GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

Guidance on the Use of EPA's MERPs to Account for Secondary Formation of Ozone and $PM_{2.5}$ in Georgia

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Introduction

The Georgia Environmental Protection Division (EPD) reviewed EPA's December 2, 2016 memorandum and February 23, 2017 errata memorandum titled "Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier l Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program". Based on EPA's MERPs modeling, EPD identified three nearby hypothetical sources that can be used to represent sources in Georgia (Table 1). One of these sources (Giles, TN) is located in the central U.S. (CUS) domain (Figure 1). This source may be used to represent sources in northern Georgia. The other two sources (Allendale, SC and Tallapoosa, AL) are located in the eastern U.S. (EUS) domain (Figure 2). These sources may be used to represent sources in middle and southern Georgia.

Table 1. Source locations, emission rates, and release heights for three nearby hypothetical sources in EPA's MERPs guidance.

Source ID	Latitude	Longitude	FIPS	Source Location	Emission Rates and Release Heights[1]
3 (CUS)	35.2912	-86.8975	47055	Giles, TN[2]	500 tpy (L), 1000 tpy (H and L), and 3000 tpy (H)
14 (EUS)	32.9727	-81.4073	45005	Allendale, SC	500 tpy (H and L), 1000 tpy (H), and 3000 tpy (H)
19 (EUS)	32.8477	-85.8094	1123	Tallapoosa, AL	500 tpy (H and L), 1000 tpy (H), and 3000 tpy (H)

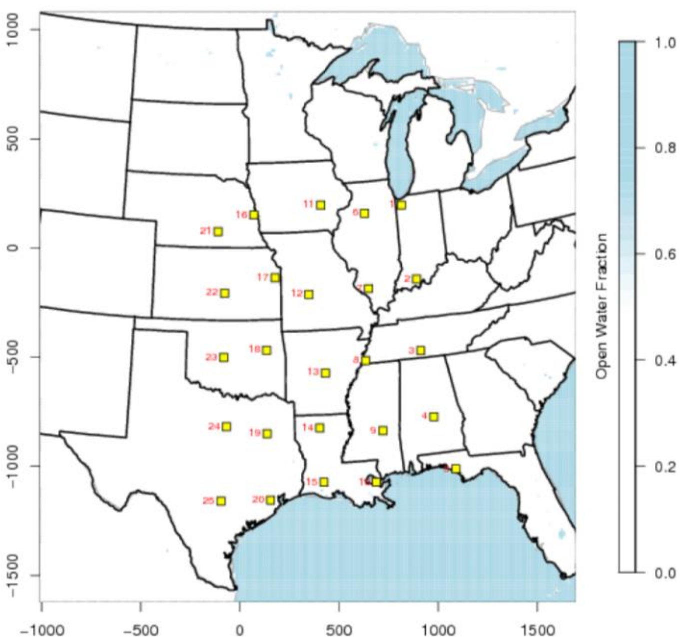

Figure 1. Hypothetical source locations for the central U.S. (CUS) domain in the EPA's MERPs modeling. Source 3 (Giles, TN) may be used to represent sources in northern Georgia.

[1] Two release heights were modeled in EPA's MERPs modeling (L and H). Sources with release type "L" represent low-level sources and were modeled with a stack height of 1 m, stack diameter of 5 m, exit temperature of 311 K, exit velocity of 27 (m/s), and flow rate of 537 (m^3/s). Sources with release type "H" represent high-level sources and were modeled using the same stack parameters except a stack height of 90 m.

[2] The source information provided in EPA's draft MERPs Guidance for Source ID #3 (Giles, TN) models 500 tpy (H and L), 1000 tpy (H), and 3000 tpy (H) for NOx impacts on ozone. This is different from the emission rates and release heights shown above for VOC impacts on ozone and NOx and SO_2 impacts on daily and annual $PM_{2.5}$.

