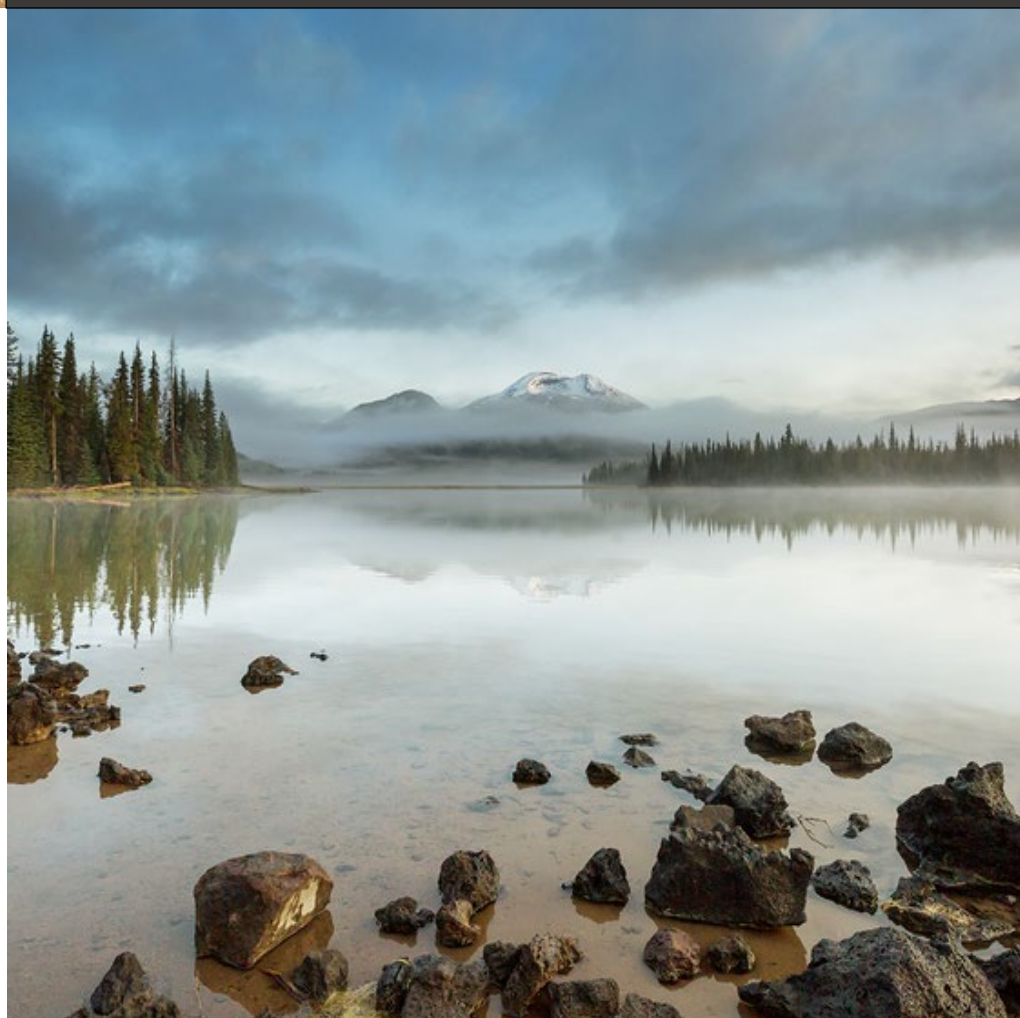
Justification for Oakridge $PM_{2.5}$ Surrogate Monitoring for the PM_{10}

Appendix I of the 2024 Oregon Annual Criteria Pollutant Monitoring Network Plan

To be submitted to: EPA Region 10

Date: TBD



State of Oregon
DEQ Department of Environmental Quality

This document was prepared by Anthony Barnack
Oregon Department of Environmental Quality
Air Quality Monitoring
7202 NE Evergreen Pkwy,
Hillsboro, OR 97124
Contact: Anthony Barnack
Phone: 971-806-2223
www.oregon.gov/deq

Translation or other formats

Español | 한국어 | 繁體中文 | Русский | Tiếng Việt | العربية
800-452-4011 | TTY: 711 | deqinfo@deq.oregon.gov

Non-discrimination statement

DEQ does not discriminate on the basis of race, color, national origin, disability, age or sex in administration of its programs or activities. Visit DEQ's Civil Rights and Environmental Justice page.

Executive Summary

Lane Regional Air Protection Agency operated Met One Inc. BAM 1022 $PM_{2.5}$ and BAM 1020 PM10 collocated FEM samplers in Oakridge from 2020 through 2023. The resulting PM_{10} and PM2.5 linear regression demonstrates that PM2.5 can be used as a surrogate for PM10. The linear regression had a very good correlation with a slope of 1.12 and an R^2 of 0.99. This is not surprising since the PM10 is 74% PM2.5, and 84% PM2.5 for wildfire smoke data.

LRAPA and DEQ are requesting a waiver to use the Oakridge PM2.5 continuous monitor as a surrogate for PM10, using the equation derived from the linear regression:

PM10 estimate = PM2.5 * M + b, where: M = 1.12 and b = 3.2

The PM10 maintenance plan control measures are street paving, woodstove changeouts, and woodstove use curtailment and PM10 is now <1/3 of the NAAQS, when wildfire smoke is excluded.

