Particulate Matter Air Quality Monitoring

In the Matanuska-Susitna Valley, Alaska

January 2010 – July 2019

October 2024

Air Quality Division

Air Monitoring
&
Quality Assurance
Program

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BAM – Beta Attenuation Monitor – Air monitoring instrument that continuously measures particulate matter using the beta ray attenuation principle.

CO – carbon monoxide

DEC – Alaska Department of Environmental Conservation

EPA – U.S. Environmental Protection Agency

Exceptional Event - Exceptional events are unusual or naturally occurring events that can affect air quality but are not reasonably controllable using techniques that tribal, state or local air agencies may implement in order to attain and maintain the National Ambient Air Quality Standards.

FEM – Federal Equivalence Method – Method designed to provide a comparable level of compliance decision making quality as provided by FRMs[1]

FRM – Federal Reference Method – Method designed to provide the most fundamentally sound and scientifically defensible concentration measurement.[1]

Mat-Su Valley – Matanuska-Susitna Valley

µm – micrometers

µg/m³ – micrograms per cubic meter

NAAQS – National Ambient Air Quality Standards – Standards defined by the Clean Air Act for six criteria air pollutants to protect public health and welfare.

NO_2 - nitrogen dioxide

O_3 - ozone

Pb - lead

PM_{10} – Particulate Matter 10 micrometers or smaller in diameter.

$PM_{2.5}$ – Particulate Matter 2.5 micrometers or smaller in diameter.

SO_2 – sulfur dioxide

[1] 40 CFR Part 53.1

EXECUTIVE SUMMARY

The State of Alaska Department of Environmental Conservation (DEC), in an effort to protect the public health and the environment, has been mandated by the legislature to evaluate, assess, and mediate environmental issues that may affect the health and welfare of residents within the state. To further these objectives, DEC established a statewide air monitoring network. The network currently consists of sites in Juneau, Anchorage, Fairbanks, and the Matanuska-Susitna Valley (Mat-Su Valley). This report provides information about air monitoring in the Mat-Su Valley from 2010 through 2019.

Between 2010 and 2019, DEC monitored particulate matter in Palmer and Wasilla. DEC monitors two sizes of particulate matter, particulate matter 10 micrometers or smaller (PM_{10}), and particulate matter 2.5 micrometers or smaller ($PM_{2.5}$), in aerodynamic diameter. The U.S. Environmental Protection Agency (EPA) sets National Ambient Air Quality Standards (NAAQS) for each pollutant.

Two potential air quality concerns in the Mat-Su Valley are windblown dust from nearby glaciers and river basins, seen as PM_{10}, and wintertime wood smoke from home heating and slash burning, seen as $PM_{2.5}$. No exceedances of the PM_{10} standard have been recorded in Wasilla since 2010. In the spring of 2015, monitoring stopped in Wasilla. Six exceedances have been documented in Palmer; the Palmer site was shut down in 2019. These are typically related to windblown dust events when weather conditions are dry.

Monitoring efforts indicate that the PM_{10} NAAQS was rarely exceeded in the Mat-Su Valley, and when it was exceeded, it was due to natural events. In Palmer, a single $PM_{2.5}$ NAAQS exceedance was recorded in 2019 and was due to wildfire smoke; this exceedance was not flagged as an exceptional event[2]. Two $PM_{2.5}$ NAAQS exceedances were recorded in Wasilla, one due to fireworks in 2012 and the 2nd due to wildfire smoke in 2014. DEC continues to monitor particulate matter in the Butte. Continuous hourly data can be found on the DEC real time air monitoring website[3].

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[2] Exceptional Event: Unusual or naturally occurring events that can affect air quality but are not reasonably controllable using techniques that tribal, state or local air agencies may implement in order to attain and maintain the National Ambient Air Quality Standards. https://www.epa.gov/air-quality-analysis/treatment-air-quality-monitoring-data-influenced-exceptional-events

[3] https://dec.alaska.gov/air/air-monitoring/responsibilities/database-management/alaska-air-quality-real-time-data/

INTRODUCTION

The State of Alaska Department of Environmental Conservation (DEC) is mandated by the Alaska State Legislature to "conserve, improve, and protect its natural resources and environment and control water, land, and air pollution, in order to enhance the health, safety, and welfare of the people of the state and their overall economic and social well-being"[4].

The DEC Division of Air Quality operates a statewide air monitoring network with permanent monitoring sites in Juneau, Anchorage/Matanuska-Susitna Valley (Mat-Su Valley), and Fairbanks, as well as additional special purpose or temporary sites. This report provides information about air monitoring conducted in the Mat-Su Valley at the Palmer and Wasilla monitoring sites. DEC and the U.S. Environmental Protection Agency (EPA) used these data to determine compliance with the National Ambient Air Quality Standards (NAAQS) set by the EPA.

Background

DEC began monitoring ambient air quality in the Palmer and Butte areas in summer 1985 in response to smoke generated by fires used to clear land at Point Mackenzie, across Cook Inlet from Anchorage. DEC located one of the smoke monitoring sites at the Palmer airport. Although the monitors did not detect smoke, there were several sampling days with heavy dust loads. At that time, dust was covered by the "rural fugitive dust" waiver, an EPA policy that acknowledged that dust was part of farming. Efforts of measuring particulate matter has since continued in the Mat-Su Valley with an additional site operating in Wasilla from 2010 to spring 2015. The Palmer monitoring site was operated from 2010 to 2019. In accordance with the 2008 NAAQS ozone rule, ozone monitoring began in the Valley in 2011. Particulate Matter monitoring continues currently in the Butte.

Public Health and Air Quality Standards

The EPA regularly performs a multi-tiered comprehensive review of scientific literature and a rise and exposure assessment to set the NAAQS for six criteria pollutants and to determine compliance with the Clean Air Act (Table 1). The criteria pollutants regulated in the NAAQS are carbon monoxide (CO), lead (Pb), ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2). The EPA sets both primary and secondary standards. $PM_{2.5}$ has both a 24-hour standard and an annual standard. The EPA set primary standards for public health, including higher risk populations, and secondary standards for public welfare and environmental protection.

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[4] Alaska Statute 46.03.010

***Table 1**. Primary and Secondary NAAQS Criteria Pollutants*[5].

Pollutant	Primary/ Secondary	Standard	Averaging Time	Compliance Criteria
Carbon Monoxide	P	9 ppm	8 hours	Not to be exceeded more than once per year.
		35 ppm	1 hour	
Lead	P & S	0.15 µg/m^3	Rolling 3-month average	Not to be exceeded.
Nitrogen Dioxide	P	100 ppb	1 hour	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years.
	P & S	53 ppb	1 year	Annual mean.
Ozone	P & S	70 ppb	8 hours	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years.
PM_{10}	P & S	150 µg/m^3	24 hours	Not to be exceeded more than once per year on average over 3 years.
$PM_{2.5}$	P & S	35 µg/m^3	24 hours	98th percentile, averaged over 3 years.
	P	9 µg/m^3	1 year	Annual mean, averaged over 3 years.
	S	15 µg/m^3	1 year	Annual mean, averaged over 3 years.
Sulfur Dioxide	P	75 ppb	1 hour	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years.
	S	0.5 ppm	3 hours	Not to be exceeded more than once per year.

Each criteria pollutant is associated with a set of detrimental health effects including, but not limited to, irritation of the respiratory system, tightness in the chest, headache and fatigue, increased chance of respiratory infection, and the aggravation of asthma. The elderly, children, and people with chronic respiratory illnesses or asthma are especially sensitive to air pollutants.

For particulate matter, particle size is directly related to the potential adverse health effects. Different sized particles behave differently in the atmosphere and have different human health and environmental effects. Therefore, particulates are classified by aerodynamic diameter. Particle size directly relates to how particulates behave in air, most strongly influenced by shape and density. The smaller the particle, the greater the potential effect, as it can penetrate further into the respiratory system. PM_{10} is defined as particles with an aerodynamic diameter of less than or equal to 10 micrometers (µm). $PM_{2.5}$ is defined

[5] 40 CFR part 50

as particles with an aerodynamic diameter of less than or equal to 2.5 µm. The body can naturally eliminate larger particles; thus, they do not penetrate deeply into the respiratory tract.

$PM_{2.5}$ particles can lodge in the very small air sacs of the lungs, the alveoli. These particulates slow the transfer of oxygen and carbon dioxide and cause the heart to work harder to achieve the same rate of transfer. This effect is most noticeable in children, the elderly, and people with respiratory diseases like bronchitis, asthma, emphysema, or heart problems. However, particulate inhalation affects all people and immediate adverse or chronic effects may appear after repeated or continuous exposures at ranges from low to extremely high concentrations. $PM_{2.5}$ particulates may contain carcinogens and other harmful substances.

PM_{10} often consists of common crustal materials such as dust from roads as well as volcanic ash whereas $PM_{2.5}$ generally comes from combustion processes like industrial stack emissions, motor vehicles, wood smoke from forest fires or home heating, and chemical processes that emit gases containing sulfur dioxide and other volatile organic compounds. $PM_{2.5}$ also forms when pollutant gases combine in the atmosphere. Natural sources of suspended particulates include volcanic ash, glacial silt, windblown dust from unpaved roads and non-vegetated land, and ash from forest and grass fires. These natural sources contribute both fine and coarse particles to ambient air. Anthropogenic sources include industrial processes, mining, vehicles, and home heating.

