Results of an Emission and Air Dispersion Modeling Study and Public Health Evaluation of the Virginia Paving Company Facility 5601 Courtney Avenue Alexandria, Virginia

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Summary

This report predicts and evaluates impacts from the Virginia Paving Company — a facility that manufactures hot mix asphalt in Alexandria, Virginia. In particular, the report presents the results of our emissions and air quality modeling study of the site and its operations. Our study evaluated airborne emissions from multiple point sources[1] and fugitive sources[2] at the site, and focused on both "criteria pollutants"[3] and "toxic air pollutants."[4] We found that, with some specific upgrades and permit limitations (described herein), the facility can continue to operate in its current setting, during the day and at night, and pose no significant risk to the public health.

Introduction

This study is submitted as part of the Virginia Paving Company's application for a new special use permit (SUP). The new SUP would explicitly allow the facility to transport materials to and from the site at night.

To evaluate the impacts of day-time and night-time operations on the neighborhoods immediately surrounding the facility, we applied standard scientific and engineering techniques for modeling airborne emissions from the site and its operations. We generally followed the approach laid out in our Protocol of September 13, 2005

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[1] In air pollution modeling, a "point source" is an exhaust stack or other discrete, typically ducted source of airborne emissions. For this facility, the main emission sources of each plant are the exhaust stacks of the aggregate dryers, which generate heat by burning oil (principally on-specification waste oil, or "spec oil"). The other ducted emission source at the facility is the hot oil heater, which burns a smaller quantity of oil to warm the liquid asphalt cement and spec oil.

[2] In air pollution modeling, a "fugitive source" is a non-ducted airborne emission, such as dust from plowed fields, or material re-suspended from roads by traffic. For this facility, some vapors will escape control devices, and/or emanate from the loading of hot-mix asphalt onto trucks. Fugitive particulate matter (PM) emissions arise from the handling of aggregate as it is dropped from conveyors, loaded onto and out of trucks, and moved and dropped by front-end loaders. PM emissions also arise from travel on roads and surfaces and from wind erosion of storage piles.

[3] "Criteria pollutants" are the seven airborne substances (or mixtures) for which U.S. EPA, *per* the Clean Air Act, has established National Ambient Air Quality Standards (NAAQS) for safe levels of exposure. The current criteria pollutants are carbon monoxide, lead, nitrogen oxides, ozone, particulate matter (both PM_{10} and $PM_{2.5}$), and sulfur dioxide.

[4] "Toxic air pollutants" are chemicals (such as benzene or formaldehyde) or mixtures that, at sufficiently high concentrations, harm health, but that are not regulated *via* national ambient air standards. Virginia DEQ, like many other state agencies, has set guidelines for acceptably small ambient concentrations for these pollutants.

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(provided here as Appendix A), modified by subsequent discussions with, and input from, Lalit Sharma and William Skrabak (City of Alexandria), Dennis Hlinka and David Sullivan (Sullivan Environmental Consulting), Maureen Barrett (Aero Engineering Services), and engineers and operators at Virginia Paving and its parent company, Lane Construction.

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Methods

Emissions modeling

Emissions were modeled based on the following conditions and limitations.

Table 1. Conditions and limitations.

Operation / Condition	Limit / specification	Source / basis
Hot mix asphalt production — yearly maximum	1,200,000 tons per year	Proposed SUP
Hot mix asphalt production — daily and hourly maxima	10,000 tons per day; 1,000 tons per hour	Proposed SUP
Hot oil heater (#2 fuel oil) usage — yearly maximum	100,000 gallons per year	Proposed SUP
Height of dryer exhaust stacks	20 meters	Proposed SUP
Height of hot oil heater exhaust stack	6 meters	Proposed SUP
Stack gas concentration of total suspended particles (TSP) — maximum	0.03 grains per dry standard cubic foot	Proposed SUP
Installation, operation, and maintenance of Blue Smoke Control system (six-stage filtration; Butler-Justice, Inc.)	99% control efficiency for particulate emissions within capture zone	Vendor specification
Watering of on site paved roadways	Twice daily	Proposed SUP
Truck access areas at the eastern end of the facility, for trucks receiving product from plant #2	To be paved	Proposed SUP
On-site diesel engines in front end loaders	Installation of 90% efficient particle traps	Proposed SUP
Rock and aggregate processing	Water sprays and enclosure of transfer points	Proposed SUP
Asphalt storage tank emissions	Tank vent condensers	Proposed SUP
NO_x emissions from driers	Low NO_x burners	Proposed SUP

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Additional details regarding emissions modeling inputs (and air modeling) are found in our spreadsheets and accompanying documentation (available upon request).

Air quality modeling

Air quality modeling was performed using the AERMOD modeling system. *Per* U.S. EPA (see http://www.epa.gov/ttn/scram/dispersion_prefrec.htm and associated links), AERMOD is "a steady-state plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain." It is the regulatory model that EPA currently prefers for this type of application.

Our initial modeling, reported on September 30, 2005 (please see Appendix B), utilized receptors at residences, schools, parks, and elsewhere, and used the ISC modeling system, as described and plotted in our September 13, 2005 Protocol (please see Appendix A). Additional modeling, using AERMOD and reported here, utilized receptor coordinates and elevations provided by Maureen Barrett, as depicted below in Figure 1. These receptors include (1) an outer polar grid that extends from distances of 300 m to 2,000 m (~1,000 ft to 1¼ miles) from the main asphalt plant, (2) an intermediate Cartesian grid set at a spacing of 50 m (160 ft) at locations close to the asphalt plant property, and (3) a fenceline grid of locations along the perimeter of the asphalt plant property. Receptors are spaced at close intervals so that the highest modeled impacts of the facility may be identified.

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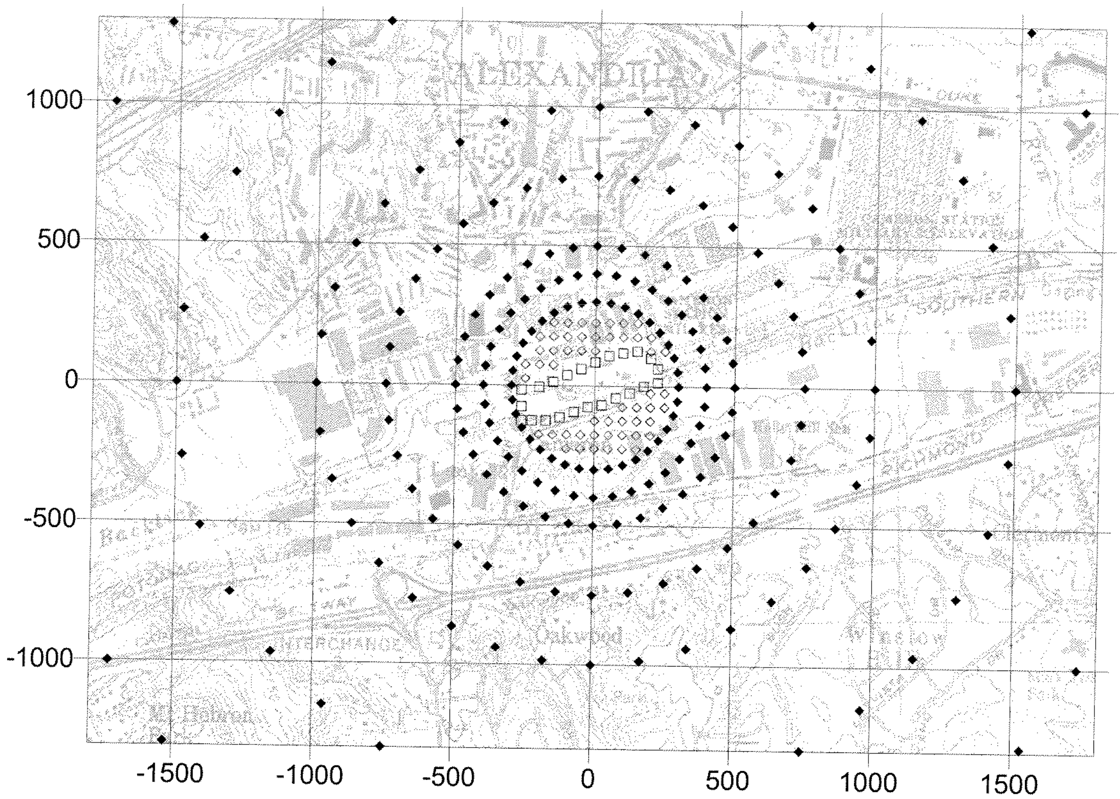

Figure 1. Receptors used for air modeling. The open squares (□) represent the fenceline grid of locations along the perimeter of the asphalt plant property; the open diamonds (◊) represent an immediate grid set at a spacing of 50 m (160 ft) at locations close to the asphalt plant property; and the solid diamonds (♦) represent the gridded receptors that extend from distances of 300 m to 2,000 m (~1,000 ft to 1¼ miles) from the main asphalt plant (the outer most of which fall beyond the boundaries of this map).

For criteria pollutants, estimated impacts from the facility were added to impacts from all other sources in or near Alexandria, as measured by air quality monitors nearby. By convention, these measurements are taken to be an indication of "background" air quality (even though, of course, they represent both background and some increment from the facility itself, since the facility was typically operating when the monitors were sampling). Background air quality data used here are tabulated below.

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Table 2. Background air quality, in or near Alexandria.

Pollutant and Averaging time	Background ($\mu g/m^3$)	Source of data: monitor at:
CO - 8-hour	3,206	Alexandria Health Dept., Alexandria
CO - 1-hour	4,580	Alexandria Health Dept., Alexandria
Lead (Pb) - Quarterly	0.013	Doctor's Exchange, Springfield
NO_x - Annual	45.1	Alexandria Health Dept., Alexandria
PM_{10} - annual	19.3	Doctor's Exchange, Springfield
PM_{10} - 24-hour	43.0	Doctor's Exchange, Springfield
$PM_{2.5}$ - annual	13.4	Lee District Park, Franconia
$PM_{2.5}$ - 24-hour	35.3	Lee District Park, Franconia
SO_2 - Annual	15.7	Alexandria Health Dept., Alexandria
SO_2 - 24-hour	60.2	Alexandria Health Dept., Alexandria
SO_2 - 3-hour	238.3	Alexandria Health Dept., Alexandria

Per City staff request, we also modeled and added in impacts from maximum permitted emissions of sulfur oxides and nitrogen oxides from two other facilities in the area — the Alexandria/Arlington Covanta waste-to-energy combustor, and the Washington Gas Light Company. (Again, this technique partially "double counts" pollutant concentrations, since the measurements of background were typically made when these facilities were operating).

Evaluation of Toxic Air Pollutants

Toxic air pollutants were evaluated according to guidance provided by Virginia DEQ in its *New Source Review Permits Program Manual* (available at http://www.deq.virginia.gov/air/pdf/air/airguide.pdf). In particular, we followed procedures listed in Appendix FF of the Manual, and, for each relevant pollutant, compared facility emission rates to DEQ's emission rate exemption levels.[5] For three pollutants —acrolein, formaldehyde, and quinone — facility emission rates exceeded the exemption levels. Thus, ambient air impacts from these three compounds were modeled, and the estimated impacts were compared to the DEQ's Significant Ambient Air Concentrations (SAACs).

[5] Exemption levels are established by the Virginia DEQ as emission rates that, with a high level of confidence, will result in no significant risks to human health. Emission rates lower than the exemption levels are thus deemed safe.

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We also evaluated risks to public health using conventional methods of quantitative health risk assessment, as reported in our earlier document, "Summary Results of an Emission and Air Dispersion Modeling Study and Public Health Evaluation of the Virginia Paving Company Facility, Alexandria, Virginia" (Ames *et al.*, September 30, 2005), provided here as Appendix B.[6]

[6] Please note that our earlier modeling relied on ISC for dispersion modeling, not AERMOD, and used some different conditions and receptors, so that results reported in Appendix B are not directly comparable to those reported here. Nonetheless, the qualitative conclusions of our earlier work and this work agree.

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Results

Criteria Pollutants

The results of the emissions and air quality modeling for the criteria pollutants are presented in the tables below. As shown, for the gaseous pollutants, lead, and PM_{10}, all estimated impacts at all receptors are acceptably small. As also shown, modeled impacts for $PM_{2.5}$, when added to background, slightly exceed the NAAQS, but only at a few fenceline receptors, and not at any receptors beyond the fenceline. As discussed below, for several reasons and in several respects, these modeled impacts are likely to be overestimates. Moreover, the modeled impacts decline rapidly away from the site, such that impacts at receptors at all nearby parks, residences, schools, and other public properties are all acceptably small.

Table 3. Modeling results, carbon monoxide, 1-hour averaging period.

Pollutant	**Carbon monoxide**		
Averaging period	1-hour		
Statistical metric	Maximum second highest value at each receptor		
Sources	VA Paving: Dryer stacks, loadout, yard, silos, asphalt storage tanks, hot oil heater, and diesel exhaust Other: U.S. Filter		
Maximum predicted concentration (at any receptor)			
Modeling year	Concentration ($\mu g/m^3$)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	597	103	282
2001	622	103	282
2002	602	103	282
2003	535	50	108
2004	528	50	108
Highest of all	622	103	282
Background	4,580		
Background plus highest increment	**5,202**		
National Ambient Air Quality Standard (NAAQS)	**40,000**		

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Table 4. Modeling results, carbon monoxide, 8-hour averaging period.

Pollutant	**Carbon monoxide**		
Averaging period	8-hour		
Statistical metric	Maximum second highest value at each receptor		
Sources	VA Paving: Dryer stacks, loadout, yard, silos, asphalt storage tanks, hot oil heater, and diesel exhaust Other: U.S. Filter		
Maximum predicted concentration (at any receptor)			
Modeling year	Concentration ($\mu g/m^3$)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	383	50	108
2001	379	50	108
2002	452	50	108
2003	388	50	108
2004	462	50	108
Highest of all	462	50	108
Background	3,206		
Background plus highest increment	**3,668**		
National Ambient Air Quality Standard (NAAQS)	**10,000**		

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Table 5. Modeling results, lead (Pb).

Pollutant	Lead (Pb)		
Averaging period	Quarterly		
Statistical metric	Highest quarterly average value		
Sources	VA Paving: Dryer stacks, hot oil heater		
Maximum predicted concentration (at any receptor)			
Modeling year (Max. quarter)	Concentration (µg/m^3)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000 (2nd)	0.00093	0	225
2001 (3rd)	0.00199	-25	-75
2002 (3rd)	0.00235	50	108
2003 (2nd)	0.00217	50	108
2004 (4th)	0.00183	50	175
Highest of all	0.00235	50	108
Background	0.013		
Background plus highest increment	**0.015**		
National Ambient Air Quality Standard (NAAQS)	**1.5**		

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Table 6. Modeling results, nitrogen oxides.

Pollutant	**Nitrogen oxides**		
Averaging period	Annual		
Statistical metric	Annual average value at each receptor		
Sources	VA Paving: Dryer stacks, hot oil heater, diesel exhaust Other: U.S. Filter, Covanta and Washington Gas		
Maximum predicted concentration (all sources combined at any receptor)			
Modeling year	Concentration ($\mu g/m^3$)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	8.3	100	118
2001	9.1	100	118
2002	8.3	100	118
2003	7.4	100	118
2004	7.6	100	118
Highest of all	9.1	100	118
Background	45.1		
Background plus highest increment	**54.2**		
National Ambient Air Quality Standard (NAAQS)	**100**		

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Table 7. Modeling results, PM_{10}, annual averaging period.

Pollutant	PM_{10}		
Averaging period	Annual		
Statistical metric	Annual average at each receptor		
Sources	VA Paving: Dryer stacks, hot oil heater, silos, loadout, yard, liquid asphalt storage, diesel exhaust, paved roads, unpaved surfaces, batch dropping, wind erosion, RAP crushing Other: U.S. Filter		
Maximum predicted concentration (all sources combined at any receptor)			
Modeling year	Concentration (μg/m³)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	5.4	125*	-25*
2001	5.5	125*	-25*
2002	5.0	150*	125*
2003	5.0	125*	-25*
2004	4.8	125*	-25*
Highest of all	5.5	125*	-25*
Background	19.3		
Background plus highest increment	**24.8**		
National Ambient Air Quality Standard (NAAQS)	**50.0**		

* As would be expected, the maximum predicted concentration is at the facility fenceline. Please see Figure 2, which displays isopleths of predicted concentrations.

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Table 8. Modeling results, PM_{10}, 24-hour averaging period.

