Appendix A
DESCRIPTION OF METHODOLOGY

Statistical Methodology: The Air Quality Data.

Data Sources

The data on air quality throughout the United States were obtained from the U.S. Environmental Protection Agency's Air Quality System (AQS), formerly called Aerometric Information Retrieval System (AIRS) database. The American Lung Association contracted with Dr. Allen S. Lefohn, A.S.L. & Associates, Helena, Montana, to characterize the hourly averaged ozone concentration information and the 24-hour averaged $PM_{2.5}$ concentration information for the 3-year period for 2006-2008 for each monitoring site.

Design values for the annual $PM_{2.5}$ concentrations by county were collected from data previously summarized by the U.S. Environmental Protection Agency (EPA) and were downloaded on December 1, 2009 from EPA's website at http://www.epa.gov/air/airtrends/values.html.

Ozone Data Analysis

The 2006, 2007, and 2008 AQS hourly ozone data were used to calculate the daily 8-hour maximum concentration for each ozone-monitoring site. The data were considered for a 3-year period for the same reason that EPA uses 3 years of data to determine compliance with the ozone: to prevent a situation in any single year, where anomalies of weather or other factors create air pollution levels, which inaccurately reflect the normal conditions. The highest 8-hour daily maximum concentration in each county for 2006, 2007, and 2008, based on the EPA-defined ozone season, was identified.

On March 12, 2008, the EPA lowered the national ambient air quality standard for ozone to 0.075 ppm measured over 8-hours and adjusted the Air Quality Index to reflect the tighter standard. Using these results, A.S.L. & Associates prepared a table by county that summarized, for each of the 3 years, the number of days the ozone level was within the ranges identified by EPA based on the EPA Air Quality Index:

8-hour Ozone Concentration	Air Quality Index Levels
0.000 – 0.059 ppm	Good (Green)
0.060 – 0.075 ppm	Moderate (Yellow)
0.076 – 0.095 ppm	Unhealthy for Sensitive Groups (Orange)
0.096 – 0.115 ppm	Unhealthy (Red)
0.116 – 0.374 ppm	Very Unhealthy (Purple)
>0.374 ppm	Hazardous (Maroon)

The goal of this report was to identify the number of days that 8-hour daily maximum concentrations occurred within the defined ranges, not just those days that would fall under the requirements for attaining the national ambient air quality standards. Therefore, no data capture criteria were applied to eliminate monitoring sites or to require a number of valid days for the ozone season. All valid days of data within the ozone season were used in the analysis. However, for computing an 8-hour average, at least 75 percent of the hourly concentrations (i.e., 6-8 hours)

had to be available for the 8-hour period. In addition, an 8-hour daily maximum average was identified if valid 8-hour averages were available for at least 75 percent of possible hours in the day (i.e., at least 18 of the possible 24 8-hour averages). Because the EPA includes days with inadequate data if the standard value is exceeded, our data capture methodology may result at times in underestimations of the number of 8-hour averages within the higher concentration ranges. However, our experience is that underestimates are infrequent.

Following receipt of the above information, the American Lung Association identified the number of days each county, with at least one ozone monitor, experienced air quality designated as orange (Unhealthy for Sensitive Groups), red (Unhealthy), or purple (Very Unhealthy).

Short-term Particle Pollution Data Analysis

A.S.L. & Associates identified the maximum daily 24-hour AQS $PM_{2.5}$ concentration for each county in 2006, 2007, and 2008 with monitoring information. Using these results, A.S.L. & Associates prepared a table by county that summarized, for each of the 3 years, the number of days the maximum of the ***daily*** $PM_{2.5}$ concentration was within the ranges identified by EPA based on the EPA Air Quality Index, adjusted by the American Lung Association as discussed below:

24-hour $PM_{2.5}$ Concentration	Air Quality Index Levels
0.0 µg/m^3 to 15.4 µg/m^3	Good (Green)
15.5 µg/m^3 to 35.0 µg/m^3	Moderate (Yellow)
35.1 µg/m^3 to 65.4 µg/m^3	Unhealthy for Sensitive Groups (Orange)
65.5 µg/m^3 to 150.4 µg/m^3	Unhealthy (Red)
150.5 µg/m^3 to 250.4 µg/m^3	Very Unhealthy (Purple)
greater than or equal to 250.5 µg/m^3	Hazardous (Maroon)

On September 21, 2006, the EPA announced a revised 24-hour National Ambient Air Quality standard for $PM_{2.5}$, changing the standard to 35 µg/m^3 from 65 µg/m^3. As of December 2008, the EPA had not yet announced changes to the Air Quality Index based on the new standard. The Lung Association adjusted the level of the category "Unhealthy for Sensitive Groups" to include the new standard, making that category range from 35.1 µg/m^3 to 65.4 µg/m^3.