The 2022 PM10 maintenance plan's contingency measures are the same as the PM2.5 maintenance plan. The PM2.5 plan is more protective and will be triggered first. The contingency states that, if the PM10 design value is above 150 µg/m3, and is not from wildfire smoke, LRAPA will strengthen the woodstove advisory program by:

- lowering the red advisory thresholds and,
- prohibition fireplace usage on yellow advisory days

If the PM10 estimate is greater than the NAAQS from non-exceptional event sources, LRAPA will place a PM10 monitor back in Oakridge prior to January 1st of the following year. The monitor will run indefinitely or until another waiver is agreed upon or the maintenance plan requirement is removed or expired.

Table of Contents

Executive Summary ..... above
1. Introduction 1
2. Most of PM10 in Oakridge is PM2.5 1
2.1 Emission Inventory 1
2.1.1 2017 Lane County PM10 NEI 1
2.1.2 PM10 vs. PM2.5 NEI 3
2.1.3 PM10 NEI Trends 3
2.2 Monitoring 5
2.2.1 Trends 5
2.2.2 PM10 and PM2.5 2020 correlation 6
3. Calculating PM10 9
3.1 DEQ annual PM10 demonstration 9
4. Monitoring Contingency if PM10 Violates 10
5. Conclusion 10

Table of Tables

Table 1. PM10 monitoring requirements from 40 CFR Part 58 Appendix D, Section 4.6. 1
Table 2. Percent of the total emissions in Lane County by general category 3
Table 3. Number of days over the NAAQS 3
Table 4. Oakridge 2020-2023 PM10/PM2.5 Correlation – All days 8
Table 5. Oakridge 2020-2023 PM10/PM2.5 Correlation – Days > 50µg/m3 8
Table 6. Linear regression equations and ratios used to estimate PM10 using PM2.5. 10

Table of Figures

Figure 1. 2020 Lane County NEI by source type 2
Figure 2. 2020 NEI for Lane County PM10, excluding wildfires, prescribed burning, and dust. .. 2
Figure 3. Lane County NEI PM10 trends for major emission categories. 4
Figure 4. Lane County NEI PM10 trends for emission categories excluding wildfires, prescribe burning, and dust. 5
Figure 5. Oakridge PM10 trends. 6
Figure 6. Oakridge PM10 and PM2.5 time series for 2020-2023. 7
Figure 7. PM10/PM2.5 linear regression 8
Figure 8. 2020-2023 Oakridge calculated PM10 from PM2.5 vs. Actual PM10 in a Linear Regression. 9

1. Introduction

PM10 monitoring has been required in Oakridge for two reasons. First, Oakridge was a PM10 non-attainment area and is now a maintenance area. Second, the Eugene-Springfield MSA includes all of Lane County and with the elevated levels in the 1990s, two monitors were required. Eugene was also a non-attainment area, so it made sense to meet this criterion with monitors in Eugene and in Oakridge.

Oakridge was declared in non-attainment for PM10 in 1994. Its second highest, non-wildfire value, has been below the NAAQS since 1993 and its State Implementation Plan was approved in 1999. Its maintenance plan was approved in 2022. The contingency plan section of the maintenance plan requires PM10 monitoring. The monitored value can trigger contingency section of the plan, which would tighten residential wood combustion restrictions. This is the same requirement as in Oakridge's PM2.5 maintenance plan, but PM2.5 is more protective since it is closer to the standard.

The 40 CFR Part 58 Appendix D, Section 4.6 outlines how many monitors are required in each Metropolitan Statistical Area. Table D-4 of the Appendix (shown in Table 1), indicates that monitoring is required based on population and concentration. The Eugene-Springfield MSA encompasses all of Lane County, which includes Oakridge. The 2023 Census Bureau 2023 population estimate for Lane County is 381K and Oakridge makes up around 1% of the population. There are two PM10 monitors in the MSA, one in Eugene and one in Oakridge. The maximum 2021-2023 non-wildfire smoke PM10 concentration in the MSA was 40 µg/m3. According to Table 1, this means that the MSA is only required to have 0 to 1 monitor.

Table 1. PM10 monitoring requirements from 40 CFR Part 58 Appendix D, Section 4.6.

Population Category	High Concentration	Medium Concentration	Low Concentration
>1,000,000	6 – 10	4 – 8	2 - 4
500,000 – 1,000,000	4 – 8	2 - 4	1 - 2
250,000 – 500,000	3 – 4	1 - 2	0 - 1
100,000 – 250,000	1 – 2	0 - 1	0

Low Concentrations areas were below 80% of the NAAQS.

2. Most of PM_{10} in Oakridge is $PM_{2.5}$

2.1 Emission inventory

2.1.1 2017 Lane County PM_{10} NEI

The emission inventory provides details on the source of PM10 in the MSA and whether they are anthropogenic or exceptional events. According to the 2020 Lane County NEI shown in Figure 1 below, Lane County PM10 is 74% wildfire smoke, 21% dust, 4% prescribed burning and 1% residential wood combustion. 93% Of the dust in the county is from unpaved roads. For

prescribed burning, Oakridge may be impacted occasionally, but Oakridge is a Sensitive Receptor Area and the smoke management program works to limit smoke impacts.