Pollutant	**PM_{10}**		
Averaging period	24-hour		
Statistical metric	Maximum fourth-highest value at each receptor		
Sources	VA Paving: Dryer stacks, hot oil heater, silos, loadout, yard, liquid asphalt storage, diesel exhaust, paved roads, unpaved surfaces, batch dropping, wind erosion, RAP crushing Other: U.S. Filter		
Maximum predicted concentration (all sources combined at any receptor)			
Modeling year	Concentration ($\mu g/m^3$)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	54.6	150*	125*
2001	57.5	150*	125*
2002	59.1	150*	125*
2003	53.8	125*	-25*
2004	52.6	125*	-25*
Highest of all	59.1	150*	125*
Background	43.0		
Background plus highest increment	**102.1**		
National Ambient Air Quality Standard (NAAQS)	**150**		

* As would be expected, the maximum predicted concentration is at the facility fenceline. Please see Figure 3, which displays isopleths of predicted concentrations.

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Table 9. Modeling results, $PM_{2.5}$, annual averaging period.

Pollutant	$PM_{2.5}$		
Averaging period	Annual		
Statistical metric	Annual average value at each receptor		
Sources	VA Paving: Dryer stacks, hot oil heater, silos, loadout, yard, liquid asphalt storage, diesel exhaust, paved roads, unpaved surfaces, batch dropping, wind erosion, RAP crushing Other: U.S. Filter		
Maximum predicted concentration (all sources combined at any receptor)			
Modeling year	Concentration ($\mu g/m^3$)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	2.4	-50*	60*
2001	2.5	-50*	60*
2002	2.1	-50*	60*
2003	2.2	125*	-25*
2004	2.0	50*	108*
Highest of all	2.5	-50*	60*
Background	13.4		
Background plus highest increment	**15.9***		
National Ambient Air Quality Standard (NAAQS)	**15.0**		

* As would be expected, the maximum predicted concentration is at the facility fenceline. Please see Figures 4a and 4b, which display isopleths of predicted concentrations and modeled impacts at receptors.

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Table 10. Modeling results, $PM_{2.5}$, 24-hour averaging period.

Pollutant	**$PM_{2.5}$**		
Averaging period	24-hour		
Statistical metric	Maximum fourth-highest value at each receptor		
Sources	VA Paving: Dryer stacks, hot oil heater, silos, loadout, yard, liquid asphalt storage, diesel exhaust, paved roads, unpaved surfaces, batch dropping, wind erosion, RAP crushing Other: U.S. Filter		
Maximum predicted concentration (all sources combined at any receptor)			
Modeling year	Concentration ($\mu g/m^3$)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	30.9	125*	-25*
2001	33.2	125*	-25*
2002	24.2	125*	-25*
2003	30.1	125*	-25*
2004	29.1	125*	-25*
Highest of all	33.2	125*	-25*
Background	35.3		
Background plus highest increment	**68.5***		
National Ambient Air Quality Standard (NAAQS)	**65**		

* As would be expected, the maximum predicted concentration is at the facility fenceline. Please see Figures 5a and 5b, which display isopleths of predicted concentrations and modeled impacts at receptors.

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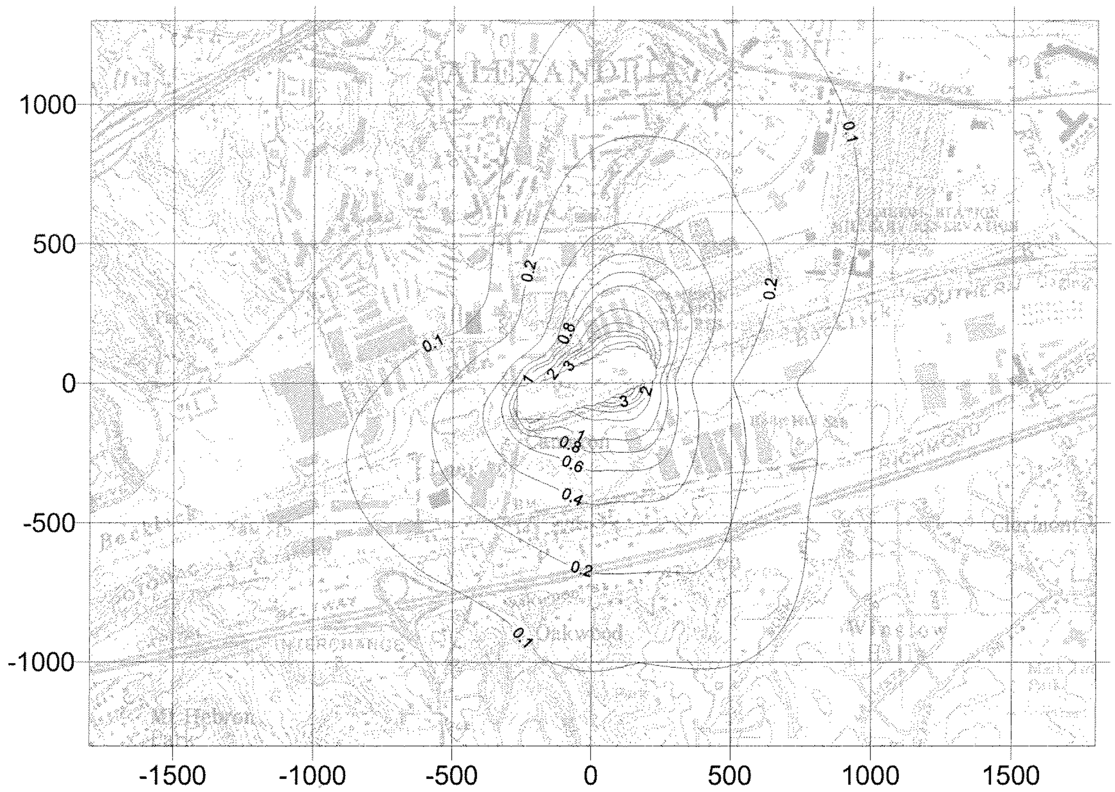

Figure 2. PM10: annual average modeled increments, µg/m3, isopleths. Axes are in meters.

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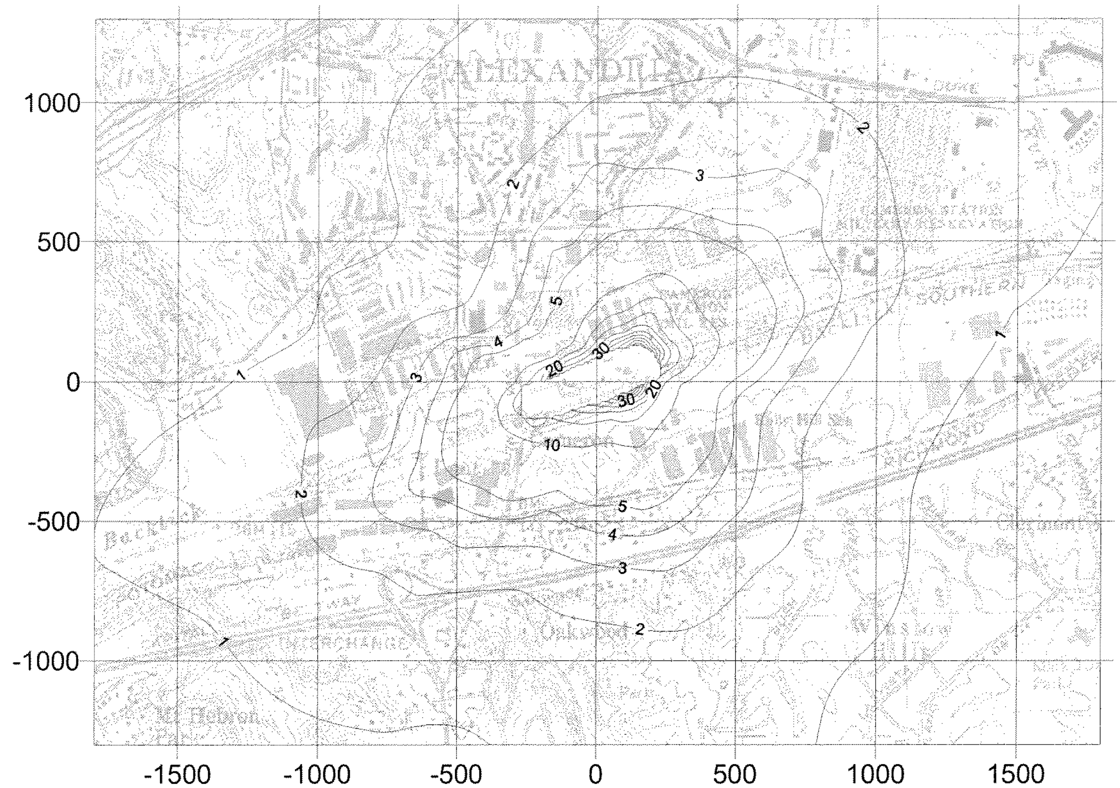

Figure 3. PM10: maximum, fourth-highest, 24-hour average modeled increments, μg/m3, isopleths. Axes are in meters.

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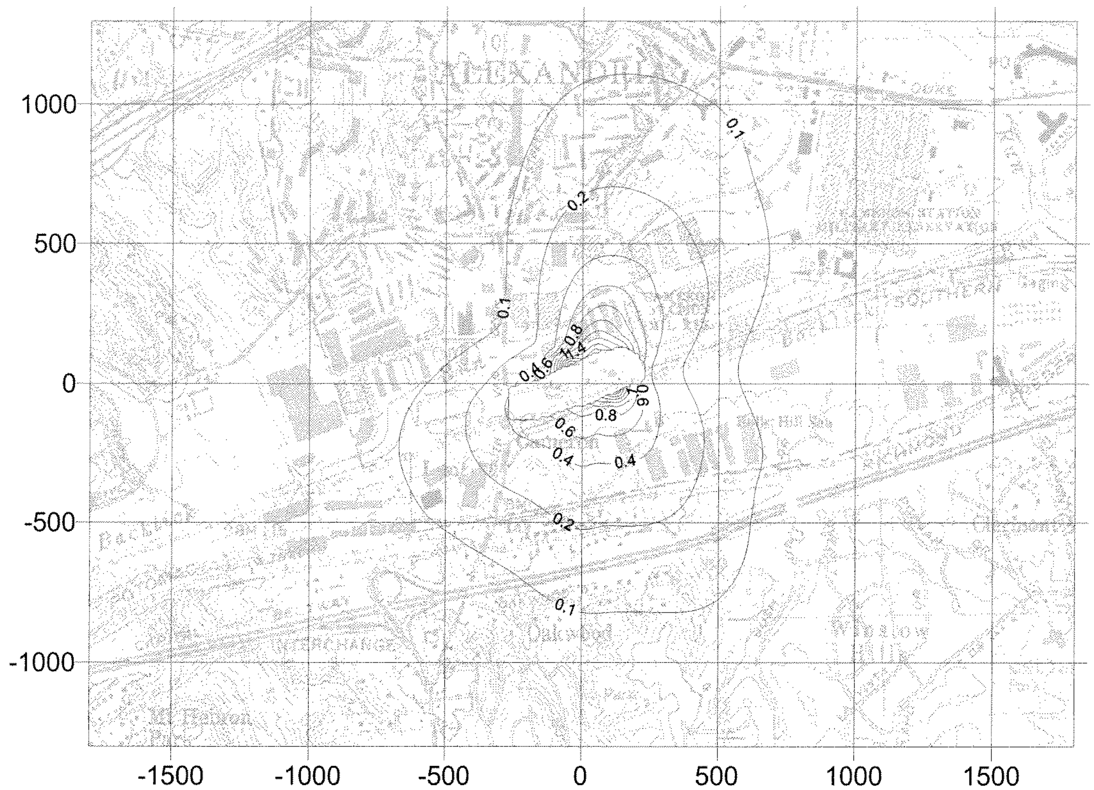

Figure 4a. PM2.5: annual average modeled increments, µg/m3, isopleths. Axes are in meters.

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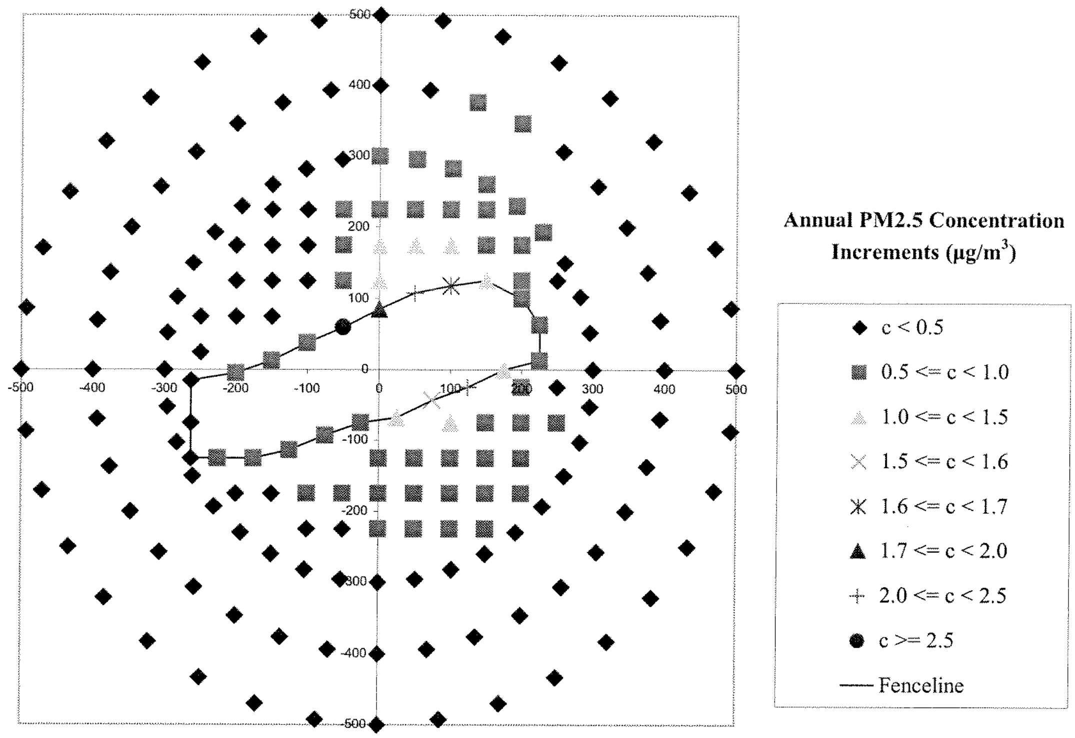

Figure 4b. Modeled, incremental, PM2.5 impacts, annual, at receptors. Axes are in meters.

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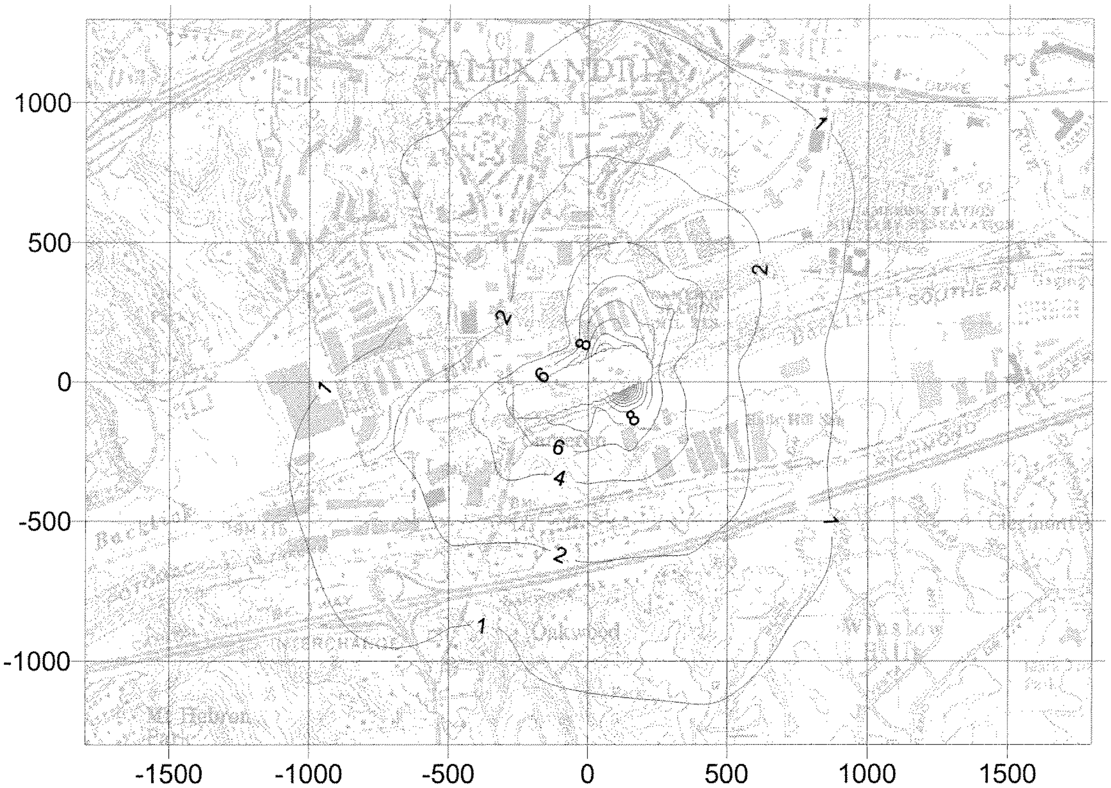

Figure 5a. PM2.5: maximum, 4th highest, 24-hour average modeled increments, µg/m3, isopleths. Axes are in meters.

