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 2008-2010 for each monitoring site.

Design values for the annual $PM_{2.5}$ concentrations by county for the period 2008 - 2010 were downloaded on September 24, 2011 from EPA's website at http://www.epa.gov/air/airtrends/values.html.

Ozone Data Analysis

The 2008, 2009, and 2010 AQS hourly ozone data were used to calculate the daily 8-hour maximum concentration for each ozone-monitoring site. The hourly averaged ozone data were downloaded on June 28, 2011. 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 standard: 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 2008, 2009, and 2010, based on the EPA-defined ozone season, was identified.

The current national ambient air quality standard for ozone is 0.075 ppm measured over 8-hours. EPA's Air Quality Index reflects the 0.075 ppm standard. 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 PM2.5 concentration for each county in 2008, 2009, and 2010 with monitoring information. The 24-hour PM2.5 data were downloaded on August 1, 2011. In addition, hourly averaged PM2.5 concentration data were characterized into 24-hour average PM2.5 values by the EPA and provided to A.S.L. & Associates. 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 PM2.5 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)

In 2006, the EPA revised the 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 2011, the EPA had not announced changes to the Air Quality Index based on that standard. The Lung Association adjusted the level of the category "Unhealthy for Sensitive Groups" to reflect the 2006 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. Both 24-hour averaged PM data, as well as hourly averaged PM data averaged over 24 hours were used. Included in the analysis are data collected using only FRM and FEM methods, which reported hourly and 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 "98th 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 "99th percentile" form) of the $PM_{2.5}$. The American Lung Association supports using the tighter limits in a 99th 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 and the 24-hour $PM_{2.5}$ standards. EPA determines whether a county violates the standard based on the 4th 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. The American Lung Association's position is that the evidence shows that the 1997 and 2008 ozone standards fail to protect public health.

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 2009 as defined by the White House Office of Management and Budget (OMB).

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 the national ambient air quality standard for annual $PM_{2.5}$ of 15 $\mu g/m^3$. Counties that EPA listed as being at 15.0 $\mu g/m^3$ were given grades of "Pass." Counties EPA listed as being at 15.1 $\mu g/m^3$ were given grades of "Fail." Where insufficient data existed for EPA to determine a design value, 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 2009 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.