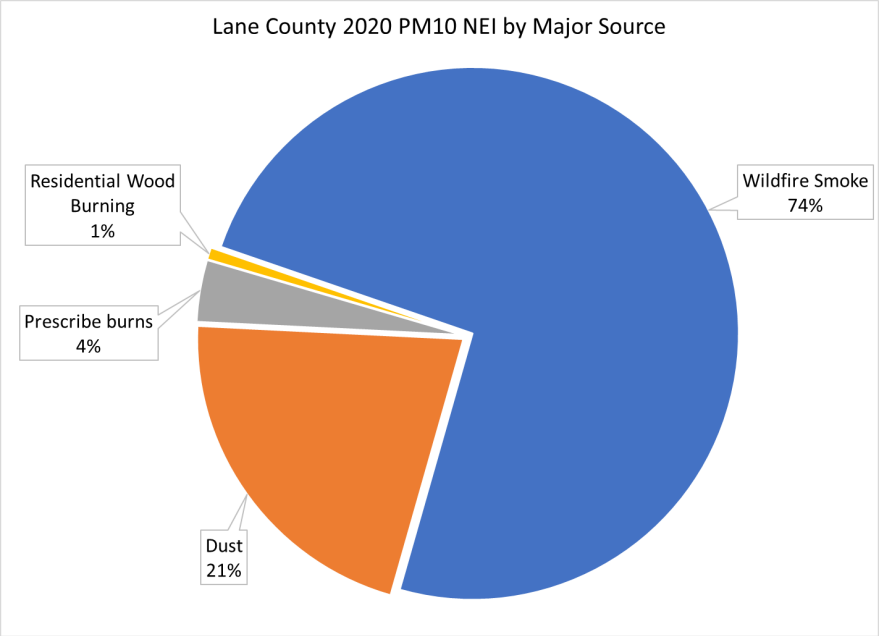


Figure 1. 2020 Lane County NEI by source type

Aside from non-wildfire smoke, prescribed burning, and dust, Lane County's next highest PM10 source is from residential wood combustion. This is shown in Figure 2 along with the other minor sources.

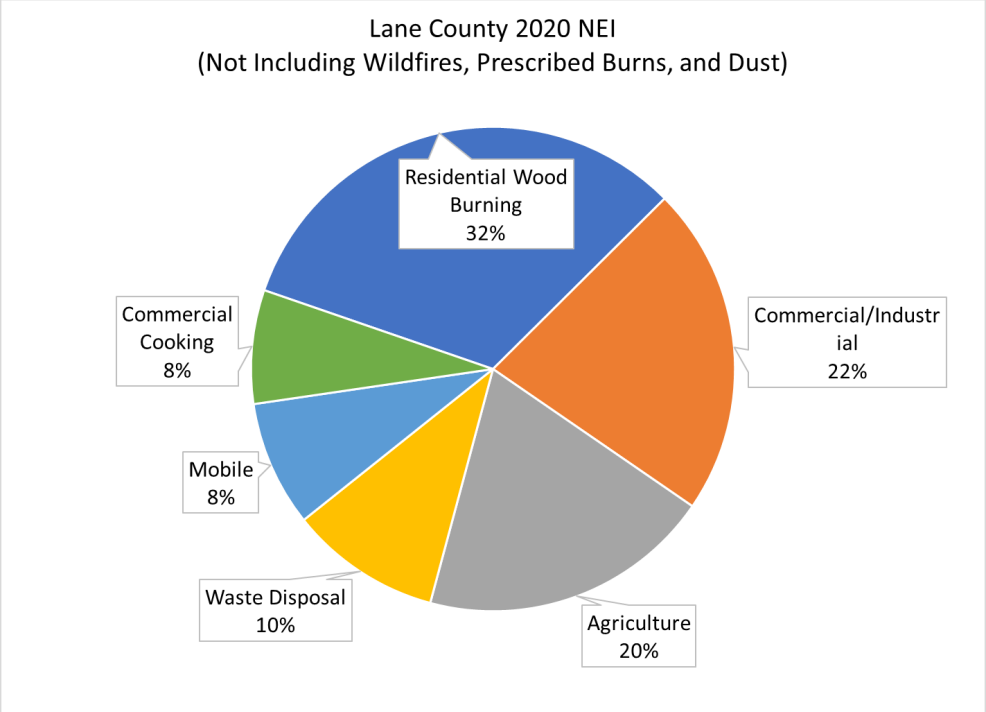


Figure 2. 2020 NEI for Lane County PM10, excluding wildfires, prescribed burning, and dust.

2.1.2 PM_{10} vs. $PM_{2.5}$ NEI

The 2020 Lane County NEI for PM10 and PM2.5 can be compared to see what percentage of the PM10 is made up of PM2.5. Table 2 shows the tons emitted in 2020 for both PM10 and PM2.5, along with the percentage of PM10 that is made up of PM2.5. In most cases PM10 is made up of 85% or more of PM2.5. The PMcoarse (PM10 minus PM2.5) is only dominant in the dust and agricultural sources. Oakridge does not have a dust or agriculture PM10 source within or near its boundaries. Most of this is going to be in the Willamette Valley agricultural region.

Table 2. Percent of the total emissions in Lane County by general category

	PM2.5 2020	PM10 2020	2020 % of PM10 that is PM2.5
Wildfire Smoke	116,185	137,098	85%
Prescribe burns	5,889	6,949	85%
Dust	4,155	39,530	11%
Residential Wood Burning	1,355	1,355	100%
Commercial/Industrial	902	925	98%
Waste Disposal	387	425	91%
Commercial Cooking	296	319	93%
Mobile	231	353	66%
Agriculture	168	823	20%
Misc	16	20	81%

Lane Regional Air Protection Agency operates two PM10 sites, one in Eugene and one in Oakridge. Both of these communities were designated as non-attainment areas in the 1990s but are now maintenance areas. Both are now well below the NAAQS except when wildfire smoke heavily impacts the area. Table 3 shows the number of days over the NAAQS, measured by the FEM BAM1020 continuous samplers for Oakridge and for Eugene from 2021 through 2023, except in July 2023, when the Eugene site switched to a every sixth day schedule using an FRM sampler.

Table 3 also shows Oakridge's 2021-2023 dates and concentrations over 120 µg/m3. Eugene had no days higher than 120 µg/m3. Based on these guidelines Eugene is a low concentration area and Oakridge is a high concentration area.

