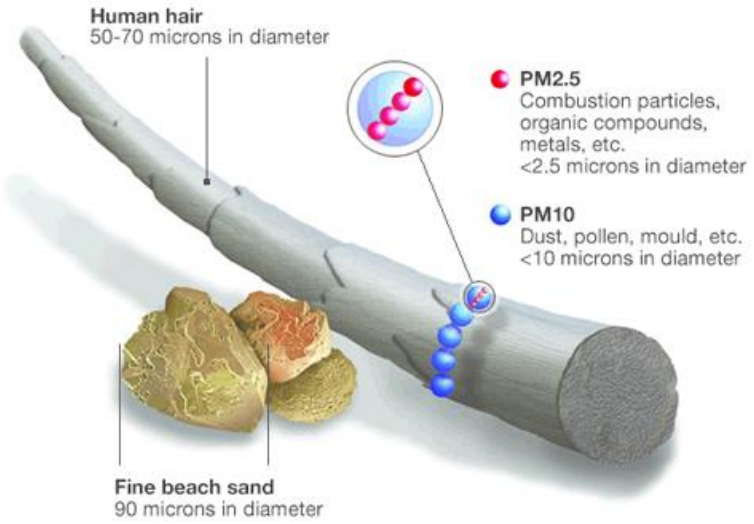
Appendix J of the 2023 Annual Criteria Monitoring Network Plan. Lakeview PM2.5 Surrogate Monitoring for the PM10 Maintenance Plan Requirements



Source: US EPA

Contents

Executive Summary

Oregon DEQ operated Partasol 2025 PM2.5 (145) and PM10 (method 127) collocated samplers in Lakeview in 2022. This data provided PM10 and PM2.5 correlation information which are used in this report to demonstrate that PM2.5 can be a surrogate for PM10 estimates.

Lakeview's PM10 is 64% PM2.5 during the winter and 44% PM2.5 in the summer. The low summer PM2.5 percentage would be concerning if the concentrations weren't so low. The maximum 2022 summer PM10 concentration was only 24% of the NAAQS and the summer average PM10 estimate was more protective than the actual PM10 by 1.9 µg/m^3. If the summer PM10 was near the NAAQS, it would likely from wildfire smoke or dust off of nearby Goose Lake. Both would be meet the requirements for an exceptional event.

DEQ will use PM2.5 24 hour average from the FEM to calculated the PM10 estimates using the linear regression equation: PM10 = PM2.5 * M + b The estimates will be seasonal with one calculation for quarters 1&4 and a different for quarters 2&3. The wildfire correction will be used for PM2.5 data flagged for wildfire smoke impacts.

Date Range	Q1 & Q4	Q2 & Q3	Wildfire smoke
M =	1.5	2.9	1.1
b =	3.0	0.6	15.6

If the estimated PM10 is > 93% of the NAAQS (140µg/m3) and is not from an exceptional event such as wildfires or a dust storm, the contingency triggers from the 2006 PM10 Maintenance Plan will be activated. If the estimate is > 93% of the NAAQS from non-exceptional event sources, DEQ will also place a PM10 monitor back in Lakeview 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.

1. Introduction

Lakeview was declared in non-attainment for PM10 in 1993. Its second highest daily value has been below the NAAQS since 1995 and its maintenance plan was approved in 2006. The maintenance plan required PM10 monitoring to track how well the maintenance plan was performing. The plan also includes contingency measures if the monitored PM10 exceeds 140 µg/m3 or 93% of the NAAQS.

The 40 CFR Part 58 Appendix D, Section 4.6 outlines how many monitors are required in each city. Table D-4 of the Appendix (shown in Table 1), indicates that monitoring is required based on population and concentration. Lakeview has a Census Bureau 2021 population estimate of 8,177 and a 2022 maximum PM10 concentration of 55 µg/m3. According to Table 1, this means there is no CFR PM10 monitoring requirement.

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.

Lakeview's PM10 monitoring was discontinued for budgetary reasons after 2006 with EPA approval. At the time, the 2nd highest PM10 value was 46 µg/m3 which is 31% of the NAAQS. PM2.5 monitoring had started in 1999 and was primarily used to alert Lakeview of health concerns. In 2011, EPA approved the use of PM2.5 as a surrogate for PM10 in Klamath Falls and Grants Pass because DEQ was able to show that most of the PM10 was PM2.5 and that PM2.5 could be correlated with PM10. EPA Region 10 is requiring that Lakeview PM10 be restarted or that DEQ formal request that PM2.5 be used as a surrogate for PM10. This will satisfy the requirements of the PM10 maintenance plan.

2. Percentage of PM2.5 in PM10

2.1 Emission Inventory

2.1.1 2017 Lake County NEI

According to the 2017 Lake County NEI shown in Table 2 below, Lake County PM10 is mostly from unpaved road dust, agricultural dust, and prescribed burning. Lakeview takes up a small area of Lake County and most of its roads are paved. There is no agriculture in Lakeview. For prescribed burning, Lakeview is impacted occasionally, but Lakeview is a Sensitive Receptor Area and the smoke management program works to limit smoke impacts in Lakeview.

Most of the Lakeview's PM10 is dust from paved roads, smoke from residential wood combustion, and on road diesel. These are the main sources located within the Lakeview boundaries and not far away in Lake County. On rare occasions, Lakeview will also be impacted by dust storms from Goose Lake, but this is an exceptional event. Wildfires have been the only

source of PM10 violations across Oregon in the past 20 years. Wildfire smoke impacts are increasing and will be the main focus of future NAAQS exceedances. Wildfire smoke is an exceptional event and none of the contingencies in the maintenance plan will address wildfire smoke intrusions.