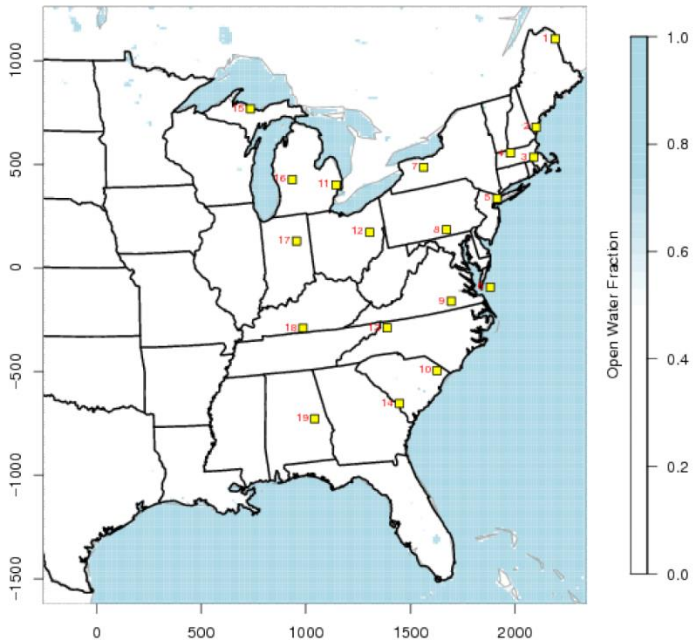

Figure 2. Hypothetical source locations for the eastern U.S. (EUS) domain in the EPA's MERPs modeling. Source 14 (Allendale, SC) and Source 19 (Tallapoosa, AL) may be used to represent sources in middle and southern Georgia.

MERP Calculations

MERPs were calculated for each of the three nearby hypothetical sources using the following equation:

$$MERP\ (tpy) = Significant\ Impact\ Level * \frac{Precursor\ Emissions\ Rate\ (tpy)}{Maximum\ Model\ Impact} \qquad \textbf{Equation (1)}$$

The Significant Impact Level (SIL) for ozone is 1 ppb, the SIL for annual $PM_{2.5}$ is 0.2 μg/m^3, and the SIL for daily $PM_{2.5}$ is 1.2 μg/m^3. The units for the Maximum Model Impact are ppb for ozone and μg/m^3 for $PM_{2.5}$. The most conservative (lowest) MERP values from the three nearby hypothetical sources by precursor and pollutant are summarized in Table 2. These default MERP values can be used for Tier 1 demonstrations in Georgia without further justification.

Table 2. Default MERP values (tpy) for Georgia PSD applications.

Precursor	8-hour Ozone	Daily $PM_{2.5}$	Annual $PM_{2.5}$
NOx	156	4,014	7,427
SO_2	----	667	6,004
VOC	3,980	----	----

An applicant may choose to use a different site-specific MERP based on one of the three nearby hypothetical sources in Tables 3-8 on pages 4 and 5. However, the applicant will need to submit a detailed justification describing why the alternate MERP is representative for their project. The justification for the selection of an alternate hypothetical source should include a discussion on (1) distance to project site, (2) meteorological conditions (e.g., average and peak temperatures, humidity, and wind patterns), (3) terrain, (4) emission rates, (5) stack heights, (6) the rural or urban nature of the area, (7) nearby regional sources of pollutants (e.g., biogenic emissions, other industry, etc.), and (8) ambient concentrations of relevant pollutants (where available). The justification for alternate MERPs should be included in the modeling protocol and is subject to EPD approval.

Table 3. NOx MERP values for ozone. The lowest MERP is shown in **bold red**.