Table 3. Number of days over the NAAQS

	Days over 150µg/m3		Days over 120µg/m3	
	Oakridge	**Eugene**	**Oakridge**	**Eugene**
2021	1	0	3	0
2022	19	0	20	0
2023	0	0	0	0
2021-23	6.7	0	7.7	0

2.1.3 PM_{10} NEI trends

For Lane County the PM10 trends have been going up mainly due to wildfire smoke but also due to prescribe burning, and dust. Figure 3 shows the Lane County PM10 NEI trends. The increase in wildfires smoke dominates all the other categories in Lane County and will likely continue to do so when the 2023 NEI is released. The next highest category is dust, primarily from unpaved roads. This is likely increasing because of the way the NEI is calculated rather than an actual increase in dust. Prescribed burning is increasing as a preventive tool to reduce the size of the wildfires.

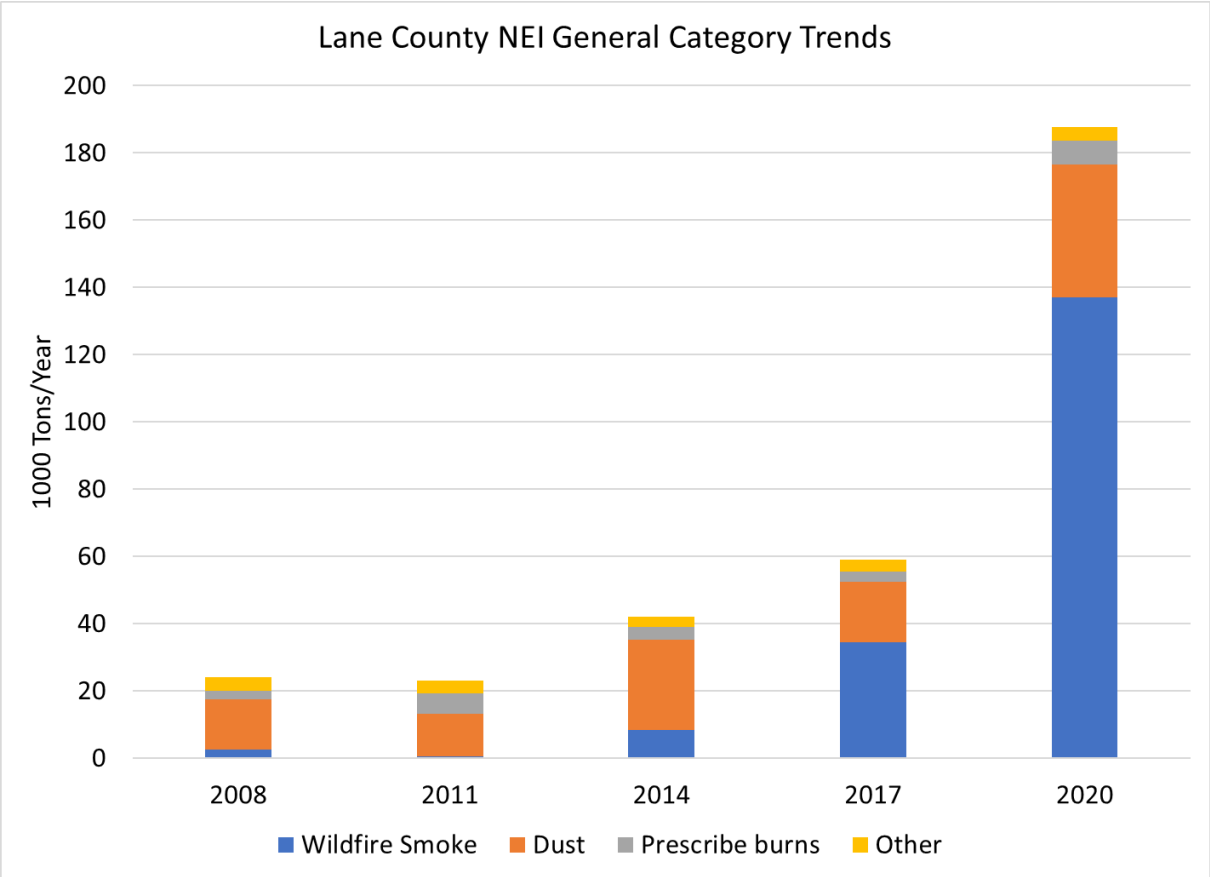


Figure 3. Lane County NEI PM10 trends for major emission categories.

When wildfires, dust, and prescribed burning sources are excluded from the NEI, residential wood combustion and other anthropogenic sources can be seen more clearly. Figure 4 shows that residential wood combustion has been increasing. This may be the case in the county, or it may be due to the way the emissions are calculated each time. Either way, residential wood combustion is best measured using PM2.5 not PM10.