The EPA employs a statistic called the design value. Design values can be calculated from the sample data, using modeling results, or be a count of the number of exceedances of a NAAQS. Design values change from year to year depending on meteorological conditions and pollutant levels. The design value shows compliance with the NAAQS.

EPA has two methods for determining compliance, or attainment, with ambient air quality standards: deterministic and probabilistic.

A deterministic method allows a certain (low) number of exceedances over a set time and specific number of valid samples. EPA uses this method to determine compliance with the 24-hour PM_{10} NAAQS of 150 micrograms per cubic meter ($\mu g/m^3$) under standard conditions of temperature and pressure. An area complies with the NAAQS if the average number of exceedances for three consecutive years is less than one. This average is referred to as the design value.

A probabilistic method allows for multiple exceedances as long as the distribution of sampled values is such that a set statistic is less than the NAAQS. This method makes compliance with the NAAQS less sensitive to extreme conditions that may not be typical of the local area. EPA uses this method to determine compliance with the $PM_{2.5}$ 24-hour NAAQS of 35 $\mu g/m^3$ under actual conditions of temperature and pressure. An area complies with the 24-hour NAAQS if the average of the 98^{th} percentile values for three consecutive years is less than 35 $\mu g/m^3$. This value is known as the design value. An area complies with the annual $PM_{2.5}$ NAAQS if the 3-year average of weighted annual means is less than 9 $\mu g/m^3$.

The EPA allows data arising from exceptional events to be excluded when determining compliance with the NAAQS. Exceptional events are events, such as a wildfire or windblown dust event that DEC can adequately demonstrate was of natural origin and could not be reasonably prevented or controlled. EPA introduced the exceptional events policy in 2007. Between 2010 and 2015, DEC has marked several days as exception events due to the Funny River Fire in May 2014, and dust events in 2014 and 2015 in Palmer.

If an area is unable to meet the air quality standards, the Clean Air Act may designate it as a nonattainment area. This designation triggers a five-year window during which the state must gather additional data, submit a State Implementation Plan to the EPA, institute control measures, and meet the standard at the end of that time. The EPA can levy sanctions against a designated nonattainment area that may result in loss of federal highway funding and of economic development opportunities.

Monitoring Requirements

DEC samples airborne particulates with special filters in instruments that operate at specified flow rates for specified times, based on EPA requirements. Current PM_{10} and $PM_{2.5}$ samplers employ either Teflon or glass fiber filters. The Federal Reference Method (FRM) Partisol 2000 collects a sample by continuously pumping ambient air through a size selective inlet and a pre-weighed Teflon filter for 24 hours. DEC staff collects the filters, weighs them, and uses the difference between the filter weights along with flow rate, flow duration, ambient temperature, and ambient barometric pressure to calculate concentration. DEC programs these samplers to run on the national EPA schedule and typically samples every sixth day.

DEC also employs an automated Federal Equivalent Method (FEM) Beta Attenuation Monitor 1020. This instrument uses a glass-fiber filter tape that lasts for several weeks. This sampler draws ambient air through a size selective inlet every hour. The sampler measures the amount of beta radiation that passes through the tape and uses that data to calculate the mass of the sample. It also uses the flow rate, flow duration, ambient temperature, and ambient barometric pressure to calculate a concentration.

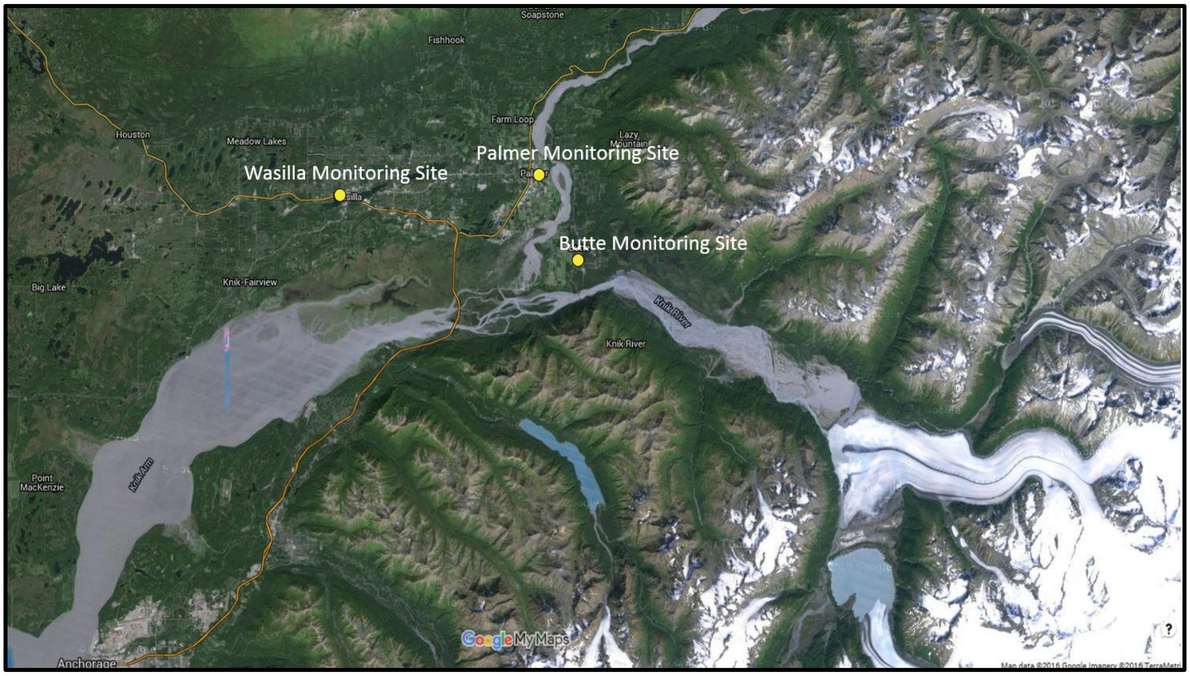

Figure 1. *Locations of Mat-Su Valley Air Monitoring Sites as of 2014.*

Palmer Monitoring

Palmer, a city of approximately 6,000[6], is located on the Glenn Highway in the Mat-Su Borough (Fig. 1). An insulated, temperature-controlled trailer houses the continuous particulate monitors and ozone monitor. All inlets are approximately four meters above the ground with uninterrupted airflow around the heads. Ozone was monitored during the EPA mandated season from April through October. The Palmer monitoring site was operated from 2010 to 2019.

Between 2010 and 2019 the Palmer Site was equipped with:
PM_{10} – FEM Beta Attenuation Monitor (BAM) 1020
$PM_{2.5}$ – FRM Partisol 2000 Sampler, decommissioned in January 2015
$PM_{2.5}$ – FEM BAM 1020, the primary $PM_{2.5}$ monitor

The Partisol and the inlet heads of the BAMs can be seen in Figure 2.

[6] United States Census Bureau, 2010 Census

Figure 2. *Palmer Trailer near the tennis courts and baseball fields.*

Site Description

The Palmer monitoring site was located on South Gulkana Street between East Dahlia Ave and East Elmwood Ave near the city tennis court and Little League baseball field (Fig. 3). Site coordinates are latitude 61° 35' 56" north, longitude 149° 6' 14" west. The average elevation for Palmer is 73 meters above mean sea level. The site was in the downtown district where the dominant land use within a 400-meter radius was residential and commercial buildings, and large, open, grass-covered areas. All main roads in the immediate area of the site are paved. Palmer was a neighborhood scale monitoring site.

***Figure 3**. Map of Palmer Site. The red circle indicates the location of the monitoring site.*

Primarily, particulate matter comes from the Knik and Matanuska River basins in the form of glacial dust. These glacier-fed rivers meander and deposit glacial silt over wide, braided riverbeds out to the Cook Inlet tidal zone. When the gravel bars lose snow cover in the spring, and until it returns in the fall, dry windy weather can suspend large amounts of silt in the air. Local sources, such as road dust from city traffic, fugitive dust from adjacent ball fields, local farming, and other recreation areas contribute to the particulate matter in the area. In the past, the Matanuska-Susitna Borough or DEC issued several air quality alerts per year during spring and fall months due to wind-blown dust events, but responsibility for issuing advisories has shifted to DEC in the past 3-4 years. Sources of $PM_{2.5}$ include wood smoke generated by residential heating, vehicle exhaust, and forest fires.

Wasilla Monitoring

Wasilla, a city of approximately 8,000[7], is located on the Parks Highway in the Matanuska-Susitna Borough (Fig. 1). The site was established in 2010 as a Special Purpose Monitoring site and removed in spring 2015, due to low concentrations and budget constraints. An insulated, temperature-controlled trailer housed the continuous particulate monitors and ozone monitor. All inlets were approximately

[7] United States Census Bureau, 2010 Census

four meters above the ground with uninterrupted airflow around the heads. DEC monitored ozone during the EPA mandated season from April through October.

Between 2010 and 2015 the Wasilla Site was equipped with:
PM_{10} – FEM Beta Attenuation Monitor (BAM) 1020
$PM_{2.5}$ – FRM Partisol 2000 Sampler, decommissioned in September 2012
$PM_{2.5}$ – FEM BAM 1020, the primary $PM_{2.5}$ monitor

The Partisol and the inlet heads of the BAMs can be seen in Figure 4.

