2017 BASE YEAR EMISSIONS INVENTORY

Appendix B1c

Nonpoint and Marine/Air/Rail Inventory Development Overview (Virginia)

FOR THE
WASHINGTON DC-MD-VA
2015 OZONE NAAQS NONATTAINMENT AREA

Prepared by:

Virginia Department of Environmental Quality,
on behalf of the
Metropolitan Washington Air Quality Committee

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Virginia 2017 Emission Estimation Approach Overview

Staff for the Virginia Department of Environmental Quality, VDEQ, compiled Northern Virginia 2017 annual and ozone season daily emission estimates from the April 30, 2020 release of the EPA 2017 National Emission Inventory database. The EPA 2017 NEI is composed of state supplied emission data supplemented with emission estimates developed using various EPA emission modeling tools and EPA and/or EPA contractor developed emission estimates.

State Developed Annual Emission Estimates

Appendix B2c-1 contains sample calculations illustrating how each Virginia in-house developed nonpoint and marine/air/rail annual emission estimate was calculated for each Northern Virginia jurisdiction for each pollutant. Appendix B2c-1 contains activity level data, emission factors, control factors, fuel loading factors, apportionment factors, and sample calculations demonstrating how state developed nonpoint and marine/air/rail annual emissions estimates were calculated.

Ozone Season Daily Emissions Estimates for Northern Virginia jurisdictions.

Appendix B2c-2 contains the raw data that VDEQ staff used to develop ozone season daily emission estimates from Annual emission estimates for all nonpoint and marine/air/rail category. For calculating 2017 ozone season daily emissions, OSD, VDEQ staff followed a methodology similar to what has been used previously in developing daily emission estimates for Northern Virginia jurisdictions. The use of this methodology was originally proposed by the Maryland Department of the Environment. VDEQ adopted the proposed methodology in order that the process of converting annual emissions to ozone season daily emissions for Maryland and Virginia would be consistent for jurisdictions that are part of state implementation plans and maintenance plans prepared by the Metropolitan Washington Council of Governments. This methodology was based on a procedure contained in the document titled 'Introduction to area source emission inventory development', Volume III, Chapter 1, Revised Final January 2001, developed by the EPA Emission Inventory Improvement Program. A copy of the document can be found on the EPA website at the following web address:

https://www.epa.gov/sites/production/files/2015-08/documents/iii01_apr2001.pdf

An example for calculating ozone season daily emissions is provided in the document in section 4.2.8 'Calculations for Temporal Adjustments', equation 1.4-11 on page 1.4-13 and 1.4.14 of the EIIP document and is shown below.

> *An example calculation of a peak ozone season daily emission estimate where the peak ozone season is the 3 months of summer, is shown in Equation 1.4-11:*
>
> *Example:*
> *Annual Emissions = 1.3 tons of VOCs*
> *SAF = 0.28 (28 percent)*
> *Peak Ozone Season = 0.25 (25 percent or 3 months)*
> *Operating Schedule = 6 days per week, 52 weeks per year*
>
> *Typical Ozone Season Daily Emissions*
> *= (1.3 tons year)*(2,000 lb ton)* ((0.28)/(0.25))/(6 days/week) (52 weeks/year)*
> *= 9.3 lb VOCs per day (1.4-11)*

Information specific to Virginia's application of the above mentioned methodology is described below:

Ozone Season Daily Emissions (tons/day)

= Annual Emissions (tons) *[SAF] / [Peak Ozone Season] / [Days per Period]

Where:

"The SAF (Seasonal Adjustment Factor) divided by the Peak Ozone Season Value is the fraction of annual emissions emitted over a period of time that is reflected in the Days per Period value" (R. Thunell, MDE, 18 Nov 2019).

Specifically:

SAF = The component of emissions associated with the designated period that occur during the designated season. A value of 1 would indicate that 100% percent of the emissions for the designated period also occur during the designated season.

Peak Ozone Season = The portion of the days associated with Days per Period that also take place during the season. A value of 1 would indicate that 100% of the 'Days per Period' also take place in the designated season.

Days per Period = Number of operating days in the designated period.

The following pages demonstrate 4 examples of how VDEQ calculated OSD emission using the EPA EIIP methodology.