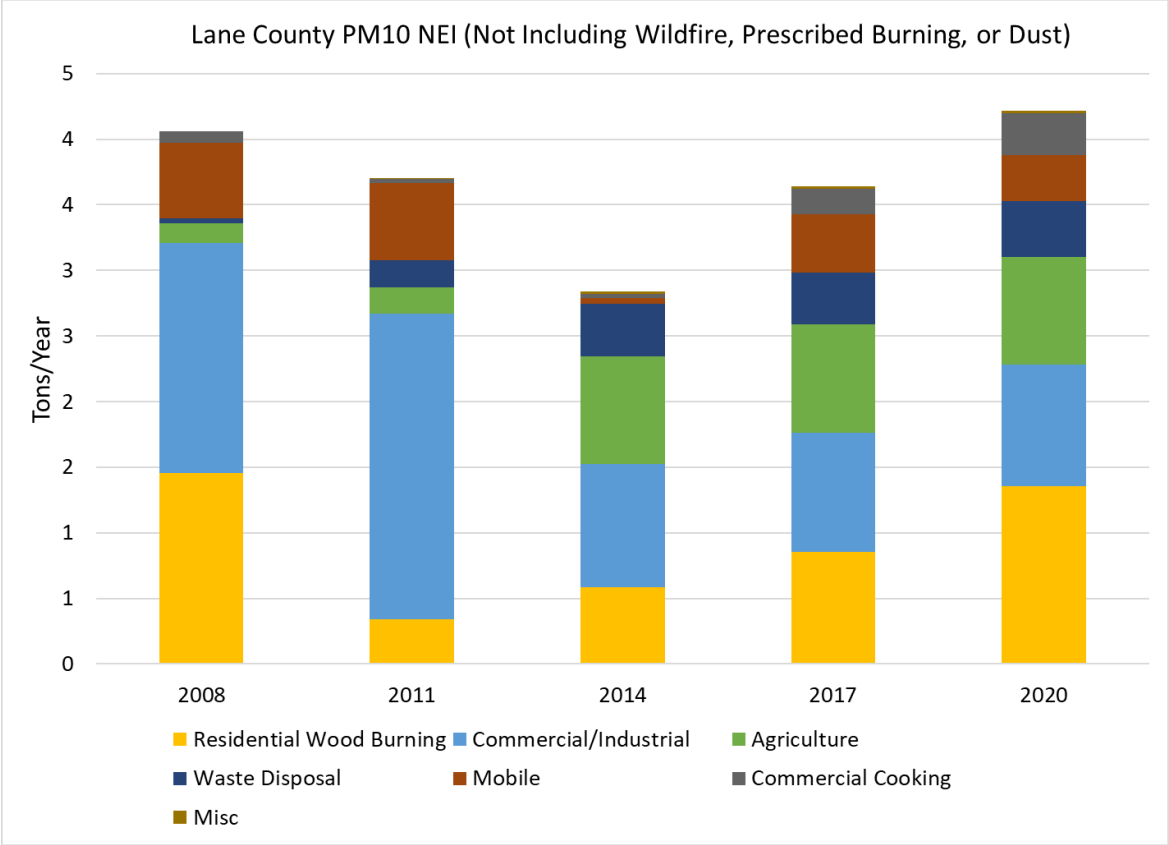


Figure 4. Lane County NEI PM10 trends for emission categories excluding wildfires, prescribe burning, and dust.

2.2 Monitoring

2.2.1 Trends

Oregon's PM10 monitoring data showed a huge reduction in PM10 from the 1990s when the numerous PM10 SIPs were developed, and the Title V permits went into effect. By 2006, Oakridge's levels were at around 1/3 of the NAAQS. The Oakridge 2020-2023 non-wildfire smoke PM10 high was only 40 µg/m3. In 2017, the wildfire smoke started impacting Oakridge and the PM10 went back up. Figure 5 shows the 2nd highest day trends for Oakridge. The trends are separated with and without wildfire data after 2017 because of the increase in wildfire smoke intrusions.

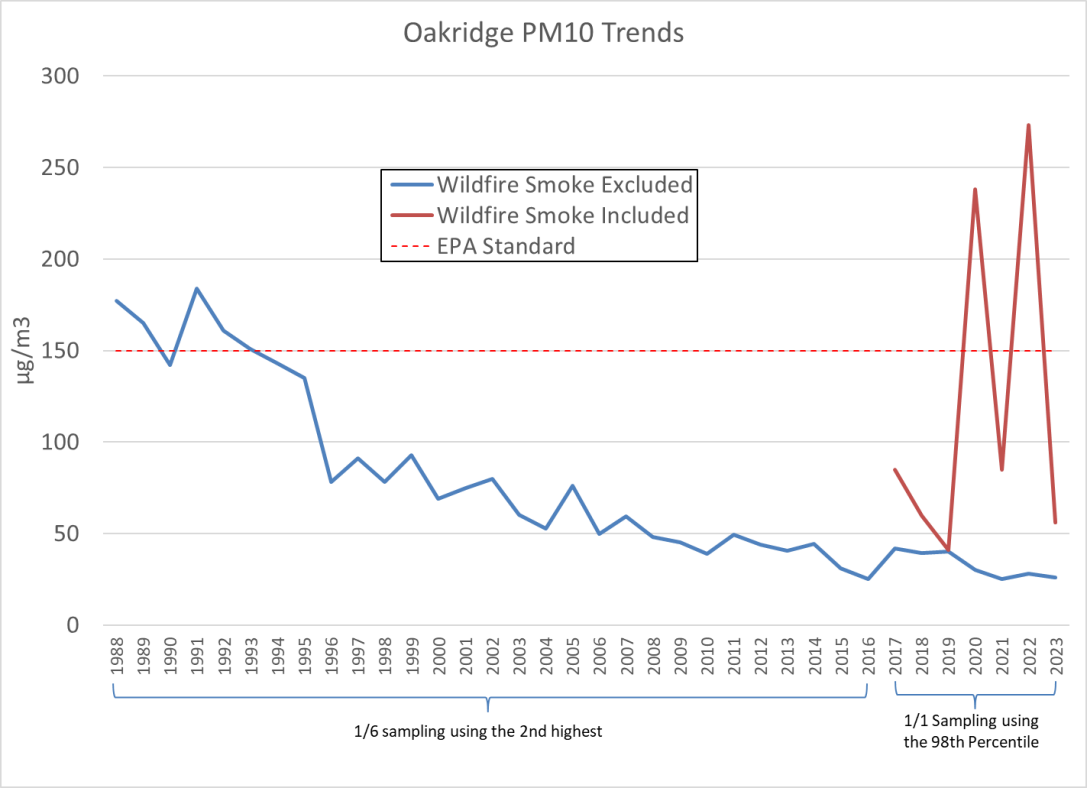


Figure 5. Oakridge PM10 trends.

