Risk and Technology Review -

Final Analysis of Socio-Economic Factors for Populations Living Near Secondary Lead Smelting Facilities

Prepared by:

EC/R Incorporated
501 Eastowne Drive, Suite 250
Chapel Hill, NC 27514

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Prepared for:

Regina Chappell, Work Assignment Manager
Community and Tribal Programs Group
Office of Air Quality Planning and Standards
U.S. Environmental Protection Agency
Research Triangle Park, North Carolina 27711

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Disclaimer

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Contents

1. Introduction

This document describes the approach used to evaluate the potential cancer and noncancer risks associated with inhalation and air-related exposures to hazardous air pollutants (HAP) in different social, demographic, and economic groups within the population living near secondary lead smelting production facilities in the United States. This work was carried out in support of the U.S. Environmental Protection Agency's Residual Risk and Technology Review (RTR) for secondary lead smelting emissions subject to Maximum Available Control Technology (MACT) requirements under 40 CFR 63 Subpart X.

In the RTR analysis, the Human Exposure Model, Version 3 (HEM-3)[1,2] was used to estimate cancer and noncancer risks due to the inhalation of HAP for the populations residing within 50 kilometers of each secondary lead smelting facility in the country. HEM-3 estimates cancer and noncancer risks at the level of census blocks using the AERMOD state-of-the-art air dispersion model developed under the direction of the American Meteorological Society (AMS) / EPA Regulatory Model Improvement Committee (AERMIC). Each census block typically includes about 50 people. Additional information on the risk analysis is available in the docket for the **National Emission Standards for Hazardous Air Pollutant Emissions: Secondary Lead Smelting Operations** rulemaking where a report is provided, covering the inputs and specific assumptions, and addressing uncertainties.

In the current analysis, cancer and noncancer risk estimates from the secondary lead smelting HEM-3 modeling effort were linked to detailed census data in order to evaluate the distribution of risks for different demographic groups (including racial, ethnic, age, economic, educational, disabled and linguistically isolated population categories). The following population categories were included in this analysis:

- Total population
- White
- Minority
- African American (or Black)
- Native Americans
- Other races and multiracial
- Hispanic or Latino
- Children 17 years of age and under
- Adults 18 to 64 years of age
- Adults 65 years of age and over
- Adults without a high school diploma

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1. EC/R. 2006. Modeling for the Residual Risk and Technology Review Using the Human Exposure Model 3 – AERMOD Version. Prepared by EC/R Incorporated for the U.S. Environmental Protection Agency, Research Triangle Park, NC.

2. EC/R. 2008. HEM-3 User's Guide. Prepared by EC/R Incorporated for the U.S. Environmental Protection Agency, Research Triangle Park, NC. http://www.epa.gov/ttn/fera/human_hem.html#guide

- Households earning under the national median income
- People living below the poverty line
- Working aged people (16-64) with a disability
- Linguistically isolated people[3]

The HEM-3 results for a particular census block reflect the estimated level of cancer risk that would be experienced by an individual residing in the block for 70 years, and/or the estimated noncancer hazards experienced by an individual residing in the block due to chronic exposure. In this analysis, the latter includes the development of chronic hazard quotients for lead which are derived from estimated maximum 3-month rolling average exposures divided by the National Ambient Air Quality Standard (NAAQS) for lead. As a result of secondary lead smelting emissions, the demographic composition of the population estimated to experience a risk greater than 1 in 1 million – and the population estimated to experience ambient lead concentrations exceeding the NAAQS –is compared to the demographic composition of the overall nationwide population.

The census data used in this analysis is described in Section 2. The algorithms used to compute the distributions of risk and exposure are presented in Section 3. The results of this analysis are presented in Section 4.

2. Census Data

Table 1 summarizes the census data used in this analysis, showing the source of each dataset and the level of geographic resolution. All of the data are from the 2000 Decennial census. Race, ethnicity and age data were obtained at the census block level. Distributions regarding educational status, poverty status, household income, disabilities and linguistic isolation were obtained at the block group level. A census block contains about 50 people on average; and a block group contains about 26 blocks on average, or about 1,350 people. (For comparison, a census tract is larger than a block group, with each tract containing an average of 3 block groups, or about 4,300 people.)