Sample Calculation Example 1:

Given:
SCC = 2102004002, Industrial Distillate Combustion
FIPS 51059, Fairfax County Virginia
Annual Emissions = 1.1238 tons VOC per year
SAF = 0.25 because 25% of annual emission take place during the designated 'season'
Peak Ozone Season = 0.25 because the 'season' represents 25% of the 'Days per Period'
Days per Period = 312 because the source operates 312 days
Length of Season = 3 months (0.25 years)
Length of Period = 1 year

Ozone Season Daily Emissions (tons/day)

= Annual Emissions (tons VOC/year) *[SAF] / [Peak Ozone Season] / [Days per Period]
= 1.1238 tons VOC/year * [0.25] / [0.25] / [312 days/year]
= 0.0036 tons/day

Sample Calculation Example 2:

Given:
SCC = 2302002200, Under-fired Charbroiling Commercial Cooking
FIPS 51059, Fairfax County Virginia
Annual Emissions = 46.3874 tons VOC per year
SAF = 0.3333 because 33.33% of annual emission take place during the designated 'season'
Peak Ozone Season = 0.25 because the 'season' represents 25% of the 'Days per Period'
Days per Period = 365 because the source operates 365 days
Length of Season = 3 months (0.25 years)
Length of Period = 1 year

Ozone Season Daily Emissions (tons/day)

= Annual Emissions (tons VOC/year) *[SAF] / [Peak Ozone Season] / [Days per Period]
= 46.3874 tons VOC/year * [0.3333] / [0.25] / [365 days/year]
= 0.1695 tons VOC / day

Sample Calculation Example 3:

Given:
SCC = 2461022000, Emulsified Asphalt Paving
FIPS 51059, Fairfax County Virginia
Annual Emissions = 471.8353 tons VOC per year
SAF = 0.3893 because 38.93% of annual emission take place during the designated 'season'
Peak Ozone Season = 0.25 because the 'season' represents 25% of the 'Days per Period'
Days per Period = 260 because the source operates 260 days (5 days/week, 52 weeks/year)
Length of Season = 3 months (0.25 years)
Length of Period = 1 year

Ozone Season Daily Emissions (tons/day)

= Annual Emissions (tons VOC/year) *[SAF] / [Peak Ozone Season] / [Days per Period]
= 471.8353 tons VOC/year * [0.3893] / [0.25] / [260 days/year]
= 2.8258 tons VOC / day

Sample Calculation Example 4:

Given:
SCC = 2104006000, Residential Natural Gas Combustion
FIPS 51059, Fairfax County Virginia
Annual Emissions = 45.1947 tons VOC per year
SAF = 0.0000665589 because 0.00665589% of annual emission take place during July, which is a month with 31 days
Peak Ozone Season = 1.00 because all 31 days in July take place in the peak ozone season
Days per Period = 31 because the source operates 31 days in the month of July
Length of Season = 1 monthLength of Period = 1 month

Ozone Season Daily Emissions (tons/day)

= Annual Emissions (tons VOC/year) *[SAF] / [Peak Ozone Season] / [Days per Period]
= 45.1947 tons VOC/year * [0.0000665589] / [1.00] / [31 days/year]
= 9.704E-05 tons VOC/day

Annual and Ozone Season Emission Summaries:

Northern Virginia Nonpoint Emissions				
AREA	Pollutant	Sector	Annual emissions (tons/year)	Ozone Season Daily (tons/day)
51013 Arlington, VA	CO	Nonpoint	602.40	1.1215
51059 Fairfax County VA	CO	Nonpoint	5155.02	7.4241
51107 Loudoun County, VA	CO	Nonpoint	7279.54	14.9858
51153 Prince William County, VA	CO	Nonpoint	6778.21	12.8605
51510 Alexandria City, VA	CO	Nonpoint	430.53	0.8919
51600 Fairfax City, VA	CO	Nonpoint	181.08	0.3400
51610 Falls Church City, VA	CO	Nonpoint	68.21	0.1468
51683 Manassas City, VA	CO	Nonpoint	272.04	0.6245
51685 Manassas Park City, VA	CO	Nonpoint	81.76	0.1834
Total	CO	Nonpoint	20848.80	38.5785