Precursor	Area	Emissions (tpy)	Release Height	Source ID	FIPS	State	County	Max. Value (ppbv)	MERP Value (tpy)
NOx	CUS	500	H	3	47055	TN	Giles	3.208	**156**
NOx	CUS	500	L	3	47055	TN	Giles	3.072	163
NOx	CUS	1000	H	3	47055	TN	Giles	5.387	186
NOx	CUS	3000	H	3	47055	TN	Giles	10.356	290
NOx	EUS	500	H	14	45005	SC	Allendale	2.876	174
NOx	EUS	500	L	14	45005	SC	Allendale	2.938	170
NOx	EUS	1000	H	14	45005	SC	Allendale	4.990	200
NOx	EUS	3000	H	14	45005	SC	Allendale	11.240	267
NOx	EUS	500	H	19	01123	AL	Tallapoosa	1.528	327
NOx	EUS	500	L	19	01123	AL	Tallapoosa	1.872	267
NOx	EUS	1000	H	19	01123	AL	Tallapoosa	3.061	327
NOx	EUS	3000	H	19	01123	AL	Tallapoosa	6.494	462

Table 4. VOC MERP values for ozone. The lowest MERP is shown in **bold red**.

Precursor	Area	Emissions (tpy)	Release Height	Source ID	FIPS	State	County	Max. Value (ppbv)	MERP Value (tpy)
VOC	CUS	500	L	3	47055	TN	Giles	0.040	12,362
VOC	CUS	1000	H	3	47055	TN	Giles	0.100	9,986
VOC	CUS	1000	L	3	47055	TN	Giles	0.091	10,992
VOC	CUS	3000	H	3	47055	TN	Giles	0.754	**3,980**
VOC	EUS	500	H	14	45005	SC	Allendale	0.012	42,974
VOC	EUS	500	L	14	45005	SC	Allendale	0.017	29,925
VOC	EUS	1000	H	14	45005	SC	Allendale	0.061	16,480
VOC	EUS	3000	H	14	45005	SC	Allendale	0.428	7,008
VOC	EUS	500	H	19	01123	AL	Tallapoosa	0.048	10,483
VOC	EUS	500	L	19	01123	AL	Tallapoosa	0.063	7,950
VOC	EUS	1000	H	19	01123	AL	Tallapoosa	0.103	9,709
VOC	EUS	3000	H	19	01123	AL	Tallapoosa	0.550	5,459

Table 5. NOx MERP values for annual $PM_{2.5}$. The lowest MERP is shown in **bold red**.

Precursor	Area	Emissions (tpy)	Release Height	Source ID	FIPS	State	County	Max. Value ($\mu g/m^3$)	MERP Value (tpy)
NOx	CUS	500	L	3	47055	TN	Giles	0.0119	8,426
NOx	CUS	1000	H	3	47055	TN	Giles	0.0059	34,153
NOx	CUS	1000	L	3	47055	TN	Giles	0.0269	**7,427**
NOx	CUS	3000	H	3	47055	TN	Giles	0.0243	24,646
NOx	EUS	500	H	14	45005	SC	Allendale	0.0015	68,788
NOx	EUS	500	L	14	45005	SC	Allendale	0.0058	17,138
NOx	EUS	1000	H	14	45005	SC	Allendale	0.0027	73,092
NOx	EUS	3000	H	14	45005	SC	Allendale	0.0071	84,585
NOx	EUS	500	H	19	01123	AL	Tallapoosa	0.0009	116,399
NOx	EUS	500	L	19	01123	AL	Tallapoosa	0.0034	29,585
NOx	EUS	1000	H	19	01123	AL	Tallapoosa	0.0016	121,751
NOx	EUS	3000	H	19	01123	AL	Tallapoosa	0.0044	137,516

Table 6. SO_2 MERP values for annual $PM_{2.5}$. The lowest MERP is shown in **bold red**.