Figure 4*. Wasilla Trailer on West Swanson Ave.*

Site Description

The Wasilla monitoring site was in the 100 block of West Swanson Avenue adjacent to Fire Station 61, near the intersection with Lucille St. Site coordinates are latitude 61° 34' 59.9" north and longitude 149° 27' 16.7" west (Fig. 7). Average elevation of Wasilla is 104 meters above mean sea level. The site was in the downtown district approximately 200 meters north of the George Parks Highway. The dominant land use was residential and commercial buildings with paved roads, parking lots, and mixed areas of vegetated and gravel-covered land. Wasilla was a neighborhood scale monitoring site.

Figure 5*. Map of Wasilla. The red circle indicates the location of the monitoring site.*

Major sources of PM at the Wasilla site were wind-blown dust from unpaved areas, dust from traffic on roadways, and glacial dust from gravel bars along rivers flowing into the north end of Cook Inlet. Commuter and daily traffic along the George Parks Highway can be heavy, especially during summer. Sources of $PM_{2.5}$ include residential wood smoke, vehicle exhaust, and forest fires. The Matanuska-Susitna Borough or DEC typically issue several air quality alerts per year during spring and fall because of wind-blown dust events.

RESULTS

This report summarized data collected at the Palmer, and Wasilla monitoring sites from January 2010 through July 2019. The following section provides a summary of the statistical analysis and a brief discussion of the data. Complete annual data can be found in Appendices A and B.

PM_{10} Summary

Exceedances of the PM_{10} standard have only been recorded at the Palmer monitoring site since 2010. Annual maximum values at the Wasilla monitoring site have been below the standard. Annual graphs can be found in Appendix A.

PALMER

Between 2011 and 2019 there were nine exceedances of the 150 µg/m^3 NAAQS (Table 2). The highest value recorded was 376 µg/m^3 in 2014. DEC flagged two days in 2014 and two days in 2015 as exceptional events due to high winds in the Mat-Su Valley. The 2014 and 2015 maximums excluding the exceptional events are the values in parentheses in Table 2. In 2015, the estimated design value exceeded the allowed design value of one. EPA can concur with DEC to omit the exceptional event from the NAAQS compliance calculation; however, DEC has not submitted an exceptional event waiver request to EPA (Table 2).

Table 2. *Palmer PM_{10} summary, 2011-2019. Annual means, maximums, second maximums, and number of exceedances.*

	Median (µg/m^3)	Maximum (µg/m^3)	2nd Maximum (µg/m^3)	# of Exceedances	Design Value
2011	8	214	174	2	0.7
2012	6	152*	121	0	0.7
2013	7	113	83	0	0.7
2014	7	376ǂ(143)	214ǂ(138)	2	0.7
2015	8	192ǂ(112)	159ǂ(94)	2	1.4
2016	7	210	112	1	1.7
2017	7	156	119	1	1.4
2018	7	255	131	1	1.0
2019	7	90	58	0	0.7

*EPA rounds PM_{10} to the nearest 10 µg/m^3, thus a value of 152 µg/m^3 does not exceed the NAAQS.

ǂThese exceedances of the NAAQS have been flagged as exceptional events.

Figure 6 shows the 24-hour averages in 2019. The data shows heightened PM_{10} values in both the spring and fall, the typically dryer times of year. Similar trends are seen between 2011-2018 (Appendix A: Fig. 12-19). These elevated values are typically due to windblown dust events in the Mat-Su Valley.

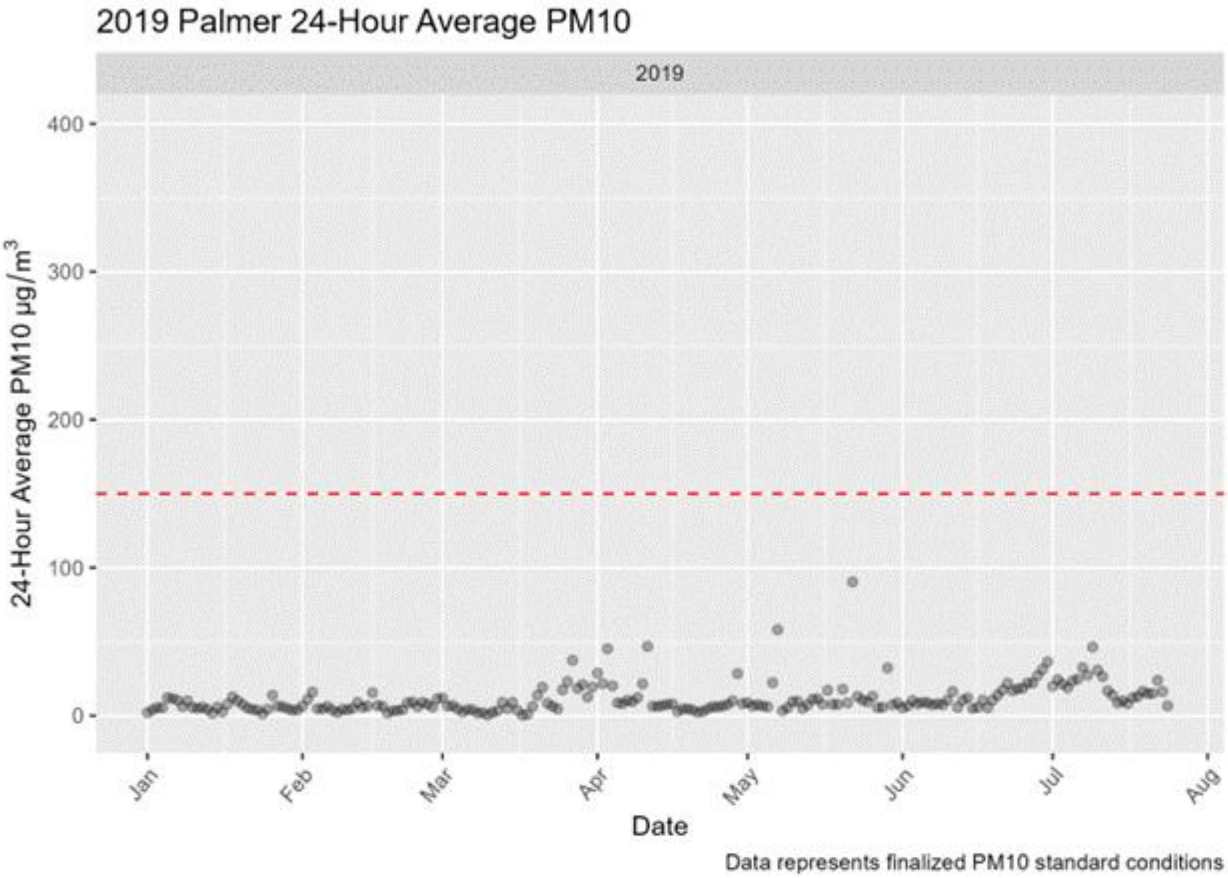

Figure 6. *24-hour average of $PM_{2.5}$ in 2019, Palmer. Maximum value: 90.0 µg/m^3. The red line is the NAAQS of 35 µg/m^3.*

WASILLA

Between 2011 and 2015 there were no PM_{10} exceedances of the 150 µg/m^3 NAAQS recorded in Wasilla (Table 4). The highest value recorded was 128 µg/m^3 in 2014, 85% of the standard.

Table 3. *Wasilla PM_{10} summary, 2011-2015. Annual means, maximums, second maximums, and number of exceedances.*

	Median (µg/m^3)	**Maximum (µg/m^3)**	**2nd Maximum (µg/m^3)**	**# of Exceedances**	**Design Value**
2011	13	68	60	0	0
2012	10	121	110	0	0
2013	10	78	64	0	0
2014	10	128	119	0	0
2015	10	78	70	0	0

Figure 7 shows the 24-hour averages in Wasilla in 2014. Heightened PM_{10} values occurred in both the spring and fall, the typically dryer times of year. Similar trends are seen in 2011, 2012, 2013, and 2015

(Appendix A: Fig 20-23). These elevated values are typically due to windblown dust events in the Mat-Su Valley.