Northern Virginia Nonpoint Emissions				
AREA	Pollutant	Sector	Annual emissions (tons/year)	Ozone Season Daily (tons/day)
51013 Arlington, VA	NOx	Nonpoint	447.04	0.8779
51059 Fairfax County VA	NOx	Nonpoint	2274.20	4.7444
51107 Loudoun County, VA	NOx	Nonpoint	958.18	2.2104
51153 Prince William County, VA	NOx	Nonpoint	781.19	1.7575
51510 Alexandria City, VA	NOx	Nonpoint	318.46	0.6537
51600 Fairfax City, VA	NOx	Nonpoint	101.09	0.2110
51610 Falls Church City, VA	NOx	Nonpoint	39.25	0.0886
51683 Manassas City, VA	NOx	Nonpoint	122.12	0.3240
51685 Manassas Park City, VA	NOx	Nonpoint	41.68	0.1103
Total	NOx	Nonpoint	5083.22	10.9776

Northern Virginia Nonpoint emissions				
AREA	Pollutant	Sector	Annual emissions (tons/year)	Ozone Season Daily (tons/day)
51013 Arlington, VA	VOC	Nonpoint	1540.68	4.8746
51059 Fairfax County VA	VOC	Nonpoint	8308.65	25.9624
51107 Loudoun County, VA	VOC	Nonpoint	3576.74	10.5509
51153 Prince William County, VA	VOC	Nonpoint	4212.84	12.3567
51510 Alexandria City, VA	VOC	Nonpoint	1066.40	3.3456
51600 Fairfax City, VA	VOC	Nonpoint	280.42	0.8788
51610 Falls Church City, VA	VOC	Nonpoint	128.08	0.4064
51683 Manassas City, VA	VOC	Nonpoint	386.04	1.1821
51685 Manassas Park City, VA	VOC	Nonpoint	241.74	0.7949
Total	VOC	Nonpoint	19741.59	60.3524

Northern Virginia Marine/Air/Rail emissions				
AREA	Pollutant	Sector	Annual emissions (tons/year)	Ozone Season Daily (tons/day)
51013 Arlington, VA	CO	Marine/Air/Rail	4734.88	12.9723
51059 Fairfax County VA	CO	Marine/Air/Rail	54.69	0.1498
51107 Loudoun County, VA	CO	Marine/Air/Rail	5177.90	14.1860
51153 Prince William County, VA	CO	Marine/Air/Rail	46.98	0.1287
51510 Alexandria City, VA	CO	Marine/Air/Rail	26.86	0.0736
51600 Fairfax City, VA	CO	Marine/Air/Rail	0.00	0.0000
51610 Falls Church City, VA	CO	Marine/Air/Rail	0.00	0.0000
51683 Manassas City, VA	CO	Marine/Air/Rail	235.19	0.6444
51685 Manassas Park City, VA	CO	Marine/Air/Rail	0.71	0.0020
Total	**CO**	**Marine/Air/Rail**	10277.21	28.1567

Northern Virginia Marine/Air/Rail emissions				
AREA	Pollutant	Sector	Annual emissions (tons/year)	Ozone Season Daily (tons/day)
51013 Arlington, VA	NOx	Marine/Air/Rail	1679.19	4.6005
51059 Fairfax County VA	NOx	Marine/Air/Rail	211.18	0.5786
51107 Loudoun County, VA	NOx	Marine/Air/Rail	2113.70	5.7909
51153 Prince William County, VA	NOx	Marine/Air/Rail	189.63	0.5195
51510 Alexandria City, VA	NOx	Marine/Air/Rail	111.61	0.3058
51600 Fairfax City, VA	NOx	Marine/Air/Rail	0.00	0.0000
51610 Falls Church City, VA	NOx	Marine/Air/Rail	0.00	0.0000
51683 Manassas City, VA	NOx	Marine/Air/Rail	21.09	0.0578
51685 Manassas Park City, VA	NOx	Marine/Air/Rail	1.05	0.0029
Total	**NOx**	**Marine/Air/Rail**	4327.44	11.8560

Northern Virginia Marine/Air/Rail emissions				
AREA	Pollutant	Sector	Annual emissions (tons/year)	Ozone Season Daily (tons/day)
51013 Arlington, VA	VOC	Marine/Air/Rail	532.46	1.4588
51059 Fairfax County VA	VOC	Marine/Air/Rail	10.99	0.0301
51107 Loudoun County, VA	VOC	Marine/Air/Rail	496.20	1.3594
51153 Prince William County, VA	VOC	Marine/Air/Rail	9.06	0.0248
51510 Alexandria City, VA	VOC	Marine/Air/Rail	5.24	0.0144
51600 Fairfax City, VA	VOC	Marine/Air/Rail	0.00	0.0000
51610 Falls Church City, VA	VOC	Marine/Air/Rail	0.00	0.0000
51683 Manassas City, VA	VOC	Marine/Air/Rail	11.25	0.0308
51685 Manassas Park City, VA	VOC	Marine/Air/Rail	0.08	0.0002
Total	**VOC**	**Marine/Air/Rail**	1065.30	2.9186

