METROPOLITAN WASHINGTON AIRPORTS AUTHORITY

NOV 19 2001

Mr. James E. Sydnor, Director
Office of Long-Range Environmental Planning
Department of Environmental Quality
P.O. Box 10009
Richmond, VA 23240

RE: Construction Emissions, Washington Dulles International Airport

Dear Jim:

In following up our meeting of June 25 in your offices, I have had several discussions with the staff of the Metropolitan Washington Council of Governments (COG) in an effort to quantify the level of emissions included in the State Implementation Plan that is attributable to construction activity at Washington Dulles International Airport. Those discussions led to the development of the enclosed analysis which I delivered to COG on November 16. Joan Rohlfs recommended that I forward a copy to you at this time.

If you have any questions or need additional information, please feel free to contact me at 703-417-8168.

Sincerely,

Charles

J. Charles Baummer, Jr., Ph.D.
Environmental Planner

Enclosure

cc: Joan Rohlfs (COG)

JCB:pp

METROPOLITAN WASHINGTON AIRPORTS AUTHORITY

Ronald Reagan Washington National Airport ✈ Washington, DC 20001-4901

NOV 16 2001

Ms. Joan Rohlfs
Chief, Air Quality Planning
Metropolitan Washington Council of Governments
777 North Capitol Street, N.E.
Washington, DC 20002-7239

Dear Ms. Rohlfs:

During the past several months I have had several discussions with your Dr. Rama Tangirala concerning the issue of construction equipment emissions of NOx and VOC in the State Implementation Plan (SIP) for the Metropolitan Washington, DC-MD-VA Nonattainment Area. My specific interest has been in establishing the portion of the total SIP construction equipment emissions that is attributable to Washington Dulles International Airport.

Based on those discussions I prepared the enclosed analysis which quantifies the Dulles emissions included in the SIP. Dr. Tangirala was kind enough to review a preliminary draft of the analysis, and had several helpful suggestions which I incorporated. I would appreciate it if you would review the document and let me know whether its conclusions appear reasonable to you.

Please feel free to contact me if you have any questions or need any additional information. Thank you.

Sincerely,

J. Charles Baummer

J. Charles Baummer, Jr., Ph.D.
Environmental Planner, MA-32E

Enclosure

cc: R. Tangirala (COG)

JCB:pp

METROPOLITAN WASHINGTON
AIRPORTS AUTHORITY

CONSTRUCTION EQUIPMENT EMISSIONS FOR WASHINGTON DULLES INTERNATIONAL AIRPORT INCLUDED IN THE STATE IMPLEMENTATION PLAN

Prepared by

Planning Department
Metropolitan Washington Airports Authority

November 2001

Construction Equipment Emissions for Washington Dulles International Airport Included in the State Implementation Plan

Washington Dulles International Airport (IAD) is located within the Metropolitan Washington DC Non-Attainment Area. The area is designated a "serious" non-attainment area for ozone, under the Clean Air Act Amendments of 1990, for its failure to meet the National Ambient Air Quality Standard for ozone. As a non-attainment area, the Washington region was required to prepare a State Implementation Plan (SIP) identifying the actions necessary to meet the standard. The current version of the SIP was prepared by the Metropolitan Washington Council of Governments (COG) on February 3, 2000.

Because ground-level ozone is formed by a complex set of reactions involving volatile organic compounds (VOC), oxides of nitrogen (NOx) and sunlight, it is not practicable to regulate ozone directly. For this reason the SIP establishes budgets for emissions of VOC and NOx as precursors of ozone.

The Metropolitan Washington Airports Authority (Authority), which operates IAD, has initiated a capital construction program which includes upgrades to the airport's boarding concourses and other passenger handling facilities, and ultimately new runway construction. Federal environmental review of the projects includes a determination of whether they are in conformity with the SIP. Federal agencies, including the Federal Aviation Administration, are prohibited by the Clean Air Act from engaging in, providing financial assistance for, or issuing permits, licenses or approvals for any activity which does not conform to a State Implementation Plan. One means of demonstrating conformity is to show that the increases in emissions caused by the federal action are specifically identified in the SIP.

The purpose of this document is to identify the level of emissions of NOx and VOC from construction equipment that are included in the SIP, and to determine how much of those emissions are associated with construction activities at IAD.

