pb Concentration (µg/m³)	Air to PbB Ratios (µg/m³ : µg/dL) with PbB Contribution from:		
		Inhalation (Recent Air) [a]	Inhalation +Ingestion (Recent Air) [a]	Inhalation +Ingestion (Recent and Past Air) [a,b]
Concurrent PbB Metric				
Air-only regression-based	0.056	1 : 0.2	1 : 4.0	1 : 21.9
Lifetime PbB Metric				
Air-only regression-based	0.056	1 : 0.3	1 : 5.7	1 : 31.2
Concurrent PbB Metric				
Hybrid	0.056	1 : 0.2	1 : 9.9	1 : 24.6
Lifetime PbB Metric				
Hybrid	0.056	1 : 0.3	1 : 14.2	1 : 35.5

[a] These results exclude application of the GSD reflecting inter-individual variability in Pb exposure and biokinetics.
[b] "Past air" includes contributions from outdoor soil/dust contribution to indoor dust, historical air contribution to indoor dust, and outdoor soil/dust pathways, and "recent air" refers to contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-11. General Urban Case Study: Current NAAQS (1.5 μg/m³, Maximum Quarterly Average) – Ambient Air Pb to PbB Ratios

Dust Model	Ambient Air Annual Average Pb Concentration (μg/m³)	Air to PbB Ratios (μg/m³ : μg/dL) with PbB Contribution from:		
		Inhalation (Recent Air) [a]	Inhalation +Ingestion (Recent Air) [a]	Inhalation +Ingestion (Recent and Past Air) [a,b]
Concurrent PbB Metric				
Air-only regression-based	0.600	1 : 0.2	1 : 3.7	1 : 5.3
Lifetime PbB Metric				
Air-only regression-based	0.600	1 : 0.2	1 : 5.4	1 : 7.6
Concurrent PbB Metric				
Hybrid	0.600	1 : 0.2	1 : 3.2	1 : 4.4
Lifetime PbB Metric				
Hybrid	0.600	1 : 0.2	1 : 4.6	1 : 6.3

[a] These results exclude application of the GSD reflecting inter-individual variability in Pb exposure and biokinetics.
[b] "Past air" includes contributions from outdoor soil/dust contribution to indoor dust, historical air contribution to indoor dust, and outdoor soil/dust pathways, and "recent air" refers to contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-12. General Urban Case Study: Alternative NAAQS 1 (0.2 μg/m³, Maximum Quarterly Average) – Ambient Air Pb to PbB Ratios

Dust Model	Ambient Air Annual Average Pb Concentration (μg/m³)	Air to PbB Ratios (μg/m³ : μg/dL) with PbB Contribution from:		
		Inhalation (Recent Air) [a]	Inhalation +Ingestion (Recent Air) [a]	Inhalation +Ingestion (Recent and Past Air) [a,b]
Concurrent PbB Metric				
Air-only regression-based	0.080	1 : 0.2	1 : 4.0	1 : 16.4
Lifetime PbB Metric				
Air-only regression-based	0.080	1 : 0.3	1 : 5.7	1 : 23.5
Concurrent PbB Metric				
Hybrid	0.080	1 : 0.2	1 : 8.4	1 : 18.5
Lifetime PbB Metric				
Hybrid	0.080	1 : 0.3	1 : 12.1	1 : 26.7

[a] These results exclude application of the GSD reflecting inter-individual variability in Pb exposure and biokinetics.
[b] "Past air" includes contributions from outdoor soil/dust contribution to indoor dust, historical air contribution to indoor dust, and outdoor soil/dust pathways, and "recent air" refers to contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-13. General Urban Case Study: Alternative NAAQS 2 (0.5 μg/m³, Maximum Monthly Average) – Ambient Air Pb to PbB Ratios

Dust Model	Ambient Air Annual Average Pb Concentration (μg/m³)	Air to PbB Ratios (μg/m³ : μg/dL) with PbB Contribution from:		
		Inhalation (Recent Air) [a]	Inhalation +Ingestion (Recent Air) [a]	Inhalation +Ingestion (Recent and Past Air) [a,b]
Concurrent PbB Metric				
Air-only regression-based	0.125	1 : 0.2	1 : 3.9	1 : 11.8
Lifetime PbB Metric				
Air-only regression-based	0.125	1 : 0.3	1 : 5.7	1 : 17.0
Concurrent PbB Metric				
Hybrid	0.125	1 : 0.2	1 : 6.8	1 : 13.1
Lifetime PbB Metric				
Hybrid	0.125	1 : 0.3	1 : 9.9	1 : 19.0

[a] These results exclude application of the GSD reflecting inter-individual variability in Pb exposure and biokinetics.
[b] "Past air" includes contributions from outdoor soil/dust contribution to indoor dust, historical air contribution to indoor dust, and outdoor soil/dust pathways, and "recent air" refers to contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-14. General Urban Case Study: Alternative NAAQS 3 (0.2 μg/m³, Maximum Monthly Average) – Ambient Air Pb to PbB Ratios

Dust Model	Ambient Air Annual Average Pb Concentration (μg/m³)	Air to PbB Ratios (μg/m³ : μg/dL) with PbB Contribution from:		
		Inhalation (Recent Air) [a]	Inhalation +Ingestion (Recent Air) [a]	Inhalation +Ingestion (Recent and Past Air) [a,b]
Concurrent PbB Metric				
Air-only regression-based	0.050	1 : 0.2	1 : 4.0	1 : 24.0
Lifetime PbB Metric				
Air-only regression-based	0.050	1 : 0.3	1 : 5.7	1 : 34.3
Concurrent PbB Metric				
Hybrid	0.050	1 : 0.2	1 : 10.4	1 : 27.1
Lifetime PbB Metric				
Hybrid	0.050	1 : 0.3	1 : 14.9	1 : 38.9

[a] These results exclude application of the GSD reflecting inter-individual variability in Pb exposure and biokinetics.
[b] "Past air" includes contributions from outdoor soil/dust contribution to indoor dust, historical air contribution to indoor dust, and outdoor soil/dust pathways, and "recent air" refers to contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-15. General Urban Case Study: Alternative NAAQS 4 (0.05 μg/m^3, Maximum Monthly Average) – Ambient Air Pb to PbB Ratios

Dust Model	Ambient Air Annual Average Pb Concentration (μg/m^3)	Air to PbB Ratios (μg/m^3 : μg/dL) with PbB Contribution from:		
		Inhalation (Recent Air) [a]	Inhalation +Ingestion (Recent Air) [a]	Inhalation +Ingestion (Recent and Past Air) [a,b]
Concurrent PbB Metric				
Air-only regression-based	0.013	1 : 0.2	1 : 4.0	1 : 84.9
Lifetime PbB Metric				
Air-only regression-based	0.013	1 : 0.2	1 : 5.7	1 : 120.6
Concurrent PbB Metric				
Hybrid	0.013	1 : 0.2	1 : 17.1	1 : 90.8
Lifetime PbB Metric				
Hybrid	0.013	1 : 0.2	1 : 24.4	1 : 129.3

[a] These results exclude application of the GSD reflecting inter-individual variability in Pb exposure and biokinetics.
[b] "Past air" includes contributions from outdoor soil/dust contribution to indoor dust, historical air contribution to indoor dust, and outdoor soil/dust pathways, and "recent air" refers to contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

I.3. PRIMARY PB SMELTER CASE STUDY

I.3.1. Description of PbB Model Scenarios Run for the Primary Pb Smelter Case Study

Ambient air and soil Pb concentration estimates for the primary Pb smelter case study were estimated as described in Appendix D. Exposure concentrations were assumed to be constant throughout the seven-year duration of the exposure scenario. Data from the U.S. Census provided estimates of the numbers of children (birth to seven years of age) living in each block or block group in the year 2000 (U.S. Census Bureau, 2005). The numbers of exposed children in each U.S. Census block or block group were assumed to be constant through the entire seven-year exposure period. In- and out-migration to and from the case study areas was not considered. PbB levels were modeled for each child as though exposure started at birth and continued through 84 months (seven years of age). Maternal PbB levels during pregnancy were assumed to be identical for all children at a level consistent with nationally representative values for women of childbearing age. Thus, all children were assumed to start with the same body burden of Pb at birth. Similarly, all exposed children were assumed to receive the same pattern of nationally representative policy-relevant background exposures throughout the exposure period.

Estimates of indoor dust Pb concentrations were generated using the site-specific H6 model for the U.S. Census blocks and block groups within 1.5 kilometer (km) of the source. Dust Pb concentration estimates in more distant U.S. Census blocks and block groups were derived using the U.S. EPA air+soil regression-based model, as discussed in Appendix G. Thus, unlike the general urban case study, only a single set of indoor dust concentrations was input to the IEUBK model (along with the outdoor soil/dust, inhalation exposure, dietary, and drinking water Pb concentrations) to generate GM PbB estimates for each U.S. Census block and block group. As in the urban case study, both concurrent (at 75 and 81 months during the seventh year of life) and lifetime (ages 6 to 84 months) average PbB metrics were estimated for each NAAQS scenario.

To capture the inter-individual variability and the PbB levels for the whole population, random lognormal probability distributions, represented by GSD values, were superimposed on the U.S. Census block GM estimates, as discussed in Appendix H. In each iteration of the probabilistic model, a single U.S. Census block or block group was randomly selected, where the probability of selecting a given block was proportional to the number of children ages birth to seven years in that block. A random uniform variate was sampled and used as the probability ("p") input to the Excel® LOGINV function, along with the GM value for the block group and the GSD value selected for the case study and exposure scenario. The resulting PbB estimate for each iteration was therefore a lognormally distributed variate reflecting the GM for the randomly chosen U.S. Census block and the specified GSD value. This process was repeated for 50,000 iterations, and the resultant distribution of PbB estimates was used to generate population PbB percentile estimates. For the primary Pb smelter case study, a single set of GSD values was used for each PbB metric, as shown in Exhibit I-16. Supporting data for the GSD estimates are provided in Appendix H.

Exhibit I-16. PbB Model Scenarios Run for the Primary Pb Smelter Case Study

NAAQS Scenario	GSD (µg/dL)	PbB Metric
Current NAAQS (1.5 µg/m^3, max quarterly average)	1.7	Concurrent
	1.6	Lifetime
Alternative NAAQS 1 (0.2 µg/m^3, max quarterly average)	1.7	Concurrent
	1.6	Lifetime
Alternative NAAQS 2 (0.5 µg/m^3, max monthly average)	1.7	Concurrent
	1.6	Lifetime
Alternative NAAQS 3 (0.2 µg/m^3, max monthly average)	1.7	Concurrent
	1.6	Lifetime
Alternative NAAQS 4 (0.05 µg/m^3, max monthly average)	1.7	Concurrent
	1.6	Lifetime

I.3.2. PbB Results for the Primary Pb Smelter Case Study

Exhibit I-17 through Exhibit I-21 summarize PbB distribution percentile estimates for all scenarios in the primary Pb smelter case study. In addition, the estimates of the percent contribution of each exposure pathway to the overall Pb uptake estimates are given for each percentile. The indoor dust contribution is separated into the contribution derived from recent ambient air and that from other sources (e.g., indoor paint, outdoor soil/dust, and additional sources including historical air), as described in Appendix G. These contribution estimates were derived for the GM PbB estimates for each U.S. Census block or block group before the GSD is applied to generate the PbB distributions. The PbB percentile estimates, however, are those after the application of the GSD. Thus, as some of the high percentile PbB values are actually associated with U.S. Census blocks (or block groups) with low PbB GMs (and vice versa), these exhibits contain some seemingly irregular trends in pathway contributions.

Also included in Exhibit I-17 through Exhibit I-21 are the estimated numbers of children with PbB levels above the various percentiles. As in the general urban case study, the concurrent PbB percentile estimates tend to be lower than the corresponding percentiles of lifetime estimates under all of the exposure scenarios.

Exhibit I-17. Primary Pb Smelter Case Study: Current NAAQS Scenario (1.5 $\mu g/m^3$, Maximum Quarterly Average) – Estimated PbB Levels

PbB Percentile	Population Above	Predicted PbB (µg/dL)	Pathway Contribution					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent)								
99.9th	4	18.8	3.0%	1.7%	11.5%	27.0%	56.0%	0.8%
99.5th	19	11.7	4.0%	2.3%	14.7%	35.9%	42.5%	0.6%
99th	39	9.2	6.3%	3.7%	6.8%	56.7%	25.9%	0.6%
95th	194	4.8	21.6%	12.6%	39.1%	17.1%	9.0%	0.7%
90th	388	3.6	15.1%	8.8%	48.5%	17.1%	9.8%	0.7%
75th	970	2.3	32.9%	19.1%	22.6%	17.2%	7.6%	0.6%
Median	1940	1.5	11.1%	6.5%	53.9%	16.9%	10.8%	0.9%
25th	2910	1.0	36.9%	21.5%	18.9%	17.7%	4.6%	0.4%
1st	3841	0.4	30.9%	18.0%	27.1%	17.5%	6.1%	0.4%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime)								
99.9th	4	24.3	4.9%	2.9%	9.8%	44.6%	37.2%	0.6%
99.5th	19	15.4	4.9%	2.8%	8.2%	44.2%	39.2%	0.7%
99th	39	12.5	18.0%	10.5%	45.1%	17.3%	8.5%	0.7%
95th	194	6.5	12.4%	7.2%	49.3%	16.3%	13.7%	1.1%
90th	388	4.8	18.0%	10.5%	44.7%	17.2%	8.9%	0.7%
75th	970	3.2	32.9%	19.1%	22.6%	17.2%	7.6%	0.6%
Median	1940	2.1	15.0%	8.7%	47.7%	16.8%	10.9%	0.9%
25th	2910	1.4	32.9%	19.1%	22.6%	17.2%	7.6%	0.6%
1st	3841	0.6	31.7%	18.5%	28.0%	18.1%	3.5%	0.3%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-18. Primary Pb Smelter Case Study: Alternative NAAQS 1 (0.2 $\mu g/m^3$, Maximum Quarterly Average) – Estimated PbB Levels

PbB Percentile	Population Above	Predicted PbB (µg/dL)	Pathway Contribution					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent)								
99.9th	4	11.3	5.3%	3.1%	26.8%	15.5%	48.9%	0.4%
99.5th	19	7.8	10.3%	6.0%	63.1%	18.9%	1.6%	0.1%
99th	39	6.6	12.2%	7.1%	59.3%	18.6%	2.6%	0.2%
95th	194	4.1	16.5%	9.6%	52.8%	18.6%	2.3%	0.2%
90th	388	3.2	23.9%	13.9%	41.2%	18.5%	2.3%	0.2%
75th	970	2.2	12.2%	7.1%	59.3%	18.6%	2.6%	0.2%
Median	1940	1.4	32.5%	18.9%	28.6%	18.5%	1.4%	0.1%
25th	2910	0.9	16.5%	9.6%	52.8%	18.6%	2.3%	0.2%
1st	3841	0.4	38.4%	22.4%	19.7%	18.4%	1.0%	0.1%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime)								
99.9th	4	14.3	7.1%	4.2%	68.5%	19.0%	1.1%	0.1%
99.5th	19	10.2	16.0%	9.3%	53.8%	18.7%	2.1%	0.2%
99th	39	8.6	6.0%	3.5%	16.9%	17.7%	55.3%	0.5%
95th	194	5.5	7.7%	4.5%	17.0%	22.6%	47.8%	0.4%
90th	388	4.3	12.2%	7.1%	59.3%	18.6%	2.6%	0.2%
75th	970	2.9	25.5%	14.8%	39.7%	18.7%	1.3%	0.1%
Median	1940	1.9	34.3%	20.0%	25.7%	18.4%	1.4%	0.1%
25th	2910	1.3	22.7%	13.2%	43.4%	18.6%	2.0%	0.2%
1st	3841	0.5	31.9%	18.6%	28.9%	18.3%	2.1%	0.2%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-19. Primary Pb Smelter Case Study: Alternative NAAQS 2 (0.5 µg/m^3, Maximum Monthly Average) – Estimated PbB Levels

PbB Percentile	Population Above	Predicted PbB (µg/dL)	Pathway Contribution					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent)								
99.9th	4	14.1	4.8%	2.8%	18.5%	23.9%	49.4%	0.6%
99.5th	19	9.1	4.8%	2.8%	18.5%	23.9%	49.4%	0.6%
99th	39	7.4	10.2%	5.9%	7.3%	50.4%	25.7%	0.4%
95th	194	4.3	25.6%	14.9%	37.3%	18.1%	3.8%	0.3%
90th	388	3.4	18.9%	11.0%	47.6%	18.2%	3.9%	0.3%
75th	970	2.2	16.1%	9.4%	51.5%	18.1%	4.6%	0.4%
Median	1940	1.4	35.9%	20.9%	22.6%	18.2%	2.2%	0.2%
25th	2910	1.0	34.4%	20.1%	23.7%	18.0%	3.5%	0.3%
1st	3841	0.4	35.9%	20.9%	22.6%	18.2%	2.2%	0.2%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime)								
99.9th	4	18.4	11.7%	6.8%	56.1%	17.7%	7.1%	0.6%
99.5th	19	12.2	3.7%	2.1%	18.5%	18.1%	57.0%	0.6%
99th	39	9.7	4.8%	2.8%	18.5%	23.9%	49.4%	0.6%
95th	194	5.8	11.9%	6.9%	57.6%	18.1%	5.1%	0.4%
90th	388	4.5	7.9%	4.6%	15.7%	38.9%	32.5%	0.4%
75th	970	3.0	16.0%	9.3%	51.1%	18.0%	5.1%	0.4%
Median	1940	2.0	32.0%	18.7%	28.1%	18.2%	2.8%	0.2%
25th	2910	1.3	34.4%	20.1%	23.7%	18.0%	3.5%	0.3%
1st	3841	0.6	25.6%	14.9%	37.3%	18.1%	3.8%	0.3%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-20. Primary Pb Smelter Case Study: Alternative NAAQS 3 (0.2 µg/m^3, Maximum Monthly Average) – Estimated PbB Levels

PbB Percentile	Population Above	Predicted PbB (µg/dL)	Pathway Contribution					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent)								
99.9th	4	10.9	12.3%	7.2%	58.8%	18.5%	3.0%	0.2%
99.5th	19	7.8	16.6%	9.7%	52.8%	18.6%	2.1%	0.2%
99th	39	6.5	14.1%	8.2%	56.1%	18.6%	2.8%	0.2%
95th	194	4.1	19.8%	11.5%	48.2%	18.7%	1.7%	0.1%
90th	388	3.2	14.1%	8.2%	56.1%	18.6%	2.8%	0.2%
75th	970	2.2	26.1%	15.2%	37.7%	18.4%	2.5%	0.2%
Median	1940	1.4	35.2%	20.5%	24.3%	18.4%	1.4%	0.1%
25th	2910	0.9	24.0%	14.0%	41.4%	18.5%	1.9%	0.1%
1st	3841	0.4	34.5%	20.1%	25.3%	18.4%	1.5%	0.1%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime)								
99.9th	4	14.0	10.4%	6.0%	63.3%	18.9%	1.3%	0.1%
99.5th	19	10.0	5.8%	3.4%	29.5%	14.7%	46.2%	0.4%
99th	39	8.5	16.6%	9.7%	52.8%	18.6%	2.1%	0.2%
95th	194	5.5	16.6%	9.6%	53.1%	18.7%	1.9%	0.1%
90th	388	4.3	12.2%	7.1%	24.2%	30.7%	25.6%	0.3%
75th	970	2.9	35.2%	20.5%	24.3%	18.4%	1.4%	0.1%
Median	1940	1.9	26.3%	15.3%	38.2%	18.6%	1.5%	0.1%
25th	2910	1.3	16.6%	9.6%	53.1%	18.7%	1.9%	0.1%
1st	3841	0.5	35.2%	20.5%	24.3%	18.4%	1.4%	0.1%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-21. Primary Pb Smelter Case Study: Alternative NAAQS 4 (0.05 µg/m^3, Maximum Monthly Average) – Estimated PbB Levels

PbB Percentile	Population Above	Predicted PbB (µg/dL)	Pathway Contribution					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent)								
99.9th	4	9.8	16.4%	9.6%	45.0%	14.9%	14.0%	0.1%
99.5th	19	7.1	7.6%	4.5%	68.4%	19.2%	0.3%	0.0%
99th	39	6.0	16.8%	9.8%	53.9%	19.0%	0.5%	0.0%
95th	194	3.9	16.6%	9.7%	54.1%	19.0%	0.6%	0.0%
90th	388	3.1	23.1%	13.5%	44.1%	18.9%	0.4%	0.0%
75th	970	2.1	28.5%	16.6%	35.9%	18.8%	0.3%	0.0%
Median	1940	1.4	32.9%	19.2%	29.0%	18.7%	0.2%	0.0%
25th	2910	0.9	14.4%	8.4%	57.4%	19.0%	0.7%	0.1%
1st	3841	0.4	19.1%	11.1%	38.0%	17.3%	14.4%	0.1%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime)								
99.9th	4	12.2	14.4%	8.4%	57.4%	19.0%	0.7%	0.1%
99.5th	19	9.0	14.4%	8.4%	57.4%	19.0%	0.7%	0.1%
99th	39	7.8	14.4%	8.4%	57.4%	19.0%	0.7%	0.1%
95th	194	5.1	14.4%	8.4%	57.4%	19.0%	0.7%	0.1%
90th	388	4.1	8.7%	5.1%	66.8%	19.2%	0.3%	0.0%
75th	970	2.9	35.6%	20.8%	24.6%	18.6%	0.4%	0.0%
Median	1940	1.9	35.6%	20.8%	24.6%	18.6%	0.4%	0.0%
25th	2910	1.3	18.7%	10.9%	50.9%	19.0%	0.5%	0.0%
1st	3841	0.5	36.0%	21.0%	24.1%	18.6%	0.3%	0.0%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

I.3.3. Ambient Air to PbB Ratios for the Primary Pb Smelter Case Study

Exhibit I-22 through Exhibit I-26 show the ratios of the ambient air Pb concentration to estimated PbB, where a ratio of 1:2.0 indicates that the PbB is twice the ambient air concentration, using ambient air units of $\mu g/m^3$ and PbB units of $\mu g/dL$. In all of these exhibits, the ratios are calculated before the application of the GSD representing inter-individual variability to the U.S. Census block or block group GM Pb values. And, the PbB estimates used to calculate air to blood ratios come from either the median or 99.5th percentile U.S. Census blocks or block groups (with regard to air concentration), as indicated in the tables. All ratios are presented to one decimal place, which results in various numbers of implied significant figures (e.g., 1 to 5).[2] This is not intended to convey greater precision for some ratios than others; it is simply an expedient and initial result of the software used for the calculation. Greater attention is given to significant figures in the presentation of ratios in the main body of the report.

As in the general urban case study, ratios are provided for different portions of the estimated PbB. The first ratio (inhalation [recent air]) is for that portion of PbB estimated to be derived from inhalation of ambient air. The second (inhalation+ingestion [recent air]) is for the aggregate PbB estimated to result from inhalation of ambient air plus ingestion of the Pb in indoor dust that is predicted to be associated with ambient air Pb levels. The third (inhalation+ingestion [recent and past air]) is the aggregate PbB resulting from the inhalation of ambient air, the ingestion of indoor dust, and the ingestion of outdoor soil/dust. As the Pb in dust (that is included within the 3rd ratio) is inclusive of non-air-related sources such as Pb paint (captured via the intercept of both indoor dust models employed for this case study), this third ratio may be an overestimate of the relationship of ambient air Pb concentration to the portion of PbB derived from recent and past air Pb throughout the study area.

[2] Similarly, the ambient air annual average Pb concentration estimates are presented to three decimal places, resulting in various numbers of implied significant figures (e.g., 1 to 3). No difference in precision is intended to be conveyed; this is simply an expedient and initial result of the software used for presentation.

Exhibit I-22. Primary Pb Smelter Case Study: Current NAAQS Scenario (1.5 µg/m^3, Maximum Quarterly Average) – Ambient Air to PbB Ratios

Dust Model	Ambient Air Annual Average Pb Concentration (µg/m^3)		Air to PbB Ratios (µg/m^3 : µg/dL) with PbB Contribution from:		
			Inhalation (Recent Air) [a]	Inhalation +Ingestion (Recent Air) [a]	Inhalation +Ingestion (Recent and Past Air) [a,b]
Concurrent PbB Metric					
Air+soil regression-based and H6	Median	0.093	1 : 0.2	1 : 2.7	1 : 12.5
Air+soil regression-based and H6	99.5th Percentile	0.740	1 : 0.2	1 : 11.1	1 : 15.1
Lifetime PbB Metric					
Air+soil regression-based and H6	Median	0.059	1 : 0.3	1 : 3.8	1 : 28.0
Air+soil regression-based and H6	99.5th Percentile	0.740	1 : 0.2	1 : 15.2	1 : 20.7

[a] These results exclude application of the GSD reflecting inter-individual variability in Pb exposure and biokinetics.

[b] "Past air" includes contributions from outdoor soil/dust contribution to indoor dust, historical air contribution to indoor dust, and outdoor soil/dust pathways, and "recent air" refers to contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-23. Primary Pb Smelter Case Study: Alternative NAAQS 1 (0.2 µg/m^3, Maximum Quarterly Average) – Ambient Air to PbB Ratios

Dust Model	Ambient Air Annual Average Pb Concentration (µg/m^3)		Air to PbB Ratios (µg/m^3 : µg/dL) with PbB Contribution from:		
			Inhalation (Recent Air) [a]	Inhalation +Ingestion (Recent Air) [a]	Inhalation +Ingestion (Recent and Past Air) [a,b]
Concurrent PbB Metric					
Air+soil regression-based and H6	Median	0.017	1 : 0.2	1 : 2.7	1 : 62.8
Air+soil regression-based and H6	99.5th Percentile	0.147	1 : 0.2	1 : 19.8	1 : 36.7
Lifetime PbB Metric					
Air+soil regression-based and H6	Median	0.017	1 : 0.3	1 : 3.9	1 : 89.2
Air+soil regression-based and H6	99.5th Percentile	0.147	1 : 0.3	1 : 28.7	1 : 53.4

[a] These results exclude application of the GSD reflecting inter-individual variability in Pb exposure and biokinetics.

[b] "Past air" includes contributions from outdoor soil/dust contribution to indoor dust, historical air contribution to indoor dust, and outdoor soil/dust pathways, and "recent air" refers to contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-24. Primary Pb Smelter Case Study: Alternative NAAQS 2 (0.5 µg/m^3, Maximum Monthly Average) – Ambient Air to PbB Ratios

Dust Model	Ambient Air Annual Average Pb Concentration (µg/m^3)		Air to PbB Ratios (µg/m^3 : µg/dL) with PbB Contribution from:		
			Inhalation (Recent Air) [a]	Inhalation +Ingestion (Recent Air) [a]	Inhalation +Ingestion (Recent and Past Air) [a,b]
Concurrent PbB Metric					
Air+soil regression-based and H6	Median	0.033	1 : 0.2	1 : 2.7	1 : 32.3
Air+soil regression-based and H6	99.5th Percentile	0.326	1 : 0.2	1 : 15.2	1 : 21.5
Lifetime PbB Metric					
Air+soil regression-based and H6	Median	0.033	1 : 0.3	1 : 3.8	1 : 45.9
Air+soil regression-based and H6	99.5th Percentile	0.326	1 : 0.2	1 : 21.7	1 : 30.7

[a] These results exclude application of the GSD reflecting inter-individual variability in Pb exposure and biokinetics.

[b] "Past air" includes contributions from outdoor soil/dust contribution to indoor dust, historical air contribution to indoor dust, and outdoor soil/dust pathways, and "recent air" refers to contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-25. Primary Pb Smelter Case Study: Alternative NAAQS 3 (0.2 µg/m^3, Maximum Monthly Average) – Ambient Air to PbB Ratios

Dust Model	Ambient Air Annual Average Pb Concentration (µg/m^3)		Air to PbB Ratios (µg/m^3 : µg/dL) with PbB Contribution from:		
			Inhalation (Recent Air) [a]	Inhalation +Ingestion (Recent Air) [a]	Inhalation +Ingestion (Recent and Past Air) [a,b]
Concurrent PbB Metric					
Air+soil regression-based and H6	Median	0.013	1 : 0.2	1 : 2.7	1 : 77.2
Air+soil regression-based and H6	99.5th Percentile	0.119	1 : 0.2	1 : 21.8	1 : 42.5
Lifetime PbB Metric					
Air+soil regression-based and H6	Median	0.013	1 : 0.3	1 : 3.9	1 : 109.2
Air+soil regression-based and H6	99.5th Percentile	0.119	1 : 0.3	1 : 31.8	1 : 61.9

[a] These results exclude application of the GSD reflecting inter-individual variability in Pb exposure and biokinetics.

[b] "Past air" includes contributions from outdoor soil/dust contribution to indoor dust, historical air contribution to indoor dust, and outdoor soil/dust pathways, and "recent air" refers to contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-26. Primary Pb Smelter Case Study: Alternative NAAQS 4 (0.05 µg/m^3, Maximum Monthly Average) – Ambient Air to PbB Ratios

Dust Model	Ambient Air Annual Average Pb Concentration (µg/m^3)		Air to PbB Ratios (µg/m^3 : µg/dL) with PbB Contribution from:		
			Inhalation (Recent Air) [a]	Inhalation +Ingestion (Recent Air) [a]	Inhalation +Ingestion (Recent and Past Air) [a,b]
Concurrent PbB Metric					
Air+soil regression-based and H6	Median	0.002	1 : 0.2	1 : 2.7	1 : 387.4
Air+soil regression-based and H6	99.5th Percentile	0.006	1 : 0.2	1 : 2.5	1 : 887.3
Lifetime PbB Metric					
Air+soil regression-based and H6	Median	0.002	1 : 0.3	1 : 3.9	1 : 547.1
Air+soil regression-based and H6	99.5th Percentile	0.006	1 : 0.3	1 : 3.7	1 : 1294.4

[a] These results exclude application of the GSD reflecting inter-individual variability in Pb exposure and biokinetics.

[b] "Past air" includes contributions from outdoor soil/dust contribution to indoor dust, historical air contribution to indoor dust, and outdoor soil/dust pathways, and "recent air" refers to contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

I.4. SECONDARY PB SMELTER CASE STUDY

I.4.1. Description of PbB Model Scenarios Run for the Secondary Pb Smelter Case Study

Ambient air and soil Pb concentration estimates for the secondary Pb smelter case study were estimated as described in Appendix E. Exposure concentrations were assumed to be constant throughout the seven-year duration of the exposure scenario. As in the primary Pb smelter case study, the numbers of exposed children in each U.S. Census block or block group were assumed to be constant through the entire seven-year exposure period. In- and out-migration to and from the case study areas was not considered. PbB levels were modeled for each child as though exposure started at six months and continued through 84 months. Maternal PbB levels during pregnancy were assumed to be identical for all children at a level consistent with nationally representative values for women of childbearing age. Thus, all children were assumed to start with the same body burden of Pb at birth. Similarly, all exposed children were assumed to receive the same pattern of nationally representative policy-relevant background exposures throughout the exposure period.

For all of the scenarios evaluated, indoor dust Pb concentrations were estimated using the air-only regression-based model. Thus, as for the primary Pb smelter case study, only one set of indoor dust concentrations were input to the IEUBK model (along with the outdoor soil/dust, inhalation exposure, dietary, and drinking water Pb concentrations) to generate PbB estimates for each scenario evaluated. Concurrent and lifetime average PbB metrics were generated for each NAAQS scenario. The probabilistic model was then run in the same manner as described in I.3.1 for the primary Pb smelter case study. Exhibit I-27 summarizes the various model scenarios run for the secondary Pb smelter case study.

Exhibit I-27. PbB Model Scenarios Run for the Secondary Pb Smelter Case Study

NAAQS Scenario	GSD (μg/dL)	PbB Metric
Current Conditions	1.7	Concurrent
	1.6	Lifetime
Alternative NAAQS 1 (0.2 μg/m^3 max quarterly average)	1.7	Concurrent
	1.6	Lifetime
Alternative NAAQS 2 (0.5 μg/m^3, max monthly average)	1.7	Concurrent
	1.6	Lifetime
Alternative NAAQS 3 (0.2 μg/m^3, max monthly average)	1.7	Concurrent
	1.6	Lifetime
Alternative NAAQS 4 (0.05 μg/m^3, max monthly average)	1.7	Concurrent
	1.6	Lifetime

I.4.2. PbB Results for the Secondary Pb Smelter Case Study

Exhibit I-28 through Exhibit I-32 provide the population percentile PbB estimates for the secondary Pb smelter case study scenarios, along with estimates of the pathway contributions to total Pb uptake. The indoor dust contribution is separated into the contribution derived from recent ambient air, and that from other sources (e.g., indoor paint, outdoor soil/dust, and additional sources including historical air), as described in Appendix G. These estimates of pathway contributions were derived for the GM PbB estimates for the individual U.S. Census blocks, before the GSDs for inter-individual PbB variability were applied to generate the PbB distributions. The PbB percentile estimates, however, are those after application of the GSD. Thus, as some of the high percentile PbB values are actually associated with U.S. Census blocks with low PbB GMs (and vice versa), these exhibits contain some seemingly irregular trends in pathway contributions. The exhibits also provide estimates of the numbers of children estimated to have PbB levels greater than the various percentiles. As in the previous two case studies, the concurrent PbB population percentile estimates are less than the lifetime estimates for the corresponding percentiles in all cases.

Exhibit I-28. Secondary Pb Smelter Case Study: Current Conditions Scenario (1.5 µg/m³, Maximum Quarterly Average) – Estimated PbB Levels

PbB Percentile	Population Above	Predicted PbB (µg/dL)	Pathway Contribution					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [a]	Recent Air	
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent)								
99.9th	2	5.3	39.7%	23.1%	4.5%	31.3%	1.3%	0.1%
99.5th	8	4.0	33.4%	19.4%	17.6%	26.3%	3.1%	0.2%
99th	17	3.5	42.0%	24.5%	0.3%	33.1%	0.2%	0.0%
95th	85	2.4	41.1%	24.0%	1.9%	32.5%	0.5%	0.0%
90th	170	2.0	29.4%	17.1%	25.1%	23.2%	5.0%	0.3%
75th	425	1.4	37.9%	22.1%	8.2%	29.9%	1.9%	0.1%
Median	849	1.0	39.7%	23.1%	4.5%	31.3%	1.3%	0.1%
25th	1274	0.7	41.8%	24.3%	0.6%	33.0%	0.3%	0.0%
1st	1681	0.3	41.8%	24.3%	0.6%	33.0%	0.2%	0.0%
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime)								
99.9th	2	5.9	13.8%	8.0%	46.9%	10.9%	19.3%	1.1%
99.5th	8	4.5	38.7%	22.5%	6.2%	30.5%	2.0%	0.1%
99th	17	4.0	39.3%	22.9%	5.4%	31.0%	1.3%	0.1%
95th	85	2.9	41.6%	24.2%	1.0%	32.8%	0.3%	0.0%
90th	170	2.4	38.7%	22.5%	6.2%	30.5%	2.0%	0.1%
75th	425	1.8	39.6%	23.0%	4.9%	31.2%	1.2%	0.1%
Median	849	1.3	41.4%	24.1%	1.3%	32.6%	0.5%	0.0%
25th	1274	0.9	40.4%	23.5%	3.1%	31.9%	1.0%	0.1%
1st	1681	0.4	41.7%	24.3%	0.8%	32.9%	0.3%	0.0%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-29. Secondary Pb Smelter Case Study: Alternative NAAQS 1 (0.2 µg/m^3, Maximum Quarterly Average) – Estimated PbB Levels

PbB Percentile	Population Above	Predicted PbB (µg/dL)	Pathway Contribution					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [a]	Recent Air	
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent)								
99.9th	2	5.1	40.1%	23.3%	4.6%	31.6%	0.4%	0.0%
99.5th	8	3.9	39.7%	23.1%	5.5%	31.3%	0.3%	0.0%
99th	17	3.4	41.0%	23.9%	2.7%	32.3%	0.2%	0.0%
95th	85	2.3	41.9%	24.4%	0.6%	33.0%	0.1%	0.0%
90th	170	1.9	41.6%	24.2%	1.2%	32.8%	0.1%	0.0%
75th	425	1.4	40.7%	23.7%	3.1%	32.1%	0.3%	0.0%
Median	849	1.0	39.4%	22.9%	6.2%	31.1%	0.5%	0.0%
25th	1274	0.7	40.1%	23.3%	4.6%	31.6%	0.4%	0.0%
1st	1681	0.3	41.9%	24.4%	0.6%	33.0%	0.1%	0.0%
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime)								
99.9th	2	5.6	32.9%	19.2%	20.5%	26.0%	1.3%	0.1%
99.5th	8	4.4	40.4%	23.5%	3.9%	31.9%	0.4%	0.0%
99th	17	3.9	37.0%	21.6%	11.3%	29.2%	0.9%	0.0%
95th	85	2.8	37.5%	21.9%	10.4%	29.6%	0.5%	0.0%
90th	170	2.4	40.1%	23.3%	4.5%	31.6%	0.4%	0.0%
75th	425	1.8	38.7%	22.5%	7.7%	30.5%	0.5%	0.0%
Median	849	1.3	41.7%	24.3%	0.9%	32.9%	0.1%	0.0%
25th	1274	0.9	39.9%	23.2%	5.1%	31.4%	0.4%	0.0%
1st	1681	0.4	41.3%	24.0%	1.9%	32.6%	0.2%	0.0%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-30. Secondary Pb Smelter Case Study: Alternative NAAQS 2 (0.5 µg/m^3, Maximum Monthly Average) – Estimated PbB Levels

PbB Percentile	Population Above	Predicted PbB (µg/dL)	Pathway Contribution					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [a]	Recent Air	
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent)								
99.9th	2	5.2	15.2%	8.8%	51.5%	12.0%	11.9%	0.7%
99.5th	8	3.9	40.1%	23.3%	4.2%	31.6%	0.7%	0.0%
99th	17	3.4	41.7%	24.3%	0.9%	32.9%	0.2%	0.0%
95th	85	2.4	35.0%	20.4%	14.9%	27.6%	2.1%	0.1%
90th	170	2.0	41.4%	24.1%	1.5%	32.7%	0.2%	0.0%
75th	425	1.4	39.2%	22.8%	6.2%	30.9%	0.8%	0.0%
Median	849	1.0	31.5%	18.4%	22.5%	24.9%	2.6%	0.1%
25th	1274	0.7	41.2%	24.0%	2.0%	32.5%	0.4%	0.0%
1st	1681	0.3	39.2%	22.8%	6.2%	30.9%	0.8%	0.0%
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime)								
99.9th	2	5.9	35.4%	20.6%	13.5%	28.0%	2.4%	0.1%
99.5th	8	4.5	39.0%	22.7%	6.2%	30.8%	1.1%	0.1%
99th	17	3.9	18.3%	10.6%	50.4%	14.4%	6.0%	0.3%
95th	85	2.8	39.1%	22.8%	6.2%	30.9%	1.0%	0.1%
90th	170	2.4	39.0%	22.7%	6.2%	30.8%	1.1%	0.1%
75th	425	1.8	41.7%	24.3%	0.9%	32.9%	0.2%	0.0%
Median	849	1.3	41.4%	24.1%	1.5%	32.7%	0.2%	0.0%
25th	1274	0.9	41.1%	23.9%	2.1%	32.4%	0.3%	0.0%
1st	1681	0.4	39.8%	23.2%	4.9%	31.4%	0.7%	0.0%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-31. Secondary Pb Smelter Case Study: Alternative NAAQS 3 (0.2 µg/m³, Maximum Monthly Average) – Estimated PbB Levels

PbB Percentile	Population Above	Predicted PbB (µg/dL)	Pathway Contribution					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [a]	Recent Air	
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent)								
99.9th	2	5.2	19.0%	11.1%	52.3%	15.0%	2.5%	0.1%
99.5th	8	3.9	41.8%	24.3%	0.8%	33.0%	0.1%	0.0%
99th	17	3.4	32.0%	18.6%	22.6%	25.2%	1.5%	0.1%
95th	85	2.4	33.9%	19.7%	18.3%	26.8%	1.2%	0.1%
90th	170	1.9	42.0%	24.5%	0.3%	33.2%	0.0%	0.0%
75th	425	1.4	39.4%	23.0%	6.1%	31.1%	0.4%	0.0%
Median	849	1.0	38.8%	22.6%	7.4%	30.7%	0.4%	0.0%
25th	1274	0.7	38.8%	22.6%	7.4%	30.7%	0.4%	0.0%
1st	1681	0.3	36.2%	21.1%	13.3%	28.5%	0.9%	0.1%
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime)								
99.9th	2	5.8	39.4%	23.0%	6.1%	31.1%	0.4%	0.0%
99.5th	8	4.5	37.6%	21.9%	10.4%	29.6%	0.4%	0.0%
99th	17	3.9	41.3%	24.1%	1.9%	32.6%	0.1%	0.0%
95th	85	2.8	41.3%	24.1%	1.9%	32.6%	0.1%	0.0%
90th	170	2.4	33.7%	19.6%	19.4%	26.6%	0.7%	0.0%
75th	425	1.8	38.6%	22.5%	7.9%	30.5%	0.5%	0.0%
Median	849	1.3	41.8%	24.4%	0.7%	33.0%	0.1%	0.0%
25th	1274	0.9	37.0%	21.5%	11.7%	29.2%	0.6%	0.0%
1st	1681	0.4	42.0%	24.5%	0.3%	33.1%	0.0%	0.0%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-32. Secondary Pb Smelter Case Study: Alternative NAAQS 4 (0.05 µg/m^3, Maximum Monthly Average) – Estimated PbB Levels

PbB Percentile	Population Above	Predicted PbB (µg/dL)	Pathway Contribution					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [a]	Recent Air	
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent)								
99.9th	2	5.1	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%
99.5th	8	3.9	41.8%	24.4%	0.8%	33.0%	0.0%	0.0%
99th	17	3.4	37.6%	21.9%	10.7%	29.7%	0.2%	0.0%
95th	85	2.4	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%
90th	170	1.9	17.1%	10.0%	58.0%	13.5%	1.3%	0.1%
75th	425	1.4	39.6%	23.0%	6.1%	31.2%	0.1%	0.0%
Median	849	1.0	39.8%	23.2%	5.5%	31.4%	0.1%	0.0%
25th	1274	0.7	41.8%	24.3%	0.8%	33.0%	0.0%	0.0%
1st	1681	0.3	37.6%	21.9%	10.7%	29.7%	0.2%	0.0%
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime)								
99.9th	2	5.7	40.2%	23.4%	4.6%	31.7%	0.1%	0.0%
99.5th	8	4.4	40.3%	23.5%	4.3%	31.8%	0.1%	0.0%
99th	17	3.9	39.5%	23.0%	6.3%	31.2%	0.1%	0.0%
95th	85	2.8	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%
90th	170	2.4	40.2%	23.4%	4.7%	31.7%	0.1%	0.0%
75th	425	1.8	39.8%	23.2%	5.5%	31.4%	0.1%	0.0%
Median	849	1.3	39.5%	23.0%	6.2%	31.2%	0.1%	0.0%
25th	1274	0.9	40.2%	23.4%	4.7%	31.7%	0.1%	0.0%
1st	1681	0.4	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

I.4.3. Ambient Air to PbB Ratios for the Secondary Pb Smelter Case Study

Exhibit I-33 through Exhibit I-37 show the ratio of ambient air Pb concentration to PbB estimates, where a ratio of 1:2.0 indicates that the PbB, estimated in µg/dL, is twice the ambient air concentration, estimated in µg/m^3. The ratios are calculated before the application of the GSD to the GM PbB values to account for inter-individual variability. And, as in the primary Pb smelter case study, the PbB estimates come from either the median or 99.5th percentile U.S. Census blocks or block groups (with regard to air concentration). All ratios are presented to one decimal place, which results in various numbers of implied significant figures (e.g., 1 to 5).[3] This is not intended to convey greater precision for some ratios than others; it is simply an expedient and initial result of the software used for the calculation. Greater attention is given to significant figures in the presentation of ratios in the main body of the report.

