BEFORE THE
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

AIR QUALITY DESIGNATIONS AND CLASSIFICATIONS FOR THE FINE PARTICLES (PM-2.5) NATIONAL AIR QUALITY STANDARDS	)	Air Docket No. OAR-2003-0061 RIN-2060-AM04
FINAL RULE	)	
40 CFR PART 81	)	

PETITION OF OAKLAND COUNTY, MICHIGAN FOR RECONSIDERATION OF EPA'S PM-2.5 NON-ATTAINMENT DESIGNATION

Keith J. Lerminiaux
Deputy Corporation Counsel
OAKLAND COUNTY
Department of Corporate Counsel
1200 North Telegraph Road, Department 419
Pontiac, MI 48341-0419
(248) 858-0557
lerminiauxk@co.Oakland.mi.us

Thomas P. Wilczak
Kurt A. Kissling
PEPPER HAMILTON LLP
100 Renaissance Center – 36th Floor
Detroit, MI 48243-1157
(313) 259-7110
wilczakt@pepperlaw.com
kisslingk@pepperlaw.com

John W. Carroll
PEPPER HAMILTON LLP
200 One Keystone Plaza
North Front & Market Streets
Harrisburg, PA 17108-1181
(717) 255-1155
carrollj@pepperlaw.com

Marc D. Machlin
PEPPER HAMILTON LLP
Hamilton Square
600 Fourteenth Street, N.W.
Washington, D.C. 20005-2004
(202) 220-1200
machlinm@pepperlaw.com

Attorneys for Petitioner Oakland County

March 7, 2005

TABLE OF CONTENTS

PAGE

INTRODUCTIONS AND SUMMARY 2

PROCEDURAL HISTORY 4

ARGUMENT 13

I. UNDER THE CLEAN AIR ACT, AN AREA MAY BE DESIGNATED AS A NON-ATTAINMENT AREA ONLY IF THE AREA IS VIOLATING ONE OF EPA'S PM-2.5 STANDARDS OR IS CONTRIBUTING TO VIOLATIONS IN A NEARBY AREA 13

A. The Clean Air Act Requires EPA To Give Substantial Deference To State Designations 13

B. The Clean Air Act Requires EPA To Base All PM-2.5 Designations On Actual Monitoring Data For PM-2.5 Levels In Ambient Air 14

II. AS MDEQ HAS DETERMINED, OAKLAND COUNTY IS MEETING EPA'S AMBIENT AIR STANDARDS FOR PM-2.5 16

III. AS MDEQ HAS DETERMINED, OAKLAND COUNTY MAKES NO "CONTRIBUTION" TO NON-ATTAINMENT IN ANY NEARBY AREAS 17

A. Air Flowing From Oakland County To Wayne County Contains PM-2.5 At Levels That Are Lower Than Rural Background Concentrations 17

B. In Rejecting MDEQ's Recommended Designations, And In Establishing A Presumption Requiring A Uniform Designation For Metropolitan Statistical Areas, EPA Violated The Clean Air Act And The Data Quality Act 19

1. EPA's Actions Violated The Clean Air Act And The PM-2.5 Regulations 19

2. EPA's Actions Not Only Were Arbitrary And Capricious, But Also Violated The Data Quality Act 21

3. EPA's Actions Failed To Meet Due Process And APA Requirements 25

C. Even Under EPA's Unlawful Multi-Factor Test, Oakland County Qualifies As An Attainment Area For PM-2.5 27

1. *Factor One* – Comparison of emissions 27
2. *Factor Two* – Comparison of air quality 28
3. *Factor Three* – Population Density and Degree of Urbanization 29
4. *Factor Four* – Traffic and Commuting Patterns 30
5. *Factor Five* - Extent of Growth 30
6. *Factor Six* – Meteorology 31
7. *Factor Seven* – Geography/topography 31
8. *Factor Eight* – Jurisdictional boundaries 31
9. *Factor Nine* – Level of Control of Emissions 32

CONCLUSION 33

EXHIBIT 1 REPORT OF GRADIENT CORPORATION ..... TAB 1

BEFORE THE
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

AIR QUALITY DESIGNATIONS AND CLASSIFICATIONS FOR THE FINE PARTICLES (PM-2.5) NATIONAL AIR QUALITY STANDARDS	)	Air Docket No. OAR-2003-0061 RIN-2060-AM04
FINAL RULE	)	
40 CFR PART 81	)	

PETITION OF OAKLAND COUNTY, MICHIGAN FOR RECONSIDERATION OF EPA'S PM-2.5 NON-ATTAINMENT DESIGNATION

Pursuant to Section 107(d)(6)(A) and Section 307(d)(6)(B) of the Clean Air Act, 42 U.S.C § 7407(d)(6)(A) and 7607(d)(6)(B), respectively, Oakland County, a Michigan municipal corporation, hereby petitions for reconsideration of the decision of the U.S. Environmental Protection Agency ("EPA") designating Oakland County as a non-attainment area for fine particulate matter ("PM-2.5"). EPA's decision was published in *Air Quality Designations and Classifications for Fine Particles (PM-2.5) National Ambient Air Quality Standards,* 70 Fed. Reg. 944, 980 (January 5, 2005). For the reasons specified below, Oakland County respectfully requests re-designation as a PM-2.5 attainment area. Re-designation of Oakland County as an attainment area would be fully consistent with the recommendations issued by the State of Michigan, acting through the Michigan Department of Environment Quality ("MDEQ").

INTRODUCTION AND SUMMARY

Oakland County requests re-designation as a PM-2.5 attainment area on five separate and independent grounds.

1. Section 107 of the Clean Air Act requires EPA to give substantial deference to the attainment and non-attainment recommendations issued by the states. EPA may override such recommendations only when "necessary" based upon monitoring data for PM-2.5.

2. The quality-assured PM-2.5 monitoring data show that Oakland County is in attainment. As of January 5, 2005, when EPA issued its decision, the agency did not yet have the PM-2.5 data for calendar year 2004. MDEQ submitted the new data on February 22, 2005, and it again proved that Oakland County is complying fully with EPA's PM-2.5 standards. MDEQ also established that only one county in the Detroit Metropolitan Statistical Area, Wayne County, could legitimately be classified as a non-attainment area for PM-2.5. *See* Letter from Steven E. Chester, MDEQ Director, to Bharat Mathur, Acting Regional Administrator for EPA Region 5 (February 22, 2005).

MDEQ's submission was based upon certified quality-assured monitoring data for PM-2.5. For calendar year 2004, MDEQ reported that in Oakland County, the annual average PM-2.5 level was 12.76 $\mu g/m^3$. On a three-year basis, Oakland County's average annual PM-2.5 level was 14.1 $\mu g/m^3$, which is well below the applicable EPA standard. As explained in the accompanying report from the Gradient Corporation, these reported levels actually overstate the PM-2.5 level in Oakland County because the County's monitoring station is located in a "worst-case" site near Wayne County, and near the confluence of several large highways. In any event, whether measured on a one year basis or a three-year average, Oakland County unquestionably is meeting EPA's ambient air quality standards within its own boundaries.

3. Based upon the monitoring data, PM-2.5 levels in Oakland County are not contributing to non-attainment in Wayne County. The 2004 data confirm that, throughout the Detroit Metropolitan Statistical Area, the PM-2.5 levels are declining. Even in Wayne County itself, at three of the seven monitoring stations, including the stations closest to Oakland County, the PM-2.5 levels are now at or below EPA's annual standard of 15 $\mu g/m^3$.

Moreover, as MDEQ has explained, PM-2.5 levels in Wayne County are highest, by far, when the wind is coming from the south and southwest, not from Oakland County, which is located north of Wayne County. This strongly suggests that Oakland County is not contributing in any way to PM-2.5 levels in Wayne County. In the accompanying report, Gradient has now expanded upon MDEQ's analysis. Based upon certified quality-assured monitoring data for PM-2.5, Gradient has shown that when the wind is blowing southward (from Oakland County to Wayne County), the ambient air from Oakland County contains PM-2.5 levels that are at or below rural background levels. As a result, the air from Oakland County is actually lowering PM-2.5 levels in Wayne County, thereby improving ambient air quality.

Gradient's report also demonstrates that the highest levels of PM-2.5 in Oakland County are associated with winds moving from the south (or from Wayne County). In 2004, for example, when the winds were from the south, the average PM-2.5 level in Oakland County was 15.5 $\mu g/m^3$. By contrast, when the winds were from the north, the average PM-2.5 level was only 8.3 $\mu g/m^3$, which is below rural background levels identified by EPA. Thus, the data show conclusively that Oakland County is not making any "contribution" to PM-2.5 levels in Wayne County.

4. The analysis used by EPA to justify designation of Oakland County as a non-attainment area is flawed in many respects. From a statutory standpoint, EPA failed to give the

State's proposed designations the required level of deference. Rather than modifying the State's proposed designations only when "necessary," as required by Section 107(d)(1) of the Clean Air Act, EPA adopted a "presumption" requiring uniform designations for Metropolitan Statistical Areas, including the Detroit area. Under this approach, EPA unlawfully shifted to MDEQ the burden of proving under a nine-factor test that individual counties were entitled to a different classification.

Neither EPA's "presumption" nor its "nine-factor test" can be reconciled with Section 107 of the Clean Air Act. The Act specifically requires that attainment decisions be based upon certified qualified-assured monitoring data for PM-2.5. The methodology adopted in the EPA Guidance and applied in EPA's January 5, 2005 decision, however, requires a subjective evaluation of other factors, including estimated emissions data, population density, population growth, and traffic and commuting patterns. This entire approach is unlawful and should be discarded.

5. Lastly, in applying its nine-factor test, EPA made a series of errors. When these errors are corrected, Oakland County qualifies as an attainment area even under this unlawful and subjective test.

PROCEDURAL HISTORY

In mid-2003, EPA began to solicit PM-2.5 attainment recommendations from the States and Indian tribes. Initially, EPA Region 5 solicited the State of Michigan's recommendations for PM-2.5 non-attainment areas in a June 2, 2003 letter from then-Regional Administrator Thomas Skinner to Governor Granholm (OAR-2003-0061-0010). The Regional Administrator attached to his letter the April 1, 2003 guidance memo issued by Jeffrey

Holmstead, the Assistant Administrator for Air and Radiation (OAR-2003-0061-0002) ("EPA Guidance").

The EPA Guidance outlined EPA's approach to designating PM-2.5 non-attainment areas. EPA emphasized that designation recommendations, as well as comments on EPA's ultimate determinations, would be solicited from states and tribes, but not from local governments or the public. *Id.* at Att. 2, pp. 2-3. EPA stated that it would presume that an entire Metropolitan Statistical Area[1] was non-attainment if a single violation occurred within the boundaries of that Metropolitan Statistical Area. *See id.* at Att. 2, pp. 4-5. EPA also stated its goal of "maximize[ing] consistency between designations for PM-2.5 and designations for the 8-hour ozone standard." *Id.* at Att. 2, p. 6. In addition, EPA predicted, before receiving a single state or tribal recommendation, that only a "limited number" of situations would warrant variation from the "presumption" of non-attainment throughout an entire Metropolitan Statistical Area. *See id.* at Att. 2, p. 6.

In the EPA Guidance, EPA also adopted a multi-factor approach as the only basis for overcoming the "presumption." This multi-factor test was to be used for determining when to exclude an area or county in attainment from a Metropolitan Statistical Area containing a non-attainment area located elsewhere. *Id.* at Att. 2, p. 7. States and tribes were given the burden of proving to EPA that an area should be carved out of the defined Metropolitan Statistical Area. *Id.* Each "factor" was described in a separate bullet, but the bullets consisted of one or two lines

[1] While the Office of Management and Budget ("OMB") has varied its nomenclature for the different types of Metropolitan Statistical Areas, *e.g.*, using CMSAs, MSAs, CSAs, and CBSAs, the key concept employed by OMB and adopted by EPA is that a Metropolitan Statistical Area encompasses a mass of related urban areas independent of city or county boundaries. OMB included Oakland County in the "Detroit-Ann Arbor-Flint" Metropolitan Statistical Area, which also includes Monroe, Wayne, Livingston, Macomb, St. Clair, Washtenaw, Genesee, Lapeer, and Lenawee Counties.

of text, were incomplete sentences, did not explain how or why the factor was relevant; nor did these bullets identify the relative importance of the factors. *Id.* Although EPA stated that "[t]his guidance is not binding on States, Tribes, the public, or EPA," this was the only substantive guidance provided by EPA for the purpose of differentiating between attainment and non-attainment areas within a Metropolitan Statistical Area.[2]

On February 13, 2004, the State of Michigan submitted its recommendations.[3] The State indicated to EPA Region 5 that Wayne and Monroe[4] Counties should be designated as separate non-attainment areas. In his cover letter to the EPA Regional Administrator, Steven E. Chester, the Director of the Michigan Department of Environmental Quality ("MDEQ"), made several points in support of this recommendation. Initially, he explained that the "presumptive point of origin for non-attainment designations…is arbitrary as it applies to PM-2.5, which is clearly evident after reviewing current PM-2.5 monitoring data and historical monitoring data for particulate matter." MDEQ February 2004 Letter at p. 1.

In MDEQ's view, the data from the monitoring stations in Michigan conclusively established that PM-2.5 non-attainment was limited to a discrete area within Wayne County with identified boundaries. *Id.* MDEQ also explained that an EPA decision to create a "widespread"

---

[2] Although additional EPA guidance later issued, it focused on the OMB's changing nomenclature for dealing with Metropolitan Statistical Areas and did nothing to materially alter the EPA Guidance. *Compare* the EPA Guidance with the February 13, 2004 memo by Lydia N. Wegman, Director of the Air Quality Strategies and Standards Division, to the Air Division Directors in EPA Regions I-X.

[3] *See* Steven Chester's February 13, 2004 letter to Thomas Skinner ("MDEQ February 2004 Letter"), and attached "Recommended Attainment/Non-Attainment Boundaries in Michigan for the PM-2.5 National Ambient Air Quality Standards" report, by Steve Chester (February 13, 2004) ("MDEQ Report") (docketed together as OAR-2003-0061-0096).

[4] Although Monroe County was originally recommended for non-attainment status based on the 2001-2003 data, the availability of the 2004 data allowed for consideration of the 2002-2004 period, which indicated that Monroe County is also measuring in attainment for both PM-2.5 standards.

non-attainment area that includes areas in attainment is "inappropriate from a regulatory perspective and misleading from a public health perspective." *Id.* In addition, MDEQ emphasized that several different legal authorities, independent of those created by a non-attainment designation for PM-2.5, already existed and provided mechanisms for dealing with issues related to PM-2.5 in every part of Michigan.

Lastly, MDEQ explained that despite prevailing winds from the south and southwest, monitors downwind of the discrete non-attainment area still measured attainment, demonstrating that even with high PM-2.5 contributions from a different area (*i.e.*, Wayne County), those counties downwind of Wayne County still met both PM-2.5 standards. This further demonstrated the unsuitability of the Metropolitan Statistical Area boundary created by OMB. *Id.* at p. 2.

The February 13, 2004 letter from MDEQ's Director was supported by a detailed Report. The Report provided data and analysis supporting MDEQ's recommendations. MDEQ opined that the multi-factor approach proposed by EPA for PM-2.5 purposes used in recent ozone recommendations was ill-suited for PM-2.5. Unlike ozone, the scientific understanding of PM-2.5, including the body of information regarding its formation and migration, was far less developed and detailed. *See* MDEQ Report at p. 10. For example, speciation data reflecting the make-up of PM-2.5 existed for only a fraction of monitoring stations. *See id.*

MDEQ also highlighted the wind trajectories within the State of Michigan. "The prevailing wind direction demonstrates that sources in adjacent counties do not contribute to PM-2.5 non-attainment; rather, it is a localized problem. The other adjacent counties [in the SE Michigan Metropolitan Statistical Area], while in attainment, are receiving pollution from Wayne County rather than contributi[ng] to non-attainment in Wayne County." *Id.*

Next, MDEQ explained that EPA's 1999 National Emissions Inventory ("NEI"), based its PM-2.5 estimates "on a limited number of EPA PM-2.5 emission factors. Also, many factors were of poor quality." *Id.* MDEQ argued that PM-2.5 monitoring data, not the more theoretical and subjective emissions data for 1999, should drive the designations for non-attainment. *See id.* at pp. 10-11; *see also* p. 12.

In MDEQ's view, using an OMB-defined Metropolitan Statistical Area boundary as a surrogate for monitoring data would entail an "unsupported and premature" assumption that area **c**ounties were contributing to Wayne County's non-attainment. *Id.* at 10. The geographic extent of Wayne County's zone of PM-2.5 non-attainment, which was identified by MDEQ and based on the quality-assured PM-2.5 monitoring data, coincided with a corridor of industrialized neighborhoods in urban Detroit that differed considerably in character from the rest of the counties in the Metropolitan Statistical Area. No other part of the Metropolitan Statistical Area had a similar "population density and degree of urbanization." *Id.* at 11.

Lastly, data from the air monitoring stations in the Metropolitan Statistical Area "clearly show that the highest PM-2.5 days in the Detroit area are when winds are from the south and southwest. This reinforces [MDEQ's] conclusions that the counties to the north of Wayne County are not contributing to…PM-2.5 violations." *Id.* at 13. In addition, the data established a pattern suggesting that "the sources that are pushing the monitors in Wayne County over the standard are located in Wayne County," and providing further evidence that a non-attainment designation should only apply to Wayne County. *See id.*

Under a June 29, 2004 cover letter from Bharat Mathur, the Acting Administrator for Region 5, EPA responded to MDEQ's recommended designations.[5] EPA stated that it disagreed with Michigan's analysis, and instead decided to designate 7 of the 10 counties in the Metropolitan Statistical Area as non-attainment, 5 of which were designated solely on the basis of "contributing" to non-attainment elsewhere. *See* EPA Response at p. 2. EPA "reviewed the nine factors for the counties within the Metropolitan Statistical Area as well as" adjacent counties. For Factor No. 1, EPA stated that the methodology it adopted for estimating emissions in the respective counties, was based in large part on the 1999 NEI. *Id.* at pp. 4-5. Although EPA stated that emissions information was often "the most important factor in assessing boundaries of non-attainment areas," EPA's source data and assumptions were described in less than two pages and were often unidentified. *Id.*

For Factor No. 1, EPA used speciation data for the Allen Park monitor in Wayne County, and compared it to the M.K. Goddard monitor in Pennsylvania, which was selected as a "representative" rural background site with which to calculate urban excess values. *Id.* This approach used monitoring data to extrapolate from emission data, and without explanation, EPA selected two monitoring sites as the sources of the speciation data. *Id.*

For Factor No. 5, EPA cited the population change between 1990 and 2000 for evaluating the "expected growth" in those counties and failed to consider future population growth projections available from the U.S. Census. *Id.* at 7. EPA did not explain why it considered growth in past decades rather than recent growth rates or projected growth rates.

