Missouri Department of Natural Resources

Particulate Matter Less Than Two and One Half Microns Significant Impact Determination

Particulate Matter Less Than Two and One Half Microns ($PM_{2.5}$) or fine particulate matter consists of particles that are less than two and one half microns in diameter. $PM_{2.5}$ can be directly emitted or secondarily formed in the atmosphere and is generated from various sources including the combustion of fuel, fires, industrial processes and vehicle emissions. $PM_{2.5}$ that is directly emitted as a solid or a liquid is defined as filterable particulate matter. Particulate matter that is released as a vapor and condenses to form a solid or liquid particle is defined as condensable particulate matter. Additionally, $PM_{2.5}$ can form in the presences of precursor emissions, such as nitrogen oxide and sulfur dioxide. All $PM_{2.5}$ calculations should include both filterable and condensable particles.

When a construction project triggers the need for an ambient air quality impact analysis for directly emitted $PM_{2.5}$, the applicant must first determine if the existing air quality within the region, without consideration of the proposed construction or modification, is approaching or exceeding the National Ambient Air Quality Standards (NAAQS). If the difference between the NAAQS and the monitored background number is less than the significant impact level, a full impact assessment will automatically be required prior to the issuance of the construction permit regardless of the project's predicted impact.

If existing air quality data indicates that the air quality within the region is not threatened and the difference between the NAAQS and the monitored background number is greater than the significant impact threshold, the applicant can conduct a preliminary impact analysis to determine if a cumulative assessment is necessary. Initially, the preliminary impact analysis will be used to answer the following questions:

1. Does the ambient concentration due to the proposed project exceed the significant impact levels accepted by the State of Missouri?
2. If a significant impact is predicted to occur, what is the furthest extent of the significant impact area?

$PM_{2.5}$ is said to have a significant impact if the five year average of the maximum concentrations for the 24-hour averaging period or the five year average of maximum annual concentration exceeds the thresholds contained within Table 1.

Table 1
$PM_{2.5}$ Significant Impact Thresholds

Pollutant	Averaging Time	Interim Significant Impact Level*	Comment
		($\mu g/m^3$)	
$PM_{2.5}$	24-Hour	1.2	The Multiyear Average of the Highest 24-Hour Values at Each Receptor
$PM_{2.5}$	Annual	0.3	The Multiyear Average of the Highest Annual Values at Each Receptor

**Thresholds accepted by the State of Missouri based upon the vacated significant impact thresholds developed by the Environmental Protection Agency*

If the predicted concentration exceeds the significant impact level for any averaging period, a full impact analysis is required. For example, if the predicted maximum impact for the 24-hour averaging period is 2.0 μg/m^3 and the maximum annual concentration is 0.1 μg/m^3, a full impact analysis is required for both averaging periods, even though the maximum annual concentration is less than 0.3 μg/m^3.

It is important to note that the 24-hour and annual significant impact levels for $PM_{2.5}$ are based upon a multiyear average at each receptor rather than the maximum, first high impact at each receptor. The determination to allow the use of the multiyear averages is based upon the March 23, 2010 guidance document from the Environmental Protection Agency entitled "Modeling Procedures for Demonstrating Compliance with $PM_{2.5}$ NAAQS." This document states that the determination of significant impact should be based upon a five-year average to reflect the form of the NAAQS standard while maintaining a screening level approach. This approach differs from the approach that is taken for particulate matter less than ten microns, PM_{10}, where the significant impact level continues to be based upon the overall, maximum impact on a receptor by receptor basis. Unlike $PM_{2.5}$, the concentrations for PM_{10} should not be averaged over the five year period.

For example, Table 2 contains a sample summary of 24-hour $PM_{2.5}$ concentrations obtained over a five-year period. The first four columns contain a description of the receptor data that denotes the location of the receptor followed by the predicted concentration due to the construction of a $PM_{2.5}$ source for each year modeled. The last column contains the multiyear average for the five-year period. The multiyear average determines if a significant ambient impact occurred for the 24-hour averaging period.

