

*City of Alexandria, Virginia*

**MEMORANDUM**

DATE: MAY 10, 2004  
TO: THE HONORABLE MAYOR AND MEMBERS OF CITY COUNCIL  
FROM: PHILIP SUNDERLAND, CITY MANAGER  
SUBJECT: MIRANT POTOMAC RIVER POWER PLANT

---

**ISSUE:** As a follow up to the City Council Work Session on March 31, 2004, consideration of issues related to Mirant Potomac River Power Plant ("Plant").

**RECOMMENDATION:** That City Council:

- (1) Adopt the following as City policy and long-term goal with respect to the Mirant Potomac River Power Plant: that the Plant and its coal-fired, power-generation operations are not compatible with the Council's long-term vision for Alexandria, from both an environmental and land use perspective, and, accordingly, the City's policy and long-term goal is that all Plant operations cease and all Plant facilities be removed from Alexandria.
- (2) Adopt the following as City policy and short-term goal with respect to the Mirant Potomac River Power Plant: that the Plant will operate in as safe and clean a manner as is both feasible and attainable, including in the context of its stack emissions, fugitive dust emissions, coal deliveries and coal-handling operations, and that the Plant will comply with all applicable federal and state air quality and other regulations without the trading or purchasing of pollution credits that do not directly produce significant air quality benefits to Alexandria.
- (3) Approve the following City policy with respect to the permit expected to be issued for the Mirant Potomac River Power Plant in the near future by the Virginia Department of Environmental Quality (DEQ) and with respect to any consent agreement entered by DEQ and Mirant based on emissions violations at the Plant during the summer of 2003: that any required upgrades or changes to the pollution control equipment at the Plant, and any required new control equipment, will be consistent with the following conditions:
  - a. that the upgraded, changed or new equipment will reduce significantly the emissions of pollutants from the Plant;
  - b. that the upgraded, changed or new equipment will not, directly or indirectly, have any substantial negative consequences on air quality in Alexandria or on the quality of life in the City and, in particular, in areas near the Plant; and
  - c. that the investments in the upgraded, changes or new equipment are not of such a magnitude that they may cause the life of the Plant to be substantially extended, in conflict with City's long term goal in paragraph (1) above;

- (4) Approve the following City position with respect to the permit expected to be issued for the Mirant Potomac River Power Plant in the near future by DEQ and with respect to any consent agreement entered by DEQ and Mirant based on emissions violations at the Plant during the summer of 2003:
- a. support installation of SOFA (an emissions control technology, "Separate Over Fired Air," designed to reduce NO<sub>x</sub> (nitrogen oxide) emissions) on Units 3, 4, and 5, in combination with phase out of Units 1 and 2; alternatively, support installation of SOFA on all units;
  - b. oppose any permit provisions that allow emissions trading or purchase of emissions credits for meeting emissions limits at the Plant that do not directly produce significant air quality benefits to Alexandria;
  - c. oppose control technologies that require the introduction and use of ammonia at the Plant;
  - d. support and seek additional controls at fly-ash handling facilities at the Plant to address fugitive dust issues;
  - e. support and seek improvements to coal and coal dust handling facilities at the Plant;
  - f. request DEQ to undertake a comprehensive modeling exercise or air monitoring program to determine the impact of the Plant's emissions on ambient air quality in habitable spaces near the Plant, on the ground, in high rise buildings and in the community;
  - g. support and seek funding of supplemental environmental projects as part of any penalties Mirant will pay as a result of the Plant's 2003 (and other) violations;
  - h. continue to engage state and federal regulators concerning enforcement issues related to Mirant; and
  - i. obtain increased DEQ monitoring and inspections at the Plant to ensure compliance with permit conditions.

**DISCUSSION:** At the City Council work session on March 31, we discussed three of the more troublesome emissions from the Mirant Plant: oxides of nitrogen (NO<sub>x</sub>), which contribute to the summer ozone problems in the Washington, D.C., region; large particulate matter (PM 10), which contribute to the dust and grime experienced in the nearby neighborhoods; and smaller particulates less than 2.5 microns in diameter (PM2.5), which are increasingly associated in the literature with human health issues. With respect to the PM2.5 emissions, Dr. Robert Levy participated in the work session via phone from Boston, and reviewed the report he had prepared for the City.

Following the work session, staff have undertaken a number of actions relating to the Mirant Plant. These are summarized below.

**State Operating Permit.** DEQ is currently in the process of issuing a new operating permit to Mirant for its Potomac River Plant. The permit will place limitations on the Plant for NO<sub>x</sub>. A hearing on the permit was held at the Lee Center on April 12. The City submitted written comments to DEQ on this proposed operating permit for the Mirant Plant, a copy of which is attached (Attachment 1).

All of the Metropolitan Washington Area is in severe non compliance with the Ozone Standards in summer months. The City, being part of the region, should support the provisions of Severe Area State Implementation Plan (SIP) for Northern Virginia and the metropolitan Washington area. The proposed state operating permit is the enforcement mechanism to limit the NOx emissions from the Mirant Plant and to achieve significant NOx reductions during the ozone season. The City supports the NOx emissions limit in the proposed permit.

In order for the Plant to achieve the proposed NOx limits, pollution controls will have to be implemented. Pollution controls measures range in their efficiency, and types of process, and capital investment. Because of the concerns of their impacts on the immediate neighborhood, and the City at large, control measures that required the use of ammonia (including potential ammonia slips, transport and storage of the ammonia) are not supported by the staff. Instead, we recommend supporting control measures that will lower NOx emissions without the introduction of ammonia and without other significant negative impacts. Thus, the staff comment to DEQ was that the City would support the installation of SOFA (Separate Over Fired Air) on boiler Units 3, 4, and 5 at the Plant, in combination with a specifically defined and scheduled phase out of Units 1 and 2. This would result in a significant reduction of NOx emissions consistent with the non-attainment SIP. Alternatively, staff stated support for the installation of SOFA on all five units. The draft permit under review on April 12 did not permit Mirant to use emissions trading or the purchase of emissions credits to meet the permit's NOx requirements.

DEQ is still considering the new Mirant operating permit. We are not certain when a new permit will be issued. However, as noted below, we are soon to meet with DEQ and will discuss the City's interests in the permit and its position regarding the Plant at that time.

Downwash. In response to the Community's concerns about the impacts to the immediate neighborhood from potential downwash from Plant stack emissions, staff has requested that DEQ, before taking final action on the permit or pursuant to a condition expressly set out in the permit, undertake or require Mirant to undertake a comprehensive modeling exercise or air monitoring program to determine the impact of the facility's emissions on ambient air quality in habitable spaces on the ground, in nearby high rise buildings and in the community in the immediate vicinity of the plant. Although Mirant is required to comply with host of state and federal regulations, it was never required to do a comprehensive modeling study to evaluate impacts on nearby ambient air quality. By tying the NOx issue with the comprehensive modeling need, staff hopes that DEQ will conduct or require Mirant to conduct or fund such an analysis.

Fugitive and Coal Dust. In response to concerns of neighborhood citizens regarding the impacts of the fugitive dust on their health and welfare, both in our comments and in discussions apart from the proposed permit, staff has requested that DEQ require Mirant, as a condition of the permit or any consent order regarding the Plant, to implement "best available control technologies" for particulate control at the Plant's coal handling and storage, and its coal and fly-ash unloading, facilities. An example of such technology would be the installation of a negative air pressure air handling system with filtration in buildings with operations that result in fugitive dust. These measures will help with neighborhood concerns without being in conflict with the City's long term goal.

Notice of Violation. Last year, DEQ issued a Notice of Violations (NOV) to Mirant arising from its NOx emissions during the summer of 2003. DEQ is currently in negotiations with Mirant concerning this NOV and how Mirant will comply with the NOx emissions limitations in a new permit. Staff has asked DEQ to consult with the City before any final decisions on a consent order are made. DEQ has agreed, and a meeting is being scheduled. Staff has urged DEQ that any penalties resulting from the NOV and negotiated as part of a consent order be used to fund additional local mitigation measures in Alexandria that reduce pollution locally. Staff has also requested that such penalties include (and not, in any sense, be limited to) all economic savings that Mirant has accrued as a result of its non-compliance (past and current) with applicable NOx and other emissions limits. Such penalty funding could be used to provide additional controls on coal and fly-ash handling facilities at the plant and to reduce harmful emissions from other sources in Alexandria.

Small Particulate Matter. In response to community's concerns related to health impacts and PM 2.5, Dr. Jonathan Levy of Harvard School of Public Health was commissioned by the City to evaluate the PM 2.5 issues and its impact on air quality and health of the City residents. Dr. Levy presented his findings to the City Council at the March 31 work session. The report has since been finalized, and a copy is attached (Attachment 2). A meeting with the Environmental Policy Commission, which of course is open to the public, is being planned where Dr. Levy will present his report and findings to the commission and public. As discussed at the work session with Council, the report provides important facts about the level and contributions of Mirant to PM2.5 levels in the City and on the health impacts of these contributions in Alexandria.

At the City's request DEQ has conducted limited special monitoring for PM2.5 and total PM for approximately three months at the Health Department at 517 North Saint Asaph Street, in the immediate neighborhood of the plant, less than 7 city blocks away from Mirant. The data collected found P.M. 2.5 concentrations in the City to be similar to those found throughout Northern Virginia. These results are consistent with the modeling and findings of Dr. Levy's Study of the City.