[5] The attached report, titled "Review of Designations in Michigan for the Particulate Matter Air Quality Standard" ("EPA Response"), is docketed together with the cover letter at OAR 2003-0061-0278.

For Factor No. 6, EPA listed wind directions for each county, by percentage, and noted a relationship between wind direction and PM-2.5 concentrations. EPA did not provide any additional explanation for the effect of the prevailing meteorological conditions on PM-2.5 measurements.

On September 1, 2004, MDEQ submitted comments on the EPA Response document.[6] MDEQ reiterated its original recommendations, while supplementing its analysis rationale with a series of responses to EPA's multifactor analysis. While EPA had expressed a preference for expanding non-attainment areas to include major emission sources, including area sources, MDEQ pointed out that downwind emissions sources that are in an attainment area should not be included because they do not contribute to non-attainment. Imposing additional controls on those sources would have no or little effect on the conditions in the non-attainment area. *See* MDEQ Response at pp. 2-3 & 5.

For Factor No. 2, MDEQ questioned EPA's suggestion that Oakland County should be designated as non-attainment because its design value was 14.8 μg/m³. In MDEQ's view, this was mistaken because that number, while still below the relevant threshold, exaggerated the PM-2.5 levels in Oakland County due to its location. *See id.* at p. 4. The Oak Park monitoring station yielded worst-case data for Oakland County, because it was positioned near several freeways and immediately north of Wayne County, in a somewhat industrialized area unlike the vast majority of Oakland County. *See id.* Furthermore, the 14.8 μg/m³ figure

[6] MDEQ's September 1, 2004 submission consisted of Director Chester's cover letter to Bharat Mathur (OAR-2003-0061-0397) and the attached "Comments on the U.S. Environmental Protection Agency's Proposed Designations in Michigan for the Particulate Matter Air Quality Standards" (OAR-2003-0061-0398) ("MDEQ Response").

was still less than the applicable standard, and PM-2.5 levels at that location (and in general) had been decreasing. *Id.*

MDEQ also explained that: "EPA did not adequately respond to MDEQ's trajectory analyses showing a bias towards a southwest wind when daily PM-2.5 are in the higher categories of the air quality index." *Id.* at p. 4. MDEQ maintained that its prior Report sufficiently documented the localized conditions surrounding Wayne County's non-attainment, as well as the fact that the outlying counties were not contributing to that non-attainment. *See id.*

Next, MDEQ noted that the costs of addressing a non-attainment designation would be significant. For counties measuring in attainment, such as Oakland County, incurring these costs would be pointless because any additional controls would have little or no effect on the non-attainment area needing action. *See id.* at pp. 6-7.

MDEQ explained that the scientific data providing the basis for its argument was quality-assured monitoring data, while the weighted emissions score used by EPA is "arbitrary and by design can lead to differing interpretations by everyone." *Id.* at 7. In other words, EPA was not relying on monitoring data meeting the requirements of 40 CFR Part 58, and EPA's methodology was not replicable due to its subjectivity. In addition, MDEQ pointed out that population "is not an accurate indicator of high PM-2.5." *Id.* at 8.

MDEQ further supplemented its argument with a November 30, 2004 letter from Director Chester to EPA's Acting Regional Administrator, Bharat Mathur. This letter reiterated many of MDEQ's main arguments and transmitted preliminary data for 2004 indicating that PM-2.5 levels decreased at virtually every monitoring station previously in non-attainment. *See* OAR-2003-0061-0498.

In December 2004, EPA released its report named "Technical Support for State and Tribal Air Quality Fine Particle (PM-2.5) Designations." *See* OAR-2003-0061-0606 *et seq.* For Michigan, this Report repeated the analysis presentation from the June 29, 2004 EPA Response. The final rule containing EPA's PM-2.5 designations was then published in the Federal Register on January 5, 2005 (70 Fed. Reg. 944). Notably, the final rule provided states and tribes with the opportunity to incorporate 2004 data into the determinations if such data were provided to EPA by February 22, 2005.

The State of Michigan did provide the 2004 data, by letter dated February 22, 2005 ("MDEQ 2005 Letter"). MDEQ indicated that based upon the 2004 data, Oakland County and all areas other than Wayne County were meeting EPA's standards and should be designated as attainment areas. The 2004 data demonstrated that even Monroe County was meeting both PM-2.5 standards, and therefore deserved an attainment designation.[7] S*ee* 2004 Supplement at p. 1. The data further demonstrated a decline in PM-2.5 levels across the board, with a number of previously non-attainment monitors now showing attainment. *Id.* at pp.1-2. Furthermore, using EPA's methodology, only four monitoring stations in the State of Michigan (all in Wayne County) exhibited a design value greater than 15 μg/m³. *Id.* MDEQ also questioned EPA's prior approach, including the lack of support for EPA's suggestion that "winds from all directions have impacts" on the high PM-2.5. Lastly, MDEQ highlighted the fact that the "majority of VMT [*i.e.*, vehicle miles traveled] within Wayne County come[s] from Wayne County residents." In fact, the total VMT contribution for all of the surrounding counties combined was less than 35 percent. *Id.* at p. 2.

[7] This change coincided with PM-2.5 monitors in the Toledo area also showing attainment based on the 2004 data.

EPA has yet to respond to the MDEQ's 2005 letter.

ARGUMENT

EPA should reconsider and rescind its January 5, 2005 decision designating Oakland County as a non-attainment area. The 2004 monitoring data confirm MDEQ's finding that, within the Detroit Metropolitan Statistical Area, only Wayne County may legitimately be classified as a non-attainment area for PM-2.5.

As should be obvious, Oakland County did not raise its objections to EPA's actions until now because there was no opportunity to do so. EPA never solicited public comment on its proposed PM-2.5 designations nor on its 2003 EPA Guidance, and EPA never gave interested parties other than the states an opportunity to participate in this process. Accordingly, Oakland County is presenting its objections in this petition for reconsideration.

I. UNDER THE CLEAN AIR ACT, AN AREA MAY BE DESIGNATED AS A NON-ATTAINMENT AREA ONLY IF THE AREA IS VIOLATING ONE OF EPA'S PM-2.5 STANDARDS OR IS CONTRIBUTING TO VIOLATIONS IN A NEARBY AREA

A. The Clean Air Act Requires EPA To Give Substantial Deference To State Designations

The Clean Air Act establishes specific standards with respect to designation of attainment and non-attainment areas. An "area" or county may be designated as a non-attainment area only if it does not meet the applicable ambient air quality standard *or* if it "contributes" to violations of the standard in a "nearby area." 42 U.S.C. § 7407(d)(1)(A).[8]

[8] Under the Clean Air Act, a miniscule "contribution" cannot possibly be sufficient to warrant a non-attainment designation. Otherwise, virtually every area in the United States, including nearly all counties located south or southwest of Wayne County, would be designated as non-attainment areas.

The Clean Air Act also delegates substantial responsibility to the States. Each State has "primary responsibility" for "assuring air quality" within the State and for "specify[ing] the manner in which national primary and secondary ambient air quality standards will be achieved and maintained. . . ." *Id*. § 7407(a). Likewise, each State is responsible for making "initial designations" of all areas within its borders. Such areas may be designated as "non-attainment," "attainment," or "unclassifiable." *Id*. § 7407(d)(1)(A). EPA only has authority to "make such modifications" found to be "necessary" to a State's "initial designations." *Id*. § 7407(d)(1)(B)(ii). Before making any such modifications, however, EPA "shall notify the State and provide such State with an opportunity to demonstrate why any proposed modification is inappropriate." *Id*. Thus, procedurally and substantively, the Act gives the States "primary responsibility" and allows EPA to override State designations only when "necessary."

B. The Clean Air Act Requires EPA To Base All PM-2.5 Designations On Actual Monitoring Data For PM-2.5 Levels In Ambient Air

In 1998 and again in 2004, Congress amended Section 107 of the Clean Air Act and added provisions relating specifically to PM-2.5 designations. Notably, as detailed below, Congress required that PM-2.5 designations be based upon three years of actual "monitoring data" for fine particles. 42 U.S.C. §7407 (Historical Note)

Congress established a specific time frame and a specific data source for PM-2.5 designations. Section 107(d)(6)(A), which was added by the Consolidated Appropriations Act for 2004, provides that: "Notwithstanding any other provision of law, not later than February 15, 2004, each State shall submit designations referred to in paragraph (1) for the July 1997 PM-2.5 national ambient air quality standards for each area within the State, *based on air quality monitoring data collected in accordance with any applicable Federal reference methods for the relevant areas*." 42 U.S.C. § 7407(d)(6)(A) (emphasis added). Section 107, as amended, then

provides that EPA "shall, consistent with paragraph (1), promulgate the designations" submitted by the States. *Id*. § 7407(d)(6)(B).

Congress not only required that EPA's designations be based upon "monitoring data," but also provided the funding necessary for the development of a national air monitoring network for fine particles. *Id*. § 7407 at Historical Note (referring to Pub. L. 105-178, Title VI, June 9, 1998, 112 Stat. 463). Specifically, in 1998, in the Transportation Equity Act For The 21st Century, Congress found that there was a "lack" of air quality monitoring data for PM-2.5; Congress therefore sought to ensure that States would receive "full funding" for installation of the monitoring stations required for accurate sampling. In the Transportation Equity Act, Congress declared that "such data could provide a basis for designating areas as attainment or non-attainment. . . ." (*Id*. at Historical Note.) Indeed, Congress was even more specific and directed EPA to award grants to ensure that the States collect "3 years of air quality monitoring data." (*Id*.) While indicating that the States needed time to consider "implementation guidance from EPA on drawing area boundaries," Congress declared repeatedly that PM-2.5 designations had to be based upon sampling data obtained "from the monitoring network" established with EPA grants. *Id*.

Ultimately, Section 107 of the Clean Air Act, as amended, is very explicit. PM-2.5 designations must be based upon "air quality monitoring data for fine particle levels," as measured over a three-year period in accordance with "Federal reference methods." 42 U.S.C. § 7407 (Historical Note) (quoting from § 6101(a)(1), (a)(2), (a)(4)). Such data must be obtained from the national air monitoring network funded by EPA. (*Id*. at Historical Note (quoting from § 6102).) Only data from the monitoring network for PM-2.5 "shall be considered" by the States

in issuing such designations and by EPA in making any "necessary" modifications to State designations. (*Id*. at Historical Note (quoting from § 6102(c)(1), § 7407(d)(1)(B)(ii).)

II. AS MDEQ HAS DETERMINED, OAKLAND COUNTY IS MEETING EPA'S AMBIENT AIR STANDARDS FOR PM-2.5

As MDEQ has determined, and as EPA appears to have conceded, Oakland County is meeting EPA's ambient air standards for PM-2.5. As explained in Gradient's report, the monitoring station in Oakland County is located in Oak Park, which is a "worst-case" location in this County. This monitoring station is located in the southeast corner of the County, only a few miles from the border with Wayne County (which contains the most industrialized areas in the region). This station also is located in the most urbanized portion of Oakland County.

In addition, the Oak Park monitoring station is near the confluence of several major highways. These include Michigan Highway 102 (Eight-Mile Road), Michigan Highway 10 (The Lodge Expressway), Michigan Highway 39 (Southfield Freeway), Interstate 75 ("I-75") and Interstate Highway 696 ("I-696"). *See* Gradient Report at 1-3.

Despite the location of this monitoring station, the data show conclusively that Oakland County is meeting the applicable ambient air quality standards. PM-2.5 levels in the County are substantially below EPA's 65 microgram per cubic meter 24-hour average concentration. Furthermore, the PM-2.5 levels in Oakland County are well below the 15.0 microgram per cubic meter annual arithmetic mean concentration. *See generally* Gradient Report and Letter From Steven E. Chester, MDEQ Director, To Bharat Mathur, Acting Regional Administrator at Attachment 2 (February 22, 2005). Even before the 2004 data had been obtained, the air quality within Oakland County's borders was meeting this EPA standard. As of 2003, the one year average in the County was 14.58 $\mu g/m^3$, and the three-year average was 14.8.

Id. at Attachment 2. With the 2004 data included, these figures continue to decline. As explained above, the 2004 average in Oakland County was 12.76 μg/m³, producing a three-year average of 14.1. *Id.* Accordingly, the County is now meeting both of EPA's PM-2.5 standards by a substantial margin.

III. AS MDEQ HAS DETERMINED, OAKLAND COUNTY MAKES NO "CONTRIBUTION" TO NON-ATTAINMENT IN ANY NEARBY AREAS

A. Air Flowing From Oakland County To Wayne County Contains PM-2.5 At Levels That Are Lower Than Rural Background Concentrations

MDEQ has correctly determined that Oakland County is not making any "contribution" to non-attainment in Wayne County. As explained in the Gradient report, within Oakland County, the highest levels of PM-2.5 are measured when the winds are from the south. In calendar year 2004, for example, when the wind direction was from the south, the average PM-2.5 level in Oakland County was 15.5 μg/m³. By contrast, when the wind direction is from the north (toward Wayne County), the average 2004 concentration in Oakland County was only 8.3 μg/m³.

Furthermore, when the wind is blowing to the south (toward Wayne County), the PM-2.5 levels at Oak Park are consistently at or below the rural background levels identified by EPA. At the M.K. Goddard Station in rural Pennsylvania, EPA reported that during the April 2002 – March 2003 time period, the PM-2.5 level averaged 11.9 μg/m³. This actually exceeds the levels measured in Oakland County when the wind is blowing to the south (toward Wayne County). Gradient has calculated these annual PM-2.5 concentrations in Oakland County as 9.4 μg/m³ (2000), 9.3 μg/m³ (2001), 8.2 μg/m³ (2002), 9.7 μg/m³ (2003), and 8.3 μg/m³ (2004). These numbers show conclusively that air from Oakland County is not causing any harm whatsoever in Wayne County.

Moreover, even in Wayne County, the air monitoring stations on the northern end of the County (closest to Oakland County) are measuring PM-2.5 levels at or below the federal standard. In Wayne County, the three-year average for the Livonia Station is 13.7 μg/m³, and the three-year average for the East Seven-Mile Station is 14.5 μg/m³. These two monitoring stations are located between Oakland County and the industrial corridor of Wayne County where exceedances have occurred. As MDEQ has stated, PM-2.5 exceedances exist only in the "highly industrialized area of Wayne County." *See* Letter from Steven E. Chester, MDEQ Director, to Acting Regional Administrator Bharat Mathur at 2 (February 22, 2005).

If anything, as Gradient's report explains, the impacts run in the opposite direction; Wayne County and other areas to the south are generating PM-2.5 that is reducing air quality in Oakland County. Despite that adverse impact, however, the monitoring data show that Oakland County is meeting the federal standards, both for the three-year annual average and for the 24-hour period.

In addition, the 2004 monitoring data further support the State of Michigan's argument that PM-2.5 levels are declining. Oakland County's PM-2.5 levels fell to historic lows in 2004. In Oakland County, the annual average levels have declined from 15.00 (2002), to 14.58 (2003), to 12.76 (2004). This is consistent with the national and "Industrial Midwest" trends identified in a December 2004 report issued by EPA. *See* EPA, *The Particle Pollution Report* (December 2004). Indeed, EPA has reported that since 1999, PM-2.5 levels have decreased by nine percent in the "Industrial Midwest," a region that includes Michigan. *Id*. at 14. As EPA has stated: "National programs that affect regional emissions – including EPA's Acid Rain Program – have contributed to lower sulfate concentrations and consequently, to lower PM-2.5 concentrations, particularly in the Industrial Midwest and Southeast." *Id*. In

making attainment and non-attainment designations, it would be irrational for EPA to disregard this downward trend in PM-2.5 levels. After all, these designations will be used *in the future* to decide whether additional emissions controls are necessary.

B. In Rejecting MDEQ's Recommended Designations, And In Establishing A Presumption Requiring A Uniform Designation For Metropolitan Statistical Areas, EPA Violated The Clean Air Act And The Data Quality Act

1. EPA's Actions Violated The Clean Air Act And The PM-2.5 Regulations

EPA's PM-2.5 designations in the State of Michigan have violated two statutory requirements. *First*, EPA failed to give the State of Michigan "primary responsibility" for the PM-2.5 designations within the State. Rather than adopting the State's initial designations or making only those modifications that are truly "necessary," EPA has imposed a presumption that treats the entire Metropolitan Statistical Area as a non-attainment area. By imposing this "presumption" on a national basis, and by requiring use of the Metropolitan Statistical Area unless a State is able to justify a deviation under EPA's multi-factor test, EPA has effectively denied to the State of Michigan and to all States the primacy intended by Congress. Within the State of Michigan, this has resulted in non-attainment designations for a multitude of counties in the Detroit Metropolitan Statistical Area, despite the fact that only one of the seven counties has PM-2.5 levels above the 15 microgram per cubic meter annual standard for PM-2.5.

Second, EPA's PM-2.5 designations have not been based upon the monitoring data for PM-2.5, as required by the Clean Air Act. Instead, EPA applied the EPA Guidance, which establishes the presumption in favor of a single designation for an entire Metropolitan Statistical Area. The EPA Guidance then requires consideration of a multitude of factors, including estimated emissions data, population density, degree of urbanization, traffic and commuting patterns, expected growth rates, weather, jurisdictional boundaries, and geographic

or topographic features. *See* EPA Guidance. Under the first factor (emissions data), EPA has evaluated the estimated emissions of PM-2.5 and for certain precursors to PM-2.5, such as nitrous oxides (NOx) and sulfur oxides (SOx). Yet the emissions data for these precursor compounds are based partly on estimates, as are most of the data for PM-2.5 emissions. Ultimately, instead of focusing on reliable, measured emission concentrations of PM-2.5 from monitoring stations, EPA has focused on a multitude of surrogates, each of which has some indirect and possibly unknown relationship to the actual level of fine particles in the air. EPA has then compounded the inherent inaccuracies of the emissions data by using speciated monitoring data from non-certified air monitoring devices to estimate the proportion of emissions which might be contributing to non-attainment. Thus, the first factor (emissions data) is actually a combination of emission estimates filtered through comparison with monitoring data of questionable reliability.

In the end, neither the "presumption" in favor of Metropolitan Statistical Areas nor the "multi-factor" approach devised by EPA can be reconciled with Section 107 of the Clean Air Act, which focuses on the measurement and evaluation of actual PM-2.5 levels. EPA's "multi-factor" approach is designed to give the agency broad discretion to evaluate and weigh on a highly subjective basis surrogates for PM-2.5. This approach deviates impermissibly from the monitoring data-driven approach embodied in the statute.