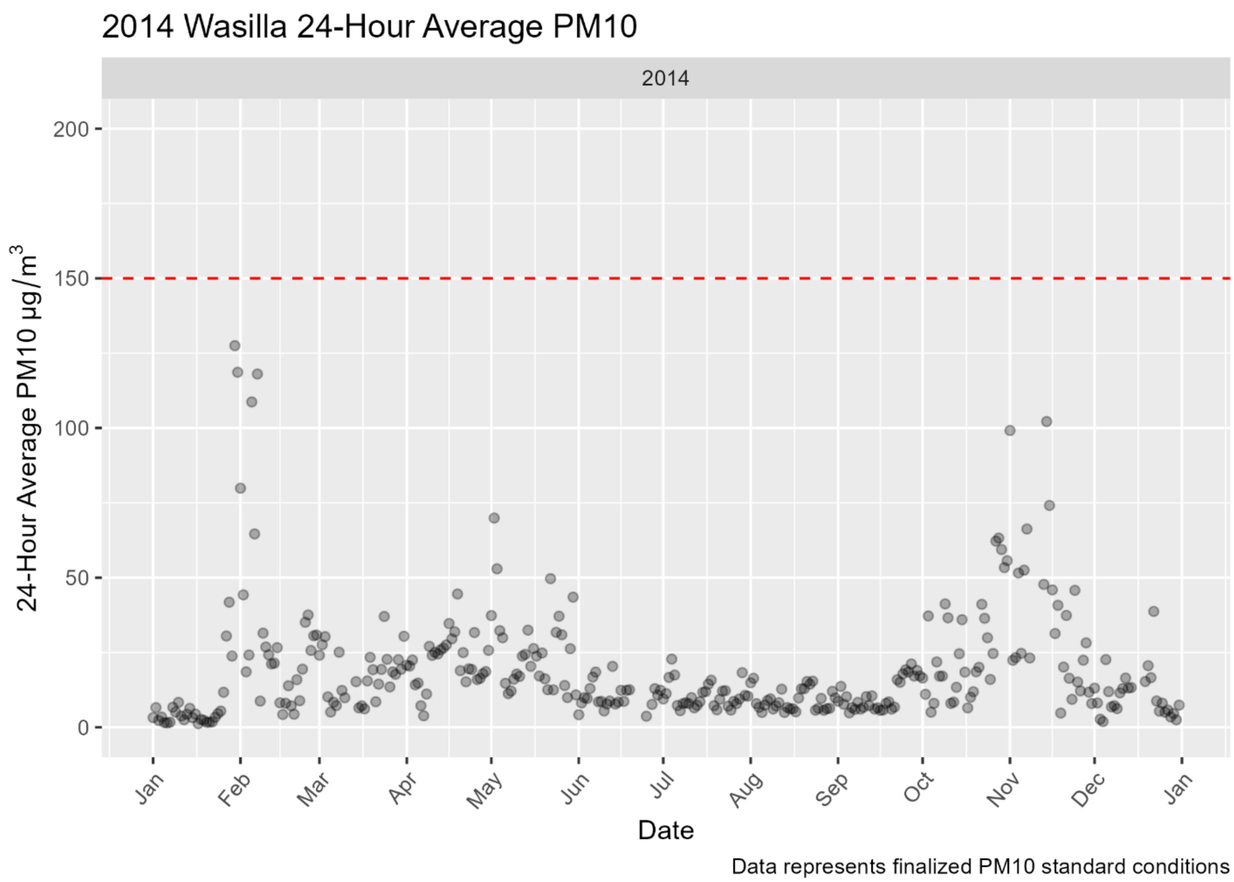

Figure 7. *24-hour average of PM_{10} in 2014, Wasilla. Maximum value: 128 µg/m³. The red line is the NAAQS of 150 µg/m³.*

$PM_{2.5}$ Summary

$PM_{2.5}$ values are generally higher in Wasilla than in Palmer. Using the EPA determined probabilistic method of determining compliance with the standard, the yearly 98th percentile values and resulting design values were far higher in Wasilla than in Palmer (Fig. 8). The annual design values acquired from both sites did not exceed the primary annual $PM_{2.5}$ standard of 9µg/m³. The 24-hour design values from both sites also did not exceed the primary 24-hour $PM_{2.5}$ standard of 35µg/m³. Annual graphs can be found in Appendix B.

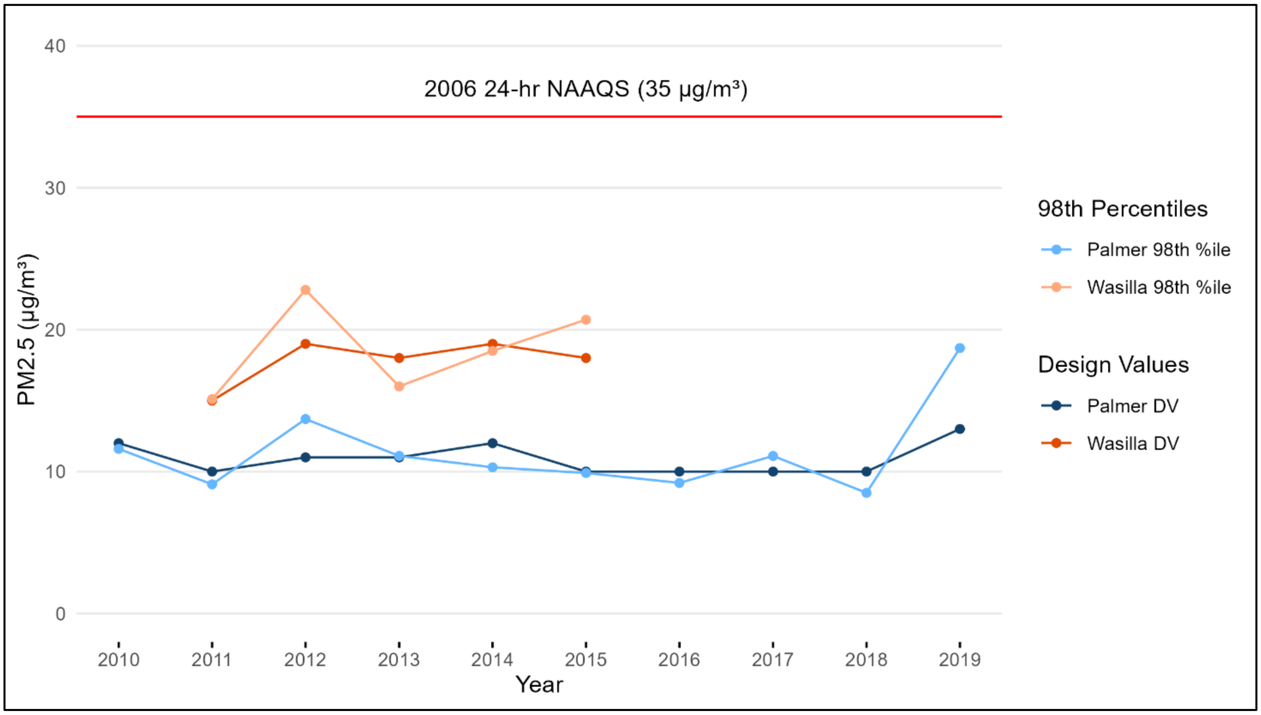

Figure 8. *Palmer and Wasilla 24-hour $PM_{2.5}$ 98th percentile values and design values 2010-2019. The 98th percentile values for 2010 Palmer, 2019 Palmer and 2015 Wasilla do not meet EPA completeness criteria. The red line is the NAAQS of 35 µg/m^3.*

In May 2014, the Funny River and Tyonek fires caused elevated smoke levels in the Mat-Su Valley. The Funny River Fire began on May 19, 2014 on the western side of the Kenai Peninsula. The Tyonek Fire also began on the 19th on the western side of Cook Inlet. The smoke produced by these fires drifted north along Cook Inlet, elevating $PM_{2.5}$ concentrations from Anchorage through the Fairbanks North Star Borough. Days between May 22 and May 30 have been flagged as exceptional events in the Mat-Su Valley due to this smoke (Fig. 14).

PALMER

From 2010 to 2019, Palmer has no recorded exceedances of the 35 µg/m^3 NAAQS (Table 4). The single exceedance and highest 24-hour value recorded was 36.3 µg/m^3 in 2019, slightly above the 24-hour, 3-year standard of 35 µg/m^3. (Table 4 & Fig. 9). This exceedance was due the Swan Lake Fire on the Kenai, but it was not flagged as an exceptional event. Weighted mean and 98th percentile values in 2010 and 2019 did not meet the EPA completeness criteria. As a result, the 24-hour and annual design values were invalidated as well. Design values in 2011 and 2012 were also invalidated due to not meeting the completeness criteria, however, between 2010 and 2019, neither design value exceeded their respective NAAQS concentration.

Table 4. *Palmer $PM_{2.5}$ summary, 2010-2019. Annual maximums, second maximums, weighted means, number of exceedances, 98th percentile values, 3 year 24-hour design values, and annual design values.*

	Maximum (µg/m^3)	**2nd Maximum (µg/m^3)**	**Weighted Mean (µg/m^3)**	**# of Exceedances**	**98th Percentile**	**24-hour Design Value**	**Annual Design Value**
2010	21.3	14.5	3.1*	0	11.6*	12ǂ	3.1ǂ
2011	21.1	17.8	4.1	0	9.1	10ǂ	3.6ǂ
2012	21.5	19.5	4.2	0	13.7	11ǂ	3.8ǂ
2013	15.7	13.04	3.2	0	11.1	11	3.8
2014	29.2	26.0	2.3	0	10.3	12	3.2
2015	15.1	12.9	2.7	0	9.9	10	2.7
2016	16.2	13.4	2.8	0	9.2	10	2.6
2017	25.7	21.5	3.2	0	11.1	10	2.9
2018	11.9	11.5	3.0	0	8.5	10	3.0
2019	36.3	24.9	6.3*	1	18.7*	13ǂ	4.1ǂ

* The value does not meet EPA completeness criteria.
ǂ The design value does not meet EPA completeness criteria and is invalid.

Figure 9 shows the 24-hour averages in Palmer in 2019. Heightened $PM_{2.5}$ values occurred in the winter months. Similar trends can be seen from 2010 - 2018 (Appendix B: Fig. 24-32).