As in the other two case studies, ratios are provided for different pathway contributions to PbB. The first ratio (inhalation [recent air]) is for that portion of PbB estimated to be derived from inhalation of ambient air. The second (inhalation+ingestion [recent air]) is for the aggregate PbB estimated to result from inhalation of ambient air plus ingestion of the Pb in indoor dust that is predicted to be associated with ambient air Pb levels. The third (inhalation+ingestion [recent and past air]) is the aggregate PbB resulting from the inhalation of ambient air, the ingestion of indoor dust, and the ingestion of outdoor soil/dust.

The indoor dust model used to estimate indoor dust Pb concentrations in this case study does not distinguish Pb contributions to indoor dust other than that from recent ambient air Pb levels. This is because indoor paint, outdoor soil/dust and other sources are all represented by a single constant intercept in the model. Therefore, the third ratio includes contributions to PbB from indoor paint as well as recent ambient air Pb levels and recent plus past deposition of ambient air Pb to outdoor soil/dust. Accordingly, this ratio may be an overestimate of the relationship of ambient air Pb concentration to the portion of PbB derived from recent and past air sources.

[3] Similarly, the ambient air Pb concentration estimates are presented to three decimal places, resulting in various numbers of implied significant figures (e.g., 1 to 3). No difference in precision is intended to be conveyed; this is simply an expedient and initial result of the software used for presentation.

Exhibit I-33. Secondary Pb Smelter Case Study: Current Conditions Scenario (1.5 µg/m^3, Maximum Quarterly Average) – Ambient Air to PbB Ratios

Dust Model	Ambient Air Annual Average Pb Concentration (µg/m^3)		Air to PbB Ratios (µg/m^3 : µg/dL) with PbB Contribution from:		
			Inhalation (Recent Air) [a]	Inhalation +Ingestion (Recent Air) [a]	Inhalation +Ingestion (Recent and Past Air) [a,b]
Concurrent PbB Metric					
Air-only regression-based	Median	0.005	1 : 0.2	1 : 4.5	1 : 73.9
Air-only regression-based	99.5th Percentile	0.052	1 : 0.2	1 : 3.6	1 : 24.5
Lifetime PbB Metric					
Air-only regression-based	Median	0.003	1 : 0.3	1 : 5.9	1 : 184.8
Air-only regression-based	99.5th Percentile	0.052	1 : 0.3	1 : 5.1	1 : 34.9

[a] These results exclude application of the GSD reflecting inter-individual variability in Pb exposure and biokinetics.
[b] "Past air" includes contributions from outdoor soil/dust contribution to indoor dust, historical air contribution to indoor dust, and outdoor soil/dust pathways, and "recent air" refers to contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-34. Secondary Pb Smelter Case Study: Alternative NAAQS 1 (0.2 µg/m³, Maximum Quarterly Average) – Ambient Air to PbB Ratios

Dust Model	Ambient Air Annual Average Pb Concentration (µg/m³)		Air to PbB Ratios (µg/m³ : µg/dL) with PbB Contribution from:		
			Inhalation (Recent Air) [a]	Inhalation +Ingestion (Recent Air) [a]	Inhalation +Ingestion (Recent and Past Air) [a,b]
Concurrent PbB Metric					
Air-only regression-based	Median	0.001	1 : 0.2	1 : 4.5	1 : 264.1
Air-only regression-based	99.5th Percentile	0.014	1 : 0.2	1 : 3.6	1 : 81.2
Lifetime PbB Metric					
Air-only regression-based	Median	0.001	1 : 0.3	1 : 5.9	1 : 344.2
Air-only regression-based	99.5th Percentile	0.014	1 : 0.3	1 : 5.1	1 : 115.2

[a] These results exclude application of the GSD reflecting inter-individual variability in Pb exposure and biokinetics.
[b] "Past air" includes contributions from outdoor soil/dust contribution to indoor dust, historical air contribution to indoor dust, and outdoor soil/dust pathways, and "recent air" refers to contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-35. Secondary Pb Smelter Case Study: Alternative NAAQS 2 (0.5 µg/m³, Maximum Monthly Average) – Ambient Air to PbB Ratios

Dust Model	Ambient Air Annual Average Pb Concentration (µg/m³)		Air to PbB Ratios (µg/m³ : µg/dL) with PbB Contribution from:		
			Inhalation (Recent Air) [a]	Inhalation +Ingestion (Recent Air) [a]	Inhalation +Ingestion (Recent and Past Air) [a,b]
Concurrent PbB Metric					
Air-only regression-based	Median	0.003	1 : 0.2	1 : 4.5	1 : 127.7
Air-only regression-based	99.5th Percentile	0.029	1 : 0.2	1 : 3.6	1 : 40.6
Lifetime PbB Metric					
Air-only regression-based	Median	0.002	1 : 0.3	1 : 5.9	1 : 238
Air-only regression-based	99.5th Percentile	0.029	1 : 0.3	1 : 5.1	1 : 57.9

[a] These results exclude application of the GSD reflecting inter-individual variability in Pb exposure and biokinetics.

[b] "Past air" includes contributions from outdoor soil/dust contribution to indoor dust, historical air contribution to indoor dust, and outdoor soil/dust pathways, and "recent air" refers to contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-36. Secondary Pb Smelter Case Study: Alternative NAAQS 3 (0.2 µg/m^3, Maximum Monthly Average) – Ambient Air to PbB Ratios

Dust Model	Ambient Air Annual Average Pb Concentration (µg/m^3)		Air to PbB Ratios (µg/m^3 : µg/dL) with PbB Contribution from:		
			Inhalation (Recent Air) [a]	Inhalation +Ingestion (Recent Air) [a]	Inhalation +Ingestion (Recent and Past Air) [a,b]
Concurrent PbB Metric					
Air-only regression-based	Median	0.001	1 : 0.2	1 : 4.5	1 : 315.1
Air-only regression-based	99.5th Percentile	0.012	1 : 0.2	1 : 3.6	1 : 96.3
Lifetime PbB Metric					
Air-only regression-based	Median	0.001	1 : 0.3	1 : 5.9	1 : 410.7
Air-only regression-based	99.5th Percentile	0.012	1 : 0.3	1 : 5.1	1 : 136.5

[a] These results exclude application of the GSD reflecting inter-individual variability in Pb exposure and biokinetics.

[b] "Past air" includes contributions from outdoor soil/dust contribution to indoor dust, historical air contribution to indoor dust, and outdoor soil/dust pathways, and "recent air" refers to contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit I-37. Secondary Pb Smelter Case Study: Alternative NAAQS 4 (0.05 µg/m³, Maximum Monthly Average) – Ambient Air to PbB Ratios

Dust Model	Ambient Air Annual Average Pb Concentration (µg/m³)		Air to PbB Ratios (µg/m³ : µg/dL) with PbB Contribution from: Inhalation (Recent Air) [a]	Inhalation +Ingestion (Recent Air) [a]	Inhalation +Ingestion (Recent and Past Air) [a,b]
Concurrent PbB Metric					
Air-only regression-based	Median	0.000	1 : 0.2	1 : 4.5	1 : 1780.5
Air-only regression-based	99.5th Percentile	0.003	1 : 0.2	1 : 3.6	1 : 373.5
Lifetime PbB Metric					
Air-only regression-based	Median	0.000	1 : 0.3	1 : 5.9	1 : 2864.7
Air-only regression-based	99.5th Percentile	0.003	1 : 0.3	1 : 5.1	1 : 529.9

[a] These results exclude application of the GSD reflecting inter-individual variability in Pb exposure and biokinetics.
[b] "Past air" includes contributions from outdoor soil/dust contribution to indoor dust, historical air contribution to indoor dust, and outdoor soil/dust pathways, and "recent air" refers to contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

REFERENCES

U.S. Census Bureau. (2005) United States Census 2000: Summary File 1. Public Information Office. Available online at: http://www.census.gov/Press-Release/www/2001/sumfile1.html.

U.S. Environmental Protection Agency (USEPA). (2006) Air Quality Criteria for Lead (Final). Volume I and II. Research Triangle Park, NC: National Center for Environmental Assessment; EPA/600/R-05/144aF-bF. Available online at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=158823.

July 25, 2007

Appendix J: Performance Evaluation of Blood Pb (PbB) Models

Prepared by:

ICF International
Research Triangle Park, NC

Prepared for:

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina

Contract No. EP-D-06-115
Work Assignment No. 0-4

Table of Contents

List of Exhibits

J. PERFORMANCE EVALUATION OF BLOOD PB MODELS

This appendix presents the results of performance evaluation analyses of the models used to estimate blood Pb (PbB) levels in this assessment. Section J.1 describes the relative performance of two biokinetic models when applied to a range of exposure scenarios for individuals and for populations of children exposed to Pb. The two models are the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) (hereafter referred to as the "IEUBK model") (USEPA, 1994) and the International Commission for Radiation Protection (ICRP) model (hereafter referred to as the "Leggett model") (Leggett, 1993). Both models are well-documented, widely used, and have been subject to a range of testing and calibration exercises (see Section 4.4 of USEPA [(2006)]). Section J.2 describes the performance of the "empirical" model (hereafter referred to as the "Lanphear model"), which includes children 6 to 24 months of age (Lanphear et al., 1998). Section J.3 describes the performance of the biokinetic and empirical models when applied to selected populations of children exposed to Pb and Section J.4 summarizes the results of the performance analysis.

J.1. EVALUATION OF BIOKINETIC MODELS (IEUBK AND LEGGETT): BLOOD PB PREDICTIONS FOR INDIVIDUAL CHILDREN

The performance of the two biokinetic models, IEUBK and Leggett, was evaluated by comparing the PbB predictions from each model to results obtained previously by the U.S. EPA and other investigators when the models were tested using specific exposure scenarios. The purpose of this evaluation was to ensure that the model results were consistent with previous calibration results.

J.1.1. Exposure Scenarios

The following three exposure scenarios were used to examine the performance of the two biokinetic models:

- Scenario 1: This scenario compared the predicted PbB levels in two- to three-year-old children in response to a range of constant Pb uptakes from 0.1 to 100 micrograms (µg) per day. This scenario is described on page 4-122 and is illustrated in Figure 4-32 of the U.S. EPA Air Quality Criteria Document for Lead (USEPA, 2006). The primary output measure from this scenario is the slope of the relationship between estimated PbB at age three years and Pb uptake in the low-dose range (0 to 10 µg/day), where the model responses are very nearly linear. Estimates of the daily Pb uptake were also compared, which resulted in a predicted average PbB level of 10 µg per deciliter (dL), and a predicted PbB level associated with 100 µg/day Pb uptake. This scenario provides a straightforward test of the biokinetic components of the models because it bypasses assumptions related to Pb absorption from different media. In the Leggett model, Pb was assumed to directly enter the blood stream, as described below. In the IEUBK model, Pb uptake occurs through the ingestion pathway with an assumed ingestion absorption fraction (AFI) value of 1.0 (or 100 percent absorption), or through the "alternative" pathway, also with 100 percent absorption.

- Scenario 2: In this scenario, a constant Pb uptake is assumed to begin at birth, resulting in a PbB level of 2.0 µg/dL at two years of age. At age two, Pb "exposure" (actually, oral intake) is increased by 100 µg/day for one year. This scenario is described in the U.S. EPA Air Quality Criteria Document for Lead (USEPA, 2006; page 4-127, Figure 4-35). Consistent with the description in the legend for Figure 4-32 of the U.S. EPA Air Quality Criteria Document for Lead, "default bioavailability assumptions" were used (USEPA, 2006). The default was interpreted to be the Leggett default age-specific AFI values for children from birth through three years of age, which is 45 percent from birth through age 100 days, decreasing linearly to 30 percent by one year of age, and remaining at 30 percent through childhood (USEPA, 2006). For the IEUBK runs, the default absorption factor for outdoor soil/dust and indoor dust (30 percent) was used.

- Scenario 3: Scenario 3 is a multi-pathway exposure scenario, described by Pounds and Leggett (1998). This exposure scenario was derived from the IEUBK default exposure concentration and exposure/uptake/intake factor values, as defined in the U.S. EPA 1994 Technical Support Document (USEPA, 1994). In their study, Pounds and Leggett used the IEUBK default values to derive annual average Pb intake and uptake estimates for seven one-year age ranges beginning at birth. Exposure sources included diet, drinking water, outdoor soil/dust, and indoor dust. Two sets of model inputs were developed for the Leggett model: one set was the Pb intake estimates derived from the IEUBK defaults, and the other set was the Pb uptake estimates corresponding to the same set of exposures. In reproducing these two sets of estimates (see below), the age-specific Pb intakes were input to the model using the default age-specific AFI values described in Scenario 2. Pb uptake for input to the Leggett models was assumed to occur either directly into the blood stream or by ingestion with 100 percent gastrointestinal (GI) absorption. All IEUBK model inputs were maintained at their default values, except for indoor dust Pb concentration, which was set to 200 µg per gram (g), consistent with the value that Pounds and Leggett assumed.

J.1.2. Model Setup

Dr. Joel Pounds of Battelle Pacific Northwest Laboratories provided the Leggett model FORTRAN code. The code (Pounds, 2000) was imported into the Digital Visual FORTRAN® compiler and compiled into an .exe file that could be run from Windows®. The original input and output file formats were preserved. A batch version of the model (also in FORTRAN) was also created that repeatedly called the original model code as a subroutine, passing results to various sets of ingestion and inhalation Pb intake or uptake estimates for each age range. No other features were added to the batch version of the model.

In both FORTRAN versions, the assumption that all ingested Pb was absorbed with the same efficiency was maintained (i.e., only a single AFI value applies to all ingested Pb).

Therefore, to evaluate PbB impacts of multi-source scenarios (involving, for example, dietary, drinking water, and outdoor soil/dust exposures), calculating Pb uptake (input to the GI tract or blood stream) external to the model was necessary, so that a single "ingestion" intake or uptake value could be provided for each age interval evaluated.

For simplicity, age-specific Pb inputs to the Leggett model were specified in one of two ways: (1) as ingestion uptake values, assigning a constant value of 100 percent to the GI absorption fraction; or (2) by using the "chronic" exposure pathway of the model, in which all uptake is assumed to enter the blood/extra-vascular fluid compartment instantaneously. These two approaches resulted in nearly identical PbB estimates, except for the first iterations following large changes in exposures. In these cases, slightly more rapid increases in PbB levels occurred in the "chronic" pathway than in other compartments. All biokinetic modeling parameters and age ranges were maintained exactly as in the default input file Dr. Pounds provided. In all tests performed, the batch version of the Leggett model generated identical results to the off-the-shelf version (Pounds, 2000).

Also as part of the testing process, the effects of using different simulation time steps in the Leggett model were examined. In all scenarios tested, time steps shorter than 0.1 day resulted in nearly identical results, except in the first few iterations of each run. The differences essentially disappeared for time steps of 0.01 days or less. Therefore, a constant iteration step of 0.01 days was used for all Leggett model testing. The default time step of 4 hours was used in all IEUBK runs.

To reproduce comparisons with the IEUBK results, the U.S. EPA IEUBKwin32 model Version 1.0©, build 261, was used. Both single-run and batch model results were used, with input parameter values specified as discussed below.

J.1.3. Performance Evaluation Results

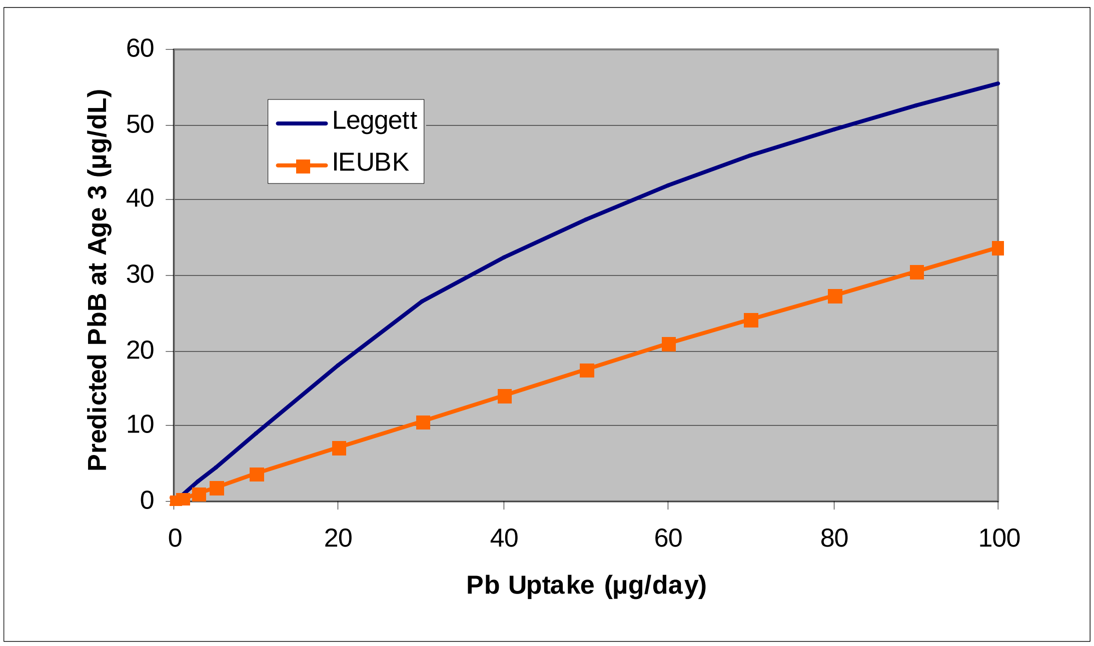
J.1.3.1. Scenario 1: Change in Predicted PbB with Increasing Pb Uptake

The FORTRAN version of the Leggett model, in response to varying Pb uptake levels between 1.0 and 100 µg/dL, produced results that were very similar to those presented in the U.S. EPA Air Quality Criteria Document for Lead (see Exhibit J-1 and Figure 4-32 from the U.S. EPA Air Quality Criteria Document for Lead). In the uptake range of 0.1 to 10 µg/day, an increase in Pb uptake of 0.90 µg/dL per 1.0 µg/day was estimated between the ages of two and three years, which corresponds to 0.88 µg/dL per µg/day in Pb uptake reported in the U.S. EPA Air Quality Criteria Document for Lead (USEPA, 2006). The U.S. EPA Air Quality Criteria Document for Lead reported that a 10 µg/dL PbB level would result from a 12 µg/day Pb uptake.

Based on the Leggett modeling results, a value of 11.1 µg/day was calculated. The PbB concentration associated with 100 µg/day Pb uptake in Figure 4-31 of the U.S. EPA Air Quality Criteria Document for Lead is around 55 µg/dL (the axes of the chart are not labeled clearly); the corresponding value predicted by the Leggett model was 55.4 µg/dL.

Initially, the PbB levels predicted using the IEUBK model differed slightly from the results presented in the U.S. EPA Air Quality Criteria Document for Lead (USEPA, 2006), in that the results of this assessment show a slight downward curvature with increasing Pb uptake. However, essentially identical PbB predictions were obtained if the nonlinear uptake module in the IEUBK was bypassed by setting the “Fraction Passive” input value to 1.0 (100 percent). It was assumed that the U.S. EPA Office of Research and Development (ORD) also overrode this module in their performance analysis, given the lack of curvature demonstrated in the PbB-Pb uptake plot in the U.S. EPA Air Quality Criteria Document for Lead (USEPA, 2006; Figure 4-32), which is reproduced by the results in Exhibit J-1.

Exhibit J-1. Predicted PbB at Age 3 Years versus Pb Intake



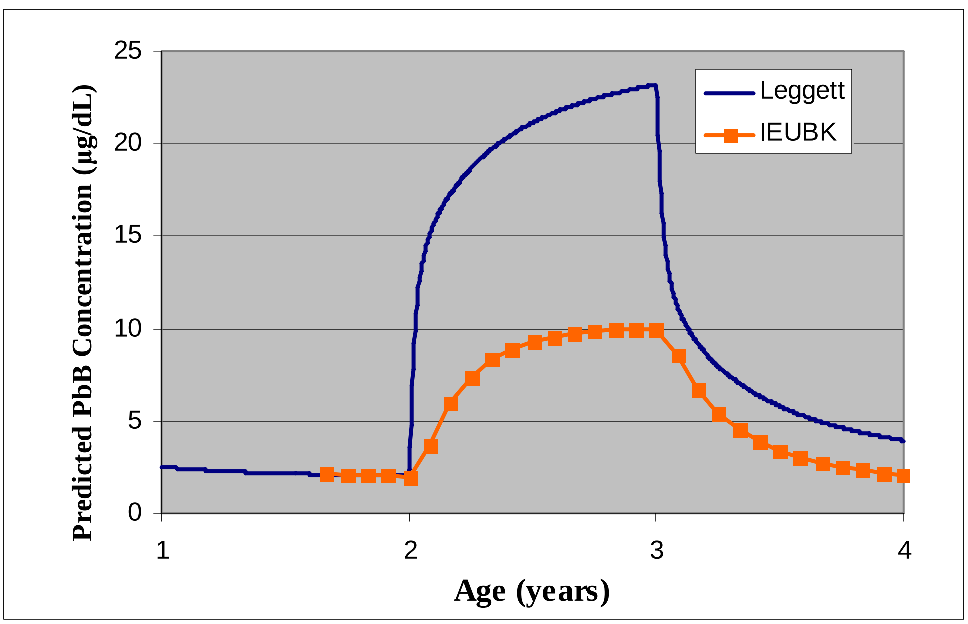
From the IEUBK runs, a PbB-Pb uptake slope of 0.36 µg/dL per µg/day uptake was estimated, which is identical to the value reported in the U.S. EPA Air Quality Criteria Document for Lead. A Pb uptake of 27 µg/day corresponded to an estimated PbB level of 10 µg/dL for a three-year old, close to the value of 29 µg/day reported in the Criteria Document for Lead (USEPA, 2006). The IEUBK estimated PbB at 100 µg/day uptake was 33.7 µg/dL; the corresponding value from the U.S. EPA Air Quality Criteria Document for Lead figure is approximately 33 µg/dL.

The results presented here closely agree with the results of the Leggett and IEUBK model comparisons reported in the U.S. EPA Air Quality Criteria Document for Lead. The reasons for the small differences between these results and those in the U.S. EPA Air Quality Criteria Document for Lead are unclear, but they could include minor differences in the specification of model inputs, limitations in machine precision, or rounding error. As mentioned above, identical results were obtained with the off-the-shelf and batch versions of the FORTRAN version of the Leggett model.

J.1.3.2. Scenario 2: Leggett and IEUBK Model Responses to Episodic High Exposure

As noted above, the second scenario examined the Leggett and IEUBK model response to a sudden increase in Pb exposure beginning at two years of age. As shown in Exhibit J-2, the results obtained using the FORTRAN version of the Leggett model are indistinguishable from those presented in Figure 4-32 of the U.S. EPA Air Quality Criteria Document for Lead. When the U.S. EPA ran this scenario through the Leggett model, the peak PbB achieved at age three years was 23 µg/dL. The corresponding result with the FORTRAN Leggett model was 23.2 µg/dL. The maximum PbB predicted by the IEUBK model (10.0 µg/dL) also precisely matched the results presented in the U.S. EPA Air Quality Criteria Document for Lead.

Exhibit J-2. FORTRAN Leggett Model Predicted PbB Response to a 1 Year Increase in Pb Intake of 100 µg/day Starting at Age 2



J.1.3.3. Scenario 3: IEUBK Default Multipathway Exposure Scenario

To compare results from the Leggett and IEUBK models, Pounds and Leggett (1998) constructed an exposure scenario for children 0 to 7 years of age based on the default input parameter values for the IEUBK model. For each age group, they estimated Pb intake (administered dose) and uptake (absorbed dose) using IEUBK default exposure concentrations, behavioral variables, and absorption fractions. The IEUBK model was run using the default values and the estimated annual average PbB for children from birth through age 7 years served as the basis for comparison with the Leggett model predictions.

Pounds and Leggett (1998) ran the Leggett model using two different sets of intakes. First, the uptake values were used as direct inputs to the biokinetic algorithms. Second, they used the calculated Pb intake values as inputs, apparently applying the Leggett model default AFI values to the summed intakes. (Note that the exact methods used to calculate uptake are not well documented). Exhibit J-3 displays the intake and uptake estimates from Pounds and Leggett (1998).

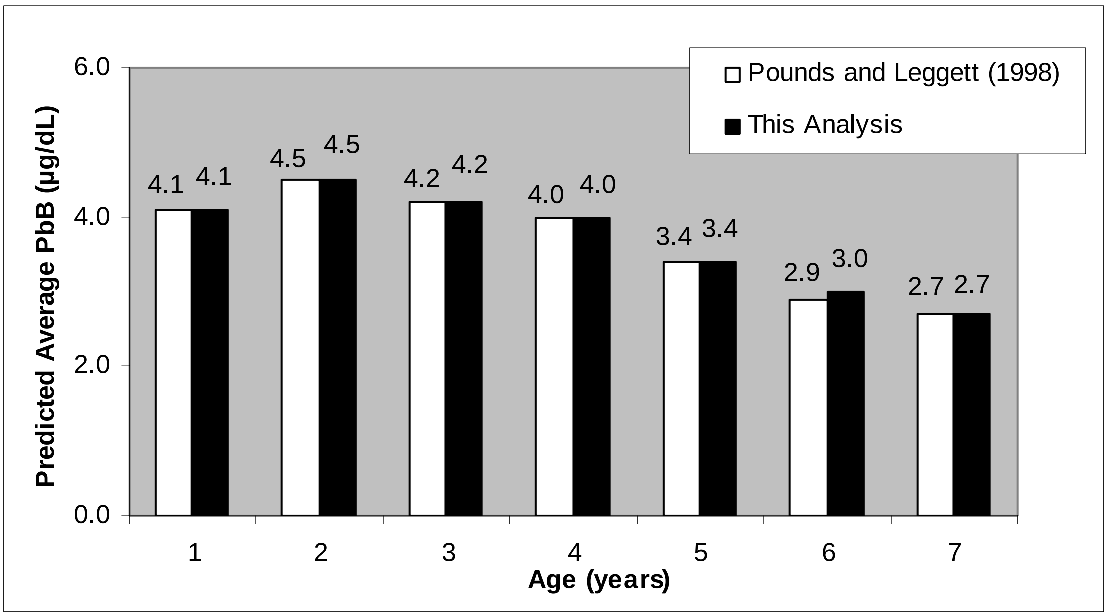
Exhibit J-3. Estimated Age-Specific Pb Intakes and Uptakes Derived Based on the IEUBK Default Input Parameters

Source of Exposure	Age Range (months)						
	6 to 12	12 to 23	24 to 35	36 to 47	48 to 59	60 to 71	72 to 84
Default Intake, µg/day							
Air	0.07	0.11	0.19	0.21	0.21	0.29	0.29
Diet	5.53	5.78	6.49	6.24	6.01	6.34	7.00
Drinking Water	0.80	2.00	2.08	2.12	2.20	2.32	2.36
Outdoor Soil/Dust	7.65	12.15	12.15	12.15	9.00	8.10	7.65
Indoor Dust	9.35	14.85	14.85	14.85	11.00	9.90	9.35
Pb Paint	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Intake	23.40	34.89	35.76	35.57	28.42	26.95	26.65
Default Uptake, µg/day							
Air	0.02	0.04	0.06	0.07	0.07	0.09	0.09
Diet	2.54	2.63	2.98	2.90	2.86	3.03	3.36
Drinking Water	0.37	0.91	0.96	0.99	1.04	1.11	1.13
Outdoor Soil/Dust + Indoor Dust	4.68	7.36	7.44	7.53	5.69	5.16	4.89
Pb Paint	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Uptake	7.59	10.90	11.38	11.42	9.58	9.30	9.30

Note: Data extracted from Pounds and Leggett (1998).

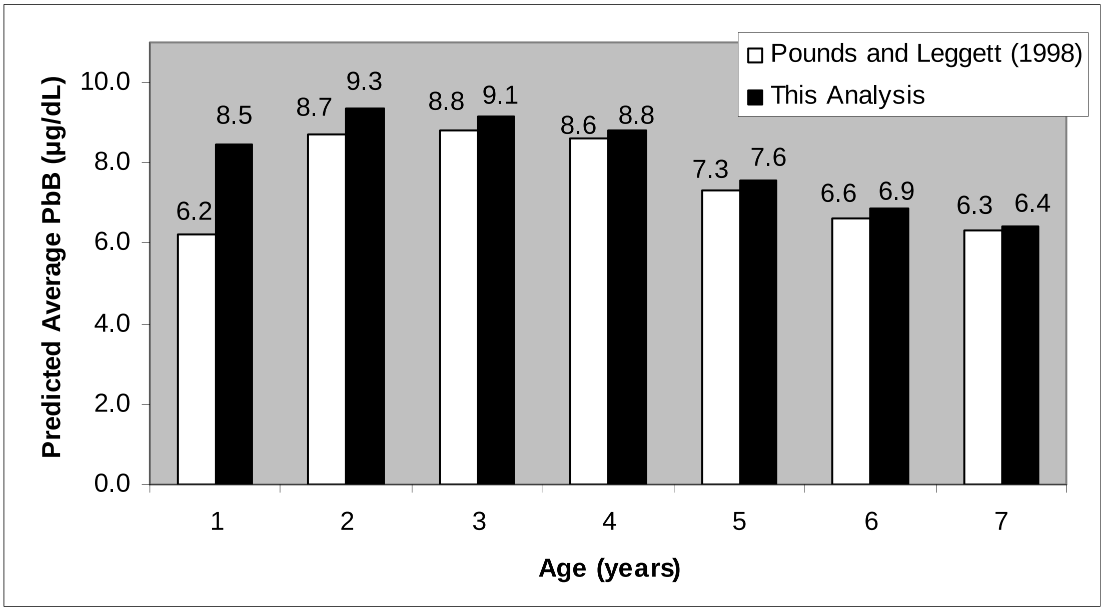
The Pounds and Leggett (1998) IEUBK exposure scenario estimates were reproduced by simply running the IEUBK with its default inputs, which have not changed since the 1994 Technical Support Document was issued. As noted above, the only input that was adjusted was the default indoor dust concentration, which was adjusted from 150 µg/g to 200 µg/g to yield intake values consistent with Pounds and Leggett (1998). As shown in Exhibit J-4, resulting PbB predictions were essentially identical to those reported by Pounds and Leggett (1998).

Exhibit J-4. Comparison of IEUBK PbB Predictions from the Pounds and Leggett (1998) Multi-Source Exposure Scenario with Results Obtained in this Analysis Using IEUBKwin32



When the Pb intake values from Exhibit J-3 were used as inputs to the Leggett model in this analysis, the results were generally similar to the Leggett model results obtained by Pounds and Leggett (see Exhibit J-5). Except for age “1,” which is defined by Pounds and Leggett as from birth to the first birthday, results presented here are very close to the values from the previous scenario. For infants less than 1 year old, the average PbB estimate is about 36 percent higher than the earlier estimate (8.5 versus 6.2 µg/dL) (Pounds and Leggett, 1998). Possible explanations for this rather large difference may be differing assumptions about very early exposure patterns and/or assumptions about when the averaging of PbB concentrations was initiated.

Exhibit J-5. Comparison of Leggett Model-Predicted Annual Average PbB Concentrations Obtained Based on the IEUBK Default Pb Intake Estimates with the Results of Pounds and Leggett (1998)



For older children, predicted PbB levels (based on intake) were very close to, but slightly higher than, the corresponding values Pounds and Leggett obtained. For age "2," the prediction is about 7 percent higher than the earlier estimate, and the difference decreases with age until age 7 when the difference is less than 2 percent. Given the inherent uncertainty in PbB modeling and potentially numerous subtle differences in the way the model could have been run, these results represent very good agreement.

When the calculated Pb uptake values from Exhibit J-3 were used as model inputs to the Leggett model, results differed substantially from those of Pounds and Leggett, even though they (presumably) used the same assumptions (see Exhibit J-6). For all age groups, predicted PbB levels in this analysis using the Leggett model are 26 to 43 percent higher than the Pounds and Leggett predictions. The reason for these differences is not clear. However, although the age-specific Pb intakes obtained were consistent with the default IEUBK input parameters, the pathway-specific or total Pb uptake (Pounds and Leggett, 1998) using the default values from the 1994 Technical Support Document (USEPA, 1994) were not. A more complete understanding of the differences in PbB predictions requires access to documentation of the exact approaches Pounds and Leggett used in deriving the intake and uptake estimates and in running the Leggett model. Given the close agreement between the intake-based results, however, the differences are almost certainly due to differences in model inputs, rather than significant differences in model performance.

Exhibit J-6. Comparison of Leggett Model-Predicted Annual Average PbB Concentrations Obtained Based on the IEUBK Default Pb Uptake Estimates with the Results of Pounds and Leggett (1998)

J.1.3.4. Summary of Biokinetic Model Performance on Defined Exposure Scenarios

IEUBK results reported in previous model comparisons were almost exactly replicated here using the newest version of the model. The low-dose PbB slope estimate for three-year-olds exactly matched the value reported in the U.S. EPA Air Quality Criteria Document for Lead, as did the maximum predicted PbB response to episodic high exposure beginning at age two. IEUBK estimates of annual average PbB estimates arising from the Pounds and Leggett (1998) multi-source scenario were also identical (within 0.1 µg/dL or less) to the previously reported values for all age groups. These results indicate that application of the IEUBK model is basically consistent with the approaches used in previous model comparisons.

In two of the three tests conducted, the FORTRAN version of the Leggett model generated PbB predictions that were close or identical to the results obtained in previous calibration and comparison exercises. The low-dose PbB slope for three-year-old children was within about two percent (0.90 versus 0.88 µg/dL per µg/day uptake) of the value reported in the U.S. EPA Air Quality Criteria Document for Lead (2006). The maximum predicted PbB level in response to a sudden increase for one year in exposure beginning at age two (23.2 µg/dL) was identical to that reported in the U.S. EPA Air Quality Criteria Document for Lead (23 µg/dL). Thus, when the exposure scenarios and intake/uptake assumptions are precisely duplicated, the FORTRAN version of the Leggett model appears to produce essentially the same results as the model when applied by other investigators.

Even when the exposure conditions are less well documented and more difficult to duplicate, results presented here for the Leggett model are similar to those obtained in previous analyses. As noted above, for similar age patterns of total Pb intake, results matched fairly closely (within seven percent, except for the youngest age group) those that Pounds and Leggett (1998) obtained in their model comparison. Larger differences from the Pounds and Leggett results were observed when uptake estimates were used as the basis for PbB prediction. As explained above, these differences are likely related to potential inconsistencies in the way Pb uptakes were calculated, rather than to differences in model performance per se.

Consistent with previous analyses, the Leggett model predicts PbB levels that are significantly higher than the IEUBK model levels for similar exposure scenarios. The Pb intake-PbB slope estimate derived from the Leggett model for exposure between ages two and three years was approximately 2.5 times higher than that derived using the IEUBK model. This difference is entirely due to differences in the biokinetic components of the two models, because PbB uptake (the dose entering the biokinetic modules) was the same for both models. Similarly, the Leggett prediction for the other two scenarios was 2.1 to 2.6 times greater than the IEUBK-predicted response for the same exposures.

J.2. EVALUATION OF LANPHEAR ET AL. (1998) EMPIRICAL BLOOD PB MODEL

Lanphear et al.(1998) reported on the results of analyzing the relationships among observed PbB levels in young children, socioeconomic and behavioral variables, and several Pb exposure metrics in indoor dust, outdoor soil/dust, Pb paint, and drinking water. The model was derived based on data from 12 United States epidemiologic studies of approximately 1,300 children, aged 6 months to 24 months, published between 1985 and 1996. Five of the studies focused on children in urban areas while the others focused on children living near Pb smelting or mining sites. Geometric mean (GM) PbB levels in the individual studies ranged from 1.92 μg/dL to 11.17 μg/dL; the GM PbB for the collective study population was 5.02 μg/dL.

In the best fitting (log-linear) model, wipe-dust Pb loading, outdoor soil/dust Pb concentration, exterior sample location, paint condition, race, mouthing behavior, and several interaction terms were significantly related to PbB. Lanphear et al.(1998) presented the results in look-up tables showing the predicted PbB concentrations, with covariates set to mean values, as a function of outdoor soil/dust Pb concentration and indoor dust Pb loading (Lanphear et al., 1998; Table 4). The results in these tables can easily be interpolated using multiple regressions to derive models to predict PbB in 16-month-olds (the mean age in the study population).

J.2.1. Performance and Limitations of the Lanphear PbB Model

The performance of the Lanphear model has not been compared to that of other PbB models to the same extent as the biokinetic models previously discussed. Although several other empirical models have been developed to predict children's PbB (USEPA, 2006; Section 4.4.2), variations in study populations, model structure, and input variables make model comparisons difficult.

For human exposure and health risk assessment, the Lanphear model has two distinct limitations. The first is that the model estimates PbB levels as a function of wipe-dust Pb loading, rather than Pb dust concentration, which is the dust Pb metric used by many biokinetic models (including the IEUBK and Leggett models). As discussed in Attachment G-1, deriving empirical estimates of dust Pb concentrations from dust Pb loading values using the few data sets that contain both measurements appears possible, but a substantial degree of uncertainty is introduced into the estimates of the exposure metrics. Furthermore, the Lanphear model estimates PbB levels for an infant of mean study age 16 months based on point estimates of outdoor soil/dust and indoor dust exposure, with no temporal variation. Thus, no dynamic component is incorporated, and the model cannot (except by averaging) predict PbB for situations where exposures change over time.

More importantly, the Lanphear model was derived based on data from infants and toddlers age 6 to 24 months and thus cannot be used to estimate PbB in older children. The Lanphear model predictions are for children near their expected peak PbB levels; these values cannot be directly compared to the lifetime and concurrent PbB metrics used in this assessment for estimating IQ decrement (presented in Appendix K). These reasons limit use of the Lanphear et al. (1998) model as a primary tool in this assessment. However, comparisons of the Lanphear model predictions with predictions of the biokinetic models are presented later in this appendix for a small cohort of young children with known dust Pb loading, dust Pb concentration, and PbB levels as a further check on the performance of the biokinetic models.

J.3. PREDICTION OF BLOOD PB MODELS COMPARED TO POPULATION BLOOD PB DATA

J.3.1. Comparison of Biokinetic Model Predictions to NHANES PbB Survey Data

The biokinetic models were further evaluated by comparing results (predicted PbB levels) to statistics from PbB surveys of large populations. The premise underlying this comparison was that, if the exposure factors and exposure concentrations used in the simulations were, in fact, representative of recent general population exposures, a finding of predicted age-

PbB profiles that were similar to the reported general population PbB profiles would increase confidence in the ability of the models to capture impacts of changes in aggregate Pb intakes.

The model predictions were compared to data from the NHANES surveys conducted from 1999 to 2002 (USEPA, 2006) and data from the National Human Exposure Assessment Survey (NHEXAS) (USEPA, 2004) that measured children's PbB concentrations in three areas of the United States in 1994. The biokinetic model simulations relied on the exposure factor values, drinking water Pb concentrations and age-specific dietary Pb intake values used in this risk assessment (Appendix H). Two sets of model outputs, based on two sets of indoor dust and outdoor soil/dust Pb concentrations (see below) were generated for comparison to the PbB survey data. Additionally an ambient air concentration of 0.06 microgram per cubic meter (μg/m^3) was assumed for the inhalation exposure pathway, which contributed little to overall Pb intake compared to the other pathways.

Two sets of "typical" indoor dust and outdoor soil/dust Pb concentrations were derived for use in the simulations. The first set consisted of the population-weighted GM indoor dust and outdoor soil/dust Pb concentrations from the Housing and Urban Development (HUD) National Survey data (86 and 200 μg/g, respectively) (USEPA, 1996).[1] See Appendix G for a more detailed discussion of the HUD Survey data. The second set of outdoor soil/dust and indoor dust concentration estimates was derived from data gathered during the NHEXAS. Weighted GM soil/dust (56 μg/g) and dust Pb (162 μg/g) concentrations from the combined NHEXAS study areas (Arizona; Baltimore, Maryland; and Region 5) were input into the IEUBK and Leggett models to simulate typical children's exposures.

The IEUBK and Leggett models were run using both sets of outdoor soil/dust and indoor dust inputs, and the other inputs described above, to generate age profiles of estimated PbB concentrations. The results are summarized in Exhibit J-7.

---

[1] Data on the relationship between dust Pb loading and Pb concentration was gathered as part of the HUD National Survey of Lead-Based Paint in Housing conducted between November 1989 and 1990 (USEPA, 1995). The goal of the survey was to obtain information on the presence and condition of Pb paint, outdoor soil/dust and indoor dust Pb loading and Pb concentrations, as well as other household data, from a representative national sample of 300 private homes and 100 public housing facilities. The data used to estimate outdoor soil/dust and indoor dust Pb concentration in this analysis came from 284 private households that were ultimately sampled during the survey.

Exhibit J-7. Comparison of Biokinetic Model PbB Predictions to PbB Survey Data

PbB Levels from Biokinetic Models or Survey Data by Age in Months		PbB Levels (µg/dL)
Age 13 to 24 Months		
GM PbB Levels from Survey Data	NHANES IV 1999 to 2000 [a]	2.5
PbB Levels Predicted by Biokinetic Models	Leggett (NHEXAS, outdoor soil/dust and indoor dust)	6.9
	Leggett (HUD, outdoor soil/dust and indoor dust)	9.4
	IEUBK (NHEXAS, outdoor soil/dust and indoor dust)	2.5
	IEUBK (HUD Survey, outdoor soil/dust and indoor dust)	3.4
Age 13 to 60 Months		
GM PbB Levels from Survey Data	NHANES IV 1999 to 2000 [b]	2.2
	NHANES IV 2001 to 2002 [b]	1.7
PbB Levels Predicted by Biokinetic Models	Leggett (NHEXAS, outdoor soil/dust and indoor dust)	6.7
	Leggett (HUD, outdoor soil/dust and indoor dust)	9.2
	IEUBK (NHEXAS, outdoor soil/dust and indoor dust)	2.2
	IEUBK (HUD Survey, outdoor soil/dust and indoor dust)	3.0
Age 37 to 84 Months		
GM PbB Levels from Survey Data	NHEXAS IV 1994	2.1
PbB Levels Predicted by Biokinetic Models	Leggett (NHEXAS, outdoor soil/dust and indoor dust)	5.9
	Leggett (HUD, outdoor soil/dust and indoor dust)	8.1
	IEUBK (NHEXAS, outdoor soil/dust and indoor dust)	1.7
	IEUBK (HUD Survey, outdoor soil/dust and indoor dust)	2.3

[a] Data extracted from Hattis (2006).
[b] Data extracted from U.S. EPA (2006; Table 4.4).

