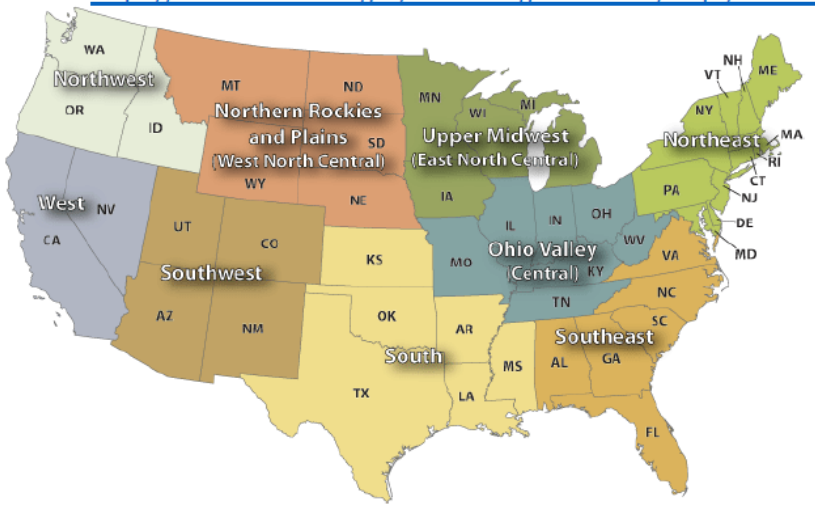
Tier 1 $PM_{2.5}$ MERPs Demonstration Example

A step by step demonstration of how to apply Tier 1 MERPs to assess secondary $PM_{2.5}$ impacts in PSD permits

Tier 1 Demonstration: Selecting an appropriate hypothetical MERPs

Step 1) Start with lowest, most conservative, illustrative MERPs for selected Climate Zone (Table 4-1, new to revised guidance):

Figure 3-4. NOAA climate zone map with number of hypothetical source locations modeled in each climate zone.
Source: https://www.ncdc.noaa.gov/monitoring-references/maps/us-climate-regions.php



Climate Zone	Sources
Northeast	10
Southeast	9
Ohio Valley	19
Upper Midwest	12
Rockies/Plaines	14
South	17
Southwest	15
West	6
Northwest	3

Table 4-1. Lowest, median, and highest illustrative MERP values (tons per year) by precursor, pollutant and climate zone.
Note: illustrative MERP values are derived based on EPA modeling and EPA recommended SILs from EPA's final SILs guidance (U.S. Environmental Protection Agency, 2018).

	8-hr O_3 from NO_X			8-hr O_3 from VOC		
Climate Zone	Lowest	Median	Highest	Lowest	Median	Highest
Northeast	209	495	5,773	2,068	3,887	15,616
Southeast	170	272	659	1,936	7,896	42,964
Ohio Valley	126	340	1,346	1,159	3,802	13,595
Upper Midwest	125	362	4,775	1,560	2,153	30,857
Rockies/Plains	184	400	3,860	1,067	2,425	12,788
South	190	417	1,075	2,307	4,759	30,381
Southwest	204	422	1,179	1,097	10,030	144,744
West	218	429	936	1,094	1,681	17,086
Northwest	199	373	4,031	1,049	2,399	15,929

	Daily PM2.5 from NO_X			Daily PM2.5 from SO_2		
Climate Zone	Lowest	Median	Highest	Lowest	Median	Highest
Northeast	2,218	15,080	34,307	623	3,955	8,994
Southeast	1,943	8,233	23,043	367	2,475	5,685
Ohio Valley	2,570	10,119	32,257	348	3,070	16,463
Upper Midwest	2,963	10,043	29,547	454	2,482	6,096
Rockies/Plains	1,740	9,389	31,263	251	2,587	19,208
South	1,881	8,079	24,521	274	1,511	10,112
Southwest	6,514	26,322	101,456	1,508	8,730	27,219
West	1,073	8,570	34,279	188	2,236	24,596
Northwest	3,003	11,943	20,716	1,203	3,319	8,418