To some extent, EPA has attempted to justify its Metropolitan Statistical Area presumption by invoking its past practice in making attainment and non-attainment designations for ozone. *See* EPG Guidance. This completely disregards the fact that ozone and PM-2.5 designations are governed by very different statutory provisions. While the PM-2.5 provisions require the agency to rely upon "air quality monitoring data" for fine particles, the ozone

provisions specifically authorize designations based upon "a metropolitan statistical area or consolidated metropolitan statistical area." *Compare* 42 U.S.C. § 7407(d)(6)(A) and Historical Note (governing PM-2.5 designations) *to* 42 U.S.C. § 7407(d)(4)(A) (governing ozone and carbon monoxide).

Furthermore, EPA's non-attainment designations in Michigan are inconsistent with EPA's own regulations establishing air quality standards for PM-2.5. EPA's regulations do not authorize the subjective application of a multi-factor test. The regulations require the use of designated air monitors and provide for use of a specified reference method. *See* 40 C.F.R. § 50.7, Appendix N to Part 50, and 40 C.F.R. Part 58. As pertinent here, the regulations then provide that: "The national primary and secondary ambient air quality standards for particulate matter are: (1) 15.0 micrograms per cubic meter ($\mu g/m^3$) annual arithmetic mean concentration, and 65 $\mu g/m^3$ 24-hour average concentration measured in the ambient air as $PM_{2.5}$ . . . ." 40 C.F.R. § 50.7(a)(1). Essentially, the regulations now in place establish air quality standards based upon measured concentrations of PM-2.5, not based upon a subjective review of estimated emissions data or other factors.

2. EPA's Actions Not Only Were Arbitrary And Capricious, But Also Violated The Data Quality Act

EPA's approach has not only been inconsistent with the Clean Air Act, but also has been arbitrary and capricious. To start with, the use of an Metropolitan Statistical Area as a presumptive non-attainment area corrupts the purpose for which Metropolitan Statistical Areas are established. As the Office of Management and Budget ("OMB") cautioned when promulgating the standards for establishing Metropolitan Statistical Areas, they are statistical areas only and should not form the basis for policy decisions, such as establishment of non-

attainment areas.[9] There is no evidence or data supporting a "presumption" that Oakland County is contributing to non-attainment in nearby Wayne County based solely on inclusion in a statistically based urban area. In order to bridge this technical chasm, EPA published its guidance document setting forth nine criteria under which a state could seek to exclude from a Metropolitan Statistical Area-based non-attainment area certain geographic regions which met the exclusionary criteria. That guidance, however, inadequately defines the criteria and provides no system for weighting of the individual criteria. Additionally, as applied by EPA in its December 2004 Comment and Response Document, the criteria are unevenly applied by EPA in making decisions about which areas should be included or excluded from non-attainment areas.

Since EPA has chosen to make decisions on area inclusion/exclusion on the basis of the nine factors, each of which has some data component, it is critical that the data used to make these critical decisions be carefully reviewed, consistent with the agency's obligations under the Data Quality Objectives Act (DQOA), 44 U.S.C § 3516 (Note).[10] A cursory

---

[9] "The Metropolitan Area concept has been successful as a statistical representation of the social and economic linkages between urban cores and outlying, integrated areas. This success is evident in the continued use and application of Metropolitan Area definitions across broad areas of data collection, presentation, and analysis. This success also is evident in the use of statistics for Metropolitan Areas to inform the debate and development of public policies and in the use of Metropolitan Area definitions to implement and administer a variety of nonstatistical Federal programs. These last uses, however, raise concerns about the distinction between appropriate uses—collecting, tabulating, and publishing statistics as well as informing policy — and inappropriate uses — implementing nonstatistical programs and determining program eligibility. OMB establishes and maintains these areas solely for statistical purposes." 65 Fed. Reg. 82,228, December 22, 2000.

[10] On December 21, 2000, Congress passed PL 106-554. Section 515 Title V of that law, 114 Stat. 2763, 2763A-453, has been named the Data Quality Objectives Act ("DQOA"). The DQOA required the OMB to issue guidelines to ensure that information disseminated by federal agencies is supported by valid data. In compliance with the DQOA, OMB issued guidelines effective January 3, 2002. 67 Fed. Reg. 8452.

Each federal agency responsible for disseminating influential scientific, financial or statistical information shall include a high degree of "transparency" about the data and methods to facilitate the reproducibility of such information by qualified third parties. 67 Fed. Reg. 8452 (January 3, 2002). "Reproducibility" of data is an indication of transparency, according to OMB's guidelines. *Id.* at 8460.

(continued...)

examination of the data employed by EPA in evaluating the request by MDEQ to exclude Oakland County reveals the dearth of support for the data relied upon in EPA's December Report. For example, in applying the first factor, which calls for a comparison of emission data, the Report ignores available emission inventory data in favor of emissions estimates derived from air quality monitoring data. Then, artificially starting with the assumption that all areas included in an Metropolitan Statistical Area contribute to the overall air emissions for the area, the agency merely determines what percent of the total emissions for the area are derived from the various counties which comprise the Metropolitan Statistical Area. After putting the rabbit in the hat, EPA then concludes that the counties comprising the Metropolitan Statistical Area contribute to non-attainment in the county monitoring non-attainment. Rather than looking at actual ambient air levels for PM-2.5, as is required by the Clean Air Act, however, EPA uses emissions data for other criteria pollutants and ascribes an urban excess matrix to derive a weighted PM-2.5 emissions factor for each county. This hypothetical calculation methodology

---

(continued...)

With regard to analytical results, OMB guidelines state that guidelines "shall generally require sufficient transparency about data and methods that an independent reanalysis could be undertaken by a qualified member of the public." *Id.*

EPA's data quality standards were adopted in October 2002 under the title, "Guidelines For Ensuring and Maximizing the Quality, Objectivity, Utility and Integrity of Information Disseminated by the Environmental Protection Agency," EPA/260R-02-008 (the "Guidelines"). EPA later directed the Science Policy Council to develop assessment factors as a "complement" to the Guidelines. The Council's factors are published in EPA 100/B-03/001 (June 2003)("Assessment Factors").

The Assessment Factors are: Soundness, Applicability and Utility, Clarity and Completeness, Uncertainty and Variability, Evaluation and Review. All data reviewed must meet the highest standards possible under each factor. EPA must also review the scientific and technical basis for the designations because this process of review and approval involves the "dissemination of information" to the public that falls under the scrutiny of EPA's Data Quality Guidelines.

Many of the methodologies employed by EPA in the designation of Oakland County are based on emission assumptions rather than real data. The only qualified data is the monitoring data, which conclusively demonstrate that Oakland County is an attainment area and is not contributing to non-attainment in a nearby area.

naturally shows that each county has emissions which "contribute" to the total Metropolitan Statistical Area emissions total, since the formula demands that each county be ascribed a percentage of the whole. What the methodology fails to do, however, is to compare the "urban" excess with actual background emissions from non-urban settings during actual monitored non-attainment events. Accordingly, the data are not replicable and fail to satisfy the DQOA criteria. The DQOA was enacted by Congress specifically to prevent such specious analyses.

The data quality review is especially important in the process of promulgating a federal non-attainment designation over the objection of the Governor, as in this case. No other agency action demands higher scrutiny than adopting a non-attainment designation, which can have significant negative economic impact on a County, discouraging the siting and expansion of business and industry, and unfairly affecting quality of life issues by suggesting that the air quality of the County fails to meet minimum health-based standards.[11]

Oakland County adopts many of the comments filed by MDEQ in its letters of February 13, 2004, September 1, 2004, November 30, 2004, and February 22, 2005 with respect to designating Oakland County as attainment for PM-2.5. In addition to the comments, data, and analysis provided by MDEQ, Oakland County presents the attached report from Gradient Corporation evaluating the potential contribution of Oakland County source area emissions to the measured non-attainment in Wayne County. Oakland County also takes exception to the utilization of the nine-factor analysis set forth initially in the EPA Guidance from Assistant Administrator Jeffrey Holmstead to Regional Administrators dated April 1, 2003. Tellingly,

[11] In adopting a presumption that all counties within an Metropolitan Statistical Area should be considered non-attainment if even one monitor demonstrates non-attainment, and in applying the nine-factor analysis, EPA has offered at best only superficial explanations. The Data Quality Objectives Act (DQOA) and the EPA data quality Guidelines demand more substantive analyses.

before introducing those nine factors in the EPA Guidance, the Assistant Administrator made this statement about the factors: "These factors resemble the factors identified in previous EPA guidance on 8-hour ozone non-attainment boundaries, though *EPA will make its decisions based on the distribution of sources contributing to PM-2.5 concentrations*." (emphasis supplied). Despite compelling evidence that Oakland County is **not** contributing to monitored *PM-2.5* non-compliance in the area of Wayne County in which non-attainment has been monitored (Dearborn 16.5; Allen Park 15.1; SWHS 16.5; Wyandotte 15.4), and despite the fact that the monitors in Wayne County closest to Oakland County are measuring attainment (Livonia 13.7; East 7 Mile 14.5; Linwood 15.0), EPA classified Oakland County as non-attainment and ignored this geographic pattern.

3. EPA's Actions Failed To Meet Due Process And APA Requirements

The EPA Guidance has been used by the agency as a legislative rule with the force and effect of law. As explained below, however, this rule was issued by EPA unlawfully, and without soliciting public comment.

While EPA asserts that it's the EPA Guidance is a non-binding policy statement, EPA has used this memorandum as a legislative rule. The April 2003 "guidance" created an entirely new methodology for determining whether an area is in attainment for PM-2.5. This "guidance" was sent to all Regional Administrators and was obviously intended to be binding on all EPA personnel and on the States and other interested parties. This was confirmed in the February 13, 2004 memorandum supplementing this guidance and in EPA's January 5, 2005 decision published in the Federal Register. Nowhere in the February 2004 supplement or in the January 5, 2005 decision did EPA indicate that States or EPA regional offices were free to disregard the EPA Guidance or to deviate from the agency's "nine-factor" test.

In distinguishing between legislative rules and non-binding guidance or non-binding statements of policy, the courts have focused on whether the agency action "(1) impose[s] any rights and obligations' or (2) 'genuinely leaves the agency and its decision makers free to exercise discretion.'" *General Electric Co. v EPA*, 290 F.3d 377, 382 (D.C. Cir. 2002) (citations omitted); *Appalachian Power Co. v EPA*, 208 F.3d 1015 (D.C. Cir. 2000) In this proceeding, after issuance of the 2003 guidance, the agency did not act as if it were "free" to exercise its discretion. Indeed, in the January 5, 2005 decision published in the Federal Register, EPA treated the "guidance" document as having the force and effect of law.

Under the Clean Air Act and/or the Administrative Procedures Act, EPA generally must go through notice and comment rulemaking prior to issuing legislative rules. *See generally* 42 U.S.C. § 7607(d); 5 U.S.C. § 553. Since the agency failed to do this, the EPA Guidance should be rescinded and declared null and void.

In addition, EPA issued its non-attainment designations improperly without giving interested parties, such as Oakland County, an opportunity to be heard. Even if the designation process were exempt from the statutory provisions on notice and comment rulemaking, EPA would still be required to ensure that its procedures meet due process requirements. The essential requirements of due process are notice and an opportunity to be heard. *See, e.g.*, *General Electric Co. v. EPA*, 53 F.3d 1324, 1329 (D.C. Cir. 1995); *Amoco Products Co. v Fry*, 118 F.3d 812, 819 (D.C. Cir. 1997) ("[n]otice and a meaningful opportunity to challenge the agency's decision are the essential elements of due process").

In this proceeding, EPA solicited comment from the State of Michigan, as required by statute. Yet EPA failed to give other interested parties, such as Oakland County, any

opportunity to submit comments. The agency therefore failed to meet basic due process requirements.

C. Even Under EPA's Unlawful Multi-Factor Test, Oakland County Qualifies As An Attainment Area For PM-2.5

Notwithstanding the irrationality of the "nine-factor" analysis, the County has attempted to re-examine the key factors and the data used by EPA. This re-examination confirms that the agency erred in designating Oakland County as a non-attainment area.

1. *Factor One* – Comparison of Emissions

The Gradient report discusses EPA's "factor one" analysis in some detail. Gradient shows that when a more appropriate rural background site in Illinois is used, Oakland County's "composite emissions score" drops from 13.6 to 12.6. (*See* Gradient Report at pp. 11-12.)[12] Gradient also shows that EPA's factor one analysis is biased against counties that are large in size. When EPA's composite score for Oakland County is normalized on a square mile basis to remove this bias, the County's score falls from 13.6 to 11.5. (*Id*.)

In addition, EPA's selection of a rural background location in Pennsylvania appears to have inflated the "urban increment" for the Detroit area. Even without the 2004 data,

[12] EPA chose to use speciation data from two monitors that created an unbalanced and unrealistic data set for consideration. EPA first chose speciation data from the Allen Park monitor in the heavily industrialized Detroit non-attainment corridor. Then, EPA chose a rural monitor in a non-attainment county in western Pennsylvania, downwind of Ohio's power plants as a background monitor for comparison to the urban data from the Allen Park speciation monitor. Not surprisingly, the Pennsylvania monitor showed a higher percentage of sulfate as compared to nitrate. The ratio at the Pennsylvania site (50% vs. 16%) reflects emissions from upwind coal-fired power plants and is not believed to be indicative of the mix of PM-2.5 emissions monitored as true background for Wayne County. The use of the Illinois monitor used for the Chicago comparison, at which the sulfate to nitrate ratio was 43% vs. 30%, is a better measure of background air quality from which to calculate the so-called "urban excess" for the Detroit area. Because the ratio of "emissions" for the Detroit Metropolitan Statistical Area was 37% vs. 26% for sulfate vs. nitrate, the Illinois rural monitor gives a more realistic value for background.

which show a lower urban increment, using the Illinois monitor as the background drops the "urban increment" for the Detroit Metropolitan Statistical Area from 4.3 μg/m^3 to 3.9 μg/m^3; these numbers were generated at a time when the Detroit monitor was reporting 16.1 μg/m^3. Since the date of EPA's analysis, the average monitored value at the monitor location used to represent the Detroit Metropolitan Statistical Area has dropped to 15.1 μg/m^3, thus potentially reducing the "urban increment" to 2.9 μg/m^3.

More importantly, as Gradient explains, EPA's weighted emissions score "is an uncertain and imperfect metric" for making PM-2.5 attainment decisions. Among other things, this "score" wrongly assumes that there is a direct relationship between estimated SO_2 and NOx emission rates and actual levels of sulfate and nitrate particles in the air. (Gradient Report at 12-13.) Furthermore, EPA's "emissions score" relies upon speciation data from a single monitoring station in Wayne County. These data are unlikely to be representative of conditions throughout the Detroit Metropolitan Statistical Area. (*Id*. at 13.)

2. *Factor Two* – Comparison of Air Quality

As explained in the various reports filed by MDEQ and the appended expert report of Gradient, the air quality in Oakland County meets EPA's annual attainment standard by a large margin on days when air contaminants from neighboring Wayne County are not affecting the Oakland County monitor, which is located near the boundary of the two counties. The average concentration in Oakland County is less than 10 μg/m^3 for every year when winds are from the north. By contrast, virtually all of the Oak Park monitor's PM-2.5 measurements over 15 μg/m^3 over the past five years occurred when winds came from the south, which indicates transport from Wayne County and its industrialized non-attainment area. Despite this occasional contribution from Wayne County, the average long-term concentration at the Oakland County

monitor is only 14.1 μg/m^3. The values measured at the Oakland County monitoring station for days when the wind is not carrying contaminants into Oakland County from Wayne County are far less than the measured values in other attainment counties in Michigan which have monitoring stations, such as Allegan, Bay, Berrien, Genesee, Ingham, Kalamazoo, Kent, Muskegon, Ottawa, and Saginaw Counties. Since the non-affected background air quality in Oakland County is cleaner than surrounding counties, Oakland County cannot be contributing to non-attainment in Wayne County on those days when the wind is from the north. To the contrary, on such days, the cleaner air in Oakland County would be diluting the more contaminated air from sources within Wayne County.

When comparing Oakland County to its neighboring downwind counties, it is important to note that EPA is proposing to designate the downwind counties (Lapeer and Genesee) as attainment. Other counties adjacent to Oakland County (other than Wayne which is discussed above), include Macomb to the east, Livingston to the west and Washtenaw to the southwest. While these counties are currently proposed for inclusion in the Detroit Metropolitan Statistical Area non-attainment area, none of them has recorded monitored non-attainment. Consequently, Oakland County cannot be designated as non-attainment with respect to ambient air quality in these counties, since these counties also have ambient air quality which meets the NAAQS.

3. *Factor Three* – Population Density and Degree of Urbanization

EPA's data shows that Wayne County has a population density 240% higher than that of Oakland County. Oakland County has a mix of urban, suburban, and rural areas, and while it has a significant population of over 1.2 million, that factor is irrelevant for the purposes of designation of air quality; this is demonstrated by the monitor demonstrating attainment being

located in the most populous portion of the County (Oak Park). The overall housing density in Oakland County is less than one housing unit per acre, a value consistent with the overall suburban character of the County.[13]

4. *Factor Four* – Traffic and Commuting Patterns

Fewer than 18% of Oakland County workers commute into Wayne County. Seventy-one percent of Oakland County workers live and commute to work within Oakland County. The County's many small livable communities allow most workers to live and work in the same area, with short commutes from home to work. Thus, generalized calculations of VMT based solely upon miles of roads or population misrepresent the true commuting pattern within this County.[14]

5. *Factor Five* - Extent of Growth

U.S. Census data indicate that from 2002 to 2003, Oakland County's population increased by a very modest 0.4 percent. The County itself has estimated that from 2000 to 2030, population growth will be in the range of 14 percent. Again, over a 30 year period, this is a modest growth rate.

[13] U.S. Census information is available at its web site, http://www.census.gov, and information specific to Oakland County is available at http://www.census.gov/acs/www/Products/Profiles/Single/2003/ACS/MI.htm. Housing density information is available at http://factfinder.census.gov/servlet/GCTTable?_bm=y&-context=gct&ds_name=DEC_2000_SF1_U&-CONTEXT=gct&-mt_name=DEC_2000_SF1_U_GCTPH1R_US13S&-tree_id=4001&-redoLog=true&-_caller=geoselect&-geo_id=04000US26&-format=ST-2|ST-2S&-_lang=en.

[14] U.S. Census information regarding commuting patters of Oakland County residents can be found at http://www.census.gov/acs/www/Products/Profiles/Single/2003/ACS/Tabular/050/05000US261253.htm.

6. *Factor Six* – Meteorology

Gradient's report establishes the direct and incontrovertible correlation between ambient air quality data and wind direction. This report proves conclusively that Oakland County air emission sources are not contributing to monitored non-attainment in Wayne County.