Exhibit J-7 shows that the IEUBK model PbB concentrations were much closer to the NHANES IV GM than those of the Leggett model. Using the lower NHEXAS outdoor soil/dust and indoor dust Pb concentration data, the PbB level for the youngest children (ages 13 to 24 months) predicted by IEUBK matched the NHANES age GM value for the same age group of 2.5 µg/dL. The predicted PbB levels for children ages one through five years of age (2.2 or 3.0 µg/dL, depending on the assumed outdoor soil/dust and indoor dust Pb concentrations) were somewhat lower than the GM values for children in the same age range (2.2 µg/dL and 1.7 µg/dL) seen in the 1999 to 2000 and 2001 to 2002 NHANES data, respectively. The same pattern was seen when the age-averaged PbB predictions for older children (age 37 to 84 months) are compared to survey data. The IEUBK model predictions were very close to the GM values derived from the survey data, while the Leggett predictions were much higher.

When the higher GM indoor dust and outdoor soil/dust Pb concentrations from the HUD National Survey are used as inputs to the IEUBK model, the predicted PbB levels for young children are higher than the GM values from the NHANES IV. The IEUBK blood predictions decrease from 3.4 μg/dL for a 13- to 24-month-old to 2.4 μg/dL for a 49- to 60-month-old, compared to NHANES GM PbB estimates for one- through five-year-olds of 2.2 μg/dL (1999 to 2000) and 1.7 μg/dL (2001 to 2002).

The ratio of Leggett predictions to survey GM PbB values ranges from 2.74 to 5.41 depending on the age group and assumed indoor dust and outdoor soil/dust Pb concentrations.

Using the GM indoor dust loading and outdoor soil/dust Pb concentration from the HUD national survey as inputs to the Lanphear et al. (1998) empirical model results in a PbB estimate for a 16-month-old of 5.1 μg/dL. This estimate is roughly twice the observed GM value from the NHANES IV (1999-2000) data for ages 13 to 24 months, but as high as that obtained with the Leggett model for that age group.

J.3.2. Comparison of Predicted PbB Concentrations to Measured PbB Values from an Urban Cohort

As the final test of model performance, the predicted PbB levels from the IEUBK, Leggett, and Lanphear models were compared to measured PbB levels in a cohort of young children for whom Pb outdoor soil/dust and indoor dust exposures have been well characterized.

J.3.2.1. Overview of the Data Set

Data relating to PbB levels, outdoor soil/dust Pb concentrations, indoor dust Pb concentrations, and loading for a cohort of 204 children who had been the subjects of a previous epidemiological investigation were obtained from Dr. Bruce Lanphear (Lanphear et al., 1995; Lanphear and Roghmann, 1997). The purpose of the study was to measure the levels of Pb in outdoor soil/dust, indoor dust, paint, drinking water and PbB levels among children who had lived at the same address in Rochester, New York, since six months of age. PbB and environmental sampling were conducted in 1991 through 1994, when the children were between12 to 30 months old. Also included in the data set were a number of variables related to socioeconomic status, ethnicity, and income level. This cohort was one of the 12 (Lanphear et al., 1998) later used to derive the previously discussed empirical model for predicting PbB from outdoor soil/dust concentration and indoor dust Pb loading.

Data were obtained as a SAS transport file; relevant variables were extracted to spreadsheets. Arithmetic and GM values of outdoor soil/dust Pb concentration, house floor dust loading, and house floor dust concentration values were derived for each sampled household. Dust loading and concentration values were included in calculations of summary statistics irrespective of floor covering type. Missing values were excluded from the calculation of average and GM values; all households had at least one outdoor soil/dust and indoor dust sample, and most had multiple samples. Outdoor soil/dust samples measured in the play yard, however, were available for only 86 of the 204 households. Single PbB measurements (means of triplicate analyses of the same sample) were also extracted from the SAS file.

J.3.2.2. Model Test Procedures

All three previously discussed models (the IEUBK and Leggett biokinetic models and the Lanphear empirical equation) were used to derive PbB estimates for individual children in the cohort. Estimates were derived using the outdoor soil/dust Pb, indoor dust loading, or indoor dust Pb concentration data reported for the households for each child as model inputs. Reported outdoor soil/dust concentrations measured in the play yard and the arithmetic mean indoor dust concentrations measured on the floor were used as inputs to the biokinetic models. Outdoor soil/dust concentrations measured in the play yard were found to be much more strongly correlated with PbB levels than perimeter [drip line] outdoor soil/dust Pb levels. Air concentration data were not collected in the study. One U.S. EPA Air Quality System (AQS) monitor collected total suspended particulate matter (TSP) during the sampling time period (January 1993 to June 1996) and within 50 kilometer (km) of the homes where indoor dust and outdoor soil/dust samples were collected (USEPA, 2007). Concentrations from this monitor were averaged from January 1993 to December 1996 to yield an average Pb air concentration of 0.035 $\mu g/m^3$. This value was used to approximate concentrations for input into the biokinetic models. As in the other PbB estimating exercises, ambient air Pb concentrations (used here only for the inhalation exposure pathway) contributed only a very small proportion of total Pb intake. Pb exposures from other pathways (diet, drinking water) were also simulated; the inputs and values for other exposure factors were described in Appendix H.

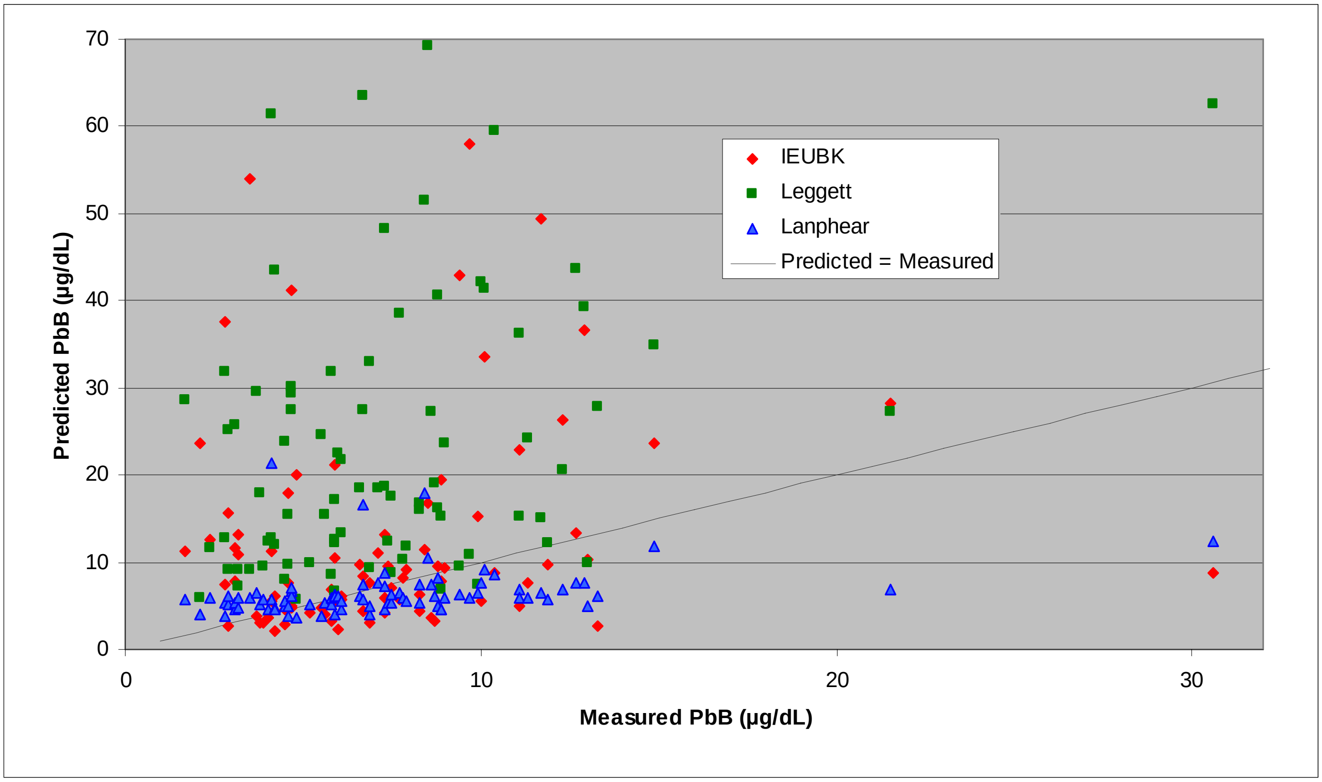
Biokinetic model PbB estimates for each child were the annual average PbB outputs for the age group corresponding to the child's age at the time of the PbB measurement (rounded to the nearest year (i.e., age groups one to two years or two to three years). Estimates were derived only for the 86 of the 204 children for whom play yard outdoor soil/dust Pb concentrations Pb concentrations had been measured, because, as noted above, outdoor soil/dust concentration in the play yard was found to be much more strongly correlated to measured PbB concentration than other outdoor soil/dust metrics. The estimates discussed below were derived using arithmetic mean indoor dust Pb concentrations, unless otherwise specified.

PbB estimates were also derived for the Lanphear et al. (1998) empirical model, using average play yard and indoor dust Pb loading values for the households where the children lived. The Lanphear model provides estimates of PbB concentrations for 16-month-olds (the mean age of children in the cohorts used to estimate the model). PbB concentrations from the model were not corrected for variation with age (the Lanphear et al. (1998) model results were compared to measured levels for all children, irrespective of the age at which PbB was measured) or for other covariates.

J.3.2.3. Model Evaluation Results

Exhibit J-8 provides a comparison of the relationship between the measured PbB concentrations (the x-axis) and PbB concentrations predicted (as described in Section J.3.2.2) for the same child (the y-axis). The black line corresponds to equality between the measured and predicted PbB levels (i.e., no prediction "error"). The strongest pattern visible is the large number of children for which the Leggett PbB predictions were very much higher than the measured PbB levels. Only two children had measured PbB levels greater than those predicted for them by the Leggett model.

Exhibit J-8. Comparison of Observed and Predicted PbB Concentrations for the Rochester, New York, Cohort



Note: IEUBK and Leggett predictions are for age of child associated with measured PbB value, while Lanphear predictions are based on children, age 16 months

A substantial proportion of the PbB levels predicted by the IEUBK model also fell well above the measured values. In contrast to the Leggett model, however, a cluster of IEUBK predicted PbB concentrations fell near or below the measured values. Finally, the bulk of the Lanphear PbB model predictions were near or below the corresponding measured PbB values. The slope of the Lanphear model predictions, however, appeared to be very small; compared to measured values PbB tends to have been over-predicted at low Pb levels and under-predicted at high Pb levels.

A more detailed breakdown of the PbB predictions for each model is presented in Exhibit J-9. In this exhibit, average measured and predicted PbB levels are shown for the entire cohort and for the cohort broken down by quintiles with regard to measured PbB levels. For the entire data set, the average PbB levels predicted by IEUBK (12.3 µg/dL) and Leggett (22.4 µg/dL) were substantially greater than the average measured PbB (7.3 µg/dL). The IEUBK predictions were on average about 70 percent greater than the corresponding measured values for the data set taken as a whole, while the PbB levels Leggett model predictions were on average 3.1 times greater. This pattern is consistent with the relative magnitude of IEUBK and Leggett predictions based on typical population exposures discussed in Section J.3.1.

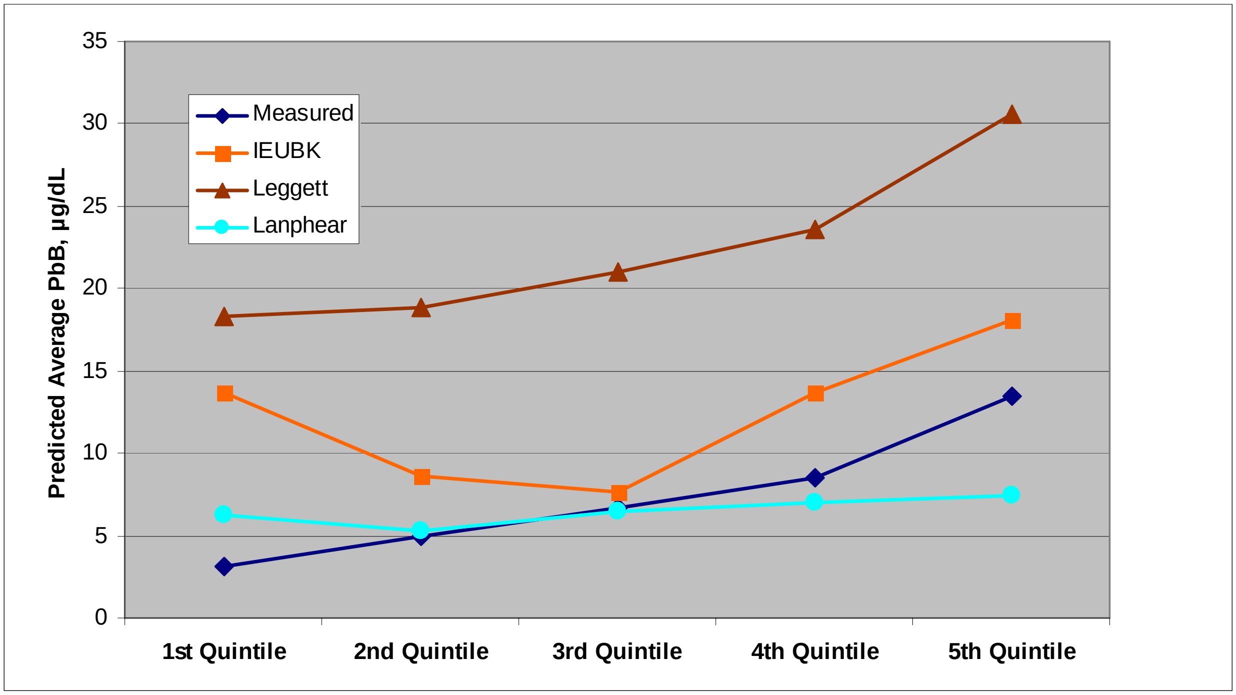
Exhibit J-9. Measured and Predicted PbB Levels for Subsets of the Rochester, New York, Cohort Data

Group	Measured	IEUBK	Leggett	Lanphear
Arithmetic Mean Measured/Estimated PbB (µg/dL)				
Whole Data Set	7.3	12.3	22.4	6.5
1st Quintile	3.1	13.7	18.3	6.2
2nd Quintile	4.9	8.6	18.9	5.3
3rd Quintile	6.7	7.6	21.0	6.5
4th Quintile	8.5	13.7	23.6	7.0
5th Quintile	13.5	18.1	30.6	7.5
Ratio of Prediction to Measured PbB (unitless)				
Whole Data Set	--	1.7	3.1	0.9
1st Quintile	--	4.4	5.9	2.0
2nd Quintile	--	1.8	3.8	1.1
3rd Quintile	--	1.1	3.1	1.0
4th Quintile	--	1.6	2.8	0.8
5th Quintile	--	1.3	2.3	0.6

Note: IEUBK and Leggett predictions are for age of child associated with measured PbB value, while Lanphear predictions are based on children, age 16 months

Exhibit J-10 provides a graphical summary of the data in Exhibit J-9. This exhibit clearly illustrates how much greater the average modeled Leggett PbB predictions were across all quintiles than the measured PbB levels for the same quintiles. Interestingly, however, the "slope" of the Leggett predictions across the quintiles was very similar to that seen in the observed average PbB levels.

Exhibit J-10. Comparison of Average PbB Predictions from the IEUBK, Leggett, and Lanphear Models with Measured PbB Levels from the Rochester Cohort



In contrast, PbB predictions from the IEUBK model did not increase monotonically across the measured PbB quintiles. Predicted PbB values for the two lowest quintiles were higher than the observed average PbB levels, but the IEUBK predictions for the three highest quintiles increased with a slope not very dissimilar from that seen in the data. As shown in Exhibit J-9, the IEUBK model over predicted PbB levels compared to the measured average values by between 30 to 60 percent for the two highest quintiles. Finally, it can be seen that the Lanphear model gave average PbB predictions that were, on the whole, closest to those seen in the Rochester data set. However, the “slope” across the quintiles was much lower than that seen in the data set.

Looking at the performance of the three models in predicting PbB levels for this data set, three distinct patterns can be seen. The Leggett model consistently and substantially over predicted average PbB relative to the observed data, but the change in predicted PbB levels across the quintiles was very close to that seen in the data set. This suggests that the low-exposure “intercept” of the Leggett model was set too high, while the “slope” (response to increasing Pb uptake) reproduced the pattern seen in the data quite well. In the case of the IEUBK model, it was hard to understand the pattern of PbB predictions that were seen for the two lowest quintiles. Based on the pattern shown in Exhibit J-10, it appeared that outdoor soil/dust and indoor dust Pb exposure levels associated with relatively low PbB levels in the data set were consistently being given undue weight in the model's exposure, intake and uptake modules, while at higher exposures, the outdoor soil/dust and indoor dust Pb intake values were weighted so as to given similar PbB increments as observed in the data set. Finally, while the Lanphear model yielded PbB predictions that most closely matched the observed quintile averages, in terms of absolute differences, it appeared that the response to increasing Pb uptake from outdoor soil/dust and indoor dust was weaker (the "slope" is shallower) than the pattern seen in the Rochester data set. Potential explanations for these patterns of model behavior are discussed in Section J.3.2.4.

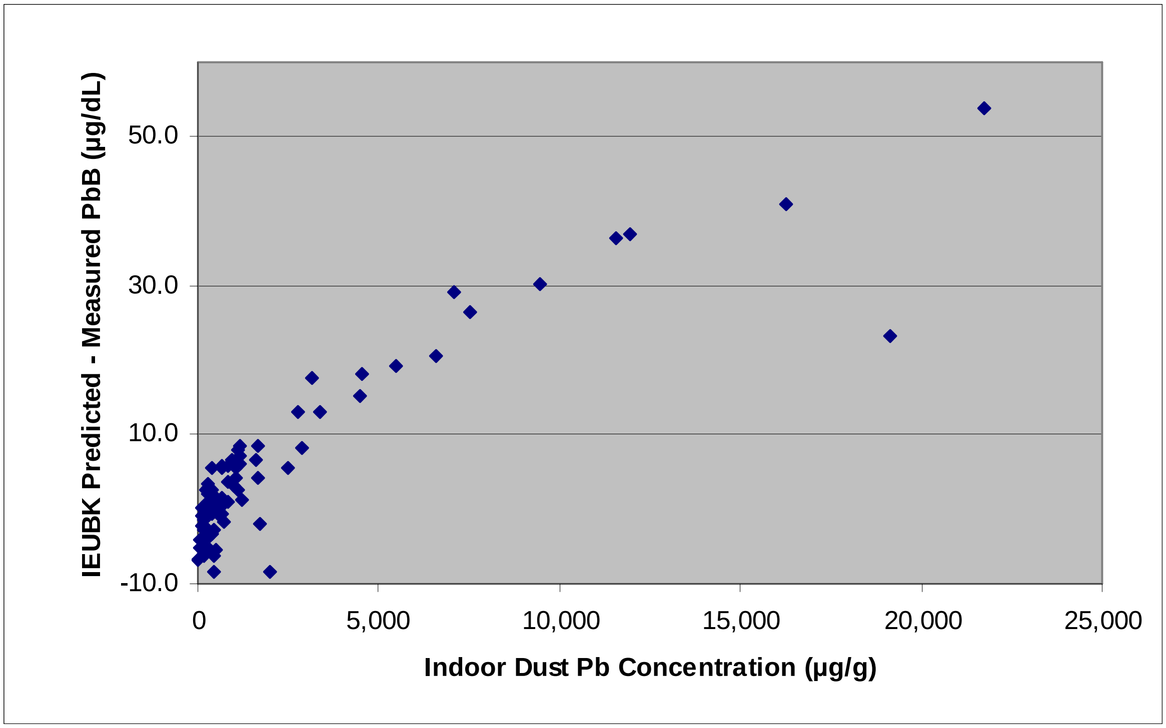
J.3.2.4. Explanation for the Discrepancies between Measured and Predicted PbB Concentrations

One issue that effected the evaluation of all of the models was the difficulty of estimating the contribution of inter-individual variability in exposures, and responses to Pb exposures, to the observed variability in measured PbB levels in the Rochester cohort. When the biokinetic models were applied to estimate PbB levels for children in this cohort, Pb exposure concentrations inputs were measurements at a single point in time which did not reflect potential temporal (e.g., seasonal) variability. Similarly, the uptake and biokinetic module parameters were single-valued estimates, and likewise did not reflect inter-individual differences in Pb absorption, deposition, and elimination. In the case of the Lanphear empirical model, variability in exposure, absorption, and responsiveness were "lumped" into the central tendency estimates of the model parameters that were used in this analysis.

To the extent that the various sources of uncertainty were not accounted for in the PbB modeling, the overall variability of predicted PbB values can be expected to be lower than they would be if all of these factors could be included in the analysis. Exposure concentrations and other input parameters tend to be positively skewed (often lognormal) with long "tails" increasing the mean of the distribution. Therefore, it is likely that the overall impact of not including all sources of variability in the PbB modeling was to give arithmetic means that are somewhat underestimated compared to those that would be obtained if all sources of variability could be included. The available data do not allow the extent of this potential bias to be estimated. It is not likely that the general patterns of predicted versus measured PbB values shown in Exhibit J-9 and Exhibit J-10 depend very strongly on the on the extent to which inter-individual variability is accounted for in the PbB modeling.

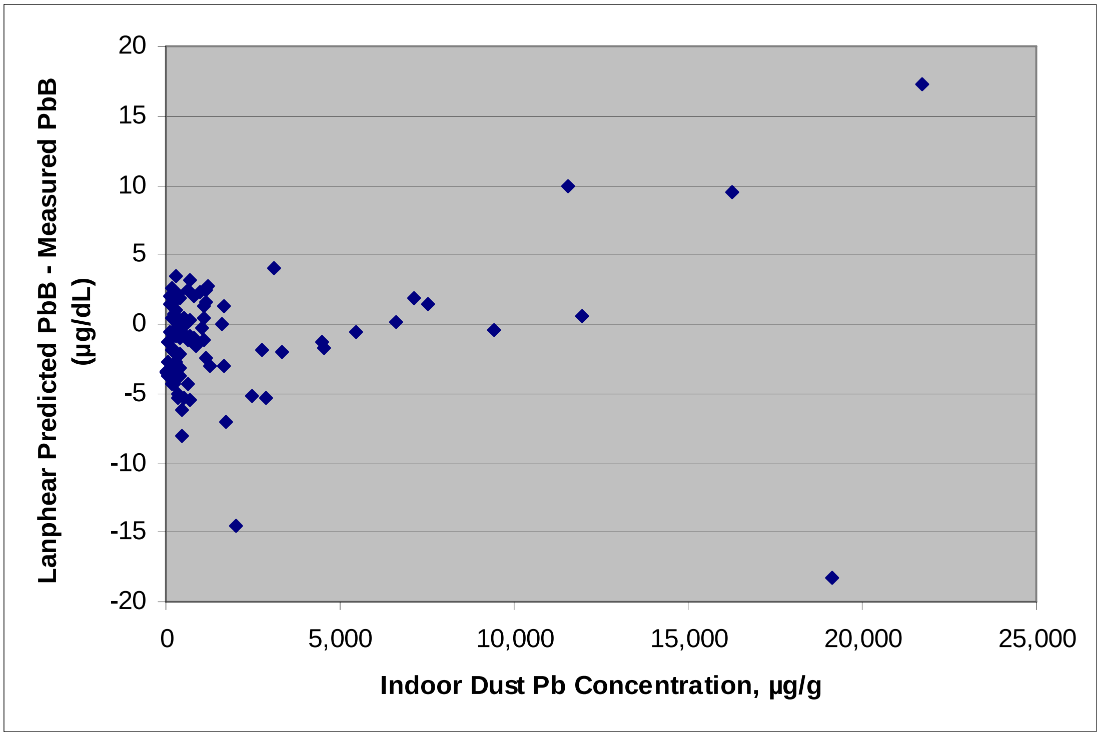
Predictions from the IEUBK model seem to match population PbB distributions more closely than those from the Leggett model. For the Rochester cohort data, the extent to which the IEUBK model overestimated PbB compared to measured Pb was strongly correlated with the average measured indoor dust Pb concentration (see Exhibit J-11). That is, the IEUBK model appeared to be giving a greater influence to the higher dust Pb concentrations than was seen in the PbB measurements.

Exhibit J-11. Correlation between IEUBK PbB Prediction Errors and Measured Arithmetic Mean Indoor Dust Pb Concentrations



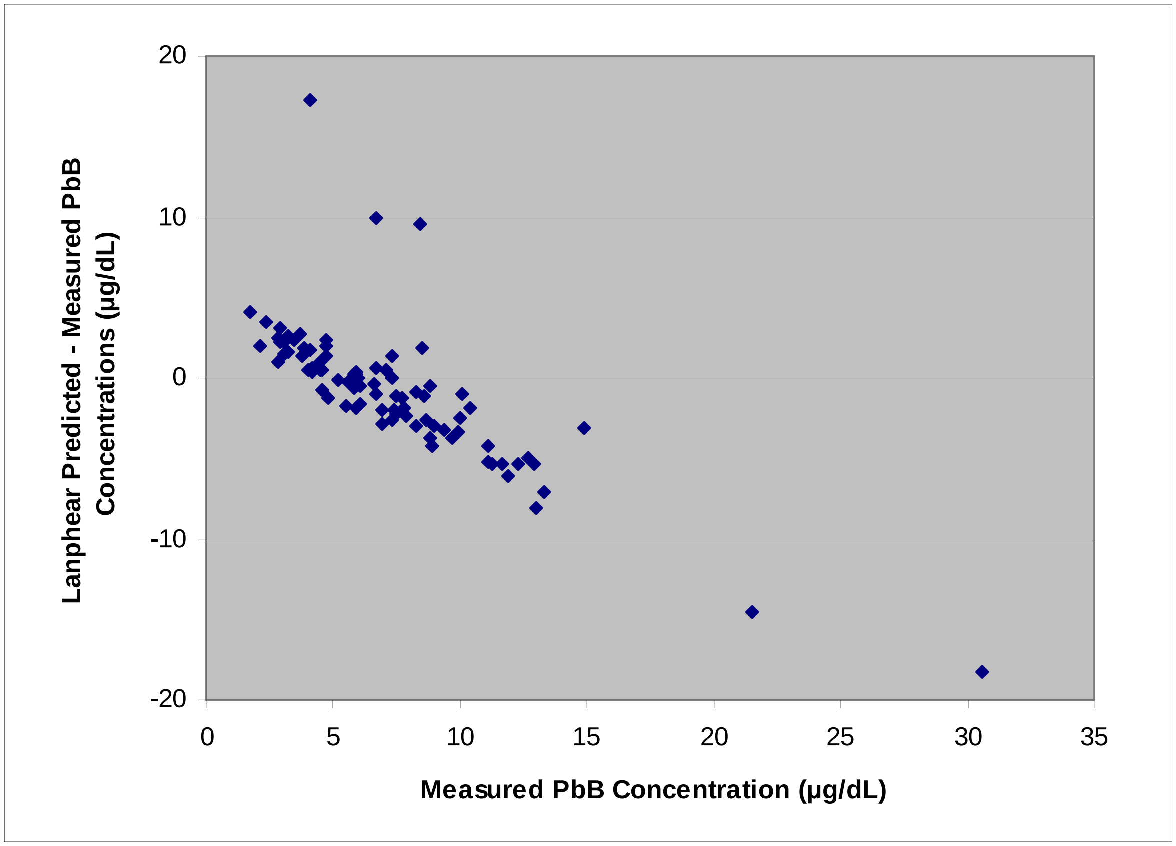
In contrast, Lanphear model errors (differences from measured values) were somewhat more weakly related to indoor dust Pb concentrations than the IEUBK model errors (see Exhibit J-12). Also, the correlation between the Lanphear PbB prediction error and play yard soil/dust Pb was not significant (R = 0.024, p = 0.82). In contrast, the correlation between the Lanphear model prediction error and wipe dust Pb loading was significant (R = 0.53, p < 0.001), but the relationship was largely determined by two very high dust Pb loading observations. Interestingly, the relationship between the Lanphear PbB model error and the age of the children when PbB was measured was not significant (R = 0.12, p = 0.27).

Exhibit J-12. Errors in Lanphear Predicted PbB Concentrations versus Measured Arithmetic Mean Indoor Dust Pb Concentrations



In fact, the strongest predictor of the Lanphear model error (predicted - measured PbB) was measured PbB itself (see Exhibit J-13). This pattern suggests that, despite its relatively good overall accuracy at predicting PbB levels (based on the average ratio of predicted versus measure values), the Lanphear model was not adequately capturing the exposure factors that cause PbB levels to change in this cohort. Instead, the model was predicting more or less constant, relatively low, PbB levels across the entire range of exposures. This behavior may be a function of how the model was derived; the equation used in this evaluation exercise was developed using data from 12 study cohorts. The result was a rather generic model, based on the averages of many covariates, which may not be the best fit to the Rochester cohort. A more detailed, multivariate model might perform better.

Exhibit J-13. Errors in Lanphear Predicted PbB Concentrations versus Measured PbB Concentrations



J.4. SUMMARY OF BLOOD PB MODEL EVALUATION

The IEUBK and Leggett biokinetic model evaluations established, first of all, that the performance of these models was consistent with that reported by previous investigators (USEPA, 2006; Lanphear and Roghmann, 1997; Pounds and Leggett, 1998). Tests of the models against specific individual exposure scenarios (Section J.1.3) to a very high degree reproduced the results of previous model comparisons.

Age profiles of predicted PbB levels were also compared against PbB data from the NHANES IV national survey, under the assumption that children in the sample population experienced "typical" pathway-specific Pb exposures as determined from reviews of the recent literature (see Section J.3.1). Depending on the assumptions made regarding typical outdoor soil/dust and indoor dust Pb concentrations, the IEUBK model either moderately over-predicted age-specific GM PbB levels (by two-fold or less) or generated predictions that were very close to the NHANES summary statistics. In contrast, age-averaged predictions from the Leggett model were between 2.7 and 5.4 times higher than the age-specific NHANES IV GM values.

Comparisons of the model predictions to individual measured PbB values in a small urban cohort of urban toddlers (see Section J.3.2) showed similar results. Average PbB predictions from the IEUBK model were about 70 percent higher than the average measured PbB for the entire study cohort. The differences between IEUBK-predicted and measured PbB levels varied, however, for subsets of the study groups with different average measured PbB levels. For children in the first quintile of measured PbB, the IEUBK predictions were about four-fold higher than the average measured value. For higher PbB quintiles, while the IEUBK predictions were still greater than the measured values, the extent of agreement between the IEUBK predictions and measured PbB was much better (differences between 10 and 80 percent). The increase in PbB levels predicted by the IEUBK model across the three highest quintiles was similar to that seen in the data.

As shown in the comparison to the NHANES data, PbB predictions from the Leggett model were all much higher than the corresponding average values in the urban cohort. The average ratio of Leggett-predicted PbB to the measured values was 3.1 for the entire study group. The increments in predicted average PbB values were very similar to the increments seen in the PbB data (see Exhibit J-10).

The Lanphear empirical equation model predicted steady-state PbB concentrations that were quite close to the measured values in the study cohort. The average ratio of Lanphear-predicted PbB to measured PbB values was 0.9 for the entire study population. The average predicted PbB was two-fold greater than the measured values for the lowest PbB quintile, decreasing to 40 percent below the average measured values for the highest quintile. The increments in predicted PbB across the quintiles was much smaller than the increments seen in the data, suggesting that the Lanphear model was underestimating the effect of increasing exposure on PbB compared to that seen in the data.

The results of this evaluation suggest that, of the two biokinetic models, the IEUBK generates PbB estimates that are most similar to measured values in populations of Pb-exposed children, especially for children with higher Pb uptakes. The Leggett PbB predictions are consistently much higher than both measured PbB levels and PbB levels predicted by the other models that have been tested.

Although the Lanphear model generated PbB predictions that were relatively close to measured values in the small urban cohort, it tends to under-predict the slope of the relationship between Pb exposure (i.e., indoor dust Pb and outdoor soil/dust Pb) and PbB. Additionally, the potential utility of the Lanphear model in this assessment is limited by the lack of a dynamic component and the inability to predict PbB levels for children outside of the age range for which the model was derived (12 to 30 months). Thus, it cannot be used to calculate the "concurrent" or "lifetime" PbB metrics that are the primary inputs to the PbB-IQ modeling.

Differences between measured PbB levels and the levels predicted by the IEUBK model were greatest for children associated with high measured indoor dust Pb levels (and to a lesser extent, high outdoor soil/dust Pb concentrations). The IEUBK model would appear to give undue weight to these high Pb exposure concentrations compared to the strength of their influence on PbB levels in the urban child data set. This may be because the high measured dust Pb values are unrepresentative of time-averaged exposures. While the arithmetic mean indoor dust Pb concentrations used in the model evaluation may provide the theoretical best estimates of the expected values of exposure Pb concentrations, the mean values for some children may be highly influenced by high “outlier” values, whose concentrations are not representative of long-term averages. Using the household GM indoor dust Pb concentrations, which reduced the effect of "outliers," instead of the arithmetic means as inputs to the IEUBK model, results in PbB predictions for the urban cohort that are much closer to the measured values. For the entire study population, the average difference between the IEUBK model prediction and measured PbB was 20 percent. While this argument provides a plausible explanation for some of the difference between the observed and predicted PbB values for this cohort, it does not imply that any adjustment to the exposure Pb concentration estimates is necessary in this assessment. Unlike the test cases evaluated above, the exposure Pb concentration estimates in this assessment were intended to be representative of long-term Pb exposures.

REFERENCES

Hattis, D. (2006) Analysis of Trends in NHANES Children's Blood Lead Distributions. Submitted to the Office of Science and Technology, Office of Water, U.S. Environmental Protection Agency; November.

Lanphear, B. P.; Emond, M.; Jacobs, D. E.; Weitzman, M.; Tanner, M.; Winter, N. L.; Yakir, B.; Eberly, S. (1995) A Side-by-Side Comparison of Dust Collection Methods for Sampling Lead-Contaminated House Dust. *Environ. Res.* 68(2): 114-123.

Lanphear, B. P.; Matte, T. D.; Rogers, J.; Clickner, R. P.; Dietz, B.; Bornschein, R. L.; Succop, P.; Mahaffey, K. R.; Dixon, S.; Galke, W.; Rabinowitz, M.; Farfel, M.; Rohde, C.; Schwartz, J.; Ashley, P.; Jacobs, D. E. (1998) The Contribution of Lead-Contaminated House Dust and Residential Soil to Children's Blood Lead Levels: A Pooled Analysis of 12 Epidemiologic Studies. *Environmental Research.* 79: 51-68.

Lanphear, B. P.and Roghmann, K. J. (1997) Pathways of Lead Exposure in Urban Children. *Environ. Res.* 74(67): 73

Leggett, R. W. (1993) An Age-Specific Kinetic Model of Lead Metabolism in Humans. *Environ Health Perspect.* 101: 598-616.

Pounds, J. G. (2000) An Operators Manual for the Leggett Age-Dependent Biokinetic Model for Lead. Version 1.1.

Pounds, J. G.and Leggett, R. W. (1998) The ICRP Age-Specific Biokinetic Model for Lead: Validations, Empirical Comparisons, and Explorations. *Environ Health Perspect.* 106 Suppl 6: 1505-1511.

U.S. Environmental Protection Agency (USEPA). (1994) Technical Support Document: Parameters and Equations Used in the Integrated Exposure Uptake Biokinetic Model for Lead in Children (v.099d). EPA 540/R-94/040. Office of Solid Waste.

U.S. Environmental Protection Agency (USEPA). (1995) Report on the National Survey of Lead-Based Paint in Housing: Appendix I: Design and Methodology. EPA 747-R95-004. Office of Pollution Prevention and Toxics.

U.S. Environmental Protection Agency (USEPA). (1996) Adjustments to the HUD National Survey Dust Data for Section 403 Analyses. EPA 747-R-96-011. Office of Pollution, Prevention, and Toxics.

U.S. Environmental Protection Agency (USEPA). (2004) Exposure Measurements: The National Human Exposure Assessment Survey. Available online at: http://www.epa.gov/heasd/edrb/nhexas.htm.

U.S. Environmental Protection Agency (USEPA). (2006) Air Quality Criteria for Lead (Final). Volume I and II. Research Triangle Park, NC: National Center for Environmental Assessment; EPA/600/R-05/144aF-bF. Available online at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=158823.

U.S. Environmental Protection Agency (USEPA). (2007) Air Quality System (AQS) Database. Available online at: http://www.epa.gov/ttn/airs/airsaqs/aqsweb/aqswebwarning.htm.

July 25, 2007

Appendix K: Risk (IQ Decrement) Estimates

Prepared by:

ICF International
Research Triangle Park, NC

Prepared for:

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina

Contract No. EP-D-06-115
Work Assignment No. 0-4

Table of Contents

List of Exhibits

K. IQ DECREMENT RESULTS

This appendix presents the estimated distributions of intelligence quotient (IQ) decrements for each of the case studies and for all National Ambient Air Quality Standards (NAAQS) scenarios considered in this analysis. Section K.1 contains the results for the general urban case study, including an overview of the scenarios run (see Section K.1.1) and the estimated IQ decrement distributions (see Section K.1.2). Similarly, Section K.2 provides the results for the primary lead (Pb) smelter case study, including an overview of the scenarios run (see Section K.2.1) and the estimated IQ decrement distributions (see Section K.2.2). Finally, Section K.3 presents the results for the secondary Pb smelter case study, including an overview of the scenarios run (see Section K.3.1) and the estimated IQ decrement distributions (see Section K.3.2).

Estimates presented in this appendix are specified with regard to number of decimal places, which results in various numbers of implied significant figures. This is not intended to convey greater precision for some estimates than others; it is simply an expedient and initial result of the software used for the calculation. Greater attention is given to significant figures in the presentation of estimates in the main body of the report.

K.1. GENERAL URBAN CASE STUDY

K.1.1. Description of Scenarios Analyzed

Exhibit K-1 lists the general urban case study scenarios for which IQ decrement estimates were generated for the general urban case study. As discussed in Appendix I, blood Pb (PbB) distributions were generated using two different indoor dust Pb concentration models (i.e., the air-only regression-based model and the hybrid mechanistic-empirical model [“hybrid model”]) and two different PbB metrics (i.e., concurrent [average of the results at 75 and 81 months of age in the seventh year of life] and lifetime [average of the results between age 6 and 84 months]). These PbB estimates included a correction to account for inter-individual variability using two different geometric standard deviation (GSD) values. These corrections were applied in 50,000 iterations of a probabilistic model in order to generate a distribution of PbB estimates for each NAAQS scenario. Finally, three different IQ functions (i.e., the two-piece linear IQ change function [“two-piece linear”], the log-linear IQ change function [“log-linear with cutpoint”], and the log-linear IQ change function with low-exposure linearization [“log-linear with linearization”]), as described in Section 4.1.1 of the main body of the report, were used to estimate IQ loss impacts from the PbB concentration distributions estimated for each scenario.

Exhibit K-1. IQ Decrement Scenarios Run for the General Urban Case Study

NAAQS Scenario [a]	Dust Model	GSD (microgram per deciliter [µg/dL])	PbB Metric	IQ Decrement Models
Current conditions (95th percentile)	Air-only regression-based model	2.1	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		2.0	Lifetime	
		1.7	Concurrent	
		1.6	Lifetime	
	Hybrid mechanistic-empirical model	2.1	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		2.0	Lifetime	
		1.7	Concurrent	
		1.6	Lifetime	
Current conditions (mean)	Air-only regression-based model	2.1	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		2.0	Lifetime	
		1.7	Concurrent	
		1.6	Lifetime	
	Hybrid mechanistic-empirical model	2.1	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		2.0	Lifetime	
		1.7	Concurrent	
		1.6	Lifetime	
Current NAAQS (1.5 µg/m^3, max quarterly average)	Air-only regression-based model	2.1	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		2.0	Lifetime	
		1.7	Concurrent	
		1.6	Lifetime	
	Hybrid mechanistic-empirical model	2.1	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		2.0	Lifetime	
		1.7	Concurrent	
		1.6	Lifetime	
Alternative 1 NAAQS (0.2 µg/m^3, max quarterly average)	Air-only regression-based model	2.1	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		2.0	Lifetime	
		1.7	Concurrent	
		1.6	Lifetime	
	Hybrid mechanistic-empirical model	2.1	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		2.0	Lifetime	
		1.7	Concurrent	
		1.6	Lifetime	
Alternative 2 NAAQS (0.5 µg/m^3, max monthly average)	Air-only regression-based model	2.1	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		2.0	Lifetime	
		1.7	Concurrent	
		1.6	Lifetime	
	Hybrid mechanistic-empirical model	2.1	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		2.0	Lifetime	
		1.7	Concurrent	
		1.6	Lifetime	

Exhibit K-1. IQ Decrement Scenarios Run for the General Urban Case Study

NAAQS Scenario [a]	Dust Model	GSD (microgram per deciliter [µg/dL])	PbB Metric	IQ Decrement Models
Alternative NAAQS 3 (0.2 µg/m^3, max monthly average)	Air-only regression-based model	2.1	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		2.0	Lifetime	
		1.7	Concurrent	
		1.6	Lifetime	
	Hybrid mechanistic-empirical model	2.1	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		2.0	Lifetime	
		1.7	Concurrent	
		1.6	Lifetime	
Alternative NAAQS 4 (0.05 µg/m^3, max monthly average)	Air-only regression-based model	2.1	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		2.0	Lifetime	
		1.7	Concurrent	
		1.6	Lifetime	
	Hybrid mechanistic-empirical model	2.1	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		2.0	Lifetime	
		1.7	Concurrent	
		1.6	Lifetime	

[a] For a more detailed discussion of the NAAQS scenarios see Appendix C.

K.1.2. IQ Decrement Results for the General Urban Case Study

Exhibits K-2 through K-8 summarize the distributions of estimated losses in IQ associated with each of the scenarios analyzed for the general urban case study. In the exhibits, IQ decrements less than one IQ point are considered to be indistinguishable from zero within the expected error of the PbB and IQ models, and are reported as "<1." IQ losses that were exactly zero because the estimated PbB was below the cutpoint are reported as "-." The PbB values corresponding to the each IQ percentile are also given. In addition, the approximate contribution from each exposure pathway to the overall IQ change is provided. The indoor dust contribution is separated into an ambient air contribution (ingestion [recent air]) and a contribution from other sources (e.g., indoor paint, outdoor soil/dust, and additional sources [including historical air]), as described in Appendix G. The pathway associated with inhalation of policy-relevant air Pb concentrations is shown as "inhalation (recent air)."

The pathway contribution estimates correspond to the fraction of Pb uptake coming from each pathway, and the assumption is made that these fractions map linearly to IQ effects. Because of the nonlinearity of the IQ models themselves, there is considerable ambiguity about how best to assign proportional pathway contributions to IQ loss; using the proportional contribution to total Pb uptake as proxy estimates is a simplification which introduces uncertainty into these estimates. Because there is no underlying population in the general urban case study (unlike the two point source case studies), these percentages do not vary by IQ decrement percentile.