Table 2. 2017 Lake County NEI by source type

	Individual tpy			Category tpy		
	PM10	**PM2.5**	**PM2.5/ PM10**	**PM10**	**PM2.5**	**PM2.5/ PM10**
Dust						
Dust - Unpaved Road Dust	3,990	398	10%	6,571	921	14%
Agriculture - Crops & Livestock Dust	2,438	495	20%			
Dust - Paved Road Dust	79	20	25%			
Industrial Processes - Mining	64	8.0	13%			
Wood Combustion						
Fires - Prescribed Fires	1,382	1,171	85%	2,175	1,848	85%
Fires - Wildfires	754	639	85%			
Fuel Comb - Residential - Wood	35	35	100%			
Fuel Comb-Comm/Institutional Biomass	1.3	1.1	86%			
Fires - Agricultural Field Burning	3.1	2.3	74%			
Misc						
Waste Disposal	9.1	8.3	91%	12	11	91%
Commercial Cooking	2.9	2.7	93%			
Vehicle exhaust						
Mobile On-Road Diesel Light Duty	3.5	3.0	86%	37	31	86%
Mobile On-Road non-Diesel Heavy Duty	0.1	0.1	100%			
Mobile Non-Road Equipment - Other	0.04	0.04	100%			
Mobile Non-Road Equipment - Gasoline	10	10	92%			
Mobile Non-Road Equipment - Diesel	7.0	6.8	97%			
Mobile On-Road Diesel Heavy Duty	11.0	8.9	81%			
Mobile On-Road non-Diesel Light Duty	4.4	2.7	61%			

Table 3. Percent of the total emissions in Lake County by general category

	PM10 (tpy)	**PM2.5 (tpy)**
Dust	75%	33%
Wood combustion	25%	66%
Misc	0.1%	0.4%
Vehicle Exhaust	0.4%	1.1%

Most of the PM10 in Lake County are dust sources outside of the City Limits. PM10 can travel as dust storms, but this is infrequent in Lakeview. Most of the dust remains outside of the city limits. Most of PM2.5 are from combustion sources from outside of the city like wildfires and prescribed burning. 85% of the PM10 from these combustion sources are PM2.5 and can travel further to impact Lakeview. PM2.5 sources inside of Lakeview are mostly from residential wood combustion where 100% of PM10 is PM2.5.

Other PM10 sources from vehicles, cooking, and waste disposal are mainly PM2.5.

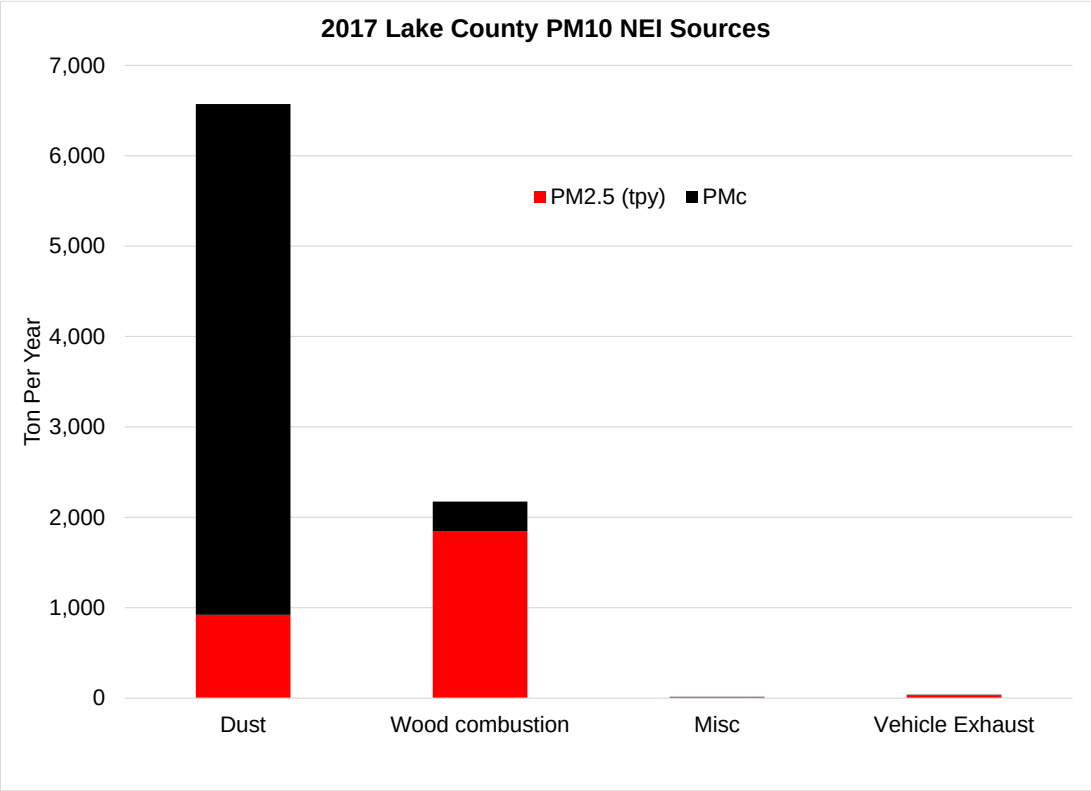


Figure 1. 2017 Lake County PM10 NEI Sources

2.1.2 Trends

The Oregon PM10 emission inventory trend is going up for PM10 and PM2.5. In the last decade, this is due to wildfires. When wildfire is removed the trends still go up for Oregon are shown in Figure 2.