**FISCAL IMPACT:** The City is responsible for the normal administrative costs associated with these efforts.

**ATTACHMENTS:**

1. City of Alexandria Comments letter to DEQ on Draft State Operating Permit
2. Report: *Analysis of Particulate Matter Impacts for the City of Alexandria, Virginia*, Dr. Jonathan Levy

**STAFF:**

Richard Baier, P.E., Director, T&ES  
Dr. Charles Konigsberg, M.D, Director, Alexandria Health Department  
William J. Skrabak, Division Chief, Environmental Quality, T&ES



*City of Alexandria, Virginia*

**Department of  
Transportation and Environmental Services**

P. O. Box 178 - City Hall  
Alexandria, Virginia 22313



April 12, 2004

Director  
Office of Regulatory Development  
Department of Environmental Quality  
629 East Main Street  
P.O. Box 10009  
Richmond, VA 23240

Re: City of Alexandria Comments on the Draft State Operating Permit and impending negotiations to resolve Notice of Violations for Mirant, Potomac River Generating Station located at 1400 N. Royal Street Alexandria, Virginia

Dear Sir:

This letter is in response to the Public Hearing Notice and request for comments concerning the proposed state operating permit for the Mirant, Potomac River Generating Station located at 1400 North Royal Street in the City of Alexandria. The following comments are on behalf of the City of Alexandria.

The City of Alexandria is a member of the Metropolitan Washington Air Quality Committee and supported the adoption of the Severe Area State Implementation Plan (SIP) for Northern Virginia and the metropolitan Washington area. This revision to the SIP, because of U.S. EPA rule called the "NOx SIP Call", requires that the emissions of oxides of nitrogen (NOx) from the Mirant Potomac River plant in Alexandria be limited to an average rate of 0.15 pounds per million Btu of heat input resulting in a NOx cap of 1,019 tons during the ozone season from May through September. The proposed state operating permit is the enforcement mechanism to limit the NOx emissions from Mirant Potomac River plant and achieve significant NOx reductions during the ozone season. The City strongly supports the NOx emission limit in the proposed permit.

However, the City has a number of concerns regarding this plant and its emissions, and requests that these concerns be addressed in the ways outlined below.

The City is concerned about how the NOx emission reductions required by the new permit will be achieved at the Potomac River Generating Plant. The current draft permit does not permit trading or the purchase of credits from reductions at other facilities. The City strongly supports this provision and opposes any use of trading or credit purchases to achieve compliance. The

City would support the installation of SOFA (Separate Over Fired Air) on Units 3, 4, and 5, in combination with a specifically defined and scheduled phase out of Units 1 and 2. This would result in a significant reduction of NOx emissions. Alternatively, the City would support installation of SOFA on all units, 1 through 5, as long as the NOx emissions limit is met through reduced energy production at this facility and not through trading or credit purchases.

The City of Alexandria is a densely populated urban area and is opposed to the installation at the Potomac River Generating Plant of any pollution control methods, such as SCR (Selective Catalytic Reduction) and SNCR (Selective Noncatalytic Reductions), that would require the use of ammonia in the process, potentially causing ammonia slip from stacks and potentially worsening primary particulate problems in the City. The City is also opposed to these control methods because of the significant safety issues raised by the transport, handling and storage of large quantities of ammonia that would be required at the facility. As a result, the City requests that it be consulted before any final decisions on control technologies that will be installed by Mirant are decided.

The City and the Alexandria community also are concerned about the impacts of this facility's NOx and other emissions on ambient air quality in Alexandria and the health of community residents. A particular concern is the potential impact on air quality and health of the short stacks of Mirant's Alexandria facility on nearby high rise buildings, and the potential for down wash in the community. The City requests that VDEQ, either before taking final action on this permit or pursuant to a condition expressly set out in any issued permit, undertake or require Mirant to undertake, a comprehensive modeling exercise or air monitoring program to determine the impact of the facility's emissions, including but not limited to NOx, on ambient air quality in habitable spaces on the ground, in nearby high rise buildings and in the community in the immediate vicinity of the plant.

The City also is concerned about fugitive dust emissions as the result of the operations at Mirant Potomac River plant. The City has consistently received complaints concerning fugitive dust emissions leaving the Mirant facility from the coal pile, and as a result of coal unloading and fly-ash loading operations, and landing in the immediate neighborhood. The City believes that current state regulations regarding fugitive dust emissions are not adequate for an urban community such as Alexandria where a large scale coal-fired power plant is located practically in the heart of a residential neighborhood. VDEQ's own analysis shows that particulates, including coal dust, are leaving the Mirant site, and make up to 50% of the dirt and dust found in the nearby neighborhood. The City requests that Mirant be required, as a condition of this permit or any consent order issued to or regarding this facility, to implement best available control technologies for particulate control at this facility for coal handling and storage and for coal and fly-ash unloading operations. An example of such technology would be the installation of a negative air pressure air handling system with filtration in buildings with operations that result in fugitive dust. This would go a long way in reducing fugitive emissions. This also would help allay the concerns of the neighborhood citizens regarding the impacts of the fugitive dust on their health and welfare.

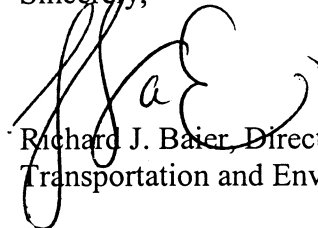
Another major concern is Mirant's failure to comply with the existing state operating permit, issued in 2000, which limits the NOx emissions from the Mirant Potomac River plant during the

ozone season. VDEQ issued a Notice Of Violation (NOV) to Mirant on September 10, 2003, for failing to meet these emissions limits in the 2003 ozone season. It is the City's understanding that VDEQ is currently in negotiations with Mirant concerning the NOV and how Mirant will comply with the NOx emissions limitations in a new permit. The results of these negotiations will have long-term impacts in Alexandria and on our residents. Therefore, the City requests that it be consulted before any final decisions on a consent order are made.

The City urges that any penalties resulting from the NOV and negotiated as part of a consent order be used to fund additional local mitigation measures in Alexandria that reduce pollution locally. The City also urges that such penalties include (and not, in any sense, be limited to) all economic savings that Mirant has accrued as a result of its non-compliance (past and current) with applicable NOx and other emissions limits, and that Mirant will accrue in future years as a result of its ability to continue operations at the Potomac River plant without installation of best available control technology. Such penalty funds could be used to provide additional controls on coal and flyash handling facilities at the plant and to reduce harmful emissions from other sources in Alexandria.

The City appreciates the opportunity to submit these comments. If there are any questions concerning these comments, please contact William Skrabak, Chief, Division of Environmental Quality, at 703-838-4334.

Sincerely,



Richard J. Baier, Director  
Transportation and Environmental Services

cc: The Honorable Mayor and Members of the City Council  
Philip Sunderland, City Manager  
William Skrabak, Chief, Division of Environmental Quality  
Robert Burnley, Director, VDEQ  
Jeffery A. Steers, Regional Director, NRO, VDEQ

**EXECUTIVE SUMMARY: Analysis of Particulate Matter Impacts for the City of Alexandria, Virginia**

Jonathan Levy, Assistant Professor of Environmental Health and Risk Assessment, Harvard School of Public Health

This report provides a detailed look at the influence of five power plants on air pollution and health in Alexandria, based on a previously published regional analysis. The focus is on fine particulate matter (PM<sub>2.5</sub>), since studies have shown that respiratory and cardiovascular health are affected by PM<sub>2.5</sub> at current outdoor levels in Alexandria.

We modeled sulfur dioxide (SO<sub>2</sub>), nitrogen dioxide (NO<sub>2</sub>), and directly-emitted (primary) PM<sub>2.5</sub> emissions from Benning, Chalk Point, Dickerson, Possum Point, and Potomac River. We considered both current emissions and what the plants would emit if Best Available Control Technology were used.

The Potomac River plant contributes about 0.2-0.6 µg/m<sup>3</sup> of PM<sub>2.5</sub> in Alexandria (where outdoor levels are about 13-15 µg/m<sup>3</sup>). The variation within Alexandria is mostly from primary PM<sub>2.5</sub>, since the secondary particulate matter (formed from SO<sub>2</sub> and NO<sub>2</sub> emissions) is more uniform across the city. The maximum impact of the Potomac River plant occurs in Washington, about 4 km from the plant.

When we consider all five power plants together, they contribute about 0.6-1.1 µg/m<sup>3</sup> of PM<sub>2.5</sub> in Alexandria. The five power plants contribute about 2.3 deaths, 0.7 cardiovascular hospital admissions, and 1.2 pediatric asthma emergency room visits per year within Alexandria. This is about 1% of the total regional impacts, given that only 0.2% of the regional population is found in Alexandria. If Best Available Control Technology were used, it would eliminate 1.7 deaths, 0.5 cardiovascular hospital admissions, and 0.9 pediatric asthma emergency room visits per year in Alexandria (31% of which are related to Potomac River).

Interpretation of these findings is complex. Although much of the PM<sub>2.5</sub> in Alexandria would remain if these emission controls were implemented, the Potomac River plant is likely the single largest contributor to PM<sub>2.5</sub> in Alexandria. It is also clear that emission control decisions must consider regional impacts if total public health benefits are a concern, but must also evaluate local impacts to ensure that populations are not disproportionately impacted. Our findings cannot provide a definitive policy recommendation, in part because we did not consider control costs and did not conduct detailed near-source modeling necessary to fully understand spatial patterns. However, this report provides some information about the relative importance of local and regional power plants for air pollution in Alexandria, which can be used to inform future policy decisions.