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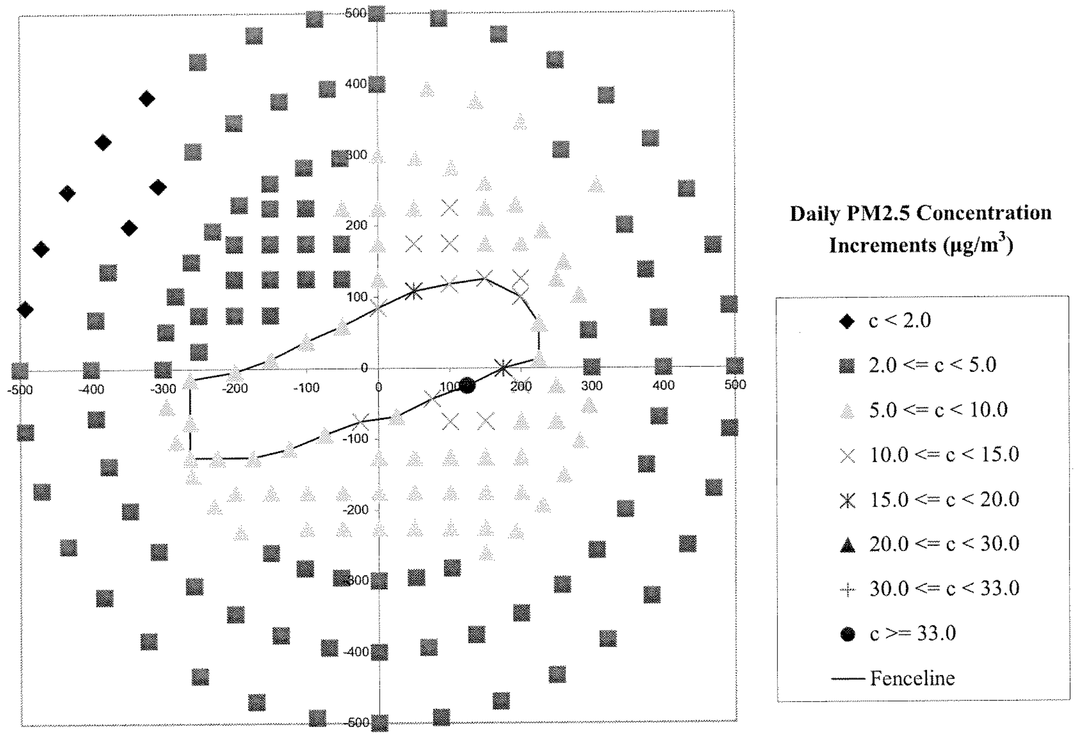

Figure 5b. Modeled, incremental, PM2.5 impacts, 24-hour, at receptors. Axes are in meters.

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Table 11. Modeling results, sulfur dioxide, 3-hour averaging period.

Pollutant	**Sulfur dioxide**		
Averaging period	3-hour		
Statistical metric	Maximum second highest value at each receptor		
Sources	VA Paving: Dryer stacks, hot oil heater, diesel exhaust Other: U.S. Filter, Covanta, and Washington Gas		
Maximum predicted concentration (all sources combined at any receptor)			
Modeling year	Concentration ($\mu g/m^3$)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	271	-50	60
2001	270	-50	60
2002	250	50	108
2003	294	-50	60
2004	296	-50	60
Highest of all	296	-50	60
Background	238.3		
Background plus highest increment	**534.3**		
National Ambient Air Quality Standard (NAAQS)	**1300**		

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Table 12. Modeling results, sulfur dioxide, 24-hour averaging period.

Pollutant	**Sulfur dioxide**		
Averaging period	24-hour		
Statistical metric	Maximum second highest value at each receptor		
Sources	VA Paving: Dryer stacks, hot oil heater, diesel exhaust Other: U.S. Filter, Covanta, and Washington Gas		
Maximum predicted concentration (all sources combined at any receptor)			
Modeling year	Concentration ($\mu g/m^3$)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	134	-50	60
2001	114	-50	60
2002	115	-50	60
2003	131	-50	60
2004	116	-50	60
Highest of all	134	-50	60
Background	60.2		
Background plus highest increment	**194.2**		
National Ambient Air Quality Standard (NAAQS)	**365**		

Table 13. Modeling results, sulfur dioxide, annual averaging period.

Pollutant	**Sulfur dioxide**		
Averaging period	Annual		
Statistical metric	Annual average value at each receptor		
Sources	VA Paving: Dryer stacks, hot oil heater, diesel exhaust Other: U.S. Filter, Covanta and Washington Gas		
Maximum predicted concentration (all sources combined at any receptor)			
Modeling year	Concentration ($\mu g/m^3$)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	36.6	-50	60
2001	38.3	-50	60
2002	31.8	-50	60
2003	27.8	-50	60
2004	28.5	-50	60
Highest of all	38.3	-50	60
Background	15.7		
Background plus highest increment	**54.0**		
National Ambient Air Quality Standard (NAAQS)	**80**		

Toxic Air Pollutants

As summarized in Appendix B, our quantitative health risk assessment, performed using conventional methods, found that the toxic air pollutants emitted from this site posed no significant risks to health. More generally, these pollutants are primarily products of incomplete combustion, and so are the same as those emitted by gasoline or diesel powered cars, trucks, buses, and other vehicles, by other combustion of fuel (such as in residential and commercial furnaces and boilers), and by fossil-fueled power plants. At high concentrations, of course, these pollutants can harm health, but at the very low concentrations of interest here, they are neither known nor expected to do so.

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Following Virginia DEQ guidance, toxic air pollutants were also found to be emitted at low rates, such that only three substances —acrolein, formaldehyde, and quinone — required modeling *per* Appendix FF of the Virginia DEQ *New Source Review Permits Program Manual* (available at http://www.deq.virginia.gov/air/pdf/air/airguide.pdf). The results of this modeling appear below, and show that impacts from these three substances are also acceptably small.

Table 14. Modeling results, acrolein.

Pollutant	**Acrolein**		
Averaging period	1-hour*		
Statistical metric	Highest hourly value at each receptor		
Sources	Dryer stacks		
Maximum predicted concentration (at any receptor)			
Modeling year	Concentration (μg/m^3)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	0.12	-193	-230
2001	0.12	0	750
2002	0.11	0	750
2003	0.11	100	118
2004	0.11	100	118
Highest of all	**0.12**	0	750
Significant Ambient Air Concentration (SAAC)	**17.25**		

* The yearly emission rate for this compound is smaller than the VDEQ yearly emission exemption level, so only hourly impacts are modeled.

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Table 15. Modeling results, formaldehyde, 1-hour averaging period.

Pollutant	Formaldehyde		
Averaging period	1-hour		
Statistical metric	Highest hourly value at each receptor		
Sources	Dryer stacks, loadout, yard, and silos, asphalt storage tanks and hot oil heater		
Maximum predicted concentration (at any receptor)			
Modeling year	Concentration ($\mu g/m^3$)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	14.5	-193	-230
2001	14.6	103	282
2002	13.9	103	282
2003	13.3	100	118
2004	14.2	-193	-230
Highest of all	**14.6**	103	282
Significant Ambient Air Concentration (SAAC)	**62.5**		

Table 16. Modeling results, formaldehyde, annual averaging period.

Pollutant	Formaldehyde		
Averaging period	Annual		
Statistical metric	Annual average at each receptor		
Sources	Dryer stacks, loadout, yard, and silos, asphalt storage tanks and hot oil heater		
Maximum predicted concentration (at any receptor)			
Modeling year	Concentration ($\mu g/m^3$)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	0.153	50	108
2001	0.159	50	108
2002	0.198	50	108
2003	0.147	50	108
2004	0.213	50	108
Highest of all	**0.213**	50	108
Significant Ambient Air Concentration (SAAC)	**2.4**		

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Table 17. Modeling results, quinone, 1-hour averaging period.

Pollutant	Quinone		
Averaging period	1-hour		
Statistical metric	Highest hourly value at each receptor		
Sources	Dryer stacks		
Maximum predicted concentration (at any receptor)			
Modeling year	Concentration (μg/m^3)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	0.720	-193	-230
2001	0.730	0	750
2002	0.684	0	750
2003	0.673	100	118
2004	0.705	100	118
Highest of all	**0.730**	0	750
Significant Ambient Air Concentration (SAAC)	**22**		

Table 18. Modeling results, quinone, annual averaging period.

Pollutant	Quinone		
Averaging period	Annual		
Statistical metric	Annual average at each receptor		
Sources	Dryer stacks		
Maximum predicted concentration (at any receptor)			
Modeling year	Concentration (μg/m^3)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	0.00659	50	108
2001	0.00689	50	175
2002	0.00890	50	108
2003	0.00641	50	108
2004	0.00978	50	108
Highest of all	**0.00978**	50	108
Significant Ambient Air Concentration (SAAC)	**0.88**		

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Discussion

Comparison between modeled and measured impacts

In August 2004, measurements of ambient PM_{10} were taken at an air quality monitor located at the Armistead Boothe Park, about 1,000 feet to the east-northeast of the Virginia Paving property (see "Draft Report on Ambient Air Quality Monitoring Cameron Station Alexandria, Virginia" by Marshall Miller & Associates Inc.) The average of the nine, 24-hour measurements of PM_{10} at this site was 49 $\mu g/m^3$, and the maximum was 71 $\mu g/m^3$. These measurements were collected on days when the PM levels were expected to be highest.

Our modeled results are quite consistent[7] with these August 2004 measurements: our highest, modeled, 24-hour, incremental impacts from the site and its operations, at receptors near this location, are 10 – 20 $\mu g/m^3$, which, combined with the highest background measurements at Doctor's Exchange in August 2004 of about 50 $\mu g/m^3$, give total maxima of about 70 $\mu g/m^3$.

Comparison between our results and the results of other models of the impacts of hot mix asphalt facilities.

The results of our study are similar to results reported by others. In particular, U.S. EPA has extensively tested, or overseen the testing of, hot mix asphalt production,[8] and the Agency and others have used these test results to assess environmental and public health impacts. U.S. EPA's study of hot mix asphalt production led the Agency to conclude that these facilities are minor sources of pollution.[9] Because emissions were found to be acceptably small, U.S. EPA withdrew its plans to develop National Emission Standards for Hazardous Air Pollutants from hot-mix asphalt plants (which standards would have been required if emissions had been larger). In other words, U.S. EPA

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[7] For several reasons, model predictions would not be expected to precisely match measured concentrations. Background levels fluctuate, meteorologic and other local factors vary, emissions scenarios do not perfectly mimic actual emissions, and dispersion models may tend to over-predict impacts, even given accurate input information.

[8] Many of these test results are available on the web at http://www.epa.gov/ttn/chief/ap42/ch11/related/c11s01.html and associated links, especially in the *Emission Assessment Report* at http://www.epa.gov/ttn/chief/ap42/ch11/related/ea-report.pdf.

[9] See *Federal Register*: February 12, 2002, Volume 67, Number 29, Pages 6521-6536, "National Emission Standards for Hazardous Air Pollutants: Revision of Source Category List Under Section 112 of the Clean Air Act," available at http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=2002_register&docid=02-3348-filed.pdf.

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determined that additional controls or emissions reductions, beyond those already in place, were not required.[10]

Community concerns

Our analyses have been geared toward addressing specific concerns raised both by community members and by City of Alexandria staff. Among these concerns are the following.

First, some residents in or near the Cameron Station development have reported malodors from time to time, especially noticeable in the early morning hours. The odors parse into two categories. First, there seems to be a "natural gas odorant" smell that arises occasionally, but Virginia Paving does not use natural gas: various investigations have been performed to try to identify the odor and track its source, but these have not been successful, and the odor at Cameron Station remains a mystery. Second, an asphalt-like odor is sometimes noticeable in the immediate area. Virginia Paving, and commercial trucks carrying hot mix asphalt, are the likely sources of this odor. Use of Ecosorb additives by the facility have partially mitigated the problem, and additional controls on site are expected to further reduce these odors.

Second, the use of spec oil as a fuel by this facility leads to somewhat higher levels of some air pollutants than would be emitted were the facility to burn natural gas, for example. Fortunately, the air quality modeling analyses reported here indicate that existing levels are still acceptably small, and so pose no significant risk to the environment or public health. More generally, the recycling and use of spec oil in hot mix asphalt production is an efficient, well-established method of handling this locally generated waste product.[11]

Third, dust from the facility has been raised as a concern by some. Dust control measures have been — and will be further — improved at the site, and measurements of PM emissions from the dryer stacks, silt-loading measurements on paved surfaces at the site, and modeling results indicate acceptably small impacts, both for total dust and for

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[10] In its *Federal Register* notice (p. 6522), U.S. EPA explained, "Emissions data, along with emission factors, were used to estimate hazardous air pollutant (HAP) emissions from eleven asphalt concrete manufacturing plants employing various production processes and different fuels. . . . Based on the above information, we have concluded that no asphalt concrete manufacturing facility has the potential to emit HAP approaching major source levels."

[11] *Per* U.S. EPA 530-F-94-008 *Collecting Used Oil for Recycling/Reuse*, "In the United States alone, an estimated 200 million gallons of used motor oil are improperly disposed of by being dumped on the ground, tossed in the trash (ending up in landfills), and poured down storm sewers and drains. Just one gallon of used oil has the potential to contaminate up to one million gallons of drinking water."

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inhalable particulate matter. Additional landscaping will further reduce off site dust migration.

Fourth, some community members have wondered whether the production of hot mix asphalt is compatible with nearby residential land uses. Although Alexandria is an increasingly densely occupied city, air quality modeling and measurements indicate that, with the exception of occasional ozone problems in the summer, primarily associated with the high volume of motor vehicles in and around the City (which problems plague large areas of the urban and suburban U.S.), air quality is good. With regard to hot mix asphalt production in general, there are some 3,600 hot mix asphalt plants in the U.S. (U.S. EPA, 2000, available at http://www.epa.gov/ttn/chief/ap42/ch11/related/ea-report.pdf), and many of these operate in or near residential neighborhoods.[12]

[12] Hot-mix asphalt is typically produced at temperatures of between 300 and 325 degrees Fahrenheit, and needs to be applied at no less than about 250 degrees. It must therefore be produced relatively close to where it is needed. This is why hot-mix asphalt is produced at many small facilities near population centers and roadways, rather than at a few large facilities at distant locations.

Uncertainties and overestimates

Like all modeling exercises, ours is not, and cannot be, entirely accurate. When modeling air quality, analysts attempt to over-predict impacts, and so to err on the side of public health. We have done so here.

In particular, we have overestimated impacts of fine particulate matter ($PM_{2.5}$). We and many others in the scientific and engineering community believe that regulatory compliance modeling of $PM_{2.5}$ is premature and likely to be especially inaccurate — particularly when modeled impacts are dominated by poorly characterized fugitive emissions of ordinary crustal material. Indeed, we know of no other hot mix asphalt facility that has been the subject of fugitive $PM_{2.5}$ impact modeling.