Precursor	Area	Emissions (tpy)	Release Height	Source ID	FIPS	State	County	Max. Value (μg/m^3)	MERP Value (tpy)
SO_2	CUS	500	L	3	47055	TN	Giles	0.0091	10,932
SO_2	CUS	1000	H	3	47055	TN	Giles	0.0102	19,572
SO_2	CUS	1000	L	3	47055	TN	Giles	0.0333	**6,004**
SO_2	CUS	3000	H	3	47055	TN	Giles	0.0602	9,962
SO_2	EUS	500	H	14	45005	SC	Allendale	0.0059	17,011
SO_2	EUS	500	L	14	45005	SC	Allendale	0.0161	6,228
SO_2	EUS	1000	H	14	45005	SC	Allendale	0.0111	17,968
SO_2	EUS	3000	H	14	45005	SC	Allendale	0.0289	20,750
SO_2	EUS	500	H	19	01123	AL	Tallapoosa	0.0047	21,106
SO_2	EUS	500	L	19	01123	AL	Tallapoosa	0.0098	10,252
SO_2	EUS	1000	H	19	01123	AL	Tallapoosa	0.0090	22,176
SO_2	EUS	3000	H	19	01123	AL	Tallapoosa	0.0239	25,103

Table 7. NOx MERP values for daily $PM_{2.5}$. The lowest MERP is shown in **bold red**.

Precursor	Area	Emissions (tpy)	Release Height	Source ID	FIPS	State	County	Max. Value (μg/m^3)	MERP Value (tpy)
NOx	CUS	500	L	3	47055	TN	Giles	0.148	4,044
NOx	CUS	1000	H	3	47055	TN	Giles	0.115	10,392
NOx	CUS	1000	L	3	47055	TN	Giles	0.299	**4,014**
NOx	CUS	3000	H	3	47055	TN	Giles	0.480	7,505
NOx	EUS	500	H	14	45005	SC	Allendale	0.028	21,437
NOx	EUS	500	L	14	45005	SC	Allendale	0.081	7,399
NOx	EUS	1000	H	14	45005	SC	Allendale	0.051	23,432
NOx	EUS	3000	H	14	45005	SC	Allendale	0.163	22,047
NOx	EUS	500	H	19	01123	AL	Tallapoosa	0.047	12,686
NOx	EUS	500	L	19	01123	AL	Tallapoosa	0.092	6,555
NOx	EUS	1000	H	19	01123	AL	Tallapoosa	0.088	13,691
NOx	EUS	3000	H	19	01123	AL	Tallapoosa	0.215	16,767

Table 8. SO_2 MERP values for daily $PM_{2.5}$. The lowest MERP is shown in **bold red**.

Precursor	Area	Emissions (tpy)	Release Height	Source ID	FIPS	State	County	Max. Value (μg/m^3)	MERP Value (tpy)
SO_2	CUS	500	L	3	47055	TN	Giles	0.439	1,368
SO_2	CUS	1000	H	3	47055	TN	Giles	0.889	1,350
SO_2	CUS	1000	L	3	47055	TN	Giles	1.577	761
SO_2	CUS	3000	H	3	47055	TN	Giles	5.397	**667**
SO_2	EUS	500	H	14	45005	SC	Allendale	0.143	4,183
SO_2	EUS	500	L	14	45005	SC	Allendale	0.514	1,168
SO_2	EUS	1000	H	14	45005	SC	Allendale	0.273	4,395
SO_2	EUS	3000	H	14	45005	SC	Allendale	0.633	5,686
SO_2	EUS	500	H	19	01123	AL	Tallapoosa	0.231	2,593
SO_2	EUS	500	L	19	01123	AL	Tallapoosa	0.325	1,844
SO_2	EUS	1000	H	19	01123	AL	Tallapoosa	0.405	2,966
SO_2	EUS	3000	H	19	01123	AL	Tallapoosa	0.891	4,040

SILs Analysis

MERPs can be used to determine if a facility's proposed emission increases will result in total impacts (including both primary and secondary impacts) that are above the SILs. All relevant pollutants need to be included in the analysis. If emission increases from all relevant pollutants are below their respective Significant Emission Rates (SERs), no further analysis is required.

For ozone, the following equation should be used:

$$\frac{PEMIS\_NOx}{MERP\_NOx} + \frac{PEMIS\_VOC}{MERP\_VOC} < 1 \qquad \textbf{Equation (2)}$$

PEMIS_NOx and P*EMIS_VOC* are the proposed emission increases for NOx and VOC (tpy). *MERP_NOx* and *MERP_VOC* are the MERPs for NOx and VOC (tpy). If the sum of the ratios is less than 1, the secondary ozone impacts are below the ozone SIL and the applicant does not need to perform a cumulative analysis for ozone. If the sum of the ratios is equal to or greater than 1, the applicant should perform a cumulative analysis for ozone.