Construction equipment is classified as a non-road mobile source. COG's current SIP budget for construction emissions was prepared by taking their emissions inventory for 1990 as a base year, multiplying it by a growth factor, and adjusting the result to account for emission reductions required by federal or state regulations.

COG's 1990 emissions inventory was derived from a 1991 EPA contractor's report entitled *Non-Road Engine and Vehicle Emission Inventories for CO and Ozone Nonattainment Boundaries, Washington D.C MSA*. The EPA contractor estimate for the region was adjusted by the Maryland Department of the Environment to correct certain inaccuracies before COG incorporated the result into the emissions inventory for the region.

COG used total regional employment growth as the growth factor for projecting uncontrolled future emissions from the 1990 base year emissions inventory. The growth factor was calculated

by dividing the projected employment for 2005 by the actual employment for 1990. The 2005 employment figures came from COG's Round 6.1 Cooperative Forecast (Farina and Goodwin, 1999).

Actual employment for 1990 and employment forecasts for 2005 are available at multiple levels: the region, the state level (i.e., state portion of the non-attainment area), county level, and Traffic Analysis Zone (TAZ). IAD falls in three TAZs: Loudoun County TAZ 1780, and Fairfax County TAZs 1697 and 1699. The combined boundaries of these TAZs very closely match the IAD property line, so that information from the Cooperative Forecast for these TAZs can be interpreted as applicable to IAD (**Figure 1**).

Table 1 presents the 1990 employment and the projected 2005 employment as shown in COG documents for the Round 6.1 Cooperative Forecast. Information is given for Fairfax County, Loudoun County, and the three TAZs comprising the airport property. In 1990, IAD employment was 9,528, of which 1,491 jobs were in the Fairfax County portion of the airport and 8,037 were in the Loudoun County portion. In 1990, IAD accounted for 0.37% of the Fairfax County employment and 20.45% of the Loudoun County employment. By 2005, IAD employment is projected to increase to 16,394, with 394 jobs in the Fairfax County portion of the airport and 16,000 in the Loudoun County portion. The 2005 projection is 6.5% higher than Authority data for 2000 which shows employment of 15,400 (www.mwaa.com/Dulles/history, 11/15/00). In 2005, IAD is expected to account for 0.07% of the Fairfax County employment, and 17.26% of the Loudoun County employment.

These percentages were used to determine the portion of the Fairfax County and Loudoun County construction emissions attributable to IAD. COG used employment growth as a surrogate for projecting 2005 county-by-county uncontrolled construction emissions based on 1990 emissions; therefore, it is reasonable to use employment as a basis for allocating construction emissions within defined zones of individual counties.

County-by-county data for construction emissions included in the SIP are contained in supporting data available from COG (**Attachment A**). **Table 2** presents the determination of the NOx emissions from construction equipment at IAD. In 1990, IAD NOx emissions were 0.052 tons/day in Fairfax County (0.37% of the 14.106 tons/day Fairfax County construction emissions) plus 0.405 tons/day in Loudoun County (20.45% of the 1.980 tons/day Loudoun County emissions), for a total of 0.457 tons/day. By 2005, NOx emissions are projected by the SIP increase to 20.228 tons/day in Fairfax County and 4.678 tons/day in Loudoun County, in the absence of controls. IAD accounts for 0.821 ton/day of these amounts (0.07% of the Fairfax County NOx emissions plus 17.26% of the Loudoun County NOx emissions).

Table 3 presents the determination of the VOC emissions from construction equipment at IAD. In 1990, IAD VOC emissions were 0.008 tons/day in Fairfax County (0.37% of the 2.181 tons/day Fairfax County construction emissions) plus 0.063 tons/day in Loudoun County (20.45% of the 0.307 tons/day Loudoun County emissions), for a total of 0.071 tons/day. By

2005, VOC emissions are projected by the SIP increase to 3.128 tons/day in Fairfax County and 0.725 tons/day in Loudoun County, in the absence of controls. IAD accounts for 0.127 ton/day of these amounts (0.07% of the Fairfax County VOC emissions plus 17.26% of the Loudoun County VOC emissions).