Note: The trend chart uses the second highest PM10 level per year between 1988 to 2016.

2.2.2 PM_{10} and $PM_{2.5}$ 2020 correlation

Time series

In 2020, LRAPA installed a Met One BAM 1022 PM2.5 FEM sampler in Oakridge next to the existing Met One BAM 1020 PM10 FEM. Both are continuous monitors that provide daily averages for comparison to the NAAQS. The 2023 PM10 and PM2.5 time series graph in Figure 6, shows that the two particulates track each other closely, and have similar concentrations. This indicates that that most of the PM10 is also PM2.5.

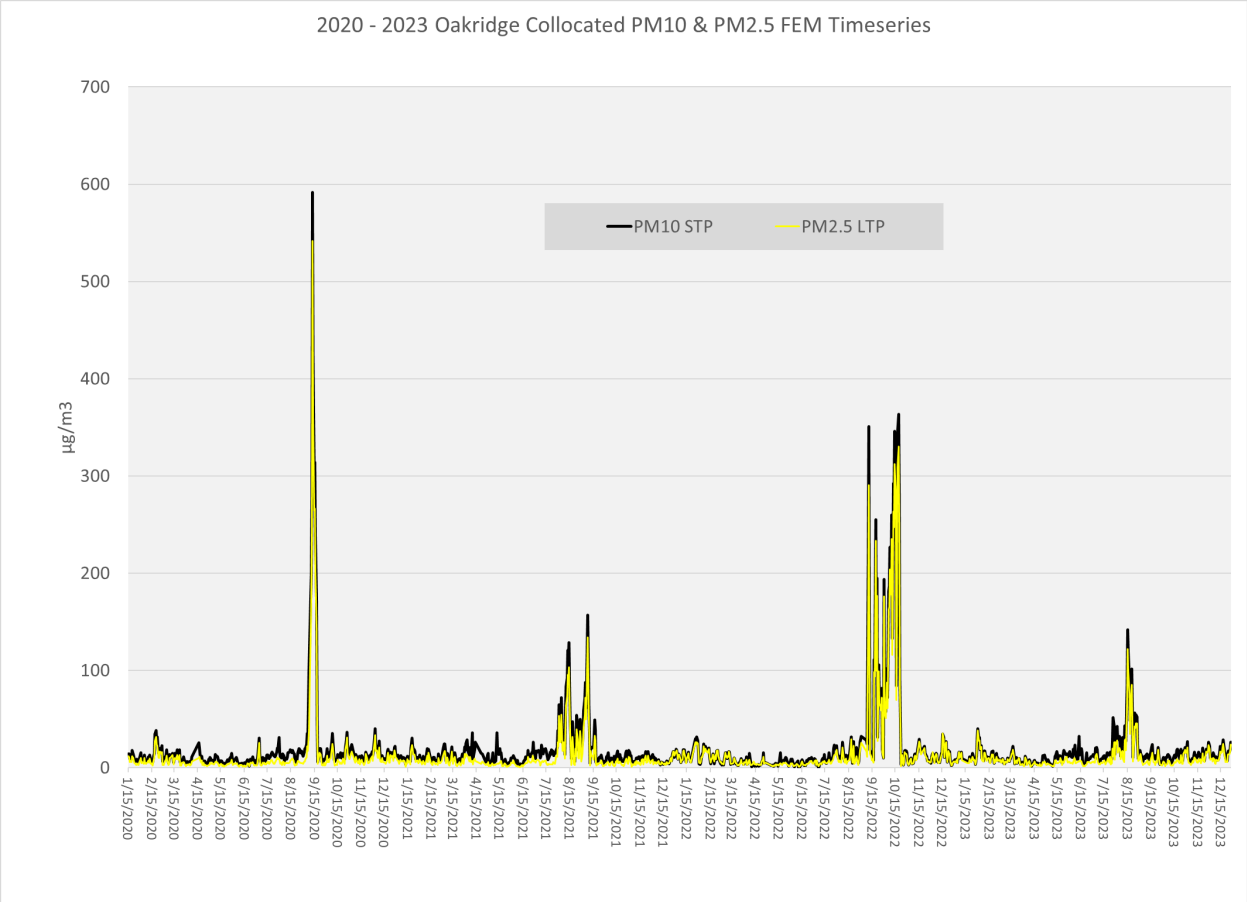


Figure 6. Oakridge PM10 and PM2.5 time series for 2020-2023.

Linear Regression

The linear regression was done for PM10 and PM2.5 (Figure 77) using 2020 through 2023 data. The R square was very good at 0.99 with a slope of 1.12. A summary of the correlation statistics is shown in Table 4 for all the data points and in Table 5 for data over 1/3 of the NAAQS. All of the PM10 over 1/3 of the NAAQS was from wildfire smoke intrusions. The linear regression equations derived from these comparisons are also in the Tables.