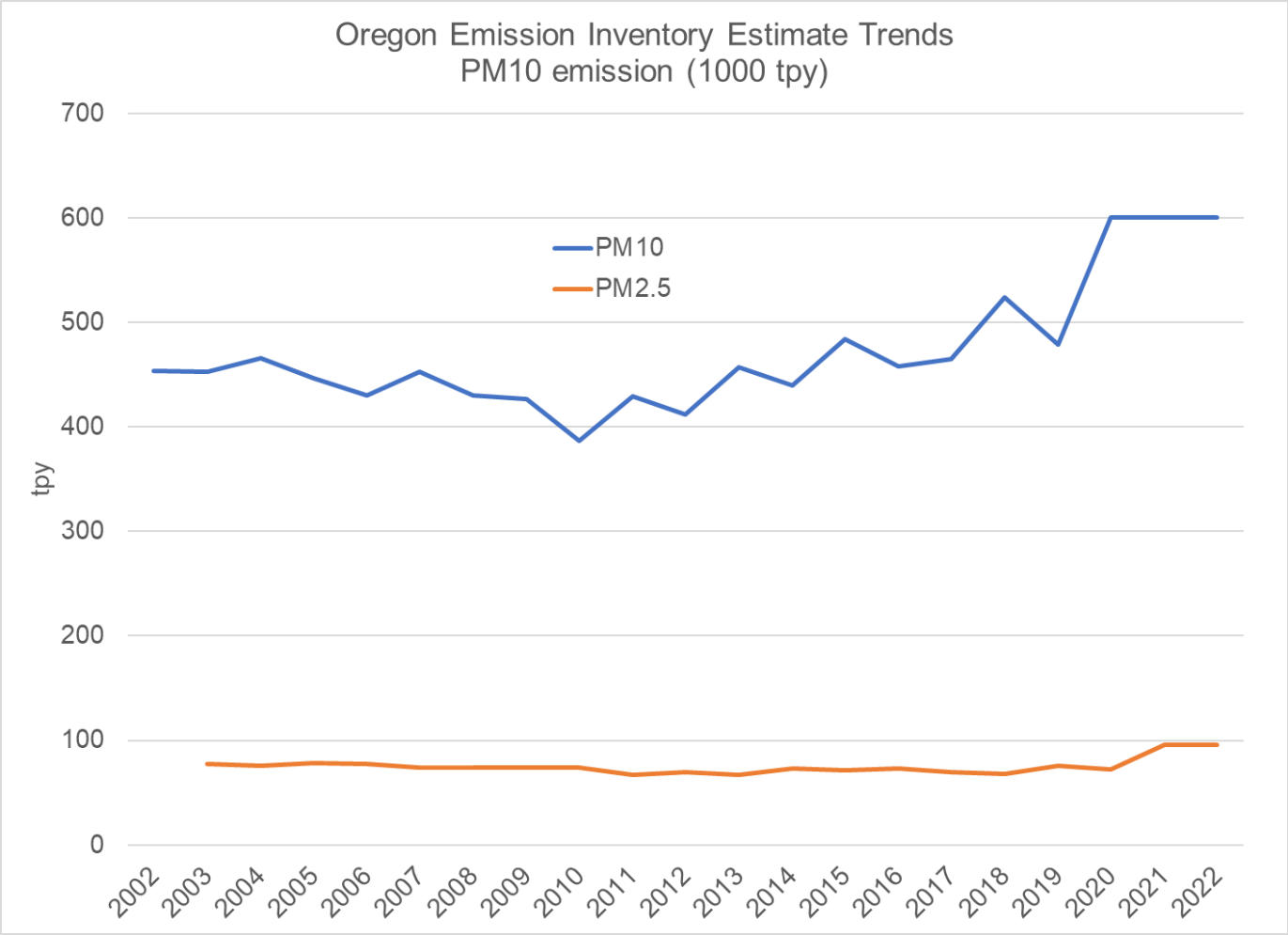


Figure 2. Non-Wildfire Oregon PM10 and PM2.5 NEI Trends

Source: https://www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data

2.2 Monitoring

2.2.1 Trends

Oregon's PM10 monitoring data showed a huge reduction in PM10 in the 1990s when the numerous PM10 SIPs were developed, and the Title V permits went into effect. By 2006, the levels around the state were at around 1/3 to 1/2 of the NAAQS. Lakeview's 2006 PM10 concentration was 46µg/m3. In 2017, the values went back up to in many areas because of wildfire smoke impacts. Figure 3 shows the maximum, minimum, and average PM10 trends for Oregon for the 2nd highest day. Figure 4 shows the 2nd highest day trends for Lakeview.