The SIP identifies two control measures applicable to construction emissions: new diesel engine standards and the Spark Ignition Rule. The new diesel engine standards are estimated in the SIP to reduce NOx emissions by 9.7%, and VOC emissions by 13.3% relative to uncontrolled levels from diesel engines. The Spark Ignition Rule would reduce VOC emissions from gasoline-powered equipment (2-stroke and 4-stroke) by 30.5% relative to uncontrolled levels, but would increase NOx from these engines by 50.7%.

In the absence of controls, according to the SIP, 99.7% of the construction equipment NOx emissions originate from diesel engines and 0.3% comes from 4-stroke engines; 2-stroke engines account for less than 0.1% of the NOx emissions. For VOC, the corresponding figures are 79.4% diesel, 11.3% 4-stroke, and 9.3% 2-stroke.

Applying the reductions from the new diesel engine standards and the Spark Ignition Rule to the IAD emissions for 2005 reduces the IAD NOx emissions to 0.744 tons/day, and reduces the IAD VOC emissions to 0.106 tons/day, as shown in **Tables 2** and **3**. Relative to 1990 levels, the 2005 controlled emissions represent increases of 0.287 tons/day NOx and 0.035 tons/day VOC from construction equipment at IAD.

It is concluded from this analysis that the State Implementation Plan for the Metropolitan Washington, DC non-attainment area includes 0.744 tons/day NOx and 0.106 tons/day VOC emissions from construction equipment at Washington Dulles International Airport. On an annual basis, the IAD construction emissions included in the SIP are 272 tons/year NOx and 39 tons/year VOC.

References

Farina, D. and G.C. Goodwin. 1999. Round 6.1 Cooperative Forecasting: Employment Forecasts to 2020 by Traffic Analysis Zone. Metropolitan Washington Council of Governments. December.

Metropolitan Washington Council of Governments (COG). 2000. State Implementation Plan (SIP) Revision, Phase II Attainment Plan, for the Washington DC-MD-VA Nonattainment Area. Prepared by Metropolitan Washington Council of Governments for the District of Columbia Department of Health, Maryland Department of the Environment, and the Virginia Department of Environmental Quality, on behalf of the Metropolitan Washington Air Quality Committee, February 3.