Regarding some of the special uncertainties involved in fugitive PM modeling, Dr. Thompson Pace (2003; at http://www.cleanairnet.org/caiasia/1412/articles-58212_resource_5.pdf) of U.S. EPA has noted:

> For a number of years air quality analysts have recognized that fugitive dust emission inventories, when coupled with air quality models, substantially overestimate $PM_{2.5}$ ambient crustal material when compared to the crustal material found in ambient samples. In the mid 1990's, the U.S. Environmental Protection Agency's (EPA) Office of Air Quality Planning and Standards (OAQPS) began to use, as an interim measure, a factor to 'adjust' the fugitive dust emission estimates in regional modeling analyses to obtain better agreement between the regional model results and ambient data. This adjustment was an ad hoc 'one value fits all' approach to reduce the disparity between modeling and ambient data but it did not address possible regional differences in the adjustment factor. The adjustment factor was conceived with the acknowledgement that an investigation was needed to identify what specific problems in the inventory and model were causing the discrepancy. Since the late '90s, the EPA has been actively working to understand the nature of those specific problems. Emphasis has been on developing a conceptual model of the potential dust removal processes near the source and on field work to evaluate the removal effectiveness. Much work has been accomplished and refinements to the 'divide-by-four' national factor are proposed, even as work continues to refine both the inventory methodology and models.

More recently, Pace (2004; at http://www.epa.gov/ttn/chief/conference/ei14/session5/pace.pdf) summarized the problems:

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> . . . the emissions inventory suggests that about one half of primary $PM_{2.5}$ emissions are from fugitive dust, and these emissions contribute to the overestimation of ambient $PM_{2.5}$ concentrations by air quality models. This overestimation creates problems for those involved in $PM_{2.5}$, regional haze and PM Coarse analyses. Most experts agree that this overestimation is due to a combination of shortcomings in the inventory-modeling process: 1) the multiplier used to "scale" or infer $PM_{2.5}$ from PM_{10} emissions in the inventory, 2) faulty emission factor algorithms, 3) imprecise or difficult to obtain activity data to apply these algorithms (including inability to account for the effect of actual meteorological conditions on emissions), and 4) modeling deficiencies (especially in the treatment of particles near their point of emissions).

Research in this area is extensive, ongoing, and unlikely to resolve the inaccuracies and over-estimates any time soon.

More generally, our modeling is based on several unrealistic assumptions, namely: (1) the facility will generate as much asphalt as it is legally permitted to produce, on an hourly, daily, and yearly basis (although actual production is less than these limits); (2) these maximal generation rates will coincide both with worst-case meteorologic conditions (so that dispersion is poorest) and with maximal generation of pollution from U.S. Filter, the Alexandria/Arlington Covanta waste-to-energy combustor, and the Washington Gas Light Company, combined; (3) the #2 fuel oil and spec oil used at the facility will contain that highest levels of impurities legally allowed (despite actual test data indicating cleaner-than-required quality); and (4) the air pollution control devices (such as the baghouses) will operate at the poorest efficiency legally allowed (although test results indicate better-than-permit performance).

Overall, then, the modeling results reported here, together with local and site-specific measurements, indicate that operations at the Virginia Paving Co. facility, *per* the proposed special use permit, result in no significant impacts on local air quality or public health.

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Appendix A

Protocol for Emission and Air Dispersion Modeling and Public Health Evaluation of the Virginia Paving Company Facility, Alexandria, Virginia

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Introduction

We plan to perform an emission and air dispersion modeling study to estimate pollutant concentrations in ambient air resulting from operation of the Virginia Paving Company's hot-mix asphalt plants, located at 5601 Courtney Avenue in Alexandria, Virginia. Like all industrial and commercial processes, the production of asphalt results in the emission of some amounts of pollutants to the atmosphere. Pollutant emissions disperse and are transported to locations away from the facility. The concentrations of pollutants in ambient air depend upon the rates of emission, the dispersion characteristics of the atmosphere, and various facility-specific and site-specific features.

Regulatory agencies such as the U.S. EPA and Virginia Department of Environmental Quality (DEQ) require major sources of air pollution to conduct modeling studies to demonstrate that emissions will not lead to unacceptable air quality impacts (such as exceedances of National Ambient Air Quality Standards, or NAAQS). Hot-mix asphalt plants are generally exempt from modeling requirements because they do not exceed emission thresholds that identify major sources. The assumption for minor air pollution sources, such as hot-mix asphalt plants, is that they are too small to cause unacceptable air pollution impacts.

The U.S. EPA has compiled extensive test data and information in reaching its determination that hot-mix asphalt plants are minor air pollution sources. These data and the same types of procedures used to evaluate major air pollution sources may be applied to minor air pollution sources such as hot-mix asphalt plants. Two basic steps are involved. First, sources of pollution are identified, and quantitative estimates of emissions are calculated based on facility-specific operating data (such as the amount of asphalt produced) and emission factors that reflect industry-wide testing of hot-mix asphalt plants. Second, dispersion modeling is used to estimate the concentrations of pollutants in ambient air that will result from emissions at the facility.

Standard procedures are used to estimate pollutant emissions and dispersion from the Virginia Paving Company facility, tailored to the extent possible to simulate typical operating procedures of the facility. For example, facility-specific data on asphalt production volumes are used to apportion emissions among various months of the year, and emissions tied to asphalt production are weighted toward the plant's daily production schedule (including both day and night operations). Additionally, two sets of calculations are modeled, one set based on likely asphalt production volumes, and another set based on maximum permitted production volumes.

Emission Sources

Various processes and activities at hot-mix asphalt plants emit pollutants. The Virginia Paving Company operates two asphalt production plants (Plant 1 and Plant 2) at its Alexandria site. Each of these plants produces hot-mix asphalt by heating and drying aggregate material (stone and sand) and combining it with liquid asphalt cement and recycled asphalt pavement (RAP, as recovered from existing roads or other asphalt surfaces). Once produced, the hot-mix asphalt is transferred into storage silos. The hot-mix asphalt is dropped into delivery trucks stationed under the silos, and then transported to its point of application. Figure 1 depicts a process schematic for a hot-mix asphalt plant (as taken from the U.S. EPA's Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, commonly referred to as "AP42"), and Figure 2 delineates the components of the two plants at the of the Virginia Paving Company facility.

The main emission source of each plant is the exhaust stack of the aggregate dryer, which generates heat by burning oil (principally on-specification waste oil, or "spec oil"). The other ducted emission source at the facility is the hot oil heater, which burns a smaller quantity of spec oil to keep the liquid asphalt cement and spec oil above ambient temperature.

In addition to the ducted sources, there are several fugitive emission sources relevant to the Virginia Paving Company facility. Fugitive emissions include vapors and particulate matter (PM, some of which is inhalable, or PM10, PM2.5, etc., and some of which is too large to inhale, such as visible dust). The major emission sources of vapors are (1) the vent effluents located at the tops of the asphalt storage silos, (2) vent effluents from the asphalt cement storage tanks, and (3) emanations from the loadout of hot-mix asphalt onto trucks and additional escape of vapors from the freshly loaded trucks. Fugitive PM emissions arise from the handling of aggregate as it is dropped from conveyors, loaded onto and out of trucks, and moved and dropped by front-end loaders. PM emissions also arise from travel on roads and surfaces and from wind erosion of storage piles.

Emission Quantification

Pollutants of potential concern vary among the emission sources, as do the techniques and data used to estimate their emission rates from the Virginia Paving Company facility. Most of the emission sources are tied directly to the level of asphalt production at the facility. Two different production scenarios are considered. First, a baseline scenario is designed to simulate as close as possible the manner in which the facility has historically operated (and is expected to continue to operate). An assumed production volume of 900,000 tons of hot-mix asphalt, as achieved in calendar year 2004, is assumed for the baseline scenario, accompanied by the consumption of 65,000 gallons of spec fuel in the hot oil heater. Although these quantities are not likely to increase, they are legally allowed to do so by the provisions of the air emissions permit held by the Virginia Paving Company facility. Consequently, a permit limit scenario is also developed to estimate potential air quality impacts associated with hypothetical facility operation at its permit limits, which allow for annual production of 1,500,000 tons of hot-mix asphalt and consumption of 225,000 gallons of spec oil in the hot oil heater.

Both seasonal and diurnal variation of emissions are considered to match the actual operating patterns of the Virginia Paving Company facility. The seasonal pattern is captured by assuming that emissions are proportional to monthly production volume. A plot of the monthly production rates for plants 1 and 2 is provided in Figure 3, as based on actual operations from January 2002 through June 2004. Additionally, emissions during the day and night are tied to typical hours of operation. The Virginia Paving Company normally produces hot-mix asphalt during three periods: a daytime production run from 5:30 AM to 4:00 PM, an evening production run from 6:00 PM to 10:00 PM, and a nighttime production run from 1:00 AM to 3:00 AM. Asphalt deliveries from the silos occur over somewhat different periods, a daytime period from 7:00 AM to 5:00 PM, an evening period from 7:00 PM to 11:00 PM, and a nighttime period from 2:00 AM to 3:30 AM. This cycle, of course, relates to historical operations prior to the recent cessation of nighttime production. Current daytime-only operations will also be modeled. Activities such as RAP crushing and aggregate unloading from train cars are assigned to daytime hours, as these activities are not normally undertaken at night. Sources such as the hot oil heater operate more or less continuously independent of production.

Table 1 summarizes the major emission sources of the Virginia Paving Company facility and provides information on the data to be used to estimate pollutant emissions for each. Emission rates will be estimated based on AP42 emission factors, with facility-specific data used when possible.

Dispersion Modeling

The Industrial Source Complex Short Term (ISCST3) model will be used to predict pollutant dispersion. ISCST3 is recommended by the U.S. EPA as a refined air dispersion model. Regulatory default settings will be used. The rural land use option will likely be used based on initial examination of local land use characteristics, pending application of Auer's method for land use determination and discussion with VADEQ on the use of urban parameters. Point (stack) emission sources will be evaluated for plume downwash. The stack/building-specific dimensions required by the ISCST3 model will be determined using the U.S. EPA's BPIP preprocessor program. A five-year set of meteorological data for the Washington National Airport (the closest meteorological station to Alexandria) will be considered to capture the long-term array of meteorological data. The Washington National Airport surface observations will be processed along with upper air data collected at Sterling, Virginia within the U.S. EPA's PCRAMMET program.

Since there are multiple pollutants to be modeled, the ISCST3 model will be run with nominal emission rates for each source and the results will be scaled according to pollutant-specific emission rates. Output will be generated for a variety of different averaging periods (1-hour, 3-hour, 8-hour, 24-hour, and long-term) consistent with pollutant-specific standards and toxicity data and assumptions.

Pollutant concentrations will be modeled at a variety of receptor locations in the vicinity of the Virginia Paving Company facility. Categories of receptors to be distinguished include residential, industrial/commercial, and special interest (schools and parks). The nearby residential and industrial/commercial receptor areas will be modeled using a small grid of locations; special receptors will be modeled at single locations. The base elevation of each receptor will be determined using the electronic topographic maps and TOPO! software (National Geographic Society). Additionally, flagpole receptors will be considered at various locations, as much of the housing stock in the Cameron Station and Summer's Grove developments is multi-story. A preliminary figure of receptor locations is provided in Figure 3.

Public Health Evaluation

The predicted pollutant concentrations due to emissions from the Virginia Paving Company facility will be evaluated in two ways. For criteria pollutants, total pollutant concentrations, calculated as the *sum* of facility-specific impacts plus representative background levels, will be compared to the appropriate National Ambient Air Quality Standards. Background concentrations will be selected from recent, nearby monitoring data. Background locations within a few miles of the Virginia Paving Company facility at which ambient air quality data are collected include the Alexandria Health Department,. Lee District Park, Doctor's Exchange, the Mt. Vernon Fire Station.

Hazardous Air Pollutants (HAPs) and other air toxics (non-criteria pollutants) will be evaluated according to standard human health risk assessment practices. Calculations will be developed for chronic health effects (typically the most sensitive endpoints) based on long-term exposure considerations. Two types of calculations will be performed.

First, theoretical, incremental, lifetime risks of cancer will be estimated for pollutants that are known or suspected to be human carcinogens (at much larger concentrations or exposures). Estimates of the carcinogenic potencies of each chemical will be derived from standard sources, such as U.S. EPA's Integrated Risk Information System (IRIS). A 30-year exposure period to facility-generated pollutant concentrations will be assumed, in accordance with standard risk assessment practices. Incremental risk estimates smaller than 1 in 100,000 will be assumed to be insignificant.

Second, risks of chronic health effects *other* than cancer will be estimated, again using standard practices. In particular, predictions of long-term concentrations of pollutants due to Virginia Paving Company emissions will be compared with "reference concentrations," which by design represent concentrations that can be safely breathed on a continuous basis with no appreciable risk of adverse health effects. This comparison will yield a "hazard ratio," which is simply the predicted incremental pollutant concentration divided by the reference concentration. For any individual pollutant, a hazard ratio less than one indicates that adverse health risks are unlikely, while a hazard ratio greater than one indicates a potential for concern (though not necessarily a likelihood of health risk, depending upon the levels of safety embodied in the reference concentration).

Conclusion

The purpose of this exercise, of course, is to determine whether impacts from the site, as it currently operates, are or are not acceptably small with regard to protection of public health. If they are not, modeling of altered conditions (such as a taller exhaust stack, reduced hot mix asphalt production, or reduced reliance on spec oil) may be conducted.

Table 1 Summary of emission sources from the Virginia Paving Company facility

Source description		Modeled location (center) [A]	Source type (for modeling)	Pollutants of concern [B]	Relevant parameters		Diurnal pattern [E]
Dryer stacks	Plant 1	314,968E 4,297,096N	Point	Criteria pollutants CO, NO_x, TSP, PM_{10}, and $PM_{2.5}$ from recent stack test data; other criteria pollutants and HAPs per AP42 Tables 11.1-7, 8, 10, and 12	Stack parameters: 367°K, 1.89 m effective diameter, flow velocity 8.24 m/s (stack test)	Downwash analysis to include the following buildings/structures: Plant 1 baghouse, Plant 1 silos, Plant 2 baghouse, Plant 2 silos, lime silo, asphalt storage tanks and liquid fuel tanks, aggregate storage structure, and US Filter storage tanks	Day/night production
	Plant 2	315,016E 4,297,163N			Stack parameters: 396°K, 1.19 m effective diameter, flow velocity 11.41 m/s (stack test)		Day/night production
Hot oil heater stack		315,015E 4,297,137N	Point	Criteria pollutants & HAPs per AP42 in Chapter 1.11	Stack parameters: 589°K, 0.43 m effective diameter, flow velocity 0.047 m/s (estimated)[D]		Continuous
Loadout and yard emissions from asphalt vapors	Plant 1	314,977E 4,297,083N	Fugitive volume	Criteria pollutants & HAPs per AP42 Tables 11.1-13 through 11.1-16	An source reduction factor will be applied to loadout emissions to account for addition of "Blue Smoke" control system.		Day/night operations
	Plant 2	314,982E 4,297,150N					
Storage silo vents	Plant 1	314,974E 4,297,088N	Fugitive volume	Criteria pollutants & HAPs per AP42 Tables 11.1-13 through 11.1-16	An source reduction factor will be applied to silo venting emissions to account for addition of "Blue Smoke" control system.		Day/night operations
	Plant 2	314,973E 4,297,148N					
Asphalt cement tank vents		315,028E 4,297,153N	Fugitive volume	Criteria pollutants & HAPs per AP42 Tables 11.1-13 through 11.1-16			Continuous

Table 1 Summary of emission sources from the Virginia Paving Company facility

Source description	Modeled location (center) [A]	Source type (for modeling)	Pollutants of concern [B]	Relevant parameters	Diurnal pattern [E]
Recycled asphalt pavement (RAP) crushing	315,152E 4,297,165N	Fugitive area	Particulate matter[C] AP42 Table11.19.2-1	AP42 factor for controlled tertiary crushing: TSP: 0.0006 kg/Mg PM_{10}: 0.00027 kg/Mg $PM_{2.5}$: 0.00005 kg/Mg	Daytime
Material handing (batch or continuous drop operations)	Aggregate storage piles in, and to the south of the Stone Bins (Figure 2); rail loadout, conveyors, hoppers and	Fugitive area	Particulate matter[C] AP42 section 13.2.4.3	AP42 equation : $Ed(kg/Mg)=0.35\times0.0016\times(\frac{U}{2.2})^{1.3}\times(\frac{M}{2})^{1.4}$ Utilize material-specific moisture content, M, for each type of aggregate. Wind speed, U, and hour of operation dependent.	Day/night dependent on production
Material handing (bulldozing)	Aggregate storage piles in, and to the south of the stone bins. RAP storage piles are to the west of Courtney Ave. and at the eastern end of the facility.	Fugitive area	Particulate matter[C] AP42 Table11.9-2	AP42 equation for overburden inTable11.9-2: $Ed(kg/hr)=k\times(\frac{s}{2.2})^{a}\times(\frac{M}{2})^{b}$ Utilize material-specific silt content, s, and moisture content, M, for each type of aggregate. Parameters k, a, and b are particle size dependent. Hour of operation dependent.	Daytime
Wind erosion from storage piles	Same areas as Material Handling (bulldozing) above.	Fugitive area	Particulate matter[C] AP42 section 13.2.5.3	AP42 equations 13.2.5.3 (1) and (3) [F]: $u(z)=\frac{u*}{0.4}\ln\frac{z}{z_o}$ $Ew=k\times(58(u^*-u_t^*)^2+25(u^*-u_t^*))$ Threshold velocity, u_t*, is dependent on storage pile roughness; no emission occur at wind speeds below threshold velocity. Parameter k is particle size dependent.	Evaluated every hour, emissions only occur during high winds

Table 1 Summary of emission sources from the Virginia Paving Company facility

Source description	Modeled location (center) [A]	Source type (for modeling)	Pollutants of concern [B]	Relevant parameters	Diurnal pattern [E]
Paved area travel	Paved area emissions will be modeled as being to be to the west of the Stone Bins (Figure 2)	Fugitive area	Particulate matter[C] AP42 section 13.2.1.3	AP42 equation 13.2.1.3 (1): $Ep(g/VMT)=k\times(\frac{sL}{2})^{0.65}\times(\frac{W}{3})^{1.5}$ Factor k is particle size specific multiplier. Emission reduction factor of 0.5 will be applied to account for roadway sweeping and wetting.	Day/night dependent on production
Unpaved area travel	Paved area emissions will be modeled as being to be to the east of the western end of the Stone Bins (Figure 2)	Fugitive area	Particulate matter[C] AP42 section 13.2.2.2	AP42 equation 13.2.2, (1a): $Ep(g/VMT)=k\times(\frac{sL}{12})^{a}\times(\frac{W}{3})^{b}$ Parameter s k, a, and b are particle size dependent.	Daytime

Notes:

[A] Values are UTM zone 18, NAD83 coordinates, in meters.