[3] According to the U.S Census, a household is linguistically isolated if all adults speak a language other than English and none speaks English very well. Adult is defined as age 14 or older, which identifies household members of high school age and older.

Table 1. Summary of Census Data used to Analyze Risks for Different Socioeconomic Groups

Type of population category	Source of data	Level of geographic resolution
Racial and ethnic categories	Landview®	Census block
Age groups	SF1 Table P12	Census block
Level of education - adults without a high school diploma	SF3 Table 37	Block group
Households earning below the national median income	SF3 Table 52	Block group
People living below the poverty line	SF3 Table P87	Block group
Working age people (16-64) with a disability	SF3 Table P42	Block group
Linguistically isolated people	SF3 Table P20	Block group

Data on race and ethnicity were obtained primarily from the Landview® database compiled by the Census Department.[4] Landview® gives a breakdown for the population of each census block among different racial classifications, including: White, African American or Black, American Indian or Native Alaskan, Asian, Native Hawaiian or other South Pacific Islander, other race, and two or more races. In the current analysis, the Asian, Native Hawaiian or other South Pacific Islander, and other race categories were combined into a single category. The Landview® database also indicates the number of people in each tract that are of Hispanic or Latino ethnicity. Landview® covers the 50 states, the District of Columbia, and Puerto Rico, but does not cover the Virgin Islands. Race and ethnicity data on the Virgin Islands were obtained from the Virgin Islands Summary File.[5]

Data on age distributions in the U.S. and Puerto Rico for each census block were obtained from the 2000 Census of Population and Housing Summary File 1 (SF1) Short Form, Table P12. Data on poverty status, household income, education level, disabilities and linguistic isolation for each block group in the U.S. and Puerto Rico were obtained from the 2000 Census of Population and Housing Summary File 3 (SF3) Long Form. For the U.S. this file was accessed on a DVD version prepared by GeoLytics.[6] SF3 data for Puerto Rico were obtained from the Census Department website,[7] and data for the Virgin Islands were retrieved from similar tables in the Virgin Islands Summary File.[4]

4. Census. 2002. LandView 5 on DVD [electronic resource] : a viewer for EPA, Census and USGS data and maps. U.S. Census Bureau, Washington, D.C.

5. Census. 2008. Virgin Islands Summary File. U.S. Census Bureau, Washington, D.C. www.factfinder.census.gov

6. Census. 2004. Census DVD 2000 Long Form SF3, Release 2.2. Geolytics, Inc., East Brunswick, NJ. www.geolytics.com

7. Census. 2008. SF3 Data for Puerto Rico. U.S. Census Bureau, Washington, D.C. www.factfinder.census.gov

The SF3 data set consists of over 800 separate tables, each providing information on a different subject. For the current analysis, data were obtained from Tables P20, P37, P42, P52, and P87. Table P37 analyzes the level of education attained by men and women over 25 years of age (e.g. some high school but no high school diploma, high school graduate, some college, etc.) in each block group. Table P52 gives information on household income in 1999. Table P87 estimates the number of people living below the poverty line in each block group. Table P42 estimates the number of people in different age categories with disabilities in each block group. And Table P20 estimates the fraction of households in each block group that are considered linguistically isolated.

3. Calculation Methods

The HEM-3 models the cancer and noncancer risk at a point near the geographic center of each census block.[8] For the current analysis, this risk estimate was assumed to apply to all individuals residing in the block. We used block identification codes to link the HEM-3 modeling results for each block to the appropriate census statistics. This allowed us to estimate the numbers of people falling into different population categories within each block. We then analyzed the distribution of estimated inhalation risks within each population category, given the numbers of people within the category that are exposed to different risk levels. Each distribution involved a tabulation of all the census blocks modeled for the secondary lead smelting source category. We also computed the average risk for all individuals in each population category.

Distributions of risk and average risks were computed for the raw HEM-3 model results for secondary lead smelting operations. For comparison, the nationwide demographic composition (i.e., population percentage in each demographic group for the country as a whole, based on the 2000 Census) is also provided in the results table.

Section 3.1 describes the calculation method used for categories where block-level data were available – racial, ethnic and age categories and the total population. Sections 3.2 through 3.6 describe calculation methods for education status, household income, poverty status, disability and linguistic isolation, respectively.