7. *Factor Seven* – Geography/topography

In addition to the known localized air quality conditions in Wayne County, as demonstrated by Michigan's array of monitoring stations, one must also consider that pollutants from Canada, which lies south and east of Wayne County, also may be affecting the air quality within Wayne County. These industrial sources are not adequately accounted for in EPA's evaluation of contributing source areas. Lying north and west of the major point source emitters of PM-2.5, Oakland County enjoys cleaner air than its upwind neighboring communities in Wayne and Monroe Counties.

8. *Factor Eight* – Jurisdictional Boundaries

Oakland County is comprised of 30 small cities, 21 townships, and 10 villages. The County's Planning and Economic Development Department administers the County's Environmental Stewardship Program to assist its communities in achieving sustainable environmental quality. Oakland County is a discrete jurisdiction and designating the whole county as attainment would certainly allow for efficient administration of the program.

As MDEQ repeatedly stated, from an administrative perspective, having Wayne County designated as non-attainment while having Oakland County designated attainment would be simple to administer from an air quality program perspective.[15]

9. *Factor Nine* – Level of Control of Emissions

Oakland County's point source emissions are among the lowest per capita emissions in the region. Although an imprecise method of measurement of level of control of emissions, this comparison is useful in demonstrating the relative level of point source emissions and their presumed control by geographic area. The 1999 emissions inventory lists the point source emissions for PM-2.5 at 230 tpy or 0.4 lb/per capita/year (lb/p/yr) for Oakland County. Similar per capita figures for surrounding counties are: Monroe County – 81.3 lb/p/yr; St. Clair County – 41.6 lb/p/yr; Lenawee County – 4.8 lb/p/yr; Wayne County – 3.5 lb/p/yr; Livingston County –1.8 lb/p/yr; Genesee County – 1.2 lb/p/yr; Macomb County – 0.9 lb/p/yr; Washtenaw County – 0.7 lb/p/yr; and Lapeer County – 0.1 lb/p/yr. As can be seen from this comparison, Oakland County's point source emissions on a per capita basis are less than each of the counties included in the non-attainment area and lower than two of the three attainment counties that were excluded from the Metropolitan Statistical Area (Lenawee and Genesee).

A comparison of PM-2.5 area source emissions is even more dramatic. Oakland County's per capita area source PM-2.5 emissions were only 13.6 lb/p/yr in 1999, as compared to Lapeer (52.1 lb/p/yr), Lenawee (49.2 lb/p/yr), Livingston (39.2 lb/p/yr), Monroe (38.4 lb/p/yr), St. Clair (35.5 lb/p/yr), Washtenaw (21.5 lb/p/yr), Genesee (20.2 lb/p/yr), Macomb (12.3 lb/p/yr), and Wayne (6.4 lb/p/yr) Counties. Thus, Oakland County's area source PM-2.5

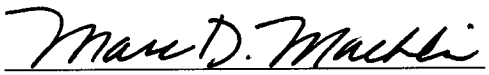
[15] *See* MDEQ's submissions on February 13, 2004, September 1, 2004, November 30, 2004, and February 22, 2005.

emissions on a per capita basis are less than all of the attainment counties that were excluded from the Metropolitan Statistical Area. On a per capita basis, Oakland County's emissions are lower than emissions in four out of the other six counties included in EPA's non-attainment designation. This indicates that the existing "level of control" is more than adequate.

CONCLUSION

EPA should rescind its non-attainment designation for Oakland County. As recommended by MDEQ, Oakland County should be designated as being in attainment with all PM-2.5 standards.

Respectfully Submitted,



Keith J. Lerminiaux
Deputy Corporation Counsel
OAKLAND COUNTY
Department of Corporate Counsel
1200 North Telegraph Road, Department 419
Pontiac, MI 48341-0419
(248) 858-0557
lerminiauxk@co.Oakland.mi.us

John W. Carroll
PEPPER HAMILTON LLP
200 One Keystone Plaza
North Front & Market Streets
Harrisburg, PA 17108-1181
(717) 255-1155
carrollj@pepperlaw.com

Thomas P. Wilczak
Kurt A. Kissling
PEPPER HAMILTON LLP
100 Renaissance Center – 36th Floor
Detroit, MI 48243-1157
(313) 259-7110
wilczakt@pepperlaw.com
kisslingk@pepperlaw.com

Marc D. Machlin
PEPPER HAMILTON LLP
Hamilton Square
600 Fourteenth Street, N.W.
Washington, D.C. 20005-2004
(202) 220-1200
machlinm@pepperlaw.com

Attorneys for Petitioner Oakland County

March 7, 2005

BEFORE THE
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

AIR QUALITY DESIGNATIONS AND CLASSIFICATIONS FOR THE FINE PARTICLES (PM-2.5) NATIONAL AIR QUALITY STANDARDS FINAL RULE 40 CFR PART 81	Air Docket No. OAR-2003-0061 RIN-2060-AM04

CERTIFICATE OF SERVICE

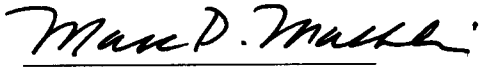
I hereby certify that on March 7, 2005, a copy of the foregoing Petition for Reconsideration was served by electronic mail and by either hand or overnight mail, on the following persons:

Stephen L. Johnson, Acting Administrator
U.S. Environmental Protection Agency
Ariel Rios Building, 1102A
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460
(202) 564-7411
johnson.stephen@epa.gov

Ann R. Klee, Esq., General Counsel
U.S. Environmental Protection Agency
Ariel Rios Building, 2310A
1200 Pennsylvania Avenue, N.W.
Washington, DC. 20460
(202) 564-8040
klee.ann@epa.gov

Bharat Mathur, Acting Regional Administrator
U.S. Environmental Protection Agency-Region 5
77 West Jackson Boulevard, R-19J
Chicago, IL 60604-3507
(312) 886-3000
mathur.bharat@epa.gov

Jeffrey R. Holmstead
Assistant Administrator For Air and Radiation
U.S. Environmental Protective Agency
Ariel Rios Building, 6101A
1200 Pennsylvania Avenue, N.W.
Washington, DC. 20460
(202) 564-7400



Marc D. Machlin

Exhibit 1

REPORT OF GRADIENT CORPORATION/DR. PETER DRIVAS AND DR. CHRISTOPHER M. LONG

Oakland County $PM_{2.5}$

Attainment Analysis

Prepared for
Pepper Hamilton LLP
600 Fourteenth Street, N.W.
Washington, DC 20005-2004

Prepared by
Gradient Corporation
20 University Road
Cambridge, MA 02138

March 7, 2005

Table of Contents

Page

Executive Summary ES-1
1 Introduction 1
2 Oakland County $PM_{2.5}$ Data Analysis 3
2.1 Monitor Location 3
2.2 Attainment Status 4
2.3 Impact on Wayne County 5
2.4 Impact on Downwind Counties 17
3 Weighted Emissions Analysis 20
4 Conclusions 25
5 References 26

Appendix A Vector-Averaged Wind Speed and Direction

Appendix B Qualifications of Authors

Executive Summary

We have been retained by Pepper Hamilton, LLP, on behalf of Oakland County, Michigan to assess the attainment status of Oakland County with regard to the National Ambient Air Quality Standards for $PM_{2.5}$. The Michigan Department of Environmental Quality (DEQ) and EPA Region V have reached very different conclusions on the $PM_{2.5}$ attainment status of Oakland County. The DEQ's position is that only Wayne County in the Detroit metropolitan area should be designated as a $PM_{2.5}$ nonattainment area, and that Oakland County, as well as other counties near Detroit, should be designated as attainment areas for $PM_{2.5}$. The DEQ's position is based primarily on air monitoring data, which show attainment for $PM_{2.5}$ for all counties except for Wayne.

Although the monitor in Oakland County shows attainment for $PM_{2.5}$, EPA Region V disagrees with the DEQ, and holds a position that seven counties in the Detroit metropolitan area, including Oakland County, should be designated as nonattainment for $PM_{2.5}$. The EPA Region V position is based on a number of factors that are subjectively applied, especially in light of actual attainment data, including location in the same metropolitan area, a comparison of county emissions of $PM_{2.5}$ precursors, and the possibility that transport of $PM_{2.5}$ emissions from Oakland County may contribute to the $PM_{2.5}$ violations in Wayne County.

We have analyzed the $PM_{2.5}$ data taken at the Oakland County monitor in Oak Park, Michigan, over the last five years, from 2000 to 2004, and have compared the $PM_{2.5}$ data with meteorological data from Detroit City Airport. Based upon our analysis of the available $PM_{2.5}$ and meteorological data, Oakland County should be designated as in $PM_{2.5}$ attainment, for the following main reasons:

1. The one $PM_{2.5}$ monitor in Oakland County is located in Oak Park, which is in the southeast corner of Oakland County and only about one mile north of the Wayne County border. The site is also located near the intersection of two major highways and is in the most heavily industrialized portion of the county. This monitoring location likely will record the highest $PM_{2.5}$ values in Oakland County, due to nearby local sources and its proximity to Wayne County emissions.

2. Even with this "worst-case" location in Oakland County, the $PM_{2.5}$ monitor at Oak Park is currently in attainment for $PM_{2.5}$, with a 3-year average $PM_{2.5}$ concentration less than 15 $\mu g/m^3$ for the years 2001-2003 and 2002-2004. The DEQ has previously demonstrated that the Oak Park monitor is in attainment for the $PM_{2.5}$ standard.

3. When the Oak Park $PM_{2.5}$ data are compared with local meteorological data, almost all the high $PM_{2.5}$ values above 15 $\mu g/m^3$ over the last five years have occurred with winds blowing from the south (*i.e.*, indicative of transport from Wayne County and other potential emission sources to the south). This trend is very consistent from year to year.

4. When winds are blowing from the north towards Wayne County, the annual-average $PM_{2.5}$ values at the Oak Park monitor were very low, less than 10 $\mu g/m^3$ for every year. These $PM_{2.5}$ values are less than those at rural regional background locations. Thus, the transport of emissions from Oakland County is not contributing to $PM_{2.5}$ violations in Wayne County. Note that because the Oak Park monitor is located near the southern border of Oakland County, it is well positioned to detect emissions from Oakland County sources prior to transport to Wayne County. A similarly positioned monitor at Livonia, which is just across the Wayne County border near the southwestern corner of Oakland County, has recorded a 3-year average of 13.7 $\mu g/m^3$.

EPA Region V's nonattainment position for Oakland County is also based on other factors that are subjectively applied, such as projected population growth and the emission levels of $PM_{2.5}$ precursors in Oakland County compared with other counties. These factors can vary widely depending on the data sources, and techniques such as "weighted emissions score" are highly uncertain and depend strongly on the choice of a regional background monitoring location. The use of actual $PM_{2.5}$ monitoring data and meteorological data should take precedence over any subjective factors, and the actual $PM_{2.5}$ data and meteorological factors strongly support a designation of $PM_{2.5}$ attainment for Oakland County.

IV. 1 Introduction

On February 13, 2004, the Michigan Department of Environmental Quality (DEQ) submitted an analysis of $PM_{2.5}$ attainment status (Chester, 2004a) for a number of counties in the Detroit Consolidated Metropolitan Statistical Area (CMSA). The Michigan DEQ's position was that only Wayne and Monroe Counties in the Detroit CMSA should be designated as $PM_{2.5}$ nonattainment areas, and that Oakland County, as well as all other counties in the Detroit CSMA, should be designated as attainment areas for $PM_{2.5}$.[16] The DEQ's position was based primarily on air monitoring data through 2003, which showed attainment for $PM_{2.5}$ for all counties except for Wayne and Monroe. Also, the $PM_{2.5}$ data in Wayne County were compared with meteorological data, and the analysis showed that the high $PM_{2.5}$ values at two monitors in Wayne County were primarily related to southerly winds (*i.e.*, from the south), indicating that high $PM_{2.5}$ values at Wayne County monitors were caused primarily by transport of emissions from the south.

On July 29, 2004, EPA Region V presented an analysis on $PM_{2.5}$ attainment status (Mathur, 2004) for the Detroit CMSA that disagreed with the DEQ position. Although $PM_{2.5}$ monitors in Oakland County and other nearby counties have demonstrated attainment of the $PM_{2.5}$ standard of 15 $\mu g/m^3$ over the last three years, EPA Region V's position was that, in addition to Wayne and Monroe Counties, five other counties in the Detroit CMSA (Oakland, Livingston, Macomb, St. Clair, and Washtenaw Counties) should be designated as nonattainment for $PM_{2.5}$. This position was based on a number of factors which were subjectively applied, including location in the same CSMA, projected population growth, a comparison of county emissions of $PM_{2.5}$ precursors, and the possibility that transport of $PM_{2.5}$ emissions from other counties may contribute to the $PM_{2.5}$ violations in Wayne and Monroe Counties.

We have been retained by Pepper Hamilton, LLP, on behalf of Oakland County to assess the attainment status of Oakland County with regard to the National Ambient Air Quality

[16] On February 22, 2005, DEQ submitted 2004 monitoring data and amended its recommended designations to redesignate Monroe County as attainment.

Standards for $PM_{2.5}$. For this purpose, we have examined relevant documents and analyses prepared by both the DEQ and EPA Region V, and have compared detailed $PM_{2.5}$ data from Oakland County with meteorological data from Detroit City Airport.

Our analysis is focused on three of the nine factors used by USEPA to designate nonattainment areas. Section 2, which presents our analysis of the Oakland County $PM_{2.5}$ data and meteorological data, addresses both *Factor 2: Air Quality in Potentially Included Versus Excluded Areas* and *Factor 6: Meteorology*. Section 3 of our report addresses *Factor 1: Emissions in Areas Potentially Included Versus Excluded from the Nonattainment Area* and highlights the highly uncertain nature of this factor. DEQ has previously addressed these three factors, as well as the six remaining factors, and shown major flaws in the USEPA methodology. We summarize our conclusions in Section 4 of this report and provide references in Section 5.

This document was prepared by Dr. Peter Drivas and Dr. Chris Long of Gradient Corporation. The qualifications of the authors are presented in Appendix B.

V. 2 Oakland County $PM_{2.5}$ Data Analysis

A. 2.1 Monitor Location

The one $PM_{2.5}$ monitor in Oakland County is located in Oak Park, which is in the southeast corner of Oakland County and only about one mile north of the Wayne County border. The site is also located near the intersection of two major highways in the most heavily industrialized portion of the county, as shown in Figure 1. Because of its location, the Oak Park monitor will likely record the highest $PM_{2.5}$ values in Oakland County, due to nearby local sources and its proximity to Wayne County (*i.e.*, the strong possibility of transport of Wayne County emissions during the prevailing winds from the south).

Because of its location, the Oak Park monitor is essentially a "worst-case" monitor for Oakland County to determine attainment for $PM_{2.5}$. Oakland County extends approximately 30 miles in the north-south direction, and if the monitor were placed near the center of Oakland County, it would be about 15 miles from the Wayne County border instead of only one mile, and likely would record lower $PM_{2.5}$ concentrations.

Figure 1. Counties in Detroit Metropolitan Area

B. 2.2 Attainment Status

USEPA established National Ambient Air Quality Standards (NAAQS) for fine particles in 1997 that included both an annual average $PM_{2.5}$ standard of 15 $\mu g/m^3$ and a 24-hour $PM_{2.5}$ standard of 65 $\mu g/m^3$. In order to determine compliance with these standards and to designate nonattainment areas, USEPA required that three consecutive years of clean data be collected and used to calculate the 3-year average of annual arithmetic mean $PM_{2.5}$ concentrations and the 3-year average of the 98^{th} percentile of 24-hour $PM_{2.5}$ concentrations for comparison with the annual average and 24-hour $PM_{2.5}$ standards, respectively.

Table 1 below demonstrates that, despite the "worst-case" location of the county's $PM_{2.5}$ monitor, the Oakland County $PM_{2.5}$ monitoring data meet the $PM_{2.5}$ NAAQS and thus meet the definition of an attainment area. As shown in this table, both the 3-year average $PM_{2.5}$ concentrations for the years 2001-2003 and 2002-2004 (14.8 and 14.1 $\mu g/m^3$, respectively) are less than the 15 $\mu g/m^3$ standard. In addition, the 3-year average of the 98^{th} percentiles of both 2001-2003 and 2002-2004 24-hour $PM_{2.5}$ concentrations (38.1 and 36.0 $\mu g/m^3$, respectively) are well below the 24-hour $PM_{2.5}$ standard of 65 $\mu g/m^3$. The DEQ has previously demonstrated that the Oak Park monitor is in attainment for the $PM_{2.5}$ standard.

Table 1
Summary of 2001-2004 $PM_{2.5}$ Monitoring Data for Oak Park, MI

Year	Annual Ave.	3-year Annual Ave.	98th Percentile	3-year Ave. of 98th Percentiles
2001	14.70	--	39.4	--
2002	15.00	--	38.4	--
2003	14.58	14.8	36.6	38.1
2004	12.76	14.1	33	36.0

Notably, as recently highlighted in documents submitted by the DEQ (Chester, 2005), $PM_{2.5}$ levels in Southeast Michigan show a downward trend in recent years. Table 1 confirms the presence of a strong downward trend for the Oakland County $PM_{2.5}$ monitoring data. In

particular, the 2004 $PM_{2.5}$ annual average was the lowest on record for Oak Park, and the 2004 data dropped the 2002-2004 three-year average $PM_{2.5}$ concentration to 14.1 $\mu g/m^3$.

Additionally, just across the Wayne County border near the southwestern corner of Oakland County, the Livonia monitor has recorded three year averages of 14.4 $\mu g/m^3$ and 13.7 $\mu g/m^3$ for 2001-2003 and 2002-2004, respectively, thus providing additional evidence that no portion of Oakland County is contributing to nonattainment in Wayne County.

The Oakland County $PM_{2.5}$ monitoring data are thus conclusive that the county is in attainment with the $PM_{2.5}$ standard, and since the monitoring data represent a worst-case location in the county, it is clear that Oakland County should be designated as an attainment area.

C. 2.3 Impact on Wayne County

Based on analyses of meteorological data and $PM_{2.5}$ measurement data, Michigan DEQ has previously concluded that Wayne and Monroe Counties are receiving pollution from emission sources to the south. In particular, in the February 13, 2004 $PM_{2.5}$ Designation Recommendations Technical Support Document (Chester, 2004a), DEQ presented three sets of back trajectory paths corresponding to the 2002 Dearborn $PM_{2.5}$ sampling days with daily $PM_{2.5}$ concentrations of less than 15 $\mu g/m^3$, daily $PM_{2.5}$ concentrations between 28 $\mu g/m^3$ and 40 $\mu g/m^3$, and daily $PM_{2.5}$ concentrations greater than or equal to 40 $\mu g/m^3$. Back trajectory paths show the origin and path of transport of air parcels to a particular destination area. The Michigan DEQ trajectories clearly showed that the highest $PM_{2.5}$ days in the Detroit CMSA occurred when winds were from the south and southwest, indicating that counties to the north of Detroit such as Oakland County are not associated with high PM levels in Wayne County. Only for cleaner days (*i.e.*, $PM_{2.5}<15$ $\mu g/m^3$) in Wayne County were trajectories consistently from the north, indicating that the northern counties were associated with improved air quality in Wayne County.