## Analysis of Particulate Matter Impacts for the City of Alexandria, Virginia

Jonathan Levy, Assistant Professor of Environmental Health and Risk Assessment, Harvard School of Public Health

### Background

In 2002, I published an analysis with colleagues at Harvard School of Public Health that evaluated the public health benefits associated with hypothetical emission reductions at five power plants in the Washington, DC area (Levy *et al.*, 2002a). This publication documented the impacts that emission controls at these five power plants would have on fine particulate matter (PM<sub>2.5</sub>) levels in the region, and estimated the associated health benefits (including reduced premature deaths, hospital admissions for cardiovascular disease, and emergency room visits for pediatric asthma).

Since that work was completed, there has been interest in a more comprehensive understanding of the implications of the study for the City of Alexandria, Virginia. Alexandria is home to the Potomac River power plant, one of the five plants studied in our analysis, and there are obvious questions about the magnitude of benefits in Alexandria associated with emission controls at Potomac River. There are also broader questions about how these benefits compare with the benefits from controlling other pollution sources, including the other four power plants we studied and other sources of PM<sub>2.5</sub>.

In this report, I attempt to provide more detailed information aimed at helping citizens and decision makers in Alexandria to appropriately interpret the results of our study and make the best public policy decisions possible. I first provide some general background about PM<sub>2.5</sub> in and around Alexandria and about the five power plants we studied. I then estimate the contribution of the Potomac River power plant to concentrations in Alexandria and across the region, and I compare this with the contributions from the other four power plants studied. I calculate the health impacts of each power plant within the City of Alexandria, and estimate the benefits of applying emission control technology. I conclude with a general discussion of the implications of these findings.

It is important to state upfront that the evidence in this report does not by itself imply that any specific policy decisions should be made, in part because I only consider a subset of the pertinent questions. For example, the costs or feasibility of controls are not addressed, nor are the full array of impacts from the plants. This report does not provide specific policy recommendations, but rather aims to provide quantitative, science-based evidence that can be used to inform decisions.

## What is PM<sub>2.5</sub>, and why are we concerned about it in Alexandria?

Before discussing the findings of our study, it is worth providing some basic background about the air pollutant of interest – fine particulate matter (PM<sub>2.5</sub>). Although other air pollutants influence public health, our study (and the findings reported below) only addresses the impacts of PM<sub>2.5</sub>.

The formal definition of particulate matter is any solid or liquid substance suspended in the air. It therefore includes a large number of different constituents, of different sizes and different chemical composition. Particulate matter is often described by its size, considering all different constituents together. PM<sub>2.5</sub> refers to the fraction of particles that are less than 2.5 µm in diameter (there are one million µm in a meter). This is a definition of interest because particles this size are best able to travel to the lower portions of the lung, and would be most likely to contribute to health effects.

Particulate matter can exist in one of two basic forms. It can either be directly emitted from a source, or it can be created through chemical reactions in the atmosphere. Directly emitted particulate matter, like fly ash or carbon particles from diesel vehicles, is known as primary particulate matter. Particulate matter formed through chemical reactions, like sulfate and nitrate particles formed due to sulfur dioxide (SO<sub>2</sub>) and nitrogen oxide (NO<sub>x</sub>) emissions, is known as secondary particulate matter. I will use these terms throughout the report.

Fine particulate matter (PM<sub>2.5</sub>) is of interest in this context for two major reasons. First, there has been extensive health evidence linking PM<sub>2.5</sub> with a variety of adverse health impacts, including respiratory symptoms, hospitalizations for respiratory or cardiovascular disease, and premature mortality. The evidence supporting this relationship is too extensive to discuss in detail here, but some of the major studies are referenced in our article (Levy *et al.*, 2002a), and many others are documented in the US EPA Criteria Document (US Environmental Protection Agency, 2003a).

For the purpose of this report, an obvious question is whether PM<sub>2.5</sub> in Alexandria would be expected to contribute to public health impacts. To answer this question, we need to know two things: what is the composition and concentration of PM<sub>2.5</sub> in Alexandria, and does the health evidence show that this level of PM<sub>2.5</sub> has health implications?

Regarding the first question, I am not aware of detailed assessments of the PM<sub>2.5</sub> composition in Alexandria itself, but analyses based in the Washington, DC region are informative about general concentration patterns. Speciated PM<sub>2.5</sub>

data are available at <http://www.epa.gov/air/oagps/pm25/analysis.html> for a site in Washington, DC and for a site in Richmond, VA. Figure 1 depicts the composition of PM<sub>2.5</sub> at these two sites on an annual average basis.

Figure 1: Composition of PM<sub>2.5</sub> in Richmond, VA and Washington, DC.

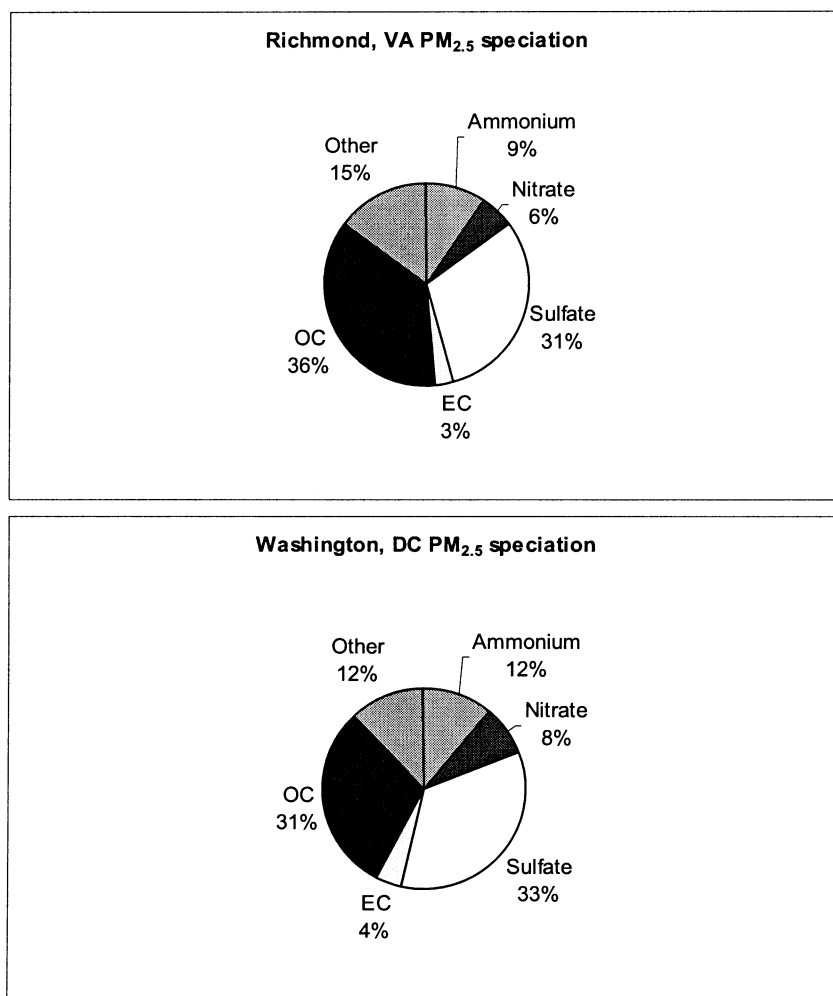


Figure 1 illustrates that in the Washington, DC area, slightly more than one-third of fine particulate matter is related to elemental carbon (EC) or organic carbon (OC), which are generally more strongly associated with motor vehicles than with power plants. About half of PM<sub>2.5</sub> is associated with ammonium, sulfate, or nitrate, which are generally secondarily formed particles often related to power plants. Ammonium sulfate, which dominates the secondarily formed particles, is almost entirely related to power plant emissions. The above figures also demonstrate that the particle composition only varies slightly between settings in close proximity to one another, indicating that these figures likely reasonably capture particle speciation in Alexandria.

Now, what is known about the magnitude of PM<sub>2.5</sub> concentrations in Alexandria? For this, I turn to information from the Virginia Department of Environmental Quality (<http://www.deq.state.va.us/airmon/pm25home.html>). For monitors in the Northern Region of Virginia (including measurements in Arlington, Fairfax, and Loudon Counties), annual average PM<sub>2.5</sub> concentrations consistently ranged between 13 and 15 µg/m<sup>3</sup> from 1999 to 2003. In addition, data from Virginia DEQ consistently demonstrates higher concentrations during the third quarter (July-September) than during other quarters. This pattern is typical in settings where ammonium sulfate comprises a significant portion of PM<sub>2.5</sub>, because sulfate particles form more readily at higher temperatures and more electricity is used during the summer (for air conditioning) than during other seasons. Thus, it is reasonable to assume that annual average PM<sub>2.5</sub> concentrations in Alexandria are approximately 13-15 µg/m<sup>3</sup>, with a pronounced summertime peak.

Turning to the second question above, is there evidence that PM<sub>2.5</sub> concentrations of approximately 13-15 µg/m<sup>3</sup> on an annual average basis could contribute to human health impacts? A critical fact to realize is that, although the National Ambient Air Quality Standard for PM<sub>2.5</sub> (which is currently 15 µg/m<sup>3</sup>) is above these levels, the National Ambient Air Quality Standard (NAAQS) is not meant to be a zero-risk level.

Quoting from the US EPA, "The Act does not require the Administrator to establish a primary NAAQS at a zero-risk level, but rather at a level that reduces risk sufficiently so as to protect public health with an adequate margin of safety" (US Environmental Protection Agency, 1997). Although many people commonly interpret a NAAQS as a threshold below which no health effects are found, this is not necessarily a correct interpretation. One must look to the health evidence to determine whether current PM<sub>2.5</sub> levels in Alexandria might cause health problems.