The goal of this report was to identify the number of days that the maximum in each county of the ***daily*** $PM_{2.5}$ concentration occurred within the defined ranges, not just those days that would fall under the requirements for attaining the national ambient air quality standards. Therefore, no data capture criteria were used to eliminate monitoring sites. Only 24-hour averaged PM data were used. Included in the analysis are data collected using only FRM and FEM methods, which reported 24-hour averaged data. As instructed by the Lung Association, A.S.L. & Associates included the exceptional and natural events that were identified in the database and identified for the Lung Association the dates and monitoring sites that experienced such events.

Following receipt of the above information, the American Lung Association identified the number of days each county, with at least one $PM_{2.5}$ monitor, experienced air quality designated

as orange (Unhealthy for Sensitive Groups), red (Unhealthy), purple (Very Unhealthy) or maroon (Hazardous).

Description of County Grading System.

Ozone and short-term particle pollution (24-hour $PM_{2.5}$)

The grades for ozone and short-term particle pollution (24-hour $PM_{2.5}$) were based on a weighted average for each county. To determine the weighted average, the Lung Association followed these steps:

1. First, assigned weighting factors to each category of the Air Quality Index. The number of orange days experienced by each county received a factor of 1; red days a factor of 1.5; purple days a factor of 2; and maroon days a factor of 2.5. This allowed days where the air pollution levels were higher to receive greater weight.
2. Next, multiplied the total number of days within each category by their assigned factor, then summed all the categories to calculate a total.
3. Finally, divided the total by three to determine the weighted average, since the monitoring data were collected over a three-year period.

The weighted average determined each county's grades for ozone and 24-hour $PM_{2.5}$.

- All counties with a weighted average of zero (corresponding to no exceedances of the standard over the three-year period) were given a grade of "A."
- For ozone, an "F" grade was set to generally correlate with the number of unhealthy air days that would place a county in nonattainment for the ozone standard.
- For short-term particle pollution, fewer unhealthy air days are required for an F than for nonattainment under the $PM_{2.5}$ standard. The national air quality standard is set to allow 2 percent of the days during the 3 years to exceed 35 $\mu g/m^3$ (called a "98^{th} percentile" form) before violating the standard. That would be roughly 21 unhealthy days in 3 years. The grading used in this report would allow only about 1 percent of the days to be over 35 $\mu g/m^3$ (called a "99^{th} percentile" form) of the $PM_{2.5}$. The American Lung Association supports using the tighter limits in a 99^{th} percentile form as a more appropriate standard that is intended to protect the public from short-term spikes in pollution.

Grading System		
Grade	**Weighted Average**	**Approximate Number of Allowable Orange/Red/Purple/Maroon days**
A	0.0	None
B	0.3 to 0.9	1 to 2 orange days with no red
C	1.0 to 2.0	3 to 6 days over the standard: 3 to 5 orange with no more than 1 red OR 6 orange with no red
D	2.1 to 3.2	7 to 9 days over the standard: 7 total (including up to 2 red) to 9 orange with no red
F	3.3 or higher	9 days or more over the standard: 10 orange days or 9 total including at least 1 or more red, purple or maroon

Weighted averages allow comparisons to be drawn based on severity of air pollution. For example, if one county had 9 orange days and 0 red days, it would earn a weighted average of 3.0 and a D grade. However, another county which had only 8 orange days but also 2 red days, which signify days with more serious air pollution, would receive a F. That second county would have a weighted average of 3.7.

Note that this system differs significantly from the methodology EPA uses to determine violations of both the ozone standard and the 24-hour $PM_{2.5}$. EPA determines whether a county violates the standard based on the 4^{th} maximum daily 8-hour ozone reading each year averaged over three years. Multiple days of unhealthy air beyond the highest four in each year are not considered. By contrast, the system used in this report recognizes when a community's air quality repeatedly results in unhealthy air throughout the three years. Consequently, some counties will receive grades of "F" in this report, showing repeated instances of unhealthy air, while still meeting EPA's 2008 or 1997 ozone standard. EPA is currently reconsidering the 2008 standard based on evidence that that standard failed to protect the health of the public.