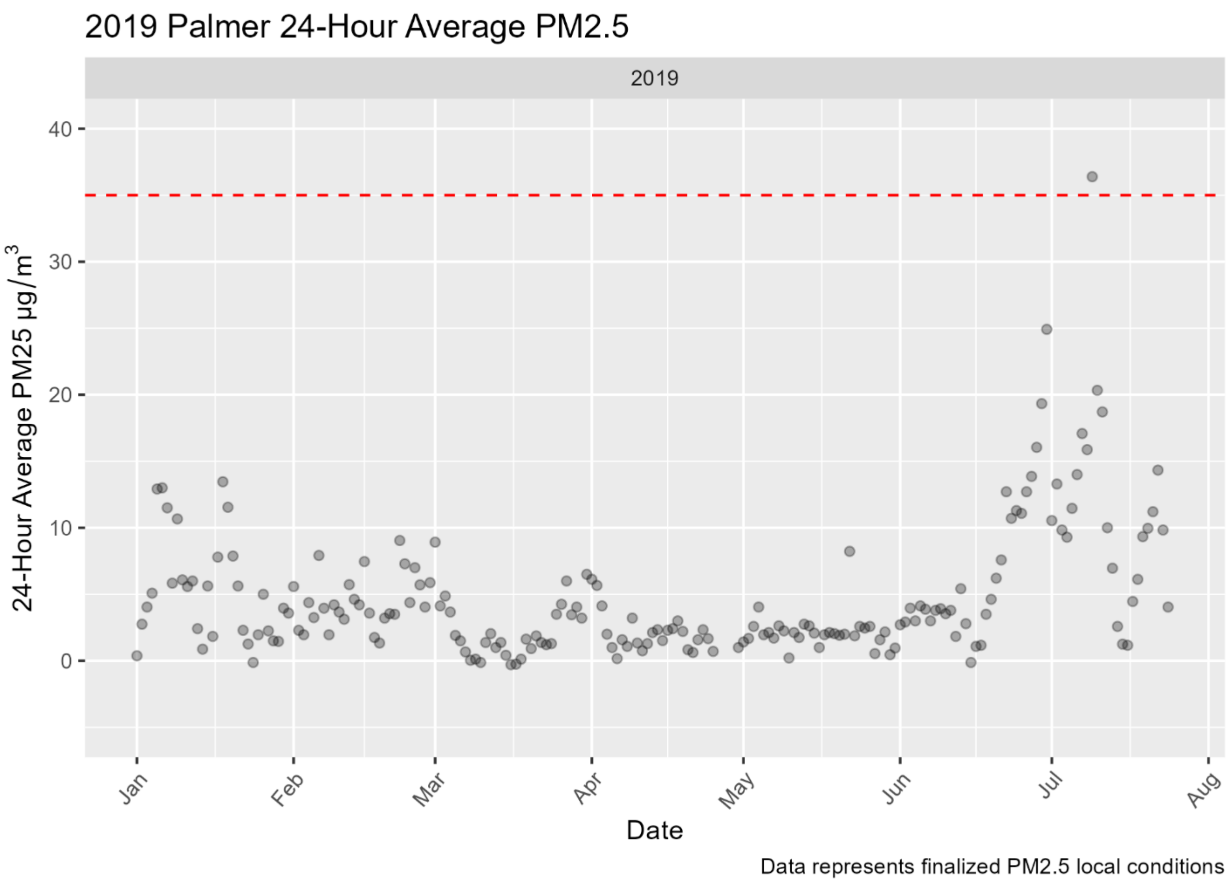

Figure 9. *24-hour average of $PM_{2.5}$ in 2019, Palmer. Maximum value: 36.4 µg/m³. The red line is the NAAQS of 35 µg/m³. The single exceedance in early July was due to the Swan Lake Fire on the Kenai Peninsula but was not flagged as an exceptional event.*

WASILLA

From 2011 to 2015, Wasilla had two recorded exceedances of the 35 µg/m^3 NAAQS (Table 5). The standard was exceeded once in 2012 and once in 2014. The 2012 exceedance on the 1st of January was due to fireworks in the area. The May 2014 exceedance can be attributed to the Funny River Fire and Tyonek Fires. The highest value recorded was 45.9 µg/m^3 in 2012 (Table 5). Values from 2015 were calculated with data from January 1st to March 31st, as the site was decommissioned at the end of the first quarter. Thus, the weighted mean and 98th percentile in 2015 did not meet the EPA completeness criteria and the design values were invalidated. The 2011 and 2012 design values were also invalidated due to not meeting the completeness criteria. Like Palmer, neither Wasilla design value exceeded their respective NAAQS concentration.

Table 5*. Wasilla $PM_{2.5}$ summary, 2011-2015. Annual maximums, second maximums, weighted means, number of exceedances, 98th percentile values, 3 year 24-hour design values, and annual design values.*

	Maximum (µg/m^3)	**2nd Maximum (µg/m^3)**	**Weighted Mean (µg/m^3)**	**# of Exceedances**	**98th Percentile**	**24-hour Design Value**	**Annual Design Value**
2011	26.1	20.9	6.3	0	15.1	15ǂ	6.3ǂ
2012	45.9	33.3	5.7	1	22.8	19ǂ	6.0ǂ
2013	22.6	20.2	4.0	0	16.0	18	5.3
2014	38.3	24.9	3.8	1	18.5	19	4.5
2015	24.3	23.6	6.1*	0	20.7*	18ǂ	4.6ǂ

* The value does not meet EPA completeness criteria.
ǂ The design value does not meet EPA completeness criteria and is invalid.

Figure 10 shows the 24-hour averages in Wasilla in 2014. Heightened $PM_{2.5}$ values occurred in the winter months. Similar trends were observed in 2011, 2012, 2013, and the first quarter of 2015 (Appendix B: Fig. 33-36).

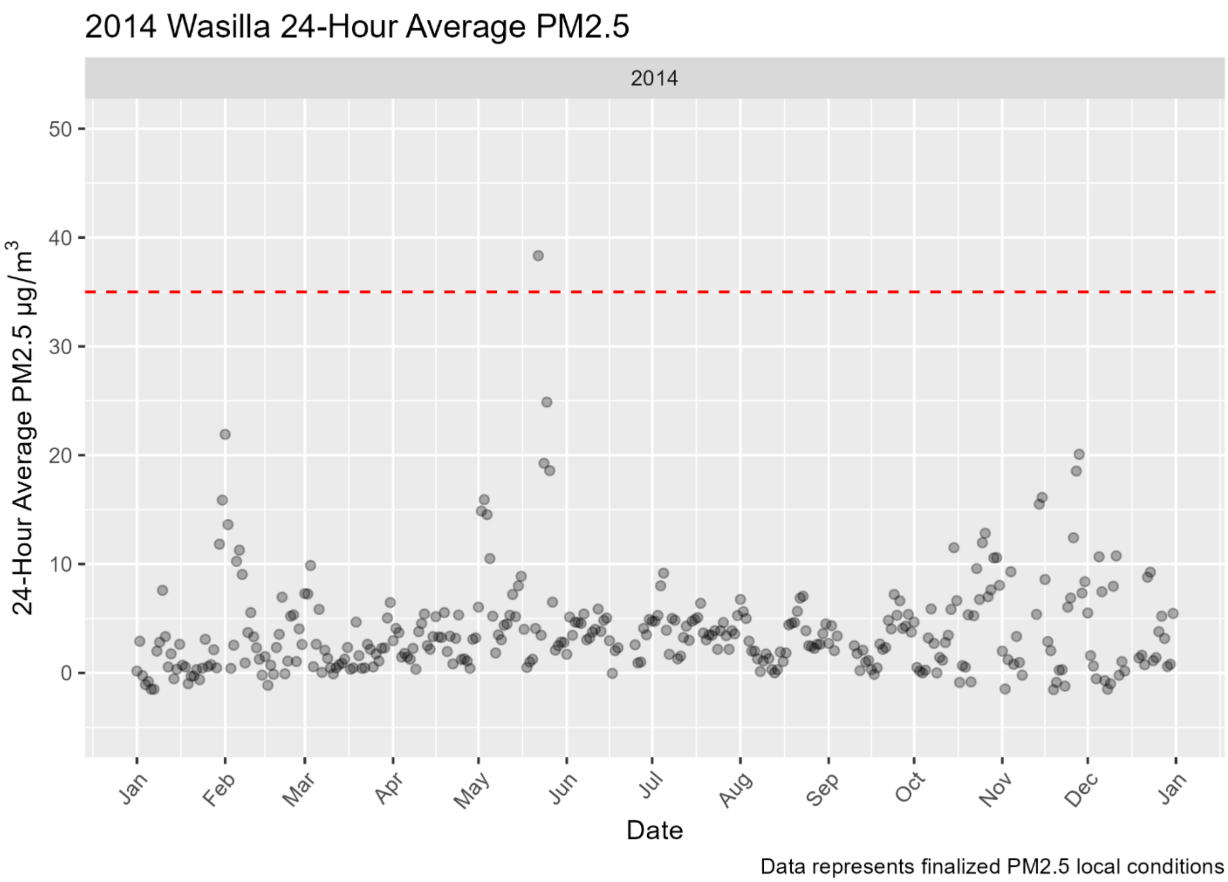

Figure 10. *24-hour average of $PM_{2.5}$ in 2014, Wasilla. Maximum value: 38.3 µg/m^3. The red line is the NAAQS of 35 µg/m^3. Four days have been flagged as exceptional events due to smoke from the Funny River and Tyonek Fires.*

CONCLUSIONS

From 2010 through 2019, DEC continuously monitored ambient concentrations of particulate matter, PM_{10} and $PM_{2.5}$, in the Mat-Su Valley. Monitoring sites were located in Palmer and Wasilla. The Wasilla site was removed in the spring of 2015 due to low concentrations and budget constraints. DEC uses these sites to demonstrate compliance with the National Ambient Air Quality Standards (NAAQS).

The only exceedances of the PM_{10} NAAQS in the Mat-Su Valley have been recorded in Palmer. These exceedances can be attributed to windblown dust from nearby river basins and glaciers. Windblown dust events occur with strong winds and dry conditions. Low snow levels in the winter leave ground exposed, contributing to the high values.