In general, the two-piece linear IQ function predicts the lowest IQ losses and the log-linear with linearization IQ function predicts the highest IQ losses at the specified percentiles. The trends in IQ tend to follow the trends in PbB across the different dust models, GSD values, and NAAQS scenarios. In particular, the hybrid model, which tends to predict higher Pb concentration than the air-only regression-based model for most NAAQS scenarios, also predicts larger losses in IQ. The exception is the current NAAQS scenario. As discussed in Appendix I, this is the only NAAQS scenario which predicts ambient air Pb concentrations above 0.28 micrograms per cubic meter (µg/m^3) (the point at which the hybrid model and air-only regression-based model cross) and thus is the only scenario for which the hybrid model predicts lower indoor dust concentrations than the air-only regression model. In addition, in the second alternative NAAQS (0.5 µg/m^3, maximum monthly average) scenario, the PbB values obtained using the higher GSD (2.1 µg per deciliter [dL]) for the concurrent PbB metric are higher for the 95th, 99th, 99.5th, and 99.9th percentiles when the air-only regression-based model is used than when the hybrid model is used. This unexpected trend is likely due to sampling error in the "tails" of the distribution, as discussed in Appendix I.

Exhibit K-2. General Urban Case Study: Current Conditions (95th Percentile) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	4.5	10.0						
99.5th	3.5	7.6						
99th	3.0	6.7						
95th	2.1	4.7						
90th	1.8	3.9	17.1%	10.0%	36.5%	13.5%	21.8%	1.0%
75th	1.3	2.8						
Median	<1	2.0						
25th	<1	1.4						
1st	<1	0.6						
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	6.2	10.0						
99.5th	5.5	7.6						
99th	5.1	6.7						
95th	4.2	4.7						
90th	3.7	3.9	17.1%	10.0%	36.5%	13.5%	21.8%	1.0%
75th	2.8	2.8						
Median	1.8	2.0						
25th	<1	1.4						
1st	-	0.9						
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	8.9	10.0						
99.5th	8.2	7.6						
99th	7.8	6.7						
95th	6.9	4.7						
90th	6.4	3.9	17.1%	10.0%	36.5%	13.5%	21.8%	1.0%
75th	5.5	2.8						
Median	4.5	2.0						
25th	3.6	1.4						
1st	1.6	0.6						
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	4.5	11.9						
99.5th	3.6	9.4						
99th	3.2	8.4						
95th	2.3	6.1						
90th	2.0	5.2	17.1%	10.0%	36.5%	13.5%	21.8%	1.0%
75th	1.5	3.9						
Median	1.1	2.8						
25th	<1	2.1						
1st	<1	1.0						

Exhibit K-2. General Urban Case Study: Current Conditions (95th Percentile) Estimated IQ Losses

<table>
<tr><th rowspan="4">IQ Loss Percentile</th><th rowspan="4">Predicted IQ Loss</th><th rowspan="4">Predicted PbB (µg/dL)</th><th colspan="7">Pathway Contribution [a]</th></tr>
<tr><th colspan="6">Ingestion</th><th rowspan="3">Inhalation (Recent Air)</th></tr>
<tr><th rowspan="2">Diet</th><th rowspan="2">Drinking Water</th><th rowspan="2">Outdoor Soil/Dust</th><th colspan="2">Indoor Dust</th></tr>
<tr><th>Other [b]</th><th>Recent Air</th></tr>
<tr><td colspan="9">Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)</td></tr>
<tr><td>99.9th</td><td>6.5</td><td>11.9</td><td rowspan="9">17.1%</td><td rowspan="9">10.0%</td><td rowspan="9">36.5%</td><td rowspan="9">13.5%</td><td rowspan="9">21.8%</td><td rowspan="9">1.0%</td></tr>
<tr><td>99.5th</td><td>5.7</td><td>9.4</td></tr>
<tr><td>99th</td><td>5.4</td><td>8.4</td></tr>
<tr><td>95th</td><td>4.4</td><td>6.1</td></tr>
<tr><td>90th</td><td>3.9</td><td>5.2</td></tr>
<tr><td>75th</td><td>3.1</td><td>3.9</td></tr>
<tr><td>Median</td><td>2.1</td><td>2.8</td></tr>
<tr><td>25th</td><td>1.1</td><td>2.1</td></tr>
<tr><td>1st</td><td><1</td><td>1.4</td></tr>
<tr><td colspan="9">Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)</td></tr>
<tr><td>99.9th</td><td>9.5</td><td>11.9</td><td rowspan="9">17.1%</td><td rowspan="9">10.0%</td><td rowspan="9">36.5%</td><td rowspan="9">13.5%</td><td rowspan="9">21.8%</td><td rowspan="9">1.0%</td></tr>
<tr><td>99.5th</td><td>8.8</td><td>9.4</td></tr>
<tr><td>99th</td><td>8.4</td><td>8.4</td></tr>
<tr><td>95th</td><td>7.5</td><td>6.1</td></tr>
<tr><td>90th</td><td>6.9</td><td>5.2</td></tr>
<tr><td>75th</td><td>6.1</td><td>3.9</td></tr>
<tr><td>Median</td><td>5.1</td><td>2.8</td></tr>
<tr><td>25th</td><td>4.2</td><td>2.1</td></tr>
<tr><td>1st</td><td>2.0</td><td>1.0</td></tr>
<tr><td colspan="9">Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)</td></tr>
<tr><td>99.9th</td><td>4.9</td><td>10.8</td><td rowspan="9">15.7%</td><td rowspan="9">9.1%</td><td rowspan="9">33.4%</td><td rowspan="9">3.6%</td><td rowspan="9">37.2%</td><td rowspan="9">0.9%</td></tr>
<tr><td>99.5th</td><td>3.7</td><td>8.2</td></tr>
<tr><td>99th</td><td>3.3</td><td>7.3</td></tr>
<tr><td>95th</td><td>2.3</td><td>5.1</td></tr>
<tr><td>90th</td><td>1.9</td><td>4.2</td></tr>
<tr><td>75th</td><td>1.4</td><td>3.1</td></tr>
<tr><td>Median</td><td><1</td><td>2.1</td></tr>
<tr><td>25th</td><td><1</td><td>1.5</td></tr>
<tr><td>1st</td><td><1</td><td>0.6</td></tr>
<tr><td colspan="9">Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)</td></tr>
<tr><td>99.9th</td><td>6.4</td><td>10.8</td><td rowspan="9">15.7%</td><td rowspan="9">9.1%</td><td rowspan="9">43.7%</td><td rowspan="9">11.1%</td><td rowspan="9">37.2%</td><td rowspan="9">0.1%</td></tr>
<tr><td>99.5th</td><td>5.7</td><td>8.2</td></tr>
<tr><td>99th</td><td>5.4</td><td>7.3</td></tr>
<tr><td>95th</td><td>4.4</td><td>5.1</td></tr>
<tr><td>90th</td><td>3.9</td><td>4.2</td></tr>
<tr><td>75th</td><td>3.0</td><td>3.1</td></tr>
<tr><td>Median</td><td>2.0</td><td>2.1</td></tr>
<tr><td>25th</td><td>1.1</td><td>1.5</td></tr>
<tr><td>1st</td><td>-</td><td>1.0</td></tr>
</table>

Exhibit K-2. General Urban Case Study: Current Conditions (95th Percentile) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	9.1	10.8						
99.5th	8.4	8.2						
99th	8.1	7.3						
95th	7.1	5.1						
90th	6.6	4.2	15.7%	9.1%	33.4%	3.6%	37.2%	0.9%
75th	5.7	3.1						
Median	4.7	2.1						
25th	3.8	1.5						
1st	1.7	0.6						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	4.9	13.0						
99.5th	3.9	10.2						
99th	3.5	9.1						
95th	2.5	6.7						
90th	2.1	5.6	15.7%	9.1%	33.4%	3.6%	37.2%	0.9%
75th	1.6	4.2						
Median	1.2	3.1						
25th	<1	2.2						
1st	<1	1.0						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	6.7	13.0						
99.5th	6.0	10.2						
99th	5.6	9.1						
95th	4.7	6.7						
90th	4.2	5.6	15.7%	9.1%	33.4%	3.6%	37.2%	0.9%
75th	3.3	4.2						
Median	2.3	3.1						
25th	1.4	2.2						
1st	-	1.4						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	9.7	13.0						
99.5th	9.0	10.2						
99th	8.7	9.1						
95th	7.7	6.7						
90th	7.2	5.6	15.7%	9.1%	33.4%	3.6%	37.2%	0.9%
75th	6.3	4.2						
Median	5.4	3.1						
25th	4.4	2.2						
1st	2.2	1.0						

Exhibit K-2. General Urban Case Study: Current Conditions (95th Percentile) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	5.9	19.9	17.1%	10.0%	36.5%	13.5%	21.8%	1.0%
99.5th	5.2	13.1						
99th	4.9	11.1						
95th	3.0	6.7						
90th	2.3	5.1						
75th	1.5	3.3						
Median	<1	2.0						
25th	<1	1.2						
1st	<1	0.4						
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	8.1	19.9	17.1%	10.0%	36.5%	13.5%	21.8%	1.0%
99.5th	7.0	13.1						
99th	6.5	11.1						
95th	5.1	6.7						
90th	4.4	5.1						
75th	3.2	3.3						
Median	1.8	2.0						
25th	<1	1.2						
1st	-	0.6						
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	10.8	19.9	17.1%	10.0%	36.5%	13.5%	21.8%	1.0%
99.5th	9.7	13.1						
99th	9.2	11.1						
95th	7.8	6.7						
90th	7.1	5.1						
75th	5.9	3.3						
Median	4.5	2.0						
25th	3.2	1.2						
1st	<1	0.4						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	6.4	24.6	17.1%	10.0%	36.5%	13.5%	21.8%	1.0%
99.5th	5.5	16.7						
99th	5.2	14.3						
95th	3.4	8.9						
90th	2.6	6.9						
75th	1.7	4.5						
Median	1.1	2.8						
25th	<1	1.8						
1st	<1	0.6						

Exhibit K-2. General Urban Case Study: Current Conditions (95th Percentile) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	8.6	24.6	17.1%	10.0%	36.5%	13.5%	21.8%	1.0%
99.5th	7.5	16.7						
99th	7.0	14.3						
95th	5.5	8.9						
90th	4.8	6.9						
75th	3.5	4.5						
Median	2.1	2.8						
25th	<1	1.8						
1st	-	0.9						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	11.7	24.6	17.1%	10.0%	36.5%	13.5%	21.8%	1.0%
99.5th	10.5	16.7						
99th	10.0	14.3						
95th	8.6	8.9						
90th	7.8	6.9						
75th	6.5	4.5						
Median	5.1	2.8						
25th	3.7	1.8						
1st	1.2	0.6						
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	6.1	21.5	15.7%	9.1%	33.4%	3.6%	37.2%	0.9%
99.5th	5.3	14.2						
99th	5.1	12.0						
95th	3.3	7.2						
90th	2.5	5.5						
75th	1.6	3.5						
Median	<1	2.1						
25th	<1	1.3						
1st	<1	0.4						
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	8.3	21.5	15.7%	9.1%	33.4%	3.6%	37.2%	0.9%
99.5th	7.2	14.2						
99th	6.7	12.0						
95th	5.3	7.2						
90th	4.6	5.5						
75th	3.4	3.5						
Median	2.0	2.1						
25th	<1	1.3						
1st	-	0.7						

Exhibit K-2. General Urban Case Study: Current Conditions (95th Percentile) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	11.0	21.5						
99.5th	9.9	14.2						
99th	9.4	12.0						
95th	8.0	7.2						
90th	7.3	5.5	15.7%	9.1%	33.4%	3.6%	37.2%	0.9%
75th	6.1	3.5						
Median	4.7	2.1						
25th	3.4	1.3						
1st	1.0	0.4						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	6.7	26.7						
99.5th	5.6	18.1						
99th	5.3	15.5						
95th	3.7	9.6						
90th	2.8	7.5	15.7%	9.1%	33.4%	3.6%	37.2%	0.9%
75th	1.9	4.9						
Median	1.2	3.1						
25th	<1	1.9						
1st	<1	0.6						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	8.9	26.7						
99.5th	7.7	18.1						
99th	7.3	15.5						
95th	5.8	9.6						
90th	5.0	7.5	15.7%	9.1%	33.4%	3.6%	37.2%	0.9%
75th	3.8	4.9						
Median	2.3	3.1						
25th	<1	1.9						
1st	-	1.0						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	11.9	26.7						
99.5th	10.8	18.1						
99th	10.3	15.5						
95th	8.8	9.6						
90th	8.1	7.5	15.7%	9.1%	33.4%	3.6%	37.2%	0.9%
75th	6.8	4.9						
Median	5.4	3.1						
25th	4.0	1.9						
1st	1.3	0.6						

[a] Pathway contributions apply to all percentiles. See text for further discussion.
[b] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit K-3. General Urban Case Study: Current Conditions (Mean) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	4.1	9.0						
99.5th	3.1	6.8						
99th	2.7	6.0						
95th	1.9	4.2						
90th	1.6	3.5	19.4%	11.3%	41.3%	15.3%	12.1%	0.6%
75th	1.1	2.5						
Median	<1	1.8						
25th	<1	1.2						
1st	<1	0.5						
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	5.9	9.0						
99.5th	5.2	6.8						
99th	4.8	6.0						
95th	3.9	4.2						
90th	3.4	3.5	19.4%	11.3%	41.3%	15.3%	12.1%	0.6%
75th	2.5	2.5						
Median	1.5	1.8						
25th	<1	1.2						
1st	-	0.7						
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	8.6	9.0						
99.5th	7.9	6.8						
99th	7.5	6.0						
95th	6.6	4.2						
90th	6.1	3.5	19.4%	11.3%	41.3%	15.3%	12.1%	0.6%
75th	5.2	2.5						
Median	4.2	1.8						
25th	3.3	1.2						
1st	1.4	0.5						
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	4.0	10.7						
99.5th	3.2	8.3						
99th	2.8	7.4						
95th	2.1	5.5						
90th	1.7	4.6	19.4%	11.3%	41.3%	15.3%	12.1%	0.6%
75th	1.3	3.5						
Median	<1	2.5						
25th	<1	1.8						
1st	<1	0.8						

Exhibit K-3. General Urban Case Study: Current Conditions (Mean) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	6.1	10.7	19.4%	11.3%	41.3%	15.3%	12.1%	0.6%
99.5th	5.4	8.3						
99th	5.0	7.4						
95th	4.1	5.5						
90th	3.6	4.6						
75th	2.7	3.5						
Median	1.7	2.5						
25th	-	1.8						
1st	<1	1.1						
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	9.1	10.7	19.4%	11.3%	41.3%	15.3%	12.1%	0.6%
99.5th	8.4	8.3						
99th	8.0	7.4						
95th	7.1	5.5						
90th	6.6	4.6						
75th	5.7	3.5						
Median	4.8	2.5						
25th	3.8	1.8						
1st	1.8	0.8						
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	4.4	9.8	17.7%	10.3%	37.6%	5.6%	28.3%	0.5%
99.5th	3.5	7.6						
99th	3.0	6.6						
95th	2.1	4.6						
90th	1.7	3.8						
75th	1.3	2.8						
Median	<1	1.9						
25th	<1	1.3						
1st	<1	0.6						
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	6.2	9.8	17.7%	10.3%	43.7%	11.1%	28.3%	0.1%
99.5th	5.5	7.6						
99th	5.1	6.6						
95th	4.1	4.6						
90th	3.6	3.8						
75th	2.7	2.8						
Median	1.8	1.9						
25th	<1	1.3						
1st	-	0.9						

Exhibit K-3. General Urban Case Study: Current Conditions (Mean) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	8.9	9.8						
99.5th	8.2	7.6						
99th	7.8	6.6						
95th	6.8	4.6						
90th	6.3	3.8	17.7%	10.3%	37.6%	5.6%	28.3%	0.5%
75th	5.4	2.8						
Median	4.5	1.9						
25th	3.5	1.3						
1st	1.5	0.6						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	4.4	11.7						
99.5th	3.6	9.4						
99th	3.1	8.3						
95th	2.3	6.0						
90th	1.9	5.1	17.7%	10.3%	37.6%	5.6%	28.3%	0.5%
75th	1.4	3.8						
Median	1.0	2.8						
25th	<1	2.0						
1st	<1	0.9						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	6.4	11.7						
99.5th	5.7	9.4						
99th	5.3	8.3						
95th	4.4	6.0						
90th	3.9	5.1	17.7%	10.3%	37.6%	5.6%	28.3%	0.5%
75th	3.0	3.8						
Median	2.0	2.8						
25th	1.0	2.0						
1st	-	1.4						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	9.4	11.7						
99.5th	8.8	9.4						
99th	8.4	8.3						
95th	7.4	6.0						
90th	6.9	5.1	17.7%	10.3%	37.6%	5.6%	28.3%	0.5%
75th	6.0	3.8						
Median	5.0	2.8						
25th	4.1	2.0						
1st	2.0	0.9						

Exhibit K-3. General Urban Case Study: Current Conditions (Mean) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	5.5	16.4						
99.5th	5.0	11.7						
99th	4.5	9.9						
95th	2.7	6.0						
90th	2.1	4.5	19.4%	11.3%	41.3%	15.3%	12.1%	0.6%
75th	1.3	2.9						
Median	<1	1.8						
25th	<1	1.1						
1st	<1	0.3						
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	7.6	16.4						
99.5th	6.6	11.7						
99th	6.2	9.9						
95th	4.8	6.0						
90th	4.1	4.5	19.4%	11.3%	41.3%	15.3%	12.1%	0.6%
75th	2.9	2.9						
Median	1.5	1.8						
25th	<1	1.1						
1st	-	0.6						
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	10.3	16.4						
99.5th	9.3	11.7						
99th	8.9	9.9						
95th	7.5	6.0						
90th	6.8	4.5	19.4%	11.3%	41.3%	15.3%	12.1%	0.6%
75th	5.6	2.9						
Median	4.2	1.8						
25th	2.9	1.1						
1st	<1	0.3						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	5.9	20.2						
99.5th	5.2	14.8						
99th	4.8	12.6						
95th	3.0	7.8						
90th	2.3	6.1	19.4%	11.3%	41.3%	15.3%	12.1%	0.6%
75th	1.5	4.0						
Median	<1	2.5						
25th	<1	1.6						
1st	<1	0.5						

Exhibit K-3. General Urban Case Study: Current Conditions (Mean) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	8.1	20.2						
99.5th	7.1	14.8						
99th	6.6	12.6						
95th	5.2	7.8						
90th	4.4	6.1	19.4%	11.3%	41.3%	15.3%	12.1%	0.6%
75th	3.1	4.0						
Median	1.7	2.5						
25th	<1	1.6						
1st	-	1.0						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	11.1	20.2						
99.5th	10.1	14.8						
99th	9.7	12.6						
95th	8.2	7.8						
90th	7.4	6.1	19.4%	11.3%	41.3%	15.3%	12.1%	0.6%
75th	6.2	4.0						
Median	4.8	2.5						
25th	3.4	1.6						
1st	1.1	0.5						
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	5.7	17.9						
99.5th	5.1	12.9						
99th	4.9	10.8						
95th	2.9	6.5						
90th	2.2	5.0	17.7%	10.3%	37.6%	5.6%	28.3%	0.5%
75th	1.4	3.1						
Median	<1	1.9						
25th	<1	1.2						
1st	<1	0.3						
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	7.8	17.9						
99.5th	6.9	12.9						
99th	6.4	10.8						
95th	5.0	6.5						
90th	4.3	5.0	17.7%	10.3%	37.6%	5.6%	28.3%	0.5%
75th	3.1	3.1						
Median	1.8	1.9						
25th	<1	1.2						
1st	-	0.3						

Exhibit K-3. General Urban Case Study: Current Conditions (Mean) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	10.5	17.9						
99.5th	9.6	12.9						
99th	9.1	10.8						
95th	7.7	6.5						
90th	7.0	5.0	17.7%	10.3%	37.6%	5.6%	28.3%	0.5%
75th	5.8	3.1						
Median	4.5	1.9						
25th	3.1	1.2						
1st	<1	0.3						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	6.1	22.2						
99.5th	5.4	16.4						
99th	5.1	13.9						
95th	3.3	8.6						
90th	2.5	6.7	17.7%	10.3%	37.6%	5.6%	28.3%	0.5%
75th	1.7	4.4						
Median	1.0	2.8						
25th	<1	1.7						
1st	<1	0.5						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	8.3	22.2						
99.5th	7.4	16.4						
99th	6.9	13.9						
95th	5.5	8.6						
90th	4.7	6.7	17.7%	10.3%	37.6%	5.6%	28.3%	0.5%
75th	3.4	4.4						
Median	2.0	2.8						
25th	<1	1.7						
1st	-	0.6						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	11.4	22.2						
99.5th	10.5	16.4						
99th	10.0	13.9						
95th	8.5	8.6						
90th	7.7	6.7	17.7%	10.3%	37.6%	5.6%	28.3%	0.5%
75th	6.5	4.4						
Median	5.0	2.8						
25th	3.6	1.7						
1st	1.2	0.5						

[a] Pathway contributions apply to all percentiles. See text for further discussion.
[b] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit K-4. General Urban Case Study: Current NAAQS (1.5 µg/m^3, Maximum Quarterly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust: Other [b]	Indoor Dust: Recent Air	
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	5.8	18.4						
99.5th	5.3	14.2						
99th	5.1	12.6						
95th	4.0	8.7						
90th	3.3	7.2	8.7%	5.1%	18.6%	6.9%	58.0%	2.8%
75th	2.4	5.2						
Median	1.7	3.7						
25th	1.2	2.6						
1st	<1	1.1						
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	7.9	18.4						
99.5th	7.2	14.2						
99th	6.8	12.6						
95th	5.9	8.7						
90th	5.3	7.2	8.7%	5.1%	18.6%	6.9%	58.0%	2.8%
75th	4.5	5.2						
Median	3.5	3.7						
25th	2.5	2.6						
1st	<1	1.1						
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	10.6	18.4						
99.5th	9.9	14.2						
99th	9.5	12.6						
95th	8.6	8.7						
90th	8.0	7.2	8.7%	5.1%	18.6%	6.9%	58.0%	2.8%
75th	7.2	5.2						
Median	6.2	3.7						
25th	5.2	2.6						
1st	2.8	1.1						
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	6.1	22.2						
99.5th	5.6	17.7						
99th	5.4	15.8						
95th	4.3	11.5						
90th	3.7	9.7	8.7%	5.1%	18.6%	6.9%	58.0%	2.8%
75th	2.8	7.3						
Median	2.0	5.3						
25th	1.5	3.9						
1st	<1	1.8						

Exhibit K-4. General Urban Case Study: Current NAAQS (1.5 µg/m^3, Maximum Quarterly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust: Other [b]	Indoor Dust: Recent Air	
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	8.3	22.2	8.7%	5.1%	18.6%	6.9%	58.0%	2.8%
99.5th	7.6	17.7						
99th	7.3	15.8						
95th	6.3	11.5						
90th	5.8	9.7						
75th	5.0	7.3						
Median	4.0	5.3						
25th	3.0	3.9						
1st	-	1.8						
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	11.4	22.2	8.7%	5.1%	18.6%	6.9%	58.0%	2.8%
99.5th	10.7	17.7						
99th	10.3	15.8						
95th	9.4	11.5						
90th	8.9	9.7						
75th	8.0	7.3						
Median	7.0	5.3						
25th	6.1	3.9						
1st	3.7	1.8						
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	5.6	16.5	10.4%	6.0%	22.1%	1.1%	57.1%	3.3%
99.5th	5.1	12.6						
99th	4.9	11.0						
95th	3.4	7.6						
90th	2.8	6.2						
75th	2.0	4.5						
Median	1.4	3.1						
25th	1.0	2.2						
1st	<1	0.9						
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	7.6	16.5	10.4%	6.0%	43.7%	11.1%	57.1%	0.1%
99.5th	6.8	12.6						
99th	6.5	11.0						
95th	5.5	7.6						
90th	4.9	6.2						
75th	4.1	4.5						
Median	3.1	3.1						
25th	2.1	2.2						
1st	-	0.8						

Exhibit K-4. General Urban Case Study: Current NAAQS (1.5 µg/m^3, Maximum Quarterly Average) Estimated IQ Losses

<table>
<tr><th rowspan="4">IQ Loss Percentile</th><th rowspan="4">Predicted IQ Loss</th><th rowspan="4">Predicted PbB (µg/dL)</th><th colspan="6">Pathway Contribution [a]</th></tr>
<tr><th colspan="5">Ingestion</th><th rowspan="3">Inhalation (Recent Air)</th></tr>
<tr><th rowspan="2">Diet</th><th rowspan="2">Drinking Water</th><th rowspan="2">Outdoor Soil/Dust</th><th colspan="2">Indoor Dust</th></tr>
<tr><th>Other [b]</th><th>Recent Air</th></tr>
<tr><td colspan="9">Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)</td></tr>
<tr><td>99.9th</td><td>10.3</td><td>16.5</td><td rowspan="9">10.4%</td><td rowspan="9">6.0%</td><td rowspan="9">22.1%</td><td rowspan="9">1.1%</td><td rowspan="9">57.1%</td><td rowspan="9">3.3%</td></tr>
<tr><td>99.5th</td><td>9.5</td><td>12.6</td></tr>
<tr><td>99th</td><td>9.2</td><td>11.0</td></tr>
<tr><td>95th</td><td>8.2</td><td>7.6</td></tr>
<tr><td>90th</td><td>7.6</td><td>6.2</td></tr>
<tr><td>75th</td><td>6.8</td><td>4.5</td></tr>
<tr><td>Median</td><td>5.8</td><td>3.1</td></tr>
<tr><td>25th</td><td>4.8</td><td>2.2</td></tr>
<tr><td>1st</td><td>2.5</td><td>0.9</td></tr>
<tr><td colspan="9">Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)</td></tr>
<tr><td>99.9th</td><td>5.8</td><td>19.7</td><td rowspan="9">10.4%</td><td rowspan="9">6.0%</td><td rowspan="9">22.1%</td><td rowspan="9">1.1%</td><td rowspan="9">57.1%</td><td rowspan="9">3.3%</td></tr>
<tr><td>99.5th</td><td>5.3</td><td>15.5</td></tr>
<tr><td>99th</td><td>5.1</td><td>13.7</td></tr>
<tr><td>95th</td><td>3.7</td><td>9.9</td></tr>
<tr><td>90th</td><td>3.1</td><td>8.3</td></tr>
<tr><td>75th</td><td>2.4</td><td>6.2</td></tr>
<tr><td>Median</td><td>1.7</td><td>4.5</td></tr>
<tr><td>25th</td><td>1.3</td><td>3.3</td></tr>
<tr><td>1st</td><td><1</td><td>1.5</td></tr>
<tr><td colspan="9">Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)</td></tr>
<tr><td>99.9th</td><td>8.0</td><td>19.7</td><td rowspan="9">10.4%</td><td rowspan="9">6.0%</td><td rowspan="9">22.1%</td><td rowspan="9">1.1%</td><td rowspan="9">57.1%</td><td rowspan="9">3.3%</td></tr>
<tr><td>99.5th</td><td>7.2</td><td>15.5</td></tr>
<tr><td>99th</td><td>6.9</td><td>13.7</td></tr>
<tr><td>95th</td><td>5.9</td><td>9.9</td></tr>
<tr><td>90th</td><td>5.3</td><td>8.3</td></tr>
<tr><td>75th</td><td>4.5</td><td>6.2</td></tr>
<tr><td>Median</td><td>3.5</td><td>4.5</td></tr>
<tr><td>25th</td><td>2.6</td><td>3.3</td></tr>
<tr><td>1st</td><td><1</td><td>1.5</td></tr>
<tr><td colspan="9">Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)</td></tr>
<tr><td>99.9th</td><td>11.0</td><td>19.7</td><td rowspan="9">10.4%</td><td rowspan="9">6.0%</td><td rowspan="9">22.1%</td><td rowspan="9">1.1%</td><td rowspan="9">57.1%</td><td rowspan="9">3.3%</td></tr>
<tr><td>99.5th</td><td>10.3</td><td>15.5</td></tr>
<tr><td>99th</td><td>9.9</td><td>13.7</td></tr>
<tr><td>95th</td><td>8.9</td><td>9.9</td></tr>
<tr><td>90th</td><td>8.4</td><td>8.3</td></tr>
<tr><td>75th</td><td>7.5</td><td>6.2</td></tr>
<tr><td>Median</td><td>6.5</td><td>4.5</td></tr>
<tr><td>25th</td><td>5.6</td><td>3.3</td></tr>
<tr><td>1st</td><td>3.2</td><td>1.5</td></tr>
</table>

Exhibit K-4. General Urban Case Study: Current NAAQS (1.5 µg/m³, Maximum Quarterly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	7.7	35.1						
99.5th	6.5	25.0						
99th	6.1	20.9						
95th	5.1	12.3						
90th	4.3	9.4	8.7%	5.1%	18.6%	6.9%	58.0%	2.8%
75th	2.7	6.0						
Median	1.7	3.6						
25th	1.0	2.2						
1st	<1	0.6						
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	9.6	35.1						
99.5th	8.7	25.0						
99th	8.2	20.9						
95th	6.8	12.3						
90th	6.1	9.4	8.7%	5.1%	18.6%	6.9%	58.0%	2.8%
75th	4.8	6.0						
Median	3.5	3.6						
25th	2.1	2.2						
1st	-	0.7						
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	12.3	35.1						
99.5th	11.4	25.0						
99th	10.9	20.9						
95th	9.5	12.3						
90th	8.8	9.4	8.7%	5.1%	18.6%	6.9%	58.0%	2.8%
75th	7.5	6.0						
Median	6.2	3.6						
25th	4.8	2.2						
1st	1.7	0.6						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	8.7	43.9						
99.5th	7.3	32.0						
99th	6.7	27.1						
95th	5.4	16.5						
90th	4.9	12.8	8.7%	5.1%	18.6%	6.9%	58.0%	2.8%
75th	3.2	8.4						
Median	2.0	5.3						
25th	1.3	3.3						
1st	<1	1.0						

Exhibit K-4. General Urban Case Study: Current NAAQS (1.5 µg/m^3, Maximum Quarterly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust: Other [b]	Indoor Dust: Recent Air	
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	10.4	43.9	8.7%	5.1%	18.6%	6.9%	58.0%	2.8%
99.5th	9.4	32.0						
99th	8.9	27.1						
95th	7.4	16.5						
90th	6.7	12.8						
75th	5.4	8.4						
Median	4.0	5.3						
25th	2.6	3.3						
1st	-	1.1						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	13.5	43.9	8.7%	5.1%	18.6%	6.9%	58.0%	2.8%
99.5th	12.5	32.0						
99th	12.0	27.1						
95th	10.5	16.5						
90th	9.7	12.8						
75th	8.4	8.4						
Median	7.0	5.3						
25th	5.6	3.3						
1st	2.2	1.0						
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	6.9	28.5	10.4%	6.0%	22.1%	1.1%	57.1%	3.3%
99.5th	6.1	21.0						
99th	5.6	17.3						
95th	4.8	10.6						
90th	3.7	8.1						
75th	2.3	5.1						
Median	1.4	3.1						
25th	<1	1.9						
1st	<1	0.6						
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	9.0	28.5	10.4%	6.0%	22.1%	1.1%	57.1%	3.3%
99.5th	8.2	21.0						
99th	7.7	17.3						
95th	6.4	10.6						
90th	5.6	8.1						
75th	4.4	5.1						
Median	3.1	3.1						
25th	1.7	1.9						
1st	-	0.7						

Exhibit K-4. General Urban Case Study: Current NAAQS (1.5 µg/m^3, Maximum Quarterly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	11.7	28.5						
99.5th	10.9	21.0						
99th	10.4	17.3						
95th	9.1	10.6						
90th	8.3	8.1	10.4%	6.0%	22.1%	1.1%	57.1%	3.3%
75th	7.1	5.1						
Median	5.8	3.1						
25th	4.4	1.9						
1st	1.5	0.6						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	7.7	35.6						
99.5th	6.7	26.7						
99th	6.1	22.3						
95th	5.2	14.1						
90th	4.1	10.9	10.4%	6.0%	22.1%	1.1%	57.1%	3.3%
75th	2.7	7.2						
Median	1.7	4.5						
25th	1.1	2.8						
1st	<1	0.9						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	9.8	35.6						
99.5th	8.9	26.7						
99th	8.4	22.3						
95th	6.9	14.1						
90th	6.2	10.9	10.4%	6.0%	22.1%	1.1%	57.1%	3.3%
75th	4.9	7.2						
Median	3.5	4.5						
25th	2.1	2.8						
1st	-	1.1						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	12.8	35.6						
99.5th	11.9	26.7						
99th	11.4	22.3						
95th	10.0	14.1						
90th	9.2	10.9	10.4%	6.0%	22.1%	1.1%	57.1%	3.3%
75th	7.9	7.2						
Median	6.5	4.5						
25th	5.1	2.8						
1st	1.9	0.9						

[a] Pathway contributions apply to all percentiles. See text for further discussion.
[b] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit K-5. General Urban Case Study: Alternative NAAQS 1 (0.2 µg/m^3, Maximum Quarterly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust: Other [b]	Indoor Dust: Recent Air	
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	4.3	9.4						
99.5th	3.3	7.3						
99th	2.9	6.4						
95th	2.0	4.4						
90th	1.7	3.6	18.4%	10.7%	39.2%	14.5%	16.3%	0.8%
75th	1.2	2.7						
Median	<1	1.9						
25th	<1	1.3						
1st	<1	0.5						
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	6.0	9.4						
99.5th	5.4	7.3						
99th	5.0	6.4						
95th	4.0	4.4						
90th	3.5	3.6	18.4%	10.7%	39.2%	14.5%	16.3%	0.8%
75th	2.6	2.7						
Median	1.7	1.9						
25th	<1	1.3						
1st	-	0.6						
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	8.7	9.4						
99.5th	8.1	7.3						
99th	7.7	6.4						
95th	6.7	4.4						
90th	6.2	3.6	18.4%	10.7%	39.2%	14.5%	16.3%	0.8%
75th	5.3	2.7						
Median	4.4	1.9						
25th	3.4	1.3						
1st	1.5	0.5						
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	4.2	11.1						
99.5th	3.4	8.9						
99th	3.0	7.9						
95th	2.2	5.7						
90th	1.8	4.8	18.4%	10.7%	39.2%	14.5%	16.3%	0.8%
75th	1.4	3.7						
Median	1.0	2.7						
25th	<1	1.9						
1st	<1	0.9						

Exhibit K-5. General Urban Case Study: Alternative NAAQS 1 (0.2 µg/m^3, Maximum Quarterly Average) Estimated IQ Losses

<table>
<tr><th rowspan="4">IQ Loss Percentile</th><th rowspan="4">Predicted IQ Loss</th><th rowspan="4">Predicted PbB (µg/dL)</th><th colspan="6">Pathway Contribution [a]</th></tr>
<tr><th colspan="5">Ingestion</th><th rowspan="3">Inhalation (Recent Air)</th></tr>
<tr><th rowspan="2">Diet</th><th rowspan="2">Drinking Water</th><th rowspan="2">Outdoor Soil/Dust</th><th colspan="2">Indoor Dust</th></tr>
<tr><th>Other [b]</th><th>Recent Air</th></tr>
<tr><td colspan="9">Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)</td></tr>
<tr><td>99.9th</td><td>6.2</td><td>11.1</td><td rowspan="9">18.4%</td><td rowspan="9">10.7%</td><td rowspan="9">39.2%</td><td rowspan="9">14.5%</td><td rowspan="9">16.3%</td><td rowspan="9">0.8%</td></tr>
<tr><td>99.5th</td><td>5.6</td><td>8.9</td></tr>
<tr><td>99th</td><td>5.2</td><td>7.9</td></tr>
<tr><td>95th</td><td>4.2</td><td>5.7</td></tr>
<tr><td>90th</td><td>3.7</td><td>4.8</td></tr>
<tr><td>75th</td><td>2.9</td><td>3.7</td></tr>
<tr><td>Median</td><td>1.9</td><td>2.7</td></tr>
<tr><td>25th</td><td>-</td><td>1.9</td></tr>
<tr><td>1st</td><td><1</td><td>1.0</td></tr>
<tr><td colspan="9">Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)</td></tr>
<tr><td>99.9th</td><td>9.3</td><td>11.1</td><td rowspan="9">18.4%</td><td rowspan="9">10.7%</td><td rowspan="9">39.2%</td><td rowspan="9">14.5%</td><td rowspan="9">16.3%</td><td rowspan="9">0.8%</td></tr>
<tr><td>99.5th</td><td>8.6</td><td>8.9</td></tr>
<tr><td>99th</td><td>8.2</td><td>7.9</td></tr>
<tr><td>95th</td><td>7.3</td><td>5.7</td></tr>
<tr><td>90th</td><td>6.7</td><td>4.8</td></tr>
<tr><td>75th</td><td>5.9</td><td>3.7</td></tr>
<tr><td>Median</td><td>4.9</td><td>2.7</td></tr>
<tr><td>25th</td><td>4.0</td><td>1.9</td></tr>
<tr><td>1st</td><td>1.9</td><td>0.9</td></tr>
<tr><td colspan="9">Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)</td></tr>
<tr><td>99.9th</td><td>4.6</td><td>10.2</td><td rowspan="9">16.7%</td><td rowspan="9">9.7%</td><td rowspan="9">35.6%</td><td rowspan="9">4.5%</td><td rowspan="9">32.7%</td><td rowspan="9">0.7%</td></tr>
<tr><td>99.5th</td><td>3.5</td><td>7.8</td></tr>
<tr><td>99th</td><td>3.1</td><td>6.9</td></tr>
<tr><td>95th</td><td>2.2</td><td>4.8</td></tr>
<tr><td>90th</td><td>1.8</td><td>4.0</td></tr>
<tr><td>75th</td><td>1.3</td><td>2.9</td></tr>
<tr><td>Median</td><td><1</td><td>2.0</td></tr>
<tr><td>25th</td><td><1</td><td>1.4</td></tr>
<tr><td>1st</td><td><1</td><td>0.6</td></tr>
<tr><td colspan="9">Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)</td></tr>
<tr><td>99.9th</td><td>6.3</td><td>10.2</td><td rowspan="9">16.7%</td><td rowspan="9">9.7%</td><td rowspan="9">43.7%</td><td rowspan="9">11.1%</td><td rowspan="9">32.7%</td><td rowspan="9">0.1%</td></tr>
<tr><td>99.5th</td><td>5.5</td><td>7.8</td></tr>
<tr><td>99th</td><td>5.2</td><td>6.9</td></tr>
<tr><td>95th</td><td>4.2</td><td>4.8</td></tr>
<tr><td>90th</td><td>3.7</td><td>4.0</td></tr>
<tr><td>75th</td><td>2.9</td><td>2.9</td></tr>
<tr><td>Median</td><td>1.9</td><td>2.0</td></tr>
<tr><td>25th</td><td><1</td><td>1.4</td></tr>
<tr><td>1st</td><td>-</td><td>0.7</td></tr>
</table>

Exhibit K-5. General Urban Case Study: Alternative NAAQS 1 (0.2 µg/m^3, Maximum Quarterly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	9.0	10.2	16.7%	9.7%	35.6%	4.5%	32.7%	0.7%
99.5th	8.2	7.8						
99th	7.9	6.9						
95th	6.9	4.8						
90th	6.4	4.0						
75th	5.6	2.9						
Median	4.6	2.0						
25th	3.6	1.4						
1st	1.6	0.6						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	4.6	12.2	16.7%	9.7%	35.6%	4.5%	32.7%	0.7%
99.5th	3.6	9.6						
99th	3.3	8.6						
95th	2.4	6.3						
90th	2.0	5.3						
75th	1.5	4.0						
Median	1.1	2.9						
25th	<1	2.1						
1st	<1	1.0						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	6.5	12.2	16.7%	9.7%	35.6%	4.5%	32.7%	0.7%
99.5th	5.8	9.6						
99th	5.5	8.6						
95th	4.5	6.3						
90th	4.0	5.3						
75th	3.1	4.0						
Median	2.2	2.9						
25th	1.2	2.1						
1st	-	1.1						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	9.6	12.2	16.7%	9.7%	35.6%	4.5%	32.7%	0.7%
99.5th	8.8	9.6						
99th	8.5	8.6						
95th	7.5	6.3						
90th	7.0	5.3						
75th	6.2	4.0						
Median	5.2	2.9						
25th	4.2	2.1						
1st	2.1	1.0						

Exhibit K-5. General Urban Case Study: Alternative NAAQS 1 (0.2 µg/m^3, Maximum Quarterly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	5.7	18.1						
99.5th	5.1	12.4						
99th	4.7	10.4						
95th	2.8	6.2						
90th	2.2	4.8	18.4%	10.7%	39.2%	14.5%	16.3%	0.8%
75th	1.4	3.1						
Median	<1	1.9						
25th	<1	1.1						
1st	<1	0.3						
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	7.8	18.1						
99.5th	6.8	12.4						
99th	6.3	10.4						
95th	4.9	6.2						
90th	4.2	4.8	18.4%	10.7%	39.2%	14.5%	16.3%	0.8%
75th	3.0	3.1						
Median	1.7	1.9						
25th	<1	1.1						
1st	-	0.8						
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	10.5	18.1						
99.5th	9.5	12.4						
99th	9.0	10.4						
95th	7.6	6.2						
90th	6.9	4.8	18.4%	10.7%	39.2%	14.5%	16.3%	0.8%
75th	5.7	3.1						
Median	4.4	1.9						
25th	3.0	1.1						
1st	<1	0.3						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	6.1	22.3						
99.5th	5.3	15.6						
99th	5.0	13.3						
95th	3.1	8.2						
90th	2.4	6.4	18.4%	10.7%	39.2%	14.5%	16.3%	0.8%
75th	1.6	4.3						
Median	1.0	2.7						
25th	<1	1.7						
1st	<1	0.5						

Exhibit K-5. General Urban Case Study: Alternative NAAQS 1 (0.2 µg/m³, Maximum Quarterly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	8.4	22.3	18.4%	10.7%	39.2%	14.5%	16.3%	0.8%
99.5th	7.3	15.6						
99th	6.8	13.3						
95th	5.3	8.2						
90th	4.6	6.4						
75th	3.3	4.3						
Median	1.9	2.7						
25th	<1	1.7						
1st	-	1.2						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	11.4	22.3	18.4%	10.7%	39.2%	14.5%	16.3%	0.8%
99.5th	10.3	15.6						
99th	9.8	13.3						
95th	8.4	8.2						
90th	7.6	6.4						
75th	6.4	4.3						
Median	4.9	2.7						
25th	3.5	1.7						
1st	1.1	0.5						
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	6.0	20.3	16.7%	9.7%	35.6%	4.5%	32.7%	0.7%
99.5th	5.3	14.1						
99th	5.0	11.5						
95th	3.2	6.9						
90th	2.4	5.3						
75th	1.5	3.3						
Median	<1	2.0						
25th	<1	1.2						
1st	<1	0.4						
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	8.1	20.3	16.7%	9.7%	35.6%	4.5%	32.7%	0.7%
99.5th	7.1	14.1						
99th	6.6	11.5						
95th	5.2	6.9						
90th	4.5	5.3						
75th	3.3	3.3						
Median	1.9	2.0						
25th	<1	1.2						
1st	-	0.9						