	Annual PM2.5 from NO_X			Annual PM2.5 from SO_2		
Climate Zone	Lowest	Median	Highest	Lowest	Median	Highest
Northeast	10,142	47,396	137,596	4,014	21,353	41,231
Southeast	5,679	45,076	137,516	859	14,447	25,433
Ohio Valley	7,625	31,931	150,868	3,098	23,420	58,355
Upper Midwest	10,011	33,497	139,184	2,522	17,997	45,113
Rockies/Plains	9,220	39,819	203,546	2,263	16,939	106,147
South	7,453	41,577	110,478	1,781	11,890	58,612
Southwest	11,960	128,564	779,117	10,884	38,937	105,417
West	3,182	29,779	103,000	2,331	11,977	66,773
Northwest	7,942	21,928	71,569	11,276	15,507	18,263

Tier 1 Demonstration: Selecting an appropriate hypothetical MERPs

Step 2) Screen the closest hypothetical sources to the project facility and select the lowest, most conservative, MERPs

Table A-2. A list of emission rates and stack release height combinations modeled for each domain. A complete list of hypothetical sources in each domain are provided in Table A-1. Figures showing the location of specific sources by domain are provided in Figures A1-A4.

Geographic Region	# hypothetical sources within the region	Release Type	Emission Rate (tpy)	NAAQS & Precursors Modeled		
				8-hr O3	Daily PM2.5	Annual PM2.5
12EUS3	18	H	3000	NOX, VOC	NOX, SO2	NOX, SO2
(eastern US)	18	H	1000	NOX, VOC	NOX, SO2	NOX, SO2
	18	H	500	NOX, VOC	NOX, SO2	NOX, SO2
	18	L	500	NOX, VOC	NOX, SO2	NOX, SO2
12EUS2	25	H	3000	NOX, VOC	NOX, SO2	NOX, SO2
(central US)	25	H	1000	NOX, VOC	NOX, SO2	NOX, SO2
	25	L	1000	VOC	NOX, SO2	NOX, SO2
	25	H	500	NOX	NOX, SO2	NOX, SO2
	25	L	500	NOX, VOC	NOX, SO2	NOX, SO2
12WUS1	26	H	3000	NOX, VOC	NOX, SO2	NOX, SO2
(western US)	26	H	1000	NOX, VOC	NOX, SO2	NOX, SO2
	26	H	500	NOX, VOC	NOX, SO2	NOX, SO2
	26	L	500	NOX, VOC	NOX, SO2	NOX, SO2
12US2	36	H	1000	NOX	NOX, SO2	NOX, SO2
(contiguous US)	36	H	500	NOX	NOX, SO2	NOX, SO2
	36	L	500	NOX, VOC	NOX, SO2	NOX, SO2

Tier 1 Demonstration: Selecting an appropriate hypothetical MERPs

Step 3) If selecting a nearby hypothetical source that is not the most conservative, the applicant should describe how the existing modeling reflects the formation of O_3 or $PM_{2.5}$ in that geographic area and is therefore most appropriate.

Information that could be used to describe the comparability of two different geographic areas include:

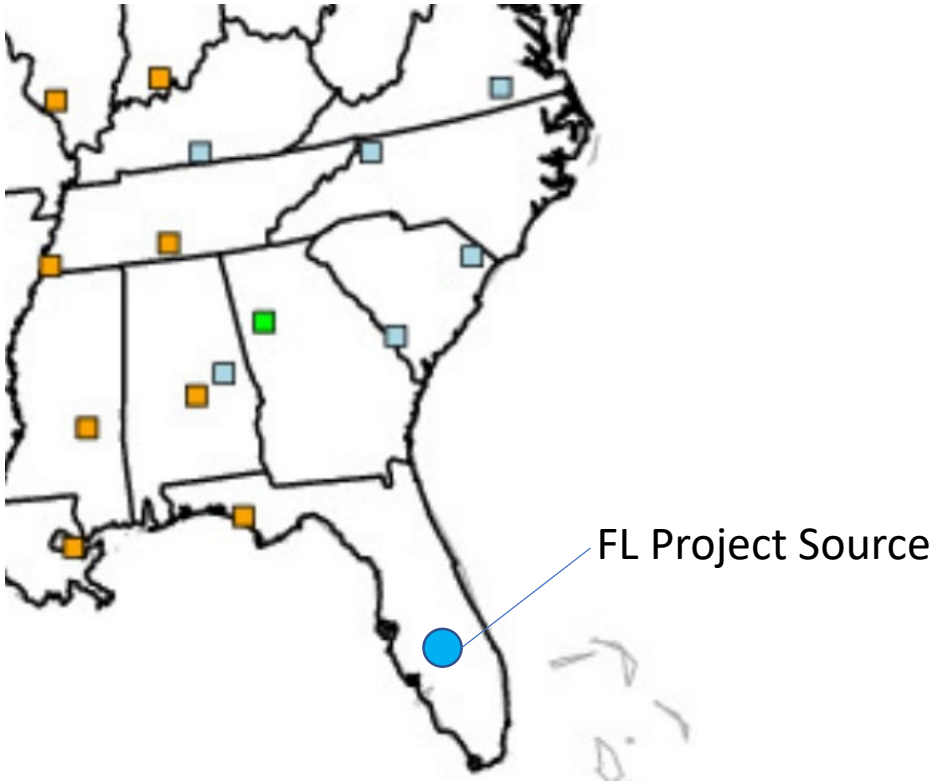
- nearby local and regional sources of pollutants and their emissions (e.g., other industry, mobile, biogenics)
- rural or urban nature of the area
- terrain
- ambient concentrations of relevant pollutants where available
- average and peak temperatures
- humidity

Table A-1. Complete list of EPA modeled hypothetical sources presented in this document. "Max Nearby Urban (%)" column provides the highest percentage urban landcover in any grid cell near (within 50 km) the source.

FIPS	State	County	Domain	Source	Latitude	Longitude	Max Nearby Terrain (m)	Max Nearby Urban (%)
1001	Alabama	Autauga	12EUS2	4	32.522	-86.550	179	25
1123	Alabama	Tallapoosa	12EUS3	19	32.848	-85.809	306	10
4005	Arizona	Coconino	12US2	36	35.428	-111.270	2483	7.4
4007	Arizona	Gila	12WUS1	14	33.469	-110.789	1592	4.3
4012	Arizona	La Paz	12WUS1	17	33.400	-113.408	757	0.9
5119	Arkansas	Pulaski	12EUS2	13	34.724	-92.275	235	32.2

Tier 1 Demonstration: $PM_{2.5}$ 24-hr Class II SIL Example

Example: A small, surface-level source in central Florida with 100 tpy of NO_x and 100 tpy of SO_2 with $\boldsymbol{1.0\ \frac{ug}{m3}}$ modeled concentration of Primary $PM_{2.5}$ for the 24-hr Class II SIL.



Tier 1 Demonstration: $PM_{2.5}$ 24-hr Class II SIL Example

NO_X and SO_2 precursor contributions to secondary $PM_{2.5}$ are considered together, in addition to modeled primary $PM_{2.5}$, to determine if the source's air quality impact would exceed the $PM_{2.5}$ SIL.

<u>Equations to assess Project emission secondary impacts:</u>

Project Impact as % of SIL = $\frac{Emission\ rate\ (tpy) from\ Project}{MERP\ (tpy) from\ hypothetical\ Source} * 100$

Project Impact in ppb or $\frac{ug}{m3}$ = $\frac{Emission\ rate\ (tpy) from\ Project}{MERP\ (tpy) from\ hypothetical\ source} * applicable\ SIL\ value\ (ppb\ or\ \frac{ug}{m3})$

Project Impact in ppb or $\frac{ug}{m3}$ = $Emission\ rate\ (tpy) from\ Project * \frac{Modeled\ air\ quality\ impact\ from\ hypothetical\ soruce}{Modeled\ emission\ rate\ (tpy)\ from\ hypothetical\ source}$

Tier 1 Demonstration: $PM_{2.5}$ 24-hr Class II SIL Example

Example: A small, surface-level source in central Florida with 100 tpy of NO_x and 100 tpy of SO_2 with $\boldsymbol{1.0\ \frac{ug}{m3}}$ modeled concentration of Primary $PM_{2.5}$ for the 24-hr Class II SIL.