Northern Virginia Nonpoint + Marine/Air/Rail Emissions				
AREA	Pollutant	Sector	Annual emissions (tons/year)	Ozone Season Daily (tons/day)
51013 Arlington, VA	CO	Nonpoint + M/A/R	5337.28	14.0938
51059 Fairfax County VA	CO	Nonpoint + M/A/R	5209.71	7.5739
51107 Loudoun County, VA	CO	Nonpoint + M/A/R	12457.44	29.1719
51153 Prince William County, VA	CO	Nonpoint + M/A/R	6825.19	12.9892
51510 Alexandria City, VA	CO	Nonpoint + M/A/R	457.39	0.9655
51600 Fairfax City, VA	CO	Nonpoint + M/A/R	181.08	0.3400
51610 Falls Church City, VA	CO	Nonpoint + M/A/R	68.21	0.1468
51683 Manassas City, VA	CO	Nonpoint + M/A/R	507.23	1.2688
51685 Manassas Park City, VA	CO	Nonpoint + M/A/R	82.48	0.1853
Total	**CO**	**Nonpoint + M/A/R**	31126.01	66.7353

Northern Virginia Nonpoint + Marine/Air/Rail emissions				
AREA	Pollutant	Sector	Annual emissions (tons/year)	Ozone Season Daily (tons/day)
51013 Arlington, VA	NOx	Nonpoint + M/A/R	2126.23	5.4784
51059 Fairfax County VA	NOx	Nonpoint + M/A/R	2485.38	5.3229
51107 Loudoun County, VA	NOx	Nonpoint + M/A/R	3071.88	8.0013
51153 Prince William County, VA	NOx	Nonpoint + M/A/R	970.82	2.2771
51510 Alexandria City, VA	NOx	Nonpoint + M/A/R	430.06	0.9595
51600 Fairfax City, VA	NOx	Nonpoint + M/A/R	101.09	0.2110
51610 Falls Church City, VA	NOx	Nonpoint + M/A/R	39.25	0.0886
51683 Manassas City, VA	NOx	Nonpoint + M/A/R	143.21	0.3818
51685 Manassas Park City, VA	NOx	Nonpoint + M/A/R	42.73	0.1132
Total	**NOx**	**Nonpoint + M/A/R**	9410.66	22.8336

Northern Virginia Nonpoint + Marine/Air/Rail emissions				
AREA	Pollutant	Sector	Annual emissions (tons/year)	Ozone Season Daily (tons/day)
51013 Arlington, VA	VOC	Nonpoint + M/A/R	2073.15	6.333407
51059 Fairfax County VA	VOC	Nonpoint + M/A/R	8319.64	25.99252
51107 Loudoun County, VA	VOC	Nonpoint + M/A/R	4072.93	11.91038
51153 Prince William County, VA	VOC	Nonpoint + M/A/R	4221.90	12.38155
51510 Alexandria City, VA	VOC	Nonpoint + M/A/R	1071.64	3.359965
51600 Fairfax City, VA	VOC	Nonpoint + M/A/R	280.42	0.878764
51610 Falls Church City, VA	VOC	Nonpoint + M/A/R	128.08	0.40639
51683 Manassas City, VA	VOC	Nonpoint + M/A/R	397.30	1.212943
51685 Manassas Park City, VA	VOC	Nonpoint + M/A/R	241.82	0.79514
Total	**VOC**	**Nonpoint + M/A/R**	20806.89	63.2710

2017 Marine/Air/Rail Emission Inventory Development

Introduction:

Northern Virginia 2017 annual and ozone season daily emission Marina, Air, and Rail, (M/A/R), emission estimates are based on the April 30, 2020 release of the EPA 2017 National Emission Inventory database.