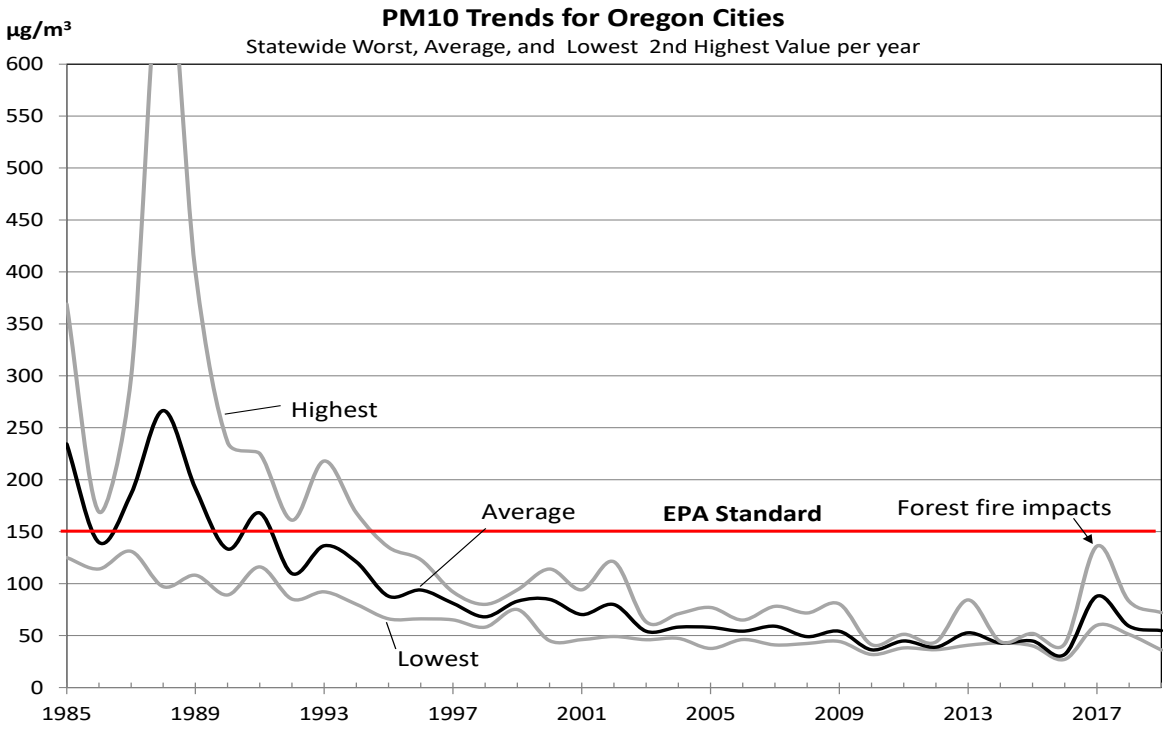


Figure 3. Oregon PM10 monitoring trends

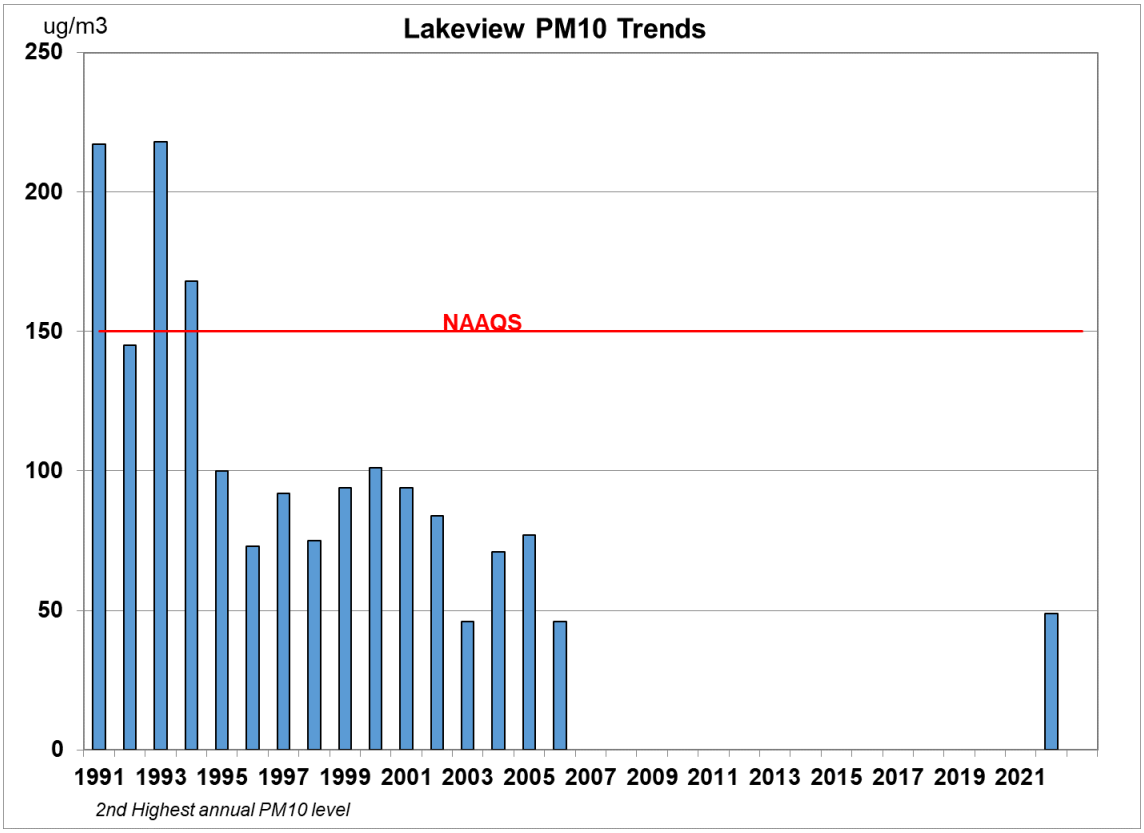


Figure 4. Lakeview PM10 monitoring trends

2.2.2 PM10 and PM2.5 2020 correlation

In 2022, DEQ installed an R&P Partisol 2025 (method 127) PM10 Federal Reference Method sampler in Lakeview. This sampler was collocated with an R&P Partisol 2025 (method 145) PM2.5 Federal Reference Method sampler. Both samplers ran every third day during the winter months and the PM10 sampler ran every sixth day during the summer. The time series graph (