Step 1): Use lowest illustrative MERP from the Southeast Climate Zone:

$\boldsymbol{PM_{2.5}\ 24\text{-}hr\ SIL = 1.2\ \frac{ug}{m3}}$

Is Primary + Secondary $PM_{2.5}$ > SIL?

Tier 1 Demonstration: $PM_{2.5}$ 24-hr Class II SIL Example

Example: A small, surface-level source in central Florida with 100 tpy of NO_x and 100 tpy of SO_2 with ***1.0*** $\frac{ug}{m3}$ modeled concentration of Primary $PM_{2.5}$ for the 24-hr Class II SIL.

$$\text{Project Impact as \% of SIL} = \frac{Emission\ rate\ (tpy) from\ Project}{MERP\ (tpy) from\ hypothetical\ Source} * 100$$

$$\text{Project Impact in } \frac{ug}{m3} = \frac{Emission\ rate\ (tpy) from\ Project}{MERP\ (tpy) from\ hypothetical\ source} * applicable\ SIL\ value\ (\frac{ug}{m3})$$

Climate Zone	Daily PM2.5 from NO_x			Daily PM2.5 from SO_2		
	Lowest	Median	Highest	Lowest	Median	Highest
Northeast	2,218	15,080	34,307	623	3,955	8,994
Southeast	1,943	8,721	23,043	367	2,516	5,685
Ohio Valley	2,570	9,814	32,257	348	2,648	16,463

Step 1): Use lowest illustrative MERP from the Southeast Climate Zone:

$$\text{Project Impact as \% of SIL} = \left(\frac{100\ tpy\ NOX\ from\ source}{1{,}943\ tpy\ NOX\ daily\ PM2.5\ MERP} + \frac{100\ tpy\ SO2\ from\ source}{367\ TPY\ SO2\ daily\ PM2.5\ MERP}\right) * 100 = \mathbf{32\%}\ \text{of SIL}$$

$$\text{Project Impact in } \frac{ug}{m3} = \left(\frac{100\ tpy\ NOX\ from\ source}{1{,}943\ tpy\ NOX\ daily\ PM2.5\ MERP} + \frac{100\ tpy\ SO2\ from\ source}{367\ TPY\ SO2\ daily\ PM2.5\ MERP}\right) * 1.2\ \frac{ug}{m3} = \mathbf{0.384}\ \frac{ug}{m3}$$

Primary + Secondary $PM_{2.5}$ as % of SIL:

$$\frac{1.0\frac{ug}{m3}\ modeled}{1.2\frac{ug}{m3}\ SIL} + 0.32 = \textbf{\textit{115\% of SIL}}$$

Primary + Secondary $PM_{2.5}$ in $\frac{ug}{m3}$:

$$1.0\ \frac{ug}{m3} + 0.384\ \frac{ug}{m3} = \textbf{\textit{1.384}}\ \frac{\mathbf{ug}}{\mathbf{m3}}$$

Tier 1 Demonstration: $PM_{2.5}$ 24-hr Class II SIL Example

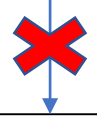
Example: A small, surface-level source in central Florida with 100 tpy of NO_x and 100 tpy of SO_2 with $\boldsymbol{1.0\ \frac{ug}{m3}}$ modeled concentration of Primary $PM_{2.5}$ for the 24-hr Class II SIL.