Exhibit K-5. General Urban Case Study: Alternative NAAQS 1 (0.2 µg/m^3, Maximum Quarterly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	10.8	20.3	16.7%	9.7%	35.6%	4.5%	32.7%	0.7%
99.5th	9.8	14.1						
99th	9.3	11.5						
95th	7.9	6.9						
90th	7.2	5.3						
75th	6.0	3.3						
Median	4.6	2.0						
25th	3.2	1.2						
1st	<1	0.4						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	6.5	25.1	16.7%	9.7%	35.6%	4.5%	32.7%	0.7%
99.5th	5.6	17.9						
99th	5.2	14.7						
95th	3.5	9.2						
90th	2.7	7.1						
75th	1.8	4.7						
Median	1.1	2.9						
25th	<1	1.8						
1st	<1	0.6						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	8.7	25.1	16.7%	9.7%	35.6%	4.5%	32.7%	0.7%
99.5th	7.7	17.9						
99th	7.1	14.7						
95th	5.7	9.2						
90th	4.9	7.1						
75th	3.6	4.7						
Median	2.2	2.9						
25th	<1	1.8						
1st	-	1.4						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	11.8	25.1	16.7%	9.7%	35.6%	4.5%	32.7%	0.7%
99.5th	10.7	17.9						
99th	10.1	14.7						
95th	8.7	9.2						
90th	7.9	7.1						
75th	6.6	4.7						
Median	5.2	2.9						
25th	3.8	1.8						
1st	1.2	0.6						

[a] Pathway contributions apply to all percentiles. See text for further discussion.
[b] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit K-6. General Urban Case Study: Alternative NAAQS 2 (0.5 µg/m³, Maximum Monthly Average) Estimated IQ Losses

<table>
<tr><th rowspan="4">IQ Loss Percentile</th><th rowspan="4">Predicted IQ Loss</th><th rowspan="4">Predicted PbB (µg/dL)</th><th colspan="7">Pathway Contribution [a]</th></tr>
<tr><th colspan="6">Ingestion</th><th rowspan="3">Inhalation (Recent Air)</th></tr>
<tr><th rowspan="2">Diet</th><th rowspan="2">Drinking Water</th><th rowspan="2">Outdoor Soil/Dust</th><th colspan="2">Indoor Dust</th></tr>
<tr><th>Other [b]</th><th>Recent Air</th></tr>
<tr><td colspan="9">Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)</td></tr>
<tr><td>99.9th</td><td>4.5</td><td>10.0</td><td rowspan="9">16.8%</td><td rowspan="9">9.8%</td><td rowspan="9">35.8%</td><td rowspan="9">13.2%</td><td rowspan="9">23.3%</td><td rowspan="9">1.1%</td></tr>
<tr><td>99.5th</td><td>3.5</td><td>7.7</td></tr>
<tr><td>99th</td><td>3.1</td><td>6.8</td></tr>
<tr><td>95th</td><td>2.2</td><td>4.8</td></tr>
<tr><td>90th</td><td>1.8</td><td>3.9</td></tr>
<tr><td>75th</td><td>1.3</td><td>2.9</td></tr>
<tr><td>Median</td><td><1</td><td>2.0</td></tr>
<tr><td>25th</td><td><1</td><td>1.4</td></tr>
<tr><td>1st</td><td><1</td><td>0.6</td></tr>
<tr><td colspan="9">Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)</td></tr>
<tr><td>99.9th</td><td>6.2</td><td>10.0</td><td rowspan="9">16.8%</td><td rowspan="9">9.8%</td><td rowspan="9">35.8%</td><td rowspan="9">13.2%</td><td rowspan="9">23.3%</td><td rowspan="9">1.1%</td></tr>
<tr><td>99.5th</td><td>5.5</td><td>7.7</td></tr>
<tr><td>99th</td><td>5.2</td><td>6.8</td></tr>
<tr><td>95th</td><td>4.2</td><td>4.8</td></tr>
<tr><td>90th</td><td>3.7</td><td>3.9</td></tr>
<tr><td>75th</td><td>2.9</td><td>2.9</td></tr>
<tr><td>Median</td><td>1.9</td><td>2.0</td></tr>
<tr><td>25th</td><td><1</td><td>1.4</td></tr>
<tr><td>1st</td><td>-</td><td>0.7</td></tr>
<tr><td colspan="9">Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)</td></tr>
<tr><td>99.9th</td><td>8.9</td><td>10.0</td><td rowspan="9">16.8%</td><td rowspan="9">9.8%</td><td rowspan="9">35.8%</td><td rowspan="9">13.2%</td><td rowspan="9">23.3%</td><td rowspan="9">1.1%</td></tr>
<tr><td>99.5th</td><td>8.2</td><td>7.7</td></tr>
<tr><td>99th</td><td>7.9</td><td>6.8</td></tr>
<tr><td>95th</td><td>6.9</td><td>4.8</td></tr>
<tr><td>90th</td><td>6.4</td><td>3.9</td></tr>
<tr><td>75th</td><td>5.6</td><td>2.9</td></tr>
<tr><td>Median</td><td>4.6</td><td>2.0</td></tr>
<tr><td>25th</td><td>3.6</td><td>1.4</td></tr>
<tr><td>1st</td><td>1.6</td><td>0.6</td></tr>
<tr><td colspan="9">Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)</td></tr>
<tr><td>99.9th</td><td>4.5</td><td>12.0</td><td rowspan="9">16.8%</td><td rowspan="9">9.8%</td><td rowspan="9">35.8%</td><td rowspan="9">13.2%</td><td rowspan="9">23.3%</td><td rowspan="9">1.1%</td></tr>
<tr><td>99.5th</td><td>3.6</td><td>9.5</td></tr>
<tr><td>99th</td><td>3.2</td><td>8.5</td></tr>
<tr><td>95th</td><td>2.4</td><td>6.2</td></tr>
<tr><td>90th</td><td>2.0</td><td>5.3</td></tr>
<tr><td>75th</td><td>1.5</td><td>4.0</td></tr>
<tr><td>Median</td><td>1.1</td><td>2.9</td></tr>
<tr><td>25th</td><td><1</td><td>2.1</td></tr>
<tr><td>1st</td><td><1</td><td>1.0</td></tr>
</table>

Exhibit K-6. General Urban Case Study: Alternative NAAQS 2 (0.5 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	6.5	12.0	16.8%	9.8%	35.8%	13.2%	23.3%	1.1%
99.5th	5.8	9.5						
99th	5.4	8.5						
95th	4.5	6.2						
90th	4.0	5.3						
75th	3.1	4.0						
Median	2.1	2.9						
25th	1.2	2.1						
1st	<1	1.1						
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	9.5	12.0	16.8%	9.8%	35.8%	13.2%	23.3%	1.1%
99.5th	8.8	9.5						
99th	8.5	8.5						
95th	7.5	6.2						
90th	7.0	5.3						
75th	6.2	4.0						
Median	5.2	2.9						
25th	4.2	2.1						
1st	2.1	1.0						
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	4.9	10.9	15.4%	9.0%	32.9%	3.4%	38.3%	1.0%
99.5th	3.9	8.5						
99th	3.4	7.5						
95th	2.4	5.2						
90th	1.9	4.3						
75th	1.4	3.1						
Median	<1	2.2						
25th	<1	1.5						
1st	<1	0.6						
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	6.4	10.9	15.4%	9.0%	43.7%	11.1%	38.3%	0.1%
99.5th	5.8	8.5						
99th	5.4	7.5						
95th	4.4	5.2						
90th	3.9	4.3						
75th	3.1	3.1						
Median	2.1	2.2						
25th	1.1	1.5						
1st	-	0.5						

Exhibit K-6. General Urban Case Study: Alternative NAAQS 2 (0.5 µg/m³, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	9.1	10.9	15.4%	9.0%	32.9%	3.4%	38.3%	1.0%
99.5th	8.5	8.5						
99th	8.1	7.5						
95th	7.1	5.2						
90th	6.6	4.3						
75th	5.8	3.1						
Median	4.8	2.2						
25th	3.8	1.5						
1st	1.7	0.6						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	5.0	13.1	15.4%	9.0%	32.9%	3.4%	38.3%	1.0%
99.5th	4.0	10.5						
99th	3.6	9.4						
95th	2.6	6.8						
90th	2.2	5.7						
75th	1.6	4.3						
Median	1.2	3.2						
25th	<1	2.3						
1st	<1	1.1						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	6.7	13.1	15.4%	9.0%	32.9%	3.4%	38.3%	1.0%
99.5th	6.1	10.5						
99th	5.7	9.4						
95th	4.7	6.8						
90th	4.2	5.7						
75th	3.4	4.3						
Median	2.4	3.2						
25th	1.4	2.3						
1st	-	0.9						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	9.8	13.1	15.4%	9.0%	32.9%	3.4%	38.3%	1.0%
99.5th	9.1	10.5						
99th	8.8	9.4						
95th	7.8	6.8						
90th	7.3	5.7						
75th	6.4	4.3						
Median	5.4	3.2						
25th	4.5	2.3						
1st	2.2	1.1						

Exhibit K-6. General Urban Case Study: Alternative NAAQS 2 (0.5 µg/m³, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	6.0	20.3	16.8%	9.8%	35.8%	13.2%	23.3%	1.1%
99.5th	5.2	13.5						
99th	5.0	11.2						
95th	3.1	6.8						
90th	2.4	5.2						
75th	1.5	3.3						
Median	<1	2.0						
25th	<1	1.2						
1st	<1	0.4						
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	8.1	20.3	16.8%	9.8%	35.8%	13.2%	23.3%	1.1%
99.5th	7.0	13.5						
99th	6.5	11.2						
95th	5.2	6.8						
90th	4.5	5.2						
75th	3.2	3.3						
Median	1.9	2.0						
25th	<1	1.2						
1st	-	0.7						
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	10.8	20.3	16.8%	9.8%	35.8%	13.2%	23.3%	1.1%
99.5th	9.7	13.5						
99th	9.2	11.2						
95th	7.9	6.8						
90th	7.2	5.2						
75th	5.9	3.3						
Median	4.6	2.0						
25th	3.2	1.2						
1st	<1	0.4						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	6.5	25.1	16.8%	9.8%	35.8%	13.2%	23.3%	1.1%
99.5th	5.5	17.2						
99th	5.2	14.5						
95th	3.4	9.1						
90th	2.7	7.0						
75th	1.7	4.6						
Median	1.1	2.9						
25th	<1	1.8						
1st	<1	0.6						

Exhibit K-6. General Urban Case Study: Alternative NAAQS 2 (0.5 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	8.7	25.1	16.8%	9.8%	35.8%	13.2%	23.3%	1.1%
99.5th	7.6	17.2						
99th	7.0	14.5						
95th	5.6	9.1						
90th	4.8	7.0						
75th	3.6	4.6						
Median	2.1	2.9						
25th	<1	1.8						
1st	-	1.2						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	11.7	25.1	16.8%	9.8%	35.8%	13.2%	23.3%	1.1%
99.5th	10.6	17.2						
99th	10.1	14.5						
95th	8.7	9.1						
90th	7.9	7.0						
75th	6.6	4.6						
Median	5.2	2.9						
25th	3.8	1.8						
1st	1.2	0.6						
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	5.8	18.6	15.4%	9.0%	32.9%	3.4%	38.3%	1.0%
99.5th	5.1	12.7						
99th	4.8	10.6						
95th	3.0	6.7						
90th	2.4	5.2						
75th	1.6	3.4						
Median	<1	2.2						
25th	<1	1.4						
1st	<1	0.4						
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	7.9	18.6	15.4%	9.0%	32.9%	3.4%	38.3%	1.0%
99.5th	6.9	12.7						
99th	6.4	10.6						
95th	5.1	6.7						
90th	4.5	5.2						
75th	3.3	3.4						
Median	2.1	2.2						
25th	<1	1.4						
1st	-	0.9						

Exhibit K-6. General Urban Case Study: Alternative NAAQS 2 (0.5 $\mu g/m^3$, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	10.6	18.6						
99.5th	9.6	12.7						
99th	9.1	10.6						
95th	7.8	6.7						
90th	7.2	5.2	15.4%	9.0%	32.9%	3.4%	38.3%	1.0%
75th	6.0	3.4						
Median	4.8	2.2						
25th	3.5	1.4						
1st	1.2	0.4						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	7.2	31.4						
99.5th	6.0	20.9						
99th	5.5	17.2						
95th	4.0	10.5						
90th	3.0	8.0	15.4%	9.0%	32.9%	3.4%	38.3%	1.0%
75th	1.9	5.1						
Median	1.2	3.1						
25th	<1	1.9						
1st	<1	0.6						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	9.4	31.4						
99.5th	8.1	20.9						
99th	7.6	17.2						
95th	6.1	10.5						
90th	5.2	8.0	15.4%	9.0%	32.9%	3.4%	38.3%	1.0%
75th	3.9	5.1						
Median	2.4	3.1						
25th	<1	1.9						
1st	-	1.2						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	12.4	31.4						
99.5th	11.2	20.9						
99th	10.6	17.2						
95th	9.1	10.5						
90th	8.3	8.0	15.4%	9.0%	32.9%	3.4%	38.3%	1.0%
75th	6.9	5.1						
Median	5.4	3.1						
25th	3.9	1.9						
1st	1.2	0.6						

[a] Pathway contributions apply to all percentiles. See text for further discussion.
[b] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit K-7. General Urban Case Study: Alternative NAAQS 3 (0.2 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	4.1	9.1						
99.5th	3.1	6.8						
99th	2.7	6.0						
95th	1.9	4.2						
90th	1.6	3.5	19.7%	11.5%	41.9%	15.5%	10.9%	0.5%
75th	1.1	2.5						
Median	<1	1.7						
25th	<1	1.2						
1st	<1	0.5						
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	6.0	9.1						
99.5th	5.2	6.8						
99th	4.8	6.0						
95th	3.9	4.2						
90th	3.3	3.5	19.7%	11.5%	41.9%	15.5%	10.9%	0.5%
75th	2.5	2.5						
Median	1.5	1.7						
25th	<1	1.2						
1st	-	0.7						
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	8.7	9.1						
99.5th	7.9	6.8						
99th	7.5	6.0						
95th	6.6	4.2						
90th	6.0	3.5	19.7%	11.5%	41.9%	15.5%	10.9%	0.5%
75th	5.2	2.5						
Median	4.2	1.7						
25th	3.2	1.2						
1st	1.4	0.5						
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	4.1	10.8						
99.5th	3.1	8.3						
99th	2.8	7.5						
95th	2.1	5.4						
90th	1.7	4.6	19.7%	11.5%	41.9%	15.5%	10.9%	0.5%
75th	1.3	3.4						
Median	<1	2.5						
25th	<1	1.8						
1st	<1	0.8						

Exhibit K-7. General Urban Case Study: Alternative NAAQS 3 (0.2 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	6.1	10.8						
99.5th	5.3	8.3						
99th	5.0	7.5						
95th	4.0	5.4						
90th	3.5	4.6	19.7%	11.5%	41.9%	15.5%	10.9%	0.5%
75th	2.7	3.4						
Median	1.7	2.5						
25th	-	1.8						
1st	<1	1.1						
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	9.2	10.8						
99.5th	8.4	8.3						
99th	8.1	7.5						
95th	7.1	5.4						
90th	6.6	4.6	19.7%	11.5%	41.9%	15.5%	10.9%	0.5%
75th	5.7	3.4						
Median	4.7	2.5						
25th	3.8	1.8						
1st	1.8	0.8						
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	4.5	9.9						
99.5th	3.4	7.5						
99th	3.0	6.5						
95th	2.0	4.5						
90th	1.7	3.7	17.9%	10.4%	38.2%	6.0%	27.0%	0.5%
75th	1.2	2.7						
Median	<1	1.9						
25th	<1	1.3						
1st	<1	0.6						
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	6.2	9.9						
99.5th	5.5	7.5						
99th	5.1	6.5						
95th	4.1	4.5						
90th	3.6	3.7	17.9%	10.4%	43.7%	11.1%	27.0%	0.1%
75th	2.7	2.7						
Median	1.7	1.9						
25th	<1	1.3						
1st	-	0.8						

Exhibit K-7. General Urban Case Study: Alternative NAAQS 3 (0.2 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	8.9	9.9	17.9%	10.4%	38.2%	6.0%	27.0%	0.5%
99.5th	8.2	7.5						
99th	7.8	6.5						
95th	6.8	4.5						
90th	6.3	3.7						
75th	5.4	2.7						
Median	4.4	1.9						
25th	3.4	1.3						
1st	1.5	0.6						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	4.5	11.8	17.9%	10.4%	38.2%	6.0%	27.0%	0.5%
99.5th	3.5	9.3						
99th	3.1	8.2						
95th	2.2	5.9						
90th	1.9	5.0						
75th	1.4	3.7						
Median	1.0	2.7						
25th	<1	2.0						
1st	<1	0.9						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	6.4	11.8	17.9%	10.4%	38.2%	6.0%	27.0%	0.5%
99.5th	5.7	9.3						
99th	5.3	8.2						
95th	4.3	5.9						
90th	3.8	5.0						
75th	2.9	3.7						
Median	1.9	2.7						
25th	<1	2.0						
1st	-	1.2						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	9.5	11.8	17.9%	10.4%	38.2%	6.0%	27.0%	0.5%
99.5th	8.7	9.3						
99th	8.3	8.2						
95th	7.3	5.9						
90th	6.8	5.0						
75th	5.9	3.7						
Median	5.0	2.7						
25th	4.0	2.0						
1st	1.9	0.9						

Exhibit K-7. General Urban Case Study: Alternative NAAQS 3 (0.2 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	5.6	17.0						
99.5th	5.0	11.7						
99th	4.5	9.9						
95th	2.7	5.9						
90th	2.0	4.5	19.7%	11.5%	41.9%	15.5%	10.9%	0.5%
75th	1.3	2.9						
Median	<1	1.8						
25th	<1	1.1						
1st	<1	0.3						
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	7.6	17.0						
99.5th	6.7	11.7						
99th	6.2	9.9						
95th	4.8	5.9						
90th	4.1	4.5	19.7%	11.5%	41.9%	15.5%	10.9%	0.5%
75th	2.9	2.9						
Median	1.5	1.8						
25th	<1	1.1						
1st	-	0.6						
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	10.3	17.0						
99.5th	9.4	11.7						
99th	8.9	9.9						
95th	7.5	5.9						
90th	6.8	4.5	19.7%	11.5%	41.9%	15.5%	10.9%	0.5%
75th	5.6	2.9						
Median	4.2	1.8						
25th	2.9	1.1						
1st	<1	0.3						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	6.0	20.9						
99.5th	5.2	14.8						
99th	4.8	12.6						
95th	3.0	7.8						
90th	2.3	6.0	19.7%	11.5%	41.9%	15.5%	10.9%	0.5%
75th	1.5	4.0						
Median	<1	2.5						
25th	<1	1.6						
1st	<1	0.5						

Exhibit K-7. General Urban Case Study: Alternative NAAQS 3 (0.2 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust: Other [b]	Indoor Dust: Recent Air	
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	8.2	20.9						
99.5th	7.1	14.8						
99th	6.6	12.6						
95th	5.2	7.8						
90th	4.4	6.0	19.7%	11.5%	41.9%	15.5%	10.9%	0.5%
75th	3.1	4.0						
Median	1.7	2.5						
25th	<1	1.6						
1st	-	0.9						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	11.2	20.9						
99.5th	10.1	14.8						
99th	9.7	12.6						
95th	8.2	7.8						
90th	7.4	6.0	19.7%	11.5%	41.9%	15.5%	10.9%	0.5%
75th	6.2	4.0						
Median	4.7	2.5						
25th	3.3	1.6						
1st	1.1	0.5						
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	5.8	18.3						
99.5th	5.1	12.6						
99th	4.8	10.6						
95th	2.9	6.4						
90th	2.2	4.9	17.9%	10.4%	38.2%	6.0%	27.0%	0.5%
75th	1.4	3.1						
Median	<1	1.9						
25th	<1	1.1						
1st	<1	0.3						
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	7.8	18.3						
99.5th	6.8	12.6						
99th	6.4	10.6						
95th	5.0	6.4						
90th	4.3	4.9	17.9%	10.4%	38.2%	6.0%	27.0%	0.5%
75th	3.1	3.1						
Median	1.7	1.9						
25th	<1	1.1						
1st	-	1.0						

Exhibit K-7. General Urban Case Study: Alternative NAAQS 3 (0.2 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	10.5	18.3	17.9%	10.4%	38.2%	6.0%	27.0%	0.5%
99.5th	9.5	12.6						
99th	9.1	10.6						
95th	7.7	6.4						
90th	7.0	4.9						
75th	5.8	3.1						
Median	4.4	1.9						
25th	3.1	1.1						
1st	<1	0.3						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	6.2	22.6	17.9%	10.4%	38.2%	6.0%	27.0%	0.5%
99.5th	5.4	16.0						
99th	5.1	13.6						
95th	3.2	8.5						
90th	2.5	6.6						
75th	1.6	4.3						
Median	1.0	2.7						
25th	<1	1.7						
1st	<1	0.5						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	8.4	22.6	17.9%	10.4%	38.2%	6.0%	27.0%	0.5%
99.5th	7.3	16.0						
99th	6.8	13.6						
95th	5.4	8.5						
90th	4.6	6.6						
75th	3.4	4.3						
Median	1.9	2.7						
25th	<1	1.7						
1st	-	0.9						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	11.4	22.6	17.9%	10.4%	38.2%	6.0%	27.0%	0.5%
99.5th	10.4	16.0						
99th	9.9	13.6						
95th	8.4	8.5						
90th	7.7	6.6						
75th	6.4	4.3						
Median	5.0	2.7						
25th	3.6	1.7						
1st	1.1	0.5						

[a] Pathway contributions apply to all percentiles. See text for further discussion.
[b] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit K-8. General Urban Case Study: Alternative NAAQS 4 (0.05 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	3.6	7.9	21.5%	12.5%	45.8%	17.0%	3.0%	0.1%
99.5th	2.8	6.3						
99th	2.5	5.5						
95th	1.8	3.9						
90th	1.5	3.2						
75th	1.0	2.3						
Median	<1	1.6						
25th	<1	1.1						
1st	<1	0.5						
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	5.6	7.9	21.5%	12.5%	45.8%	17.0%	3.0%	0.1%
99.5th	5.0	6.3						
99th	4.6	5.5						
95th	3.7	3.9						
90th	3.1	3.2						
75th	2.3	2.3						
Median	1.3	1.6						
25th	<1	1.1						
1st	-	0.5						
Dust Model (Air-only Regression-based), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	8.3	7.9	21.5%	12.5%	45.8%	17.0%	3.0%	0.1%
99.5th	7.7	6.3						
99th	7.3	5.5						
95th	6.4	3.9						
90th	5.8	3.2						
75th	5.0	2.3						
Median	4.0	1.6						
25th	3.0	1.1						
1st	1.3	0.5						
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	3.6	9.4	21.5%	12.5%	45.8%	17.0%	3.0%	0.1%
99.5th	2.9	7.6						
99th	2.6	6.8						
95th	1.9	5.0						
90th	1.6	4.2						
75th	1.2	3.1						
Median	<1	2.3						
25th	<1	1.7						
1st	<1	0.8						

Exhibit K-8. General Urban Case Study: Alternative NAAQS 4 (0.05 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	5.7	9.4	21.5%	12.5%	45.8%	17.0%	3.0%	0.1%
99.5th	5.1	7.6						
99th	4.7	6.8						
95th	3.8	5.0						
90th	3.3	4.2						
75th	2.4	3.1						
Median	1.4	2.3						
25th	-	1.7						
1st	<1	0.8						
Dust Model (Air-only Regression-based), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	8.8	9.4	21.5%	12.5%	45.8%	17.0%	3.0%	0.1%
99.5th	8.1	7.6						
99th	7.8	6.8						
95th	6.8	5.0						
90th	6.3	4.2						
75th	5.4	3.1						
Median	4.5	2.3						
25th	3.5	1.7						
1st	1.6	0.8						
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	3.9	8.5	20.5%	11.9%	43.7%	11.1%	12.6%	0.1%
99.5th	3.0	6.7						
99th	2.7	5.9						
95th	1.8	4.1						
90th	1.5	3.4						
75th	1.1	2.4						
Median	<1	1.7						
25th	<1	1.2						
1st	<1	0.5						
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	5.8	8.5	20.5%	11.9%	43.7%	11.1%	12.6%	0.1%
99.5th	5.1	6.7						
99th	4.8	5.9						
95th	3.8	4.1						
90th	3.3	3.4						
75th	2.4	2.4						
Median	1.4	1.7						
25th	<1	1.2						
1st	-	0.8						

Exhibit K-8. General Urban Case Study: Alternative NAAQS 4 (0.05 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Hybrid), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	8.5	8.5	20.5%	11.9%	43.7%	11.1%	12.6%	0.1%
99.5th	7.8	6.7						
99th	7.5	5.9						
95th	6.5	4.1						
90th	6.0	3.4						
75th	5.1	2.4						
Median	4.1	1.7						
25th	3.1	1.2						
1st	1.3	0.5						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	3.8	10.0	20.5%	11.9%	43.7%	11.1%	12.6%	0.1%
99.5th	3.1	8.1						
99th	2.7	7.2						
95th	2.0	5.2						
90th	1.7	4.4						
75th	1.3	3.3						
Median	<1	2.4						
25th	<1	1.7						
1st	<1	0.8						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	5.9	10.0	20.5%	11.9%	43.7%	11.1%	12.6%	0.1%
99.5th	5.3	8.1						
99th	4.9	7.2						
95th	3.9	5.2						
90th	3.4	4.4						
75th	2.5	3.3						
Median	1.6	2.4						
25th	<1	1.7						
1st	-	1.2						
Dust Model (Hybrid), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	9.0	10.0	20.5%	11.9%	43.7%	11.1%	12.6%	0.1%
99.5th	8.3	8.1						
99th	8.0	7.2						
95th	7.0	5.2						
90th	6.5	4.4						
75th	5.6	3.3						
Median	4.6	2.4						
25th	3.7	1.7						
1st	1.7	0.8						

Exhibit K-8. General Urban Case Study: Alternative NAAQS 4 (0.05 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	5.5	15.8						
99.5th	5.0	11.2						
99th	4.2	9.2						
95th	2.5	5.5						
90th	1.9	4.2	21.5%	12.5%	45.8%	17.0%	3.0%	0.1%
75th	1.2	2.7						
Median	<1	1.6						
25th	<1	1.0						
1st	<1	0.3						
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	7.5	15.8						
99.5th	6.5	11.2						
99th	6.0	9.2						
95th	4.6	5.5						
90th	3.9	4.2	21.5%	12.5%	45.8%	17.0%	3.0%	0.1%
75th	2.7	2.7						
Median	1.3	1.6						
25th	-	0.7						
1st	-	0.7						
Dust Model (Air-only Regression-based), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	10.2	15.8						
99.5th	9.2	11.2						
99th	8.7	9.2						
95th	7.3	5.5						
90th	6.6	4.2	21.5%	12.5%	45.8%	17.0%	3.0%	0.1%
75th	5.4	2.7						
Median	4.0	1.6						
25th	2.6	1.0						
1st	<1	0.3						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	5.8	19.3						
99.5th	5.1	14.0						
99th	4.4	11.7						
95th	2.7	7.2						
90th	2.1	5.6	21.5%	12.5%	45.8%	17.0%	3.0%	0.1%
75th	1.4	3.7						
Median	<1	2.3						
25th	<1	1.4						
1st	<1	0.5						

Exhibit K-8. General Urban Case Study: Alternative NAAQS 4 (0.05 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
						Other [b]	Recent Air	
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	7.9	19.3	21.5%	12.5%	45.8%	17.0%	3.0%	0.1%
99.5th	6.9	14.0						
99th	6.4	11.7						
95th	4.9	7.2						
90th	4.1	5.6						
75th	2.9	3.7						
Median	1.4	2.3						
25th	<1	1.4						
1st	-	1.0						
Dust Model (Air-only Regression-based), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	11.0	19.3	21.5%	12.5%	45.8%	17.0%	3.0%	0.1%
99.5th	10.0	14.0						
99th	9.4	11.7						
95th	8.0	7.2						
90th	7.2	5.6						
75th	5.9	3.7						
Median	4.5	2.3						
25th	3.1	1.4						
1st	<1	0.5						
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Two-piece Linear)								
99.9th	5.5	16.2	20.5%	11.9%	43.7%	11.1%	12.6%	0.1%
99.5th	5.0	11.5						
99th	4.3	9.5						
95th	2.6	5.7						
90th	2.0	4.4						
75th	1.3	2.8						
Median	<1	1.7						
25th	<1	1.0						
1st	<1	0.3						
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)								
99.9th	7.5	16.2	20.5%	11.9%	43.7%	11.1%	12.6%	0.1%
99.5th	6.6	11.5						
99th	6.1	9.5						
95th	4.7	5.7						
90th	4.0	4.4						
75th	2.7	2.8						
Median	1.4	1.7						
25th	<1	1.0						
1st	-	0.7						

Exhibit K-8. General Urban Case Study: Alternative NAAQS 4 (0.05 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution [a]					
			Ingestion					Inhalation (Recent Air)
			Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust: Other [b]	Indoor Dust: Recent Air	
Dust Model (Hybrid), GSD (2.1), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)								
99.9th	10.2	16.2	20.5%	11.9%	43.7%	11.1%	12.6%	0.1%
99.5th	9.3	11.5						
99th	8.8	9.5						
95th	7.4	5.7						
90th	6.7	4.4						
75th	5.4	2.8						
Median	4.1	1.7						
25th	2.7	1.0						
1st	<1	0.3						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Two-piece Linear)								
99.9th	5.9	19.9	20.5%	11.9%	43.7%	11.1%	12.6%	0.1%
99.5th	5.2	14.4						
99th	4.6	12.1						
95th	2.8	7.5						
90th	2.2	5.9						
75th	1.4	3.8						
Median	<1	2.4						
25th	<1	1.5						
1st	<1	0.5						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)								
99.9th	8.0	19.9	20.5%	11.9%	43.7%	11.1%	12.6%	0.1%
99.5th	7.0	14.4						
99th	6.5	12.1						
95th	5.0	7.5						
90th	4.3	5.9						
75th	3.0	3.8						
Median	1.5	2.4						
25th	<1	1.5						
1st	-	1.1						
Dust Model (Hybrid), GSD (2.0), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)								
99.9th	11.0	19.9	20.5%	11.9%	43.7%	11.1%	12.6%	0.1%
99.5th	10.1	14.4						
99th	9.5	12.1						
95th	8.1	7.5						
90th	7.3	5.9						
75th	6.0	3.8						
Median	4.6	2.4						
25th	3.2	1.5						
1st	1.0	0.5						

[a] Pathway contributions apply to all percentiles. See text for further discussion.
[b] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

K.2. PRIMARY PB SMELTER CASE STUDY

K.2.1. Description of Scenarios Analyzed

For the primary Pb smelter case study, Exhibit K-9 lists the NAAQS scenarios, along with the PbB metrics and IQ functions that were used to generate IQ estimates for the primary Pb smelter case study. As discussed in Appendix I, PbB results were generated using the site-specific H6 model for the U.S. Census blocks and block groups within 1.5 kilometer (km) of the source. Dust concentration estimates in more distant U.S. Census blocks and block groups were derived using the U.S. EPA air+soil regression-based model, as discussed in Appendix G. Inter-individual variability was incorporated using a single GSD for each PbB metric (i.e., concurrent and lifetime). Three different IQ functions (two-piece linear, log linear with cutpoint, and loglinear with linearization) were used to estimate the IQ decrements for each for each of the five NAAQS scenarios, as summarized in the Exhibit K-9.

Exhibit K-9. IQ Decrement Scenarios Run for the Primary Pb Smelter Case Study

NAAQS Scenario	Dust Model	GSD (µg/dL)	PbB Metric	IQ Functions
Current NAAQS (1.5 µg/m^3, max quarterly average)	H6 or air+soil regression-based model	1.7	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		1.6	Lifetime	
Alternative NAAQS 1 (0.2 µg/m^3, max quarterly average)	H6 or air+soil regression-based model	1.7	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		1.6	Lifetime	
Alternative NAAQS 2 (0.5 µg/m^3, max monthly average)	H6 or air+soil regression-based model	1.7	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		1.6	Lifetime	
Alternative NAAQS 3 (0.2 µg/m^3, max monthly average)	H6 or air+soil regression-based model	1.7	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		1.6	Lifetime	
Alternative NAAQS 4 (0.05 µg/m^3, max monthly average)	H6 or air+soil regression-based model	1.7	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		1.6	Lifetime	

K.2.2. IQ Decrement Results for the Primary Pb Smelter Case Study

Exhibits K-10 through K-14 summarize the IQ modeling distribution estimates for the NAAQS scenarios associated with the primary Pb smelter case study. Just as for the general urban case study, IQ decrements less than one IQ point are considered to be indistinguishable from zero within the expected error of the PbB and IQ models, and are reported as "<1." IQ losses that were exactly zero because the estimated PbB was below the cutpoint are reported as "-." The PbB values corresponding to the given IQ percentile are also given. The exhibits also present estimates of the proportional contribution of each exposure pathway to the total Pb uptake. The contributions from the policy-relevant air and background pathways are estimated as described in Section K.1.2. Just as in the general urban case study, because of nonlinearities in the IQ functions, the estimated pathway contributions to IQ impacts are only approximate. In addition, use of the two-piece linear IQ function results in the lowest estimated IQ losses, while the log-linear model with linearization results in the highest IQ losses.

Exhibit K-10. Primary Pb Smelter Case Study: Current NAAQS (1.5 µg/m^3, Maximum Quarterly Average) Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution					
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)									
99.9th	4	5.8	18.8	3.0%	1.7%	11.5%	27.0%	56.0%	0.8%
99.5th	19	5.0	11.7	4.0%	2.3%	14.7%	35.9%	42.5%	0.6%
99th	39	4.2	9.2	6.3%	3.7%	6.8%	56.7%	25.9%	0.6%
95th	194	2.2	4.8	21.6%	12.6%	39.1%	17.1%	9.0%	0.7%
90th	388	1.6	3.6	15.1%	8.8%	48.5%	17.1%	9.8%	0.7%
75th	970	1.1	2.3	32.9%	19.1%	22.6%	17.2%	7.6%	0.6%
Median	1940	<1	1.5	30.9%	18.0%	27.1%	17.5%	6.1%	0.4%
25th	2910	<1	1.0	36.9%	21.5%	18.9%	17.7%	4.6%	0.4%
1st	3841	<1	0.4	30.9%	18.0%	27.1%	17.5%	6.1%	0.4%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)									
99.9th	4	7.9	18.8	3.0%	1.7%	11.5%	27.0%	56.0%	0.8%
99.5th	19	6.7	11.7	4.0%	2.3%	14.7%	35.9%	42.5%	0.6%
99th	39	6.0	9.2	6.3%	3.7%	6.8%	56.7%	25.9%	0.6%
95th	194	4.2	4.8	21.6%	12.6%	39.1%	17.1%	9.0%	0.7%
90th	388	3.5	3.6	15.1%	8.8%	48.5%	17.1%	9.8%	0.7%
75th	970	2.3	2.3	32.9%	19.1%	22.6%	17.2%	7.6%	0.6%
Median	1940	1.1	1.5	30.9%	18.0%	27.1%	17.5%	6.1%	0.4%
25th	2910	-	0.9	21.9%	12.8%	37.8%	16.9%	9.8%	0.8%
1st	3841	-	0.9	21.9%	12.8%	37.8%	16.9%	9.8%	0.8%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)									
99.9th	4	10.6	18.8	3.0%	1.7%	11.5%	27.0%	56.0%	0.8%
99.5th	19	9.4	11.7	4.0%	2.3%	14.7%	35.9%	42.5%	0.6%
99th	39	8.7	9.2	6.3%	3.7%	6.8%	56.7%	25.9%	0.6%
95th	194	6.9	4.8	21.6%	12.6%	39.1%	17.1%	9.0%	0.7%
90th	388	6.2	3.6	15.1%	8.8%	48.5%	17.1%	9.8%	0.7%
75th	970	5.0	2.3	32.9%	19.1%	22.6%	17.2%	7.6%	0.6%
Median	1940	3.8	1.5	11.1%	6.5%	53.9%	16.9%	10.8%	0.9%
25th	2910	2.7	1.0	36.9%	21.5%	18.9%	17.7%	4.6%	0.4%
1st	3841	1.0	0.4	30.9%	18.0%	27.1%	17.5%	6.1%	0.4%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)									
99.9th	4	6.4	24.3	4.9%	2.9%	9.8%	44.6%	37.2%	0.6%
99.5th	19	5.3	15.4	4.9%	2.8%	8.2%	44.2%	39.2%	0.7%
99th	39	4.7	12.5	18.0%	10.5%	45.1%	17.3%	8.5%	0.7%
95th	194	2.5	6.5	12.4%	7.2%	49.3%	16.3%	13.7%	1.1%
90th	388	1.8	4.8	18.0%	10.5%	44.7%	17.2%	8.9%	0.7%
75th	970	1.2	3.2	32.9%	19.1%	22.6%	17.2%	7.6%	0.6%
Median	1940	<1	2.1	15.0%	8.7%	47.7%	16.8%	10.9%	0.9%
25th	2910	<1	1.4	32.9%	19.1%	22.6%	17.2%	7.6%	0.6%
1st	3841	<1	0.6	31.7%	18.5%	28.0%	18.1%	3.5%	0.3%

Exhibit K-10. Primary Pb Smelter Case Study: Current NAAQS (1.5 µg/m^3, Maximum Quarterly Average) Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution					
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)									
99.9th	4	8.6	24.3	4.9%	2.9%	9.8%	44.6%	37.2%	0.6%
99.5th	19	7.2	15.4	4.9%	2.8%	8.2%	44.2%	39.2%	0.7%
99th	39	6.6	12.5	18.0%	10.5%	45.1%	17.3%	8.5%	0.7%
95th	194	4.6	6.5	12.4%	7.2%	49.3%	16.3%	13.7%	1.1%
90th	388	3.7	4.8	18.0%	10.5%	44.7%	17.2%	8.9%	0.7%
75th	970	2.4	3.2	32.9%	19.1%	22.6%	17.2%	7.6%	0.6%
Median	1940	1.1	2.1	15.0%	8.7%	47.7%	16.8%	10.9%	0.9%
25th	2910	-	1.4	21.9%	12.8%	37.8%	16.9%	9.8%	0.8%
1st	3841	-	1.4	21.9%	12.8%	37.8%	16.9%	9.8%	0.8%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)									
99.9th	4	11.6	24.3	4.9%	2.9%	9.8%	44.6%	37.2%	0.6%
99.5th	19	10.3	15.4	4.9%	2.8%	8.2%	44.2%	39.2%	0.7%
99th	39	9.6	12.5	18.0%	10.5%	45.1%	17.3%	8.5%	0.7%
95th	194	7.6	6.5	12.4%	7.2%	49.3%	16.3%	13.7%	1.1%
90th	388	6.8	4.8	18.0%	10.5%	44.7%	17.2%	8.9%	0.7%
75th	970	5.5	3.2	32.9%	19.1%	22.6%	17.2%	7.6%	0.6%
Median	1940	4.2	2.1	36.9%	21.5%	18.9%	17.7%	4.6%	0.4%
25th	2910	3.0	1.4	32.9%	19.1%	22.6%	17.2%	7.6%	0.6%
1st	3841	1.2	0.6	31.7%	18.5%	28.0%	18.1%	3.5%	0.3%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit K-11. Primary Pb Smelter Case Study: Alternative NAAQS 1 (0.2 µg/m^3, Maximum Quarterly Average) Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution					
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)									
99.9th	4	5.0	11.3	5.3%	3.1%	26.8%	15.5%	48.9%	0.4%
99.5th	19	3.6	7.8	10.3%	6.0%	63.1%	18.9%	1.6%	0.1%
99th	39	3.0	6.6	12.2%	7.1%	59.3%	18.6%	2.6%	0.2%
95th	194	1.9	4.1	16.5%	9.6%	52.8%	18.6%	2.3%	0.2%
90th	388	1.5	3.2	23.9%	13.9%	41.2%	18.5%	2.3%	0.2%
75th	970	<1	2.2	12.2%	7.1%	59.3%	18.6%	2.6%	0.2%
Median	1940	<1	1.4	32.5%	18.9%	28.6%	18.5%	1.4%	0.1%
25th	2910	<1	0.9	16.5%	9.6%	52.8%	18.6%	2.3%	0.2%
1st	3841	<1	0.4	38.4%	22.4%	19.7%	18.4%	1.0%	0.1%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)									
99.9th	4	6.5	11.3	5.3%	3.1%	26.8%	15.5%	48.9%	0.4%
99.5th	19	5.6	7.8	10.3%	6.0%	63.1%	18.9%	1.6%	0.1%
99th	39	5.1	6.6	12.2%	7.1%	59.3%	18.6%	2.6%	0.2%
95th	194	3.8	4.1	16.5%	9.6%	52.8%	18.6%	2.3%	0.2%
90th	388	3.2	3.2	23.9%	13.9%	41.2%	18.5%	2.3%	0.2%
75th	970	2.1	2.2	12.2%	7.1%	59.3%	18.6%	2.6%	0.2%
Median	1940	<1	1.4	32.5%	18.9%	28.6%	18.5%	1.4%	0.1%
25th	2910	-	1.0	12.2%	7.1%	59.3%	18.6%	2.6%	0.2%
1st	3841	-	1.0	12.2%	7.1%	59.3%	18.6%	2.6%	0.2%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)									
99.9th	4	9.2	11.3	5.3%	3.1%	26.8%	15.5%	48.9%	0.4%
99.5th	19	8.3	7.8	10.3%	6.0%	63.1%	18.9%	1.6%	0.1%
99th	39	7.8	6.6	12.2%	7.1%	59.3%	18.6%	2.6%	0.2%
95th	194	6.5	4.1	16.5%	9.6%	52.8%	18.6%	2.3%	0.2%
90th	388	5.9	3.2	23.9%	13.9%	41.2%	18.5%	2.3%	0.2%
75th	970	4.8	2.2	12.2%	7.1%	59.3%	18.6%	2.6%	0.2%
Median	1940	3.6	1.4	32.5%	18.9%	28.6%	18.5%	1.4%	0.1%
25th	2910	2.5	0.9	16.5%	9.6%	52.8%	18.6%	2.3%	0.2%
1st	3841	<1	0.4	38.4%	22.4%	19.7%	18.4%	1.0%	0.1%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)									
99.9th	4	5.2	14.3	7.1%	4.2%	68.5%	19.0%	1.1%	0.1%
99.5th	19	3.9	10.2	16.0%	9.3%	53.8%	18.7%	2.1%	0.2%
99th	39	3.3	8.6	6.0%	3.5%	16.9%	17.7%	55.3%	0.5%
95th	194	2.1	5.5	7.7%	4.5%	17.0%	22.6%	47.8%	0.4%
90th	388	1.6	4.3	12.2%	7.1%	59.3%	18.6%	2.6%	0.2%
75th	970	1.1	2.9	25.5%	14.8%	39.7%	18.7%	1.3%	0.1%
Median	1940	<1	1.9	38.4%	22.4%	19.7%	18.4%	1.0%	0.1%
25th	2910	<1	1.3	22.7%	13.2%	43.4%	18.6%	2.0%	0.2%
1st	3841	<1	0.5	31.9%	18.6%	28.9%	18.3%	2.1%	0.2%