For $PM_{2.5}$, the following equation should be used if the proposed primary (direct) $PM_{2.5}$ emission increase (*PEMIS_PM2.5*) is higher than the SER for direct $PM_{2.5}$ (*SER_PM2.5*, 10 tpy):

$$\frac{HMC\_PM2.5}{SIL\_PM2.5} + \frac{PEMIS\_SO2}{MERP\_SO2} + \frac{PEMIS\_NOx}{MERP\_NOx} < 1 \qquad \textbf{Equation (3)}$$

HMC_PM2.5 is the highest modeled concentration (annual or H1H 24-hr averaged over 5 years) using AERMOD with the proposed primary (direct) $PM_{2.5}$ emission increases. *SIL_PM2.5* is 0.2 $\mu g/m^3$ for annual $PM_{2.5}$ and 1.2 $\mu g/m^3$ for daily $PM_{2.5}$. *PEMIS_SO2* and *PEMIS_NOx* are the proposed emission increases for SO_2 and NOx (tpy). *MERP_SO2* and *MERP_NOx* are the MERPs for SO_2 and NOx (tpy). If the sum of the ratios is less than 1, the total $PM_{2.5}$ impacts are below the $PM_{2.5}$ SIL and the applicant does not need to perform a cumulative analysis for $PM_{2.5}$. If the sum of the ratios is equal to or greater than 1, the applicant should perform a cumulative analysis for $PM_{2.5}$.

For $PM_{2.5}$, the following equation[3] should be used if the proposed primary (direct) $PM_{2.5}$ emission increase is less than the $PM_{2.5}$ SER (10 tpy) and either SO_2 or NOx is equal to or greater than its respective SER (40 tpy):

$$\frac{PEMIS\_PM2.5}{SER\_PM2.5} + \frac{PEMIS\_SO2}{MERP\_SO2} + \frac{PEMIS\_NOx}{MERP\_NOx} < 1 \qquad \textbf{Equation (4)}$$

If the sum of the ratios is less than 1, the $PM_{2.5}$ impacts will be below the $PM_{2.5}$ SIL and the applicant does not need to perform a cumulative analysis for $PM_{2.5}$. If the sum of the ratios is equal to or greater than 1, the applicant should perform AERMOD modeling for direct $PM_{2.5}$ and use Equation (3) to evaluate the need for a cumulative analysis. This conservative screening approach is used to avoid unnecessary AERMOD modeling when the direct $PM_{2.5}$ emissions are low (less than 10 tpy) and the secondary $PM_{2.5}$ impacts have a small contribution towards the SIL.

[3] If *PEMIS_PM2.5* is equal to *SER_PM2.5*, then *HMC_PM2.5* is less than or equal to *SIL_PM2.5*. Therefore, (*PEMIS_PM2.5*)/(*SER_PM2.5*) is greater than or equal to (*HMC_PM2.5*)/(*SIL_PM2.5*); and (*PEMIS_PM2.5*)/(*SER_PM2.5*) is a conservative estimate of (*HMC_PM2.5*)/(*SIL_PM2.5*).

Cumulative Analysis
MERPs can be used to determine if a facility's proposed emission increases will result in total impacts that are above the National Ambient Air Quality Standards (NAAQS). All relevant pollutants need to be included in the analysis.