[B] Criteria pollutants include particulate matter, nitrogen oxides, sulfur dioxide, carbon monoxide, and lead, for which National Ambient Air Quality Standards have been established. HAPs include pollutants that have been designated as Hazardous Air Pollutants in the context of the Clean Air Act as well as other non-criteria pollutants that have been measured in hot-mix asphalt plant emissions.

[C] Particulate matter includes Total Suspended Particulate (TSP), PM_{10} (particulate matter less than 10 µm aerodynamic diameter), and $PM_{2.5}$ (particulate matter less than 2.5 µm aerodynamic diameter).

[D] The flow velocity of the hot oil heater was estimated using Equation 2.4-2 from EPA AP42 Chapter 1.3 Related EIIP Document. The hot oil heater stack is covered to keep out rainwater, forcing the flow around the lid. The effective diameter is estimated by assuming the area of the emitted gas doubles to go around the lid.

[E] Day/night dryer production from 5:30AM to 4:00PM, 6:00PM to 10:00PM, 1:00AM to 3:00AM; day/night silo and loadout from 7:00AM to 5:00PM, 7:00PM to 11:00PM, 2:00AM to 3:30AM; Continuous 24 hours per day.

[F] Fastest mile of the day wind speeds area only available from Washington National Airport for the modeled year 1984; fastest mile of the day speeds for other years will be estimated on the fastest hourly speed for each day and a correlation between fastest mile of the day speeds and fastest hourly speeds from the available 1984 data.

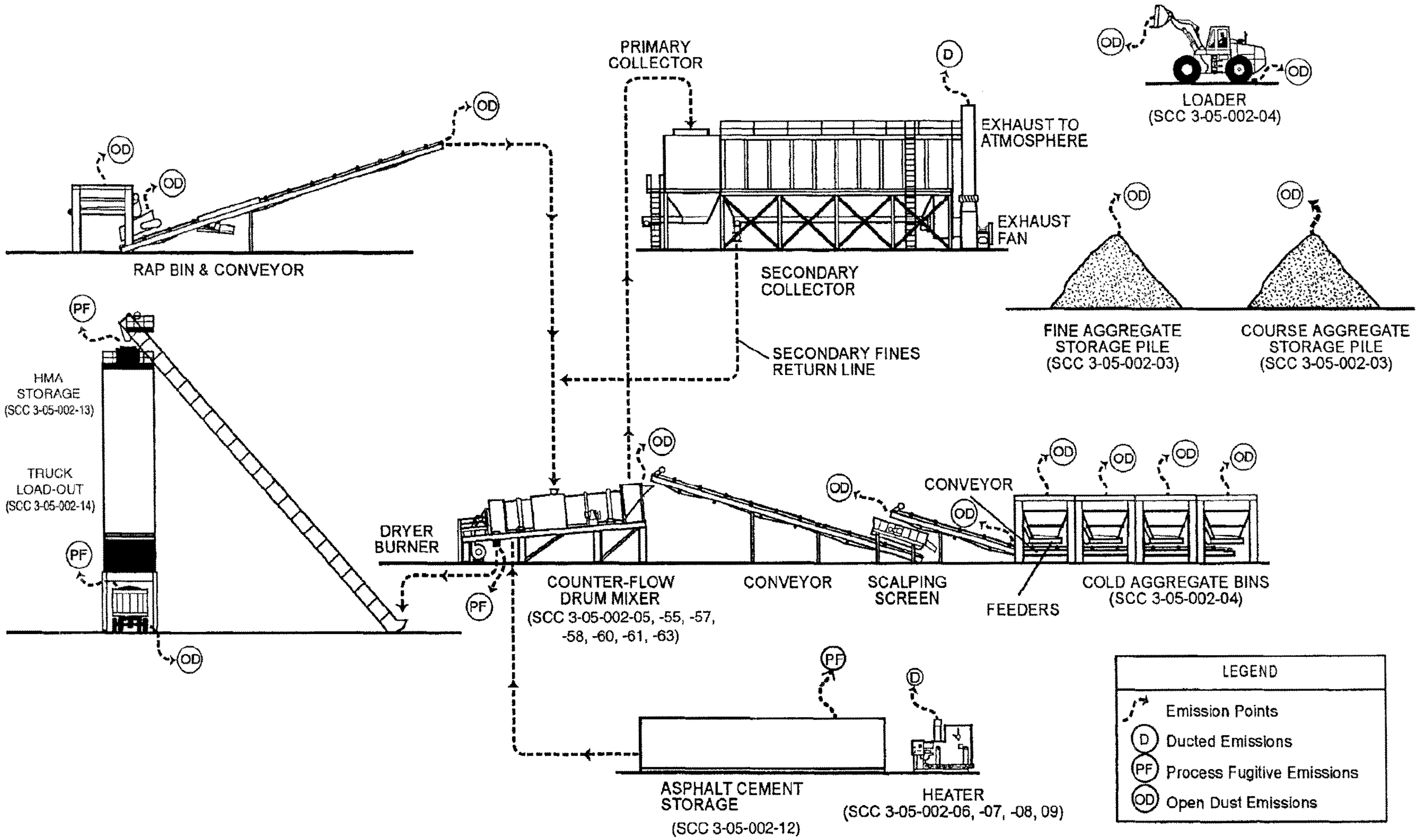
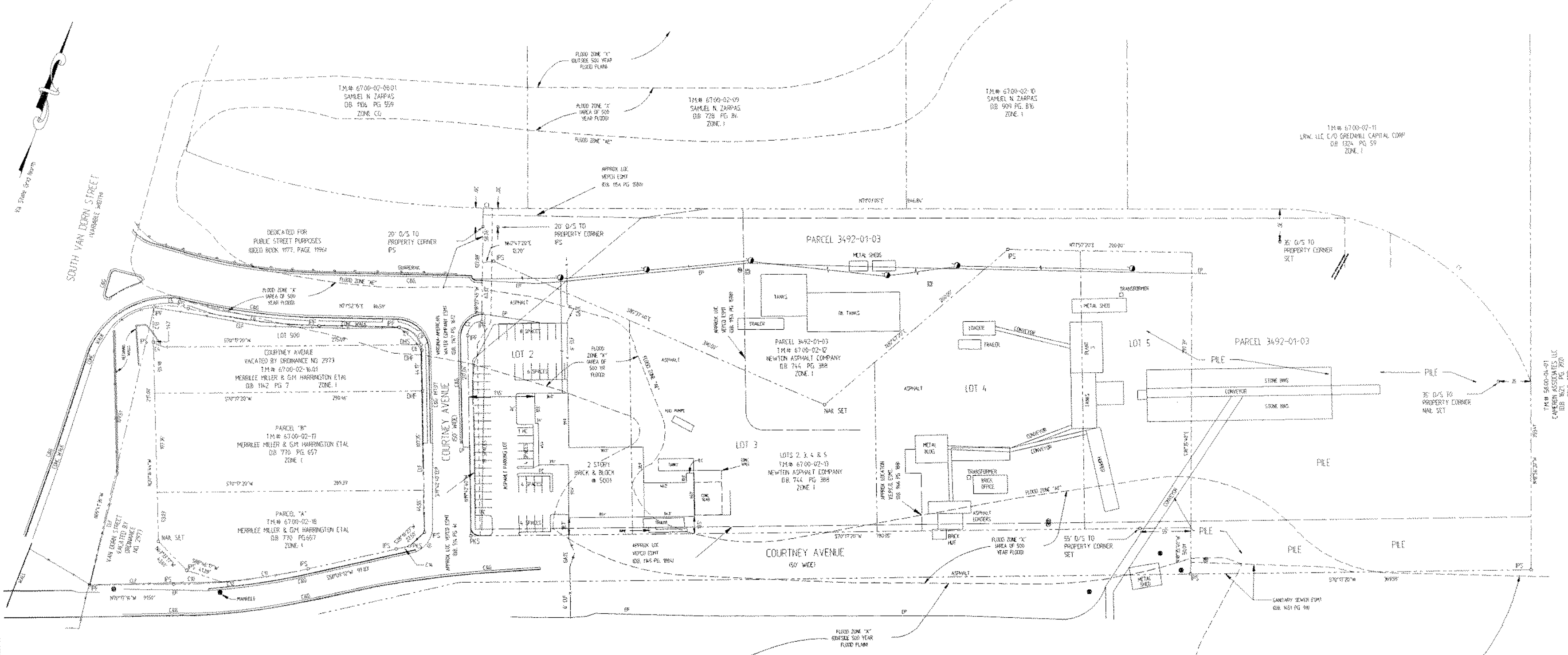


Figure 1 Schematic of a hot-mix asphalt plant (Figure 11.1-2 from U.S. EPA's AP42 document).



AREA TABULATION

PARCEL 3492-01-03	213,500	SF	OR	4.9013	AC
LOTS 2, 3, 4 & 5	188,347	SF	OR	4.3239	AC
LOT 500	7,828	SF	OR	0.1797	AC
COURTNEY AVENUE VACATED	14,559	SF	OR	0.3342	AC
PARCEL "B"	31,124	SF	OR	0.7145	AC
PARCEL "A"	23,023	SF	OR	0.5285	AC
VAN DORN STREET VACATED	12,416	SF	OR	0.2850	AC
TOTAL AREA	490,797	SF	OR	11.2671	AC

CURVE TABLE

CURVE	RADIUS	LENGTH	TANGENT	CHORD	BEARING	DELTA
1	292.00'	350.30'	199.69'	329.67'	S74°36'55"E	68°44'05"
2	15.00'	23.97'	15.41'	21.50'	N26°04'48"E	91°33'36"
3	1,000.00'	16.16'	8.07'	16.16'	N71°27'33"E	00°55'29"
4	25.00'	16.38'	8.50'	16.09'	S89°02'49"W	37°32'28"
5	89.00'	37.39'	18.98'	37.12'	N12°48'49"E	24°04'26"
6	633.00'	143.38'	72.00'	143.06'	N78°21'36"E	12°58'42"
7	25.00'	32.70'	19.16'	30.42'	S70°39'44"E	74°56'04"
8	25.00'	5.88'	2.96'	5.87'	S26°27'09"E	13°27'04"
9	25.00'	38.58'	24.32'	34.86'	S63°55'12"E	88°25'08"
10	696.20'	53.65'	26.84'	53.64'	S68°04'47"W	04°24'56"
11	696.20'	93.79'	46.97'	93.72'	S62°00'46"W	07°43'08"
12	696.20'	147.44'	74.00'	147.17'	S64°12'13"W	12°08'04"
13	380.00'	36.73'	18.37'	36.70'	N17°30'41"W	05°32'18"
14	736.20'	14.67'	7.34'	14.67'	S58°43'26"W	01°08'30"

NOTES

1. NO TITLE REPORT FURNISHED. THE PROPERTY DELINEATED HEREON IS SUBJECT TO EASEMENTS AND RESTRICTIONS OF RECORD.
2. THE PROPERTY DELINEATED HEREON IS SHOWN ON THE CITY OF ALEXANDRIA TAX ASSESSMENT MAP AS PARCELS 6704-02-12, 13, 17, 18 & 20, ALL OF WHICH ARE ZONED I - INDUSTRIAL.
3. THE PROPERTY DELINEATED HEREON IS LOCATED IN FLOOD ZONE "AE" (AREA OF 100 YEAR FLOOD, BASE FLOOD ELEVATION DETERMINED), FLOOD ZONE "X" (AREA OF 500 YEAR FLOOD), AND FLOOD ZONE "X" (AREA OUTSIDE THE 500 YEAR FLOOD PLAIN) AS SHOWN ON THE FLOOD INSURANCE RATE MAP OF ALEXANDRIA AS PREPARED BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY, COMMUNITY PANEL NUMBER 515519-0005 D, DATED MAY 15, 1991.

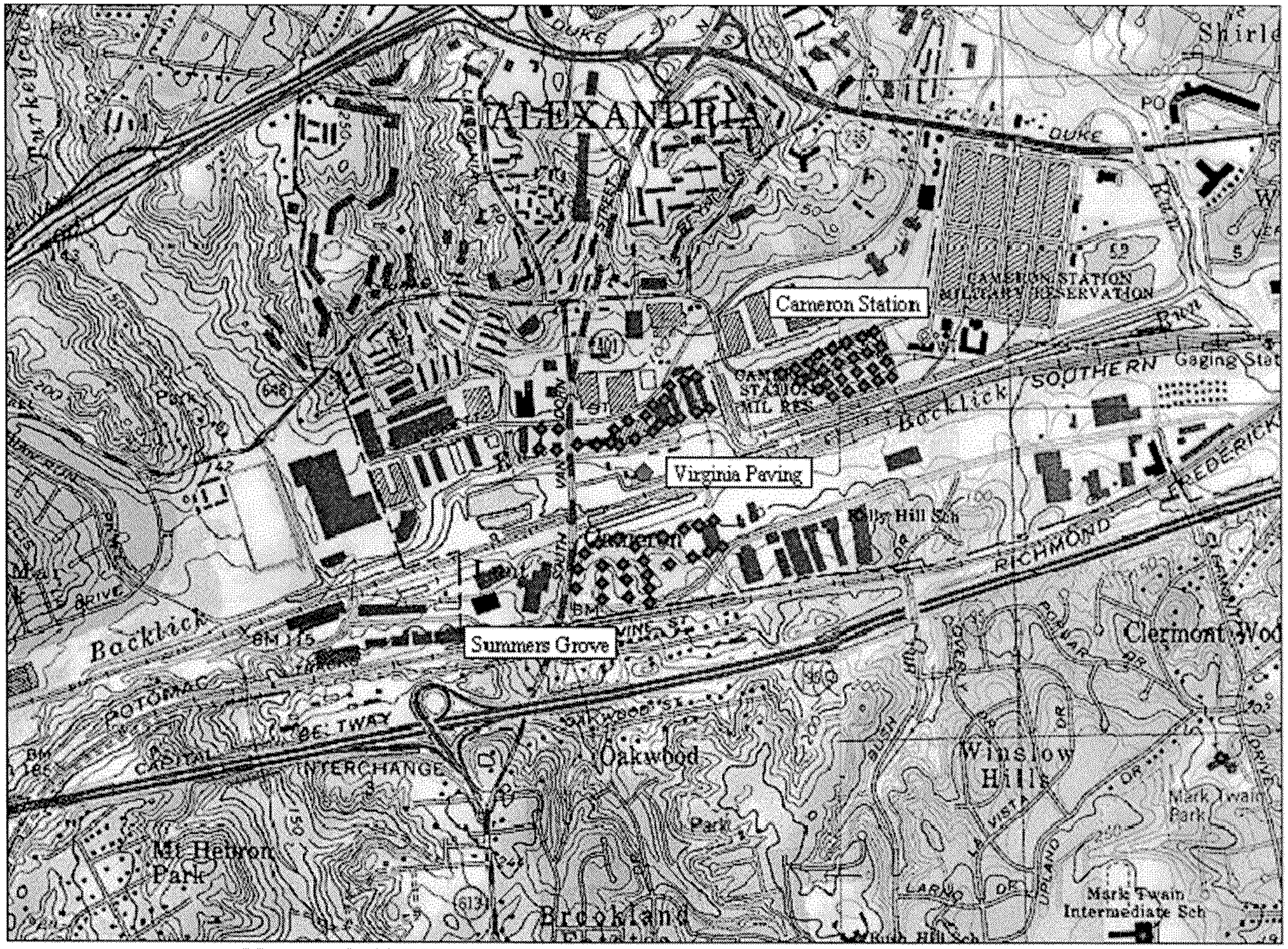
LEGEND

DHF	DRILL HOLE FOUND
IPF	IRON PIPE FOUND
IPS	IRON PIPE SET
PKS	PK NAIL SET
O/S	OFFSET
DB	DEED BOOK
PG	PAGE
EP	EDGE OF PAVEMENT
FC	FACE OF CURB
C&G	CURB & GUTTER
TM	TAX MAP
APPROX	APPROXIMATE
LOC	LOCATION
VEPCO	VIRGINIA ELECTRIC & POWER COMPANY
ESMT	EASEMENT
HC	HANDICAP SPACE
CLF	CHAIN LINK FENCE

GRAPHIC SCALE

Figure 2 11-3-05

A-9



Map created with TOPO!® ©2003 National Geographic (www.nationalgeographic.com/topo)

Figure 3. Receptor locations for ISC modeling.