In a September 1, 2004 document presenting comments on USEPA's proposed $PM_{2.5}$ designations for Michigan (Chester, 2004b), DEQ included pollution roses that depicted wind directions on days with higher (≥ 15 $\mu g/m^3$) and lower (<15 $\mu g/m^3$) $PM_{2.5}$ levels as measured at

the Allen Park and Dearborn monitors in Wayne County. As summarized by DEQ, these pollution roses show that $PM_{2.5}$ concentrations at the Wayne County monitors are highest when winds are from the south and southwest.

To complement the DEQ analyses and to specifically address $PM_{2.5}$ levels in Oakland County, we analyzed meteorological data on days with higher and lower $PM_{2.5}$ levels as measured at the Oak Park $PM_{2.5}$ monitor in Oakland County. For these analyses, we obtained the last five years (2000-2004) of 24-hour $PM_{2.5}$ data for the Oak Park $PM_{2.5}$ monitor from USEPA's Air Quality System (AQS).[17] With the exception of 2004 where individual 24-hour data were available only up through July 2004[18], daily $PM_{2.5}$ data at the Oak Park monitor were typically available for every three days between 2000-2004.

We obtained hourly meteorological data for the years 2000-2004 for the National Weather Service (NWS) station at the Detroit City Airport from the National Climatic Data Center (NCDC). This is the closest NWS meteorological station to the monitors in Oakland and Wayne Counties. Figure 2 shows a five-year average wind rose summarizing 2000-2004 wind speed and wind direction measurements at the Detroit City Airport. As shown in this wind rose, the most frequent winds are from the southwest quadrant, with the least frequent winds from the northeast quadrant.

[17] http://www.epa.gov/ttn/airs/airsaqs/detaildata/downloadaqsdata.htm

[18] The USEPA AQS website notes that complete 2004 data will be available by July 1, 2005.

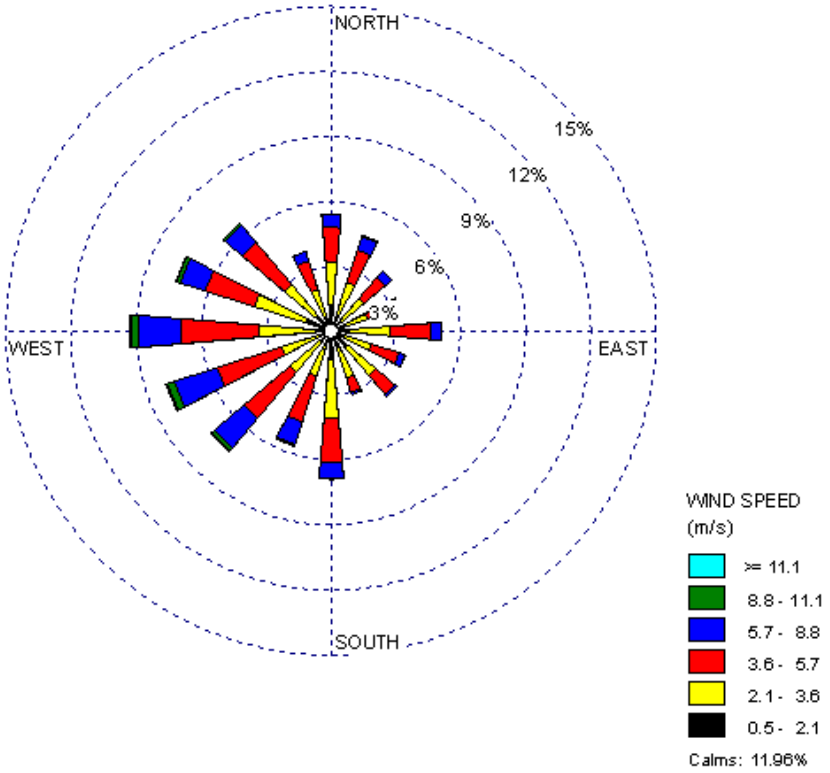


Figure 2. 2000-2004 Wind Rose for Detroit City Airport

For comparison with the daily $PM_{2.5}$ data, we calculated daily vector-averaged wind speed and directions from the hourly Detroit City Airport meteorological data. These vector-averaged calculations are described in greater detail in Appendix A. We eliminated all days without $PM_{2.5}$ data, and any days where $PM_{2.5}$ data were available but there were fewer than 12 hours of valid meteorological observations. With the exception of 2003 where eight days were eliminated due to periods of missing meteorological data, we typically only eliminated one or two days per year due to missing meteorological data.

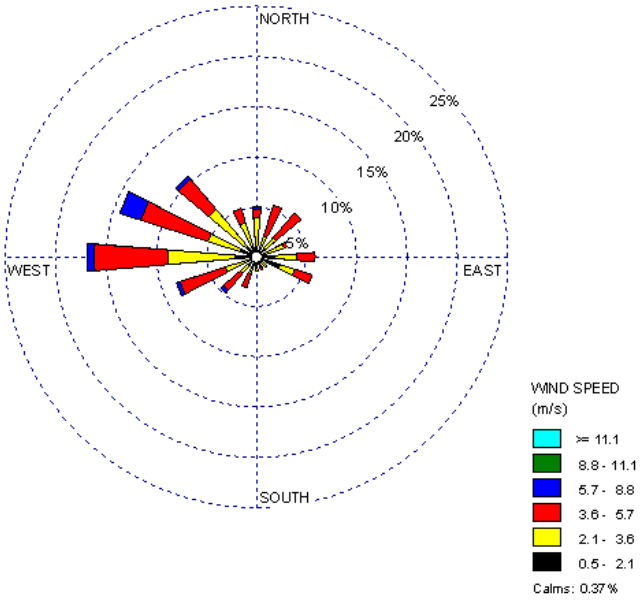
Figure 3 presents five-year average wind roses for days at the Oak Park monitor with $PM_{2.5}$ levels of less than 15 $\mu g/m^3$ (Figure 3a), and days with $PM_{2.5}$ levels greater than or equal to 15 $\mu g/m^3$ (Figure 3b). These plots clearly show that almost all the high $PM_{2.5}$ values above 15 $\mu g/m^3$ over the last five years have occurred with winds blowing from the south (*i.e.*, indicative of transport from Wayne County and other potential non-Oakland County emission sources to the south). For winds blowing from the north, which represent transport across the majority of

the Oakland County area (given that the Oak Park monitor is on the southern border of the county), $PM_{2.5}$ levels are consistently less than 15 $\mu g/m^3$.

The data are very consistent from year to year. Figures 4 through 8 show all individual 24-hour $PM_{2.5}$ data points over the last five years, with one graph per year. In Figures 4 through 8, the data have been segregated by general wind direction into "north" (blowing from the northwest and northeast quadrants) and "south" (blowing from the southwest and southeast quadrants). These figures dramatically show that significantly higher $PM_{2.5}$ measurements at the Oak Park monitor occur when winds are from the south (*i.e.*, from the direction of Wayne County). The trend is very consistent from year to year from 2000 through 2004.

Figure 9 summarizes data from Figures 4 through 8, and presents calculated annual-average $PM_{2.5}$ values at the Oak Park monitor by wind direction. Figure 9 clearly shows that when winds were blowing from the north towards Wayne County, the annual-average $PM_{2.5}$ values were less than 10 $\mu g/m^3$ for every year. Further, this plot shows that $PM_{2.5}$ levels measured at the Oak Park monitor, for winds from the north, are on average less than those from sites such as Bondville, Illinois (12.3 $\mu g/m^3$) that USEPA has selected as representative of regional background $PM_{2.5}$ levels. Thus, this analysis conclusively shows that the transport of emissions from Oakland County is not contributing to high $PM_{2.5}$ levels in Wayne County.

(a) Less than 15 μg/m^3



(b) Greater Than or Equal to 15 μg/m^3

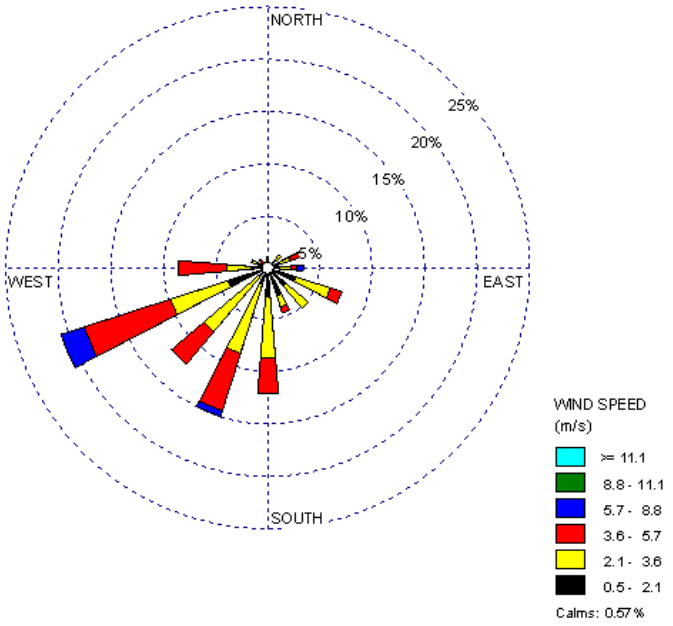


Figure 3. Wind Roses for High and Low $PM_{2.5}$ Days at Oak Park, MI: 2000-2004 Data

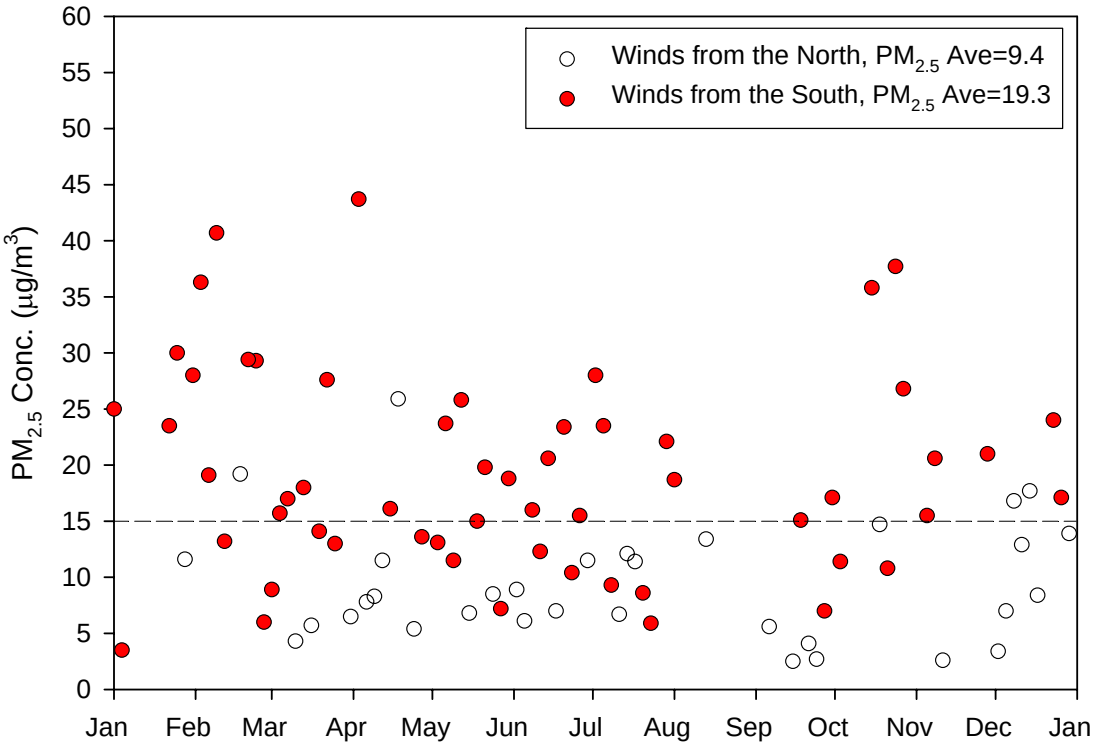


Figure 4. Daily $PM_{2.5}$ Levels at Oak Park *vs*. Daily Average Wind Direction: 2000 Data

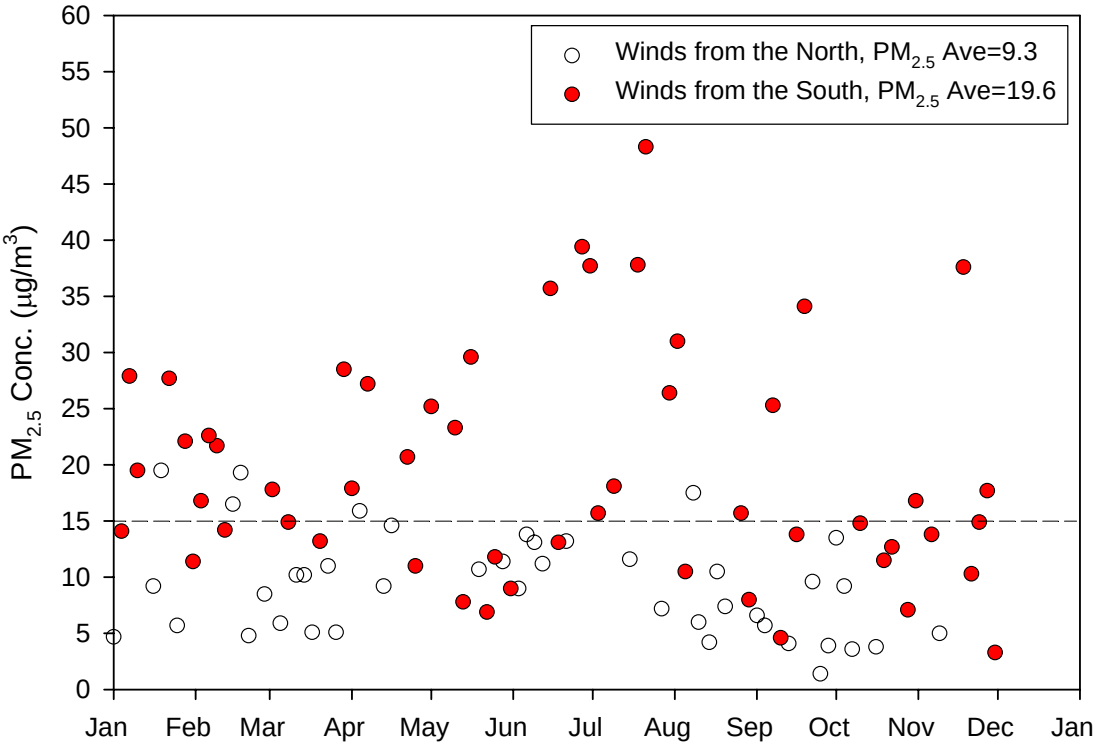


Figure 5. Daily $PM_{2.5}$ Levels at Oak Park *vs*. Daily Average Wind Direction: 2001 Data

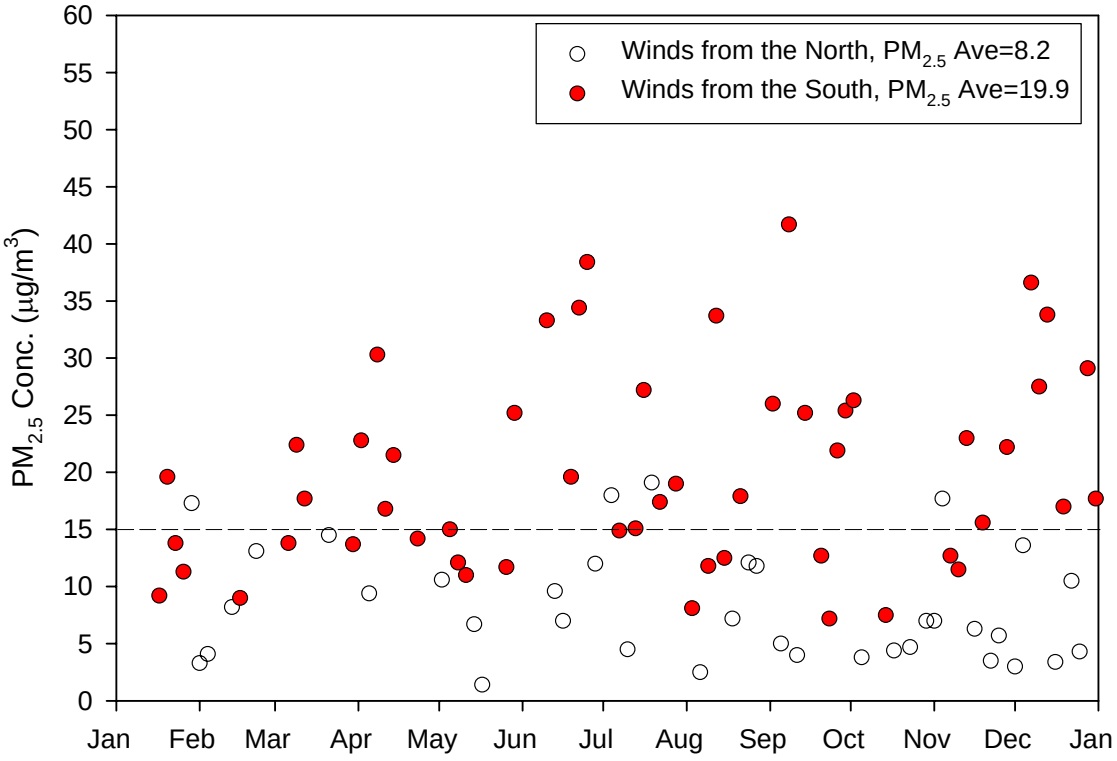


Figure 6. Daily $PM_{2.5}$ Levels at Oak Park *vs*. Daily Average Wind Direction: 2002 Data