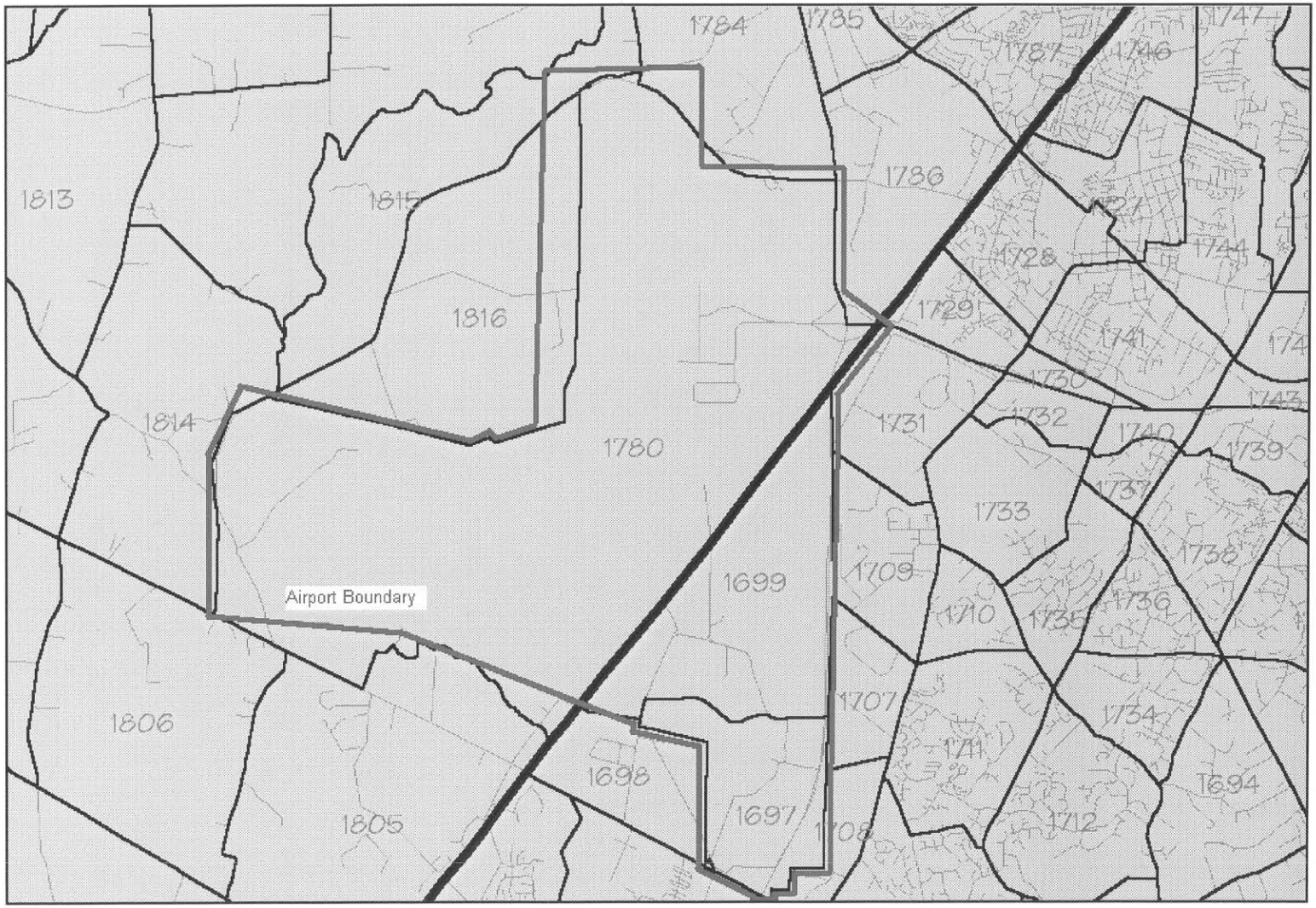

Figure 1. COG Traffic Analysis Zones at Washington Dulles International Airport

Table 1. Employment, Cooperative Forecast Round 6.1

	1990	2005	Ref.
Fairfax County			
County Total	403,700	589,300	a
Dulles Portion			
Fairfax TAZ 1697	510	198	b
Fairfax TAZ 1699	981	196	b
Dulles Fairfax Subtotal	1,491	394	c
Dulles % of Fairfax	0.37%	0.07%	
Loudoun County			
County Total	39,300	92,700	a
Dulles Portion			
Loudoun TAZ 1780	8,037	16,000	b
Dulles Loudoun Subtotal	8,037	16,000	
Dulles % of Loudoun	20.45%	17.26%	
Dulles Total	9,528	16,394	

a. COG.1999. State Implementation Plan (SIP) Revision, Phase II Attainment Plan for the Washington DC-MD-VA Nonattainment Area, Appendix E.

b. COG. 1999. Round 6.1 Cooperative Forecasting: Employment Forecasts to 2020 by Traffic Analysis Zone. December

c. Sum of TAZ 1697 and 1699.

Table 2. NOx Emissions from Construction Equipment

		1990	2005	Ref.
UNCONTROLLED EMISSIONS				
Fairfax County				
County Total	tons/day	14.106	20.228	a
Dulles Portion				
Dulles % of Fairfax	%	0.37%	0.07%	b
Dulles Fairfax Subtotal	tons/day	0.052	0.014	
Loudoun County				
County Total	tons/day	1.980	4.678	a
Dulles Portion				
Dulles % of Loudoun	%	20.45%	17.26%	b
Dulles Loudoun Subtotal	tons/day	0.405	0.807	
Dulles Total	tons/day	**0.457**	**0.821**	
% of Emissions from Diesel Engines	%	99.700%	99.700%	c
% of Emissions from 4-Stroke Engines	%	0.300%	0.300%	c
% of Emissions from 2-Stroke Engines	%	0.000%	0.000%	c
Emissions from Diesel Engines	tons/day	0.456	0.818	
Emissions from 4-Stroke Engines	tons/day	0.001	0.002	
Emissions from 2-Stroke Engines	tons/day	0.000	0.000	
DULLES CONTROLLED EMISSIONS				
Diesel	tons/day		0.739	d
4-Stroke	tons/day		0.005	e
2-Stroke	tons/day		0.000	e
Total			**0.744**	

a. COG 2001. Supporting Data from Phase II SIP. Personal Communication form R. Tangirala (COG) to C. Baummer (MWAA), November 13.

b. From Table 1.

c. COG.1999. State Implementation Plan (SIP) Revision, Phase II Attainment Plan for the Washington DC-MD-VA Nonattainment Area, Appendix K.

d. New diesel engine standards achieve a 9.7% reduction relative to uncontrolled emissions.

e. Spark Ignition Rule increases NOx by 50.7% relative to uncontrolled.