Two of the major studies examining mortality risks from long-term exposure to

PM<sub>2.5</sub> are the Harvard Six Cities Study (Dockery *et al.*, 1993) and the American Cancer Society Study (Pope *et al.*, 1995; Pope *et al.*, 2002). In both of these studies, there did not appear to be a threshold for PM<sub>2.5</sub> effects at the pollution levels measured in the studies. In other words, the risk of dying continued to decrease as the pollution level decreased, down to the lowest levels measured in the studies. Annual average PM<sub>2.5</sub> concentrations in the Harvard Six Cities Study ranged between about 11 and 30 µg/m<sup>3</sup>, while the concentrations in the American Cancer Society study ranged between about 9 and 34 µg/m<sup>3</sup> during the initial study (Pope *et al.*, 1995) and between about 6 and 21 µg/m<sup>3</sup> during a later follow-up period (Pope *et al.*, 2002).

Although there is clearly more uncertainty about effects at lower levels, given fewer historical observations, the first draft of the Particulate Matter Staff Paper (US Environmental Protection Agency, 2003b) made the following observations:

- "Studies reporting statistically significant associations in areas where the long-term mean 24-hour PM<sub>2.5</sub> concentrations ranged from approximately 14 µg/m<sup>3</sup> down to 8.5 µg/m<sup>3</sup> provide evidence of PM<sub>2.5</sub>-related total and cardiovascular mortality and emergency department visits related to asthma and cardiovascular illness at levels below the current annual standard" (p. 6-18)
- "Studies conducted in Phoenix (Mar *et al.*, 2000), Santa Clara County, CA (Fairley, 1999) and in eight Canadian cities (Burnett *et al.*, 2000) reported significant relationships between PM<sub>2.5</sub> and mortality where mean PM<sub>2.5</sub> concentrations ranged between 13 and 14 µg/m<sup>3</sup>" (p. 6-18)
- "...staff believes that it would be appropriate to consider a range of PM<sub>2.5</sub> levels for an annual standard that extends down from 15 µg/m<sup>3</sup> to as low as 12 µg/m<sup>3</sup>" (p. 6-19)

Thus, although uncertainty remains, it is reasonable to conclude that PM<sub>2.5</sub>-related health effects could be anticipated in Alexandria at current ambient concentrations.

Where are the five power plants in question, and what are their current emissions?

For our analysis, we evaluated five power plants that were within 50 miles of Washington, DC, and that were grandfathered under the Clean Air Act. This implies that these plants are not required to meet the same emission standards as newer power plants, although there are other regulations they must follow. Basic information about the five power plants is presented in Table 1 (adapted from Table 1 in (Levy *et al.*, 2002a)).

Table 1. Characteristics of power plants evaluated in this study.

	Benning	Chalk Point	Dickerson	Possum Point	Potomac River
Location	Washington, DC	Aquasco, MD	Dickerson, MD	Dumfries, VA	Alexandria, VA
Initial year of commercial operation	1968	1964	1959	1948	1949
Nameplate capacity (megawatts)	580	2046	588	1373	514
Heat input (million BTU, 1999)	3,304,107	85,352,274	33,592,811	28,930,805	32,100,184
Emissions (tons, 1999)					
SO <sub>2</sub>	1,432	57,630	30,637	19,497	17,627
NO <sub>x</sub>	447	25,222	10,709	5,116	6,893
PM <sub>2.5</sub>	12	304	14	156	106
Emissions (lb/million BTU)					
SO <sub>2</sub>	0.87	1.35	1.82	1.35	1.10
NO <sub>x</sub>	0.27	0.59	0.64	0.35	0.43
PM <sub>2.5</sub>	0.007	0.007	0.0008	0.011	0.007

A few observations can be made about these data. First, emission rates vary somewhat from year to year, so the contributions of the five power plants would

vary from year to year as well. More explicitly, if there were increases or decreases in emissions since 1999, there would be a corresponding change in concentrations and health impacts. In addition, the target emission rates (defined as the application of Best Available Control Technology) were assumed to be 0.3 lb/million BTU for SO<sub>2</sub>, 0.15 lb/million BTU for NO<sub>x</sub>, and 0.01 lb/million BTU for PM<sub>10</sub>. Looking at the last three rows of the table, meeting this level would be a substantial reduction of both SO<sub>2</sub> and NO<sub>x</sub>. For PM<sub>2.5</sub>, the degree of reduction varies, depending on the current size distribution of primary particulate matter emissions at the five plants.

What are the concentration impacts from the Potomac River power plant, in Alexandria and across the region?

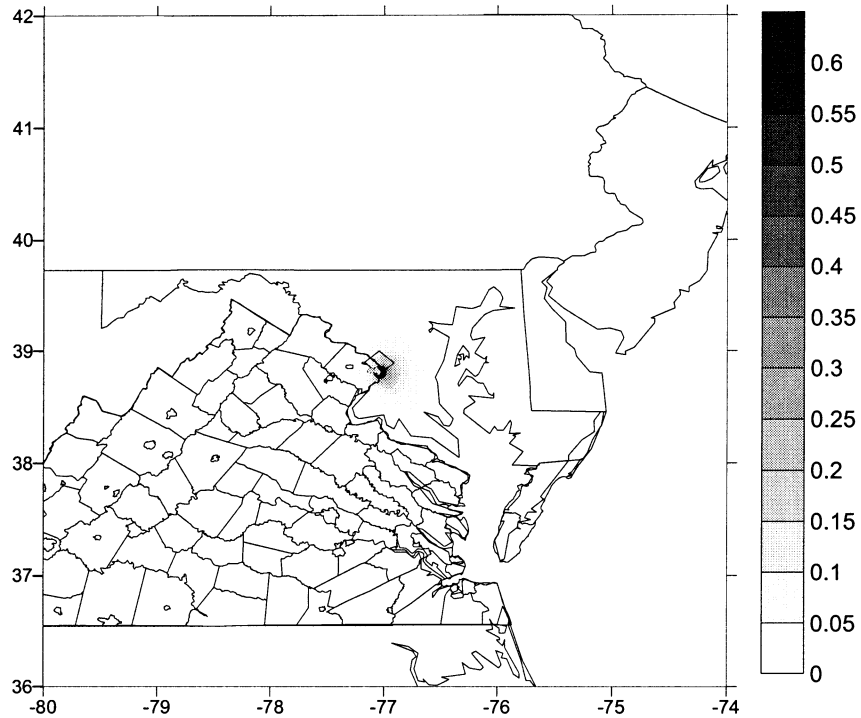
When we consider the impacts from the Potomac River power plant, it is helpful to look at this question from a few perspectives. We can consider primary and secondary  $PM_{2.5}$  separately, as well as considering the total  $PM_{2.5}$  impacts, to get a sense of differences in spatial patterns. While we are most concerned about the total, some emission control plans may only address one of the pollutants, so it is helpful to see how the concentration patterns differ. We can also look at concentrations from a regional perspective, or with a “close up” view of Alexandria. When we take the “close up” view of Alexandria, we can include nearby cities (like Washington) to help interpret the findings. By looking at the question in all of these ways, we can gain insight about the magnitude and distribution of impacts from Potomac River.

Before doing this, it is important to understand how the following maps were made and what they mean. The concentrations were estimated for each census tract in Alexandria and nearby areas. Census tracts are subsets of counties that contain about 1,000 to 8,000 people on average. So, our model cannot provide information on finer-scale concentration impacts. The regional maps are “contour plots”, which show the general concentration trends, smoothing out some of the small-scale differences. The Alexandria plots (which also include Washington) show the exact concentration increments in each census tract, so they are less “smooth”. Sometimes, the concentrations in the Alexandria plots seem to follow unintuitive patterns, but this is in part because they are based on the geographic centroid of the census tract and are not estimated across the entire tract. In addition, the figures represent annual average concentrations, so the plume may travel in one direction some of the time and another direction some of the time, which would appear in the figure as higher concentrations in multiple directions. Finally, it is important to keep in mind that the figures below depict the concentrations only associated with the modeled power plant(s), not from all sources.

First, we look at primary  $PM_{2.5}$  from the regional perspective. In the following figure, and in all subsequent regional figures, the blue dot represents the Potomac River power plant, the shaded yellow area indicates the City of Alexandria, and the red contours represent the concentration patterns. Figure 2 on the following page shows the annual average primary  $PM_{2.5}$  concentration increments associated with the Potomac River power plant.

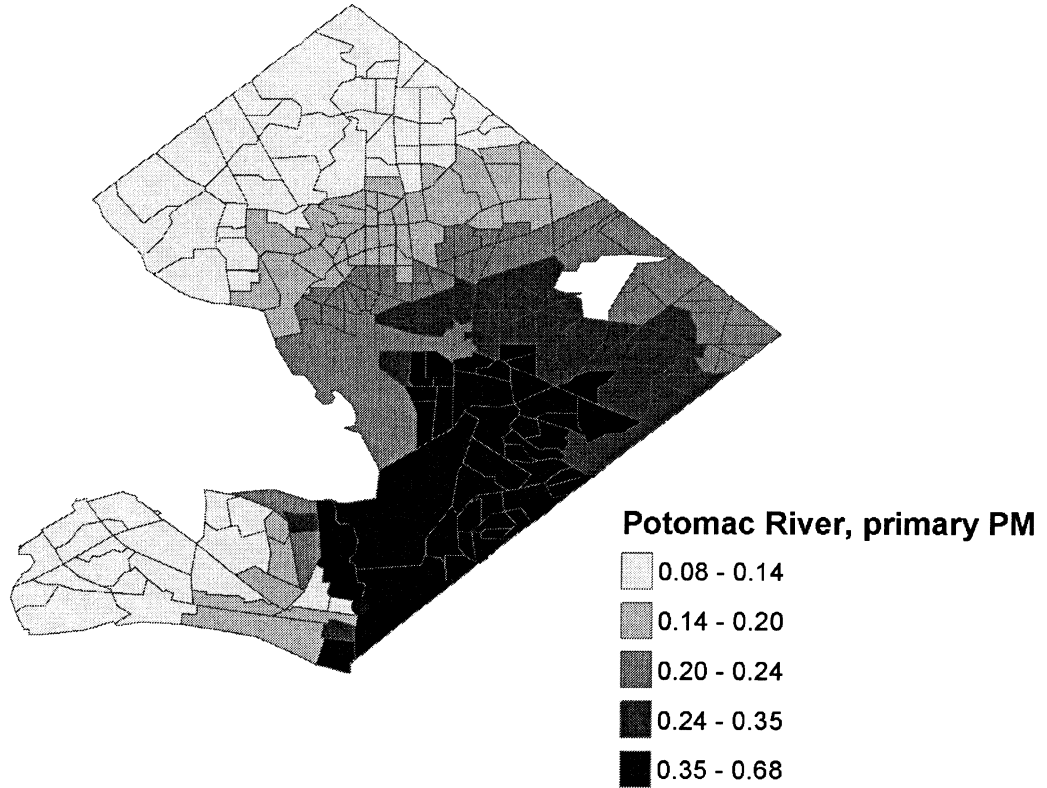


Figure 2: Annual average primary PM<sub>2.5</sub> concentration increments associated with the Potomac River power plant across the model region (in  $\mu\text{g}/\text{m}^3$ ).