3.1 Racial, Ethnic and Age Categories and the Total Population

Since race, ethnicity and age data are available at the census block level, the calculation of risk distributions for these categories involved a simple block-by-block accumulation of the people in each category. We began by identifying a set of bins reflecting the level of risk. The population of each block was then assigned to the appropriate risk bin based on the modeled risk level in the block. The numbers of people in each risk bin were then added together for all of the blocks modeled for the secondary lead smelting source category:

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8. HEM-3 generally uses the coordinates given by the census for the internal point, or "centroid" of each block. However, when the footprint of an industrial facility includes the block centroid, the model is designed to identify the highest-risk point outside of the facility's footprint.

$$H(R_{ab},s) = \sum_i^{(Ra \le Ri < Rb)} [N(s,i)] \qquad (1)$$

where:

$H(R_{ab},s) =$ the population count for risk bin R_{ab}, which is between R_a and R_b for population subgroup "s"

$R_i =$ the modeled risk level in block "í" (estimated lifetime cases of cancer per million population or noncancer hazard index)

$\sum_i^{(Ra \le Ri < Rb)}$ refers to the summation over all blocks i where R_i falls in bin R_{ab}, between R_a and R_b

$N(s,i) =$ the number of people within population subcategory s, in block i

The same approach was used for the total population. The average risk for a given population category or for the total population was then calculated using the following equation:

$$A(S) = \sum_i [N(s,i) \times R_i] / \sum_i [N(s,i)] \qquad (2)$$

where:

$A(s) =$ the average risk for population subgroup "s" (estimated lifetime cases of cancer per million population or noncancer hazard index)

$\sum_i$ refers to the summation over all blocks "í" modeled for the emission source category

$N(s,i)$ and R_i were defined above

3.2 Level of Education

Table P37 of the SF3 dataset specifies the education status for men and women age 25 and older for each census block group, based on the last grade completed. To obtain the total number of adults without a high school degree, we added together the numbers who had completed grades below a high school senior. Thus, the number of people without a high school degree equals the sum of the number of males with no schooling, the number of females with no schooling, the numbers of males and females who have completed nursery school through 4^{th} grade, up to the numbers of males and females who have completed some high school but not received a high school degree.

The number of adults without a high school degree as a fraction of the total population was assumed to be the same for each block in the block group. Thus, the number of adults without a high school degree in each block was computed as follows:

$$N(nhs,b/bg) = N(t,b/bg) \times N(nhs,bg) / N(t,bg) \qquad (3)$$

where:

$N(nhs,b/bg) =$ number of adults without a high school diploma, in block "b" of block group "bg"

$N(t,b/bg) =$ total number of people in block "b" of block group "bg"

$N(nhs,bg)$ = number of adults without a high school diploma in block group "bg"
$N(t,bg)$ = total number of people in block group "bg"

Equation (1) was then used to generate risk distributions based on the block-level results, and Equation (2) was used to compute the average risk for adults without a high school diploma.

3.3 Household Income

Table P52 of the SF3 dataset estimates the numbers of households in each block group with income for the year 1999 in various ranges, generally divided into $5,000 increments (e.g. $10,000 to $14,999, $15,000 to $19,999, etc.). The median national income for 1999 was about $42,000 per year. Therefore, in order to determine the number of households with incomes under the median income, we added the estimates for the ranges below that level. We assumed that the household incomes in the $40,000 to $44,999 increment were evenly distributed over this range. Therefore, 40% of the households in the $40,000 to $44,999 income range were assumed to be below the national median income of about $42,000. The following equation was used to estimate the fraction of households below the national median income within each census block group:

$$F(nm,bg) = [C_{<10} + C_{10\text{-}15} + \ldots + C_{35\text{-}40} + (0.4 \times C_{40\text{-}45})] / C_T \quad (4)$$

where:
$F(nm,bg)$ = fraction of households in block group "bg" with incomes below the median national income
$C_{<10}$ = number of households with incomes under $10,000
$C_{10\text{-}15}$ = number of households with incomes from $10,000 to $14,999
$C_{35\text{-}40}$ = number of households with incomes from $35,000 to $39,999
$C_{40\text{-}45}$ = number of households with incomes from $40,000 to $44,999
C_T = total number of households in block group "bg"

The fraction of people living in households below the median income for each block within the block group was assumed to be the same as the fraction of households below the median income for the block group.