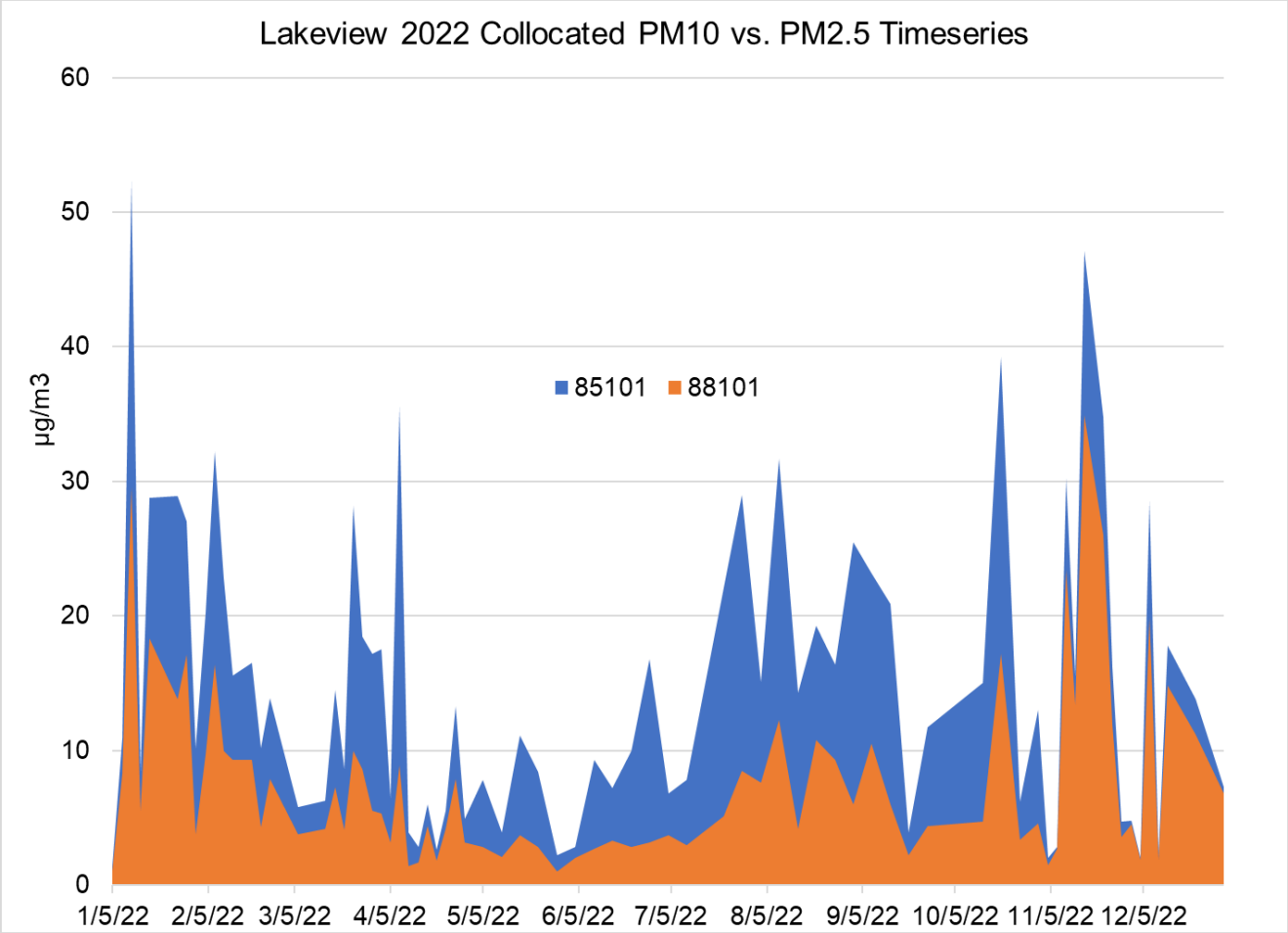


Figure 5) for the 2022 PM10 and PM2.5 shows that there are different PM10/PM2.5 ratios during different times per year. The winter and spring months show that PM2.5 is a larger component of PM10 than the summer. This is consistent with wood combustion. In the summer, the PM10/PM2.5 ratio favors PM10. This is during the dry months and is consistent with dust.

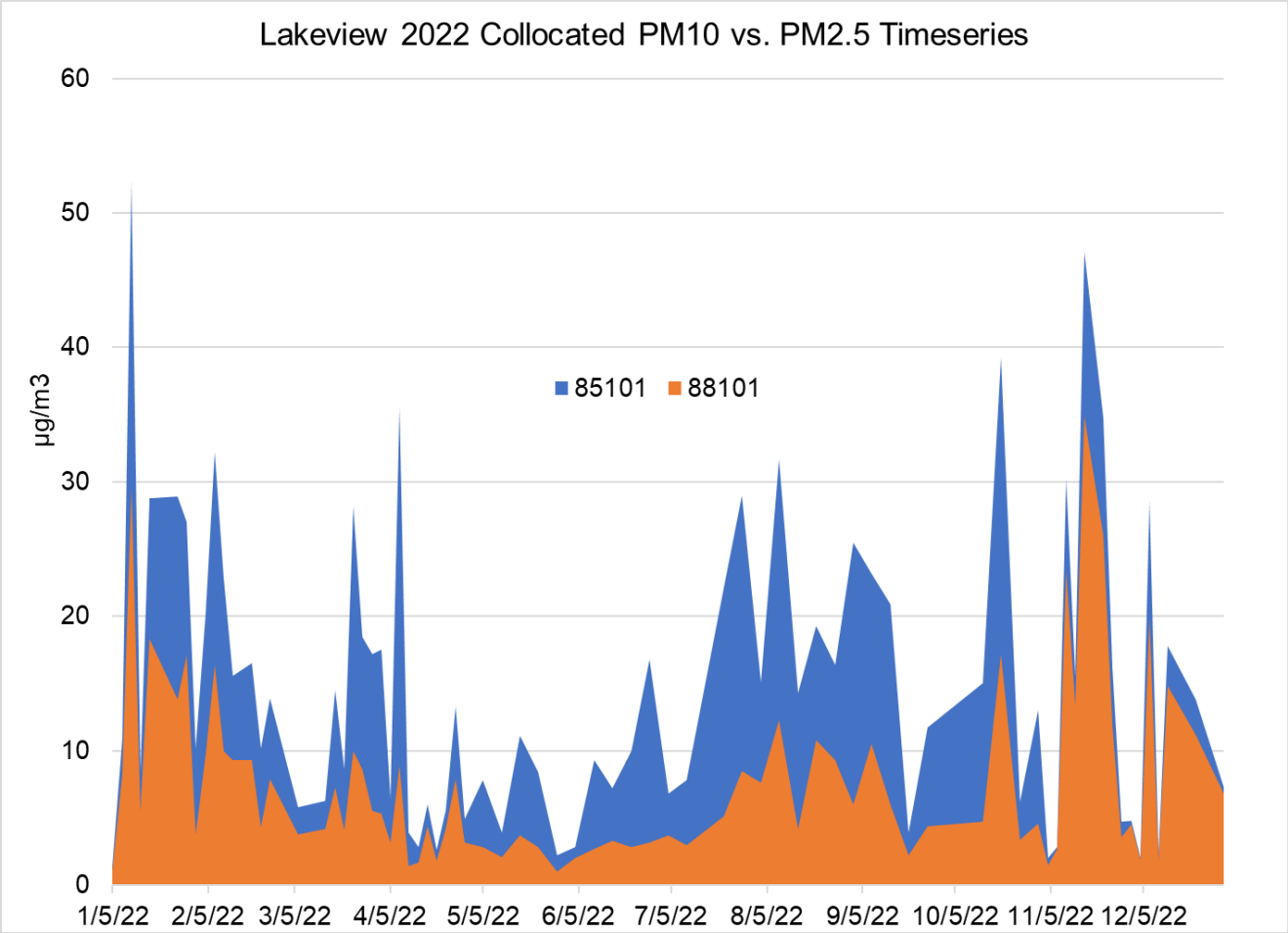


Figure 5. PM10 and PM2.5 time series

The linear regression was done for PM10 and PM2.5 (Figure 6) to determine if a correction equation can be used to convert PM2.5 into a PM10 estimate. The linear regression has two distinct groupings, one for winter and one for summer. This can be resolved by applying two distinct estimate equations based on season. A summary of the correlation statistics is shown in Table 3.