Table 3. VOC Emissions from Construction Equipment

		1990	2005	Ref.
UNCONTROLLED EMISSIONS				
Fairfax County				
County Total	tons/day	2.181	3.128	a
Dulles Portion				
Dulles % of Fairfax	%	0.37%	0.07%	b
Dulles Fairfax Subtotal	tons/day	0.008	0.002	
Loudoun County				
County Total	tons/day	0.307	0.725	a
Dulles Portion				
Dulles % of Loudoun	%	20.45%	17.26%	b
Dulles Loudoun Subtotal	tons/day	0.063	0.125	
Dulles Total	tons/day	**0.071**	**0.127**	
% of Emissions from Diesel Engines	%	79.400%	79.400%	c
% of Emissions from 4-Stroke Engines	%	11.300%	11.300%	c
% of Emissions from 2-Stroke Engines	%	9.300%	9.300%	c
Emissions from Diesel Engines	tons/day	0.056	0.101	
Emissions from 4-Stroke Engines	tons/day	0.008	0.014	
Emissions from 2-Stroke Engines	tons/day	0.007	0.012	
DULLES CONTROLLED EMISSIONS				
Diesel	tons/day		0.088	d
4-Stroke	tons/day		0.010	e
2-Stroke	tons/day		0.008	e
Total			**0.106**	

a. COG 2001. Supporting Data from Phase II SIP. Personal Communication form R. Tangirala (COG) to C. Baummer (MWAA), November 13.

b. From Table 1.

c. COG.1999. State Implementation Plan (SIP) Revision, Phase II Attainment Plan for the Washington DC-MD-VA Nonattainment Area, Appendix E.

d. New diesel engine standards achieve a 13.3% reduction relative to uncontrolled emissions.

e. Spark Ignition Rule achieves a 30.5% reduction relative to uncontrolled emissions.

Attachment A

SIP Supporting Data
County-by-County Emissions Inventory for Non-Road Sources:
1990 Base and 2005 Projected Uncontrolled Emissions

1990 Non-Road Inventory -NOx
NOx - Ozone Nonattainment Area Jurisdictional Emissior

Equipment Category	Dist. of Columbia	Calvert County	Charles County	Frederck County	Montgmry County	Pr. Geos County	Alxndria City	Arlingtn County	Fairfax County	Loudoun County	Pr. Will County	Stafford County	Virginia Total	Maryland Total	Area Total
Lawn and Garden	0.062	0.006	0.011	0.030	0.265	0.127	0.010	0.046	0.222	0.029	0.043	0.010	0.360	0.439	0.861
Airport Service	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.143	1.480	1.480	0.000	0.000	7.104	0.000	7.104
Recreational-Land	0.000	0.002	0.003	0.005	0.000	0.000	0.000	0.000	0.000	0.004	0.002	0.002	0.008	0.010	0.018
Recreational-Marine	0.141	0.070	0.027	0.004	0.004	0.008	0.019	0.015	0.177	0.033	0.130	0.061	0.435	0.113	0.689
Light Commercial	0.079	0.002	0.010	0.025	0.141	0.120	0.030	0.024	0.148	0.015	0.024	0.005	0.246	0.298	0.622
Industrial	0.490	0.015	0.037	0.239	0.644	0.433	0.097	0.167	0.571	0.097	0.213	0.022	1.168	1.368	3.025
Construction	4.680	0.662	1.121	2.641	15.535	13.253	1.857	1.161	14.106	1.980	4.461	0.692	24.257	33.212	62.149
Agricultural	0.000	0.893	1.240	3.539	1.359	1.063	0.000	0.000	0.198	1.566	0.359	0.269	2.391	8.094	10.485
Logging	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.002	0.003
Total Non-Road	5.452	1.651	2.449	6.482	17.948	15.004	2.013	5.556	16.903	5.204	5.232	1.061	35.970	43.534	84.956