Appendix B

Summary Results of an Emission and Air Dispersion Modeling Study and Public Health Evaluation of the Virginia Paving Company Facility, Alexandria, Virginia

Michael R. Ames, Sc.D., Stephen G. Zemba, Ph.D., P.E., and
Laura C. Green, Ph.D., D.A.B.T.
Cambridge Environmental Inc.

September 30, 2005

Per our Protocol of September 13, 2005, dispersion modeling of criteria pollutants was performed separately for each of the various sources at Virginia Paving, and the maximum predicted incremental concentrations were identified. For the gaseous criteria pollutants and lead all or almost all of the emissions are from the dryer stacks and the hot oil heater vent. For these pollutants the maximum predicted increments from each source were summed to derive a screening-level maximum increment, ignoring potential time and space incongruities (*i.e.*, the fact that the maximum impacts from the different sources may occur at different locations and time periods). The maximum impacts of gaseous criteria pollutants emitted from the Virginia Paving facilities are shown in Tables 1 for typical operating conditions and in Table 2 for maximum permitted operating conditions. The Tables also show the applicable National Ambient Air Quality Standards (NAAQS), locally measured levels and the sum of the plant's impact and measured background levels.

Table 1. Maximum gaseous criteria pollutant impacts from Virginia Paving emissions compared with applicable NAAQS, measured background levels and total of impacts plus background. Impacts assume day, evening, and night operating schedule at current typical annual and daily production rates (900,000 tons per year, 675 tons per hour, 16.5 hours per day).

Pollutant and averaging time ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	Background ($\mu g/m^3$)	Virginia Paving Impact ($\mu g/m^3$)	Total ($\mu g/m^3$)
NO_x - Annual	100	45.1	1.2	46.3
CO - 8-hour	10000	2290	955	3240
CO - 1-hour	40000	5710	3030	8740
SO_2 - Annual	80	15.7	1.2	16.9
SO_2 - 24-hour	365	55	72	127
SO_2 - 3-hour	1300	159	336	496
Pb - Quarterly (annual)	1.5	0.013	0.002	0.015

Table 2. Maximum gaseous impacts from Virginia Paving emissions of gaseous criteria pollutants and lead compared with applicable NAAQS, measured background levels and total of impacts plus background. Impacts assume day, evening, and night operating schedule at current permitted annual and daily production rates (1,500,000 tons per year, 1,000 tons per hour, 24 hours per day).

Pollutant and averaging time ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	Background ($\mu g/m^3$)	Virginia Paving Impact ($\mu g/m^3$)	Total ($\mu g/m^3$)
NO_x - Annual	100	45.1	2.3	47.3
CO - 8-hour	10,000	2,290	1,395	3,685
CO - 1-hour	40,000	5,710	4,390	10,100
SO_2 - Annual	80	15.7	2.4	18.1
SO_2 - 24-hour	365	55	165	220
SO_2 - 3-hour	1,300	159	575	734
Pb - Quarterly (annual)	1.5	0.013	0.006	0.019

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Because emissions of particulate matter from Virginia Paving come from a wide variety of sources which are spread around the facility's property, the impacts of these pollutants were estimated at each special receptor location and averaging period. The maximum, annual average facility impacts of these particulate pollutants at the residential receptor locations are shown in Table 3; the maximum 24-hour average facility impacts of these particulate pollutants are shown in Table 4. The PM emission rates used to predict these impacts were based on reasonable but still fairly conservative (*i.e.*, overpredictive) modeling assumptions. These assumptions include the use of a flat surface to model windblown dust emissions and a maximum estimate of the distance trucks travel over paved surfaces at the facility. A default efficiency of 90% for the silo, loadout, and storage control system (the 'blue smoke' system) has been applied in the revised maximum operating conditions cited in Table 4. The values in Tables 3 and 4 do not include emissions from diesel engines at the facility, or from the oil heater at US Filter.

Table 3. Maximum annual $PM_{2.5}$ and PM_{10} impacts of the total Virginia Paving emissions at current typical annual production rate (900,000 tons per year) and measured stack gas TSP concentrations (0.014 grains per dry standard cubic foot); and at revised maximum annual operations (1,500,000 tons per year); taller stacks of 20 meters for each of the dryers (current heights are 14.1 m and 14.6 m), and 6 m for the hot oil heater (current height is 2.95 m); 125,000 gallons per year hot oil heater fuel usage; and maximum stack gas TSP concentrations of 0.03 grains per dscf (current level is 0.014 grains per dscf).

Pollutant and averaging time (μg/m^3)	NAAQS (μg/m^3)	Background (μg/m^3)	Virginia Paving Impact (μg/m^3)	Total (μg/m^3)
TSP - annual current typical operations	75*	—*	15	—
TSP - annual revised maximum operations	75*	—*	25	—
PM_{10} - annual current typical operations	50	21	4	25
PM_{10} - annual revised maximum operations	50	21	6	27
$PM_{2.5}$ - annual current typical operations	15	13.4	0.8	14.2
$PM_{2.5}$ - annual revised maximum operations	15	13.4	1.3	14.7

* Total Suspended Particulate Matter is no longer a criteria pollutant. The former annual NAAQS for TSP is 75 μg/m^3. Ambient TSP measurements have not been taken in Virginia as part of the NAAQS program since 1990.

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Table 4. Maximum 24-hour $PM_{2.5}$ and PM_{10} impacts of the total Virginia Paving impacts for selected pollutants, plant operating conditions, and modeling conditions. Taller stacks are 20 meters tall for each of the dryers (current heights are 14.1 m and 14.6 m), and 6 m for the hot oil heater (current height is 2.95 m). Revised maximum emission conditions are 0.03 grains/dscf total stack PM gas concentration (current level is 0.014 grains/dscf), 125,000 gallons per year hot oil heater fuel usage, and 13,000 tons per day asphalt production.

Pollutant and averaging time (μg/m³)	NAAQS (μg/m³)	Background (μg/m³)	Total Virginia Paving Impact (μg/m³)	Total (μg/m³)
$PM_{2.5}$ - 24-hour current typical operations	65	35.3	20.5	55.8
$PM_{2.5}$ - 24-hour current typical operations, urban dispersion conditions	65	35.3	9.3	44.6
$PM_{2.5}$ - 24-hour, taller stacks, revised maximum emission conditions	65	35.3	28.5	64
PM_{10} - 24-hour current typical operations	150	52	54	106
PM_{10} - 24-hour current typical operations, urban dispersion conditions	150	52	15	67
PM_{10} - 24-hour, taller stacks, revised maximum emission conditions	150	52	67	119

Particulate matter emissions from the facility were also modeled over a 6 km square centered at the facility with receptors spaced on a 100 meter grid. The 5-year average increments to the PM levels were estimated. Figure 1 shows the annual average PM_{10} due to the facility's emissions over the 6 km grid.

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A comparison of the increments due to dryer and heater stack emissions, and from the venting and loadout emissions was made for the facility's operating under its previous schedule which included evening and nighttime operations, and under its current schedule which includes only daytime operation. The difference between these two operating schedules was small. PM_{10} impacts averaged over the entire 6km grid for day/night operations were slightly lower (97%) compared with the average impacts for day only operations. The maximum ratio of day/night to day only impacts was 1.07; the minimum ratio was 0.87.

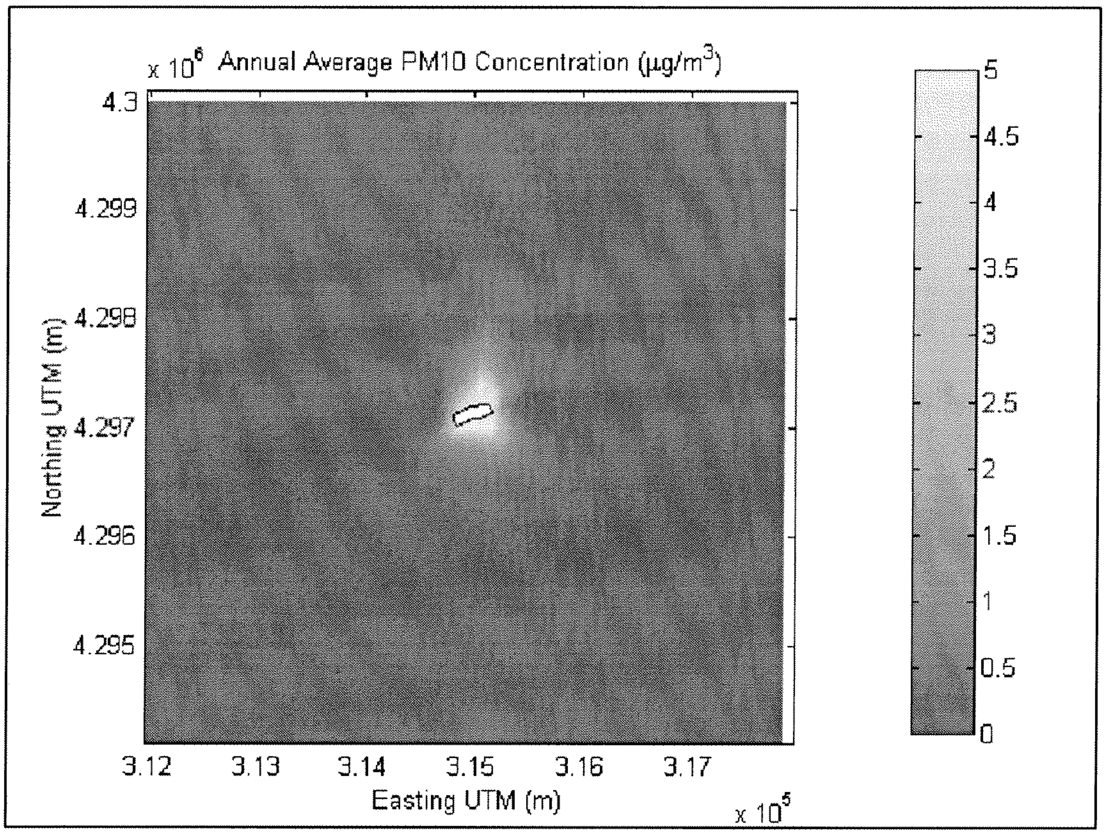

Figure 1. Estimated annual average PM_{10} impacts from the Virginia Paving facility in Alexandria, Virginia. Impacts are based on typical facility operating conditions. The facility property is within the white area in the center of the figure.

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The PM_{10} impacts of the facility were also modeled at 21 locations along the facility's property boundary or fenceline. This model included refined estimates for some of the facility's emissions as well as somewhat more restrictive operating conditions. The conditions described with Table 4 were applied with the addition of the use of the following

- use of #2 fuel oil in the hot oil heater,
- a limit of 100,000 gallons of fuel for the hot oil heater per year,
- the application of a 99% control efficiency for the 'blue smoke' system (as cited by the system's vendor),
- the addition of enclosures at all but one of the locations where the aggregate is dropped from conveyors or vehicles,
- a more realistic estimate of the total vehicle miles traveled per day by truck on the facility property,
- the application of a 75% control efficiency watering and vacuuming of the paved roadways,
- the application of a 90% control efficiency watering unpaved surfaces,
- the inclusion of a emission reduction factor of 0.2 in estimating windblown dust emissions to account for the fact that the aggregate piles are conical rather than flat,
- the addition of emissions from diesel engines at the facility, as well as from the hot oil heater at U.S. Filter.

With these additional refinements and conditions, the maximum estimated 24-hour PM_{10} impact at the facility fenceline is 84 $\mu g/m^3$ which when added to the maximum measured value of 24-hour PM_{10} in Alexandria of 52 $\mu g/m^3$ gives a total of 136 $\mu g/m^3$, which is below the 24-hour PM_{10} NAAQS of 150 $\mu g/m^3$.

The emissions and dispersion conditions employed for modeling gaseous criteria pollutants in Tables 1 and 2 were also applied to assess the potential health effects of hazardous pollutants emitted from the facility. The maximum hazard indices and incremental lifetime cancer risks for various exposure scenarios are given in Table 5.

Table 5. Maximum Hazard Indices and incremental lifetime cancer risks due to emissions from Virginia Paving.

Receptor	Maximum Hazard Index	Maximum incremental lifetime cancer risk
Maximum residence current production rate	0.08	1.2E-06
Maximum residence permitted annual production rate	0.2	2.4E-06
Maximum Commercial/industrial current production rate	0.6	1.8E-06
Maximum Commercial/industrial permitted annual production rate	1	3.5E-6
Nearest school current production rate	0.04	1.1E-07
Nearest school permitted annual production rate	0.07	2.2E-07
Nearest park current production rate	0.03	1.1E-07
Nearest park permitted annual production rate	0.08	2.6E-07

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Addendum to

Results of an Emission and Air Dispersion Modeling Study and Public Health Evaluation of the Virginia Paving Company Facility 5601 Courtney Avenue Alexandria, Virginia

Michael R. Ames, Sc.D., Stephen G. Zemba, Ph.D., P.E., and
Laura C. Green, Ph.D., D.A.B.T.
Cambridge Environmental Inc.

December 7, 2005

Evaluation of Toxic Air Pollutants

Upon detailed review of our spreadsheets, we discovered that another toxic air pollutant, namely, lead, exceeded an hourly (but not yearly) emission exemption limit, as set forth by Virginia DEQ in its *New Source Review Permits Program Manual* (available at http://www.deq.virginia.gov/air/pdf/air/airguide.pdf). Thus, hourly ambient air impacts from lead were modeled, and the estimated impacts compared to the DEQ's hourly Significant Ambient Air Concentration (SAAC) for lead. The results of this modeling appear below, and show that impacts from lead are also acceptably small.

Table 19. Modeling results, lead (Pb), 1-hour averaging period

Pollutant	**Lead (Pb)**		
Averaging period	1-hour		
Statistical metric	Highest hourly value at each receptor		
Sources	Dryer stacks and hot oil heater		
Maximum predicted concentration (at any receptor)			
Modeling year	Concentration ($\mu g/m^3$)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	0.068	-193	-230
2001	0.068	0	750
2002	0.065	-193	-230
2003	0.063	100	118
2004	0.066	-193	-230
Highest of all	**0.068**	0	750
Significant Ambient Air Concentration (SAAC)	**7.5**		

Files on the CD, VA Paving Assessment

The main directory of the CD contains our report and a short addendum thereto (which addresses a SAAC analysis for lead). Also included is the spreadsheet used to determine whether the toxic air pollutants (TAPs) are emitted at rates exceeding the exemption levels established by the Virginia DEQ. Additional supporting files are contained in subdirectories, as described in the following modeling summary.