$$N(nm,b/bg) = F(sm,bg) \times N(t,b/bg) \quad (5)$$

where:
$N(nm,b/bg)$ = number of people in block "b" of block group "bg" living in households below the national median income
$F(nm,bg)$ = fraction of households in block group "bg" below the national median income
$N(t,b/bg)$ = total number of people in block "b" of block group "bg"

Equation (1) was then used to generate risk distributions based on the block-level results, and Equation (2) was used to compute the average risk for people living in households below the national median income. It must be noted that this approach neglects any potential relationship between household size and income level within a particular block group. However, it is expected to provide a reasonable indication of the risk level of people living below the national median income, relative to the population as a whole.

3.4 Poverty Level

Table P87 of the SF3 dataset estimates the total number people in each block group living below the poverty level, as well as the numbers of people below the poverty level in different age groups. The current study did not include an analysis of poverty status by age group, only of the total population below the poverty line. The fraction of people below the poverty line was assumed to be the same for each block in the block group. Thus, the population below the poverty line in each block was computed as follows:

$$N(p,b/bg) = N(T,b/bg) \times N(p,bg) / N(T,bg) \quad (6)$$

where:

N(p,b/bg) = number of people below the poverty line in block "b" of block group "bg"
N(T,b/bg) = total number of people in block "b" of block group "bg"
N(p,bg) = number of people below the poverty line in block group "bg"
N(T,bg) = total number of people in block group "bg"

Equation (1) was then used to generate risk distributions based on the block-level results, and Equation (2) was used to compute the average risk for people living below the poverty level.

3.5 Disability

Table P42 of the SF3 dataset estimates the total number of people in each block group with disabilities, as well as the numbers of people with disabilities in different age groups. This analysis includes the total number of working aged people (16 through 64 years of age) with a disability. The fraction of working aged people with a disability was assumed to be the same for each block in the block group. Thus, the population of working aged people with a disability in each block was computed as follows:

$$N(d,b/bg) = N(T,b/bg) \times N(d,bg) / N(T,bg) \quad (7)$$

where:

N(d,b/bg) = number of working aged people with a disability in block "b" of block group "bg"
N(T,b/bg) = total number of people in block "b" of block group "bg"
N(d,bg) = number of working aged people with a disability in block group "bg"
N(T,bg) = total number of people in block group "bg"

Equation (1) was then used to generate risk distributions based on the block-level results, and Equation (2) was used to compute the average risk for working aged people with a disability.

3.6 Linguistic Isolation

Table P20 of the SF3 dataset estimates the fraction of households in linguistic isolation in each block group. For this analysis, the fraction of people living in linguistic isolation for each block within the block group was assumed to be the same as the fraction of households in linguistic isolation for the block group. Thus, the population of linguistically isolated people in each block was computed as follows:

$$N(li,b/bg) = F(li,bg) \times N(t,b/bg) \quad (8)$$

where:

N(li,b/bg) = number of people in block "b" of block group "bg" living in linguistically isolated households

F(li,bg) = fraction of households in block group "bg" in linguistic isolation

N(t,b/bg) = total number of people in block "b" of block group "bg"

Equation (1) was then used to generate risk distributions based on the block-level results, and Equation (2) was used to compute the average risk for people living in linguistic isolation.

4. Results

The distribution of estimated lifetime inhalation cancer risks greater than or equal to 1 in a million or noncancer hazard indices greater than 1 for different demographic groups living near secondary lead smelting facilities is shown in Table 2. For comparison purposes, Table 2 provides the nationwide percentages of the various demographic groups. For the secondary lead smelting source category, the facility-wide emissions and risk distribution are equivalent to the source category emissions and risk distribution, thus a separate demographic analysis based on facility-wide emissions was not performed. Moreover, for HAP other than lead, there were no estimated noncancer HI values greater than 1, thus we did not perform a demographic analysis on noncancer risks for any pollutants other than lead. The demographic noncancer results for lead are presented in Table 2 as "Population with Ambient Lead Concentrations Exceeding the NAAQS," rather than as population with HI greater than 1, because lead concentrations were compared to the NAAQS rather than to a reference concentration. Detailed demographics data and analyses used to create Table 2 can be found in Appendix A of this document.