Lakeview 2022 PM10/PM2.5 Linear Regression

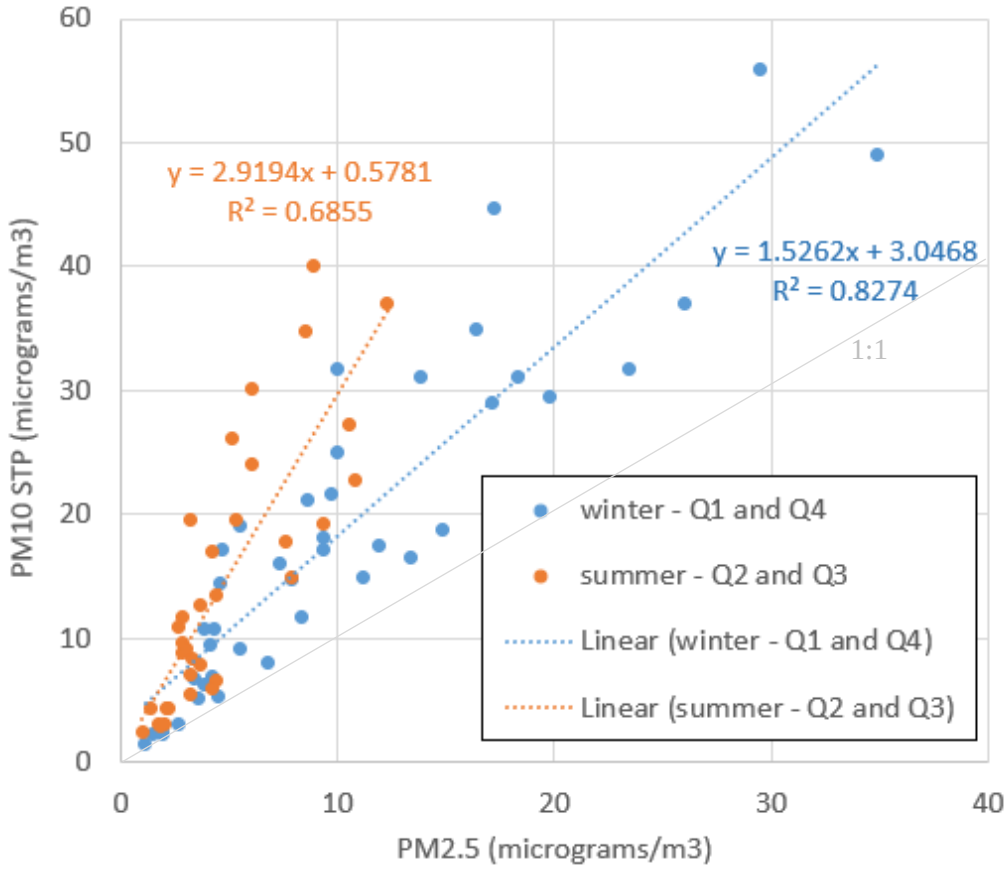


Figure 6. PM10/PM2.5 winter and summer correlations

Wildfire impacts have a different linear regression equation that can be derived by impact around the state where there are collocated PM10/PM2.5 monitors. Eugene and Oakridge where used to derive an equation because both ran low volume PM10 and PM2.5 collocated monitors and experience prolong wildfire impacts in the past five years. Figure 7 shows the linear regression for PM10 and PM2.5 collocated samplers during wildfire smoke impacts from 2020 through 2022. The R squared is 0.96 and the slope is 1.1. This is not surprising since almost all of the smoke will be fine particles and in the PM2.5 range. This equation will be used to estimate PM10 on wildfire impact days during the summer.