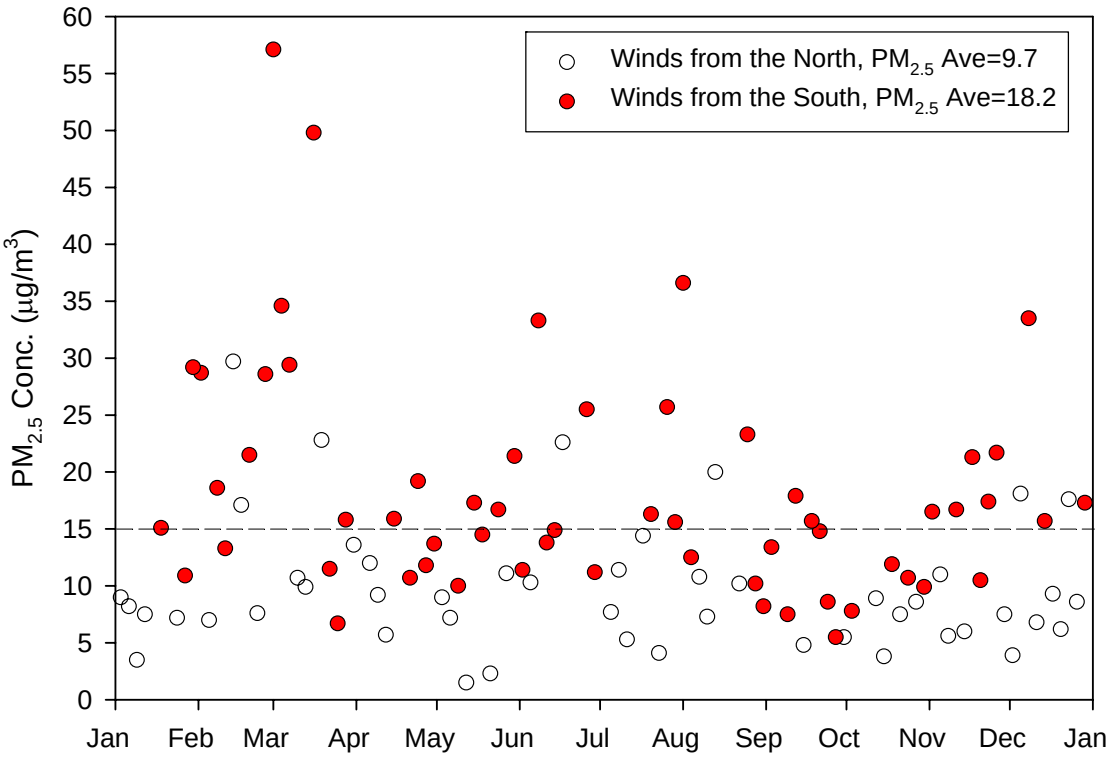


Figure 7. Daily $PM_{2.5}$ Levels at Oak Park *vs*. Daily Average Wind Direction: 2003 Data

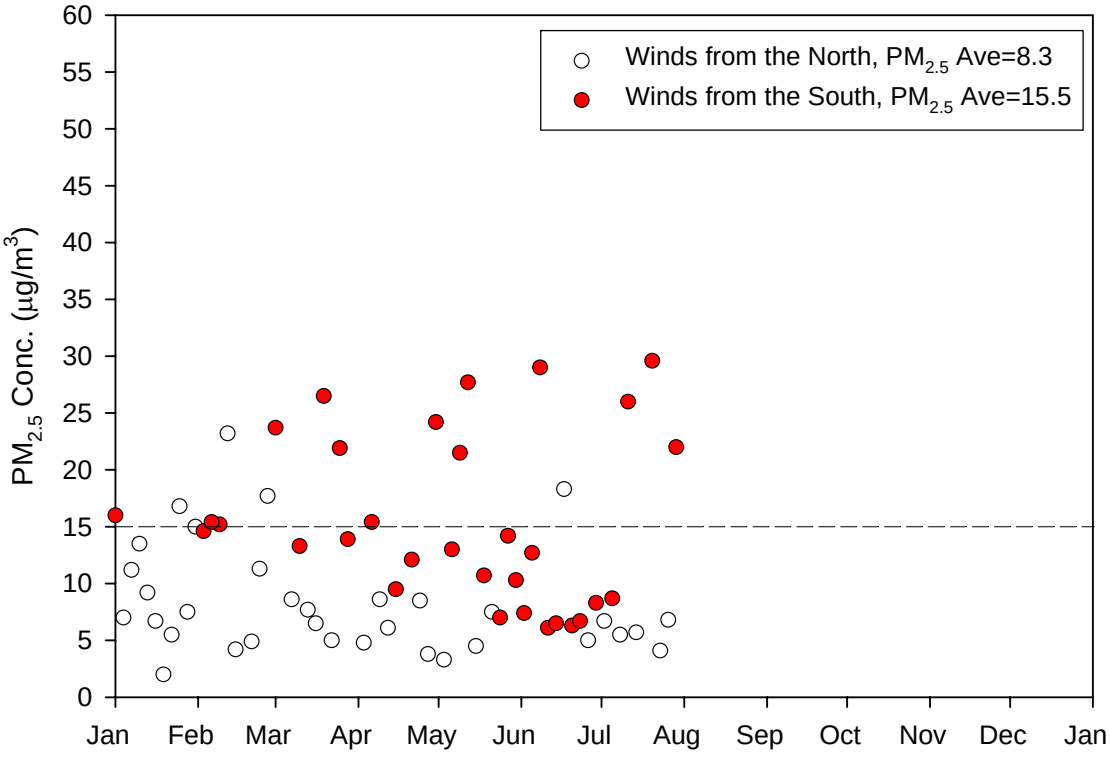


Figure 8. Daily $PM_{2.5}$ Levels at Oak Park *vs*. Daily Average Wind Direction: 2004 Data

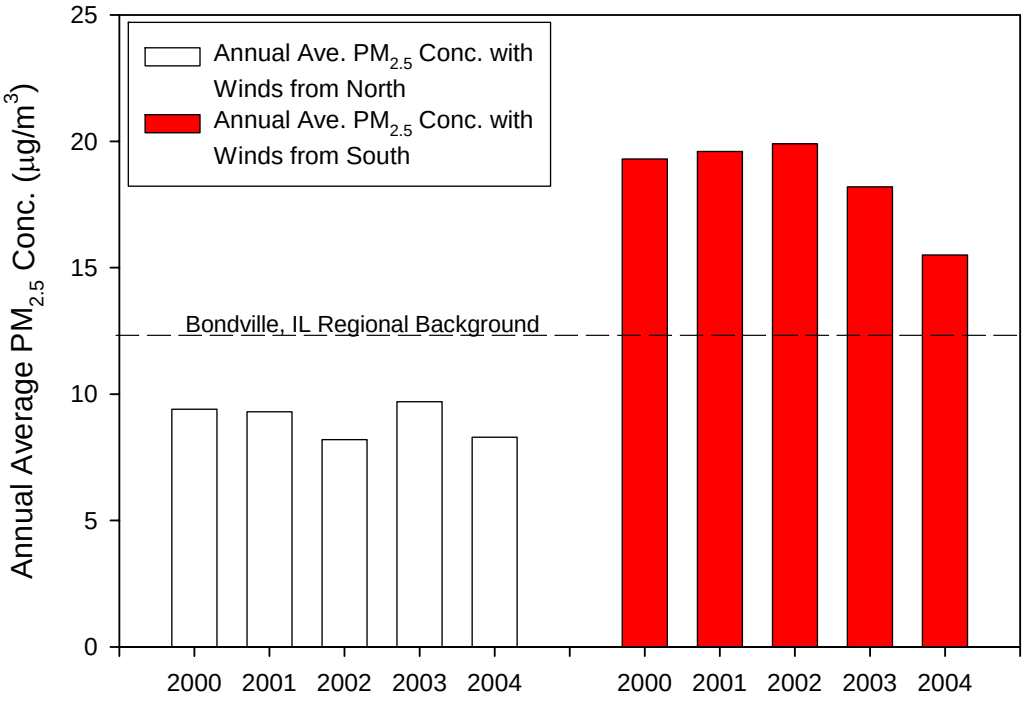


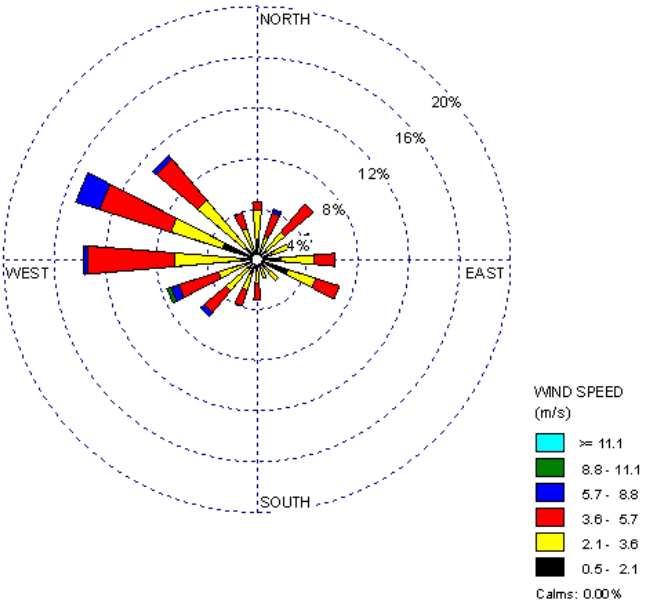
Figure 9. Summary of $PM_{2.5}$ Concentrations at Oak Park by Wind Direction

D. 2.4 Impact on Downwind Counties

To investigate whether Oakland County influences PM levels in neighboring downwind counties, particularly Macomb County directly to the east, we conducted an analogous analysis to that discussed in Section 2.3 by pairing 2000-2004 daily $PM_{2.5}$ data from the New Haven, MI monitor in Macomb County with daily averaged Detroit City Airport meteorological data. Figure 10 shows that high $PM_{2.5}$ levels in Macomb County are also associated with winds from the south and southwest, indicating that Wayne County contributes to high $PM_{2.5}$ levels in Macomb County. Winds from the direction of Oakland County (*i.e.*, winds from the west and northwest) are dominant on low $PM_{2.5}$ days, demonstrating that Oakland County does not contribute to high $PM_{2.5}$ values in neighboring Macomb County. It should be noted the New Haven monitor at Macomb County is in attainment with the $PM_{2.5}$ standard, with a 3-year average $PM_{2.5}$ value of 13.1 $\mu g/m^3$ from 2001-2003 and 12.7 $\mu g/m^3$ from 2002-2004.

The other two counties bordering Oakland County to the north (Lapeer and Genesee Counties) have been designated by EPA as attainment and thus it is presumed that Oakland County is not contributing to nonattainment in those counties.

(a) Less than 15 μg/m^3



(b) Greater Than or Equal to 15 μg/m^3

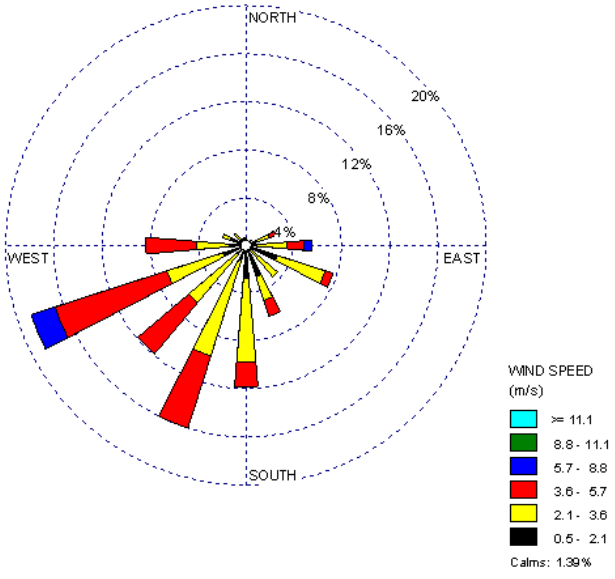


Figure 10. Wind Roses for High and Low $PM_{2.5}$ Days at New Haven, MI: 2000-2004 Data

VI. 3 Weighted Emissions Analysis

Despite the availability of monitoring data that statutorily demonstrate attainment, EPA Region V has elected to calculate what is called a "weighted emissions score" as part of the process for designating nonattainment areas for the $PM_{2.5}$ NAAQS. This is the first of nine factors (*Factor 1*) that EPA Region V used subjectively to determine Oakland County's nonattainment status. USEPA (2004) itself has acknowledged that the weighted emissions score metric has "particular uncertainties." As stated in the December 2004 *Technical Support for State and Tribal Air Quality Fine Particle ($PM_{2.5}$) Designation*, USEPA (2004) states that this metric "should be regarded simply as one way to assess multiple emissions all contributing to the 'emissions' factor identified in EPA guidance."

The weighted emissions score is determined from two primary data sources, (1) estimates of county-wide emissions of SO_2, NO_x, carbon particles, and crustal particles and (2) a measure of urban excess that reflects excess local contributions of the major $PM_{2.5}$ chemical components (sulfates, nitrates, carbon, and crustal matter) from speciation monitoring data. As defined by USEPA (2004), the weighted emissions score thus uses measured concentration data in combination with estimated county-wide emissions inventories in this calculation. This mixing and matching of measured concentration data with estimated emissions inventories contributes to the high level of uncertainty associated with this calculation.

The uncertainty associated with the pairing of measured concentration data with emissions estimates is illustrated by focusing on the use of county emissions of SO_2 and NO_x as surrogates for $PM_{2.5}$ sulfate and nitrate air concentrations. The conversion of SO_2 and NO_x emissions from point sources or area sources to sulfates and nitrates is extremely complex, and depends on the air concentrations of other pollutants, meteorology, and the travel time of the emissions from the sources to a given monitoring location. The conversion to sulfates and nitrates is primarily photochemical, and depends significantly on solar radiation and the ozone concentrations that are entrained into the air parcel containing the SO_2 and NO_x emissions. Because of the complexity of sulfate and nitrate formation, there is not a simple linear relationship between SO_2 and NO_x emission rates and the resulting sulfate and nitrate particles.

Thus, using SO_2 and NO_x emissions as surrogates for $PM_{2.5}$ concentrations introduces substantial uncertainty into the *Factor 1* analysis.

There are also uncertainties associated with the emissions inventories themselves, as they are estimated values and not actual measurement data. However, it was not possible to address emission inventory uncertainties in this report since EPA Region V does not fully document the source of the emissions estimates for carbon and crustal particles.[19] It is very unclear how the emissions inventory estimates for carbon and crustal particles were obtained, and as discussed later, the emission estimates for carbon particles are a key determinant of the weighted emissions score for Oakland County.

To calculate "urban excess", EPA Region V applied a methodology where concentrations of four $PM_{2.5}$ speciated components representative of the counties in the metropolitan area were compared to the corresponding concentrations representative of regional background levels. The difference in concentrations between the county speciation data and the regional background levels was assumed to be representative of local contributions of $PM_{2.5}$ components. Because speciation data are not available for the Oakland County $PM_{2.5}$ monitor in Oak Park, speciation data from the Allen Park monitor in Wayne County were used by EPA for assessing emissions in all counties in the Detroit CMSA, including Oakland County. Importantly, this use of speciation data from the Allen Park monitor in Wayne County to represent the speciation profile in all Detroit-CMSA counties is a potentially large source of uncertainty, especially given differences in emissions sources between the different counties.

EPA Region V chose the M.K. Goddard site in Pennsylvania as representative of regional background $PM_{2.5}$ levels in each of the counties in the Detroit metropolitan area. Little information is provided regarding the rationale for the selection of this site as representative of regional background. However, back trajectory analyses conducted by DEQ (Chester, 2004a)

[19] USEPA (2004) states that the county emissions estimates used in the Factor 1 analysis were taken from the 2001 National Emission Inventory, version 3. However, this emissions inventory could not be found on the USEPA website, nor are estimates of carbon and crustal particles typical components of USEPA emissions inventory data.

have demonstrated that air parcels in the Detroit metropolitan area rarely originate in western Pennsylvania. DEQ has previously concluded that the M.K. Goddard site was inappropriate for use in this urban excess methodology.

Based on the DEQ back trajectory analyses, Bondville, IL (southwest of Detroit) is a more appropriate site than the M.K. Goddard site in Pennsylvania to represent regional background $PM_{2.5}$ levels in the Detroit metropolitan area. The DEQ analyses of back trajectories indicate that air parcels in the Detroit CMSA frequently originate from the Bondville, IL vicinity on days of high $PM_{2.5}$ levels in Wayne County.

Table 2 compares the urban excess percentages by $PM_{2.5}$ component for the Detroit CMSA. Note that this comparison is based on 2002-2003 speciation data as provided in USEPA (2004). As shown in this comparison, the selection of a site representative of regional background has a significant impact on the speciated urban excess percentages. With the M.K. Goddard site as the regional background site, there is no urban excess of sulfates, and the majority of the urban excess is attributed to nitrates. With the Bondville site as the regional background site, the majority of the urban excess is attributed to carbon particles, with smaller percentages of nitrates and sulfates. Note that with the majority of the urban excess being attributed to carbon particles, the EPA emissions estimates for carbon particles thus play a key role in the determination of the composite emissions scores for each county. However, as discussed above, EPA did not fully document the source of the carbon particle emissions estimates.

Table 2
Urban Excess Results: M.K. Goddard, PA Site *vs*. Bondville, IL Site

	With M.K. Goddard, PA Site	With Bondville, IL Site
Total Mass Urban Excess ($\mu g/m^3$)	4.3	3.9
% Sulfates	0	17.9
% Nitrates	53.6	12.8
% Carbon Mass	42.2	69.2
% Crustal Mass	4.0	0

Notwithstanding the major flaws in the weighted emissions score methodology identified above, Table 3 demonstrates the resulting impact on the composite emissions scores for the Detroit metropolitan area counties when the Bondville, IL site is used to represent regional background. Both Table 2 and Table 3 thus illustrate the sensitivity in this metric for a change in just one of the parameters (the regional background site) employed in the calculation.

Furthermore, the composite emissions score clearly is biased by county area, since area source emissions are dependent on total county area, and area sources dominate emissions in many of the Detroit area counties (Oakland County is the largest of the Detroit-CMSA counties). It would be more appropriate to normalize emissions by county area for use in calculation of composite emissions scores, and Table 4 shows county areas and composite emissions scores when emission are normalized by area. This table again shows significant changes in composite emissions scores with a slight change in the calculation methodology.