Source Categorization:

Traditionally, sources of emissions are categorized as point, non-point, non-road, on-road or biogenic. In recent MWCOG inventory development projects, it has been beneficial to re-group certain emission sources into a separate Marine, Air, and Rail category, which are often referred to by the abbreviation "M/A/R" or "MAR". Because previous inventories developed in conjunction with MWCOG utilized the this M/A/R emission subcategory, the VDEQ again split off marine, air and rail emissions into a separate sector of their own in the BY2017 inventory for consistency with previous inventory efforts.

A brief summary of the categories that compose Virginia's BY2017 M/A/R inventory sector are described below:

Airport Ground Support Equipment (SCC 2265008005, 2267008005, 2268008005 and 2270008005)

Airport ground support equipment emissions were once generated by the Non-road Model, and later by the MOVES emission model and were assigned a data category code of 'Non-Road' by the EPA. Airport ground support emissions are now calculated by the EPA using the FAA AEDT airport emission model, which took the place of the FAA EDMS model for calculation of aircraft emissions. The EPA now categorizes Airport Ground Support Equipment as point sources because aircraft emissions and the ground support equipment that service them are considered to be a part of the airport for which they are associated with. Airports are now classified included as part of the point source inventory in the EPA National Emission Inventory, NEI, and are a part of the EPA's facility database. For consistency with previous MWCOG emission inventory projects, airport ground support equipment has been re-classified from point to M/A/R in MWCOG's base year 2017 emission inventory.

Military, Commercial, General Aviation and Air Taxi Aircraft Emissions (2275001000, 2275020000, 2275050011, 2275050012, 2275060011, and 2275060012)

Aircraft emissions were originally designated in the EPA NEI as area sources but are now assigned to the point source sector by the EPA and their emissions are included in the EPA point source facility database under the airport for which they are associated. For consistency with previous MWCOG inventory projects, the VDEQ has re-classified aircraft emissions from point source to M/A/R for the purpose of MWCOG's 2017 base year inventory project.

Aircraft Auxiliary Power Units (SCC 2275070000)

This source category which was once calculated using the Non-road Model and later the MOVES model is now generated by the EPA using the FAA AEDT aircraft emission model and incorporated into the EPA facility database under the airport where they are used. While airport auxiliary power unit emissions are estimated by both the MOVES model and FAA AEDT models, it is widely believed that

the FAA AEDT emission model produces more accurate emission estimates because the estimates are tied directly to the amount of aircraft activity taking place at each individual airport. Because aircraft auxiliary power units are now stored in the EPA NEI facility database, they are classified as point source emissions. The VDEQ has re-assigned the data category code for aircraft auxiliary power units in Virginia's BY2017 emission inventory from point to M/A/R for consistency between MWCOG's 2017 base year emission inventory and previous MWCOG inventory projects.

Commercial Marine Vessels (2280002101, 2280002202, 2280002203, and 2280002204)

Commercial marine vessel emissions are categorized by the EPA in the NEI as nonpoint sources but have been re-categorized by VDEQ to the M/A/R sector in the MWCOG 2017 base year inventory project for consistency with previous MWCOG inventories and plans.

Class 1 Railroads, Passenger Rail and Commuter Line Haul Locomotive Emissions (2285002006, 2285002008 and 2285002009)

These categories are categorized by the EPA with a nonpoint source data category code. For consistency with previous MWCOG inventories, the VDEQ has re-classified emissions associated with these rail related source categories from the nonpoint to the M/A/R sector for the purpose of the MWCOG's 2017 base year inventory project.

Railway Maintenance (2285002015, 2285004015 and 2285006015)

Emissions for these categories were generated previously using the Nonroad model and currently using the MOVES model and classified by the EPA as non-road sources. The VDEQ has re-classified railway maintenance emissions from the nonroad sector to the M/A/R sector for the MWCOG 2017 base year inventory project to be consistent with previous inventories and plans.

Yard Locomotives (28500201)

These emissions which are classified by the EPA as point sources but have been re-classified by the VDEQ to the M/A/R sector in MWCOG's 2017 base year inventory project.

Additional information about Virginia's 2017 Northern Virginia Emission Inventory can be found in the following appendixes:

Appendix B2c-1.pdf contains CY2017 Virginia DEQ Developed Area Annual Emission Emissions Sample Calculations

Appendix B2c-2.pdf contains Ozone Season Daily emission calculations for all Virginia Area and M/A/R source categories