The results of the demographic analysis presented in Table 2 indicate that there are approximately 84,000 people exposed to a cancer risk greater than 1-in-1 million The demographic analysis estimate that about 41% of this population can be classified as minority, and this minority figure is more than one-and-a-half times higher than the national minority percentage (of 25%). More specifically, the demographic analysis estimates that about 52% of the population with excess cancer risk is classified as "Hispanic", and this percentage is nearly four times the national Hispanic percentage (of 14%). Furthermore, 31% of the population estimated at a cancer risk greater than 1-in-1 million is classified as "Other and Multiracial", and this figure is nearly three times the national demographic for this category (at 12%). The demographic analysis for cancer risk also estimates that 25% of the population at excess cancer risk has no high school diploma, and this is approximately twice the national percentage for this demographic (of 13%). In addition, 21% of the population at excess cancer risk is below the poverty level, a figure which is more than one-and-a-half times the national percentage for this demographic (of 13%). The age 0 to 17 demographic percentage (of 30%) is 3 percentage points higher than the corresponding national percentage for this demographic group (of 27%). The working age with disability demographic (of 14%) is 2 percentage points higher than the corresponding national percentage (of 12%). Finally, the linguistically isolated demographic (of 18.8%) is three-and-a-half times higher than the corresponding national percentage (of 5.4%).

With respect to lead, the demographic results are below their corresponding national percentages for all racial and ethnic classifications, and similar to the national percentages for most other demographic categories. There are modest percentage increases above the corresponding national percentages with respect to people 18 to 64 years old (4 points higher), people 65 years old and older (4 points higher), people below the poverty line (2 points higher) and people over 25 without a high school diploma (5 points higher). However, considering that the total population affected is small (i.e., about 200 individuals in areas with lead concentrations above the NAAQS), this does not represent an appreciable difference.

Table 2. Summary of Demographic Assessment of Risk Results for the Secondary Lead Smelting Source Category

Emissions Basis		Demographic Group												
		Total	Minority	African American	Other and Multiracial	Hispanic or Latino	Native American	Ages 0 to 17	Ages 18 to 64	Ages 65 and up	Below the Poverty Level	Over 25 Without a HS Diploma	Working Age with Disability	Linguistic Isolation
Nationwide Demographic Breakdown	n/a	285,339,128	25%	12%	12%	14%	0.9%	27%	60%	12%	13%	13%	12%	5.4%
	Maximum Risk (in 1 million)	Population With Cancer Risk Greater Than or Equal to 1 in 1 million												
Source Category	50	84,000	41%	8%	31%	52%	0.8%	30%	60%	9%	21%	25%	14%	18.8%
	Maximum Lead Risk	Population With Ambient Lead Concentrations Exceeding the NAAQS												
Source Category	20 Times the Lead NAAQS	200	7%	5%	2%	2%	1.0%	20%	64%	16%	15%	18%	13%	2.0%

Notes:

- Source Category emissions were estimated based on ICR data collected in 2010.
- Minority population is the total population minus the white population.
- Population figures are for the population residing within 50 km from the center of these facilities whose cancer risks are estimated to be greater than or equal to 1 in a million, or whose noncancer hazard indices are estimated to be greater than 1 (based on exceeding the NAAQS for lead).
- The maximum NAAQS exceedence for a centrally located point within any populated census block is 3. (These locations are the block "internal points" as determined by the Bureau of Census.) However, ambient lead concentrations as high as 20 times the NAAQS were predicted for receptors in the HEM-3 polar receptor network between the apparent plant boundary and the nearest points selected to represent populated census blocks.
- There are no HIs > 1 for HAPS other than lead for the secondary lead smelting category.

5. Uncertainty Discussion

Our analysis of the distribution of risks across various demographic groups is subject to the typical uncertainties associated with census data (e.g., errors in filling out and transcribing census forms), which are generally thought to be small, as well as the additional uncertainties associated with the extrapolation of census-block group data (e.g., income level and education level) down to the census block level.

The uncertainties in these risk estimates include the same uncertainties in emissions data sets, in air dispersion modeling, in inhalation exposure and in dose response relationships that are associated with our source category risk estimates.