Exhibit K-11. Primary Pb Smelter Case Study: Alternative NAAQS 1 (0.2 µg/m^3, Maximum Quarterly Average) Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution					
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)									
99.9th	4	7.0	14.3	7.1%	4.2%	68.5%	19.0%	1.1%	0.1%
99.5th	19	6.0	10.2	16.0%	9.3%	53.8%	18.7%	2.1%	0.2%
99th	39	5.5	8.6	6.0%	3.5%	16.9%	17.7%	55.3%	0.5%
95th	194	4.1	5.5	7.7%	4.5%	17.0%	22.6%	47.8%	0.4%
90th	388	3.4	4.3	12.2%	7.1%	59.3%	18.6%	2.6%	0.2%
75th	970	2.2	2.9	25.5%	14.8%	39.7%	18.7%	1.3%	0.1%
Median	1940	<1	1.9	34.3%	20.0%	25.7%	18.4%	1.4%	0.1%
25th	2910	-	1.3	23.9%	13.9%	41.2%	18.5%	2.3%	0.2%
1st	3841	-	1.3	23.9%	13.9%	41.2%	18.5%	2.3%	0.2%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)									
99.9th	4	10.0	14.3	7.1%	4.2%	68.5%	19.0%	1.1%	0.1%
99.5th	19	9.0	10.2	16.0%	9.3%	53.8%	18.7%	2.1%	0.2%
99th	39	8.5	8.6	6.0%	3.5%	16.9%	17.7%	55.3%	0.5%
95th	194	7.1	5.5	7.7%	4.5%	17.0%	22.6%	47.8%	0.4%
90th	388	6.4	4.3	12.2%	7.1%	59.3%	18.6%	2.6%	0.2%
75th	970	5.2	2.9	25.5%	14.8%	39.7%	18.7%	1.3%	0.1%
Median	1940	4.0	1.9	34.3%	20.0%	25.7%	18.4%	1.4%	0.1%
25th	2910	2.8	1.3	22.7%	13.2%	43.4%	18.6%	2.0%	0.2%
1st	3841	1.2	0.5	31.9%	18.6%	28.9%	18.3%	2.1%	0.2%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit K-12. Primary Pb Smelter Case Study: Alternative NAAQS 2 (0.5 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution					
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust)	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)									
99.9th	4	5.3	14.1	4.8%	2.8%	18.5%	23.9%	49.4%	0.6%
99.5th	19	4.1	9.1	4.8%	2.8%	18.5%	23.9%	49.4%	0.6%
99th	39	3.3	7.4	10.2%	5.9%	7.3%	50.4%	25.7%	0.4%
95th	194	2.0	4.3	25.6%	14.9%	37.3%	18.1%	3.8%	0.3%
90th	388	1.5	3.4	18.9%	11.0%	47.6%	18.2%	3.9%	0.3%
75th	970	1.0	2.2	16.1%	9.4%	51.5%	18.1%	4.6%	0.4%
Median	1940	<1	1.4	35.9%	20.9%	22.6%	18.2%	2.2%	0.2%
25th	2910	<1	1.0	34.4%	20.1%	23.7%	18.0%	3.5%	0.3%
1st	3841	<1	0.4	35.9%	20.9%	22.6%	18.2%	2.2%	0.2%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)									
99.9th	4	7.1	14.1	4.8%	2.8%	18.5%	23.9%	49.4%	0.6%
99.5th	19	6.0	9.1	4.8%	2.8%	18.5%	23.9%	49.4%	0.6%
99th	39	5.4	7.4	10.2%	5.9%	7.3%	50.4%	25.7%	0.4%
95th	194	4.0	4.3	25.6%	14.9%	37.3%	18.1%	3.8%	0.3%
90th	388	3.3	3.4	18.9%	11.0%	47.6%	18.2%	3.9%	0.3%
75th	970	2.1	2.2	16.1%	9.4%	51.5%	18.1%	4.6%	0.4%
Median	1940	<1	1.4	35.9%	20.9%	22.6%	18.2%	2.2%	0.2%
25th	2910	-	0.7	25.1%	14.6%	39.2%	18.4%	2.5%	0.2%
1st	3841	-	0.7	25.1%	14.6%	39.2%	18.4%	2.5%	0.2%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)									
99.9th	4	9.8	14.1	4.8%	2.8%	18.5%	23.9%	49.4%	0.6%
99.5th	19	8.7	9.1	4.8%	2.8%	18.5%	23.9%	49.4%	0.6%
99th	39	8.1	7.4	10.2%	5.9%	7.3%	50.4%	25.7%	0.4%
95th	194	6.7	4.3	25.6%	14.9%	37.3%	18.1%	3.8%	0.3%
90th	388	6.0	3.4	18.9%	11.0%	47.6%	18.2%	3.9%	0.3%
75th	970	4.8	2.2	16.1%	9.4%	51.5%	18.1%	4.6%	0.4%
Median	1940	3.7	1.4	35.9%	20.9%	22.6%	18.2%	2.2%	0.2%
25th	2910	2.6	1.0	34.4%	20.1%	23.7%	18.0%	3.5%	0.3%
1st	3841	<1	0.4	35.9%	20.9%	22.6%	18.2%	2.2%	0.2%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)									
99.9th	4	5.7	18.4	11.7%	6.8%	56.1%	17.7%	7.1%	0.6%
99.5th	19	4.6	12.2	3.7%	2.1%	18.5%	18.1%	57.0%	0.6%
99th	39	3.7	9.7	4.8%	2.8%	18.5%	23.9%	49.4%	0.6%
95th	194	2.2	5.8	11.9%	6.9%	57.6%	18.1%	5.1%	0.4%
90th	388	1.7	4.5	7.9%	4.6%	15.7%	38.9%	32.5%	0.4%
75th	970	1.1	3.0	16.0%	9.3%	51.1%	18.0%	5.1%	0.4%
Median	1940	<1	2.0	32.0%	18.7%	28.1%	18.2%	2.8%	0.2%
25th	2910	<1	1.3	34.4%	20.1%	23.7%	18.0%	3.5%	0.3%
1st	3841	<1	0.6	25.6%	14.9%	37.3%	18.1%	3.8%	0.3%

Exhibit K-12. Primary Pb Smelter Case Study: Alternative NAAQS 2 (0.5 µg/m³, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution					
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust)	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)									
99.9th	4	7.8	18.4	11.7%	6.8%	56.1%	17.7%	7.1%	0.6%
99.5th	19	6.5	12.2	3.7%	2.1%	18.5%	18.1%	57.0%	0.6%
99th	39	5.8	9.7	4.8%	2.8%	18.5%	23.9%	49.4%	0.6%
95th	194	4.3	5.8	11.9%	6.9%	57.6%	18.1%	5.1%	0.4%
90th	388	3.5	4.5	7.9%	4.6%	15.7%	38.9%	32.5%	0.4%
75th	970	2.3	3.0	16.0%	9.3%	51.1%	18.0%	5.1%	0.4%
Median	1940	<1	2.0	32.0%	18.7%	28.1%	18.2%	2.8%	0.2%
25th	2910	-	1.0	25.1%	14.6%	39.2%	18.4%	2.5%	0.2%
1st	3841	-	1.0	25.1%	14.6%	39.2%	18.4%	2.5%	0.2%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)									
99.9th	4	10.8	18.4	11.7%	6.8%	56.1%	17.7%	7.1%	0.6%
99.5th	19	9.6	12.2	3.7%	2.1%	18.5%	18.1%	57.0%	0.6%
99th	39	8.9	9.7	4.8%	2.8%	18.5%	23.9%	49.4%	0.6%
95th	194	7.3	5.8	11.9%	6.9%	57.6%	18.1%	5.1%	0.4%
90th	388	6.5	4.5	7.9%	4.6%	15.7%	38.9%	32.5%	0.4%
75th	970	5.3	3.0	16.0%	9.3%	51.1%	18.0%	5.1%	0.4%
Median	1940	4.0	2.0	32.0%	18.7%	28.1%	18.2%	2.8%	0.2%
25th	2910	2.8	1.3	34.4%	20.1%	23.7%	18.0%	3.5%	0.3%
1st	3841	1.2	0.6	25.6%	14.9%	37.3%	18.1%	3.8%	0.3%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit K-13. Primary Pb Smelter Case Study: Alternative NAAQS 3 (0.2 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution					
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)									
99.9th	4	4.9	10.9	12.3%	7.2%	58.8%	18.5%	3.0%	0.2%
99.5th	19	3.5	7.8	16.6%	9.7%	52.8%	18.6%	2.1%	0.2%
99th	39	3.0	6.5	14.1%	8.2%	56.1%	18.6%	2.8%	0.2%
95th	194	1.9	4.1	19.8%	11.5%	48.2%	18.7%	1.7%	0.1%
90th	388	1.4	3.2	14.1%	8.2%	56.1%	18.6%	2.8%	0.2%
75th	970	<1	2.2	26.1%	15.2%	37.7%	18.4%	2.5%	0.2%
Median	1940	<1	1.4	14.1%	8.2%	56.1%	18.6%	2.8%	0.2%
25th	2910	<1	0.9	24.0%	14.0%	41.4%	18.5%	1.9%	0.1%
1st	3841	<1	0.4	34.5%	20.1%	25.3%	18.4%	1.5%	0.1%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)									
99.9th	4	6.5	10.9	12.3%	7.2%	58.8%	18.5%	3.0%	0.2%
99.5th	19	5.5	7.8	16.6%	9.7%	52.8%	18.6%	2.1%	0.2%
99th	39	5.1	6.5	14.1%	8.2%	56.1%	18.6%	2.8%	0.2%
95th	194	3.8	4.1	19.8%	11.5%	48.2%	18.7%	1.7%	0.1%
90th	388	3.1	3.2	14.1%	8.2%	56.1%	18.6%	2.8%	0.2%
75th	970	2.1	2.2	26.1%	15.2%	37.7%	18.4%	2.5%	0.2%
Median	1940	<1	1.4	35.2%	20.5%	24.3%	18.4%	1.4%	0.1%
25th	2910	-	0.4	36.4%	21.2%	22.9%	18.5%	0.9%	0.1%
1st	3841	-	0.4	36.4%	21.2%	22.9%	18.5%	0.9%	0.1%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)									
99.9th	4	9.2	10.9	12.3%	7.2%	58.8%	18.5%	3.0%	0.2%
99.5th	19	8.2	7.8	16.6%	9.7%	52.8%	18.6%	2.1%	0.2%
99th	39	7.8	6.5	14.1%	8.2%	56.1%	18.6%	2.8%	0.2%
95th	194	6.5	4.1	19.8%	11.5%	48.2%	18.7%	1.7%	0.1%
90th	388	5.8	3.2	14.1%	8.2%	56.1%	18.6%	2.8%	0.2%
75th	970	4.8	2.2	26.1%	15.2%	37.7%	18.4%	2.5%	0.2%
Median	1940	3.6	1.4	14.1%	8.2%	56.1%	18.6%	2.8%	0.2%
25th	2910	2.5	0.9	24.0%	14.0%	41.4%	18.5%	1.9%	0.1%
1st	3841	<1	0.4	34.5%	20.1%	25.3%	18.4%	1.5%	0.1%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)									
99.9th	4	5.1	14.0	10.4%	6.0%	63.3%	18.9%	1.3%	0.1%
99.5th	19	3.8	10.0	5.8%	3.4%	29.5%	14.7%	46.2%	0.4%
99th	39	3.2	8.5	16.6%	9.7%	52.8%	18.6%	2.1%	0.2%
95th	194	2.1	5.5	16.6%	9.6%	53.1%	18.7%	1.9%	0.1%
90th	388	1.6	4.3	12.2%	7.1%	24.2%	30.7%	25.6%	0.3%
75th	970	1.1	2.9	35.2%	20.5%	24.3%	18.4%	1.4%	0.1%
Median	1940	<1	1.9	26.3%	15.3%	38.2%	18.6%	1.5%	0.1%
25th	2910	<1	1.3	16.6%	9.6%	53.1%	18.7%	1.9%	0.1%
1st	3841	<1	0.5	35.2%	20.5%	24.3%	18.4%	1.4%	0.1%

Exhibit K-13. Primary Pb Smelter Case Study: Alternative NAAQS 3 (0.2 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution					
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)									
99.9th	4	6.9	14.0	10.4%	6.0%	63.3%	18.9%	1.3%	0.1%
99.5th	19	5.9	10.0	5.8%	3.4%	29.5%	14.7%	46.2%	0.4%
99th	39	5.4	8.5	16.6%	9.7%	52.8%	18.6%	2.1%	0.2%
95th	194	4.1	5.5	16.6%	9.6%	53.1%	18.7%	1.9%	0.1%
90th	388	3.3	4.3	12.2%	7.1%	24.2%	30.7%	25.6%	0.3%
75th	970	2.2	2.9	35.2%	20.5%	24.3%	18.4%	1.4%	0.1%
Median	1940	<1	1.9	20.6%	12.0%	46.9%	18.6%	1.7%	0.1%
25th	2910	-	0.7	36.4%	21.2%	22.9%	18.5%	0.9%	0.1%
1st	3841	-	0.7	36.4%	21.2%	22.9%	18.5%	0.9%	0.1%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)									
99.9th	4	10.0	14.0	10.4%	6.0%	63.3%	18.9%	1.3%	0.1%
99.5th	19	9.0	10.0	5.8%	3.4%	29.5%	14.7%	46.2%	0.4%
99th	39	8.5	8.5	16.6%	9.7%	52.8%	18.6%	2.1%	0.2%
95th	194	7.1	5.5	16.6%	9.6%	53.1%	18.7%	1.9%	0.1%
90th	388	6.4	4.3	12.2%	7.1%	24.2%	30.7%	25.6%	0.3%
75th	970	5.2	2.9	35.2%	20.5%	24.3%	18.4%	1.4%	0.1%
Median	1940	4.0	1.9	26.3%	15.3%	38.2%	18.6%	1.5%	0.1%
25th	2910	2.8	1.3	16.6%	9.6%	53.1%	18.7%	1.9%	0.1%
1st	3841	1.2	0.5	35.2%	20.5%	24.3%	18.4%	1.4%	0.1%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit K-14. Primary Pb Smelter Case Study: Alternative NAAQS 4 (0.05 µg/m³, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution					
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)									
99.9th	4	4.4	9.8	16.4%	9.6%	45.0%	14.9%	14.0%	0.1%
99.5th	19	3.2	7.1	7.6%	4.5%	68.4%	19.2%	0.3%	0.0%
99th	39	2.7	6.0	16.8%	9.8%	53.9%	19.0%	0.5%	0.0%
95th	194	1.8	3.9	16.6%	9.7%	54.1%	19.0%	0.6%	0.0%
90th	388	1.4	3.1	23.1%	13.5%	44.1%	18.9%	0.4%	0.0%
75th	970	<1	2.1	28.5%	16.6%	35.9%	18.8%	0.3%	0.0%
Median	1940	<1	1.4	32.9%	19.2%	29.0%	18.7%	0.2%	0.0%
25th	2910	<1	0.9	14.4%	8.4%	57.4%	19.0%	0.7%	0.1%
1st	3841	<1	0.4	19.1%	11.1%	38.0%	17.3%	14.4%	0.1%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)									
99.9th	4	6.2	9.8	16.4%	9.6%	45.0%	14.9%	14.0%	0.1%
99.5th	19	5.3	7.1	7.6%	4.5%	68.4%	19.2%	0.3%	0.0%
99th	39	4.9	6.0	16.8%	9.8%	53.9%	19.0%	0.5%	0.0%
95th	194	3.7	3.9	16.6%	9.7%	54.1%	19.0%	0.6%	0.0%
90th	388	3.0	3.1	23.1%	13.5%	44.1%	18.9%	0.4%	0.0%
75th	970	2.0	2.1	28.5%	16.6%	35.9%	18.8%	0.3%	0.0%
Median	1940	<1	1.4	32.9%	19.2%	29.0%	18.7%	0.2%	0.0%
25th	2910	-	0.9	35.6%	20.8%	24.6%	18.6%	0.4%	0.0%
1st	3841	-	0.9	35.6%	20.8%	24.6%	18.6%	0.4%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)									
99.9th	4	8.9	9.8	16.4%	9.6%	45.0%	14.9%	14.0%	0.1%
99.5th	19	8.0	7.1	7.6%	4.5%	68.4%	19.2%	0.3%	0.0%
99th	39	7.6	6.0	16.8%	9.8%	53.9%	19.0%	0.5%	0.0%
95th	194	6.4	3.9	16.6%	9.7%	54.1%	19.0%	0.6%	0.0%
90th	388	5.7	3.1	23.1%	13.5%	44.1%	18.9%	0.4%	0.0%
75th	970	4.7	2.1	28.5%	16.6%	35.9%	18.8%	0.3%	0.0%
Median	1940	3.6	1.4	32.9%	19.2%	29.0%	18.7%	0.2%	0.0%
25th	2910	2.5	0.9	14.4%	8.4%	57.4%	19.0%	0.7%	0.1%
1st	3841	<1	0.4	19.1%	11.1%	38.0%	17.3%	14.4%	0.1%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)									
99.9th	4	4.6	12.2	14.4%	8.4%	57.4%	19.0%	0.7%	0.1%
99.5th	19	3.4	9.0	14.4%	8.4%	57.4%	19.0%	0.7%	0.1%
99th	39	3.0	7.8	14.4%	8.4%	57.4%	19.0%	0.7%	0.1%
95th	194	1.9	5.1	14.4%	8.4%	57.4%	19.0%	0.7%	0.1%
90th	388	1.6	4.1	8.7%	5.1%	66.8%	19.2%	0.3%	0.0%
75th	970	1.1	2.9	35.6%	20.8%	24.6%	18.6%	0.4%	0.0%
Median	1940	<1	1.9	35.6%	20.8%	24.6%	18.6%	0.4%	0.0%
25th	2910	<1	1.3	18.7%	10.9%	50.9%	19.0%	0.5%	0.0%
1st	3841	<1	0.5	36.0%	21.0%	24.1%	18.6%	0.3%	0.0%

Exhibit K-14. Primary Pb Smelter Case Study: Alternative NAAQS 4 (0.05 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution					
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)									
99.9th	4	6.5	12.2	14.4%	8.4%	57.4%	19.0%	0.7%	0.1%
99.5th	19	5.6	9.0	14.4%	8.4%	57.4%	19.0%	0.7%	0.1%
99th	39	5.2	7.8	14.4%	8.4%	57.4%	19.0%	0.7%	0.1%
95th	194	3.9	5.1	14.4%	8.4%	57.4%	19.0%	0.7%	0.1%
90th	388	3.2	4.1	8.7%	5.1%	66.8%	19.2%	0.3%	0.0%
75th	970	2.1	2.9	35.6%	20.8%	24.6%	18.6%	0.4%	0.0%
Median	1940	<1	1.9	35.6%	20.8%	24.6%	18.6%	0.4%	0.0%
25th	2910	-	1.2	35.6%	20.8%	24.6%	18.6%	0.4%	0.0%
1st	3841	-	1.2	35.6%	20.8%	24.6%	18.6%	0.4%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)									
99.9th	4	9.6	12.2	14.4%	8.4%	57.4%	19.0%	0.7%	0.1%
99.5th	19	8.6	9.0	14.4%	8.4%	57.4%	19.0%	0.7%	0.1%
99th	39	8.2	7.8	14.4%	8.4%	57.4%	19.0%	0.7%	0.1%
95th	194	6.9	5.1	14.4%	8.4%	57.4%	19.0%	0.7%	0.1%
90th	388	6.3	4.1	8.7%	5.1%	66.8%	19.2%	0.3%	0.0%
75th	970	5.1	2.9	35.6%	20.8%	24.6%	18.6%	0.4%	0.0%
Median	1940	3.9	1.9	35.6%	20.8%	24.6%	18.6%	0.4%	0.0%
25th	2910	2.8	1.3	18.7%	10.9%	50.9%	19.0%	0.5%	0.0%
1st	3841	1.1	0.5	36.0%	21.0%	24.1%	18.6%	0.3%	0.0%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

K.3. SECONDARY PB SMELTER CASE STUDY

K.3.1. Description of Scenarios Analyzed

Exhibit K-15 lists the secondary Pb smelter case study scenarios, along with the PbB metrics and IQ functions used to estimate IQ decrements. As discussed in Appendix I, PbB results were generated for a single dust model and the GSD for each PbB metric (concurrent and lifetime). Three IQ functions (two-piece linear, log linear with cutpoint, and loglinear with linearization) were used to estimate the IQ decrements for each of the five NAAQS scenarios, as summarized in the Exhibit K-15.

Exhibit K-15. IQ Decrement Scenarios Run for the Secondary Pb Smelter Case Study

NAAQS Scenario	Dust Model	GSD (µg/dL)	PbB Metric	IQ Functions
Current Conditions	Air-only regression-based model	1.7	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		1.6	Lifetime	
Alternative NAAQS 1 (0.2 µg/m^3, max quarterly average)	Air-only regression-based model	1.7	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization ion
		1.6	Lifetime	
Alternative NAAQS 2 (0.5 µg/m^3, max monthly average)	Air-only regression-based model	1.7	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		1.6	Lifetime	
Alternative NAAQS 3 (0.2 µg/m^3, max monthly average)	Air-only regression-based model	1.7	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		1.6	Lifetime	
Alternative NAAQS 4 (0.05 µg/m^3, max monthly average)	Air-only regression-based model	1.7	Concurrent	Two-piece linear, log-linear with cutpoint, and log-linear with linearization
		1.6	Lifetime	

K.3.2. IQ Decrement Results Tables for the Secondary Pb Smelter Case Study

Exhibits K-16 through K-20 summarize the IQ change distribution estimates for the secondary Pb smelter case study. As in the general urban case study and primary Pb smelter case study, IQ decrements less than one IQ point are considered to be indistinguishable from zero within the expected error of the PbB and IQ models, and are reported as "<1." The PbB values corresponding to the given IQ percentile are also given. The exhibits also present estimates of the proportional contribution of each exposure pathway to the total Pb uptake, as for the other two case studies. The contributions from the policy-relevant air and background pathways are estimated as described in the previous section. Again, these serve as proxy estimates of the proportional contribution of each pathway to overall IQ loss. As for the other two case studies, use of the two-piece linear IQ function results in the lowest estimated IQ losses, while the log-linear model with linearization results in the highest IQ losses.

Exhibit K-16. Secondary Pb Smelter Case Study: Current Conditions Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution					
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)									
99.9th	2	2.4	5.3	39.7%	23.1%	4.5%	31.3%	1.3%	0.1%
99.5th	8	1.8	4.0	33.4%	19.4%	17.6%	26.3%	3.1%	0.2%
99th	17	1.6	3.5	42.0%	24.5%	0.3%	33.1%	0.2%	0.0%
95th	85	1.1	2.4	41.1%	24.0%	1.9%	32.5%	0.5%	0.0%
90th	170	<1	2.0	29.4%	17.1%	25.1%	23.2%	5.0%	0.3%
75th	425	<1	1.4	37.9%	22.1%	8.2%	29.9%	1.9%	0.1%
Median	849	<1	1.0	41.8%	24.3%	0.6%	33.0%	0.2%	0.0%
25th	1274	<1	0.7	41.8%	24.3%	0.6%	33.0%	0.3%	0.0%
1st	1681	<1	0.3	41.8%	24.3%	0.6%	33.0%	0.2%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)									
99.9th	2	4.5	5.3	39.7%	23.1%	4.5%	31.3%	1.3%	0.1%
99.5th	8	3.7	4.0	33.4%	19.4%	17.6%	26.3%	3.1%	0.2%
99th	17	3.4	3.5	42.0%	24.5%	0.3%	33.1%	0.2%	0.0%
95th	85	2.4	2.4	41.1%	24.0%	1.9%	32.5%	0.5%	0.0%
90th	170	1.8	2.0	29.4%	17.1%	25.1%	23.2%	5.0%	0.3%
75th	425	<1	1.4	37.9%	22.1%	8.2%	29.9%	1.9%	0.1%
Median	849	-	1.0	41.7%	24.3%	0.6%	32.9%	0.4%	0.0%
25th	1274	-	1.0	41.7%	24.3%	0.6%	32.9%	0.4%	0.0%
1st	1681	-	1.0	41.7%	24.3%	0.6%	32.9%	0.4%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)									
99.9th	2	7.2	5.3	39.7%	23.1%	4.5%	31.3%	1.3%	0.1%
99.5th	8	6.4	4.0	33.4%	19.4%	17.6%	26.3%	3.1%	0.2%
99th	17	6.1	3.5	42.0%	24.5%	0.3%	33.1%	0.2%	0.0%
95th	85	5.1	2.4	41.1%	24.0%	1.9%	32.5%	0.5%	0.0%
90th	170	4.5	2.0	29.4%	17.1%	25.1%	23.2%	5.0%	0.3%
75th	425	3.6	1.4	37.9%	22.1%	8.2%	29.9%	1.9%	0.1%
Median	849	2.7	1.0	41.8%	24.3%	0.6%	33.0%	0.2%	0.0%
25th	1274	1.9	0.7	41.8%	24.3%	0.6%	33.0%	0.3%	0.0%
1st	1681	<1	0.3	41.8%	24.3%	0.6%	33.0%	0.2%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)									
99.9th	2	2.2	5.9	13.8%	8.0%	46.9%	10.9%	19.3%	1.1%
99.5th	8	1.7	4.5	38.7%	22.5%	6.2%	30.5%	2.0%	0.1%
99th	17	1.5	4.0	39.3%	22.9%	5.4%	31.0%	1.3%	0.1%
95th	85	1.1	2.9	41.6%	24.2%	1.0%	32.8%	0.3%	0.0%
90th	170	<1	2.4	38.7%	22.5%	6.2%	30.5%	2.0%	0.1%
75th	425	<1	1.8	39.6%	23.0%	4.9%	31.2%	1.2%	0.1%
Median	849	<1	1.3	41.4%	24.1%	1.3%	32.6%	0.5%	0.0%
25th	1274	<1	0.9	40.4%	23.5%	3.1%	31.9%	1.0%	0.1%
1st	1681	<1	0.4	41.7%	24.3%	0.8%	32.9%	0.3%	0.0%

Exhibit K-16. Secondary Pb Smelter Case Study: Current Conditions Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution					
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)									
99.9th	2	4.3	5.9	13.8%	8.0%	46.9%	10.9%	19.3%	1.1%
99.5th	8	3.5	4.5	38.7%	22.5%	6.2%	30.5%	2.0%	0.1%
99th	17	3.1	4.0	39.3%	22.9%	5.4%	31.0%	1.3%	0.1%
95th	85	2.1	2.9	41.6%	24.2%	1.0%	32.8%	0.3%	0.0%
90th	170	1.6	2.4	38.7%	22.5%	6.2%	30.5%	2.0%	0.1%
75th	425	<1	1.8	39.6%	23.0%	4.9%	31.2%	1.2%	0.1%
Median	849	-	1.2	41.7%	24.3%	0.6%	32.9%	0.4%	0.0%
25th	1274	-	1.2	41.7%	24.3%	0.6%	32.9%	0.4%	0.0%
1st	1681	-	1.2	41.7%	24.3%	0.6%	32.9%	0.4%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)									
99.9th	2	7.4	5.9	13.8%	8.0%	46.9%	10.9%	19.3%	1.1%
99.5th	8	6.5	4.5	38.7%	22.5%	6.2%	30.5%	2.0%	0.1%
99th	17	6.2	4.0	39.3%	22.9%	5.4%	31.0%	1.3%	0.1%
95th	85	5.2	2.9	41.6%	24.2%	1.0%	32.8%	0.3%	0.0%
90th	170	4.6	2.4	38.7%	22.5%	6.2%	30.5%	2.0%	0.1%
75th	425	3.7	1.8	39.6%	23.0%	4.9%	31.2%	1.2%	0.1%
Median	849	2.8	1.3	41.4%	24.1%	1.3%	32.6%	0.5%	0.0%
25th	1274	2.0	0.9	40.4%	23.5%	3.1%	31.9%	1.0%	0.1%
1st	1681	<1	0.4	41.7%	24.3%	0.8%	32.9%	0.3%	0.0%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit K-17. Secondary Pb Smelter Case Study: Alternative NAAQS 1 (0.2 µg/m^3, Maximum Quarterly Average) Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution					
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)									
99.9th	2	2.3	5.1	40.1%	23.3%	4.6%	31.6%	0.4%	0.0%
99.5th	8	1.8	3.9	39.7%	23.1%	5.5%	31.3%	0.3%	0.0%
99th	17	1.5	3.4	41.0%	23.9%	2.7%	32.3%	0.2%	0.0%
95th	85	1.1	2.3	41.9%	24.4%	0.6%	33.0%	0.1%	0.0%
90th	170	<1	1.9	41.6%	24.2%	1.2%	32.8%	0.1%	0.0%
75th	425	<1	1.4	40.7%	23.7%	3.1%	32.1%	0.3%	0.0%
Median	849	<1	1.0	38.8%	22.6%	7.4%	30.6%	0.5%	0.0%
25th	1274	<1	0.7	40.1%	23.3%	4.6%	31.6%	0.4%	0.0%
1st	1681	<1	0.3	41.9%	24.4%	0.6%	33.0%	0.1%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)									
99.9th	2	4.4	5.1	40.1%	23.3%	4.6%	31.6%	0.4%	0.0%
99.5th	8	3.6	3.9	39.7%	23.1%	5.5%	31.3%	0.3%	0.0%
99th	17	3.3	3.4	41.0%	23.9%	2.7%	32.3%	0.2%	0.0%
95th	85	2.3	2.3	41.9%	24.4%	0.6%	33.0%	0.1%	0.0%
90th	170	1.8	1.9	41.6%	24.2%	1.2%	32.8%	0.1%	0.0%
75th	425	<1	1.4	40.7%	23.7%	3.1%	32.1%	0.3%	0.0%
Median	849	-	0.5	39.3%	22.9%	6.3%	31.0%	0.5%	0.0%
25th	1274	-	0.5	39.3%	22.9%	6.3%	31.0%	0.5%	0.0%
1st	1681	-	0.5	39.3%	22.9%	6.3%	31.0%	0.5%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)									
99.9th	2	7.1	5.1	40.1%	23.3%	4.6%	31.6%	0.4%	0.0%
99.5th	8	6.3	3.9	39.7%	23.1%	5.5%	31.3%	0.3%	0.0%
99th	17	6.0	3.4	41.0%	23.9%	2.7%	32.3%	0.2%	0.0%
95th	85	5.0	2.3	41.9%	24.4%	0.6%	33.0%	0.1%	0.0%
90th	170	4.5	1.9	41.6%	24.2%	1.2%	32.8%	0.1%	0.0%
75th	425	3.6	1.4	40.7%	23.7%	3.1%	32.1%	0.3%	0.0%
Median	849	2.6	1.0	38.8%	22.6%	7.4%	30.6%	0.5%	0.0%
25th	1274	1.9	0.7	40.1%	23.3%	4.6%	31.6%	0.4%	0.0%
1st	1681	<1	0.3	41.9%	24.4%	0.6%	33.0%	0.1%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)									
99.9th	2	2.1	5.6	32.9%	19.2%	20.5%	26.0%	1.3%	0.1%
99.5th	8	1.7	4.4	40.4%	23.5%	3.9%	31.9%	0.4%	0.0%
99th	17	1.5	3.9	37.0%	21.6%	11.3%	29.2%	0.9%	0.0%
95th	85	1.1	2.8	37.5%	21.9%	10.4%	29.6%	0.5%	0.0%
90th	170	<1	2.4	40.1%	23.3%	4.5%	31.6%	0.4%	0.0%
75th	425	<1	1.8	38.7%	22.5%	7.7%	30.5%	0.5%	0.0%
Median	849	<1	1.3	40.6%	23.6%	3.5%	32.0%	0.3%	0.0%
25th	1274	<1	0.9	39.9%	23.2%	5.1%	31.4%	0.4%	0.0%
1st	1681	<1	0.4	41.3%	24.0%	1.9%	32.6%	0.2%	0.0%

Exhibit K-17. Secondary Pb Smelter Case Study: Alternative NAAQS 1 (0.2 µg/m^3, Maximum Quarterly Average) Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution					
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)									
99.9th	2	4.2	5.6	32.9%	19.2%	20.5%	26.0%	1.3%	0.1%
99.5th	8	3.4	4.4	40.4%	23.5%	3.9%	31.9%	0.4%	0.0%
99th	17	3.1	3.9	37.0%	21.6%	11.3%	29.2%	0.9%	0.0%
95th	85	2.0	2.8	37.5%	21.9%	10.4%	29.6%	0.5%	0.0%
90th	170	1.5	2.4	40.1%	23.3%	4.5%	31.6%	0.4%	0.0%
75th	425	<1	1.8	38.7%	22.5%	7.7%	30.5%	0.5%	0.0%
Median	849	-	0.7	39.3%	22.9%	6.3%	31.0%	0.5%	0.0%
25th	1274	-	0.7	39.3%	22.9%	6.3%	31.0%	0.5%	0.0%
1st	1681	-	0.7	39.3%	22.9%	6.3%	31.0%	0.5%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)									
99.9th	2	7.2	5.6	32.9%	19.2%	20.5%	26.0%	1.3%	0.1%
99.5th	8	6.5	4.4	40.4%	23.5%	3.9%	31.9%	0.4%	0.0%
99th	17	6.1	3.9	37.0%	21.6%	11.3%	29.2%	0.9%	0.0%
95th	85	5.1	2.8	37.5%	21.9%	10.4%	29.6%	0.5%	0.0%
90th	170	4.6	2.4	40.1%	23.3%	4.5%	31.6%	0.4%	0.0%
75th	425	3.7	1.8	38.7%	22.5%	7.7%	30.5%	0.5%	0.0%
Median	849	2.7	1.3	40.6%	23.6%	3.5%	32.0%	0.3%	0.0%
25th	1274	2.0	0.9	39.9%	23.2%	5.1%	31.4%	0.4%	0.0%
1st	1681	<1	0.4	41.3%	24.0%	1.9%	32.6%	0.2%	0.0%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit K-18. Secondary Pb Smelter Case Study: Alternative NAAQS 2 (0.5 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution					
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)									
99.9th	2	2.4	5.2	15.2%	8.8%	51.5%	12.0%	11.9%	0.7%
99.5th	8	1.8	3.9	40.1%	23.3%	4.2%	31.6%	0.7%	0.0%
99th	17	1.5	3.4	41.7%	24.3%	0.9%	32.9%	0.2%	0.0%
95th	85	1.1	2.4	35.0%	20.4%	14.9%	27.6%	2.1%	0.1%
90th	170	<1	2.0	41.4%	24.1%	1.5%	32.7%	0.2%	0.0%
75th	425	<1	1.4	39.2%	22.8%	6.2%	30.9%	0.8%	0.0%
Median	849	<1	1.0	35.4%	20.6%	13.9%	27.9%	2.0%	0.1%
25th	1274	<1	0.7	41.2%	24.0%	2.0%	32.5%	0.4%	0.0%
1st	1681	<1	0.3	39.2%	22.8%	6.2%	30.9%	0.8%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)									
99.9th	2	4.5	5.2	15.2%	8.8%	51.5%	12.0%	11.9%	0.7%
99.5th	8	3.7	3.9	40.1%	23.3%	4.2%	31.6%	0.7%	0.0%
99th	17	3.3	3.4	41.7%	24.3%	0.9%	32.9%	0.2%	0.0%
95th	85	2.3	2.4	35.0%	20.4%	14.9%	27.6%	2.1%	0.1%
90th	170	1.8	2.0	41.4%	24.1%	1.5%	32.7%	0.2%	0.0%
75th	425	<1	1.4	39.2%	22.8%	6.2%	30.9%	0.8%	0.0%
Median	849	-	0.9	41.8%	24.3%	0.6%	33.0%	0.2%	0.0%
25th	1274	-	0.9	41.8%	24.3%	0.6%	33.0%	0.2%	0.0%
1st	1681	-	0.9	41.8%	24.3%	0.6%	33.0%	0.2%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)									
99.9th	2	7.2	5.2	15.2%	8.8%	51.5%	12.0%	11.9%	0.7%
99.5th	8	6.4	3.9	40.1%	23.3%	4.2%	31.6%	0.7%	0.0%
99th	17	6.0	3.4	41.7%	24.3%	0.9%	32.9%	0.2%	0.0%
95th	85	5.0	2.4	35.0%	20.4%	14.9%	27.6%	2.1%	0.1%
90th	170	4.5	2.0	41.4%	24.1%	1.5%	32.7%	0.2%	0.0%
75th	425	3.6	1.4	39.2%	22.8%	6.2%	30.9%	0.8%	0.0%
Median	849	2.7	1.0	35.4%	20.6%	13.9%	27.9%	2.0%	0.1%
25th	1274	1.9	0.7	41.2%	24.0%	2.0%	32.5% [a]	0.4%	0.0%
1st	1681	<1	0.3	39.2%	22.8%	6.2%	30.9%	0.8%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)									
99.9th	2	2.2	5.9	35.4%	20.6%	13.5%	28.0%	2.4%	0.1%
99.5th	8	1.7	4.5	39.0%	22.7%	6.2%	30.8%	1.1%	0.1%
99th	17	1.5	3.9	18.3%	10.6%	50.4%	14.4%	6.0%	0.3%
95th	85	1.1	2.8	39.1%	22.8%	6.2%	30.9%	1.0%	0.1%
90th	170	<1	2.4	39.0%	22.7%	6.2%	30.8%	1.1%	0.1%
75th	425	<1	1.8	41.7%	24.3%	0.9%	32.9%	0.2%	0.0%
Median	849	<1	1.3	41.4%	24.1%	1.5%	32.7%	0.2%	0.0%
25th	1274	<1	0.9	41.1%	23.9%	2.1%	32.4%	0.3%	0.0%
1st	1681	<1	0.4	39.8%	23.2%	4.9%	31.4%	0.7%	0.0%

Exhibit K-18. Secondary Pb Smelter Case Study: Alternative NAAQS 2 (0.5 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution					
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)									
99.9th	2	4.3	5.9	35.4%	20.6%	13.5%	28.0%	2.4%	0.1%
99.5th	8	3.5	4.5	39.0%	22.7%	6.2%	30.8%	1.1%	0.1%
99th	17	3.1	3.9	18.3%	10.6%	50.4%	14.4%	6.0%	0.3%
95th	85	2.1	2.8	39.1%	22.8%	6.2%	30.9%	1.0%	0.1%
90th	170	1.5	2.4	39.0%	22.7%	6.2%	30.8%	1.1%	0.1%
75th	425	<1	1.8	41.7%	24.3%	0.9%	32.9%	0.2%	0.0%
Median	849	-	1.1	41.8%	24.3%	0.6%	33.0%	0.2%	0.0%
25th	1274	-	1.1	41.8%	24.3%	0.6%	33.0%	0.2%	0.0%
1st	1681	-	1.1	41.8%	24.3%	0.6%	33.0%	0.2%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)									
99.9th	2	7.3	5.9	35.4%	20.6%	13.5%	28.0%	2.4%	0.1%
99.5th	8	6.5	4.5	39.0%	22.7%	6.2%	30.8%	1.1%	0.1%
99th	17	6.1	3.9	18.3%	10.6%	50.4%	14.4%	6.0%	0.3%
95th	85	5.1	2.8	39.1%	22.8%	6.2%	30.9%	1.0%	0.1%
90th	170	4.6	2.4	39.0%	22.7%	6.2%	30.8%	1.1%	0.1%
75th	425	3.7	1.8	41.7%	24.3%	0.9%	32.9%	0.2%	0.0%
Median	849	2.7	1.3	40.1%	23.3%	4.3%	31.6%	0.6%	0.0%
25th	1274	2.0	0.9	41.1%	23.9%	2.1%	32.4%	0.3%	0.0%
1st	1681	<1	0.4	39.8%	23.2%	4.9%	31.4%	0.7%	0.0%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit K-19. Secondary Pb Smelter Case Study: Alternative NAAQS 3 (0.2 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution						
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)									
99.9th	2	2.3	5.2	19.0%	11.1%	52.3%	15.0%	2.5%	0.1%
99.5th	8	1.8	3.9	41.8%	24.3%	0.8%	33.0%	0.1%	0.0%
99th	17	1.5	3.4	32.0%	18.6%	22.6%	25.2%	1.5%	0.1%
95th	85	1.1	2.4	33.9%	19.7%	18.3%	26.8%	1.2%	0.1%
90th	170	<1	1.9	42.0%	24.5%	0.3%	33.2%	0.0%	0.0%
75th	425	<1	1.4	39.4%	23.0%	6.1%	31.1%	0.4%	0.0%
Median	849	<1	1.0	38.8%	22.6%	7.4%	30.7%	0.4%	0.0%
25th	1274	<1	0.7	38.8%	22.6%	7.4%	30.7%	0.4%	0.0%
1st	1681	<1	0.3	36.2%	21.1%	13.3%	28.5%	0.9%	0.1%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)									
99.9th	2	4.4	5.2	19.0%	11.1%	52.3%	15.0%	2.5%	0.1%
99.5th	8	3.7	3.9	41.8%	24.3%	0.8%	33.0%	0.1%	0.0%
99th	17	3.3	3.4	32.0%	18.6%	22.6%	25.2%	1.5%	0.1%
95th	85	2.3	2.4	33.9%	19.7%	18.3%	26.8%	1.2%	0.1%
90th	170	1.8	1.9	42.0%	24.5%	0.3%	33.2%	0.0%	0.0%
75th	425	<1	1.4	39.4%	23.0%	6.1%	31.1%	0.4%	0.0%
Median	849	-	0.9	41.9%	24.4%	0.6%	33.0%	0.1%	0.0%
25th	1274	-	0.9	41.9%	24.4%	0.6%	33.0%	0.1%	0.0%
1st	1681	-	0.9	41.9%	24.4%	0.6%	33.0%	0.1%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)									
99.9th	2	7.1	5.2	19.0%	11.1%	52.3%	15.0%	2.5%	0.1%
99.5th	8	6.4	3.9	41.8%	24.3%	0.8%	33.0%	0.1%	0.0%
99th	17	6.0	3.4	32.0%	18.6%	22.6%	25.2%	1.5%	0.1%
95th	85	5.0	2.4	33.9%	19.7%	18.3%	26.8%	1.2%	0.1%
90th	170	4.5	1.9	42.0%	24.5%	0.3%	33.2%	0.0%	0.0%
75th	425	3.6	1.4	39.4%	23.0%	6.1%	31.1%	0.4%	0.0%
Median	849	2.6	1.0	38.8%	22.6%	7.4%	30.7%	0.4%	0.0%
25th	1274	1.8	0.7	38.8%	22.6%	7.4%	30.7%	0.4%	0.0%
1st	1681	<1	0.3	36.2%	21.1%	13.3%	28.5%	0.9%	0.1%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)									
99.9th	2	2.2	5.8	39.4%	23.0%	6.1%	31.1%	0.4%	0.0%
99.5th	8	1.7	4.5	37.6%	21.9%	10.4%	29.6%	0.4%	0.0%
99th	17	1.5	3.9	41.3%	24.1%	1.9%	32.6%	0.1%	0.0%
95th	85	1.1	2.8	41.3%	24.1%	1.9%	32.6%	0.1%	0.0%
90th	170	<1	2.4	33.7%	19.6%	19.4%	26.6%	0.7%	0.0%
75th	425	<1	1.8	38.6%	22.5%	7.9%	30.5%	0.5%	0.0%
Median	849	<1	1.3	41.8%	24.4%	0.7%	33.0%	0.1%	0.0%
25th	1274	<1	0.9	37.0%	21.5%	11.7%	29.2%	0.6%	0.0%
1st	1681	<1	0.4	42.0%	24.5%	0.3%	33.1%	0.0%	0.0%