The majority of $PM_{2.5}$ exceedances in the Mat-Su Valley occur in Butte in the winter months. Local meteorological conditions are ideal for frequent inversions, trapping wood smoke from home heating near ground level. This causes elevated $PM_{2.5}$ concentrations, as the low cloud layer prevents the smoke from dissipating. A single $PM_{2.5}$ exceedance occurred in Wasilla in May 2014, due to nearby wildfires.

At the time of this report, DEC continues to monitor particulate matter in the Butte.

APPENDIX A: Palmer PM_{10} ANNUAL 24-HOUR AVERAGES

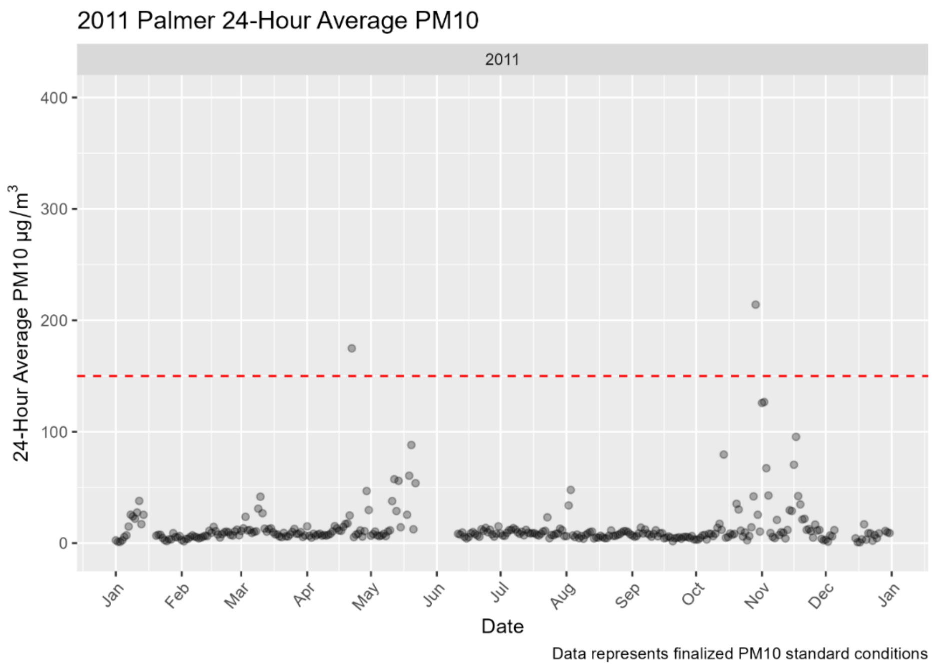

Figure 11. *24-hour average of PM_{10} in 2011, Palmer. Maximum value: 214 µg/m^3. The dotted red line is the NAAQS of 150 µg/m^3. The two exceedances, above the NAAQS line, were not flagged as exceptional events but were due to windblown dust events.*

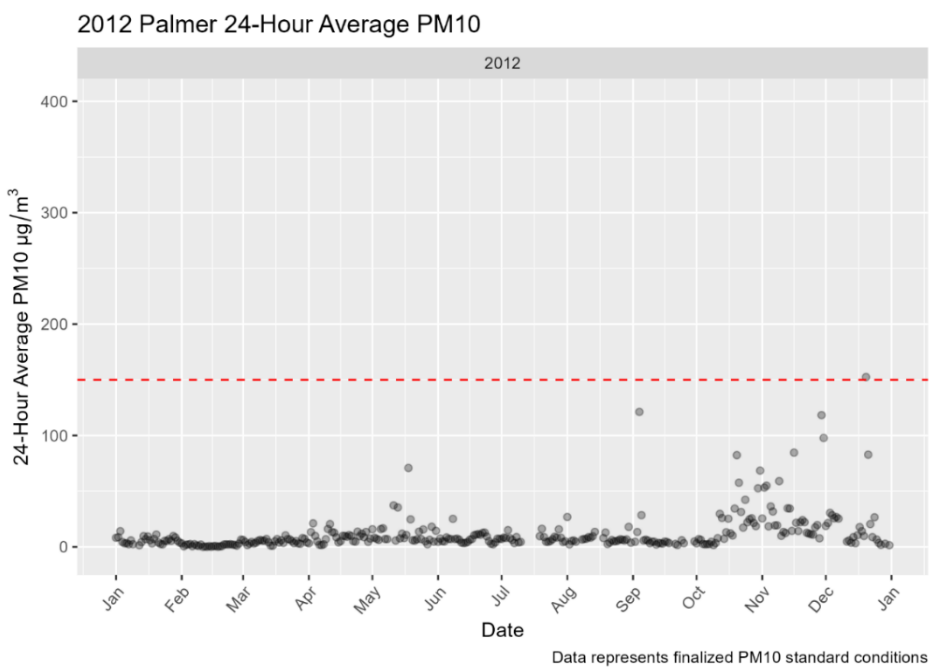

Figure 12. *24-hour average of PM_{10} in 2012, Palmer. Maximum value: 152 µg/m^3. The red line is the NAAQS of 150 µg/m^3. When determining exceedances, the EPA rounds PM_{10} to the nearest 10 µg/m^3, thus 152 µg/m^3 does not exceed the NAAQS.*

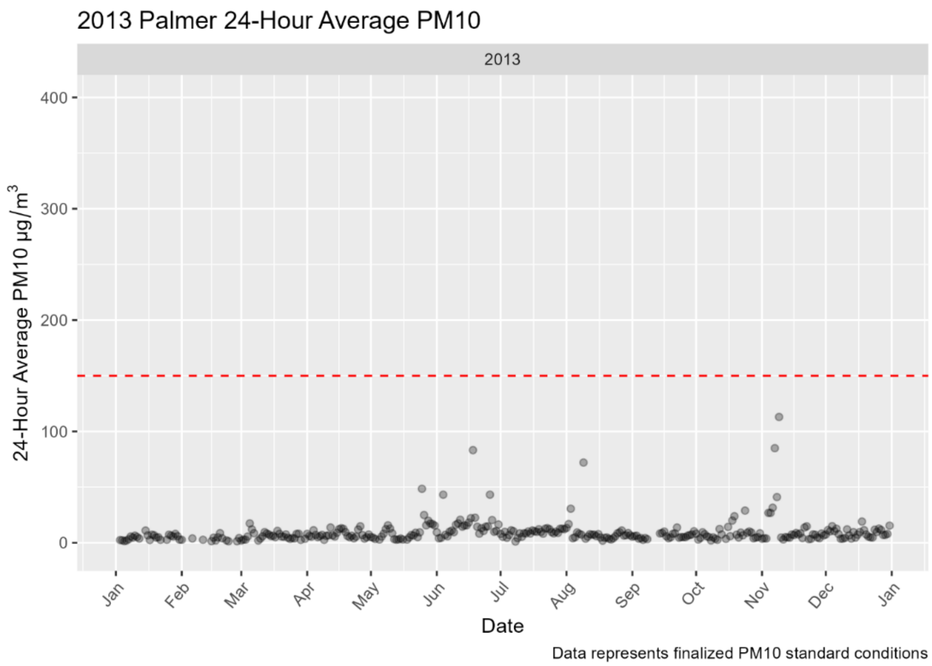

Figure 13. *24-hour average of PM_{10} in 2013, Palmer. Maximum value: 113 µg/m^3. The red line is the NAAQS of 150 µg/m^3.*

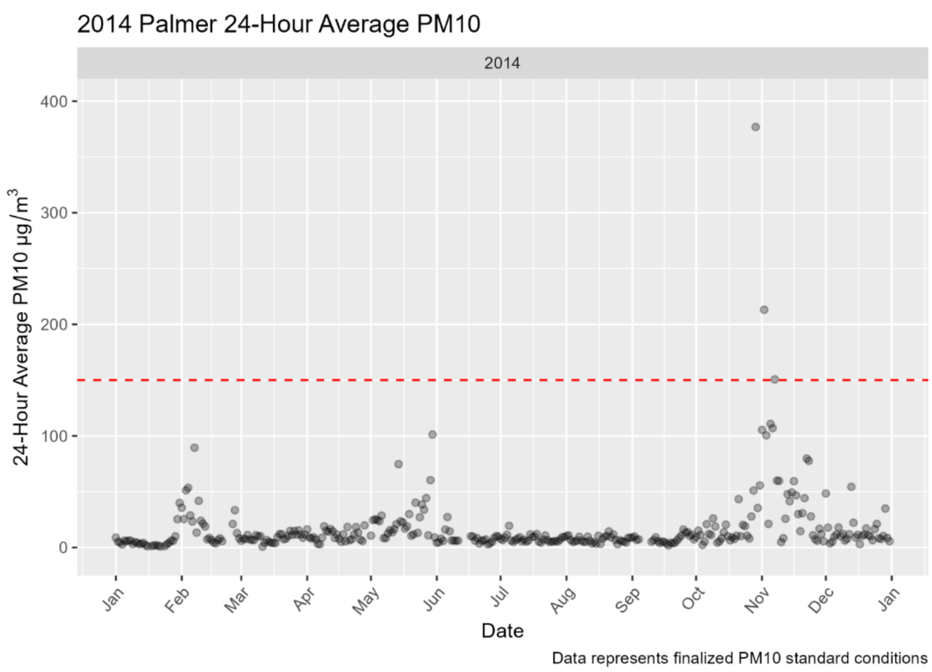

Figure 14. *24-hour average of PM_{10} in 2014, Palmer. Maximum value: 376 µg/m^3. The red line is the NAAQS of 150 µg/m^3. The two exceedances, above the NAAQS line, have been flagged as exceptional events and most likely will not be used to calculate NAAQS compliance.*