Table 2
Example 24-Hour $PM_{2.5}$ Significant Impact Determination

Receptor Data					Maximum 1-Hour Concentration					Multiyear Average
Receptor #	**Easting**	**Northing**	**Elevation**	**Hill Hgt**	**2005**	**2006**	**2007**	**2008**	**2009**	**5-Year Average**
	(Meters)	***(Meters)***	***(Meters)***	***(Meters)***	***(μg/m^3)***	***(μg/m^3)***	***(μg/m^3)***	***(μg/m^3)***	***(μg/m^3)***	***(μg/m^3)***
1	341668.22	4400623.97	253.90	253.90	5.95	4.27	5.26	4.53	5.34	5.07
2	341578.30	4400600.50	255.20	255.20	4.74	4.19	4.51	4.72	5.92	4.82
3	342600.00	4400000.00	259.70	259.70	2.02	2.48	4.61	4.35	3.54	3.40
4	342600.00	4399800.00	259.40	303.00	1.80	1.28	3.35	4.40	4.58	3.08
5	341728.30	4400050.50	274.50	274.50	1.26	1.05	1.59	1.28	1.60	1.36
6	340800.00	4401100.00	246.80	246.80	1.40	0.85	1.04	1.60	1.32	1.24
7	342100.00	4399500.00	277.80	303.00	1.29	1.10	1.14	0.88	1.12	1.11
8	340800.00	4400600.00	248.10	248.10	1.16	0.74	1.08	1.28	1.23	1.10
9	341200.00	4400000.00	253.80	307.00	0.75	1.13	1.13	1.21	1.19	1.08
10	341100.00	4401500.00	250.90	250.90	1.17	1.19	1.05	0.78	1.21	1.08
11	341000.00	4400000.00	250.40	307.00	0.88	1.18	0.74	1.13	1.30	1.05
12	341000.00	4401500.00	250.20	250.20	1.10	1.03	0.95	0.87	0.89	0.96
13	342100.00	4401000.00	298.70	298.70	0.91	0.83	1.08	0.78	0.81	0.88
14	340700.00	4400700.00	245.20	245.20	1.10	0.70	0.70	0.78	1.03	0.86
15	343000.00	4402500.00	269.00	269.00	0.60	0.60	0.97	1.09	0.88	0.83

Based upon the 5-year average, Receptor #'s 1-6 exceed the 24-hour significant impact threshold of 1.2 $\mu g/m^3$.

Table 3 provides an example of the annual significant impact determination. As noted previously, the annual significant impact determination is based upon the multiyear average of the maximum annual impacts that are predicted over the five year period being modeled.

Table 3
Example Annual $PM_{2.5}$ Significant Impact Determination

Receptor Data					Maximum Annual Concentration					
Receptor #	**Easting**	**Northing**	**Elevation**	**Hill Hgt**	**2005**	**2006**	**2007**	**2008**	**2009**	**Max Impact**
	(Meters)	***(Meters)***	***(Meters)***	***(Meters)***	***($\mu g/m^3$)***	***($\mu g/m^3$)***	***($\mu g/m^3$)***	***($\mu g/m^3$)***	***($\mu g/m^3$)***	***($\mu g/m^3$)***
1	341741.64	4400623.97	256.03	256.03	0.62	0.61	0.74	0.70	0.59	0.65
2	341763.80	4400623.97	256.03	256.03	0.59	0.60	0.73	0.70	0.60	0.64
3	341778.40	4400376.00	255.40	264.00	0.57	0.57	0.62	0.70	0.74	0.64
4	341828.30	4400800.50	261.50	301.00	0.46	0.47	0.55	0.52	0.46	0.49
5	342328.30	4400150.50	258.60	293.00	0.32	0.30	0.44	0.56	0.55	0.43
6	341803.00	4400255.00	263.00	263.00	0.33	0.34	0.42	0.47	0.56	0.42
7	341800.00	4401000.00	258.90	301.00	0.30	0.31	0.38	0.34	0.30	0.33
8	341628.30	4400550.50	255.00	255.00	0.31	0.31	0.33	0.32	0.33	0.32
9	341628.30	4400500.50	255.00	255.00	0.27	0.27	0.30	0.30	0.33	0.29
10	341678.30	4400300.50	262.20	262.20	0.21	0.21	0.30	0.35	0.38	0.29
11	342178.30	4400000.50	269.30	301.00	0.27	0.25	0.25	0.31	0.34	0.28
12	342000.00	4400800.00	279.90	301.00	0.26	0.23	0.34	0.29	0.24	0.27
13	342178.30	4400550.50	272.50	272.50	0.21	0.23	0.33	0.31	0.28	0.27
14	341978.30	4400000.50	278.80	291.00	0.24	0.23	0.24	0.29	0.32	0.26
15	342428.30	4400250.50	257.00	257.00	0.16	0.19	0.22	0.32	0.29	0.24