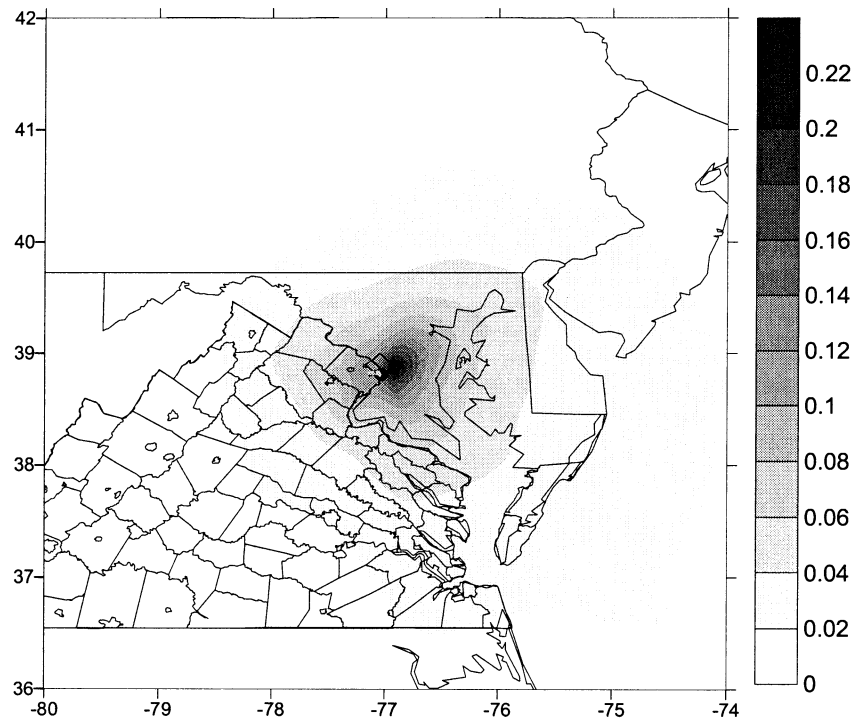
A few observations can be made. First, the concentrations peak close to the source and decrease rapidly with distance. The highest primary PM<sub>2.5</sub> concentration increment is approximately  $0.7 \mu\text{g}/\text{m}^3$ , located within Washington, DC, approximately 4 km from the Potomac River power plant. This is because it takes some time for the plume to reach the ground. As shown in Figure 3, there is a significant primary PM<sub>2.5</sub> gradient across Alexandria, with the concentration increment from Potomac River ranging from  $0.08$ - $0.45 \mu\text{g}/\text{m}^3$ . Higher levels occur in closer proximity to the plant, although the census tract housing the Potomac River plant has relatively lower concentrations.

Figure 3: Annual average primary PM<sub>2.5</sub> concentration increments associated with the Potomac River power plant across the City of Alexandria and Washington, DC (in  $\mu\text{g}/\text{m}^3$ ).



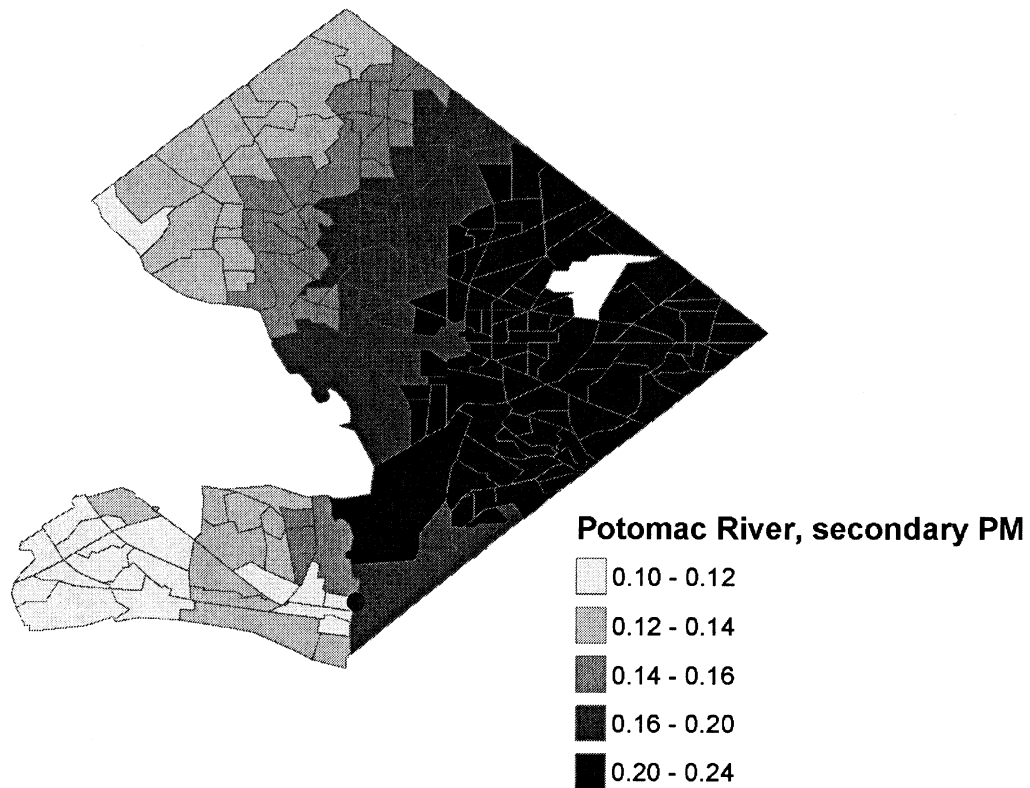
For secondary PM, we would anticipate a lesser concentration gradient, since it takes time to form secondary sulfate and nitrate particles. Figure 4 shows the annual average secondary PM<sub>2.5</sub> concentrations associated with the Potomac River power plant.

Figure 4: Annual average secondary PM<sub>2.5</sub> concentration increments associated with the Potomac River power plant across the model region (in  $\mu\text{g}/\text{m}^3$ ).



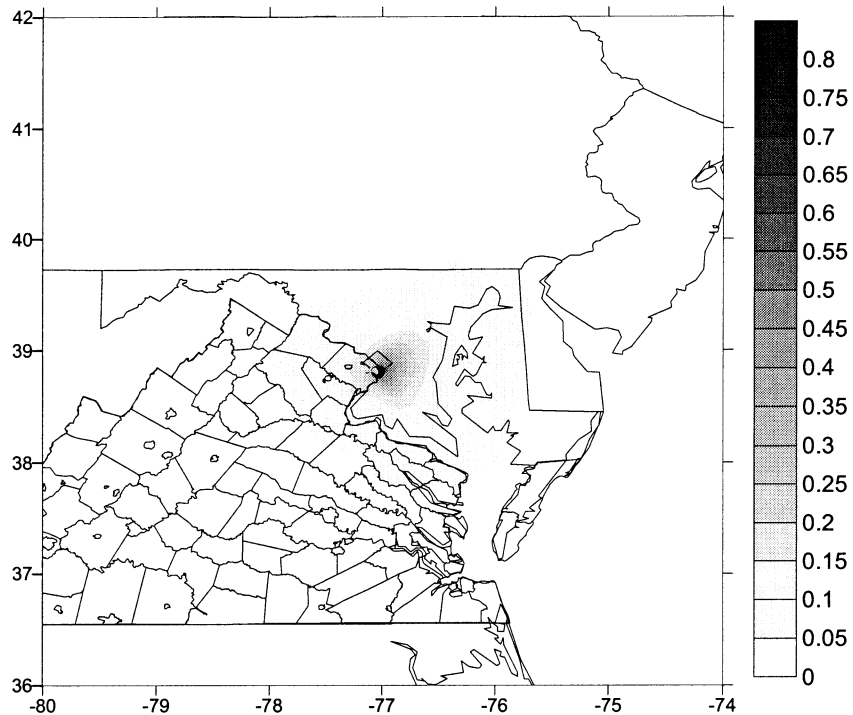
As expected, the concentration impacts are more diffuse, with a more gradual decrease in concentrations as a function of distance. The maximum secondary PM<sub>2.5</sub> concentration increment is approximately 0.24 μg/m<sup>3</sup>, occurring at a different spot within Washington, DC than the maximum primary PM<sub>2.5</sub> concentration increment, approximately 12 km from the Potomac River power plant. In general, the peak impact occurs at longer range than for primary PM<sub>2.5</sub>. Within Alexandria, the secondary PM<sub>2.5</sub> concentration increment ranges from 0.10-0.15 μg/m<sup>3</sup>, a lesser gradient than seen for primary PM<sub>2.5</sub> (Figure 5).