Step 1): Use lowest, illustrative MERP from the Southeast Climate Zone:

100 tpy NO_x from source/1,943 tpy NO_x daily $PM_{2.5}$ MERP = 0.05
100 tpy SO_2 from source/367 tpy SO_2 daily $PM_{2.5}$ MERP = 0.27
Total Secondary $PM_{2.5}$ = .05 + .27 = .32 * 100 = **32%** or 0.32 * 1.2 $\frac{\text{ug}}{\text{m3}}$ = **0.384** $\frac{\text{ug}}{\text{m3}}$

$PM_{2.5}$ 24-hr SIL = 1.2 $\frac{ug}{m3}$

Is Primary + Secondary $PM_{2.5}$ > SIL?
1.0 + 0.38 = **1.38** $\frac{\text{ug}}{\text{m3}}$



If no, then total $PM_{2.5}$ daily is below the SIL and no Class II Increment or NAAQS analysis is necessary

Step 2: Select lowest MERP from nearby sources with similar stack height:

Tier 1 Demonstration: $PM_{2.5}$ 24-hr Class II SIL Example

Example: A small, surface-level source in central Florida with 100 tpy of NO_x and 100 tpy of SO_2 with ***1.0*** $\frac{ug}{m3}$ modeled concentration of Primary $PM_{2.5}$ for the 24-hr Class II SIL.

Step 2): Select lowest MERP from nearby sources with similar stack height:

-Florida, Bay (12EUS2):

-Alabama, Tallapoosa (12EUS3):

-Alabama, Autauga (12EU2):

Metric	Poll	State	County	Emissions	Stack Height	Conc	MERP
DAILY	NITRATE	Florida	Bay	1000	10	0.618	1943
DAILY	NITRATE	Florida	Bay	500	10	0.283	2122
DAILY	NITRATE	Alabama	Autauga	500	10	0.178	3370
DAILY	NITRATE	Alabama	Autauga	1000	10	0.341	3514
DAILY	NITRATE	Alabama	Tallapoosa	500	10	0.092	6555

Metric	Poll	State	County	Emissions	Stack Height	Conc	MERP
DAILY	SULFATE	Florida	Bay	1000	10	3.271	367
DAILY	SULFATE	Alabama	Autauga	1000	10	3.097	387
DAILY	SULFATE	Florida	Bay	500	10	1.366	439
DAILY	SULFATE	Alabama	Autauga	500	10	1.231	487
DAILY	SULFATE	Alabama	Tallapoosa	500	10	0.325	1844

FL Project Source

Same MERPs from Step 1; therefore:

Total Secondary $PM_{2.5}$ = 0.384 $\frac{ug}{m3}$ or **32%** of SIL

Total $PM_{2.5}$ = 1.0 + 0.38 = **1.38** $\frac{ug}{m3}$

Tier 1 Demonstration: $PM_{2.5}$ 24-hr Class II SIL Example

Example: A small, surface-level source in central Florida with 100 tpy of NO_x and 100 tpy of SO_2 with ***1.0*** $\frac{ug}{m3}$ modeled concentration of Primary $PM_{2.5}$ for the 24-hr Class II SIL.

Step 1): Use lowest illustrative MERP from the Southeast Climate Zone:

100 tpy NO_x from source/1,943 tpy NO_x daily $PM_{2.5}$ MERP = 0.05
100 tpy SO_2 from source/367 TPY SO_2 daily $PM_{2.5}$ MERP = 0.27
Total Secondary $PM_{2.5}$ = .05 + .27 = .32 * 100 = **32%** or 0.32 * 1.2 $\frac{\text{ug}}{\text{m3}}$ = **0.384** $\frac{ug}{m3}$

$PM_{2.5}$ 24-hr SIL = 1.2 $\frac{ug}{m3}$

Is Primary + Secondary $PM_{2.5}$ > SIL?
1.0 + 0.38 = ***1.38*** $\frac{ug}{m3}$

Then Total $PM_{2.5}$ Daily is below the SIL and no Class II Increment or NAAQS analysis is necessary

Step 2: Select lowest MERP from nearby sources with similar stack height:
-Florida, Bay (12EUS2):
-Alabama, Tallapoosa (12EUS3):
-Alabama, Autauga (12EU2):

Same as Step 1:

Total Secondary $PM_{2.5}$ = 0.384 ug/m3 or 32% of SIL
Total $PM_{2.5}$ = 1.0 + 0.38 = ***1.38*** $\frac{ug}{m3}$

Step 3): Select most representative nearby source for similar scenario (500 tpy and L stack):

Tier 1 Demonstration: $PM_{2.5}$ 24-hr Class II SIL Example

Example: A small, surface-level source in central Florida with 100 tpy of NO_x and 100 tpy of SO_2 with ***1.0*** $\frac{ug}{m3}$ modeled concentration of Primary $PM_{2.5}$ for the 24-hr Class II SIL.