Exhibit K-19. Secondary Pb Smelter Case Study: Alternative NAAQS 3 (0.2 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution						
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)									
99.9th	2	4.3	5.8	39.4%	23.0%	6.1%	31.1%	0.4%	0.0%
99.5th	8	3.5	4.5	37.6%	21.9%	10.4%	29.6%	0.4%	0.0%
99th	17	3.0	3.9	41.3%	24.1%	1.9%	32.6%	0.1%	0.0%
95th	85	2.1	2.8	41.3%	24.1%	1.9%	32.6%	0.1%	0.0%
90th	170	1.5	2.4	33.7%	19.6%	19.4%	26.6%	0.7%	0.0%
75th	425	<1	1.8	38.6%	22.5%	7.9%	30.5%	0.5%	0.0%
Median	849	-	1.1	41.9%	24.4%	0.6%	33.0%	0.1%	0.0%
25th	1274	-	1.1	41.9%	24.4%	0.6%	33.0%	0.1%	0.0%
1st	1681	-	1.1	41.9%	24.4%	0.6%	33.0%	0.1%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)									
99.9th	2	7.3	5.8	39.4%	23.0%	6.1%	31.1%	0.4%	0.0%
99.5th	8	6.5	4.5	37.6%	21.9%	10.4%	29.6%	0.4%	0.0%
99th	17	6.1	3.9	41.3%	24.1%	1.9%	32.6%	0.1%	0.0%
95th	85	5.1	2.8	41.3%	24.1%	1.9%	32.6%	0.1%	0.0%
90th	170	4.6	2.4	33.7%	19.6%	19.4%	26.6%	0.7%	0.0%
75th	425	3.7	1.8	38.6%	22.5%	7.9%	30.5%	0.5%	0.0%
Median	849	2.7	1.3	41.8%	24.4%	0.7%	33.0%	0.1%	0.0%
25th	1274	2.0	0.9	37.0%	21.5%	11.7%	29.2%	0.6%	0.0%
1st	1681	<1	0.4	42.0%	24.5%	0.3%	33.1%	0.0%	0.0%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

Exhibit K-20. Secondary Pb Smelter Case Study: Alternative NAAQS 4 (0.05 µg/m^3, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution					
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Two-piece Linear)									
99.9th	2	2.3	5.1	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%
99.5th	8	1.8	3.9	41.8%	24.4%	0.8%	33.0%	0.0%	0.0%
99th	17	1.6	3.4	37.6%	21.9%	10.7%	29.7%	0.2%	0.0%
95th	85	1.1	2.4	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%
90th	170	<1	1.9	17.1%	10.0%	58.0%	13.5%	1.3%	0.1%
75th	425	<1	1.4	39.6%	23.0%	6.1%	31.2%	0.1%	0.0%
Median	849	<1	1.0	39.8%	23.2%	5.5%	31.4%	0.1%	0.0%
25th	1274	<1	0.7	41.8%	24.3%	0.8%	33.0%	0.0%	0.0%
1st	1681	<1	0.3	37.6%	21.9%	10.7%	29.7%	0.2%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Cutpoint)									
99.9th	2	4.4	5.1	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%
99.5th	8	3.7	3.9	41.8%	24.4%	0.8%	33.0%	0.0%	0.0%
99th	17	3.3	3.4	37.6%	21.9%	10.7%	29.7%	0.2%	0.0%
95th	85	2.3	2.4	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%
90th	170	1.8	1.9	17.1%	10.0%	58.0%	13.5%	1.3%	0.1%
75th	425	<1	1.4	39.6%	23.0%	6.1%	31.2%	0.1%	0.0%
Median	849	-	1.0	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%
25th	1274	-	1.0	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%
1st	1681	-	1.0	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.7), PbB Metric (Concurrent), IQ Function (Log-linear with Linearization)									
99.9th	2	7.1	5.1	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%
99.5th	8	6.4	3.9	41.8%	24.4%	0.8%	33.0%	0.0%	0.0%
99th	17	6.0	3.4	37.6%	21.9%	10.7%	29.7%	0.2%	0.0%
95th	85	5.0	2.4	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%
90th	170	4.5	1.9	17.1%	10.0%	58.0%	13.5%	1.3%	0.1%
75th	425	3.6	1.4	39.6%	23.0%	6.1%	31.2%	0.1%	0.0%
Median	849	2.6	1.0	39.8%	23.2%	5.5%	31.4%	0.1%	0.0%
25th	1274	1.8	0.7	41.8%	24.3%	0.8%	33.0% [a]	0.0%	0.0%
1st	1681	<1	0.3	37.6%	21.9%	10.7%	29.7%	0.2%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Two-piece Linear)									
99.9th	2	2.2	5.7	40.2%	23.4%	4.6%	31.7%	0.1%	0.0%
99.5th	8	1.7	4.4	40.3%	23.5%	4.3%	31.8%	0.1%	0.0%
99th	17	1.5	3.9	39.5%	23.0%	6.3%	31.2%	0.1%	0.0%
95th	85	1.1	2.8	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%
90th	170	<1	2.4	40.2%	23.4%	4.7%	31.7%	0.1%	0.0%
75th	425	<1	1.8	39.8%	23.2%	5.5%	31.4%	0.1%	0.0%
Median	849	<1	1.3	39.5%	23.0%	6.2%	31.2%	0.1%	0.0%
25th	1274	<1	0.9	40.2%	23.4%	4.7%	31.7%	0.1%	0.0%
1st	1681	<1	0.4	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%

Exhibit K-20. Secondary Pb Smelter Case Study: Alternative NAAQS 4 (0.05 µg/m³, Maximum Monthly Average) Estimated IQ Losses

IQ Loss Percentile	Population Above	Predicted IQ Loss	Predicted PbB (µg/dL)	Pathway Contribution					
				Ingestion					Inhalation (Recent Air)
				Diet	Drinking Water	Outdoor Soil/Dust	Indoor Dust		
							Other [a]	Recent Air	
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Cutpoint)									
99.9th	2	4.2	5.7	40.2%	23.4%	4.6%	31.7%	0.1%	0.0%
99.5th	8	3.4	4.4	40.3%	23.5%	4.3%	31.8%	0.1%	0.0%
99th	17	3.1	3.9	39.5%	23.0%	6.3%	31.2%	0.1%	0.0%
95th	85	2.1	2.8	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%
90th	170	1.5	2.4	40.2%	23.4%	4.7%	31.7%	0.1%	0.0%
75th	425	<1	1.8	39.8%	23.2%	5.5%	31.4%	0.1%	0.0%
Median	849	-	1.2	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%
25th	1274	-	1.2	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%
1st	1681	-	1.2	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%
Dust Model (Air+Soil Regression-based and H6), GSD (1.6), PbB Metric (Lifetime), IQ Function (Log-linear with Linearization)									
99.9th	2	7.3	5.7	40.2%	23.4%	4.6%	31.7%	0.1%	0.0%
99.5th	8	6.5	4.4	40.3%	23.5%	4.3%	31.8%	0.1%	0.0%
99th	17	6.1	3.9	39.5%	23.0%	6.3%	31.2%	0.1%	0.0%
95th	85	5.1	2.8	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%
90th	170	4.6	2.4	40.2%	23.4%	4.7%	31.7%	0.1%	0.0%
75th	425	3.7	1.8	39.8%	23.2%	5.5%	31.4%	0.1%	0.0%
Median	849	2.7	1.3	40.1%	23.3%	4.9%	31.6%	0.1%	0.0%
25th	1274	2.0	0.9	40.2%	23.4%	4.7%	31.7%	0.1%	0.0%
1st	1681	<1	0.4	41.9%	24.4%	0.6%	33.1%	0.0%	0.0%

[a] "Other" refers to contributions to indoor dust Pb from indoor paint, outdoor soil/dust, and additional sources (including historical air), and "recent air" refers to pathway contributions associated with outdoor ambient air Pb levels (either by inhalation of ambient air Pb or ingestion of indoor dust Pb predicted to be associated with outdoor ambient air Pb levels).

July 25, 2007

Appendix L. Sensitivity Analysis Approach and Results

Prepared by:

ICF International
Research Triangle Park, NC

Prepared for:

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina

Contract No. EP-D-06-115
Work Assignment No. 0-4

Table of Contents

List of Exhibits

L. SENSITIVITY ANALYSIS METHODS AND RESULTS

L.1. OVERVIEW OF SENSITIVITY ANALYSIS

This appendix describes the results of a series of modeling runs that were performed to evaluate the sensitivity of intelligence quotient (IQ) loss estimates to changes in specific models and input parameter values. The overall objective of these model runs was to identify specific models and inputs that contribute the most uncertainty to the IQ loss estimates and to help develop insights concerning the overall level of uncertainty in the estimates.

This sensitivity analysis is structured to involve "one-at-a-time" variations on given models or parameter values. In addition, in order to determine the impact of multiple parameter changes on a single model element, several cases involve simultaneous variations in more than one modeling assumption and/or parameter value. The results of the sensitivity runs are compared to the IQ loss distribution estimated for a "baseline" case, which while not a formal "central tendency" estimate, has been derived using models and parameter values which experience has demonstrated are reasonable and representative of the exposure patterns and receptors for which the analysis is being conducted (see Exhibit L-1). The baseline case (described more completely in Section L.1) generally consists of the IEUBK modeled current conditions (mean) NAAQS case using the hybrid mechanistic-empirical model, a geometric standard deviation (GSD) value of 1.6 µg/dL, the concurrent blood lead (PbB) metric, and the two-piece linear IQ change function.

The baseline case is based on the general urban case study because this case has the potential to characterize potential exposures for a larger number of exposed children than either the primary or secondary Pb smelter case studies. In addition, analyses of available data suggest that exposure patterns for urban children are highly variable and less well-documented than those near Pb smelters. In particular, the relative importance of the contribution of recent air Pb to indoor dust exposures, compared to historical outdoor soil/dust contamination and Pb paint, is not well-defined in the literature (see Appendix G), and a range of alternative assumptions regarding indoor dust models are evaluated in the sensitivity analysis, as described in Section L.2.

Exhibit L-1 provides an overview of the results of the sensitivity analysis. This exhibit describes the variables varied in the analysis, the percent change in the total IQ loss compared to the baseline case for the median and 95^{th} percentile, and the percent change in the IQ loss arising from the "recent air" (both inhalation and ingestion) pathways compared to the baseline case for the median and 95^{th} percentile. Recent air is used here to refer to Pb exposures in the general urban case study that are derived from the estimate of outdoor ambient air Pb concentration (i.e., inhalation of ambient Pb and ingestion of indoor dust Pb predicted to be associated with recent air Pb concentrations). Analyses are presented with exposure concentration variations near the top, with the results progressing through the PbB modeling assumptions and the IQ loss modeling assumptions. Further details about all the cases run are provided below.

Exhibit L-1. Summary of Sensitivity Analysis - Percent Change in IQ Loss Compared to Baseline

Variable	Description of Sensitivity Analysis Performed	Total Percent Change in IQ Loss Compared to Baseline [a]		Percent Change in IQ Loss from Recent Air [b] Pathway Contributions Compared to Baseline	
		Median (Baseline IQ Loss < 1)	95^{th} Percentile (Baseline IQ Loss = 2.1)	Median (Baseline IQ Loss < 1)	95^{th} Percentile (Baseline IQ Loss < 1)
Air conversion ratio	Maximum quarterly average to annual average air concentration conversion ratio of 7.6 (95^{th} percentile) compared to 2.5 (baseline, mean)	-11%	-11%	-49%	-50%
Outdoor soil/dust Pb concentration	648 µg/g (95^{th} percentile) compared to 198 microgram per gram (µg/g) (baseline, mean)	73%	71%	-7%	-8%
Mechanistic portion of the hybrid mechanistic-empirical model	Alternate inputs for key variables (i.e., cleaning frequency, cleaning efficiency, deposition, and air exchange rate [AER]) in the mechanistic portion of the hybrid model compared to the baseline inputs.	-9 to 45%	-9 to 45%	-19 to 139%	-19 to 139%
Empirical portion of the hybrid mechanistic-empirical model	Total dust Pb estimate of 12.2 µg/ft^2 (75^{th} percentile total dust estimate) compared to 5.32 micrograms per square foot (µg/ft^2) (baseline, median)	11%	10%	-31%	-31%
Hybrid mechanistic-empirical model	The air-only regression-based model compared to the hybrid mechanistic-empirical model (baseline)	-8%	-8%	-60%	-60%
PbB model	The International Commission for Radiation Protection (ICRP) model (or Leggett model) compared to the Integrated Exposure Uptake Biokinetic (IEUBK) Model for Children (baseline)	279%	170%	279%	170%
Diet and drinking water absorption	Diet and drinking water absorption fraction of 40% (lower) (60%) (higher) compared to 50% (baseline)	-7 to 6%	-7 to 6%	1%	0%
Outdoor soil/dust and indoor dust fraction	Percentage of soil from outdoor soil/dust+indoor dust ingestion of 58% compared to 45% (baseline)	-7%	-8%	-30%	-31%
Outdoor soil/dust and indoor dust absorption	Percentage of outdoor soil/dust and indoor dust intake that is absorbed of 18% compare to a 30% (baseline) absorption fraction	-7%	-7%	-21%	-21%

Exhibit L-1. Summary of Sensitivity Analysis - Percent Change in IQ Loss Compared to Baseline

Variable	Description of Sensitivity Analysis Performed	Total Percent Change in IQ Loss Compared to Baseline [a]		Percent Change in IQ Loss from Recent Air [b] Pathway Contributions Compared to Baseline	
		Median (Baseline IQ Loss < 1)	95th Percentile (Baseline IQ Loss = 2.1)	Median (Baseline IQ Loss < 1)	95th Percentile (Baseline IQ Loss < 1)
PbB metric	Lifetime metric compared to concurrent metric (baseline)	20%	9%	20%	9%
GSD	Lower-bound (1.6 µg/dL) and upper-bound (2.1 µg/dL) values compared to 1.7 microgram per deciliter (µg/dL) (baseline)	0%	-10 to 40%	0%	40%
IQ change function	Log-linear with cutpoint and log-linear with linearization functions compared to two-piece linear (baseline) function	102 to 412%	97 to 226%	102 to 412%	97 to 226%

[a] The baseline case consists of the IEUBK modeled current conditions (mean) NAAQS case using the hybrid mechanistic-empirical model, a GSD value of 1.6 µg/dL, the concurrent PbB metric, and the two-piece linear IQ change function.
[b] Recent air is used here to refer to Pb exposures in the general urban case study that are derived from the estimate of outdoor ambient air Pb concentration (i.e., inhalation of ambient air Pb and ingestion of indoor dust Pb predicted to be associated with ambient air Pb concentrations).

L.2. BASELINE AND SENSITIVITY ANALYSIS CASES

The "Baseline Parameter Value" column of Exhibit L-2. summarizes the baseline case which served as the basis for comparison for all of the sensitivity case results. As shown in the exhibit, the current conditions (mean) general urban case study NAAQS scenario was selected as the baseline for comparison of IQ loss estimates. The major models and assumptions associated with the baseline case are as follows:

- Exposures were estimated for a single exposed (hypothetical) population cohort, rather than for residents of many U.S. Census blocks. Thus, the output distribution of IQ loss includes no contribution from explicitly modeled variations in exposure.
- Urban annual average ambient air Pb concentrations were estimated based on analyses of maximum quarterly concentration data for 2003 to 2005 from monitors in urban areas with more than 1 million population (see Appendix C). The mean ratio of maximum quarterly average to annual average concentration of Pb in total suspended particulate matter (TSP) was used to convert the maximum quarterly average concentration to an annual average equivalent.
- The baseline outdoor soil/dust Pb exposure concentration was the arithmetic mean estimated from the interim National Survey of Lead and Allergens in housing (NSLAH) data (198 µg/g) (Westat Inc., 2002).
- The indoor dust Pb exposure concentration was estimated using the hybrid model (see Appendix G), with the non-air dust Pb concentration based on the median wipe dust loading from the Department of Housing and Urban Development (HUD) National Survey (USEPA, 1995) and the ambient air Pb contribution estimated using the mechanistic portion of the hybrid mechanistic-empirical model.
- PbB levels were estimated using the IEUBK model (USEPA, 2005), with the baseline exposure factor values and policy-relevant background pathways (drinking water and diet) Pb concentration and intake estimates described in Appendix H.
- The concurrent PbB metric (average of the results at 75 and 81 months in the seventh year of life) was used as input to the IQ loss model.
- Distributions of PbB concentrations (percentiles) were derived assuming a lognormal distribution of concurrent PbB levels with a GSD of 1.7 (background for this estimate can be found in Appendix H).
- IQ loss percentiles were derived by applying a two-piece linear IQ loss model derived from the Lanphear et al. (2005) pooled analysis of epidemiological studies of PbB and IQ (see Section 4.1.1 of the main body of this report).

Exhibit L-2. Summary of Baseline and Sensitivity Analysis Model Inputs and Assumptions

Variable	Baseline Parameter Value	Sensitivity Analysis Variations
Case study/NAAQS scenario	General urban case study, current conditions (mean)	Unchanged
Outdoor soil/dust Pb concentration	Arithmetic mean (198 µg/g) from NSLAH (see Appendix C)	Estimated 95th percentile (648 µg/g) from NSLAH
Annual average ambient air Pb concentration	Maximum quarterly-averaged Pb concentrations from urban TSP monitoring sites converted to equivalent annual average concentrations using the mean ambient air ratio (2.5) of maximum quarterly average to annual average Pb-TSP concentrations (see Appendix C)	Ambient air ratio varied from the mean ratio of maximum quarterly average to annual average Pb-TSP concentrations (2.5) to the 95th percentile ratio of maximum quarterly average to annual average Pb-TSP concentrations (7.6)
Indoor dust Pb concentration model	• Mechanistic portion of the hybrid mechanistic-empirical model estimate, using inputs as described in Appendix G • Empirical portion of the hybrid mechanistic-empirical model, using total indoor dust estimate based on HUD National Survey median	• Air-only regression-based model • Empirical portion of the hybrid mechanistic-empirical model, using total indoor dust estimate based on the HUD National Survey 75th percentile (12.5 µg/ft^2) • Multiple cases, each with variations in the mechanistic portion of the mechanistic-empirical model. Each case was run with an alternate value of a single parameter. The cases run include: low (1 cleaning per month [m^{-1}]) and high (1 cleaning per week [w^{-1}]) cleaning frequency, low cleaning efficiency (12.5%), lower-bound Pb deposition (0.39 per hour [h^{-1})], and upper-bound AER (1.26 h^{-1}) values. An overall upper-bound case was developed by simultaneously using the low cleaning frequency, low cleaning efficiency, upper bound AER, and the base case Pb deposition.
PbB estimation model	IEUBK (batch mode age profile) model	Leggett (batch mode) model
Exposure/ intake/uptake factors	Baseline exposure factor values and policy-relevant background contributions (see Appendix H)	• Absolute diet, drinking water pathway absorption fractions varied from baseline 50% to 40 and 60% • Outdoor soil/dust and indoor dust weighting factor changed from baseline 45% to 58% (von Lindern et al., 2003) • Outdoor soil/dust and indoor dust absorption fraction changed from baseline 30% to 18% (von Lindern et al., 2003)
PbB metric	Concurrent (average of results at 75 and 81 months during the seventh year of life)	Lifetime Average (average of results from 6 to 84 months of age)
Inter-individual PbB variability (GSD)	Central tendency value (1.7 µg/dL) estimated from epidemiological studies (see Appendix H)	Baseline GSD varied to a lower-bound value of 1.6 µg/dL and an upper-bound value of 2.1 µg/dL, estimated from epidemiological studies
IQ model	Two-piece linear model (break point = 13 µg/dL), derived from Lanphear et al. (2005) as described in Section 4.1.1 of the main body of this report	• Log-linear with cutpoint model • Log-linear with linearization model

The "Sensitivity Analysis Variations" column of Exhibit L-2 summarizes the alternative modeling assumptions and parameter values that were used as inputs to each of the sensitivity analysis cases. Note that the sensitivity analysis covers only a very small portion of the credible combinations of modeling assumptions and parameter values that could be tested. A full analysis of the uncertainty contributions from each model and parameter would require the use of Monte Carlo analysis or a related probabilistic method. However, data and resource limitations prevented such a full-scale probabilistic model analysis at this time.

Instead, credible alternative models and parameter values for each step in the modeling process were selected for the sensitivity analysis. The derivation of sensitivity analysis cases was informed by the results of the pilot assessment and by additional research conducted in support of this assessment. The alternative parameter values were chosen based on professional judgment, supported by quantitative data to the extent possible. Where parameters were known to be variable, but the range of variability was poorly constrained (e.g., gastrointestinal [GI] absorption fractions for Pb in diet and drinking water), reasonable upper and lower values were chosen to cover a substantial proportion of the overall variability in long-term average values.

For the exposure Pb concentrations, alternate values for both the outdoor soil/dust and the ambient air Pb concentrations were explored. For example, the alternative ("upper") outdoor soil/dust Pb exposure concentration estimate was taken as the estimated 95th percentile (rather than the baseline arithmetic mean) from the NSLAH survey (as cited in U.S. EPA (2000)). This value was estimated using the geometric mean (GM) and GSD in the NSLAH survey and assuming a lognormal distribution. For the ambient air Pb concentration, an alternate value was used to convert the maximum quarterly-averaged Pb concentrations from urban TSP monitoring sites to equivalent annual average concentrations. Rather than using mean ambient air ratio of maximum quarterly to annual average Pb-TSP concentrations (2.5), the sensitivity analysis used the 95th percentile ratio of maximum quarterly to annual average Pb-TSP concentrations (7.6). That is, the annual ambient air Pb concentration estimate is lower when the 95th percentile ratio is used.

In addition, the method for determining indoor dust Pb concentrations was also investigated. Because of the importance of determining the contribution of ambient air Pb to indoor dust concentrations, a range of sensitivity analyses were performed wherein various aspects of the indoor dust Pb estimation model were varied. Three major alternative models were evaluated, with varying assumptions related to input parameters:

- IQ estimates from the hybrid (baseline) model were compared to those obtained when indoor dust Pb concentrations were estimated using an empirical (air-only regression-based model) derived through analysis of air-indoor dust Pb relationships at Pb smelting and mining sites (see Appendix G).

- IQ estimates were developed by applying the hybrid (baseline) model, but using the 75th percentile indoor dust Pb loading (12.2 µg/ft^2) from the HUD National Survey (USEPA, 1995), instead of the survey baseline case median value (5.3 µg/ft^2) to derive the non-air estimate of Pb loading.

- The hybrid (baseline) model was applied, varying the inputs to the mechanistic portion of the model affecting indoor dust Pb deposition and removal rates. The parameter values that were varied included cleaning frequency, cleaning efficiency, AER, and the average Pb deposition rate.

For the third bullet above, the mechanistic portion of the hybrid model requires inputs (such as the AER, the deposition rate, the cleaning frequency, and the cleaning efficiency) as discussed in Appendix G. In the sensitivity analysis, two approaches were taken. First, single inputs were varied one at a time to investigate the effects of that parameter on the overall IQ change. In general, the parameter values selected were based on alternate values in the literature deemed appropriate for urban scenarios, and these values caused the overall dust exposure to either increase or decrease, depending on the value chosen. Second, a combination of these alternate values was used in which each alternate parameter value caused the dust exposure to increase. This second method then represented an overall high-end estimate of dust exposure. For the AER, an upper-bound of 1.26 h^{-1} was used, reflecting the 90th percentile AER for all regions of the country (USEPA, 1997; Table 17-10). For the Pb deposition rate, a lower-bound value of 0.39 h^{-1} was used, reflecting an estimate for particulate matter (PM) that is 2.5 micrometers (µm) or smaller ($PM_{2.5}$) (USEPA, 1997; Table 17-12). This value is lower than the Pb-specific value of 1.11 h^{-1} used in the baseline case. For the cleaning frequency, both a lower value (1 m^{-1}) and an upper value (1 w^{-1}) were compared with the baseline cleaning of 2 cleanings m^{-1}. Finally, for the cleaning efficiency, an upper-bound value of 25 percent was compared with the baseline cleaning efficiency of 12.5 percent. In each of these sensitivity cases, the mechanistic recent air contribution to total indoor dust loading was added to the other sources portion to get a total Pb dust loading. To get this other sources portion for the sensitivity analysis cases, the ratio of these two portions was calculated for the baseline case. Then, this ratio was applied to each of the sensitivity mechanistic model estimates to generate a total indoor Pb dust loading estimate for each.

Alternative PbB estimates were derived using a range of different PbB models and parameter values from those used in the baseline case, and these differences were carried through to the IQ losses using the two-piece linear model. First, the International Commission for Radiation Protection (ICRP) PbB model (hereafter referred to as the “Leggett model”), (Leggett,

1993) (see Appendix H) was applied (instead of the baseline IEUBK model (USEPA, 2005) with the same exposure factor and policy-relevant non-air exposure concentrations and intakes as those used in the baseline case. The differences in results from the baseline case thus reflect only differences in the biokinetic predictions of the two models. In addition, the impacts of varying the GI absorption fractions for diet, drinking water, outdoor soil/dust, and indoor dust exposure, and the relative amounts of outdoor soil/dust and indoor dust ingestion inputs to the IEUBK model were also estimated. The IEUBK model was used to estimate both concurrent and lifetime PbB metrics, and the impacts of using these different measures of PbB impacts on estimated IQ losses were also evaluated. The effect of applying a low-end and high-end estimate of the PbB GSD (1.6 µg/dL and 2.1 µg/dL, instead of the baseline estimate of 1.7) on estimated IQ loss percentiles was also evaluated.

In addition, IQ loss predictions derived using two alternative forms of the IQ loss model were compared to the baseline estimates. The derivation of the alternative IQ functions (log-linear with cutpoint and log-linear with linearization) was discussed in Section 4.1.1 of the main body of this report.

L.3. SENSITIVITY ANALYSIS RESULTS

Exhibit L-3 provides a summary of the sensitivity case outputs. Selected percentile IQ loss estimates are presented for each case, with the cases ranked in decreasing order of the estimated 95th percentile values, and the baseline case results indicated in bold.

Exhibit L-3. Summary of Sensitivity Analysis IQ Loss Estimates

Sensitivity Case	Percentile IQ Estimate					
	99.9^{th}	99.5^{th}	99^{th}	95^{th}	90^{th}	Median [a]
Log-linear with linearization IQ loss model	8.9	8.2	7.8	6.8	6.3	4.5
Leggett PbB model	8.0	6.9	6.5	5.7	5.3	3.3
Log-linear with cutpoint IQ loss model	6.2	5.5	5.1	4.1	3.6	1.8
Urban soil 95^{th} percentile (648 µg/g)	5.5	5.1	5.0	3.6	2.9	1.5
High-end hybrid model parameters	5.3	4.9	4.3	3.0	2.5	1.3
Hybrid model with low cleaning frequency ($1\ m^{-1}$)	4.8	3.8	3.4	2.3	1.9	1.0
Hybrid model with low cleaning efficiency (0.125)	4.8	3.8	3.3	2.3	1.9	1.0
Hybrid model based on 75^{th} percentile total indoor dust Pb ($12.2\ \mu g/ft^2$)	4.9	3.8	3.4	2.3	1.9	1.0
Lifetime PbB metric	4.4	3.6	3.1	2.3	1.9	1.0
High PbB GSD (2.1 µg/dL)	5.7	5.1	4.7	2.9	2.2	0.9
Hybrid model with high AER ($1.26\ h^{-1}$)	4.8	3.6	3.2	2.3	1.9	0.9
Diet/drinking water GI absorption fraction (60%)	4.8	3.6	3.2	2.2	1.8	0.9
Low PbB GSD (1.6 µg/dL)	3.7	2.9	2.6	1.9	1.6	0.9
Baseline	**4.4**	**3.5**	**3.0**	**2.1**	**1.7**	**0.9**
Hybrid model with low Pb deposition rate ($0.39\ h^{-1}$)	4.3	3.2	2.8	2.0	1.6	0.8
Diet/Water GI absorption fraction (40%)	4.2	3.2	2.8	1.9	1.6	0.8
Outdoor soil/dust, indoor dust GI absorption Fraction (0.18)	4.1	3.1	2.7	1.9	1.6	0.8
Outdoor soil/dust ingestion weighting factor (58%)	4.0	3.1	2.8	1.9	1.6	0.8
Air-only regression-based indoor dust model	4.1	3.1	2.7	1.9	1.6	0.8
Hybrid model with high cleaning frequency ($1\ w^{-1}$)	4.1	3.1	2.7	1.9	1.6	0.8
95^{th} Percentile ratio of maximum quarterly to annual average Pb-TSP concentrations (7.6)	4.1	3.0	2.7	1.9	1.5	0.8

[a] Values less than 1.0 should be interpreted with caution (see text following this exhibit).

The estimated median, 95th, and 99.5th percentile IQ loss estimates for the baseline case are approximately 0.9, 2.1, and 3.5 points, respectively. Quantitative estimates are presented in this appendix in order to support estimates of absolute and relative differences between the baseline sensitivity analysis case estimates discussed in the following sections.

Because more high than low parameter values were tested, the majority of the sensitivity analysis runs yielded IQ loss estimates higher than the results from the baseline case. It can be seen from the estimates in Exhibit L-2. that the cases resulting in the highest estimated IQ loss are those derived using different PbB and/or IQ loss estimation models. Use of the log-linear with linearization IQ loss model and the Leggett PbB model yield by a large margin the highest median and higher percentile IQ losses among all of the sensitivity cases. Smaller impacts are associated with cases assuming the 95th percentile soil concentration estimates and high-end mechanistic portion of the indoor hybrid mechanistic-empirical model inputs.

L.3.1. Absolute Changes in IQ Loss Estimates Associated with the Sensitivity Cases

This section discusses and compares the absolute changes in IQ loss relative to the baseline that are associated with the sensitivity cases.

Exhibit L-4 summarizes the differences between the percentile IQ loss estimated for the baseline case and the analogous percentile losses for the sensitivity analysis. The cases are again listed by decreasing order of the estimated differences in the absolute values of the 95th percentile IQ estimates relative to baseline. Cases giving the largest differences in the 95th percentile estimates compared to the baseline are at the top of the table.

As noted in the previous section, the largest "across-the-board" differences from the baseline IQ loss estimates come from the use of other than baseline IQ loss estimation models (i.e., the log-linear with linearization IQ loss model and the Leggett PbB model) to estimate PbB or IQ. Impacts of these model selections on the various percentiles range from 2.4 IQ points (the increase in the median associated with the use of the Leggett model) to 4.7 IQ points (increase in the 95th and 99.5th percentile associated with use of the log-linear with linearization IQ loss model). Application of the log-linear with cutpoint model is associated with an estimated increase in IQ loss relative to the baseline of 2.0 points at both the 99.5th and 95th percentile, and with an increase in estimated median IQ loss of 0.9 points.

Exhibit L-4. Absolute Differences in IQ Loss Estimates Between the Sensitivity and Baseline Cases

Sensitivity Case	Absolute Change (IQ Points) in Percentile Estimates Relative to Baseline		
	99.5th Percentile (Baseline=3.5)	95th Percentile (Baseline = 2.1)	Median (Baseline = 0.9)
Log-linear with linearization IQ loss model	4.7	4.7	3.6
Leggett PbB model	3.4	3.6	2.4
Log-linear with cutpoint IQ loss model	2.0	2.0	0.9
Urban soil 95th percentile (648 µg/g)	1.7	1.5	0.6
High-end hybrid model parameters	1.5	0.9	0.4
Hybrid model with low cleaning frequency (1 m^{-1})	0.4	0.2	0.1
Hybrid model with low cleaning efficiency (0.125)	0.3	0.2	0.1
Hybrid model based on 75th percentile total indoor dust Pb (12.2 µg/ft^2)	0.4	0.2	0.1
Lifetime PbB metric	0.1	0.2	0.2
High PbB GSD (2.1 µg/dL)	1.7	0.8	0.0
Hybrid model with high AER (1.26 h^{-1})	0.2	0.2	0.1
Diet/drinking water GI absorption fraction (60%)	0.1	0.1	0.1
Low PbB GSD (1.6 µg/dL)	-0.6	-0.2	0.0
Hybrid model with low Pb deposition rate (0.39 h^{-1})	-0.3	-0.1	-0.1
Diet/Water GI absorption fraction (40%)	-0.3	-0.2	-0.1
Outdoor soil/dust, indoor dust GI absorption Fraction (0.18)	-0.3	-0.2	-0.1
Outdoor soil/dust ingestion weighting factor (58%)	-0.3	-0.2	-0.1
Air-only regression-based indoor dust model	-0.4	-0.2	-0.1
Hybrid model with high cleaning frequency (1 w^{-1})	-0.4	-0.2	-0.1
95th Percentile ratio of maximum quarterly to annual average Pb-TSP concentrations (7.6)	-0.4	-0.2	-0.1

Two cases involving changes to specific exposure concentration or exposure factor values generate substantially different percentile IQ loss values at the higher percentiles, but not in the median value, compared to the baseline case. Using the 95th percentile soil Pb concentration estimate from the NSLAH data (instead of the mean), and applying a combination of high input values to the mechanistic portion of the hybrid mechanistic-empirical model results in changes in the 95th and 99.5th percentile IQ estimates ranging from 0.9 to 1.7 points. The increases in the predicted median IQ values relative to the baseline associated with these two cases were 0.6 and 0.4 points, respectively.

Cases that include a high-end assumption related to inter-individual PbB variability (GSD = 2.1 μg/dL) also strongly affect the estimated upper (95^{th} and 99^{th}) percentile IQ estimates, but as expected, have minimal impact on the estimated medians. When the high-end GSD is applied along with the baseline (two-piece linear) IQ model, the estimated 95^{th} and 99^{th} percentile IQ estimates are 0.8 and 1.7 points higher than the corresponding estimates from the baseline (GSD = 1.7 μg/dL) case. When the high-end GSD is applied in a case along with the log-linear with linearization model, the 95^{th} and 99.5^{th} percentile IQ estimates are 0.9 and 1.4 points higher than the baseline estimates.

None of the other cases result in IQ percentile estimates that differ by more than 0.6 points from the baseline estimates, and most of the impacts, even on the higher percentile estimates, are much lower.

L.3.2. Relative IQ Loss Associated with the Sensitivity Cases

Exhibit L-5 summarizes the relative differences between the IQ percentiles estimated in the sensitivity cases and the corresponding estimates from the baseline. This approach "normalizes," or scales the differences between the estimated IQ percentiles in terms of the baseline values. The cases are arranged in decreasing order according to the absolute values of the differences in the 95^{th} percentile values between the sensitivity cases and the baseline case.

Exhibit L-5. Percent Difference in IQ Loss Estimates between the Sensitivity and Baseline Cases

Sensitivity Case	Relative Change in Percentile Estimate Compared to Baseline		
	99.5^{th} (Baseline = 3.5)	95^{th} (Baseline = 2.1)	Median (Baseline = 0.9)
Log-linear with linearization IQ loss model	137%	226%	412%
Leggett PbB model	99%	170%	279%
Log-linear with cutpoint IQ loss model	59%	97%	102%
Urban soil 95^{th} percentile (648 µg/g)	49%	71%	73%
High-end hybrid model parameters	43%	45%	45%
Hybrid model with low cleaning frequency (1 m^{-1})	10%	11%	12%
Hybrid model with low cleaning efficiency (0.125)	9%	11%	12%
Hybrid model based on 75^{th} percentile total indoor dust Pb (12.2 µg/ft^2)	11%	10%	11%
Lifetime PbB metric	3%	9%	20%
High PbB GSD (2.1 µg/dL)	49%	40%	0%
Hybrid model with high AER (1.26 h^{-1})	5%	8%	9%
Diet/drinking water GI absorption fraction (60%)	4%	6%	6%
Low PbB GSD (1.6 µg/dL)	-17%	-10%	0%
Hybrid model with low Pb deposition rate (0.39 h^{-1})	-8%	-7%	-6%
Diet/Water GI absorption fraction (40%)	-9%	-7%	-7%
Outdoor soil/dust, indoor dust GI absorption Fraction (0.18)	-9%	-7%	-7%
Outdoor soil/dust ingestion weighting factor (58%)	-9%	-8%	-7%
Air-only regression-based indoor dust model	-10%	-8%	-8%
Hybrid model with high cleaning frequency (1 w^{-1})	-11%	-9%	-9%
95^{th} Percentile ratio of maximum quarterly to annual average Pb-TSP concentrations (7.6)	-12%	-11%	-11%

As expected, the proportional differences between the sensitivity case and baseline estimates closely parallel the pattern of the absolute differences shown in Exhibit L-3. The exhibit shows how some of the relatively small absolute changes in the median IQ estimates associated with the sensitivity analysis cases correspond to large proportional changes from the low baseline value.

L.3.3. Change in IQ Loss Associated with Recent Air Exposures

In addition to the total predicted IQ loss, an analysis was performed on how changes in modeling assumptions and parameters affected the proportions of IQ loss associated with the "recent air" exposure pathways. As discussed in Appendix K, the estimated contributions to IQ loss associated with specific exposure pathways are estimated from the estimated contributions to total Pb intake. Given the nonlinearity of the IQ loss model, the proportional contributions are therefore approximate. In addition, because the baseline case involves derivation of IQ loss distributions based on a single exposure value, the point estimate of the pathway contribution to IQ loss is the same across all the estimated percentiles within each case.

Exhibit L-6 summarizes the estimated changes in recent air pathway contributions (i.e., ingestion of indoor dust Pb predicted to be associated with ambient air Pb concentrations, inhalation of ambient air Pb, and the sum of the two) associated with the various sensitivity cases. These results indicate the percentage of the total IQ that comes from the recent air pathways for each case. The exhibit provides results for only 14 of the 21 sensitivity cases because cases that do not involve changes in exposure models or parameter values result in no change in the recent air contribution compared to the baseline value. This is true of all the cases that assume different PbB GSDs and different PbB and IQ loss models. In these cases, as in the baseline, the estimated contribution of recent air pathways to the total IQ loss is 29 percent (rounded), 28 percent associated with indoor dust ingestion and 0.5 percent associated with inhalation exposures.

Exhibit L-6. Percentage of IQ Loss Contributed from the Recent Air Pathways Associated with the Sensitivity Cases

Case	Recent Air [a] Contribution to IQ Loss		
	Indoor Dust Ingestion	Ambient Air Inhalation	Total Contribution
High-end hybrid model parameters	47%	0.3%	48%
Hybrid model with low cleaning efficiency (0.125)	35%	0.5%	35%
Hybrid model with low cleaning frequency (1 m^{-1})	35%	0.5%	35%
Hybrid model with high AER (1.26 h^{-1})	33%	0.5%	34%
Diet/Water GI absorption fraction (40%)	30%	0.6%	31%
Baseline	**28%**	**0.5%**	**29%**
Diet/drinking water GI absorption fraction (60%)	27%	0.5%	27%
Hybrid model with low Pb deposition rate (0.39 h^{-1})	24%	0.6%	25%
Outdoor soil/dust, indoor dust GI absorption Fraction (0.18)	24%	0.7%	25%
Hybrid model with high cleaning frequency (1 w^{-1})	22%	0.6%	23%
Outdoor soil/dust ingestion weighting factor (58%)	21%	0.5%	22%
Hybrid model based on 75th percentile total indoor dust Pb (12.2 µg/ft^2)	18%	0.5%	18%
95th Percentile ratio of maximum quarterly to annual average Pb-TSP concentrations (7.6)	16%	0.2%	16%
Urban soil 95th percentile (648 µg/g)	15%	0.3%	16%
Air-only regression-based indoor dust model	12%	0.6%	13%

[a] Recent air is used here to refer to Pb exposures in the general urban case study that are derived from the estimate of outdoor ambient air Pb concentration (i.e., inhalation of ambient air Pb and ingestion of indoor dust Pb predicted to be associated with ambient air Pb concentration).

The data in Exhibit L-6 illustrate that changing parameters in a number of exposure models can have a large impact on the proportion of IQ loss attributed to the recent air pathway. Assuming high parameter values in the mechanistic portion of the hybrid mechanistic-empirical model can substantially increase the estimated recent air contribution relative to baseline. Assuming low cleaning efficiency, low cleaning frequency, or higher air exchange rates increases the estimated recent air contribution to between 33 and 35 percent from the baseline value of 29 percent. Assuming high values for all of these values simultaneously (i.e., the high-end indoor dust model) increases the total "recent air" contribution (ingestion of indoor dust plus inhalation) to 48 percent of total IQ loss (subject to the limitations noted above).

Assumptions that significantly reduce the proportion of IQ loss attributed to recent air exposure pathways include use of the air-only regression-based model to estimate indoor dust Pb concentrations (13 percent), use of the 95th percentile urban outdoor soil/dust Pb concentration or 95th percentile ratio of maximum quarterly to annual average Pb-TSP concentrations (16 percent each), or use of the 75th percentile total indoor dust Pb estimate from the HUD National Survey (18 percent). The remaining sensitivity cases have less impact on the estimated proportion of IQ loss attributable to recent air exposure pathways.

Exhibit L-7 shows the relative changes in the IQ loss from the "recent air" pathways. This exhibit is similar to Exhibit L-5, but it shows the change relative to the baseline IQ for the IQ derived from recent air pathways only. The rank order in the table is the same as that in Exhibit L-5. In some cases, changes that result in an increase in total IQ loss compared to the baseline case cause a decrease in recent air-related IQ loss (e.g., the urban soil 95th percentile case). Percent changes tend to be larger for the recent air portion of IQ loss, compared with the total. However, the recent air portion of the IQ loss tends to be small (usually less than one IQ point), and thus the overall effect on IQ is usually small.

Exhibit L-7. Percent Differences in IQ Loss Estimates Between the Sensitivity and Baseline Cases - Recent Air Pathways

Sensitivity Case	Relative Change in Percentile Estimate Compared to Baseline for Recent Air[a] Pathways		
	99.5th (Baseline = 3.5)	95th (Baseline = 2.1)	Median (Baseline = 0.9)
Log-linear with linearization IQ loss model	137%	226%	412%
Leggett PbB model	99%	170%	279%
Log-linear with cutpoint IQ loss model	59%	97%	102%
Urban soil 95th percentile (648 µg/g)	-20%	-8%	-7%
High-end hybrid model parameters	136%	139%	139%
Hybrid model with low cleaning frequency (1 m^{-1})	35%	36%	37%
Hybrid model with low cleaning efficiency (0.125)	33%	36%	37%
Hybrid model based on 75th percentile total indoor dust Pb (12.2 µg/ft^2)	-31%	-31%	-31%
Lifetime PbB metric	3%	9%	20%
High PbB GSD (2.1 µg/dL)	49%	40%	0%
Hybrid model with high AER (1.26 h^{-1})	24%	27%	28%
Diet/drinking water GI absorption fraction (60%)	-1%	0%	1%
Low PbB GSD (1.6 µg/dL)	-17%	-10%	0%
Hybrid model with low Pb deposition rate (0.39 h^{-1})	-19%	-19%	-19%
Diet/Water GI absorption fraction (40%)	-3%	-2%	-1%
Outdoor soil/dust, indoor dust GI absorption Fraction (0.18)	-23%	-21%	-21%
Outdoor soil/dust ingestion weighting factor (58%)	-32%	-31%	-30%
Air-only regression-based indoor dust model	-61%	-60%	-60%
Hybrid model with high cleaning frequency (1 w^{-1})	-29%	-28%	-27%
95th Percentile ratio of maximum quarterly to annual average Pb-TSP concentrations (7.6)	-50%	-50%	-49%

[a] Recent air is used here to refer to Pb exposures in the general urban case study that are derived from the estimate of outdoor ambient air Pb concentration (i.e., inhalation of ambient air Pb and ingestion of indoor dust Pb predicted to be associated with ambient air Pb concentration).