Table 3
Composite Emission Scores: MK Goddard, PA Site *vs*. Bondville, IL Site

County	Composite Emission Scores	
	EPA (With MK Goddard, PA Site)	With Bondville, IL Site
Wayne	29.8	28.3
Monroe	15.1	17.7
Oakland	13.6	12.6
St. Clair	10.4	11.9
Macomb	9.5	8.1
Genesee	7.5	7.3
Washtenaw	5.3	5.0
Livingston	4.0	4.3
Lenawee	2.5	2.8
Lapeer	2.1	2.0

Table 4
Composite Emission Scores: USEPA Methodology *vs*. County Area Normalization

County	County Area (sq. miles)	Composite Emission Scores[1]	
		USEPA	With Normalization by County Area
Wayne	614.2	29.8	23.7
Monroe	551.1	15.1	18.7
St. Clair	724.4	10.4	11.6
Oakland	872.5	13.6	11.5
Macomb	480.4	9.5	8.2
Genesee	639.6	7.5	7.8
Washtenaw	709.9	5.3	5.8
Livingston	568.4	4.0	5.3
Lenawee	750.5	2.5	4.1
Lapeer	654.2	2.1	3.2

[1]*Both sets of composite emission scores use the MK Goddard, PA site as the regional background site.*

In conclusion, the weighted emissions score clearly is an uncertain and imperfect metric for assessing $PM_{2.5}$ attainment status. It is based on a number of highly uncertain assumptions, including the relationship between measured speciation data and emissions estimates. Uncertainties are introduced by assuming that there is a simple linear relationship between SO_2 and NO_x emission rates and the resulting sulfate and nitrate particles. In addition, the EPA calculation for the Detroit-area CMSA also relies upon speciation data from a single monitor in Wayne County (*i.e.*, the Allen Park monitor) to represent the speciation profiles in all other Detroit-CMSA counties despite large differences in emission sources between the different counties.

The overall lack of credibility of this metric has been demonstrated by showing significant impacts on the composite emissions scores with slight changes in the calculation methodology. Importantly, this metric does not provide any information on whether local $PM_{2.5}$ contributions in counties such as Oakland County have any impacts on concentrations in the portions of Wayne County where monitor violations have been observed. Our analyses presented in Section 2 specifically addressed the transport and impacts of local emissions in Oakland County, and they conclusively demonstrated that the transport of emissions from Oakland County is not contributing significantly to the exceedances of the $PM_{2.5}$ standard or nonattainment in the neighboring counties that include Wayne County and Macomb County.

VII. 4 Conclusions

Our analysis of the available evaluations of $PM_{2.5}$ attainment status and detailed $PM_{2.5}$ and meteorological data strongly supports a designation of $PM_{2.5}$ attainment for Oakland County, for the following main reasons:

1. The one $PM_{2.5}$ monitor in Oakland County is located in Oak Park, which is in the southeast corner of Oakland County and only about one mile north of the Wayne County border. The site is also near the intersection of two major highways and is in the most heavily industrialized portion of the county. This monitoring location will likely record the highest $PM_{2.5}$ values in Oakland County, due to nearby local sources and its proximity to Wayne County emissions.
2. Even with this "worst-case" location in Oakland County, the $PM_{2.5}$ monitor at Oak Park is currently in attainment for $PM_{2.5}$, with a 3-year average $PM_{2.5}$ concentration less than 15 $\mu g/m^3$ for the years 2001-2003 and 2002-2004. EPA Region V concurs with the Michigan DEQ that the Oak Park monitor is in attainment for the $PM_{2.5}$ standard.
3. Oakland County does not contribute to Wayne County nonattainment based on an analysis of $PM_{2.5}$ and meteorological data. Specifically, when the Oak Park $PM_{2.5}$ data are compared with local meteorological data, almost all the high $PM_{2.5}$ values above 15 $\mu g/m^3$ over the last five years have occurred with winds blowing from the south (*i.e.*, indicative of transport from Wayne County and other potential emission sources to the south). This trend is very consistent from year to year.
4. When winds are blowing from the north towards Wayne County, the annual-average $PM_{2.5}$ values at the Oak Park monitor were very low, less than 10 $\mu g/m^3$ for every year. These $PM_{2.5}$ values are less than those at rural regional background locations. Thus, the transport of emissions from Oakland County is not contributing to $PM_{2.5}$ violations in Wayne County. Our analysis also demonstrated that winds from the direction of Oakland County are dominant on low $PM_{2.5}$ days in neighboring Macomb County, demonstrating that Oakland County also does not contribute to high $PM_{2.5}$ values in this county.
5. EPA Region V's nonattainment position for Oakland County is based primarily on subjective factors, such as the county emissions of $PM_{2.5}$ precursors. These factors can vary widely depending on the data sources, and techniques such as "weighted emissions score" are highly uncertain and depend strongly on the choice of a regional background monitoring location, and can not be reasonably used in making a determination of attainment status.

The use of actual $PM_{2.5}$ monitoring data and meteorological data should take precedence over any subjective factors that contain high uncertainty. The actual $PM_{2.5}$ data and meteorological factors strongly support a designation of $PM_{2.5}$ attainment for Oakland County.

5 References

Chester, S.E. 2004a. Letter from Steven E. Chester, Michigan DEQ to Thomas V. Skinner, EPA Region V, dated February 13, 2004.

Chester, S.E. 2004b. Letter from Steven E. Chester, Michigan DEQ to Bharat Mathur, EPA Region V, dated September 1, 2004.

Chester, S.E. 2004c. Letter from Steven E. Chester, Michigan DEQ to Bharat Mathur, EPA Region V, dated November 30, 2004.

Chester, S.E. 2005. Letter from Steven E. Chester, Michigan DEQ to Bharat Mathur, EPA Region V, dated February 22, 2005.

Mathur, B. 2004. Letter from Bharat Mathur, EPA Region V to Honorable Governor Jennifer M. Granholm, Governor of Michigan, dated July 29, 2004.

U.S. Environmental Protection Agency (USEPA). 2004. *Technical Support for State and Tribal Air Quality Fine Particle ($PM_{2.5}$) Designation.* Office of Air Quality Planning and Standards, Integrated Policy and Strategies Group, Research Triangle Park, NC. December.

APPENDIX A

VECTOR-AVERAGED WIND SPEED AND DIRECTION

To compare with the 24-hour average individual $PM_{2.5}$ data, a vector-average wind direction and wind speed must be calculated over the same 24-hour period. This is a standard meteorological procedure that calculates a resultant wind direction from hourly wind direction data, weighted by the wind speed for each hour.

From a sequence of N observations of wind direction (θ_i) and wind speed (U_i), the mean east-west (V_e) and north-south (V_n) vector components of the wind are:

$$V_e = -\frac{1}{N}\sum_{i=1}^{N} U_i \sin(\theta_i)$$

$$V_n = -\frac{1}{N}\sum_{i=1}^{N} U_i \cos(\theta_i)$$

The resultant vector-average wind direction (θ_{ave}) and wind speed (U_{ave}) are:

$$\theta_{ave} = \arctan\left(\frac{V_e}{V_n}\right)$$

$$U_{ave} = \sqrt{V_e^{\,2} + V_n^{\,2}}$$

APPENDIX B

QUALIFICATIONS OF AUTHORS

Peter J. Drivas, Ph.D.
Principal Consultant

Dr. Drivas has over 20 years experience in the fields of air quality modeling, pesticide drift, reactive chemical modeling, hazardous spill assessments, and indoor air pollution. He has managed numerous air quality and multimedia modeling programs; has been an expert witness on air quality modeling; and has developed many innovative environmental models, which can predict ozone and photochemical smog formation, soil gas infiltration from buried liquid chemicals into houses, evaporation from oil spills, and the consequences of hazardous spills of toxic materials. He is an expert on numerous Agency-approved and industry standard models including ISC, CALPUFF, AERMOD, RPM-IV, PLUVUE-II, and others. He has published two books and over 30 technical articles in the environmental field.

Practice Areas & Expertise:

Air Quality Modeling
Emission Source Characterization
Soil-Gas Modeling
Chemical Engineering Processes
Accidental Releases

Education:

Ph.D., Chemical Engineering, California Institute of Technology
M.S., Chemical Engineering, Massachusetts Institute of Technology
B.S., Chemical Engineering, Massachusetts Institute of Technology

Christopher M. Long, Sc.D.
Senior Project Manager

Dr. Long is an environmental health scientist with experience in the areas of exposure assessment, indoor air pollution, human health risk assessment, and statistical data analysis. Dr. Long has several years consulting experience in the risk assessment field. At Gradient, Dr. Long has been involved in fate and transport analyses, litigation support, and exposure modeling. Prior to joining Gradient, Dr. Long completed his doctorate in environmental science and engineering at the Harvard School of Public Health. While at Harvard, Dr. Long conducted a comprehensive study investigating the sources and toxicity of indoor particulate matter in residential homes. He received a U.S. EPA graduate fellowship for this work, and he is first author on several recent papers on indoor and outdoor particulate matter.

Practice Areas & Expertise:

Indoor/Outdoor Air Quality
Airborne Toxicants
Exposure Assessment/Modeling
Human Health Risk Assessment
Epidemiology

Education:

Sc.D., Environmental Science & Engineering, Harvard School of Public Health
M.S., Environmental Engineering, MIT
A.B., Chemistry and Environmental Studies, Bowdoin College

20 University Road
Cambridge, MA 02138
617-395-5000

Peter J. Drivas, Ph.D.
Principal Consultant

Areas of Expertise

Air quality modeling, chemically reactive pollutants, accidental releases, multi-media modeling, chemical process analysis, visibility, indoor air pollution, program management.

Education

Ph.D., Chemical Engineering, California Institute of Technology, 1974.

S.M. and S.B., Chemical Engineering, Massachusetts Institute of Technology, 1970.

Professional Experience

1996 – present GRADIENT CORPORATION, Cambridge, MA
Principal Consultant. Chief scientist for air quality modeling, multi-media modeling, indoor air modeling, hazardous spill assessments, modeling of reactive pollutants, emissions characterization, and chemical process analysis.

1989 – 1996 GRADIENT CORPORATION, Cambridge, MA
Principal. Chief scientist for air quality modeling practice, hazardous spill assessments, modeling of reactive pollutants, and chemical process analysis. Director of multi-media modeling, emissions characterization, and indoor air pollution studies.

1983 – 1989 THERMO ELECTRON CORPORATION, Waltham, MA
Environmental Director. Consultant to all Thermo Electron divisions on air quality monitoring and modeling, including the use of EPA dispersion models, photochemical models, and hazardous spill models.

1982 – 1983 ENERGY RESOURCES COMPANY, La Jolla, CA
Principal Scientist. Directed development of accidental release models and managed air quality modeling activities related to permitting. Designed fluidized bed reactors to minimize emissions.

1979 – 1981 ENVIRONMENTAL RESEARCH & TECHNOLOGY, Concord, MA
Senior Consultant. Directed air quality modeling studies, including the use of EPA UNAMAP and photochemical models for permitting of new sources. Developed visibility degradation models for compliance with PSD regulations.

1975 – 1978 PACIFIC ENVIRONMENTAL SERVICES, Santa Monica, CA
Manager, Atmospheric Modeling Division. Responsible for model development, group management, and business development. Project manager for environmental permitting and research studies, including ozone and mobile source modeling.

1974 – 1975 CALIFORNIA INSTITUTE OF TECHNOLOGY, Pasadena, CA
Research Fellow. Studied indoor air pollution and infiltration rates in buildings by means of a tracer gas technique.

Professional Activities

- Chairman of AWMA national technical committee on accidental releases.
- Expert witness testimony experience for air quality modeling topics.
- Author of approximately 30 journal articles, books, and conference presentations.

Professional Affiliations

American Institute of Chemical Engineers, Consultant to Environmental Division • Air and Waste Management Association, Chairman of AT-4 Accidental Release Committee • American Chemical Society • American Meteorological Association

Projects

Martin Marietta Energy Systems: Technical consultant on reactive chemistry modifications to the HGSYSTEM model to account for UF_6 chemistry and thermodynamics. The chemistry involved UF_6 flashing to a mixture of vapor and solid particles if accidentally released, reacting with water vapor to form HF and UO_2F_2, and the HF continuing to react with water vapor. UF_6 chemistry and thermodynamic algorithms were combined with the HF chemistry and algorithms in HGSYSTEM. The solutions were obtained by solving a set of 14 simultaneous differential equations involving chemistry, dispersion, and thermodynamics.

American Institute of Chemical Engineers, Center for Chemical Process Safety: Co-authored a guideline book describing the latest techniques to calculate the source emissions, transport, and dispersion of hazardous vapor clouds. Source emission techniques that were described included gas and liquid jet releases, pool evaporation, pipeline breaks, and cryogenic releases. Topics included two-phase flow, reactive components, and calculation of multi-component releases.

State of Alaska, Department of Environmental Conservation: Managed study to evaluate health and environmental impacts on animals and plants in Prince William Sound, Alaska, caused by hydrocarbon evaporative emissions from the Exxon Valdez oil spill. Developed evaporative emission model for individual air toxics such as benzene, toluene, and xylene from oil spills. Air concentrations resulting from the evaporative emissions were used to assess the risk of adverse environmental impacts in the vicinity of Prince William Sound.

Amoco Corporation: Managed study to determine impacts of a proposed chemical plant expansion on ozone concentrations and visibility in a nearby national park, in support of a Prevention of Significant Deterioration (PSD) operating permit. A reactive plume model was used to evaluate ozone concentrations, and a visibility screening technique was used to determine the worst-case visibility impairment caused by the plant emissions.

Browning-Ferris Industries: Developed a health risk exposure assessment of stack emissions from a proposed medical waste incinerator. Estimated emission rates of possible hazardous substances released into the air from the incinerator stack, including metals, dioxins, furans, acid gases, pathogens, hydrocarbons, and radioisotopes. Conducted air dispersion modeling using the ISCST model for five years of meteorological data to predict short-term and long-term concentrations and resulting health risks at nearby resident receptor sites.

State of California, Air Resources Board: Managed an improved emission inventory for oil production and refining emission sources in the San Joaquin Valley in California, for use as input to a photochemical grid model. All available emission factor models and equations applicable to oil production facilities and refineries were reviewed and compared, and an estimate was made of the statistical accuracy of the most appropriate emission factor. Hydrocarbon emissions were apportioned into individual chemical species for use in photochemical modeling.

Major Oil Company: Developed a mathematical model for the prediction of air quality concentrations resulting from the accidental releases of hazardous components. A new algorithm was developed for multicomponent evaporation from a liquid spill mixture. Also, techniques for calculating the evaporation heat balance were evaluated, and a method was developed to determine the phase partitioning of boiling compounds.

Insurance Company: Directed scientific investigation into historical chemical manufacturing and waste disposal processes. Relevant patents and process flow sheets were reviewed to determine the basic process chemistry and the amount and type of waste material created. Based on the process chemistry, chemical reaction calculations were performed to determine the composition of the waste stream by-products.

Thermo Electron: Developed a mathematical model to predict evaporation and transport of pollutants at high temperatures through porous media. The model included the effects of cylindrical as well as rectangular geometry, considered the addition of a layer that inhibits diffusion, and included the effects of variable pore size and geometry in the porous medium.

EPA Region II: Evaluated potential human risks due to implementation of recommended remedial actions at a hazardous waste site. Calculated emissions and air concentrations resulting from five different remedial activities, including soil excavation, incineration, site capping, and sediment dredging. Exposure and resulting health risks due to emission of PCB vapors and dust were examined using EPA-recommended air quality dispersion and deposition models.

Major Chemical Company: Developed an innovative model for evaluating the air emissions from buried hazardous waste material, resulting in a presentation at the 1990 Air and Waste Management Association meeting. The new model showed that typical techniques used to calculate buried waste emissions may overpredict air concentrations by an order of magnitude. Conducted air quality dispersion modeling to estimate downwind exposures and concentrations.

Browning Ferris Industries: Investigated air quality issues associated with the expansion of a landfill in Minnesota. Calculated the air exposures of nearby populations to potential releases of air toxics emissions from the site by using EPA-recommended air quality models. Investigated the effects on the air quality modeling results of variability in terrain, year-to-year changes in site meteorology, and the use of rural vs. urban dispersion coefficients.

Law Firm: Developed a general indoor air pollution model that can predict indoor concentrations, as a function of time, of gases, particulates, or fibers such as asbestos. A Gaussian puff dispersion model was combined with a flow field and general building decay parameters for a comprehensive model of indoor air transport and dispersion of a point source of emissions.

General Electric: Provided chemical process analysis development for the manufacture of a solid-state energy conversion device. Developed time and temperature process parameters for manufacturing, both theoretically and experimentally, and calculated chemical formation and degradation rates as a function of temperature.

Government of China: Trained representatives from Beijing and Lanzhou, China, on the theory, operation, and practical application of Gaussian and photochemical air quality models. Developed a microcomputer version of the OZIPM-2 photochemical model to determine ozone control strategies in China.

Consortium of Oil Companies: Developed numerical modeling techniques for predicting the air quality impact of spills of cryogenic materials from storage tanks and pipelines, and two-phase (gas and liquid) flow from high-pressure liquid pipelines. A comprehensive modeling system was developed for handling any type of hazardous spill.

U.S. Department of Energy: Designed a fluidized bed combustion reactor to minimize air pollutant emissions of SO_2 and NO_x. A numerical model was developed to calculate fluid flow, mixing, and chemical reactions inside a fluidized bed reactor, and the results of the calculations were used to guide pilot plant experimental development.

Texaco: Managed the successful air quality permitting of an expansion of oil production operations in California. Met with state and local representatives and conducted emissions and air dispersion modeling to demonstrate compliance with current regulations.

Consolidated Edison of New York: Directed the successful air quality permitting of a change in power plant fuel from oil to coal, involving very detailed air dispersion modeling that considered "street canyon" effects in New York City. Also, developed environmental and economic analyses of currently available and possible future types of burners and control equipment for reducing pollutants from coal-fired power plants.

State of Maine, Department of Environmental Protection: Developed a liquid spill evaporation model to predict time-dependent multicomponent air pollution concentrations resulting from oil spills. Results of the model were used to analyze the health risks to residents near a liquid spill waste facility.

Northern Tier Pipeline Company: Developed an improved visibility degradation model, and used this model to predict the impact of a proposed marine terminal on visibility impacts in Washington's Olympia National Park. Ten scenic views, selected by the National Park Service, were modeled to determine the amount of visibility impairment due to emissions from the proposed marine terminal.

EPA, Office of Air Quality Planning and Standards: Directed a major atmospheric tracer study to develop basic experimental data on dispersion in complex terrain. Dual atmospheric tracers (SF_6 and Freon-11) were released from different heights over a small hill with over 50 sampling locations. Responsible for the experimental analysis and database development for thousands of air samples. Results from this study were used to develop EPA's Complex II air quality model.

Aluminum Association: Managed a comprehensive SF_6 tracer study at an aluminum plant to develop basic experimental data for the line-source type of releases characteristic of aluminum plants. Results from this study were used to develop EPA's Buoyant Line and Plume (BLP) model.

EPA, Region I: Used the city-specific version of the OZIPP photochemical model to estimate hydrocarbon emission reductions necessary to attain the ozone air quality standard in Massachusetts, Connecticut, and Rhode Island. The city-specific ozone model was run with the specific UV intensity, transported ozone, dilution rate, and emission parameters for each of five major urban areas to determine the emission reductions necessary in each area to attain the ozone standard.