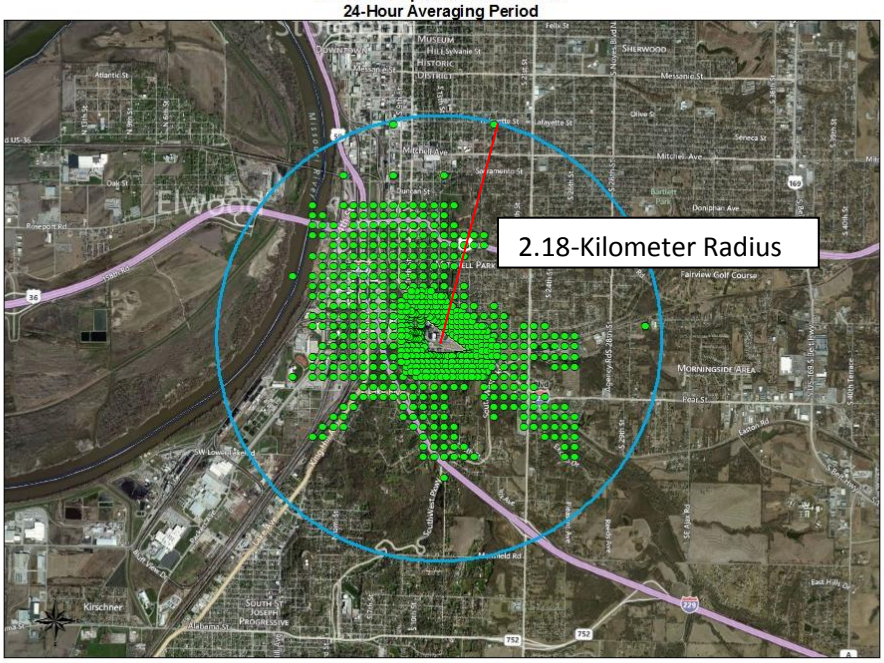
Based upon the 5-year average, Receptor #'s 1-8 exceed the annual significant impact threshold of 0.3 $\mu g/m^3$.

If it is determined that a significant impact will take place, the applicant must determine the radius of impact due to the construction of the proposed project or modification. This information will be used to determine the extent of the model domain for the cumulative impact assessment and will aid in interactive source inventory development.

The radius of impact, commonly referred to as the significant impact area, is the circular area whose radius extends from the center of the facility to the most distant receptor where a significant impact is predicted to occur, or 50-kilometers, whichever is less. In order to determine the furthest extent of the impact area, each averaging period must be reviewed. For example, the model output for a new construction project indicates that the significant impact for the 24-hour averaging period occurs out to a distance of 2.18-kilometers from the source and out to a distance of 0.84-kilometers from the same source for the annual averaging period. The $PM_{2.5}$ radius of impact for the project becomes 2.18-

kilometers because this is the largest area of impact that is predicted to occur; refer to Figure's 1, 2 and 3.

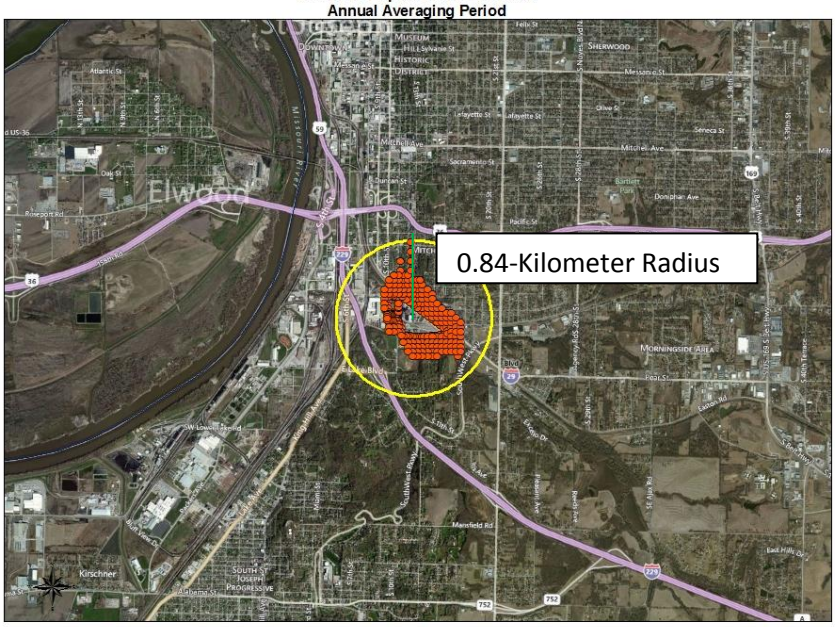
Figure 1
$PM_{2.5}$ Significant Impact Determination
Radius of Impact-2.18-Kilometers
24-Hour Averaging Period