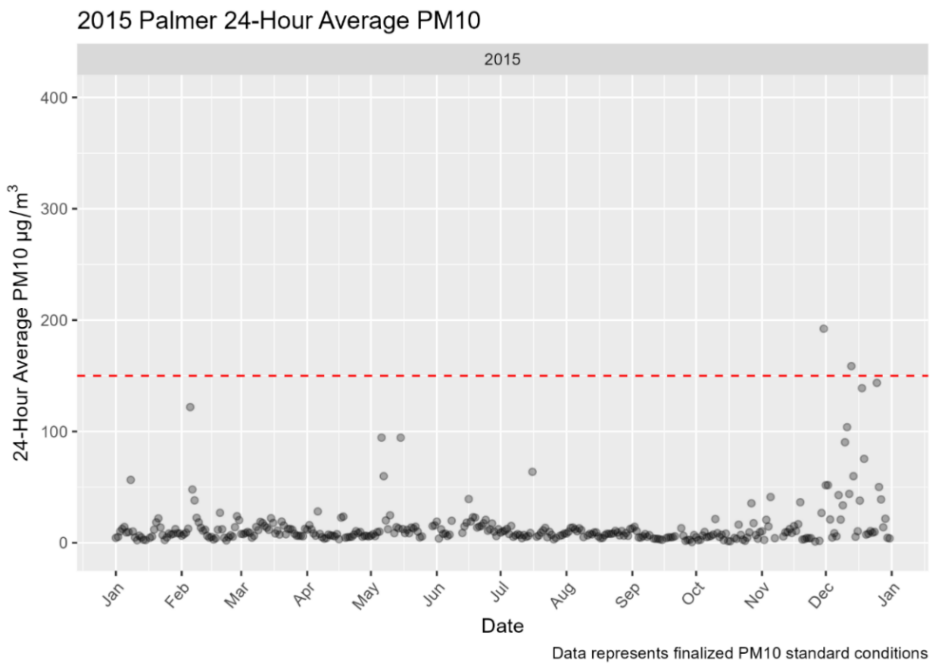

Figure 15. *24-hour average of PM_{10} in 2015, Palmer. Maximum value: 192 µg/m^3. The red line is the NAAQS of 150 µg/m^3. The two exceedances, above the NAAQS line, have been flagged as exceptional events due to high winds and most likely will not be used to calculate NAAQS compliance.*

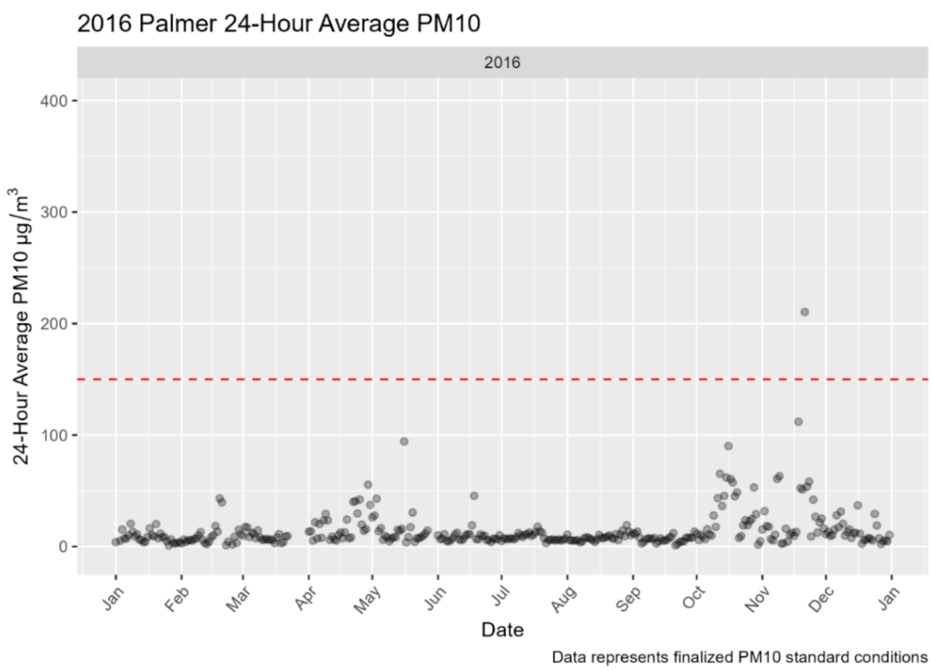

Figure 16. *24-hour average of PM10 in 2016, Palmer. Maximum value: 210 µg/m^3. The exceedance, above the NAAQS line, has been flagged as an exceptional event due to high winds and most likely will not be used to calculate NAAQS compliance. The red line is the NAAQS of 150 µg/m^3.*

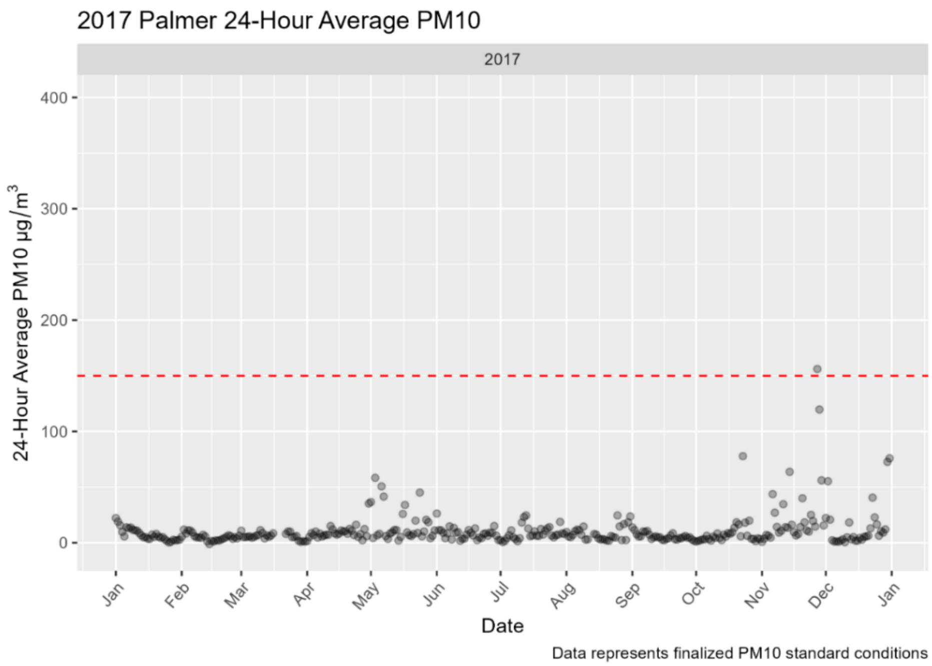

Figure 17. *24-hour average of PM10 in 2017, Palmer. Maximum value: 156 µg/m³. The exceedance, above the NAAQS line, has been flagged as an exceptional event due to high winds and most likely will not be used to calculate NAAQS compliance. The red line is the NAAQS of 150 µg/m³.*

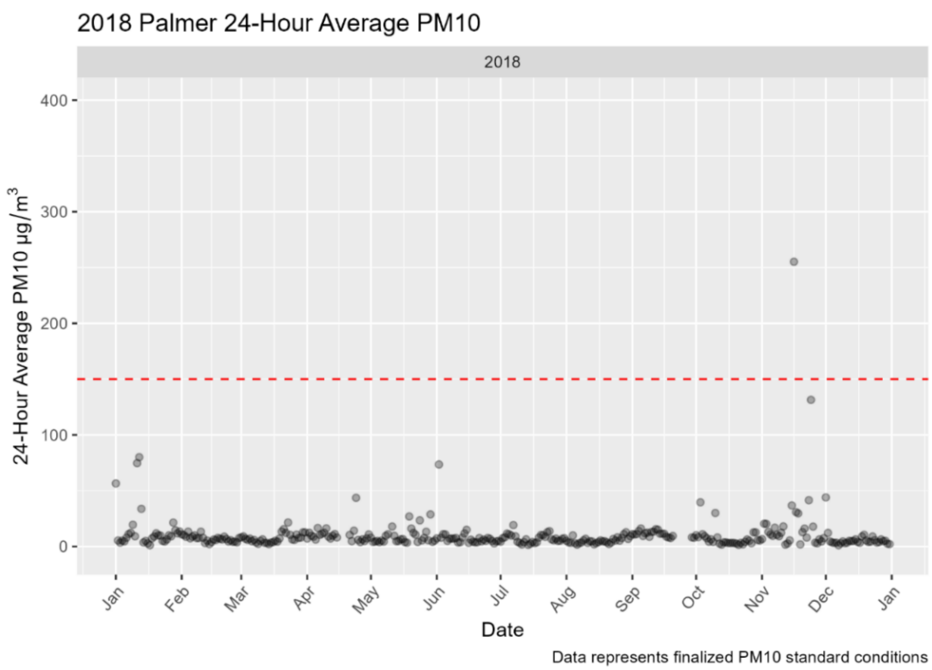

Figure 18*. 24-hour average of PM10 in 2018, Palmer. Maximum value: 255 µg/m³. The exceedances, above the NAAQS line, has been flagged as exceptional events due to windblown dust and will not be used to calculate NAAQS compliance. The red line is the NAAQS of 150 µg/m³.*