Figure 5: Annual average secondary PM<sub>2.5</sub> concentration increments associated with the Potomac River power plant across the City of Alexandria and Washington, DC (in μg/m<sup>3</sup>).



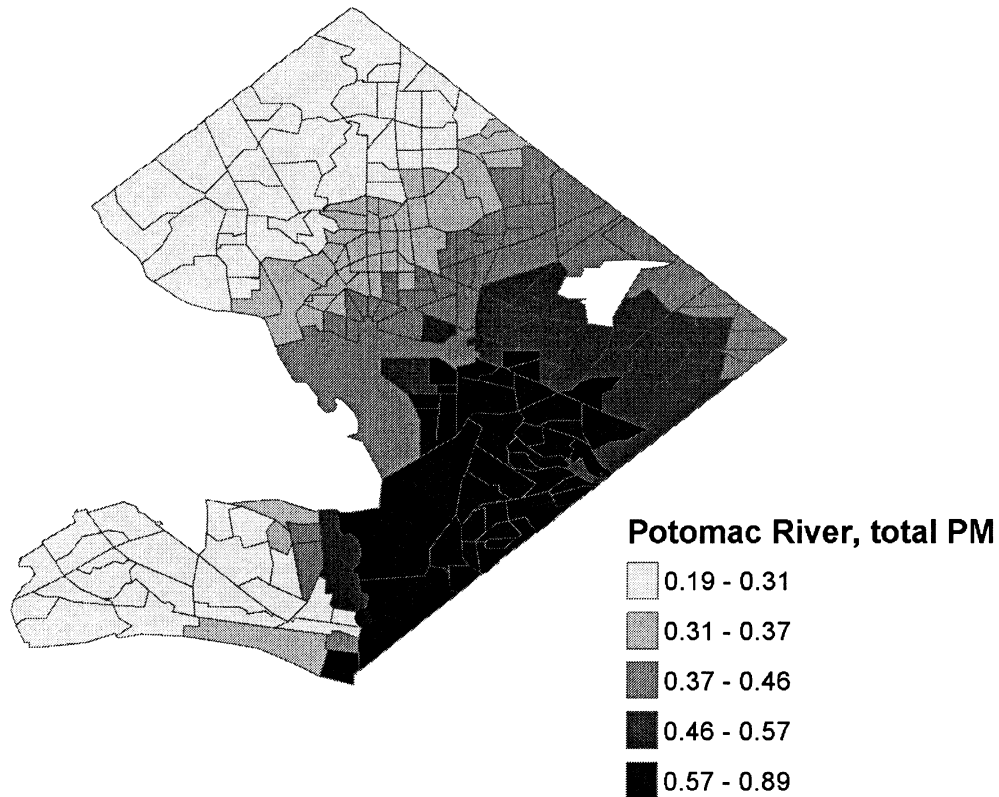
Finally, we can add up primary and secondary PM to yield total PM<sub>2.5</sub>. Figure 6 shows the annual average total PM<sub>2.5</sub> concentration increments associated with the Potomac River power plant.

Figure 6: Annual average total PM<sub>2.5</sub> concentration increments associated with the Potomac River power plant across the model region (in  $\mu\text{g}/\text{m}^3$ ).



As expected, the concentration pattern is somewhere in between the patterns for primary and secondary PM<sub>2.5</sub>. The highest total PM<sub>2.5</sub> concentration increment is approximately 0.9  $\mu\text{g}/\text{m}^3$ , at the same site in Washington, DC where the primary PM<sub>2.5</sub> increment was highest. This is not unexpected, since the maximum primary PM<sub>2.5</sub> increment is somewhat higher than the maximum secondary PM<sub>2.5</sub> increment. Within Alexandria, the total PM<sub>2.5</sub> concentration increment from the Potomac River power plants ranges between 0.19 and 0.58  $\mu\text{g}/\text{m}^3$  (Figure 7).

Figure 7: Annual average total PM<sub>2.5</sub> concentration increments associated with the Potomac River power plant across the City of Alexandria and Washington, DC (in  $\mu\text{g}/\text{m}^3$ ).



Now, how can these values be interpreted? As mentioned above, the annual average PM<sub>2.5</sub> concentration in Alexandria in 1999 (our case study modeling year) was about  $14 \mu\text{g}/\text{m}^3$ . This implies that, depending on the location in Alexandria, the Potomac River power plant contributes anywhere from 1-4% of the total ambient PM<sub>2.5</sub>. The obvious question is whether this constitutes a significant fraction or not. Although it implies that eliminating the Potomac River power plant would only decrease PM<sub>2.5</sub> concentrations by a relatively small percentage, the same argument is likely true for any single source taken in isolation. The more important questions are therefore what benefits could be obtained by alternative emission control plans, how those benefits compare across pollution sources, and whether the public health benefits of these emission controls justify the costs. In the next section, I address the question of whether controlling other power plants in the region would lead to greater or lesser concentration reductions within Alexandria than controlling Potomac River.

What are the impacts of the other four power plants on PM<sub>2.5</sub> concentrations in Alexandria, and how does this compare with the impact from Potomac River?

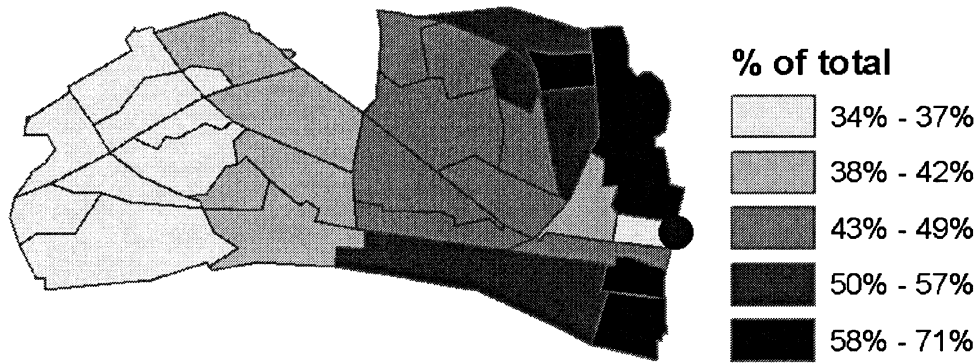
For this section, I only consider the impacts of the five power plants on PM<sub>2.5</sub> concentrations within the City of Alexandria, to answer the specific question of whether controlling higher-emitting power plants further away from Alexandria would provide greater or lesser benefits than controlling the Potomac River power plant. So, only "close in" figures are presented. As previously, I consider primary and secondary PM<sub>2.5</sub> separately before considering total PM<sub>2.5</sub>.

When considering primary PM<sub>2.5</sub>, because of the steep concentration gradient, one would expect that power plants further away from Alexandria would have a relatively small influence on concentrations within Alexandria, but that nearby upwind power plants would have a measurable influence. Indeed, this turns out to be the case. As shown in Table 2, the Potomac River plant is generally the greatest contributor to power plant primary PM<sub>2.5</sub> among the five power plants modeled, but Possum Point, Dickerson, and Chalk Point make some contributions. Figure 8 illustrates that the percentage of the total primary PM<sub>2.5</sub> impact from the five power plants that is contributed by Potomac River is as high as 70% near the facility, decreasing to 30-40% further away, with a similar spatial pattern as for primary PM<sub>2.5</sub> concentrations from Potomac River.

Table 2. Annual average PM<sub>2.5</sub> concentration increments within the City of Alexandria associated with five modeled power plants (in µg/m<sup>3</sup>).

Power plant	Primary PM <sub>2.5</sub> increment	Secondary PM <sub>2.5</sub> increment	Total PM <sub>2.5</sub> increment
Benning	0.001-0.002	0.003-0.004	0.005-0.006
Chalk Point	0.020-0.024	0.10-0.11	0.12-0.14
Dickerson	0.041-0.046	0.072-0.076	0.11-0.12
Possum Point	0.087-0.11	0.11-0.12	0.19-0.24
Potomac River	0.081-0.45	0.10-0.15	0.19-0.58
<b>Total</b>	<b>0.24-0.63</b>	<b>0.39-0.47</b>	<b>0.63-1.1</b>

Figure 8: Percentage of the annual average primary  $PM_{2.5}$  concentration increment in the City of Alexandria from the five power plants that is associated with the Potomac River power plant.

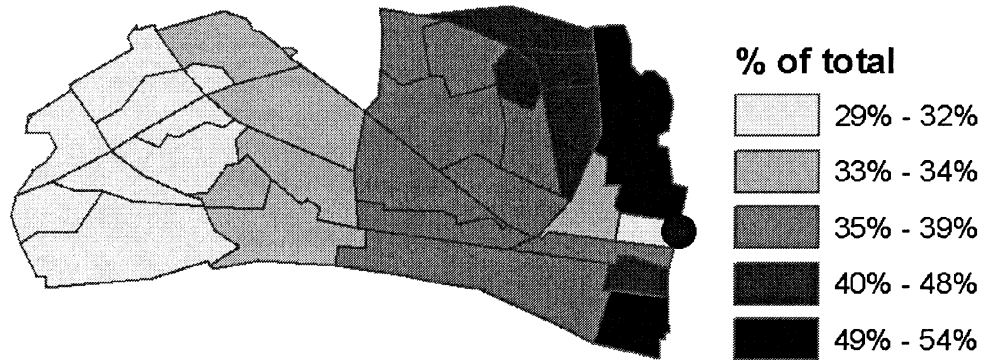


For secondary  $PM_{2.5}$ , since the concentration gradient is not as steep, the relative contribution of the Potomac River power plant is somewhat lower and is more uniform across the City of Alexandria. The percentage contribution of Potomac River ranges from 25-33%, although in nearly all cases, it is the single largest contributor among the five power plants.