Counties were ranked by weighted average. Metropolitan areas were ranked by the highest weighted average among the counties within a given Metropolitan Statistical Area as of 2008 as defined by the White House Office of Management and Budget (OMB). In 2003, the OMB published revised definitions for the nation's Metropolitan Statistical Areas. Therefore, comparisons between MSAs in the State of the Air reports from 2000 to 2003 and the State of the Air reports from 2004 and later should be made with caution.

Year-round particle pollution (Annual $PM_{2.5}$)

Since no comparable Air Quality Index exists for year-round particle pollution (annual $PM_{2.5}$), the grading was based on EPA's determination of violations of the national ambient air quality standard for annual $PM_{2.5}$ of 15 $\mu g/m^3$, as reported online and downloaded from the www.epa.gov/airtrends/values.html on December 1, 2009. Counties that EPA listed as being in attainment of the standard were given grades of "Pass." Counties EPA listed as being in nonattainment were given grades of "Fail." Where insufficient data existed for EPA to determine attainment or nonattainment, those counties received a grade of "Incomplete."

Design value is the calculated concentration of a pollutant based on the form of the national ambient air quality standard and is used by EPA to determine whether or not the air quality in a county meets the standard. Counties were ranked by design value. Metropolitan areas were ranked by the highest design value among the counties within a given Metropolitan Statistical Area as of 2008 as defined by the OMB. In 2003, the OMB published revised definitions for the nation's Metropolitan Statistical Areas. Therefore, comparisons between MSAs in the State of the Air reports from 2000 to 2003 and the State of the Air reports from 2004 and later should be made with caution.

The Lung Association received critical assistance from members of the National Association of Clean Air Administrators, formerly known as the State and Territorial Air Pollution Control Administrators and the Association of Local Air Pollution Control Administrators. With their assistance, all state and local agencies were provided the opportunity to review and comment on

the data in draft tabular form. The Lung Association reviewed all discrepancies with the agencies and, if needed, with Dr. Lefohn at A.S.L. and Associates. Questions about the annual PM design values were referred to Mr. Schmidt of EPA, who reviewed and had final decision on those determinations. The American Lung Association wishes to express its continued appreciation to the state and local air directors for their willingness to assist in ensuring that the characterized data used in this report are correct.

Calculations of Populations-at-Risk

Presently county-specific measurements of the number of persons with chronic lung disease and other chronic conditions are not generally available. In order to assess the magnitude of lung disease and other chronic conditions at the state and county levels, we have employed a synthetic estimation technique originally developed by the U.S. Census Bureau. This method uses age-specific national estimates of self-reported lung disease and other conditions to project disease prevalence to the county level. The primary exceptions to this are asthma and diabetes, as state-specific estimates for adult asthma and diabetes are available through one national survey discussed below, and poverty, for which estimates are available at the county level.

Population Estimates

The U.S. Census Bureau estimated data on the total population of each county in the United States for 2008. The Census Bureau also estimated the age specific breakdown of the population and how many individuals were living in poverty by county. These estimates are the best information on population demographics available between decennial censuses.

Poverty estimates came from the Census Bureau's Small Area Income and Poverty Estimates (SAIPE) program. SAIPE was created to provide accurate income and poverty estimates between decennial censuses. The program does not use direct counts or estimates from sample surveys, as these methods would not provide sufficient data for all counties. Instead, a model based on estimates of income or poverty from the Annual Social and Economic Supplement (ASEC) to the Current Population Survey (CPS) is used to develop estimates for all states and counties.

Prevalence Estimates

Chronic Bronchitis, Emphysema, and Pediatric Asthma. In 2008, the National Health Interview Survey (NHIS) estimated the nationwide annual prevalence of diagnosed chronic bronchitis at 9.8 million; the nationwide lifetime prevalence of diagnosed emphysema was estimated at 3.8 million. The NHIS estimated the prevalence of diagnosed pediatric asthma (under age 18) to be over 7.0 million.