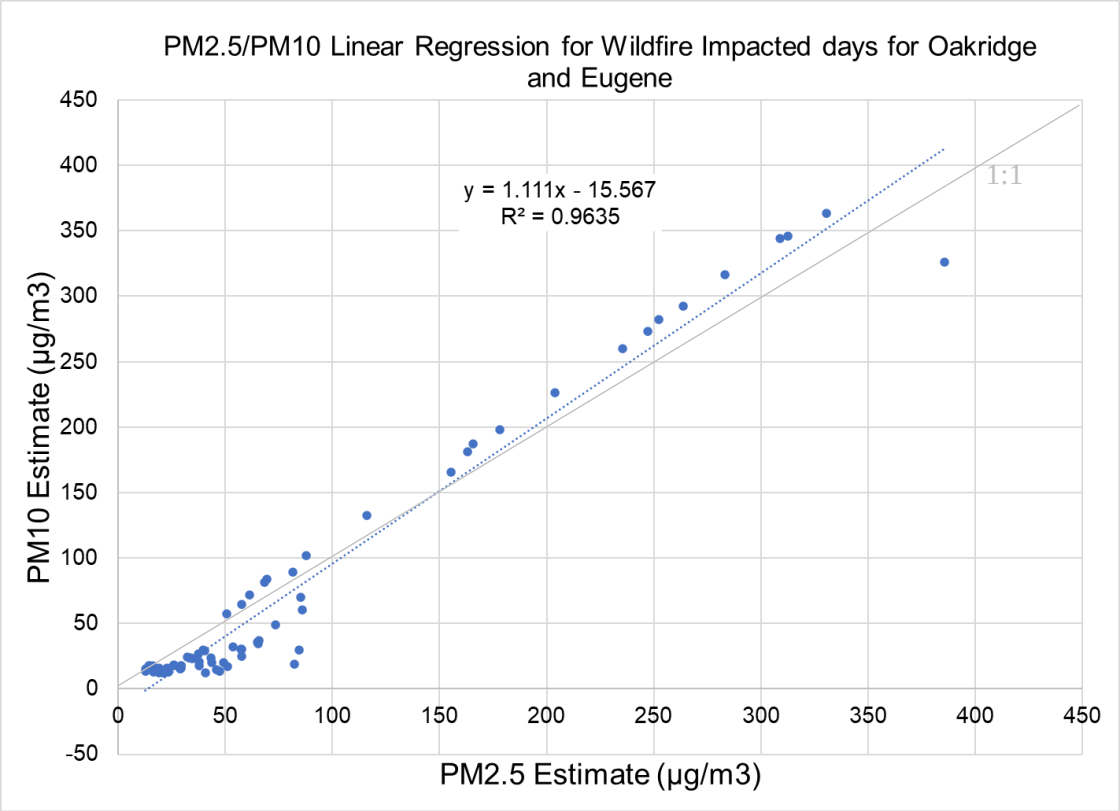


Figure 7. PM10/PM2.5 wildfire smoke linear regression

Table 4. PM10/PM2.5 correlation statistics

2022 PM10/PM2.5 Linear Regression Stats	Winter	Summer	Wildfire
n	41	34	74
Date Range	Q1 & Q4	Q2 & Q3	July-Oct
m	1.5	2.9	1.1
b	3.0	0.6	15.6
R2	0.82	0.69	0.96
2022 max PM10	52.3	35.5	
2022 PM10 Average	17.0	13.3	
2022 PM10 % of NAAQS	11%	9%	
Average % PM2.5*	64%	44%	
Max PM2.5 converted to PM10 estimate using estimate equations			

*Percent of PM10 that is PM2.5

n = number of samples, m = slope, b = y intercept

To see how well this estimate method works, the PM10 estimate equations in Table 4 were applied to the Lakeview 2022 data and compared to the actual collocated PM10 data. The results are shown in Figure 8 where the R squared is 0.82 and the slope is 0.82. The other statistics comparing the actual and estimated PM10 are shown in Table 5.

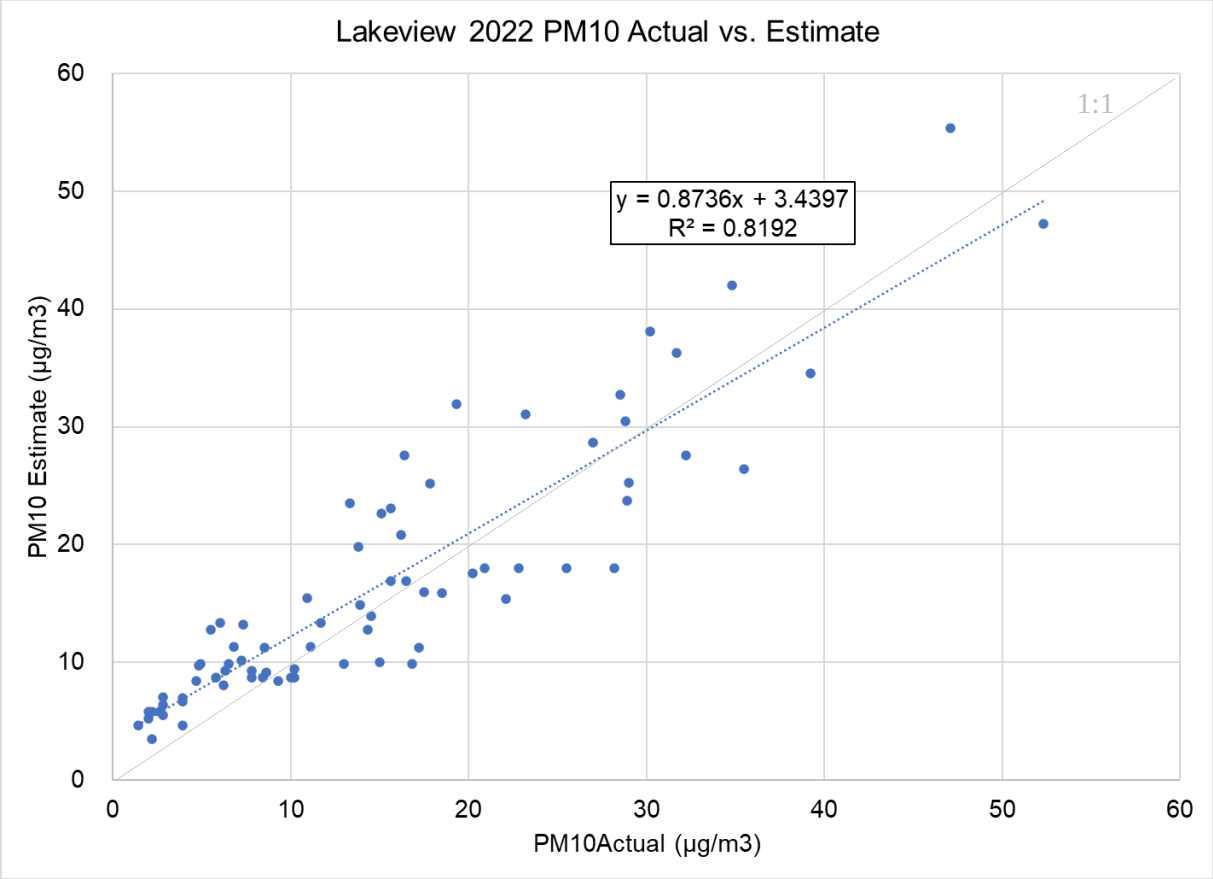


Figure 8. Linear Regression of Lakeview's 2022 PM10 Estimates from the PM2.5 FRM vs. the PM10 from the collocated sampler

Table 5. 2022 PM10 Actual vs. Estimated

2022 PM10 data comparison stats	Annual (µg/m3)	Winter (µg/m3)	Summer (µg/m3)
Max Actual (Act -Est)	52.3-47.3 = 5.1	52.3-47.3 = 5.1	35.5–26.4 = 9.1
Max Estimated (Act -Est)	47.1–55.4 = - 8.4	47.1–55.4 = - 8.4	31.7-36.3 = -4.6
Average difference (Act – Est)	-1.5	-1.2	-1.9
Stdev (Act – Est)	4.8	4.5	5.2
RMSE (Act – Est)	5.0	4.6	5.5
T Test (2 tail, type 1) P value	0.01 (significant difference)	0.08 (Insignificant difference)	0.04 (significant difference)

The Student T-Test showed that the differences in the annual monitored and estimated PM10 values were significantly different, however, during the winter the difference was insignificant. This is not surprising since in the winter the PM10 is largely from combustion and is mostly PM2.5. In the summer the PM10 is lower but largely from dust and other non-combustion sources. Dust consists of many PM coarse particles and PM2.5 will miss those.