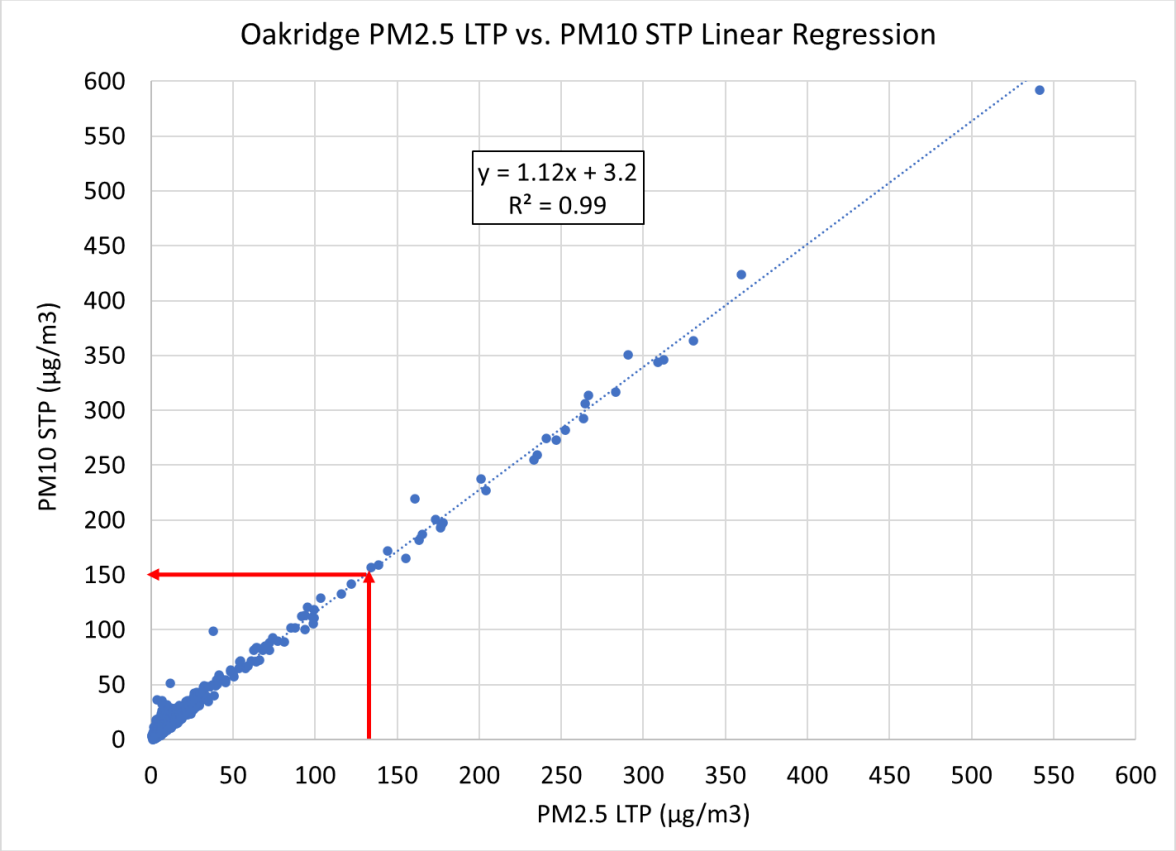


Figure 7. PM10/PM2.5 linear regression

Table 4. Oakridge 2020-2023 PM10/PM2.5 Correlation – All days

Statistic	Result
Linear Regression	PM10 = 1.12*PM2.5 + 3.2 R^2 = 0.99
Average % PM10 that is PM2.5	74%
Number used in average	1367 days
% of Days >1/3 NAAQS	5%

Table 5. Oakridge 2020-2023 PM10/PM2.5 Correlation – Days > 50µg/m3

Statistic	Result
Linear Regression	PM10 = 1.09*PM2.5 + 9.6 R^2 = 0.99
Average % PM10 that is PM2.5	86%
Number used in average	74 days
% of Days that aren't wildfire impacts	0%, all days > 50µg/m3 had wildfire smoke impacts

Testing the Linear Regression Equation

To see how well the PM10 estimate would work, the equation PM10 = 1.12*PM2.5 + 3.2 was applied to the Oakridge 2020 through 2023 PM2.5 data. The resulting PM10 estimate data was compared to the actual collocated PM10 data. The results are shown in Figure 8. The R squared is very good at 0.99 and the slope is close to one at 0.97.