For total  $PM_{2.5}$ , the Potomac River power plant contributes between 29% and 54% of the  $PM_{2.5}$  concentration increment from the five modeled power plants, with higher contributions found closer to the plant (Figure 9). For five of the 34 census tracts, Possum Point makes a greater contribution to  $PM_{2.5}$  levels than does Potomac River, but Potomac River is the largest contributor in the other 29 census tracts.



Figure 9: Percentage of the annual average total PM<sub>2.5</sub> concentration increment in the City of Alexandria from the five power plants that is associated with the Potomac River power plant.



In terms of the overall interpretation of these values, it is important to remember that the percentages represent the amount of the contribution from the five power plants that Potomac River provides, not the amount of total PM<sub>2.5</sub> exposure. The aggregate contribution of these five power plants to PM<sub>2.5</sub> levels in Alexandria ranges from about 0.63-1.1  $\mu\text{g}/\text{m}^3$  on an annual average basis. When compared with ambient PM<sub>2.5</sub> levels, this is about 4-8% of monitored concentrations.

What are the estimated health impacts in Alexandria associated with the five power plants?

As indicated in our published study (Levy *et al.*, 2002a), we estimated health impacts two different ways in our analysis. The first approach was to use the standard methodology employed in most studies, linking health evidence with concentrations directly. The second approach was to try to take account of factors that might influence susceptibility to air pollution – for example, diabetics have been shown to have greater risk of cardiovascular effects from air pollution exposure (Zanobetti and Schwartz, 2001). For this report, I focus on the first approach for simplicity's sake and to facilitate comparison with other studies.

In our study, we concluded that current emissions from the five power plants combined contribute to 270 deaths per year across the region, along with 80 cardiovascular hospital admissions (CHA) among the elderly and 190 pediatric asthma emergency room visits (ERV) per year. The number of deaths is higher than the less severe health outcomes because the morbidity outcomes are for a subset of diseases and ages, and because they are only based on short-term pollution exposures.

The question is: Of this total, what fraction occurs within Alexandria? Although particulate matter exposures from the five power plants are high in Alexandria when compared with the rest of the model region, the population of Alexandria represents about 0.2% of the population in the region. So, we would expect that only a small fraction of the total health impacts would occur in Alexandria.

Table 3 depicts the annual health impacts within Alexandria associated with each of the five power plants, using 1990 census data for comparability with our published study and with our model outputs. Of note, the population of Alexandria has increased from 111,183 to 128,283 from 1990 to 2000, a 15.4% increase, so the health impacts would be proportionately greater for the current and projected future population of Alexandria. However, the general conclusions are unchanged.

Table 3: Estimated annual public health impacts in the City of Alexandria associated with emissions from five power plants.

	Deaths/year	CHA/year	Asthma ERV/year
Benning	0.02	0.005	0.009
Chalk Point	0.4	0.1	0.2
Dickerson	0.4	0.1	0.2
Potomac Point	0.7	0.2	0.4
Potomac River	0.9	0.3	0.4
<b>Total</b>	<b>2.3</b>	<b>0.7</b>	<b>1.2</b>
<b>% of total from Potomac River</b>	<b>37%</b>	<b>37%</b>	<b>36%</b>
<b>% of total in region</b>	<b>0.9%</b>	<b>0.9%</b>	<b>0.6%</b>

Some observations are necessary to place these estimates in context. First, the five power plants are estimated to contribute slightly over 2 deaths/year to the City of Alexandria. The baseline number of deaths in Alexandria each year in the 30+ age group (the assumed at-risk population for air pollution-related deaths) is approximately 800. So, our model is indicating that these five power plants contribute to about one out of 400 deaths, or 0.25%. It should also be noted that the number of annual deaths and morbidity outcomes contains some fractional values, which can best be interpreted when thinking about the long run – 2.3 deaths/year means that over a 10 year period, 23 deaths would be expected.

In addition, of the risk within Alexandria from the five power plants, about 37% can be attributed to the Potomac River power plant. This is a function of how much PM<sub>2.5</sub> is contributed by each power plant (Figure 9), weighted by the number of people in each census tract. Finally, these health impacts within Alexandria are slightly less than 1% of the total health impacts across the region, as estimated in our original publication and reported above. This is greater than the population contribution of Alexandria to the region, because the PM<sub>2.5</sub> contribution is relatively higher in Alexandria than in many parts of the region.

What are the estimated health benefits in Alexandria if emission controls were used at the five power plants?

Given this baseline level of mortality and morbidity, we can estimate the potential health benefits if the five power plants were to adopt Best Available Control Technology. As described above, this would involve substantial emission reductions that vary in magnitude across the pollutants and the plants, making the distribution of benefits slightly different than the distribution of current health impacts.

In our original study (Levy *et al.*, 2002a), we estimated that applying Best Available Control Technology to the five power plants would reduce health impacts across the region by 210 deaths, 59 cardiovascular hospital admissions among the elderly, and 140 pediatric asthma emergency room visits per year (from a baseline of 270, 80, and 190, respectively). As above, I address the question here of the fraction of the total benefits found within Alexandria. The results of this analysis are summarized in Table 4.

Table 4: Estimated annual public health benefits in the City of Alexandria if five power plants used Best Available Control Technology.

	Deaths/year	CHA/year	Asthma ERV/year
Benning	0.007	0.002	0.004
Chalk Point	0.3	0.09	0.2
Dickerson	0.3	0.09	0.2
Possum Point	0.5	0.2	0.3
Potomac River	0.5	0.2	0.3
<b>Total</b>	<b>1.7</b>	<b>0.5</b>	<b>0.9</b>
<b>% of total from Potomac River</b>	<b>31%</b>	<b>31%</b>	<b>31%</b>
<b>% of total in region</b>	<b>0.8%</b>	<b>0.8%</b>	<b>0.6%</b>

The benefits from emission controls are distributed similarly as the baseline impacts, with some minor differences. The contribution of Potomac River to benefits is slightly less than its contribution to baseline impacts (31% of the total from the five power plants, versus 37%). This is because the potential emission reductions are slightly greater for many of the other power plants. For example, Chalk Point, Dickerson, and Possum Point all have a greater baseline emission rate of SO<sub>2</sub> in lbs/million BTU than Potomac River, implying that a greater fraction of their current impacts will be reduced by meeting Best Available

Control Technology emission rates. However, controls at Potomac River would provide among the greatest benefits to public health in Alexandria, with essentially identical benefits available through controlling Possum Point.

What do these findings mean (and not mean)?

The above figures and tables provide detailed information about the impacts of selected power plants in the Washington, DC area on air quality and public health in and around Alexandria. However, the crucial question is obviously what this means and does not mean for public policy.

When looking at current emissions, we can conclude that the Potomac River power plant is the largest single contributor to ambient  $PM_{2.5}$  in most parts of Alexandria among the five power plants modeled, but that the other four plants combined contribute 46-71% of the total from these five plants. When we look at the benefits of emission controls, the Potomac River power plant has a relatively lower contribution (31% of the total health benefits), but is still one of the two power plants contributing the most benefits (with Possum Point providing nearly identical benefits).

If we try to place the magnitude of the impacts from these five power plants in context, we see that current emissions contribute approximately  $0.6-1.1 \mu\text{g}/\text{m}^3$  of  $PM_{2.5}$  on an annual average basis (4-8% of ambient concentrations), with emission controls reducing concentrations by  $0.5-0.7 \mu\text{g}/\text{m}^3$  (3-5% of ambient concentrations). From one perspective, this may appear like a relatively small percentage, since 95-97% of  $PM_{2.5}$  would remain after these emission controls were implemented. However, it is important to compare this percentage with the concentration reductions that could be obtained through other emission control strategies. Because there are numerous power plants, millions of motor vehicles, other pollution sources, and some underlying background  $PM_{2.5}$ , one might anticipate that any small set of sources will contribute a similarly small fraction of ambient concentrations.

For example, using the results from a source-receptor matrix applied by US EPA in past regulatory impact analyses (US Environmental Protection Agency, 1999), if all light-duty and heavy-duty cars and trucks in the state of Virginia were eliminated (including both gasoline and diesel vehicles), annual average  $PM_{2.5}$  concentrations in Alexandria would decrease by approximately  $1.5 \mu\text{g}/\text{m}^3$ . Since eliminating all vehicles from Virginia is obviously not a remotely plausible control strategy, the benefits for vehicle control strategies at the state level would be a small fraction of this total.

Applying the same source-receptor matrix to power plants, a 75% emission reduction from the five power plants we evaluated would reduce  $PM_{2.5}$  concentrations in Alexandria by  $0.3 \mu\text{g}/\text{m}^3$ , while the same emission reduction at 502 other major power plants in the United States would reduce  $PM_{2.5}$

concentrations in Alexandria by an additional  $1 \mu\text{g}/\text{m}^3$ . Thus, the amount of concentration reduction available through controlling these five power plants is reasonably high in comparison with other plausible emission control strategies. Note that the absolute magnitude of benefits is slightly different with this source-receptor matrix than with our model, both because of differences in assumed emissions and model assumptions. Although the absolute numbers in this sample calculation may not be precisely correct, the relative values and general conclusions are well supported.