2005 Non-Road Inventory -UNCONTROLLEC
NOx - Ozone Nonattainment Area Jurisdictional Emissior

Equipment Category		Dist. of Columbia	Calvert County	Charles County	Frederck County	Montgmry County	Pr. Geos County	Alxndria City	Arlingtn County	Fairfax County	Loudoun County	Pr. Will County	Stafford County	Virginia Total	Maryland Total	Area Total
Lawn and Garden	emp	0.058	0.010	0.015	0.060	0.325	0.146	0.011	0.052	0.318	0.068	0.063	0.021	0.533	0.556	1.147
Airport Service	emp	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.702	2.123	3.497	0.000	0.000	10.323	0.000	10.323
Recreational-Land	pop	0.000	0.003	0.005	0.007	0.000	0.000	0.000	0.000	0.000	0.010	0.004	0.003	0.016	0.014	0.030
Recreational-Marine	pop	0.122	0.116	0.036	0.006	0.005	0.009	0.022	0.018	0.221	0.084	0.186	0.087	0.618	0.171	0.911
Light Commercial	pop	0.068	0.003	0.013	0.036	0.170	0.136	0.035	0.027	0.185	0.037	0.034	0.008	0.327	0.358	0.753
Industrial	emp	0.457	0.023	0.052	0.483	0.790	0.498	0.112	0.189	0.819	0.230	0.312	0.044	1.706	1.846	4.009
Construction	emp	4.372	0.982	1.576	5.341	19.069	15.256	2.134	1.318	20.228	4.678	6.536	1.371	36.265	42.224	82.861
Agricultural	na	0.000	0.893	1.240	3.539	1.359	1.063	0.000	0.000	0.198	1.566	0.359	0.269	2.391	8.094	10.485
Logging	na	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.002	0.003
Total Non-Road		5.078	2.030	2.937	9.471	21.717	17.109	2.315	6.307	24.093	10.169	7.493	1.802	52.179	53.265	110.522

Growth Rates (1990 to 2005)	Dist. of Columbia	Calvert County	Charles County	Frederck County	Montgmry County	Pr. Geos County	Alxndria City	Arlingtn County	Fairfax County	Loudoun County	Pr. Will County	Stafford County	VA Total	MD Total	Area Total
Emp	0.934	1.484	1.406	2.022	1.227	1.151	1.135	1.149	1.434	2.362	1.465	1.982	1.393	1.252	1.205
Pop	0.863	1.655	1.351	1.442	1.204	1.131	1.181	1.159	1.251	2.522	1.431	1.426	1.344	1.214	1.210

1990 Non-Road Inventory -VOC
VOC - Ozone Nonattainment Area Jurisdictional Emissior

Equipment Category	Dist. of Columbia	Calvert County	Charles County	Frederck County	Montgmry County	Pr. Geos County	Alxndria City	Arlingtn County	Fairfax County	Loudoun County	Pr. Will County	Stafford County	Virginia Total	Maryland Total	Area Total
Lawn and Garden	2.463	0.416	0.707	1.679	11.339	5.358	0.387	1.908	9.438	1.357	2.094	0.606	15.790	19.499	37.752
Airport Service	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.667	0.239	0.239	0.000	0.000	1.145	0.000	1.145
Recreational-Land	0.000	0.291	0.623	0.895	0.000	0.000	0.000	0.000	0.000	0.702	0.458	0.365	1.525	1.809	3.334
Recreational-Marine	1.563	0.547	0.209	0.031	0.027	0.059	0.324	0.263	3.081	0.579	2.265	1.059	7.571	0.873	10.007
Light Commercial	0.555	0.015	0.069	0.175	0.968	0.823	0.208	0.166	1.020	0.104	0.172	0.038	1.708	2.050	4.313
Industrial	0.223	0.008	0.017	0.109	0.293	0.196	0.044	0.076	0.260	0.044	0.096	0.011	0.531	0.623	1.377
Construction	0.723	0.101	0.174	0.409	2.401	2.049	0.287	0.179	2.181	0.307	0.687	0.106	3.747	5.134	9.604
Agricultural	0.000	0.201	0.282	0.801	0.308	0.241	0.000	0.000	0.045	0.354	0.082	0.060	0.541	1.833	2.374
Logging	0.006	0.020	0.034	0.063	0.127	0.050	0.000	0.016	0.098	0.030	0.042	0.024	0.210	0.294	0.510
Total Non-Road	5.533	1.599	2.115	4.162	15.463	8.776	1.250	3.275	16.362	3.716	5.896	2.269	32.768	32.115	70.416