The methodology for our demographic analyses is still evolving. While this is our best attempt to provide useful information now, our thinking is continuously advancing. EPA is in the process of developing technical guidance for environmental justice analyses. We present these analyses, with their associated uncertainties, to EPA decision makers and the public as additional analyses to inform RTR decisions.

Appendix A

Table A-1. Distribution of Inhalation Cancer Risk for Racial and Ethnic Groups

Range of lifetime individual cancer risk (chance in one million)[a]	Numbers of people in different ranges for lifetime cancer risk[b]					
	Total population	White	African American	Native American	Other and multiracial	Hispanic or Latino[c]
Modeled risk from the secondary lead source category						
0 to 1	27,601,895	18,658,981	2,498,583	162,547	6,281,784	7,861,533
1 to 5	78,352	46,263	6,189	676	25,224	42,115
5 to 10	4,500	2,872	705	18	905	1,475
10 to 20	532	350	66	2	114	136
20 to 30	134	125	2	0	7	10
30 to 40	79	69	7	1	2	3
40 to 50	21	20	0	0	1	0
50 to 100	0	0	0	0	0	0
Total number	27,685,513	18,708,680	2,505,552	163,244	6,308,037	7,905,272
Average risk (chances in one million)	0.0403	0.0349	0.055	0.0477	0.05	0.0568

Notes:

[a]Modeled risks are for a 70-year lifetime, based on the predicted outdoor concentration and not adjusted for exposure factors. For example, 78,352 people are predicted to have a lifetime individual cancer risk of greater than or equal to 1 in 1 million but less than 5 in 1 million.

[b]Distributions by race are based on demographic information at the census block level. Risks from secondary lead smelting emissions were modeled at the census block level.

[c]The Hispanic or Latino population is double-counted in this analysis, since different individuals within the category may classify themselves as White, African American, Native American, or other.

Table A-2. Distribution of Inhalation Cancer Risk for Different Age Groups

Range of lifetime individual cancer risk (chance in one million)[a]			Numbers of people in different ranges for lifetime cancer risk[b]			
			Total population	Ages 0 thru 17	Ages 18 thru 64	Ages 65 and up
Modeled risk from the secondary lead source category						
0	to	1	27,601,895	7,441,067	17,209,096	2,951,732
1	to	5	78,352	23,823	47,450	7,079
5	to	10	4,500	1,197	2,583	720
10	to	20	532	140	323	69
20	to	30	134	31	74	29
30	to	40	79	10	55	14
40	to	50	21	5	13	3
50	to	100	0	0	0	0
Total number			27,685,513	7,466,273	17,259,594	2,959,646
Average risk (chances in one million)			0.0403	0.0433	0.0394	0.0378

Notes:

[a]Modeled risks are for a 70-year lifetime, based on the predicted outdoor concentration and not adjusted for exposure factors. For example, 78,352 people are predicted to have a lifetime individual cancer risk of greater than or equal to 1 in 1 million but less than 5 in 1 million.

[b]Distributions by age are based on modeling data and age data at the census block level.

Table A-3. Distribution of Inhalation Cancer Risk for Adults with and without a High School Diploma

Range of lifetime individual cancer risk (chance in one million)[a]	Numbers of people in different ranges for lifetime cancer risk[b]		
	Total population	Total number 25 and older	Number 25 and older without a high school diploma
Modeled risk from the secondary lead source category			
0 to 1	27,601,895	17,298,010	4,019,898
1 to 5	78,352	43,763	19,696
5 to 10	4,500	2,728	1,072
10 to 20	532	331	72
20 to 30	134	88	20
30 to 40	79	53	15
40 to 50	21	14	3
50 to 100	0	0	0
Total number	27,685,513	17,344,987	4,040,775
Average risk (chances in one million)	0.0403	0.0382	0.0546

Notes:

[a]Modeled risks are for a 70-year lifetime, based on the predicted outdoor concentration and not adjusted for exposure factors. For example, 78,352 people are predicted to have a lifetime individual cancer risk of greater than or equal to 1 in 1 million but less than 5 in 1 million.

[b]Distributions by education level are based on modeling data at the census block level, and education data at the block group level. All census blocks in a block group are assumed to have the same education level distribution.