Step 3): Select most representative nearby source for similar scenario (500 tpy and L stack):

-Florida, Bay (12EUS2):

-Alabama, Tallapoosa (12EUS3):

-Alabama, Autauga (12EU2):

Information that could be used to assess the comparability of two different geographic areas include:

- nearby local and regional sources of pollutants and their emissions (e.g., other industry, mobile, biogenics)
- rural or urban nature of the area
- terrain features
- ambient concentrations of relevant pollutants where available
- average and peak temperatures
- humidity

Metric	Poll	State	County	Emissions	Stack Height	Conc	MERP
DAILY	NITRATE	Florida	Bay	500	10	0.283	2122
DAILY	NITRATE	Alabama	Autauga	500	10	0.178	3370
DAILY	NITRATE	Alabama	Tallapoosa	500	10	0.092	6555

Metric	Poll	State	County	Emissions	Stack Height	Conc	MERP
DAILY	SULFATE	Florida	Bay	500	10	1.366	439
DAILY	SULFATE	Alabama	Autauga	500	10	1.231	487
DAILY	SULFATE	Alabama	Tallapoosa	500	10	0.325	1844

$$\frac{100\ tpy\ NOX\ from\ source}{6{,}555\ tpy\ NOX\ daily\ PM2.5\ MERP} = 0.015$$

$$\frac{100\ tpy\ SO2\ from\ source}{1{,}844\ TPY\ SO2\ daily\ PM2.5\ MERP} = 0.05$$

Total Secondary $PM_{2.5}$ = .015 + .05 = .065 * 100 = **7%** of SIL

or 0.065 * 1.2 $\frac{ug}{m3}$ = **0.078** $\frac{ug}{m3}$

Total $PM_{2.5}$ = 1.0 + 0.078 = ***1.078*** $\frac{ug}{m3}$ √

Tier 1 Demonstration: $PM_{2.5}$ 24-hr Class II SIL Example

Example: A small, surface-level source in central Florida with 100 tpy of NO_x and 100 tpy of SO_2 with ***1.0*** $\frac{ug}{m3}$ modeled concentration of Primary $PM_{2.5}$ for the 24-hr Class II SIL.

Step 1): Use lowest illustrative MERP from the Southeast Climate Zone:

100 tpy NO_x from source/1,943 tpy NO_x daily $PM_{2.5}$ MERP = 0.05
100 tpy SO_2 from source/367 TPY SO_2 daily $PM_{2.5}$ MERP = 0.27
Total Secondary PM2.5 = .05 + .27 = .32 * 100 = **32%** or 0.32 * 1.2 ug/m3 = **0.384** $\frac{ug}{m3}$

$PM_{2.5}$ 24-hr SIL = 1.2 $\frac{ug}{m3}$

Is Primary + Secondary $PM_{2.5}$ > SIL?
1.0 + 0.38 = ***1.38*** $\frac{ug}{m3}$

✗

Then Total $PM_{2.5}$ Daily is below the SIL and no Class II Increment or NAAQS analysis is necessary