Legend

24-Hour Significant Impact Receptor | 24-Hour Radius of Impact | Property Boundary

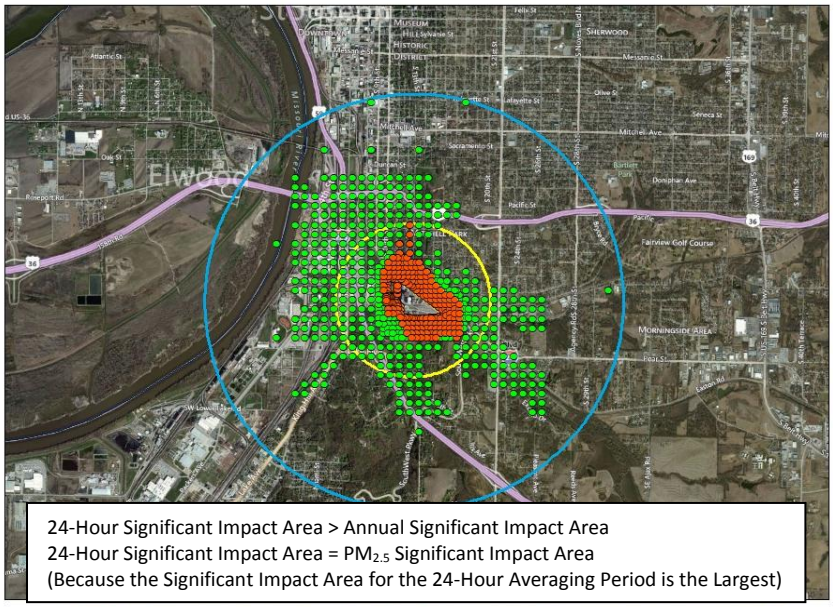
Figure 2
$PM_{2.5}$ Significant Impact Determination
Radius of Impact-0.84-Kilometers
Annual Averaging Period



Legend

Annual Radius of Impact · Annual Significant Impact Receptor · Property Boundary

Figure 3
$PM_{2.5}$ Significant Impact Determination
24-Hour and Annual Significant Impact Comparison



Legend

24-Hour Significant Impact Receptor · 24-Hour Radius of Impact · Annual Radius of Impact · Annual Significant Impact Receptor · Property Boundary

It is important to note that the determination of ambient impact due to new source or modification must consider quantifiable point source releases and fugitive source releases.

IMPORTANT!!! If a Section 8, major source permit is being sought, the applicant is required to conduct pre-construction monitoring. The primary objective of the data collection effort is to ensure that the existing air quality within the region is in compliance with the NAAQS. In addition, in order to address both directly emitted $PM_{2.5}$ and the secondary formation of $PM_{2.5}$, the Environmental Protection Agency, EPA, requires applicants to evaluate the potential impact due to precursor emissions and directly emitted emissions. If an applicant proposes to emit NO_x or SO_2 emissions in excess of 40 tons per year, an assessment of secondary impacts is required. This assessment can be in the form of a qualitative assessment or may require a quantitative review using photochemical grid models. Additional information regarding secondary formation assessments can be found in the EPA's draft guidance document entitled "Draft Guidance for $PM_{2.5}$ Permit Modeling."

The applicant must collect a minimum of one-year of data if it is determined that preconstruction monitoring is required. Additional information regarding preconstruction data collection efforts can be found at the following link: Preconstruction Monitoring Requirements.