Table A-4. Distribution of Inhalation Cancer Risk for People Living in Households below the National Median Income and Below the Poverty Line

Range of lifetime individual cancer risk (chance in one million)[a]	Numbers of people in different ranges for lifetime cancer risk[b]		
	Total population	People living in households below the national median income[c]	People living below the poverty line
Modeled risk from the secondary lead source category			
0 to 1	27,601,895	13,169,092	4,043,545
1 to 5	78,352	48,939	16,087
5 to 10	4,500	2,863	998
10 to 20	532	249	45
20 to 30	134	74	12
30 to 40	79	51	16
40 to 50	21	11	2
50 to 100	0	0	0
Total number	27,685,513	13,221,280	4,060,705
Average risk (chances in one million)	0.0403	0.0466	0.0495

Notes:

[a]Modeled risks are for a 70-year lifetime, based on the predicted outdoor concentration and not adjusted for exposure factors. For example, 78,352 people are predicted to have a lifetime individual cancer risk of greater than or equal to 1 in 1 million but less than 5 in 1 million.

[b]Distributions by income are based on modeling data at the census block level, and income data at the block group level. All census blocks in a block group are assumed to have the same income distribution.

[c]The median income is the national median household income in 1999, about $42,000.

Table A-5. Distribution of Inhalation Cancer Risk for People Living with Disabilities and in Linguistic Isolation

Range of lifetime individual cancer risk (chance in one million)[a]	Numbers of people in different ranges for lifetime cancer risk[b]		
	Total population	Working aged people with a disability	People living in linguistic isolation
Modeled risk from the secondary lead source category			
0 to 1	27,601,895	3,271,957	3,292,353
1 to 5	78,352	10,980	15,293
5 to 10	4,500	657	408
10 to 20	532	51	18
20 to 30	134	15	1
30 to 40	79	12	3
40 to 50	21	2	0
50 to 100	0	0	0
Total number	27,685,513	3,283,674	3,308,076
Average risk (chances in one million)	0.0403	0.0457	0.0475

Notes:

[a]Modeled risks are for a 70-year lifetime, based on the predicted outdoor concentration and not adjusted for exposure factors. For example, 78,352 people are predicted to have a lifetime individual cancer risk of greater than or equal to 1 in 1 million but less than 5 in 1 million.

[b]Distributions of disability and linguistic isolation are based on modeling data at the census block level, and demographic population data at the block group level. All census blocks in a block group are assumed to have the same disability and linguistic isolation population distributions.

Table A-6. Distribution of Inhalation Hazard Indices for Racial and Ethnic Groups

	Numbers of people in different ranges for lifetime hazard indices[b]					
	Total population	White	African American	Native American	Other and multiracial	Hispanic or Latino[c]
Modeled lead concentrations relative to the lead NAAQS[a]						
0 to 0.2	27,664,846	18,697,438	2,503,093	163,066	6,301,249	7,894,768
0.2 to 1	20,470	11,059	2,450	176	6,785	10,500
1 to 1.5	99	96	2	1	0	1
1.5 to 2	0	0	0	0	0	0
2 to 3	69	66	0	1	2	3
3 to 4	29	21	7	0	1	0
4 to 5	0	0	0	0	0	0
Total number	27,685,513	18,708,680	2,505,552	163,244	6,308,037	7,905,272
Average	0.0022	0.0018	0.0031	0.0027	0.0029	0.0034

Notes:

[a]Modeled concentrations relative to the lead NAAQS are based on 3-month maximum lead concentrations. For example, 29 people are predicted to be exposed to lead concentrations greater than or equal to 3 but less than 4 times the lead NAAQS (3 rounded to 1 significant figure); that is, 29 people are exposed to a lead concentration 3 times the NAAQS.

[b]Distributions by race are based on demographic information at the census block level. Risks from secondary lead smelting emissions were modeled at the census block level.

[c]The Hispanic or Latino population is double-counted in this analysis, since different individuals within the category may classify themselves as White, African American, Native American, or other.