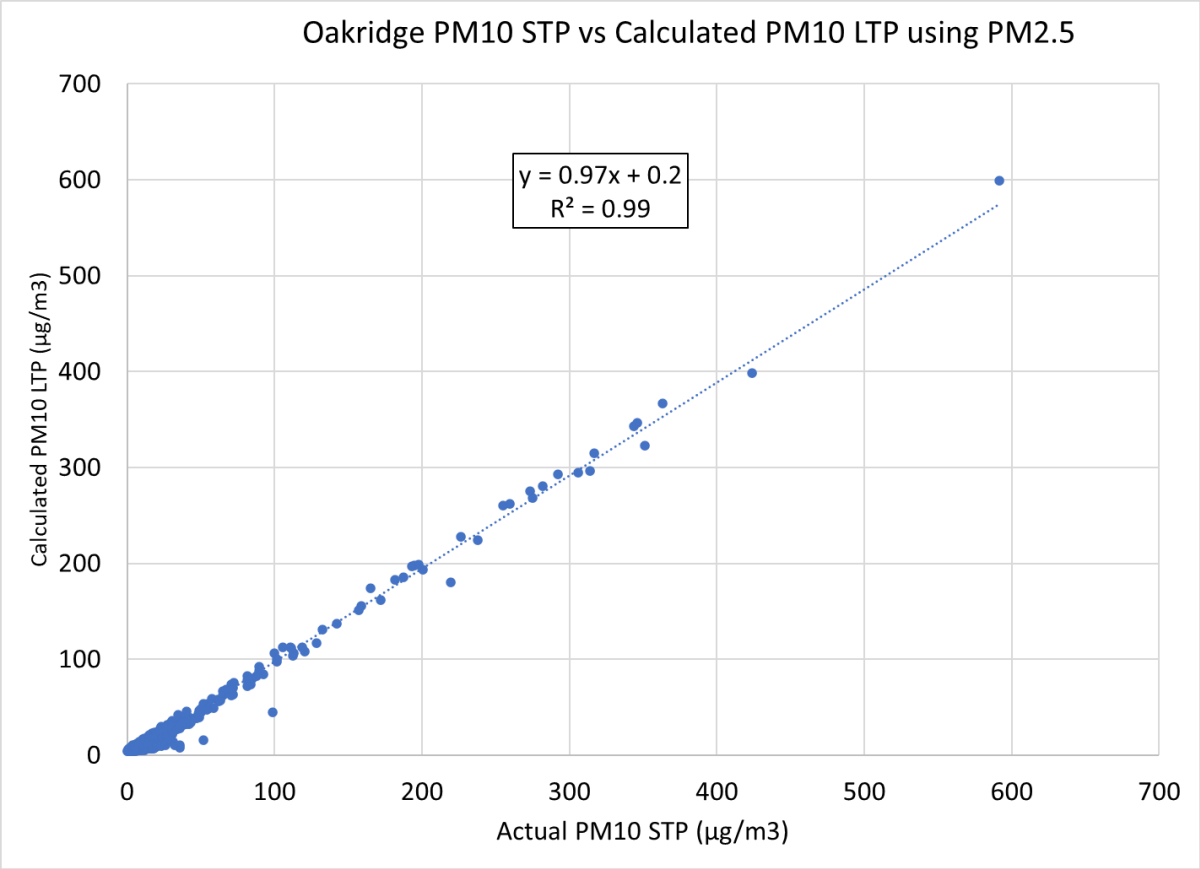


Figure 8. 2020-2023 Oakridge calculated PM10 from PM2.5 vs. Actual PM10 in a Linear Regression.

The Student T-Test was also applied to the 2020-2023 PM10 estimate vs. PM10 actual data and it had a p=0.001 which showed that the differences in the monitored and estimated PM10 2020-2023 values were insignificant.

3. Calculating PM_{10}

3.1 DEQ annual PM_{10} demonstration

PM10 in Oakridge will be tracked using the daily PM2.5 monitor by applying the correlation equation provided in Table 4. PM2.5 from the BAM 1022 will be averaged for each day from midnight to midnight, PST. The PM10 estimate calculation will be applied and the data sorted from maximum to minimum. The number of exceedances will be averaged over the most recent three years and compared to the PM10 NAAQS. The number of exceedances per year will be included in the annual network plan's to determine if the maintenance plan's contingency should

kick in and if the PM10 monitor should be restarted. Table 6 summarizes the equations and the PM2.5 concentration that would equal a PM10 of 150 µg/m^3.

Table 6. Linear regression equations and ratios used to estimate PM10 using PM2.5.

	Oakridge
Linear Regression Equation Q1 & Q4	**y = 1.12x + 3.2**
PM2.5 trigger for PM10 "Risk of Violation (150 µg/m^3)"	**131.1 µg/m^3**

y = PM10, x = PM2.5

4. Monitoring contingency if PM_{10} violates

DEQ will submit a report showing verification of continued attainment in PM10 maintenance areas to EPA every year as part of the Annual Network Plan submission. If Oakridge violates the contingency plan trigger with the estimated PM10 standard, from sources other than those determined to be exceptional events, a PM10 monitor will be reinstalled prior to January 1st of the following year. This would be proposed in the ANP along with evidence on whether a violation was caused by an exceptional event. EPA would have to approve this in the ANP approval letter.

Contingency trigger

The Oakridge PM10 Maintenance Plan references the same contingency plan included in Section 8.3 of the 2021 Oakridge-Westfir PM2.5 Maintenance Plan. This section says: …after consideration of any Exceptional Events, the following contingency strategies, or equivalent, will be implemented by LRAPA and the City of Oakridge:

- Stricter green-yellow-red advisory program, with more red advisory days each winter, by reducing the red advisory thresholds by 3 µg/m3 PM2.5 in the Oakridge Air Pollution Control Ordinance 920; this is projected to increase the average number of potential red advisory days by three to five additional days per year.
- Prohibition of fireplace use on yellow advisory days (in addition to the existing prohibition on red advisory days).

LRAPA commits to adopt and implement the necessary contingency measures as expeditiously as possible. LRAPA will require adoption of the contingency measures no later than six months and implementation of such corrective action no later than one year after a violation based on confirmed quality assured data. Any contingency measures adopted and implemented will become part of the next revised maintenance plan submitted to the EPA for approval.

5. Conclusion

Oakridge went out of attainment because of wintertime PM10 levels from unpaved road dust and residential wood combustion. Since then, the roads have been paved, certified woodstoves, have been installed, and LRAPA operates a woodstove advisory program. Most of the remaining PM10 is made of PM2.5, and the linear regression and the time series analysis demonstrates that PM10 can accurately be estimated using the PM2.5 FEM. All of the PM10 that exceeds 1/3 of the NAAQS in the last four years is from wildfire smoke.

The PM2.5 NAAQS is also more protective then PM10, and the PM2.5 contingency plan would be triggered before the PM10 trigger was hit. The contingency for both are the same, tighten wood stove curtailment.

DEQ and LRAPA request a waiver to use the PM2.5 monitor as a surrogate for PM10. DEQ will include the PM10 estimate using the equation PM10 estimate = PM2.5*1.12 + 3.2 in the Annual Network Plan. If the non-wildfire data, PM10 estimate violates the NAAQS, the PM10 monitor will be reinstalled. In this case, the PM2.5 contingency will have already kicked in because most of the PM10 is PM2.5, so this will not be of concern since they contingencies are identical.