REFERENCES

Lanphear, B. P.; Hornung, R.; Khoury, J.; Yolton, K.; Baghurst, P.; Bellinger, D. C.; Canfield, R. L.; Dietrich, K. N.; Bornschein, R.; Greene, T.; Rothenberg, S. J.; Needleman, H. L.; Schnaas, L.; Wasserman, G.; Graziano, J.; Robe, R. (2005) Low-Level Environmental Lead Exposure and Children's Intellectual Function: An International Pooled Analysis. *Environmental Health Perspectives.* 113(7)

Leggett, R. W. (1993) An Age-Specific Kinetic Model of Lead Metabolism in Humans. *Environ Health Perspect.* 101: 598-616.

U.S. Environmental Protection Agency (USEPA). (1995) Report on the National Survey of Lead-Based Paint in Housing: Appendix I: Design and Methodology. EPA 747-R95-004. Office of Pollution Prevention and Toxics.

U.S. Environmental Protection Agency (USEPA). (1997) Exposure Factors Handbook Vol. III: Activity Factors. 1-74. USEPA; August.

U.S. Environmental Protection Agency (USEPA). (2000) Hazard Standard Risk Analysis Supplement - TSCA Section 403. Available online at: http://www.epa.gov/lead/pubs/403risksupp.htm.

U.S. Environmental Protection Agency (USEPA). (2005) Integrated Exposure Uptake Biokinetic Model for Lead in Children, Windows® Version (IEUBKwin V1.0 Build 263). Available online at: http://www.epa.gov/superfund/lead/products.htm.

von Lindern, I.; Spalinger, S.; Petrosyan, V.; and von Braun, M. (2003) Assessing Remedial Effectiveness Through the Blood Lead:Soil/Dust Lead Relationship at the Bunker Hill Superfund Site in the Silver Valley of Idaho. *Sci. Total Environ.* 303: 139-170.

Westat Inc. (2002) National Survey of Lead and Allergens in Housing. Volume I: Analysis of Lead Hazards. Final Report. Revision 7.1. Washington, D.C.: Office of Health Homes and Lead Hazard Control, U.S. Department of Housing and Urban Development.

July 25, 2007

Appendix M. Qualitative Discussion of Sources of Uncertainty and Quantitative Analysis of Two Design Features

Prepared by:

ICF International
Research Triangle Park, NC

Prepared for:

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina

Contract No. EP-D-06-115
Work Assignment No. 0-4

Table of Contents

List of Exhibits

M. QUALITATIVE SOURCES OF UNCERTAINTY AND DESIGN UNCERTAINTY ANALYSES

This appendix presents an overview of the qualitative uncertainties in the risk analysis. For many of the uncertainties discussed, a full quantitative uncertainty analysis is not possible because the uncertainty in many of the exposure lead (Pb) concentrations or prediction models is not well-quantified. However, where possible, attempts have been made to account for these uncertainties by running multiple models and looking at the range of results. For example, for the general urban case study, two different indoor dust models were used to estimate indoor dust Pb concentrations; two different geometric standard deviations (GSDs) were used to estimate inter-individual variability; two different blood Pb (PbB) metrics were used to estimate PbB concentrations; and three different intelligence quotient (IQ) change functions were used to generate IQ loss estimates. Comparison across all these different cases does, however, provide some estimate of the overall uncertainty in the risk results. This appendix further delineates individual sources of uncertainty in each step of the risk analyses for each case study. Section M.1 presents a summary of the uncertainties in the Pb exposure concentrations and risk analysis models, and Section M.2 further discusses uncertainties specific to the design of the risk analyses.

M.1. QUALITATIVE SOURCES OF UNCERTAINTIES IN THE EXPOSURE CONCENTRATIONS AND RISK ANALYSES MODELS

M-1 presents a summary of limitations contributing uncertainty to the assessment that are associated with the following:

- The general (vs. specific) case study strategy (i.e., of general urban case study),
- Emissions characterization,
- Ambient air Pb concentrations,
- Roll-back approach for alternative NAAQS scenarios,
- Inhalation Pb exposure concentrations,
- Outdoor soil/dust Pb exposure concentrations,
- Indoor dust Pb exposure concentrations,
- Other sources of exposure,
- The PbB estimation model,
- Biokinetic exposure/intake/uptake factors,
- The PbB metric,
- Inter-individual PbB variability (i.e., GSD),
- The IQ loss model for each case study, and
- The apportionment of PbB concentrations and IQ loss to different exposure pathways.

Exhibit M-1. Summary of Limitations Contributing Uncertainty to Various Aspects of this Assessment

Modeling Element	Case Study [a]		
	General Urban	**Primary Pb Smelter**	**Secondary Pb Smelter**
General (vs. specific) Case Study Strategy	- **In considering the general urban case study, uncertainty results from a reliance on a general approach to characterize conditions in urban areas across the United States. Although the approach provides a reasonable approximation of average conditions within urbanized areas in the United States, it is unlikely that it could be used to accurately represent individual cities when they are considered outside the framework of this average across cities.**	--	--
Emissions Characterization	--	- Emission estimates for the current NAAQS scenario reflect the proposed Missouri Department of Natural Resources [MDNR] 2007 State Implementation Plan [SIP] [(2007). The U.S. EPA has not completed its review of this proposed SIP. Further, actual emissions from Pb sources in this case study occurring when the current or alternative NAAQS is attained may differ.	- Process-related Pb emissions for the current conditions scenario were obtained from 2005 to 2006 stack tests, and fugitive Pb emissions were estimated based on 1987 data. These estimates may differ from actual emissions from this facility.
Ambient Air Pb Concentrations	- Although the general approach provides bounds on the current situation by examining mean and 95^{th} percentile current conditions, it does not bound the conditions under each alternative NAAQS scenario. The use of single NAAQS values for the alternative NAAQS standards does not allow for consideration of the fact that attainment of an alternative NAAQS is likely to result in a non-uniform ambient air surface, including areas with levels below that standard.	- The spatial pattern of air concentrations predicted from the dispersion modeling for the current NAAQS attainment scenario is used for all scenarios.	- The spatial pattern of air concentrations predicted from the dispersion modeling for the current conditions scenario is used for all scenarios.

Exhibit M-1. Summary of Limitations Contributing Uncertainty to Various Aspects of this Assessment

Modeling Element	Case Study [a]		
	General Urban	**Primary Pb Smelter**	**Secondary Pb Smelter**
Ambient Air Pb Concentrations (Continued)	- Mean and 95th percentile ratios of maximum quarterly to annual average Pb-total suspended particulates (TSP) concentration estimates for all air monitors were used to convert the quarterly maximum concentration to an annual equivalent for current conditions. The use of these ratios incorporates uncertainty into the analysis. In addition, lower-bound estimates of these ratios were not generated, which limits the ability of this assessment to represent locations with smaller ratios.	- In dispersion modeling used to predict air concentrations for the current NAAQS scenario, only two years of meteorological data were modeled (as compared to the more traditional five), which limited the ability of the analysis to capture year-to-year variability in meteorological conditions. However, the data that were used were site-specific data, which are generally considered preferable to five years of data from the closest National Weather Service (NWS) station.	**- In dispersion modeling used to predict air concentrations for the current conditions scenario, no site-specific meteorological data were available, thus data from the nearest NWS station were used.**
Roll-back Approach for Alternative NAAQS Scenarios	--	- The roll-back approach used in this assessment assumes a proportional reduction (relative to the reduction necessary for the maximum concentration location to meet the alternative standard) for all locations across the study area. This approach does not explicitly consider the spatial differences in concentrations that may occur under different control strategies.	
Inhalation Pb Exposure Concentrations	- Concentrations were not modeled using an exposure-event model (e.g., APEX). Instead, this analysis used conversion factors developed from the U.S. EPA's 1999 National-scale Air Toxics Assessment (USEPA, 2006a) ambient and inhalation Pb exposure concentrations to develop a rough estimate of how these Pb concentrations relate to each other for each case study.		
	- The NATA results for the entire United States, rather than those specific to only urban locations, were used.	- The U.S. Census tract results from NATA were assumed to be sufficient for representing ambient Pb-exposure relationships for all U.S. Census blocks or block groups within the tract.	
	- The NATA age group used to estimate the ambient-to-inhalation Pb exposure concentration conversion was specific to 0 to 4 year olds. However, this assessment is focused on 0 to 7 year old children. The uncertainty associated with this assumption is dependent on the extent to which the activity patterns of 0 to 4 years olds does not represent 0 to 7 year olds. It is unclear whether this uncertainty results in over- or under-estimates of inhalation exposure concentrations.		
	- The penetration factor, which was used in the HAPEM modeling for NATA to estimate the fraction of Pb in outdoor air that reaches indoor air, was based on a study that examined the penetration of hexavalent chromium particles, which are generally more reactive than Pb particles (Long et al., 2004).		
	- The arithmetic mean of ambient-to-inhalation Pb exposure concentration ratios was assumed appropriate for all case studies. This approach does not capture the variability in this relationship across different individuals.		

Exhibit M-1. Summary of Limitations Contributing Uncertainty to Various Aspects of this Assessment

Modeling Element	Case Study [a]		
	General Urban	**Primary Pb Smelter**	**Secondary Pb Smelter**
Outdoor Soil/Dust Pb Exposure Concentrations	Based on time and resource constraints, this analysis used a data point from a readily available interim version of the National Survey of Lead and Allergens in Housing (NSLAH) rather than a point from the final study data, which is contained in a less user-friendly format. The primary difference between the survey versions is that the interim version contains data from 706 housing units (USEPA, 2000), while the final version uses data from 831 housing units (Westat Inc., 2002). Since the interim soil Pb concentration is calculated using weighting designed to produce a nationally representative value (the same procedure would be used for the calculation from the final version data), it is expected that the concentrations from the two versions would differ but the magnitude of the difference is expected to be small.	**- For this case study, post-excavation data were used to characterize soil/dust Pb concentrations within the remediation zone (i.e., within 1.5 kilometers [km] of the facility) and pre-excavation data were used to characterize concentrations outside of the remediation zone. The post-excavation data were collected immediately following excavation, *prior* to the yards being backfilled with clean soil. It is unclear how these measurements compare to the current, post-backfill soil/dust concentrations. In addition, none of the soil/dust concentration estimates used for this case study include consideration for continuing contamination that has occurred since the measurements were taken. Given the relatively high emissions from this facility, it is expected that these limitations result is an overall underestimate of soil/dust concentrations for this case study.**	- No direct soil measurement data for Pb were identified in the vicinity of the secondary Pb smelter case study location; therefore, it was not possible to characterize Pb levels in outdoor soil/dust around the secondary Pb smelter using strictly site-specific empirical data. Instead, soil/dust Pb concentrations were estimated using air and soil mixing models and measurement data collected around a similar facility. Without site-specific soil/dust measurements, the representativeness of the resulting concentrations could not be fully evaluated.
	- The interim NSLAH survey is not focused on urban homes, but is based on a nationally-representative survey of residential locations, which impacts the ability of these data to be used to represent urban locations.	- Current soil measurements were not available for the area outside of the soil cleanup area. Outdoor soil/dust concentrations in this area were estimated using a regression equation of the available pre-excavation soil concentrations based on distance to the main stack. Due to the soil cleanup within 1 mile of the stack, the calculated and measured soil Pb concentrations near the primary Pb smelter were in some cases lower than the soil concentrations calculated or measured in locations without soil cleanup. This likely contributes uncertainty to the risk results (e.g., underestimating the contribution from the outdoor soil/dust pathway close to the facility). However, the impact of this limitation on results was likely reduced by the selection of different indoor dust Pb prediction models for the two different parts of the study area.	- The soil mixing modeling performed for this case study uses deposition outputs from the air modeling. Thus, the limitations and uncertainties associated with the air modeling are carried through to the soil/dust Pb concentration estimates and will introduce uncertainties there as well.

Exhibit M-1. Summary of Limitations Contributing Uncertainty to Various Aspects of this Assessment

Modeling Element	Case Study [a]		
	General Urban	Primary Pb Smelter	Secondary Pb Smelter
Outdoor Soil/Dust Pb Exposure Concentrations (Continued)	- There is a significant amount of variation across cities, with regard to soil Pb levels. There is also significant variation across houses in a given city depending on housing vintage, whether renovation activities occurred on the site, historical usage of the land on which a house is built, etc. A single value (as used in the urban case study) does not capture this inter-city and inter-house variability. Consequently, risk predictions generated using this hypothetical case study could misrepresent exposures and risks for cities where soil Pb levels demonstrate a significantly different trend form the central-tendency value used in this analysis.	--	- Site-specific input parameters for the U.S. EPA (1998) Multiple Pathways of Exposure (MPE) soil mixing model were used when feasible. However, for some parameters, assumptions were made based on suggested values in the database of input parameters included with the U.S. EPA's Human Health Risk Assessment Protocol (HHRAP) (USEPA, 2005). It is unknown whether these assumptions adequately reflect site conditions.
	- The yard-wide average used in this analysis, which incorporates samples from throughout the yard, may not be the optimal way to characterize the outdoor soil/dust Pb concentrations to which children may be exposed. Children may spend significantly more time in a particular part of the yard. NSLAH sampled in the play areas for some homes, but play area data were not used in this analysis because these samples were only taken for approximately half of the homes assessed. It is unclear whether the yard-wide averages generally over- or under-estimate soil/dust concentrations to which children are exposed. However, since U.S. EPA (2000) indicates that NSLAH play area samples are assumed to come from remote areas of the yard, which generally have lower Pb soil concentrations than locations closer to the building, it is expected that the use of yard-wide averages would bias the concentration high.	--	- MPE-generated soil/dust Pb concentrations were scaled up (based on distance from the secondary Pb smelter) using soil measurements available for another secondary Pb smelter. It is unknown whether these MPE -generated and surrogate-scaled soil Pb concentrations over- or under-estimate actual soil Pb concentrations around the secondary Pb smelter.

Exhibit M-1. Summary of Limitations Contributing Uncertainty to Various Aspects of this Assessment

Modeling Element	Case Study [a]		
	General Urban	Primary Pb Smelter	Secondary Pb Smelter
Indoor Dust Pb Exposure Concentrations	**- The cleaning efficiency and frequency inputs used in the mechanistic portion of the hybrid model (i.e., the part of the model that calculates the contribution to the total indoor dust Pb loading from the ambient air) were developed based on limited data from the available literature and have significant associated uncertainties. Given the relatively high sensitivity of the model to changes in these two inputs, these limitations contribute to the uncertainties in the indoor dust Pb concentration estimates. It is unclear whether these uncertainties result in over- or under-estimates of these concentrations.**	**- For locations within 1.5 km of the primary Pb smelter, a site-specific model was used to generate indoor dust Pb concentration estimates. This model will only capture central tendency indoor dust Pb concentrations and is relatively uncertain for U.S. Census blocks or block groups with atypical exposure patterns. In addition, the model does not explicitly capture the relationships between outdoor soil/dust Pb and indoor dust Pb or road dust Pb and indoor dust Pb because no statistical relationships were identified in the data. These limitations introduce uncertainty into the estimated dust Pb concentrations, although it is unclear whether they result in over- or under-estimates.**	- The air-only regression-based model was used to estimate the indoor dust Pb concentrations for this case study due to greater uncertainty associated with characterizing outdoor soil Pb levels for this case study. Use of the air-only model reflects consideration for the longer-term impacts of ambient air Pb on outdoor soil, with subsequent effects of that soil Pb on indoor dust. Consideration for this longer-term indirect effect of ambient air Pb on indoor dust Pb through the intermediate soil media has not been considered in modeling for the other case studies.
	- The Pb deposition rate and air exchange rate (AER) used in the mechanistic portion of the hybrid model were fairly well characterized by data in the literature; however, their variability, which is excepted to be fairly high, is not fully captured by the model and may contribute to uncertainties in the indoor dust Pb concentration estimates.	- For locations greater than 1.5 km from the primary Pb smelter, the air+soil regression-based model was used for this case study. This model was developed primarily using data from the 1980s for Pb smelters in the United States and Canada. The conditions at these smelters in the 1980s may not match those currently existing at the primary Pb smelter case study. It is unclear how these uncertainties may bias the estimated indoor dust Pb concentrations.	- The air-only regression model used for this case study was developed primarily using data from the 1980s for Pb smelters in the United States and Canada. The conditions at these smelters in the 1980s may not match those currently existing at the secondary Pb smelter case study. It is unclear how these uncertainties may bias the estimated indoor dust Pb concentrations.
	- Resuspension is not explicitly modeled in the mechanistic portion of the hybrid model. For higher indoor dust Pb loadings, resuspension may be considerable and its exclusion tends to bias the indoor dust Pb loadings high. Direct quantification of the bias is not possible, however, because resuspension will depend on the total dust Pb loading, not just the portion arising from the ambient air Pb, and the mechanistic portion of the model only addresses the latter.	- Any uncertainties in the ambient air Pb concentrations and in the outdoor soil/dust concentrations for locations greater then 1.5 km from the facility will result in uncertainties in the indoor dust Pb concentration estimates.	- Any uncertainties in the ambient air Pb concentrations will result in uncertainties in the indoor dust Pb concentration estimates.

Exhibit M-1. Summary of Limitations Contributing Uncertainty to Various Aspects of this Assessment

Modeling Element	Case Study [a]		
	General Urban	Primary Pb Smelter	Secondary Pb Smelter
Indoor Dust Pb Exposure Concentrations (Continued)	**- The empirical portion of the hybrid model uses estimates of total dust Pb loading from the median values in the Department of Housing and Urban Development (HUD) survey (USEPA, 1995) as the basis for deriving non-air related indoor dust Pb concentrations. The HUD survey is designed to be representative of housing for the United States' population and thus does not represent exclusively urban homes. As a result, the variability in the indoor dust Pb loadings across the study homes is large. The median Pb background used for this case study does not capture any variability due to higher ambient Pb air, indoor Pb paint, outdoor soil/dust concentrations, or atypical cleaning habits. In addition, the HUD study was conducted over a decade ago, and background conditions may have changed between the study time period and today. The limitations in these values introduce uncertainty into the estimated dust Pb concentrations, although it is unclear whether they result in over- or under-estimates.**	--	--
	- The mechanistic portion of the hybrid model requires input of an Pb ambient air concentration that represents the conditions in the homes in the HUD study (USEPA, 1995) to ensure that the ambient air and indoor dust loadings used in the model are consistent. The ambient air concentration selected was a national average of all air monitors in urban environments operating during the time of the HUD study. However, this ambient air Pb concentration may not actually correspond to the typical air Pb concentration near the HUD study homes.	--	--

Exhibit M-1. Summary of Limitations Contributing Uncertainty to Various Aspects of this Assessment

Modeling Element	Case Study [a]		
	General Urban	Primary Pb Smelter	Secondary Pb Smelter
Indoor Dust Pb Exposure Concentrations (Continued)	**- In the hybrid model, the total indoor dust Pb loading is converted to a total Pb dust concentration using a regression equation developed from the HUD survey data (USEPA, 1995). This equation was fit by log transforming both the indoor dust Pb loading and the indoor dust Pb concentration measurements and fitting a linear equation to the data. Because the regression was done in log space, small changes to the intercept result in large changes to the predicted indoor dust Pb concentration. The use of this equation assumes the nature of the indoor dust Pb in the house in question is similar to the composition of indoor dust Pb in a typical HUD study home. Differences in percent contributions from indoor Pb paint, outdoor soil/dust, or ambient air could result in different indoor dust Pb concentrations for the same indoor dust Pb loading. Thus, there is a large degree of uncertainty associated with the conversion equation. It is unclear whether this uncertainty results in over- or under-estimates.**	--	--
	- In the hybrid model, contributions from air-related sources to indoor dust Pb loadings varied across the different NAAQS scenarios. Contributions from other (non-air) sources, however, were constant across NAAQS scenarios. As a result, there are differences in the percent contributions of these sources to indoor dust Pb loadings. These percent contributions are used in the pathway apportionment and result in limitations in the resulting apportionment of PbB and IQ loss, which are discussed below.	--	--

Exhibit M-1. Summary of Limitations Contributing Uncertainty to Various Aspects of this Assessment

Modeling Element	Case Study [a]		
	General Urban	**Primary Pb Smelter**	**Secondary Pb Smelter**
Indoor Dust Pb Exposure Concentrations (Continued)	- As part of the effort to consider uncertainty in key modeling steps, indoor dust Pb concentrations were estimated with both the hybrid model and the air-only regression-based model (same model used for the secondary Pb smelter case study – see above). Several of the locations included in the data used to generate the air-only regression-based model were in urban environments, but the data were dominated by point sources. Thus, this equation's application in urban environments is limited by the representativeness of the locations included in the original pooled analysis and the extent to which current conditions are represented by conditions in the 1980s when the data were collected. It is unclear how these uncertainties may bias the estimated indoor dust Pb concentrations.	--	--
	- Any uncertainties associated with the ambient air Pb concentrations for this case study will be carried through to the indoor Pb dust calculations and will introduce uncertainties there as well.	--	--
Other Sources of Exposure	- There is uncertainty associated with estimates of the amounts of foods eaten (by age, ethnicity) used in the generation of PbB results. Patterns of children's food consumption and thus potential dietary Pb exposures have changed over time. Limited data were available regarding differences across ethnic groups that could identify highly exposed population subgroups which may not be well represented by the modeling conducted for this analysis (in terms of background exposures).		
	- Representative residue levels of Pb in specific foods (commercial and homegrown) for each case study were not obtained. All exposed children were assumed to receive the age-specific estimates of dietary Pb intake developed by the U.S. EPA Office of Solid Waste and Emergency Response (OSWER) (U.S. Environmental Protection Agency (USEPA), 2006b). The U.S. EPA developed these estimates by analyzing food consumption data from the NHANES III, conducted by the National Center for Health Statistics , and food residue data from the U.S. FDA Total Dietary Study from 2001 (USFDA, 2001). These estimates may either over- or under-estimate the actual central tendency dietary Pb intake in each case study.		
	- There is uncertainty associated with estimates of the amounts of drinking water consumed. Existing study data were interpolated to determine age-specific consumption for each year modeled in the Integrated Exposure Uptake Biokinetic (IEUBK) model. In addition, only residential drinking water consumption was included; any consumption from non-residential sources is not reflected in this analysis.		

Exhibit M-1. Summary of Limitations Contributing Uncertainty to Various Aspects of this Assessment

Modeling Element	Case Study [a]		
	General Urban	**Primary Pb Smelter**	**Secondary Pb Smelter**
Other Sources of Exposure (Continued)	-The Pb concentration in drinking water used in this assessment was taken from samples using a limited number of children whose sample homes were built after Pb piping was banned. Consequently, this analysis does not address elevated background exposures related to drinking water containing Pb. In addition, the central tendency drinking water Pb concentration estimates will necessarily exclude any regional variations or short-term peaks in the drinking water Pb exposure. Finally, any systematic differences in background Pb water concentrations between the Pb smelter sites and the general urban case study have not been captured.		
	- Contributions of Pb to indoor dust from indoor paint were not explicitly captured, although they are covered to some extent by elements of the indoor dust Pb models used in the analysis. For the primary and secondary Pb smelter case studies, this contribution is implicitly included in the intercept of the indoor dust calculation equations. For the general urban case study hybrid model, the indoor paint contribution is captured by the calculated empirical non-air portion of the hybrid model. Any regional or temporal changes in the contribution of indoor Pb paint will not be captured.		
	- Folk medicines, toys, enamelware, and other sources are not likely to be major sources of Pb exposure for most children, and these potential exposures were not characterized for this assessment. Specific ethnic or social groups may have high risks of Pb exposure from these sources; however, the magnitude of these risks for these groups is unknown.		
PbB Estimation Model	**- Of the two biokinetic models considered, the IEUBK model generates PbB estimates that are three times lower than the Leggett model (1993) when the same Pb uptake assumptions are used. No concrete explanation for this discrepancy currently exists. However, based on the limited data available for performance evaluation, the IEUBK model appears to give estimates close to those measured in children with known Pb exposure concentrations. Because of the wide discrepancy between the models, considerable uncertainty is introduced due to the choice of the PbB model.**		
Biokinetic Exposure/Intake/Uptake Factors	- As described above, uncertainties are introduced due to the selection of food intake, Pb concentration in food, drinking water intake, and drinking water Pb concentrations (see "Other Sources of Exposure" above).		
	- The defaults for indoor dust and outdoor soil/dust ingestion rates and the fraction of outdoor soil/dust and indoor dust ingestion from soil from IEUBK were retained in this analysis. No urban-specific or Pb smelter-specific values could be determined. Thus, these values may either over- or under-estimate the outdoor soil/dust and indoor dust parameters.		
	- The GI absorption fraction of Pb from drinking water (and diet) was retained at the IEUBK default value. These absorption estimates did not account for temporal or inter-individual variations and may either over- or under-estimate the actual GI absorption rate.		

Exhibit M-1. Summary of Limitations Contributing Uncertainty to Various Aspects of this Assessment

<table>
<tr><th rowspan="2">Modeling Element</th><th colspan="3">Case Study [a]</th></tr>
<tr><th>General Urban</th><th>Primary Pb Smelter</th><th>Secondary Pb Smelter</th></tr>
<tr><td>Biokinetic Exposure/Intake/Uptake Factors (Continued)</td><td>- For this case study, the IEUBK generic default value for gastrointestinal (GI) absorption of Pb from outdoor soil/dust and indoor dust was used. This value is generally consistent with more recently reported values, although estimates vary widely. Thus, these estimates may either over- or under-estimate the actual GI absorption for a child in these study areas.</td><td>Site-specific absorption factors for outdoor soil/dust and indoor dust were derived for this case study using relative bioavailability (RBA) estimates generated based on swine studies involving outdoor soil/dust and indoor dust samples collected in the study area (Casteel et al., 2005). These site-specific absorption factors showed uptake rates that were contrary to the typical pattern seen with outdoor soil/dust and indoor dust given that the estimated GI absorption fraction for outdoor soil/dust Pb (0.48) was higher than that for indoor dust (0.26.) Because the estimated indoor dust PB concentrations were so much higher than the outdoor soil/dust Pb concentrations for the same U.S. Census blocks, use of these site-specific values probably resulted in slightly lower estimated Pb uptakes than would have resulted from using the default GI absorption fraction value of 0.30 for both outdoor soil/dust and indoor dust.</td><td>- For this case study, the IEUBK generic default value for GI absorption of Pb from outdoor soil/dust and indoor dust was used. This value is generally consistent with more recently reported values, although estimates vary widely. Thus, these estimates may either over- or under-estimate the actual GI absorption for a child in these study areas.</td></tr>
<tr><td>PbB Metric</td><td colspan="3">- In the Lanphear et al. (2005) study, the concurrent metric was shown to provide an empirical relationship with the highest predictive power. However, any errors associated with using one metric over the other are not quantified and introduce uncertainty in the IQ loss estimates calculated from them.</td></tr>
<tr><td rowspan="3">Inter-Individual PbB Variability (i.e., GSD)</td><td>-A range of GSDs were considered for the general urban case study including values reflective of a) a more homogenous population of children (in terms of Pb exposure (GSDs of 1.6 to 1.7 µg/dL) and b) a more heterogeneous population of children (GSDs of 2.0 to 2.1). There is uncertainty in inclusion of the larger values since these are based on the United States' population and may well over-state variability for any size urban population exposed to a fairly uniform ambient air Pb level (as is the case with the</td><td colspan="2">- A range of GSDs reflecting a more homogenous (local) population of children (GSDs of 1.6 to 1.7) was used for the two point source case studies. Given that exposure analysis for both point source case studies is based on application of a spatial template that stratifies the modeled population prior to the application of PbB GSDs, this may result in an over-prediction of PbB level variability. Specifically, because a key source of variability in underlying PbB levels (i.e., gradients in air-related media Pb concentrations) is already addressed through the spatial template, GSDs would ideally only cover remaining sources of variability (e.g., variability in non air-related Pb sources and variability in biokinetics and behavior related to Pb exposure).</td></tr>
<tr><td colspan="3">- Any variations in the inter-individual variability in different age groups, genders, ethnic groups, or other categories were not captured in the calculated GSD values. Thus, any differences between the population in the data from which the GSD values were derived and the populations captured by the case studies used in this analysis introduce uncertainty in the GSD estimates.</td></tr>
<tr><td colspan="3">- The GSD was observed to increase in recent years, potentially due to the persistence of a small "tail" of high-exposure children while exposures are falling for the vast majority of children. The effects of this change were not explored in this analysis.</td></tr>
</table>

Exhibit M-1. Summary of Limitations Contributing Uncertainty to Various Aspects of this Assessment

Modeling Element	Case Study [a]		
	General Urban	Primary Pb Smelter	Secondary Pb Smelter
IQ Loss Model	- Any effects of covariates on the Lanphear et al. (2005) model predictions are unknown, and the IQ change functions used in this analysis were derived from this Lanphear study. Thus, any inherent differences between the Lanphear et al. population of children and the children captured in the case studies used in this analysis introduce uncertainty in the IQ estimates.		
	- Any errors introduced during the estimation of Pb exposure concentrations or PbB levels discussed above will be carried through and introduce uncertainty in the IQ loss predictions.		
	- A key source of uncertainty related to IQ loss modeling is the degree of health decrement associated with lower exposure levels (i.e., PbB levels less than 5 µg/dL). The Lanphear pooled analysis did not provide data that pointed to a clear functional form for IQ loss at these low exposure levels and consequently, several candidate functions were included in this analysis.		
Pathway Apportionment	**- It was assumed that the central tendency pathway apportionment of PbB levels holds for higher percentiles in an exposure range (based on the pattern seen for central-tendency PbB level estimates generated for that same exposure range). In reality, pathway apportionment may shift as higher exposure percentiles are considered (e.g., Pb paint and/or drinking water exposures may increase in importance, with air-related contributions decreasing as an overall percentage of PbB levels).**		
	- As discussed above, the apportionment of PbB and IQ loss from sources of indoor dust Pb loading is based on percent contributions from air and other sources. This approach leads to estimates of other source contributions to PbB and IQ loss that are not constant across NAAQS scenarios, even though the actual sources are the same. This results from a number of factors, including non-linearities in the PbB and IQ loss modeling. The limitation generally results in higher contributions from other sources for scenarios with lower relative air source contributions.		
	- The percentage of IQ arising from different exposure pathways was assumed to be the same as the percentage of Pb uptake from each pathway. Because the IQ loss model is non-linear, this method produces approximate pathway contributions only, and the potential magnitude of the errors introduced by this assumption is unknown.		

[a] Those sources of uncertainty anticipated to have a particular significant impact on risk results generated for this analysis (based either on consideration for the results of the sensitivity analysis, where applicable, or input from the analysis team) have been bolded. Efforts to enhance the analysis through further analysis and/or research would likely be focused on these specific analytical steps/inputs.

M.2. QUANTITATIVE ANALYSIS OF TWO DESIGN ELEMENTS

In addition to the uncertainties listed in Section M.1, other uncertainties are introduced to the overall analyses due to specific aspects of the design. Two key elements of the analysis design which are subject to uncertainty are: (1) the extent of the modeling domains for the primary and secondary Pb smelter case studies (see Section M.2.1) and (2) the number of times the probabilistic model is run (see Section M.2.2).

M.2.1. Comparison of the Primary and Secondary Pb Smelter Case Study IQ Loss Estimates

The two point source case studies both have study areas that include populations living within a 10-kilometers (km) radius of the facility. Due to the differences in overall emissions from the two facilities associated with these case studies (with the primary Pb smelter emissions significantly greater than those from the secondary Pb smelter), there are concerns that the study population for each case study may not be comparable in terms of the range of air-related exposures, particularly for median and lower percentiles. Specifically, if the primary Pb smelter has significantly higher air impacts across the majority of the study area compared with the secondary Pb smelter, then the majority of the modeled individuals considered for the primary Pb smelter would have relatively high air-related exposures compared to the population associated with the secondary Pb smelter. This could result in risk distributions reflecting very different magnitudes of exposure for the two case studies, with estimates for the secondary Pb smelter being biased down (relative to the primary Pb smelter) by inclusion of children with relatively low air-related exposures. In this situation, a case could be made for extending the primary Pb smelter study area further out to include children whose air-related air exposure is more similar to lesser exposed children associated with the secondary Pb smelter, or for limiting the extent of the secondary Pb smelter case study to include only children whose air-related exposures are greater than or equal to the lesser exposed children associated with the primary Pb smelter.

To examine this issue, the various aspects of low-end population percentile risk estimates (IQ loss values) were compared for the two case studies given their current study areas (i.e., both representing 10 km radius areas surrounding the facilities). Specifically, Exhibit M-2 compares the 5th percentile estimates of IQ loss for both case studies in all NAAQS scenarios. The full IQ loss estimate shown is based on the concurrent PbB metric (average of the results at 75 and 81 months of age in the seventh year of life) and the two-piece linear IQ loss model. In addition, the portion of IQ loss arising from the “inhalation (recent air)” and “ingestion (recent air)” pathways are also shown. The 5th percentile is calculated before the application of the GSD and thus reflects the 5th percentile value from all modeled U.S. Census blocks or block groups in each case study. The total 5th percentile estimated IQ loss is approximately the same for both case studies across all NAAQS scenarios. The 5th percentile estimated IQ loss derived from the recent air pathways (combined inhalation and ingestion) tends to be higher for the primary Pb smelter case study compared to the secondary Pb smelter case study, reflecting the fact that ambient air Pb concentrations are higher in this case study for the lower percentiles. However, the actual contribution to IQ is very low in both case studies, indicating that the air-related exposures for the lesser exposed populations are fairly similar for the two case studies. Thus, it is unlikely that the choice of modeling both case studies to 10 km is biasing the risk distribution downward in the secondary Pb smelter case study to a significant extent.

Exhibit M-2. Comparison of the 5th Percentile IQ Loss Estimates for the Primary and Secondary Pb Smelter Case Studies

Case Study	Estimated IQ Loss		
	5th Percentile	5th Percentile from "Inhalation (Recent Air)" and "Ingestion (Recent Air)"	Percentage of 5th Percentile Comprised by "Inhalation (Recent Air)" and "Ingestion (Recent Air)"
Current NAAQS (1.5 µg/m³, max quarterly average)			
Primary Pb Smelter	0.5	2.0E-02	4.0%
Current Conditions			
Secondary Pb Smelter	0.4	7.0E-04	0.2%
Alternative NAAQS (0.2 µg/m³, max quarterly average)			
Primary Pb Smelter	0.4	4.0E-03	1.0%
Secondary Pb Smelter	0.4	2.0E-04	0.05%
Alternative NAAQS (0.5 µg/m³, max monthly average)			
Primary Pb Smelter	0.4	8.0E-03	2.0%
Secondary Pb Smelter	0.4	4.0E-04	0.1%
Alternative NAAQS (0.2 µg/m³, max monthly average)			
Primary Pb Smelter	0.4	3.0E-03	0.8%
Secondary Pb Smelter	0.4	2.0E-04	0.05%
Alternative NAAQS (0.05 µg/m³, max monthly average)			
Primary Pb Smelter	0.4	8.0E-04	0.2%
Secondary Pb Smelter	0.4	1.0E-04	0.03%

M.2.2. Stability of the Upper Percentiles in the Probabilistic Model Run

All of the IQ loss distributions discussed in this appendix were derived based on the probabilistic simulation model described in Appendices H and I. In this model, PbB statistics (percentiles) were derived by sampling from log-normal distributions centered on the geometric mean (GM) PbB levels estimated for the entire exposed populations (general urban case study) or the populations residing in specific U.S. Census blocks or block groups (primary and secondary Pb smelter case studies). Then, the IQ loss estimates were generated for each of the PbB statistics.

In addition to the sources of uncertainty mentioned above, the probabilistic modeling process itself introduces a degree of uncertainty into the output IQ loss statistics, and that contribution *can* be quantified, as shown in Exhibit M-3. This exhibit summarizes the observed variability in estimated IQ loss percentiles produced by repeating each run of the probabilistic model (which consists of 50,000 sampling iterations) 100 times. For this analysis, the model was run using input data from a general urban case study scenario using the hybrid mechanistic-empirical model ("hybrid" model for short), a GSD of 1.7 microgram per deciliter (µg/dL), and the concurrent PbB metric.

Exhibit M-3. Summary of Simulation Uncertainty for IQ Loss Estimates

Percentile	Distribution of IQ Loss Estimates from 100 Replicate Model Runs					
	5^{th} Percentile	Median	Mean	95^{th} Percentile	Standard Deviation	Coefficient of Variation
99.9^{th}	4.3	4.5	4.5	4.7	0.110	2.47%
99.5^{th}	3.3	3.4	3.4	3.5	0.046	1.35%
99^{th}	2.9	3.0	3.0	3.0	0.031	1.02%
95^{th}	2.1	2.1	2.1	2.1	0.012	0.56%
90^{th}	1.7	1.7	1.7	1.7	0.008	0.47%
75^{th}	1.2	1.2	1.2	1.3	0.004	0.34%
Median	<1	<1	<1	<1	0.002	0.27%
25^{th}	<1	<1	<1	<1	0.002	0.30%
1^{st}	<1	<1	<1	<1	0.002	0.86%

The rows of Exhibit M-3 correspond to the various IQ loss statistics (i.e., 99.9^{th} to 1^{st} percentile) that were estimated from the simulations. The columns of Exhibit M-3 show the distribution of the percentile estimates across the 100 repeated model runs. It can be seen that the simulation uncertainty throughout the majority of the IQ loss distribution (i.e., 99.9th to 1st percentile) is quite small. The coefficients of variation for the individual estimates (i.e., the ratio of the standard deviation to the mean) are on the order of 1 percent or less for percentiles up to the 95th percentile.[1] For the higher percentiles, the estimated simulation errors are greater. The coefficients of variation for the individual 99th, 99.5th, and 99.9th percentile estimates are 1.02, 1.35, and 2.47 percent, respectively. The difference between the median and 95th percentile estimates tend to be about the same as the differences between the median and 5th percentile estimates.

Note that the ultimate limits on the degree of accuracy with which the various percentile values can be estimated is determined by the total number of iterations and/or replicates; the standard errors of the percentile estimates can be reduced to a degree that is proportional to the square root of the number of iterations. The above analysis suggests that the existing modeling approach and number of iterations can provide IQ loss percentile estimates in which the simulation uncertainty will be far less than the uncertainty associated with, for example, the selection of PbB models or input parameter values.

---

[1] This result can be interpreted to mean that successive estimates of these percentiles generated by individual model runs can be expected to vary by approximately these amounts.

REFERENCES

Casteel, S. W.; Tessman R.; Brattin W.J.; Wahlquist A.M. (2005) Relative Bioavailability of Lead in House Dust and Soil From the Herculaneum Lead Smelter Site in Herculaneum, Missouri. Prepared for Black & Veatch Special Projects Corporation; May.

Lanphear, B. P.; Hornung, R.; Khoury, J.; Yolton, K.; Baghurst, P.; Bellinger, D. C.; Canfield, R. L.; Dietrich, K. N.; Bornschein, R.; Greene, T.; Rothenberg, S. J.; Needleman, H. L.; Schnaas, L.; Wasserman, G.; Graziano, J.; Robe, R. (2005) Low-Level Environmental Lead Exposure and Children's Intellectual Function: An International Pooled Analysis. *Environmental Health Perspectives.* 113(7)

Leggett, R. W. (1993) An Age-Specific Kinetic Model of Lead Metabolism in Humans. *Environ Health Perspect.* 101: 598-616.

Long, T.; Johnson, T.; Laurenson, J.; Rosenbaum, A. (2004) Development of Penetration and Proximity Microenvironment Factor Distributions for the HAPEM5 in Support of the 1999 National-Scale Air Toxics Assessment (NATA). Memorandum prepared for Ted Palma, U.S. EPA, Office of Air Quality Planning and Standards (OAQPS); April 5.

Missouri Department of Natural Resources (MDNR). (2007) Doe Run - Herculaneum State Implementation Plan (SIP) Dispersion Modeling Review. Memorandum From Jeffry D. Bennett to John Rustige. February 12, 2007. Available online at: http://www.dnr.mo.gov/env/apcp/herculaneumsip.htm.

U.S. Environmental Protection Agency (USEPA). (1995) Report on the National Survey of Lead-Based Paint in Housing: Appendix I: Design and Methodology. EPA 747-R95-004. Office of Pollution Prevention and Toxics.

U.S. Environmental Protection Agency (USEPA). (1998) Methodology for Assessing Health Risks Associated With Multiple Pathways of Exposure to Combustor Emissions. Update to EPA/600/6-90/003, EPA/NCEA (EPA 600/R-98/137). Cincinnati, OH: National Center for Environmental Assessment (NCEA). Available online at: oaspub.epa.gov/eims/eimscomm.getfile?p_download_id=427339.

U.S. Environmental Protection Agency (USEPA). (2000) Hazard Standard Risk Analysis Supplement - TSCA Section 403: Risk Analysis to Support Standards to Lead in Paint, Dust, and Soil: Supplemental Report. EPA 747-R-00-004. Available online at: http://www.epa.gov/lead/pubs/403risksupp.htm.

U.S. Environmental Protection Agency (USEPA). (2005) Human Health Risk Assessment Protocol (HHRAP) for Hazardous Waste Combustion Facilities. EPA530-R-05-006. Office of Solid Waste and Emergency Response; September. Available online at: http://www.epa.gov/epaoswer/hazwaste/combust/risk.htm.

U.S. Environmental Protection Agency (USEPA). (2006a) 1999 National-Scale Air Toxics Assessment. Available online at: http://www.epa.gov/ttn/atw/nata1999/nsata99.html.

U.S. Environmental Protection Agency (USEPA). (2006b) Specific Estimates of Dietary Pb Intake Developed by EPA's Office of Solid Waste and Emergency Response. Available online at: http://www.epa.gov/superfund/lead/ieubkfaq.htm#FDA.

U.S. Food and Drug Administration (USFDA). (2001) Total Diet Study. Center for Food Safety and Applied Nutrition, Office of Plant and Dairy Foods and Beverages; June. Available online at: http://www.cfsan.fda.gov/~comm/tds-toc.html.

Westat Inc. (2002) National Survey of Lead and Allergens in Housing. Volume I: Analysis of Lead Hazards. Final Report. Revision 7.1. Washington, D.C.: Office of Health Homes and Lead Hazard Control, U.S. Department of Housing and Urban Development.

United States
Environmental Protection
Agency

Office of Air Quality Planning and Standards
Health and Environmental Impacts Division
Research Triangle Park, NC

Publication No. EPA-452/D-07-001b
July 2007