For ozone, the following equation should be used:

$$Background\_ozone + \left(\frac{FEMIS\_NOx}{MERP\_NOx} + \frac{FEMIS\_VOC}{MERP\_VOC}\right) * SIL\_ozone \leq NAAQS\_ozone \quad \textbf{Equation (5)}$$

Background_ozone is the 3-year design value from a representative background ozone monitor. *FEMIS_NOx* and *FEMIS_VOC* are the facility-wide emissions (after modification) for NOx and VOC (tpy). *MERP_NOx* and *MERP_VOC* are the MERPs for NOx and VOC (tpy). *SIL_ozone* is 1 ppb. If the sum of the terms is less than or equal to *NAAQS_ozone* (70 ppb), the proposed project does not cause or contribute to a violation of the ozone NAAQS. If the sum of the terms is greater than *NAAQS_ozone* (70 ppb), the applicant may consider performing a Tier 2 demonstration or revisiting the scope of the project (e.g., reducing emissions, updating stack parameters, etc.). If a Tier 2 demonstration is pursued, the applicant must submit an updated modeling protocol to GA EPD for approval.

For $PM_{2.5}$, the following equation should be used:

$$Background\_PM2.5 + MDV\_PM2.5 + \left(\frac{FEMIS\_SO2}{MERP\_SO2} + \frac{FEMIS\_NOx}{MERP\_NOx}\right) * SIL\_PM2.5 \leq NAAQS\_PM2.5 \quad \textbf{Equation (6)}$$

Background_PM2.5 is the 3-year design value from a representative background $PM_{2.5}$ monitor. *MDV_PM2.5* is the modeled design value (not including background) using AERMOD with the facility-wide primary (direct) $PM_{2.5}$ emissions (after modification) and primary (direct) $PM_{2.5}$ emissions from nearby offsite sources. *FEMIS_SO2* and *FEMIS_NOx* are the facility-wide emissions (after modification) for SO_2 and NOx (tpy). *MERP_SO2* and *MERP_NOx* are the MERPs for SO_2 and NOx (tpy). *SIL_PM2.5* is 0.2 $\mu g/m^3$ for annual $PM_{2.5}$ and 1.2 $\mu g/m^3$ for daily $PM_{2.5}$. If the sum of the terms is less than or equal to the *NAAQS_PM2.5* (12.0 $\mu g/m^3$ for annual $PM_{2.5}$ and 35 $\mu g/m^3$ for daily $PM_{2.5}$), this is a sufficient demonstration to show that the proposed project does not cause or contribute to a violation of the $PM_{2.5}$ NAAQS. If the sum of the terms is greater than the $PM_{2.5}$ NAAQS, the traditional culpability analysis would ensue. If the project does not pass the culpability analysis, the applicant may consider performing a Tier 2 demonstration or revisiting the scope of the project (e.g., reducing emissions, updating stack parameters, etc.). If a Tier 2 demonstration is pursued, the applicant must submit an updated modeling protocol to GA EPD for approval.

PSD Application Examples
The following section contains calculations for three hypothetical PSD applications.

Example 1: Direct $PM_{2.5}$ Increase Above SER

Emissions (Table E-1), maximum AERMOD impacts (Table E-2), background monitor concentrations (Table E-3), and default MERPs (Table E-4) are provided for a hypothetical PSD application with a proposed direct $PM_{2.5}$ emissions increase above the SER (10 tpy).

Table E-1. Emissions for an example PSD application.

Precursor	Project Emissions (tpy)	Facility-wide (Pre-Project + Project) Emissions (tpy)
NOx	300	500
SO_2	300	500
VOC	300	500
$PM_{2.5}$	300	500

Table E-2. Maximum AERMOD impacts for an example PSD application.

Precursor	Project HMC	Facility-wide + Offsite Sources Impacts
Annual $PM_{2.5}$	0.15 $\mu g/m^3$	0.3 $\mu g/m^3$
Daily $PM_{2.5}$	0.6 $\mu g/m^3$	3.0 $\mu g/m^3$

Table E-3. Background monitor concentrations for an example PSD application.

Precursor	Background Concentration
Ozone	66 ppb
Annual $PM_{2.5}$	10.5 $\mu g/m^3$
Daily $PM_{2.5}$	29 $\mu g/m^3$

Table E-4. Default MERP values (tpy) for Georgia PSD applications.