It is also important to keep in mind that, while the numbers above were presented without any characterization of uncertainty, there are clearly multiple factors that are uncertain and could influence the magnitude of the estimates. The emissions values that we used represent reported emissions in 1999, but current or future emissions may differ. Our atmospheric dispersion model (CALPUFF) has been approved by US EPA for modeling of long-range pollution transport, and we have found that the CALPUFF model yields similar health risk estimates as other models (Levy *et al.*, 2003). However, any dispersion model contains some inherent uncertainties.

In addition, since CALPUFF has been designed for long-range pollution transport, it is not ideal for understanding extremely small-scale pollution patterns. We chose CALPUFF because we were interested in estimating the total health benefits of pollution control, which is largely a phenomenon of long-range pollution transport. While the patterns at the census tract level appear reasonable, the findings from our modeling effort cannot be used to determine (for example) the precise impacts on individuals very close to the power plant. Addressing this question would require additional modeling using a different model, and perhaps with a focus on short-term rather than long-term concentrations.

Looking at the health estimates, the magnitude of the mortality and morbidity effects are based on observational epidemiological studies that are somewhat uncertain, because it is difficult to estimate a precise relationship between air pollution and health given other risk factors. The question about whether a threshold for health effects exists is obviously an important and controversial one, with major implications for the interpretation of our findings.

That being said, the assumptions made in our analysis are reasonable. Whenever possible, we chose values in the middle of the range of reported values, so that we are just as likely to have overestimated or underestimated health effects (Levy and Spengler, 2002; Levy *et al.*, 2002b). More generally, health risk assessments will always contain some underlying uncertainty. More studies can always be done, and better models are constantly being built. The

mere existence of uncertainty is not a sufficient reason to delay regulatory decisions, especially when the level of knowledge is already high and the stakes are substantial.

On that point, it is important to realize that a model of this sort is the only possible way to determine the relative contributions of Potomac River (or other power plants) to air pollution and health in Alexandria. Assuming that Potomac River contributes 1-4% of ambient  $PM_{2.5}$  in Alexandria, it would be impossible to use ambient monitors to estimate this contribution. Similarly, if the five power plants combined contribute 2 deaths per year in Alexandria, there would be no way to directly observe this influence, independent from other causes of death (especially since death certificates will not say "air pollution" on them). Thus, if we want to understand the influence of a subset of sources on the population of a city, we must apply a model like the one we developed.

Given these caveats, what conclusions can be drawn from this investigation? First, while the Potomac River power plant is not the dominant contributor to either deaths or  $PM_{2.5}$  concentrations in Alexandria, it is likely the single source that contributes most to  $PM_{2.5}$  levels in Alexandria. Reducing emissions from the five modeled power plants would lower  $PM_{2.5}$  concentrations in Alexandria and the surrounding region, although some  $PM_{2.5}$ -related health risks could still remain. It is also quite clear that decisions about emission controls at power plants need to take account of the regional health impacts, since local health impacts contribute a relatively small fraction of the total. At the same time, there are clear concentration gradients across and within cities, and it is important to understand how individuals would benefit from various emission control plans.

As mentioned at the beginning of the report, it is not possible to make specific policy recommendations based solely on our analyses. However, this report should provide a more detailed understanding of how local, regional, and national sources contribute to air pollution health risks in Alexandria, which can be used to inform future policy decisions.



## References

- Burnett RT, Brook J, Dann T, Delocla C, Philips O, Cakmak S, Vincent R, Goldberg MS, Krewski D. Association between particulate- and gas-phase components of urban air pollution and daily mortality in eight Canadian cities. *Inhalation Toxicology* 2000; 12 Supp 4: 15-39.
- Dockery DW, Pope CA, Xu X, Spengler JD, Ware JH, Fay ME, Ferris BGJ, Speizer FE. An association between air pollution and mortality in six U.S. cities. *New England Journal of Medicine* 1993; 329: 1753-1759.
- Fairley D. Daily mortality and air pollution in Santa Clara County, California: 1989-1996. *Environmental Health Perspectives* 1999; 107: 637-641.
- Levy JI, Greco SL, Spengler JD. The importance of population susceptibility for air pollution risk assessment: A case study of power plants near Washington, DC. *Environmental Health Perspectives* 2002a; 110: 1253-1260.
- Levy JI, Spengler JD. Modeling the benefits of power plant emission controls in Massachusetts. *J Air Waste Manage Assoc* 2002; 52: 5-18.
- Levy JI, Spengler JD, Hlinka D, Sullivan D, Moon D. Using CALPUFF to evaluate the impacts of power plant emissions in Illinois: Model sensitivity and implications. *Atmospheric Environment* 2002b; 36: 1063-1075.
- Levy JI, Wilson AM, Evans JS, Spengler JD. Estimation of primary and secondary particulate matter intake fractions for power plants in Georgia. *Environ Sci Technol* 2003; 37: 5528-5536.
- Mar TF, Norris GA, Koenig JQ, Larson TV. Associations between air pollution and mortality in Phoenix, 1995-1997. *Environmental Health Perspectives* 2000; 108: 347-353.
- Pope CA, 3rd, Thun MJ, Namboodiri MM, Dockery DW, Evans JS, Speizer FE, Heath CW, Jr. Particulate air pollution as a predictor of mortality in a prospective study of U.S. adults. *American Journal of Respiratory & Critical Care Medicine* 1995; 151: 669-674.
- Pope CA, Burnett RT, Thun MJ, Calle EE, Krewski D, Ito K, Thurston GD. Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. *JAMA* 2002; 287: 1132-1141.

US Environmental Protection Agency. *National Ambient Air Quality Standards for Particulate Matter; Final Rule. 40 CFR Part 50*. Federal Register Vol. 62 No. 138, 1997.

US Environmental Protection Agency. *Fourth External Review Draft of Air Quality Criteria for Particulate Matter*. National Center for Environmental Assessment, Office of Research and Development, Research Triangle Park, NC, 2003a.

US Environmental Protection Agency. *Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information. OAQPS Staff Paper - First Draft*. Office of Air Quality Planning and Standards, Research Triangle Park, NC, 2003b.

Zanobetti A, Schwartz J. Are diabetics more susceptible to the health effects of airborne particles? *American Journal of Respiratory & Critical Care Medicine* 2001; 164: 1-3.

Dear Mr. Noyes we would like to  
**SPEAKER'S FORM - PLANNING COMMISSION**

*"briefly" address this issue Paul & Elizabeth*

PLEASE COMPLETE THIS FORM AND GIVE IT TO PLANNING STAFF  
BEFORE YOU SPEAK ON A DOCKET ITEM.

DOCKET ITEM NO. 17

CASE # \_\_\_\_\_

*City Council*  
PLANNING COMMISSION MEETING OF MAY 12

PLEASE ANNOUNCE THE INFORMATION SPECIFIED BELOW PRIOR TO SPEAKING.

*Paul*

1. NAME: Paul Hertel
2. ADDRESS: 1217 Michigan Court
3. DAYTIME PHONE: 703 684 5375
4. WHOM DO YOU REPRESENT, IF OTHER THAN YOURSELF? \_\_\_\_\_
5. NATURE OF YOUR INTEREST IN ITEM (PROPERTY OWNER, ATTORNEY, LOBBYIST, CIVIC INTEREST, ETC.): \_\_\_\_\_
6. ARE YOU RECEIVING COMPENSATION FOR THIS APPEARANCE BEFORE PLANNING COMMISSION? YES \_\_\_\_\_ NO ←

This form shall be kept as a part of the permanent record in those instances where financial interest or compensation is indicated by the speaker.

Guidelines for Speakers

- All speaker request forms must be submitted by the time the item is called by staff.
- There will typically be no limit on the time to speak. When required by the number of speakers at a meeting, however, time limits may have to be imposed. In such cases, a maximum of 3 minutes will generally be allowed for your presentation, unless you are or represent an applicant, in which case 10 minutes will be allowed for the applicant's presentation. Additional time may be permitted by the Chairperson.
- If you have a prepared statement, please leave a copy with staff.

# SPEAKER'S FORM - PLANNING COMMISSION

PLEASE COMPLETE THIS FORM AND GIVE IT TO PLANNING STAFF  
BEFORE YOU SPEAK ON A DOCKET ITEM.

DOCKET ITEM NO. 17

CASE # \_\_\_\_\_

*City Council*

PLANNING COMMISSION MEETING OF MAY 12

PLEASE ANNOUNCE THE INFORMATION SPECIFIED BELOW PRIOR TO SPEAKING.

1. NAME: Elizabeth Chimento
2. ADDRESS: 1200 N. Pitt St., Alex., VA
3. DAYTIME PHONE: (703) 548-7939
4. WHOM DO YOU REPRESENT, IF OTHER THAN YOURSELF? \_\_\_\_\_
5. NATURE OF YOUR INTEREST IN ITEM (PROPERTY OWNER), ATTORNEY, LOBBYIST, (CIVIC INTEREST), ETC.): \_\_\_\_\_
6. ARE YOU RECEIVING COMPENSATION FOR THIS APPEARANCE BEFORE PLANNING COMMISSION? YES \_\_\_\_\_ NO X

This form shall be kept as a part of the permanent record in those instances where financial interest or compensation is indicated by the speaker.

## Guidelines for Speakers

- All speaker request forms must be submitted by the time the item is called by staff.
- There will typically be no limit on the time to speak. When required by the number of speakers at a meeting, however, time limits may have to be imposed. In such cases, a maximum of 3 minutes will generally be allowed for your presentation, unless you are or represent an applicant, in which case 10 minutes will be allowed for the applicant's presentation. Additional time may be permitted by the Chairperson.
- If you have a prepared statement, please leave a copy with staff.