Dispersion Modeling Summary

Our compliance modeling analysis is based on AERMOD, a U.S. EPA model recently recommended as a guideline model for regulatory applications. The switch from ISCST3 (used in the analyses described in our September 30th memo) to AERMOD was prompted by discussions with the City of Alexandria staff, who, along with their consultant, Maureen Barrett, consider AERMOD to be a more appropriate model for use in this matter. To facilitate review and encourage a commonly agreeable approach, the AERMOD analysis includes significant elements provided by the City staff and Ms. Barrett. Specifically, we were provided (and are using) a five-year meteorological data set, a building downwash analysis, and a receptor network provided by Ms. Barrett. Generally, this information is used as received. A few minor exceptions are noted as follows, all of which are considered of minor importance.

1. The receptor network contained erroneous coordinates for one fenceline receptor. Coordinates were corrected by averaging the parameters (x, y, z, hill) at the two adjacent receptors on the western property line boundary. Since maxima are not predicted in this area, no significant errors are introduced.

2. Meteorological data for the 2004 calendar year were short by one day. Failure to have a complete year of data interfered with AERMOD's ability to process output with the PM10 pollutant designation. This problem was solved by adding a day of meteorological data to the 2004 data file – specifically, December 31, 2002 data were reproduced. (this involved a change in the year field for the 24 1-hour entries). Data from the 2002 year were used because it was believed that the 2002 data represented the "worst-case" modeling year. This procedure is not likely to have any significant impact on the model predictions given that it covers only a single day of the year.

3. The AERMET data files as received contain a small number of "missing" data. Model output files indicate that the percentage of missing data records averages about 2.8% per year over the 2000 to 2004 period. As a result, the model results are based on a slightly smaller number of hours than a full data set. Again, however, the model results are not likely affected in any significant manner by this level of missing data.

A variety of different sources are included in the modeling runs. The AERMOD designations of these sources and their descriptions follow:

Sources associated with the Virginia Paving facility:

P1_STK	Dryer stack for hot-mix asphalt Plant 1 (point source)
P2_STK	Dryer stack for hot-mix asphalt Plant 2 (point source)
HOT_OIL	Hot oil heater used to heat liquid asphalt (point source)
P1_SILO	Venting emissions from asphalt Plant 1 storage silos (volume source)
P2_SILO	Venting emissions from asphalt Plant 2 storage silos (volume source)
P1_LO	Fugitive loadout emissions from asphalt Plant 1 (volume source)
P2_LO	Fugitive loadout emissions from asphalt Plant 2 (volume source)
P1_YD	Fugitive yard emissions from asphalt Plant 1 (volume source)
P2_YD	Fugitive yard emissions from asphalt Plant 2 (volume source)
AC_TANKS	Venting emissions from liquid asphalt and fuel oil tanks (volume source)
DESELW	Diesel exhaust from on-site equipment, western RAP (area source)
DESELE	Diesel exhaust from on-site equipment, eastern RAP (area source)
DESELS	Diesel exhaust from on-site equipment, sand pile (area source)
DESELA	Diesel exhaust from on-site equipment, aggregate area (area source)
DROPAGGR	Material drop dust emissions, aggregate (area source)
DROPSAND	Material drop dust emissions, sand (area source)
DROPRAPW	Material drop dust emissions, RAP west pile (area source)
DROPRAPE	Material drop dust emissions, RAP east pile (area source)
CRUSHER	RAP crusher emissions (area source)
EROSSAND	Wind erosion of the sand pile (area source)
EROSAGGR	Wind erosion of the aggregate piles (area source)
PAVED1	Paved road emissions, Plant 1 (area source)
PAVED2A	Paved road emissions, Plant 2, 1 of 4 portions (area source)
PAVED2B	Paved road emissions, Plant 2, 1 of 4 portions (area source)
PAVED2C	Paved road emissions, Plant 2, 1 of 4 portions (area source)
UNPAVED	Unpaved road emissions

Sources outside the Virginia Paving facility:

COVANTA	Covanta waste-to-energy facility (point source)
WAGASLTE	Washington Gas Light Company (point source)
USF_OIL	Stack emissions from the U.S. Oil Filter facility (point source)

Finally, please note that our CD contains three areas. First is a series of emissions spreadsheets. Second are the processed meteorologic data developed from Ms. Barrett's meteorologic files. Third are the model runs themselves, with sections organized according to averaging periods and pollutants. Each directory in this area contains all of the files needed to run AERMOD and to produce the output files provided.

Mary Catherine H. Gibbs

From: "Michael Ames" <Ames@CambridgeEnvironmental.com>
To: "Mary Catherine H. Gibbs" <mcg.hcgk@verizon.net>; <DALuzier@laneconstruct.com>; <MMCote@laneconstruct.com>; <MASchiller@laneconstruct.com>; <JSCruickshank@laneconstruct.com>
Cc: <Green@cambridgeenvironmental.com>
Sent: Friday, March 10, 2006 4:55 PM
Attach: Final March addendum.pdf
Subject: March Addendum to December Air Quality Report

Virginia Paving,

Attached please find an addendum to our December 7, 2005 Air Quality report. The addendum describes the revised PM modeling performed this month, and a summary of the diesel emissions impact modeling performed in late December .

Regards,

Mike Ames

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On December 7, 2005 Cambridge Environmental submitted to the City of Alexandria a report: "Results of an Emission and Air Dispersion Modeling Study and Public Health Evaluation of the Virginia Paving Company Facility, 5601 Courtney Avenue Alexandria, Virginia." Since that time, we have been contacted by the City, its consultant at Aero Engineering Services, and consultants at Sullivan Environmental with questions and comments regarding the details of the emission and dispersion modeling. We have responded to these questions as they were received. This addendum to the report of December 7, 2005 summarizes our response to an earlier request by the City for us to model an additional source at the Virginia Paving site, and also presents the results of revised particulate matter modeling that we performed to correct two errors in the previous modeling.

On December 22, 2005, after discussion with the City and the City's consultant at Aero Engineering Services, the City of Alexandria asked us to model the combustion related $PM_{2.5}$ emissions from the trucks that are not owned by Virginia Paving but which travel across the Virginia Paving site to pick up asphalt. These emissions had not been included in the modeling performed for the December 7 report. On December 23, 2005 we sent a summary of the results of this modeling to the City along with the calculations and modeling files to the City's consultant at Aero Engineering Services.

The December 23, 2005 modeling is re-summarized as follows. Based on the proposed permit limits and the average capacity of each truck, the maximum, annual-average number of asphalt trucks per day is 183. The annual average $PM_{2.5}$ impacts due to diesel emissions from these trucks are small relative to the impacts from other sources at the site. The average annual fenceline impact is less than 0.1 $\mu g/m^3$; the average, 4^{th}-highest, 24-hour fenceline impact is 1.5 $\mu g/m^3$. At receptor locations further away from the site the impacts of the added diesel emissions are substantially smaller. Overall, the additional impacts due to diesel emissions of asphalt delivery trucks do not affect the overall conclusions of the air modeling study or the recommended operating conditions.

In January 2006 we received comments on our report by Sullivan Environmental, and a draft air quality model by Aero Engineering Services. After our review of the comments and draft modeling, we identified two errors in our previous modeling of particulate matter emissions from the facility. One relates to minor errors in the modeled dryer and oil-heater stack parameters, the other relates to the omission of a particle size-dependent reduction factor in the modeling of wind blown erosion emissions. Correction of the former error led to slightly higher maximum PM impacts at some fenceline locations. Correction of the latter error led to reduced PM impacts, most significantly those for maximum 24-hour $PM_{2.5}$ levels. The results of $PM_{2.5}$ and PM_{10} annual average and 24-hour maximum modeling runs with both of these errors corrected are given in the tables and figures that follow.

Pollutant	**PM_{10}**		
Averaging period	**Annual**		
Statistical metric	Annual average at each receptor		
Sources	VA Paving: Dryer stacks of Plants 1 & 2, hot oil heater, silos, loadout, yard, liquid asphalt storage, diesel exhaust, paved roads, unpaved surfaces, batch dropping, wind erosion, RAP crushing Other: U.S. Filter, Covanta and Washington Gas		
Maximum predicted concentration (all sources combined at any receptor)			
Modeling year	Concentration ($\mu g/m^3$)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	5.0	125*	-25*
2001	5.3	150*	125*
2002	5.0	150*	125*
2003	4.5	150*	125*
2004	4.5	150*	125*
Highest of all	5.3	150*	125*
Background	19.3		
Background plus highest increment	24.6*		
National Ambient Air Quality Standard (NAAQS)	50.0		

* The maximum predicted concentration is at the facility fenceline. See Figure 1 for predicted concentrations away from the facility.

Pollutant	PM$_{10}$		
Averaging period	**24-hour**		
Statistical metric	maximum fourth-highest value at each receptor		
Sources	VA Paving: Dryer stacks of Plants 1 & 2, hot oil heater, silos, loadout, yard, liquid asphalt storage, diesel exhaust, paved roads, unpaved surfaces, batch dropping, wind erosion, RAP crushing Other: U.S. Filter, Covanta and Washington Gas		
Maximum predicted concentration (all sources combined at any receptor)			
Modeling year	Concentration (μg/m^3)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	55.1	150*	125*
2001	58.0	150*	125*
2002	59.1	150*	125*
2003	51.3	200*	100*
2004	45.8	200*	100*
Highest of all	59.1	150*	125*
Background	43.0		
Background plus highest increment	102.1		
National Ambient Air Quality Standard (NAAQS)	150		

* The maximum predicted concentration is at the facility fenceline. See Figure 2 for predicted concentrations away from the facility.

Pollutant	**$PM_{2.5}$**		
Averaging period	**Annual**		
Statistical metric	Annual average at each receptor		
Sources	VA Paving: Dryer stacks of Plants 1 & 2, hot oil heater, silos, loadout, yard, liquid asphalt storage, diesel exhaust, paved roads, unpaved surfaces, batch dropping, wind erosion, RAP crushing Other: U.S. Filter, Covanta and Washington Gas		
Maximum predicted concentration (all sources combined at any receptor)			
Modeling year	Concentration ($\mu g/m^3$)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	2.5	-50*	60*
2001	2.6	-50*	60*
2002	2.2	-50*	60*
2003	2.0	-50*	60*
2004	2.0	50*	108*
Highest of all	2.6	-50*	60*
Background	13.4		
Background plus highest increment	16.0*		
National Ambient Air Quality Standard (NAAQS)	15.0		

* The maximum predicted concentration is at the facility fenceline. See Figure 3 for predicted concentrations away from the facility.

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Pollutant	**$PM_{2.5}$**		
Averaging period	**24-hour**		
Statistical metric	maximum fourth-highest value at each receptor		
Sources	VA Paving: Dryer stacks of Plants 1 & 2, hot oil heater, silos, loadout, yard, liquid asphalt storage, diesel exhaust, paved roads, unpaved surfaces, batch dropping, wind erosion, RAP crushing Other: U.S. Filter, Covanta and Washington Gas		
Maximum predicted concentration (all sources combined at any receptor)			
Modeling year	Concentration (μg/m³)	Coordinates relative to Plant 1 dryer stack (m)	
		x (east-west)	*y* (north-south)
2000	15.3	50*	108*
2001	14.0	50*	108*
2002	15.6	50*	108*
2003	13.8	150*	125*
2004	16.1	50*	108*
Highest of all	16.1	50*	108*
Background	35.3		
Background plus highest increment	51.4*		
National Ambient Air Quality Standard (NAAQS)	65		

* The maximum predicted concentration is at the facility fenceline. See Figure 4 for predicted concentrations away from the facility.

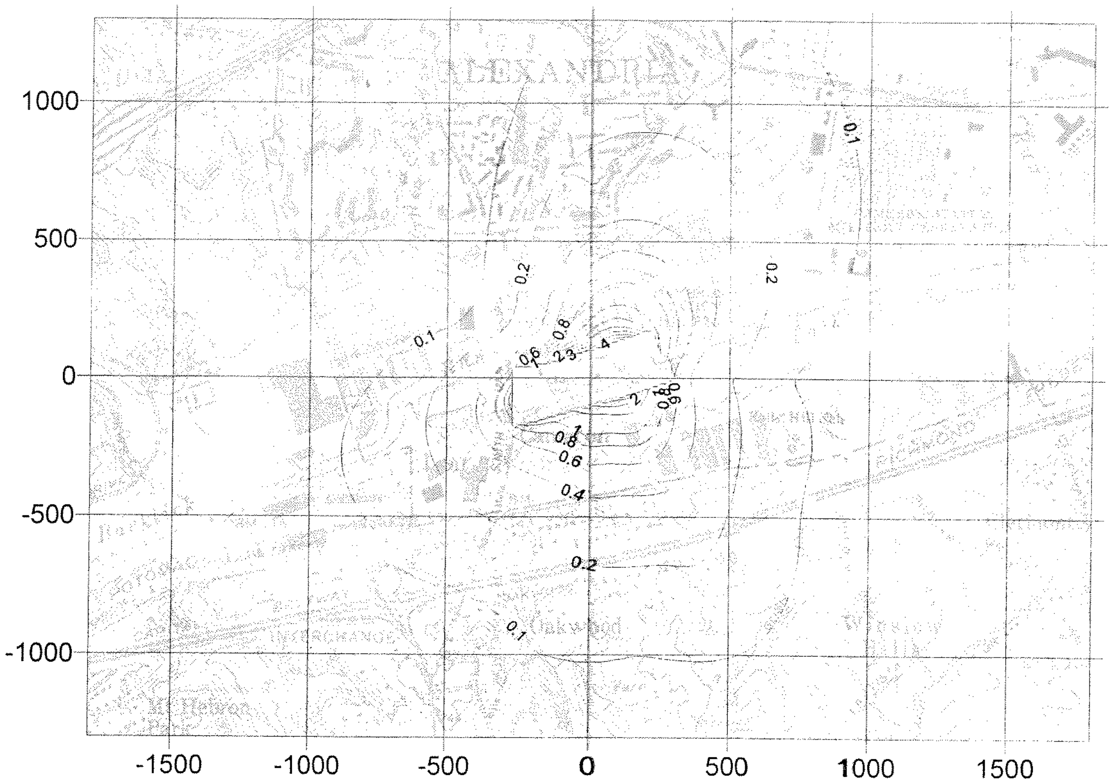

Figure1. PM10: annual average modeled increments.

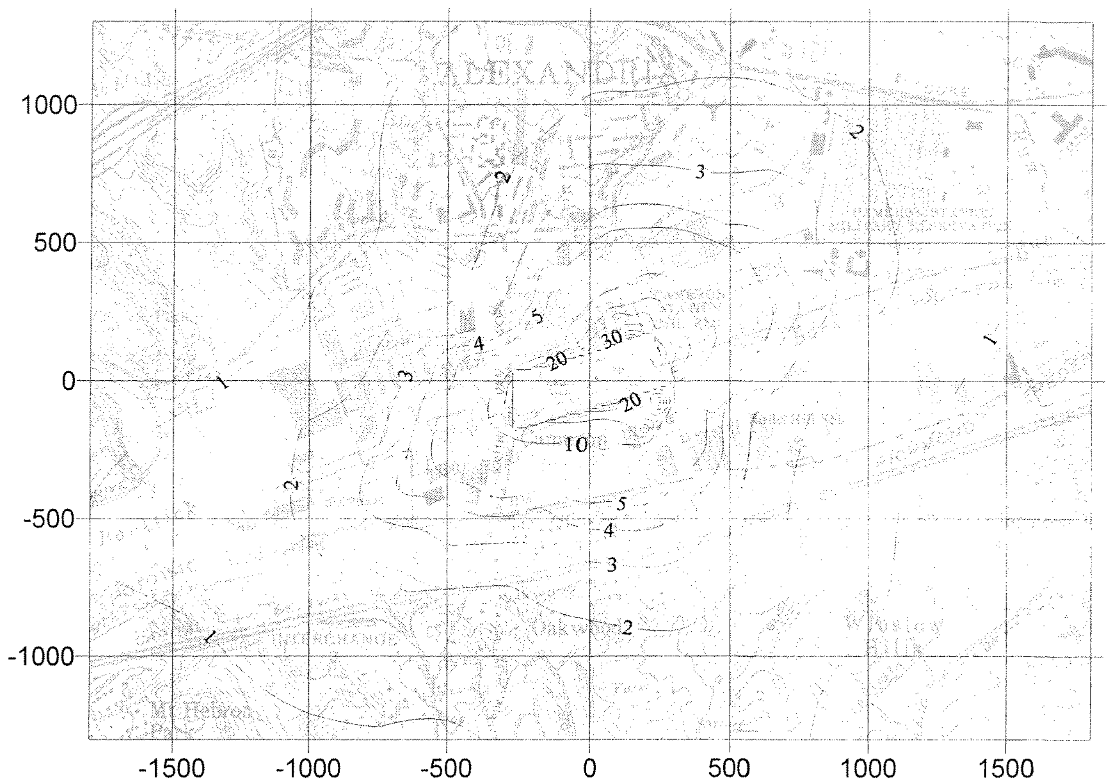

Figure 2. PM10: maximum, fourth-highest annual, 24-hour average modeled increments.