Table A-7. Distribution of Hazard Indices for Different Age Groups

	Numbers of people in different ranges for lifetime hazard indices[b]			
	Total population	Ages 0 thru 17	Ages 18 thru 64	Ages 65 and up
Modeled lead concentrations relative to the lead NAAQS[a]				
0 to 0.2	27,664,846	7,460,299	17,247,120	2,957,427
0.2 to 1	20,470	5,935	12,348	2,187
1 to 1.5	99	24	60	15
1.5 to 2	0	0	0	0
2 to 3	69	14	44	11
3 to 4	29	1	22	6
4 to 5	0	0	0	0
Total number	27,685,513	7,466,273	17,259,594	2,959,646
Average	0.0022	0.0024	0.0021	0.002

Notes:

[a]Modeled concentrations relative to the lead NAAQS are based on 3-month maximum lead concentrations. For example, 29 people are predicted to be exposed to lead concentrations greater than or equal to 3 but less than 4 times the lead NAAQS (3 rounded to 1 significant figure); that is, 29 people are exposed to a lead concentration 3 times the NAAQS.

[b]Distributions by age are based on modeling data and age data at the census block level.

Table A-8. Distribution of Hazard Indices for Adults with and without a High School Diploma

	Numbers of people in different ranges for lifetime hazard indices[b]		
	Total population	Total number 25 and older	Number 25 and older without a high school diploma
Modeled lead concentrations relative to the lead NAAQS[a]			
0 to 0.2	27,664,846	17,333,568	4,035,428
0.2 to 1	20,470	11,292	5,313
1 to 1.5	99	62	17
1.5 to 2	0	0	0
2 to 3	69	49	11
3 to 4	29	16	7
4 to 5	0	0	0
Total number	27,685,513	17,344,987	4,040,775
Average	0.0022	0.002	0.0031

Notes:

[a]Modeled concentrations relative to the lead NAAQS are based on 3-month maximum lead concentrations. For example, 29 people are predicted to be exposed to lead concentrations greater than or equal to 3 but less than 4 times the lead NAAQS (3 rounded to 1 significant figure); that is, 29 people are exposed to a lead concentration 3 times the NAAQS.

[b]Distributions by education level are based on modeling data at the census block level, and education data at the block group level. All census blocks in a block group are assumed to have the same education level distribution.

Table A-9. Distribution of Hazard Indices for People Living in Households below the National Median Income and Below the Poverty Line

	Numbers of people in different ranges for lifetime hazard indices[b]		
	Total population	People living in households below the national median income[c]	People living below the poverty line
Modeled lead concentrations relative to the lead NAAQS[a]			
0 to 0.2	27,664,846	13,207,922	4,055,955
0.2 to 1	20,470	13,237	4,721
1 to 1.5	99	60	12
1.5 to 2	0	0	0
2 to 3	69	36	6
3 to 4	29	24	11
4 to 5	0	0	0
Total number	27,685,513	13,221,280	4,060,705
Average	0.0022	0.0026	0.0028

Notes:

[a]Modeled concentrations relative to the lead NAAQS are based on 3-month maximum lead concentrations. For example, 29 people are predicted to be exposed to lead concentrations greater than or equal to 3 but less than 4 times the lead NAAQS (3 rounded to 1 significant figure); that is, 29 people are exposed to a lead concentration 3 times the NAAQS.

[b]Distributions by income are based on modeling data at the census block level, and income data at the block group level. All census blocks in a block group are assumed to have the same income distribution.

[c]The median income is the national median household income in 1999. about $42.000.

Table A-10. Distribution of Hazard Indices for People Living with Disabilities and in Linguistic Isolation

	Numbers of people in different ranges for lifetime hazard indices[b]		
	Total population	Working aged people with a disability	People living in linguistic isolation
Modeled lead concentrations relative to the lead NAAQS[a]			
0 to 0.2	27,664,846	3,280,593	3,303,987
0.2 to 1	20,470	3,055	4,085
1 to 1.5	99	12	1
1.5 to 2	0	0	0
2 to 3	69	7	2
3 to 4	29	6	1
4 to 5	0	0	0
Total number	27,685,513	3,283,673	3,308,076
Average	0.0022	0.0025	0.0029

Notes:

[a]Modeled concentrations relative to the lead NAAQS are based on 3-month maximum lead concentrations. For example, 29 people are predicted to be exposed to lead concentrations greater than or equal to 3 but less than 4 times the lead NAAQS (3 rounded to 1 significant figure); that is, 29 people are exposed to a lead concentration 3 times the NAAQS.

[b]Distributions of disability and linguistic isolation are based on modeling data at the census block level, and demographic population data at the block group level. All census blocks in a block group are assumed to have the same disability and linguistic isolation population distributions.