EPA, Office of Air Quality Planning and Standards: Developed procedures for the acquisition and compilation of emission information into the form required for input into photochemical air quality simulation models. Emission methods were applicable to both grid and trajectory photochemical models. Techniques were developed for obtaining the necessary spatial and temporal resolution, and for segregating hydrocarbon emissions into the reactive species required by the photochemical model.

State of Arizona, Highway Department: Used a photochemical trajectory model to analyze the impact on ambient ozone levels of a proposed new highway in Phoenix. Nine worst-case air trajectories were modeled that would maximize the ozone impact of the new highway in major residential communities in and near Phoenix. The highway was built after our study concluded that there would be only minor ozone impacts.

Zinc Galvanizing Company: Directed an emissions monitoring and air quality dispersion modeling study for a zinc galvanizing facility in Los Angeles. The basic galvanizing process was studied to determine emission parameters, stack testing was conducted, and the emission results were used as input to an air quality model. Provided expert witness testimony on emissions and air modeling.

United Airlines: Performed an air quality dispersion modeling study for a proposed United Airlines food waste incinerator at Los Angeles International Airport. Provided expert witness testimony on air quality modeling and the impact of the incinerator on nearby residents. The incinerator was successfully permitted and is currently operating.

ASARCO: Monte Carlo air modeling and risk assessment at operating smelter.

Publications & Presentations

Brody, J.G., D.J. Vorhees, S.J. Melly, S.R. Swedis, P.J. Drivas, and R.A. Rudel. 2002. "Using GIS and Historical Records to Reconstruct Residential Exposure to Large-Scale Pesticide Application." *Journal of Exposure Analysis and Environmental Epidemiology*, 12: 64-80.

Drivas, P.J., P.A. Valberg, B.L. Murphy, and R. Wilson. 1996. " Modeling Indoor Air Exposure from Short-term Point Source Releases." *Indoor Air* 6:271-277.

Valberg, P.A., P.J. Drivas, S.M. McCarthy, and A.Y. Watson. 1996. "Evaluating the Health Impacts of Incinerator Emissions." *J. Hazardous Material*, 47:205-227.

Hanna, S.R., P.J. Drivas, and J.C. Chang. 1996. *Guidelines for Use of Source Emissions and Atmospheric Dispersion Models for Accidental Releases.* Center for Chemical Process Safety, American Institute of Chemical Engineers, New York.

Drivas, P.J. 1995. "A Review of Source Emission Models for Accidental Releases." Paper No. 95-TP54A.03. *Proceedings: The 88th Annual Meeting of the Air and Waste Management Association*, San Antonio, TX, June 19-23.

McCarthy, S.M., P.J. Drivas, and R.J. Yamartino. 1994. "The Design and Evaluation of Oil Production Emission Database Files for Input to the SARMAP Modeling System." *Proceedings: Regional Photochemical Measurement and Modeling Studies Conference*, San Diego, CA, November 8-12.

Murphy, B.L. and P.J. Drivas. 1993. "Migration of Volatile Contaminants into Buildings." *Proceedings: Eighth Annual Conference on Contaminated Soils*, Amherst, MA.

Drivas, P.J., K. Raabe, L.C. Daly, and L.K. Zuke. 1993. "Air Toxics Modeling of Excavation and Landfilling Activities." Paper 93-RA-114A.03, 86th Annual Air and Waste Management Association Meeting, Denver, Co.

Hanna, S.R. and P.J. Drivas. 1993. "Modeling VOC Emissions and Air Concentrations from the Exxon Valdez Oil Spill." *Journal of the Air and Waste Management Association*, 43:298-309.

Drivas, P.J., B.L. Murphy, and P.A. Valberg. 1992. "Exposure Modeling of Indoor Sources of Particulates or Fibers." *Proceedings: Society for Risk Analysis - 1992 Annual Meeting*, San Diego, CA.

Drivas, P.J., P.A. Valberg, and T.D. Gauthier. 1991. "Health Assessment of Air Toxics Emissions from Alternative Fuels." Paper 91-107.6, 84th Annual Air and Waste Management Association Meeting, Vancouver, BC.

Drivas, P.J. and L.C. Daly. 1991. "Calculation of Evaporative Emission Rates of Air Toxics from a Multicomponent Liquid Spill." Paper 91-84.7, 84th Annual Air and Waste Management Association Meeting, Vancouver, BC.

Drivas, P.J. 1991. "Validation of Hazardous Spill Emission Models." Invited Paper, International Conference and Workshop on Mitigating the Consequences of Accidental Releases of Hazardous Materials, New Orleans.

Drivas, P.J., A.P. Toole, and S.C. Gnewuch. 1990. "The Effects of Global Warming and Increased UV Radiation on Urban Ozone Concentrations." Paper 40C, American Institute of Chemical Engineers, Summer National Meeting, San Diego, CA.

Drivas, P.J., D.H. Bass, and B.L. Murphy. 1990. "Atmospheric Emissions from Buried Hazardous Waste." Paper 90-74.4, 83rd Annual Air and Waste Management Association Meeting, Pittsburgh, PA.

Hanna, S.R., and P.J. Drivas. 1987. *Guidelines for Use of Vapor Cloud Dispersion Models.* Center for Chemical Process Safety, American Institute of Chemical Engineers.

Drivas, P.J. 1986. "Two-dimensional Resistance Analysis in a Thermoelectric Multicouple." *Proceedings: 21st Intersociety Energy Conversion Engineering Conference*, San Diego, CA, pp. 1353-1356.

Drivas, P.J. 1985. "Prediction of Multicouple Performance." *Proceedings: Fifth Working Group Meeting on Thermoelectrics*, Pasadena, CA.

Drivas, P.J., J.S. Sabnis, and L.H. Teuscher. 1983. "Simulation of Pipeline and Tank Storage Failures." *Oil and Gas Journal*: 162-169 (September).

Drivas, P.J. 1982. "Calculation of Evaporative Emissions from Multicomponent Liquid Spills." *Environmental Science and Technology*, 16:726-728.

Heinold, D.W., P.J. Drivas, D.A. Hansen, and T.F. Lavery. 1982. "Acid Rain Impact Assessment: From Stack to Stream." *Proceedings: AMS/APCA Third Joint Conference on Applications of Air Pollution Meteorology*, San Antonio, TX.

Drivas, P.J. and D.W. Heinold. 1981. "Visibility Impact Analysis of a Marine Oil Terminal." *Proceedings: Fifth Symposium on Turbulence, Diffusion, and Air Pollution*. Atlanta, GA.

Drivas, P.J., A. Bass, and D.W. Heinold. 1981. "A Plume Blight Visibility Model for Regulatory Use." *Atmospheric Environment* 15:2179-2184.

Drivas, P.J., K.H. Wilson, and L.W. Wayne. 1979. "A Case Study: Use of City-Specific EKMA in Massachusetts, Connecticut, and Rhode Island." *Proceedings: Specialty Conference on Ozone/Oxidants*, Houston, TX.

Drivas, P.J. 1978. "Emission Inventory Requirements for Photochemical Air Quality Simulation Models." *Proceedings: Specialty Conference on Emission Factors and Inventories*, Anaheim, CA.

Wayne, L.W. and P.J. Drivas. 1978. "Sensitivity of the Empirical Kinetic Modeling Approach to Input Data and Local Conditions." Paper 78-72.2, 71st Annual APCA Conference, Houston, TX.

Drivas, P.J. and L.W. Wayne. 1977. "Sensitivity Tests of a Lagrangian Photochemical Air Quality Simulation Model." Paper 78-10.3, 71st Annual APCA Conference, Houston, TX.

Drivas, P.J., M. Chan, and L.W. Wayne. 1977. "Validation of an Improved Photochemical Air Quality Simulation Model." *Proceedings: AMS/APCA Joint Conference on Applications of Air Pollution Meteorology*, Salt Lake City, UT.

Drivas, P.J. 1976. *Emissions from Hot-Dip Galvanizing Processes.* EPA Report No. EPA-905/4-76-002, USEPA, Region V, Chicago, IL. Available as Document PB251910, U.S. Dept. of Commerce, National Technical Information Service, Springfield, VA. March.

Drivas, P.J. 1975. "On the Measurement of Ambient Halogenated Hydrocarbons." *Proceedings: Caltech Air Quality Symposium*, Pasadena, CA.

Drivas, P.J. and F.H. Shair. 1974. "Probing the Air Flow Within the Wake Downwind of a Building by Means of a Tracer Technique." *Atmospheric Environment* 8:1165-1175.

Drivas, P.J. and F.H. Shair. 1974. "A Tracer Study of Pollutant Transport and Dispersion in the Los Angeles Area." *Atmospheric Environment* 8:1155-1163.

Griffith, G.A., P.J. Drivas, and F.H. Shair. 1974. "An Inexpensive Remote Sequential Air Sampler." *Journal of the Air Pollution Control Association* 24:776-777.

Drivas, P.J. and F.H. Shair. 1974. "Dispersion of an Instantaneous Crosswind Line Source of Tracer Released from an Urban Highway." *Atmospheric Environment* 8:475-484.

Drivas, P.J., P.G. Simmonds, and F.H. Shair. 1972. "Experimental Characterization of Ventilation Systems in Buildings." *Environmental Science and Technology* 6:609-614.

Patent

Shair, F.H., P.G. Simmonds, R.B. Leighton, and P.J. Drivas. 1975. "Technique and System for Coding and Identifying Materials."

20 University Road
Cambridge, MA 02138
617-395-5000

Christopher M. Long, Sc.D.
Environmental Scientist
clong@gradientcorp.com

Areas of Expertise

Public health and exposure assessment, with expertise in indoor/outdoor air pollution and particulate matter; air dispersion modeling; epidemiology; human health risk assessment; risk communication; statistical data analysis.

Education

Sc.D., Environmental Science & Engineering, Harvard School of Public Health, 2000.

M.S., Environmental Engineering, Massachusetts Institute of Technology, 1995.

A.B., Chemistry and Environmental Studies, *summa cum laude*, Bowdoin College, 1993.

Professional Experience

2000 – Present GRADIENT CORPORATION, Cambridge, MA
Senior Project Manager. Evaluate human exposure and health effects of environmental pollutants, specializing in airborne gases and particles. Investigate indoor and outdoor air quality problems, and perform air dispersion and exposure modeling. Conduct human health risk assessments and worker safety evaluations, and review and interpret epidemiological and toxicological studies. Prepare technical analyses, expert reports, and risk communication materials.

1997 – 2000 HARVARD SCHOOL OF PUBLIC HEALTH, Boston, MA
Research/Teaching Assistant. Designed and conducted indoor air particle characterization study of nine Boston-area homes. Also served as teaching assistant for two graduate courses: Seminar in Risk Analysis, Management, and Communication and Air Pollution: Particles and Gases.

1995 – 1997 MENZIE-CURA & ASSOCIATES, INC., Chelmsford, MA
Environmental Scientist/Risk Assessor. Conducted human health and ecological risk assessments for state and federal hazardous waste sites. Modeled fate and transport of organic and inorganic contaminants in all environmental media. Responsibilities also included project management, proposal writing, and litigation support. Participated in environmental site assessments and field sampling activities of aquatic and terrestrial habitats. OSHA-certified 40-hour training.

1993 – 1995 MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, MA
Research Assistant. Conducted research in trace organic pollutant laboratory. Modeled the fate and transport of sewage-derived linear alkylbenzenes (LABs) in the Gulf of Maine.

1992 NASA GODDARD SPACE FLIGHT CENTER, Greenbelt, MD
Research Assistant. Selected as summer intern in Summer Institute on Atmospheric and Hydrospheric Sciences; worked with atmospheric scientists in GSFC's Atmospheric Chemistry and Radiation Branch. Used a photochemical box model to explore the potential for ozone depletion in the Northern Hemisphere stratosphere at middle and low latitudes.

Professional Activities

- Invited technical peer reviewer for the *Journal of the Air & Waste Management Association*, *Environmental Science & Technology*, *Environmental Health Perspectives*, and *Journal of Exposure Analysis and Environmental Epidemiology*.

Awards/Honors

- U.S. EPA STAR Graduate Fellow, 1998-2000
- *Phi Beta Kappa*
- Student abstract/presentation award at 1999 ISEA/ISEE Annual Conference in Athens, Greece

Professional Associations

American Chemical Society (ACS) • International Society of Exposure Analysis (ISEA) • Air & Waste Management Association (AWMA) • Boston Risk Analysis Group

Projects

State of Maine: Assisted in the development of a trial guideline for protecting residents from inhalation exposure to indoor petroleum vapors released from home fuel oil spills. Wrote indoor sampling guidance.

Metropolitan District Commission (MDC): Performed mass balance calculations for mercury in Wachusett and Quabbin Reservoirs. Conducted extensive literature review on environmental Hg cycling. Wrote technical report.

Private Client: Provided technical analysis of fate and transport of zinc and fluoride emissions in subsurface environment for an aluminum manufacturing facility. Evaluated fluoride toxicity to aquatic organisms and livestock and developed ambient water quality criteria based on U.S. EPA guidelines.

Law Firm: Reviewed extensive body of epidemiological studies of ozone health effects and helped develop technical document for litigation support.

Private Client: Managed and conducted MCP Method 3 risk characterizations for a chain of Massachusetts gas stations. Contaminants of interest included BTEX and MTBE. Modeled indoor air concentrations and collected indoor VOC samples using Summa canisters to validate model findings. Conducted wetland sampling and performed screening-level ecological risk assessments

Private Client: Wrote scope of work, managed, and performed MCP Method 3 human health risk assessment for a former electronics manufacturer with subsurface dissolved-phase chlorinated hydrocarbon contamination. Indoor air modeling performed using vapor intrusion model. Risk to town drinking water wells assessed.

Private Client: Developed risk-based soil cleanup levels for BTEX and PAH compounds at a site with pervasive asphalt contamination. Provided technical support during site remedial actions.

Massachusetts Bays Program: Assisted in a project designed to quantify point and nonpoint sources of nitrogen to Massachusetts harbors and coastal embayments and to evaluate the potential for eutrophication. Delineated watersheds and subwatersheds using topographic maps.

ASTM Committee E-50: Authored sections on chemical properties and contaminant behavior in ASTM Standard Provisional Guide for Risk-Based Corrective Action (PS 104-98).

Private Client: Performed U.S. EPA screening-level ecological risk assessments for two former submarine manufacturing facilities. Extensive list of contaminants of concern including metals, PAHs, and PCBs.

Publications

Long, C.M. and J.A. Sarnat. 2003. Assessing Indoor-Outdoor Relationships and Infiltration Behavior of Elemental Components of Ambient PM2.5. Manuscript submitted to Aerosol Science & Technology.

Sarnat, J.A., C.M. Long, P. Koutrakis, B.A. Coull, J. Schwartz, and H.H. Suh. 2002. Using Sulfur as a Tracer of Outdoor Fine Particulate Matter. *Environ. Sci. Technol.* 36: 5305-5314.

Long, C.M., H.H. Suh, L Kobzik, P.J. Catalano, Y. Ning, and P. Koutrakis. 2001. A Pilot Investigation of the Relative Toxicity of Indoor and Outdoor Fine Particles: In-vitro Effects of Endotoxin and Other Particulate Properties. *Environ. Health Perspect.* 109: 1019-1026.

Long, C.M., H.H. Suh, and P. Koutrakis. 2001. Using Time- and Size-Resolved Particulate Data to Quantify Penetration and Deposition Behavior. *Environ. Sci. Technol.* 25: 2089-2099.

Gustafsson, Ö, C.M. Long, J. MacFarlane, and P.M. Gschwend. 2001. Fate of Linear Alkylbenzenes (LABs) Released to the Coastal Environment near Boston Harbor. *Environ. Sci. Technol.* 25: 2040-2048.

Long, C.M., H.H. Suh, and P. Koutrakis. 2000. Characterization of indoor particle sources using continuous mass and size monitors. *J. Air & Waste Manage. Assoc.* 50: 1236-1250.

Menzie, C.A., J.S. Freshman, and C.M. Long. 1997. Developing Environmentally Acceptable Endpoints for Soil Based on Ecological Considerations. In *Proceedings for the Air & Waste Management Association's 90th Annual Meeting & Exhibition, Toronto, Ontario,* June 8-13.

Presentations

Long, C.M. and B.D. Beck. 2002. An Evaluation of Potential Human Exposures to Trace Metals and Radionuclides in Construction and Building Materials Containing Coal Combustion Products. Poster presentation at 2002 International Society of Exposure Assessment (ISEA)/International Society of Environmental Epidemiology (ISEE) Annual Conference, Vancouver, August 11-15, 2002.

Long, C.M., H.H. Suh, and P. Koutrakis. 2001. Understanding Indoor Exposures to Ambient Particulate Matter: Estimates of Penetration Efficiencies and Deposition Rates for Residential Homes. Poster Platform Presentation at the 2001 Society for Risk Analysis Annual Meeting, Seattle, WA, December 2-5, 2001.

Sarnat, J.A., C.M. Long, P. Koutrakis, and H.H. Suh. 2001. Evaluating Tracers of Ambient $PM_{2.5}$. Platform Presentation at the ISEA 2001 Conference, Charleston, SC, November 4-8, 2001.

Long, C.M., H.H. Suh, and P. Koutrakis. 2000. Using Time- and Size-resolved Particulate Data to Investigate Infiltration and Deposition Behavior. Platform presentation at the ISEA 2000 Conference, Monterey Peninsula, CA, October 24-27.

Long, C.M., H.H. Suh, and P. Koutrakis. 2000. Using Time- and Size-resolved Particulate Data to Investigate Infiltration and Deposition Behavior. Platform presentation at the AWMA PM2000 Specialty Conference, Charleston, SC, January 24-28.

Long, C.M., H.H. Suh, and P. Koutrakis. 2000. Characterization of Indoor Particle Sources Using Continuous Mass and Size Monitors. Poster presentation at the AWMA PM2000 Specialty Conference, Charleston, SC, January 24-28.

Long, C.M., H.H. Suh, and P. Koutrakis. 1999. Characterization of Indoor Particulate Source Strengths Using Continuous Mass and Size Monitors. Platform presentation at 1999 Annual ISEE/ISEA Conference, Athens, Greece, September 5-8.

Bernays, W.H., D.J. Vorhees, C.M. Long, and P. Eremita. 1997. Trial Guideline for Protecting Residents from Inhalation Exposure to Petroleum Vapors. Poster presentation at 1997 Annual Meeting of the Society for Risk Analysis, Washington, DC, December 7-10.

Invited Talks

Long, C.M. and J.A. Sarnat. 2003. Infiltration Behavior of $PM_{2.5}$ Chemical Components: Implications for Exposure Assessment and Epidemiological Associations. Platform Presentation at the Particulate Matter: Atmospheric Sciences, Exposure and the Fourth Colloquium on PM and Human Health, Pittsburgh, PA, March 31-April 4, 2003.