Precursor	8-hour Ozone	Daily $PM_{2.5}$	Annual $PM_{2.5}$
NOx	156	4,014	7,427
SO_2	----	667	6,004
VOC	3,980	----	----

SILs Analysis

<u>Ozone</u>
(300/156) + (300/3,980) = 1.923 + 0.075 = **1.998**, which is greater than 1. Therefore, the applicant should perform a cumulative analysis for ozone.

<u>Annual $PM_{2.5}$</u>
(0.15/0.2) + (300/6,004) + (300/7,427) = 0.750 + 0.050 + 0.040 = **0.840**, which is less than 1. Therefore, the applicant does not need to perform a cumulative analysis for annual $PM_{2.5}$.

<u>Daily $PM_{2.5}$</u>
(0.6/1.2) + (300/667) + (300/4,014) = 0.500 + 0.450 + 0.075 = **1.025**, which is greater than 1. Therefore, the applicant should perform a cumulative analysis for daily $PM_{2.5}$.

Cumulative Analysis

<u>Ozone</u>
66 ppb + [(500/156) + (500/3,980)] * 1 ppb = 66 + 3.331 = **69.331**, which does not exceed 70 ppb. Therefore, the applicant does not cause or contribute to a violation of the ozone NAAQS.

<u>Daily $PM_{2.5}$</u>
29 $\mu g/m^3$ + 3.0 $\mu g/m^3$ + [(500/667) + (500/4,014)] * 1.2 $\mu g/m^3$ = 29 + 3.0 + (0.75 + 0.12) * 1.2 = 29 + 3.0 + 1.04 = **33.04** $\mu g/m^3$, which does not exceed 35 $\mu g/m^3$. Therefore, the applicant does not cause or contribute to a violation of the daily $PM_{2.5}$ NAAQS.

Example 2: Direct $PM_{2.5}$ Increase Below SER

Emissions (Table E-5) are provided for a hypothetical PSD application with a proposed direct $PM_{2.5}$ emissions increase below the SER (10 tpy). Only the $PM_{2.5}$ initial SILs screening analysis is presented here.

Table E-5. Emission increases for an example PSD application.

Precursor	Project Emissions (tpy)	SER (tpy)
NOx	300	40
SO_2	300	40
$PM_{2.5}$	5	10

Initial SILs Screening Analysis

Annual $PM_{2.5}$

(5/10) + (300/6,004) + (300/7,427) = 0.500 + 0.050 + 0.040 = **0.590**, which is less than 1. Therefore, the applicant is below the SIL and does not need to perform any AERMOD modeling for annual $PM_{2.5}$.

Daily $PM_{2.5}$

(5/10) + (300/667) + (300/4,014) = 0.500 + 0.450 + 0.075 = **1.025**, which is greater than 1. Therefore, the applicant should perform SILs modeling with AERMOD for daily $PM_{2.5}$ following the procedures in Example 1.

Example 3: Direct $PM_{2.5}$ Increase Below SER

Emissions (Table E-6) are provided for a hypothetical PSD application with a proposed direct $PM_{2.5}$ emissions increase below the SER (10 tpy). Only the $PM_{2.5}$ initial SIL screening analysis is presented here.

Table E-6. Emission increases for an example PSD application.

Precursor	Project Emissions (tpy)	SER (tpy)
NOx	100	40
SO_2	100	40
$PM_{2.5}$	5	10

Initial SILs Screening Analysis

Annual $PM_{2.5}$

(5/10) + (100/6,004) + (100/7,427) = 0.500 + 0.017 + 0.014 = **0.531**, which is less than 1. Therefore, the applicant is below the SIL and does not need to perform any AERMOD modeling for annual $PM_{2.5}$.

Daily $PM_{2.5}$

(5/10) + (100/667) + (100/4,014) = 0.500 + 0.150 + 0.025 = **0.675**, which is less than 1. Therefore, the applicant is below the SIL and does not need to perform any AERMOD modeling for daily $PM_{2.5}$.