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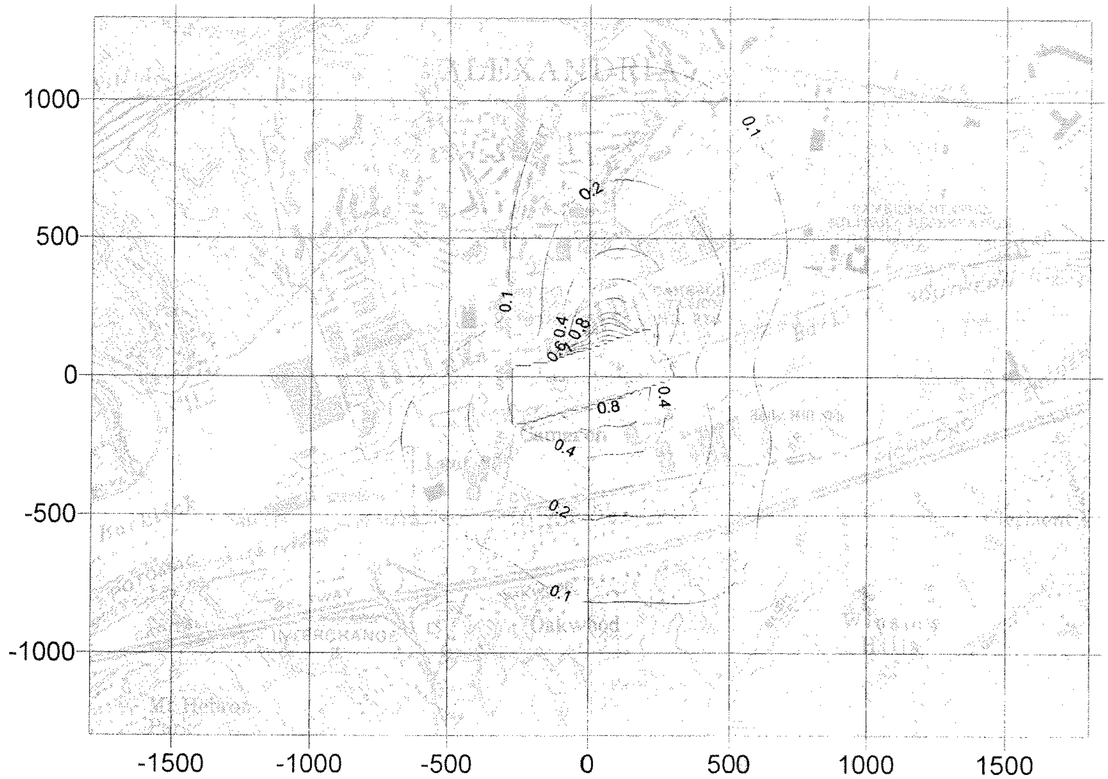

Figure 3. PM2.5: annual average modeled increments.

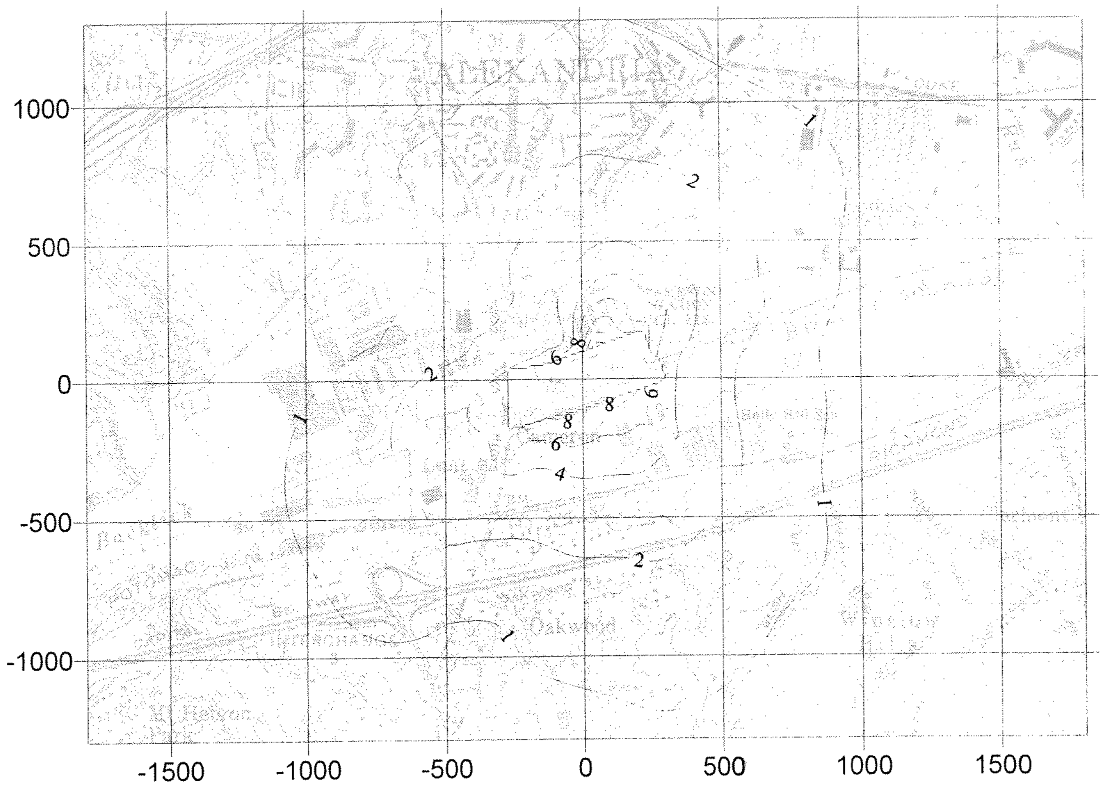

Figure 4. PM2.5: maximum, fourth-highest annual, 24-hour average modeled increments.

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Mary Catherine H. Gibbs

From: "Michael Ames" <Ames@CambridgeEnvironmental.com>
To: <MMCote@laneconstruct.com>; <JSCruickshank@laneconstruct.com>; <DALuzier@laneconstruct.com>; <CDMonahan@laneconstruct.com>; <MASchiller@laneconstruct.com>; <mcg.hcgk@verizon.net>; <Green@cambridgeenvironmental.com>
Sent: Friday, February 17, 2006 4:02 PM
Attach: P1 and P2 LO no Blue base blank closeup.pdf; P1 LO no Blue base blank closeup.pdf; P2 LO no Blue base blank closeup.pdf
Subject: Uncontrolled loadout and potential annual tonnage limits

Virginia Paving,

I've added the annual PM2.5 impacts from uncontrolled loadout emissions at Plant 1 and Plant 2 to the previous total PM2.5 impacts and attached 3 figures showing the results: one with just Plant 1 loadout emissions uncontrolled , one with just Plant 2 loadout emissions uncontrolled, and one with neither of them controlled. I've also added a blue isopleth to the figures to show the modeled line of 1.6 ug/m^3 impact which is what leads to annual PM2.5 level at the NAAQS.

As I mentioned in my Wednesday e-mail, the most significant impacts are from Plant 2 loadout because they are close to where the total maximum impacts were before.

With the P2 loadout controlled and P1 uncontrolled you're still under the NAAQS at "live, work, play" locations.

With P1 loadout controlled and P2 uncontrolled, there's maybe an exceedance in the back parking lot of the facility to your north. If the annual production limit is scaled down to 1.1 million tons, then the 1.6 ug/m^3 line should move closer to your site and avoid the potential exceedance.

With neither P1 nor P2 loadout controlled the 1.6 ug/m^3 line moves up over the buildings to your north. If the annual production limit is scaled down to about 950 thousand tons, then the line should move closer to your site and avoid the potential exceedance.

I'll be coming in around 10:00 on Monday for the call with David Sullivan. Hopefully we can clear up any questions he has pretty quickly.

Mike Ames

Michael R. Ames, Sc.D.

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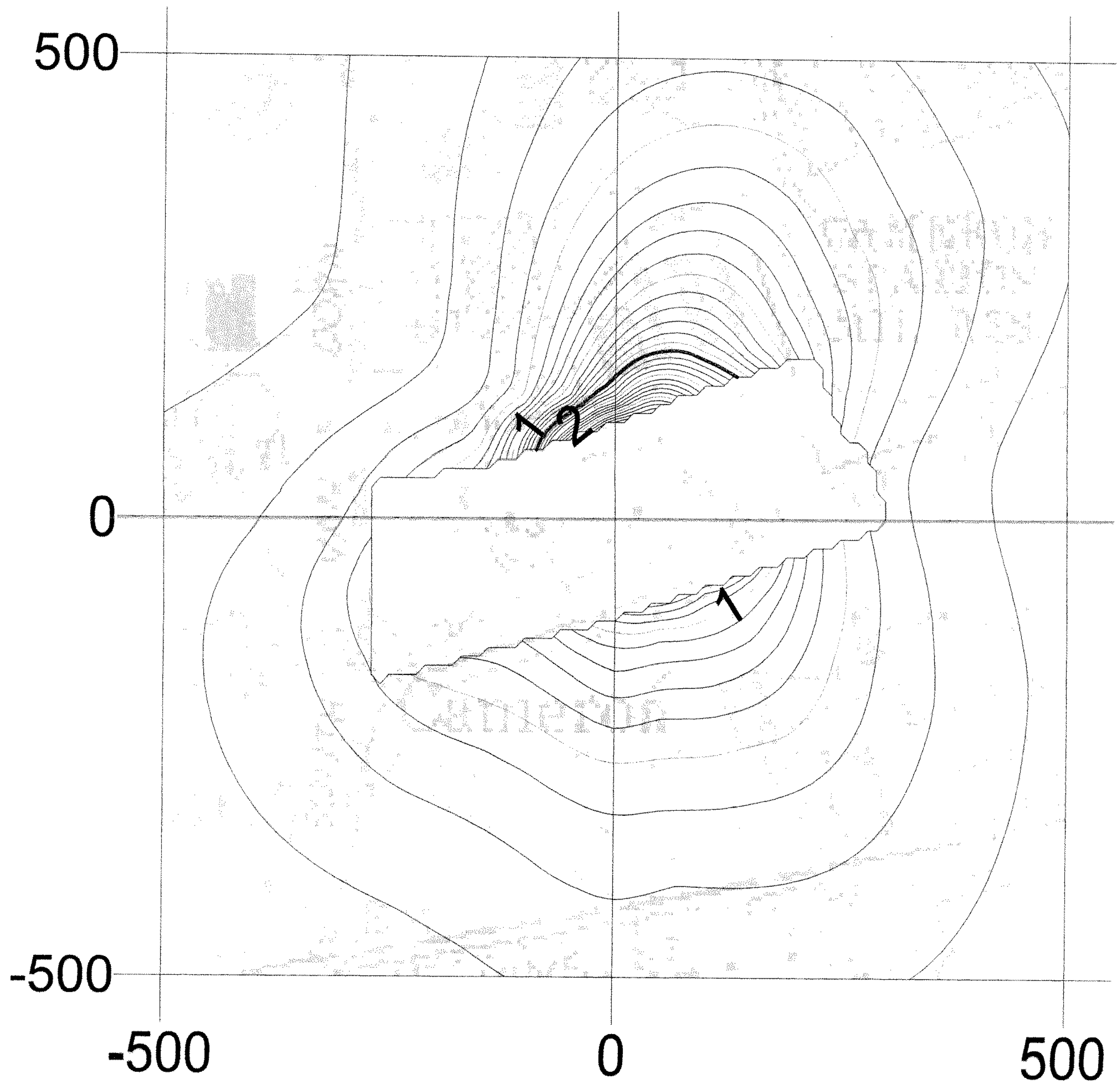
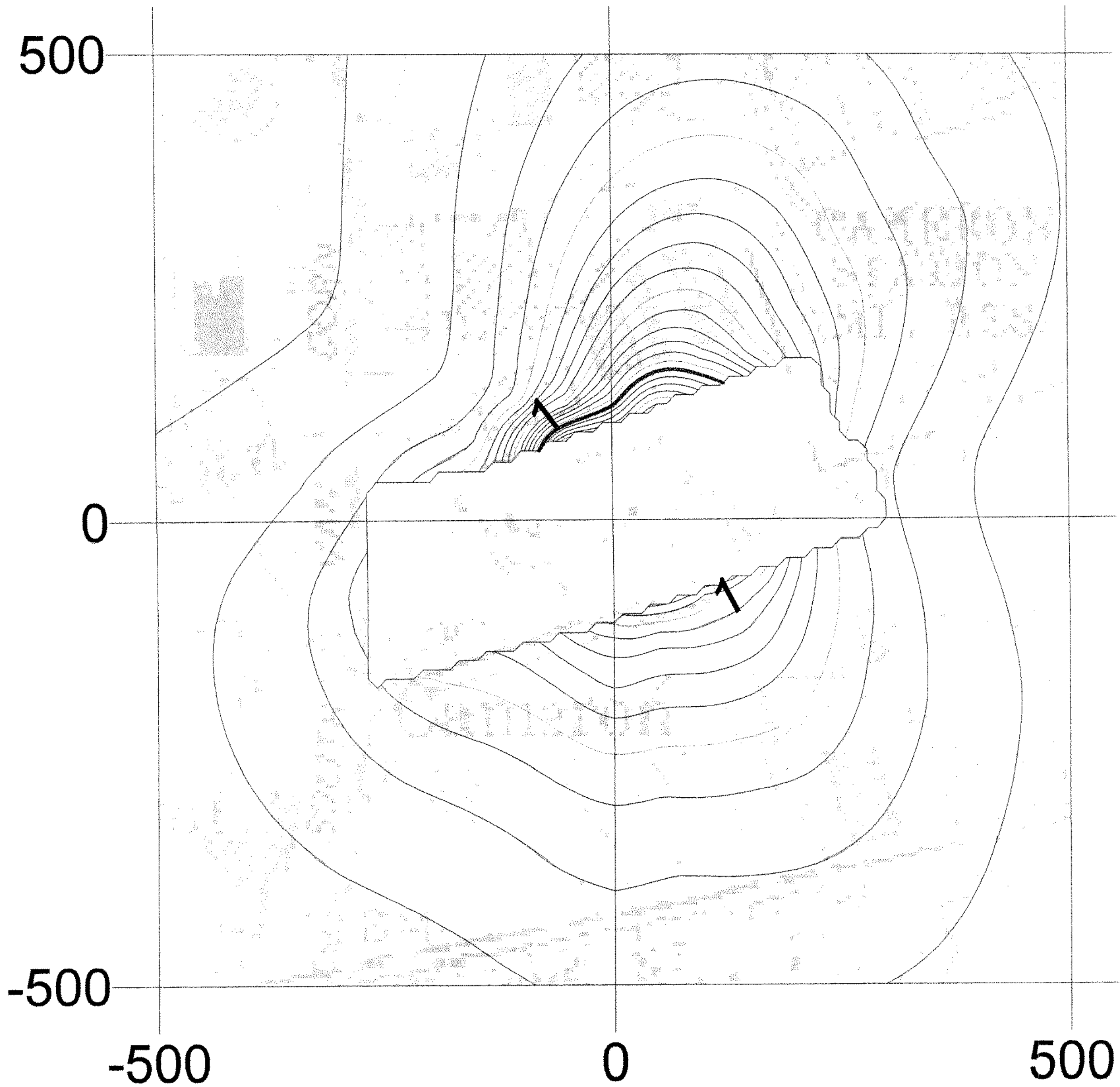
Annual total PM2.5 impacts with uncontrolled P1and P2 Loadout



Annual total PM2.5 impacts with uncontrolled P1 Loadout



Annual total PM2.5 impacts with uncontrolled P2 Loadout