2.2.3 Correlation discussion

What does all this mean? The winter data set has a very good linear regression between the PM10 actual and estimated values with an R squared of 0.83. This is not surprising because most of the winter PM in Lakeview is smoke and secondary aerosols from residential wood combustion. Snow covers the ground and keeps dust levels low and there is minimal traffic to stir up street gravel. In the summer, the PM2.5 has a much poorer estimation ability with an R squared of 0.69, however the maximum PM10 levels are < 25% of the NAAQS, and the estimate is on average 1.9 µg/m3 higher than the actual monitored value.

Lakeview went out of attainment because of wintertime PM10 levels and continued monitoring was meant to measure impacts during this time. The PM2.5 will do this by measuring residential wood burning. The summer dust is mostly from sources outside of Lakeview and would not impact the community unless there was a dust event from the Goose Lake, just to the south. This dust event would be considered an exceptional event if it had regulatory significance.

3. Calculating PM10

3.1 DEQ annual PM10 demonstration

PM10 in Lakeview will be tracked using the daily PM2.5 monitor by applying the correlation equation provided in Table 6. PM2.5 from the BAM 1022 or other continuous monitor will be averaged for each day from midnight to midnight PST. The PM10 estimates will be sorted from maximum to minimum and the number of exceedance will be averaged over the most recent three years. The number of exceedance per year will be included in the annual network plan's required monitoring and maintenance plan contingency sections.

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

	Lakeview
Linear Regression Equation Q1 & Q4	y = 1.5x + 3.0
Linear Regression Equation Q2 & Q3	y = 2.9x + 0.6
Linear Regression Equation - Wildfire	y = 1.1x + 15.6
$PM_{2.5}$ trigger for "Risk of Violation"	140 µg/m^3

y = PM10, x = PM2.5

4. Monitoring Contingency if PM10 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 Lakeview violates the 93% trigger of the estimated PM10 standard, or 140µg/m3, 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.

The PM10 Maintenance Plan Contingency section is shown below:

Contingency triggers: The 2006 Lakeview PM10 maintenance plan has a contingency section and it states:

…Lakeview's PM10 Contingency Plan is designed in phases in order to first prevent a violation of the PM10 standards, and then to promptly correct any violation that may occur.

Phase 1: Risk of Violation
If estimated ambient concentrations equal or exceed **93% (140 µg/m3)** of the NAAQS, Lakeview's air quality committee and DEQ will convene within six months of the triggering event to evaluate the cause of the exceedance and if necessary recommend implementation strategies. The schedule will include automatic implementation of more stringent requirements should phase two need to be implemented."

Note that if DEQ and EPA Region 10 agree that the exceedance or violation was caused by an exceptional event, DEQ will not convene an air quality committee to determine the source. DEQ will provide EPA Region 10 with evidence proving the exceptional event in the annual report.

Phase 2: Actual Violation
If a violation of the PM10 standard occurs and is validated by DEQ, the following contingency measures will automatically be implemented:

1) Any new major industrial source or a major modification to an existing source subject to the New Source Review (NSR) requirements will revert back to Lowest Achievable Emission Rate (LAER) control technology and emission offset requirements. All other New Source Review requirements for nonattainment areas will be reinstated.
2) The strategies developed under phase one or re-evaluated under phase two will be implemented upon the time schedule detailed in an action plan with all actions permanent and enforceable.

The contingency strategies to be considered or review include, but are not limited to:

- Review alternative heating system, including solar and geothermal;
- Review industrial strategies;
- Consider mandatory woodstove program;
- Review forest slash burning strategies;
- Consider an ordinance removing uncertified woodstoves upon sale of home;
- Consider banning outdoor burning, or developing further open burning restrictions; and
- Evaluate all sources of particulate pollution in Lakeview – Goose Lake Basin, developing additional strategies to address the most significant sources of particulate.

The plan will consider concrete actions that will occur by ordinance or agreement that are permanent and enforceable. The actions will be placed in a schedule for implementation. This schedule will include automatic implementation of more stringent requirements should phase 2 need to be implemented.

5. Conclusion

PM10 monitoring in Lakeview can be accomplished by using PM2.5 as a surrogate. PM10 sources include dust from unpaved roads, dust from nearby Goose Lake, woodstove smoke, prescribed burning and wildfires. The dust is primarily during the summer and at low concentrations, unless there is a dust storm from the nearby Goose Lake, and in that case, it is an exceptional event. Smoke from wildfires is occasionally above the NAAQS but this is also an exceptional event. Smoke from woodstoves is the primary driver of Lakeview's PM2.5 impacts and it's PM2.5/PM10 correlation is good with an R squared of 0.83.
For these reasons, the winter correlation equation will be used to estimate Quarter 1 and Quarter 4 PM10. The summer and wildfire correlation equations will be used to estimate PM10

in Quarter 2 and Quarter 3. When all the corrections equations are used to estimate the 2022 PM10 using the PM2.5 sampler, then compared to the actual monitored PM10 sampler's data, the linear regression has an R squared of 0.82. This is adequate to estimate PM10.

If the annual, PM10 estimate exceeds 93% of the NAAQS (140µg/m3), DEQ will investigate and if the exceedance is from a non-exceptional event source, a PM10 monitor will be reinstalled after discussion with EPA Region 10. The Maintenance plans contingency measures will also be triggered.