Due to the revision of the NHIS questionnaire, prevalence estimates from the *American Lung Association State of the Air 2000* cannot be compared to later publications. Estimates for chronic bronchitis and emphysema can be compared to the *State of the Air* reports for 2001 through 2009. Furthermore, estimates for chronic bronchitis and emphysema should not be combined as they represent different types of prevalence estimates.

Pediatric asthma prevalence estimates from this year's report can only be compared to those in the *State of the Air* reports since 2004 and not the *State of the Air* reports from 2000 through 2003 due to a change of the NHIS.

Local area prevalence of chronic bronchitis, emphysema, and pediatric asthma are estimated by applying age-specific national prevalence rates from the 2008 NHIS to age-specific county-level resident populations obtained from the U.S. Census Bureau web site. Prevalence estimates for chronic bronchitis and emphysema are calculated for those 18-44, 45-64 and 65+. The prevalence estimate for pediatric asthma is calculated for those under age 18.

Adult Asthma and Diabetes. In 2008, the Behavioral Risk Factor Surveillance System (BRFSS) survey indicated that approximately 8.4% of adults residing in the United States reported currently having asthma. The information on adult asthma obtained from the Behavioral Risk Factor Surveillance System survey cannot be compared with pediatric asthma estimates that are derived from the NHIS. The BRFSS indicated that 8.8% of adults in the United States had ever been diagnosed with diabetes in 2008.

The prevalence estimate for adult asthma and diabetes is calculated for those 18-44, 45-64 and 65+. Local area prevalence of adult asthma and diabetes is estimated by applying age-specific state prevalence rates from the 2008 BRFSS to age-specific county-level resident populations obtained from the U.S. Census Bureau web site.

Cardiovascular Disease Estimates. All cardiovascular disease estimates are based on the 2005 National Health and Nutrition Examination Survey and were obtained from the National Heart Lung and Blood Institute (NHBLI). According to their estimate, 79.8 million Americans suffer from one or more types of cardiovascular disease, including coronary heart disease, hypertension, stroke and heart failure. Local area prevalence of cardiovascular disease is estimated by applying age-specific prevalence rates for those 18-44, 45-64 and 65+, provided by NHLBI, to age-specific county-level resident populations obtained from the U.S. Census Bureau web site.

Limitations of Estimates. Since the statistics presented by the NHIS, BRFSS and NHANES are based on a sample, they will differ (due to random sampling variability) from figures that would be derived from a complete census or case registry of people in the U.S. with these diseases. The results are also subject to reporting, non-response and processing errors. These types of errors are kept to a minimum by methods built into the survey.

Additionally, a major limitation of both surveys is that the information collected represents self-reports of medically diagnosed conditions, which may underestimate disease prevalence since not all individuals with these conditions have been properly diagnosed. However, the NHIS is the best available source that depicts the magnitude of chronic disease on the national level and the BRFSS is the best available source for state-specific adult asthma and diabetes information. The conditions covered in the survey may vary considerably in the accuracy and completeness with which they are reported.

Local estimates of chronic diseases are scaled in direct proportion to the base population of the county and its age distribution. No adjustments are made for other factors that may affect local prevalence (e.g. local prevalence of cigarette smokers or occupational exposures) since the health surveys that obtain such data are rarely conducted on the county level. Because the estimates do not account for geographic differences in the prevalence of chronic and acute diseases, the sum of the estimates for each of the counties in the United States may not exactly reflect the national estimate derived by the NHIS or state estimates derived by the BRFSS.

REFERENCES

Irwin, R. Guide to Local Area Populations. U.S. Bureau of the Census, Technical Paper Number 39 (1972).

National Center for Health Statistics. Raw Data from the National Health Interview Survey, United States, 2008. Calculations by the American Lung Association Research and Program Services Division using PASW and SUDAAN software.

Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System, 2008.

Population Estimates Branch, U.S. Census Bureau. County Resident Population Estimates, by Age, Sex, and Race: July 1, 2008.

Office of Management and Budget. Update of Statistical Areas Definitions and Guidance on Their Uses. OMB Bulletin 09-01 November 20, 2008.

National Heart Lung and Blood Institute. Cardiovascular Disease Prevalence Estimates from 2005-2006 National Health and Nutrition Examination Survey. Unpublished data prepared by Dr. Michael Mussolino upon special request to NHLBI.

U.S. Census Bureau. Small Area Income and Poverty Estimates. State and County Data, 2008.