2005 Non-Road Inventory -UNCONTROLLEC
VOC - Ozone Nonattainment Area Jurisdictional Emissior

Equipment Category		Dist. of Columbia	Calvert County	Charles County	Frederck County	Montgmry County	Pr. Geos County	Alxndria City	Arlingtn County	Fairfax County	Loudoun County	Pr. Will County	Stafford County	Virginia Total	Maryland Total	Area Total
Lawn and Garden	emp	2.301	0.618	0.994	3.396	13.918	6.168	0.445	2.165	13.535	3.206	3.068	1.201	23.619	25.093	51.013
Airport Service	emp	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.757	0.343	0.565	0.000	0.000	1.664	0.000	1.664
Recreational-Land	pop	0.000	0.481	0.842	1.290	0.000	0.000	0.000	0.000	0.000	1.771	0.655	0.520	2.947	2.614	5.560
Recreational-Marine	pop	1.348	0.905	0.282	0.045	0.033	0.067	0.383	0.305	3.855	1.461	3.241	1.510	10.754	1.331	13.434
Light Commercial	pop	0.479	0.025	0.093	0.252	1.166	0.930	0.246	0.192	1.276	0.262	0.246	0.054	2.277	2.467	5.222
Industrial	emp	0.208	0.012	0.024	0.220	0.360	0.226	0.051	0.086	0.373	0.104	0.141	0.022	0.776	0.841	1.826
Construction	emp	0.675	0.150	0.245	0.827	2.947	2.359	0.330	0.203	3.128	0.725	1.006	0.210	5.602	6.528	12.805
Agricultural	na	0.000	0.201	0.282	0.801	0.308	0.241	0.000	0.000	0.045	0.354	0.082	0.060	0.541	1.833	2.374
Logging	na	0.006	0.020	0.034	0.063	0.127	0.050	0.000	0.016	0.098	0.030	0.042	0.024	0.210	0.294	0.510
Total Non-Road		5.017	2.412	2.795	6.895	18.858	10.041	1.453	3.725	22.652	8.477	8.482	3.601	48.391	41.001	94.409

1990 Non-Road Inventory -CO

CO - Ozone Nonattainment Area Emissions (Emissions at county level not available by catego

	Dist. of Columbia	Calvert County	Charles County	Frederck County	Montgmry County	Pr. Geos County	Alxndria City	Arlingtn County	Fairfax County	Loudoun County	Pr. Will County	Stafford County	Virginia Total	Maryland Total	Area Total
Total Non-Road	145.00	12.27	24.17	35.89	180.86	174.23	26.56	40.84	202.55	20.58	59.82	14.63	364.98	427.42	937.40

2005 Non-Road Inventory -UNCONTROLLED

CO - Ozone Nonattainment Area Emissions (Emissions at county level not available by catego

	Dist. of Columbia	Calvert County	Charles County	Frederck County	Montgmry County	Pr. Geos County	Alxndria City	Arlingtn County	Fairfax County	Loudoun County	Pr. Will County	Stafford County	Virginia Total	Maryland Total	Area Total
Total Non-Road	135.451	18.214	33.975	72.584	221.995	200.569	30.525	46.351	290.466	48.617	87.636	28.994	532.59	547.34	1215.38

(Employment growth surrogate applied to total for each county)

Memo from...
RAMA S. TANGIRALA, Ph.D.
Department of Environmental Programs
Metropolitan Washington Council of Governments

2005

	NOx	VOC
Fairfax	20.228	3.128
Loudoun	4.678	0.725

2005 Dulles

	NOx	VOC
Fairfax	0.01	0.002
Loudoun	0.81	0.125
2005 Dulles =	0.82	0.127

1990

	NOx	VOC
Fairfax	14.106	2.181
Loudoun	1.980	0.307

1990 Dulles

	NOx	VOC
Fairfax	0.052	0.008
Loudoun	0.39	0.063
	0.442	0.071

777 North Capitol Street, N.E.
Washington, D.C. 20002-4226
Phone: 202/962-3200
Fax: 202/962-3201

. Dulles

	NOX	VOC
Δ 1990 - 2005	(0.82 - 0.44)	(0.127 - 0.071)
→	= 0.38	0.056 tpd.
your estimates from example	0.45	0.07
→	0.07	0.014