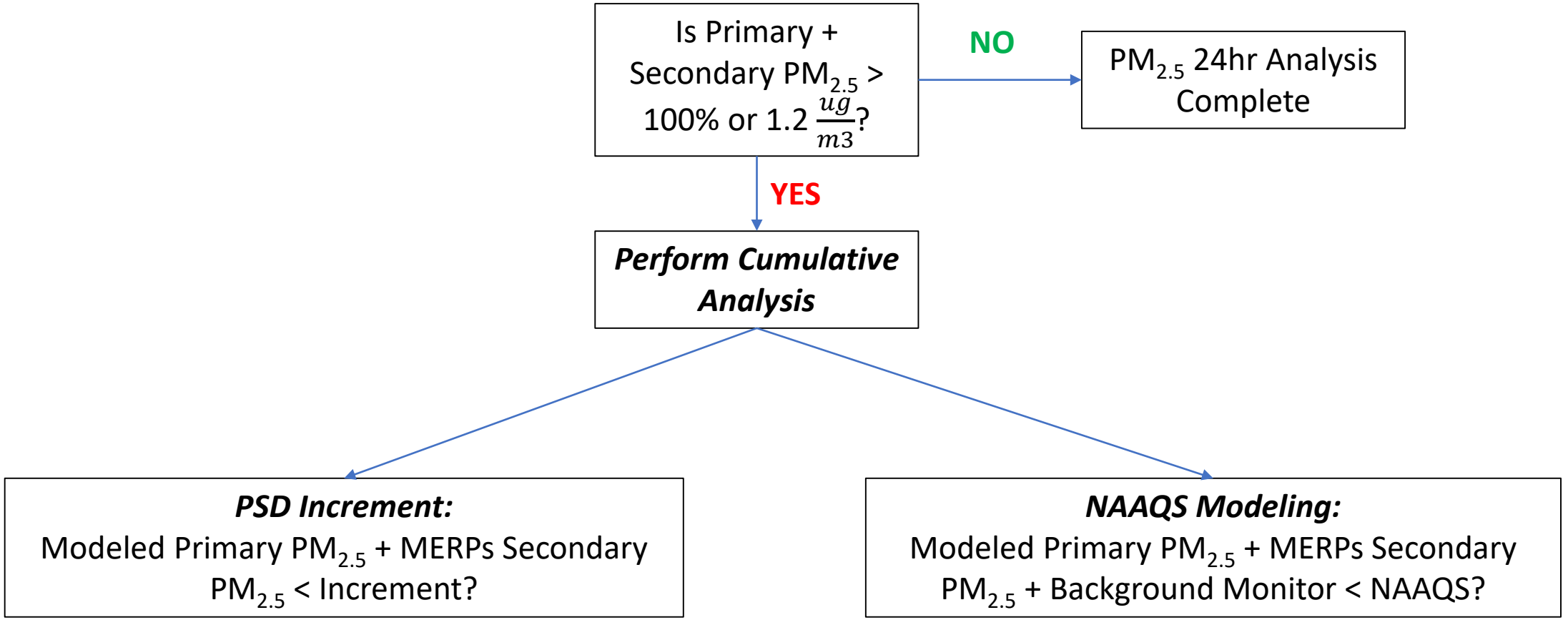
Step 2: Select lowest MERP from nearby sources with similar stack height:
-Florida, Bay (12EUS2):
-Alabama, Tallapoosa (12EUS3):
-Alabama, Autauga (12EUS2):

Same as Step 1:
Total Secondary $PM_{2.5}$ = **32%** of SIL
or 0.384 $\frac{ug}{m3}$
Total $PM_{2.5}$ = 1.0 + 0.38 = ***1.38*** $\frac{ug}{m3}$ ✗

Step 3): Select representative nearby source for similar scenario (500 tpy and L stack)
-Florida, Bay (12EUS2):
-Alabama, Tallapoosa (12EUS3):
-Alabama, Autauga (12EU2):

NO_x: 100 tpy/6555 MERP = 0.015
SO_2: 100 tpy/1844 MERP = 0.05
Total Secondary $PM_{2.5}$ = **7%** of SIL or **0.078** $\frac{ug}{m3}$
Total $PM_{2.5}$ = 1.0 + 0.078 = ***1.078*** $\frac{ug}{m3}$ ✓

Tier 1 Demonstration: $PM_{2.5}$ 24-hr Class II SIL Example



Development of MERPs Assessment Tool – ‘MERPs View’

- EPA Region 4 and OAQPS are developing an online tool to assist in Tier 1 demonstrations based on MERPs analyses
- The tool is based on the ‘Qlik App’ software which provides greater interactivity and visualization of the available MERPs data
- The tool will combine existing MERPs data with more detailed, refined assessments (i.e. air quality impacts as a function of distance from a modeled source)
- This tool will allow end-users to view and extract MERPs data that is most useful to them
- Short demo to follow…..