APPENDIX B: Wasilla PM_{10} ANNUAL 24-HOUR AVERAGES

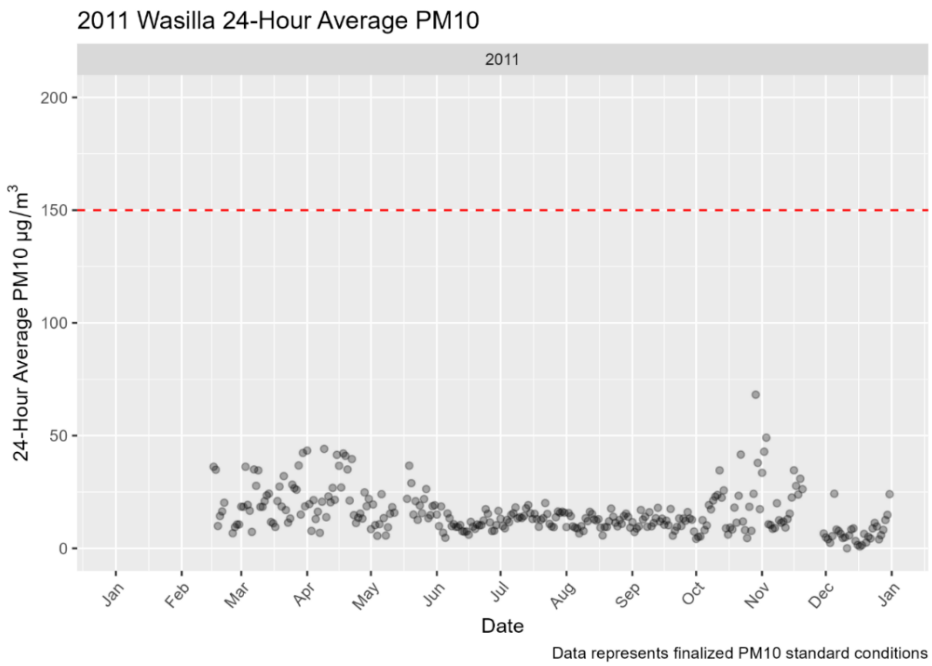

***Figure 19**. 24-hour average of PM_{10} in 2011, Wasilla. Maximum value: 68 µg/m^3. The red line is the NAAQS of 150 µg/m^3.*

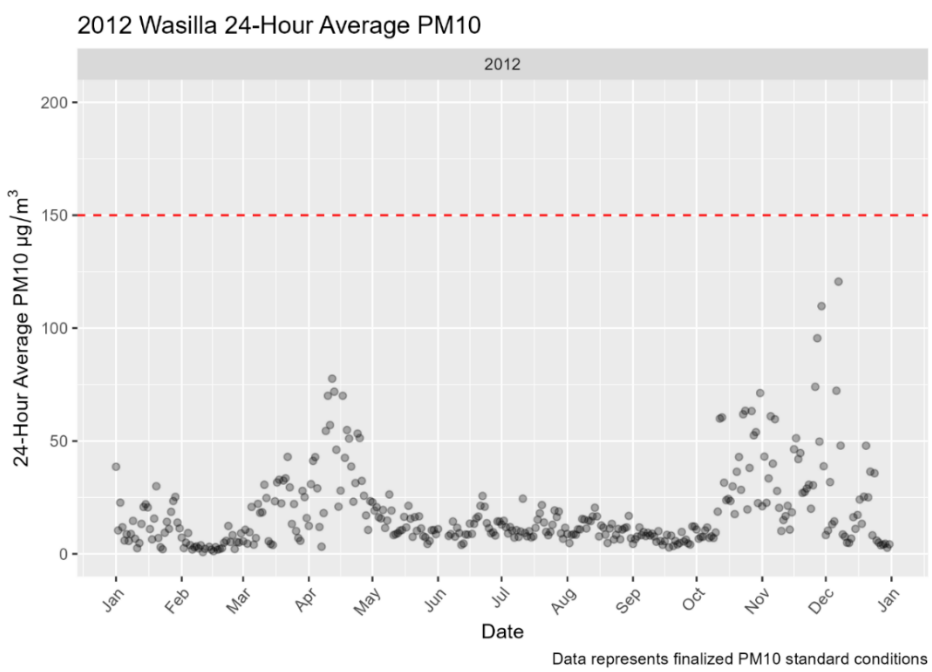

***Figure 20**. 24-hour average of PM_{10} in 2012, Wasilla. Maximum value: 121 µg/m^3. The red line is the NAAQS of 150 µg/m^3.*

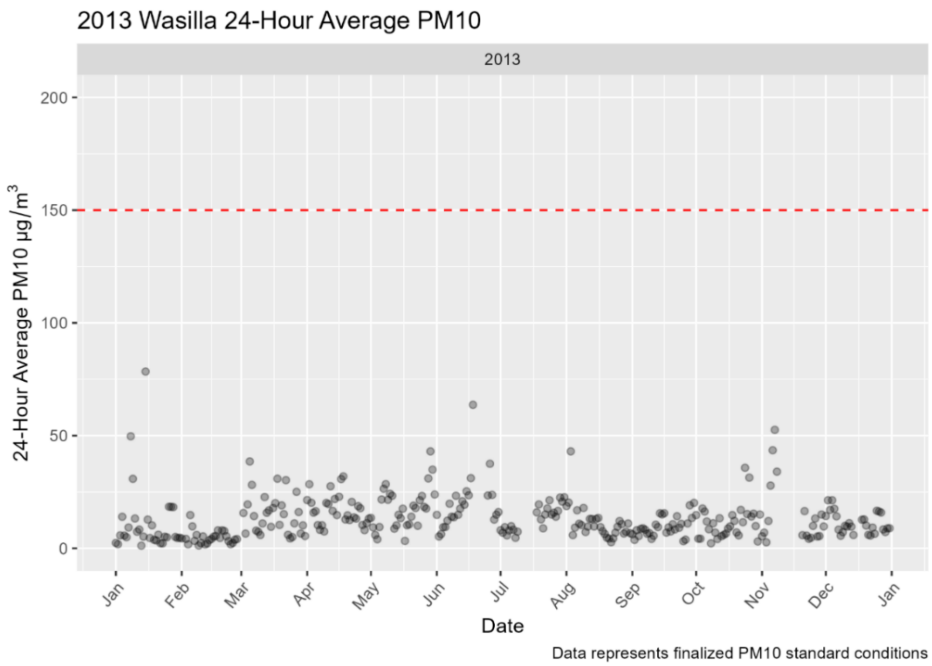

Figure 21. *24-hour average of PM_{10} in 2013, Wasilla. Maximum value: 78 µg/m^3. The red line is the NAAQS of 150 µg/m^3.*

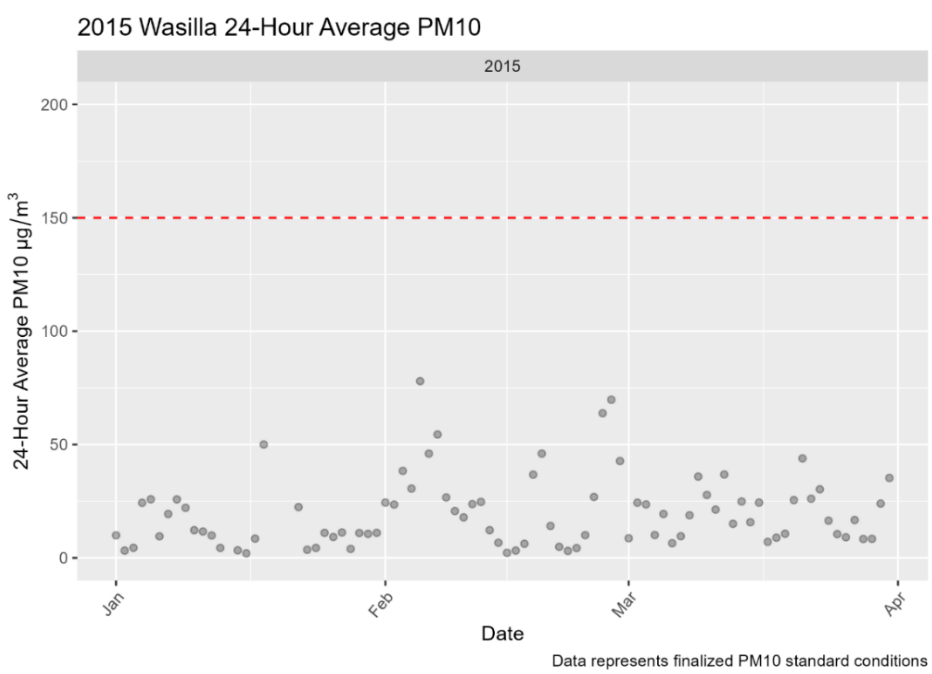

Figure 22. *24-hour average of PM_{10} in 2015, Wasilla. Maximum value: 78 µg/m^3. The red line is the NAAQS of 150 µg/m^3. Data were only collected for the first quarter of 2015. The site was decommissioned on March 31.*

APPENDIX C: Palmer $PM_{2.5}$ ANNUAL 24-HOUR AVERAGES

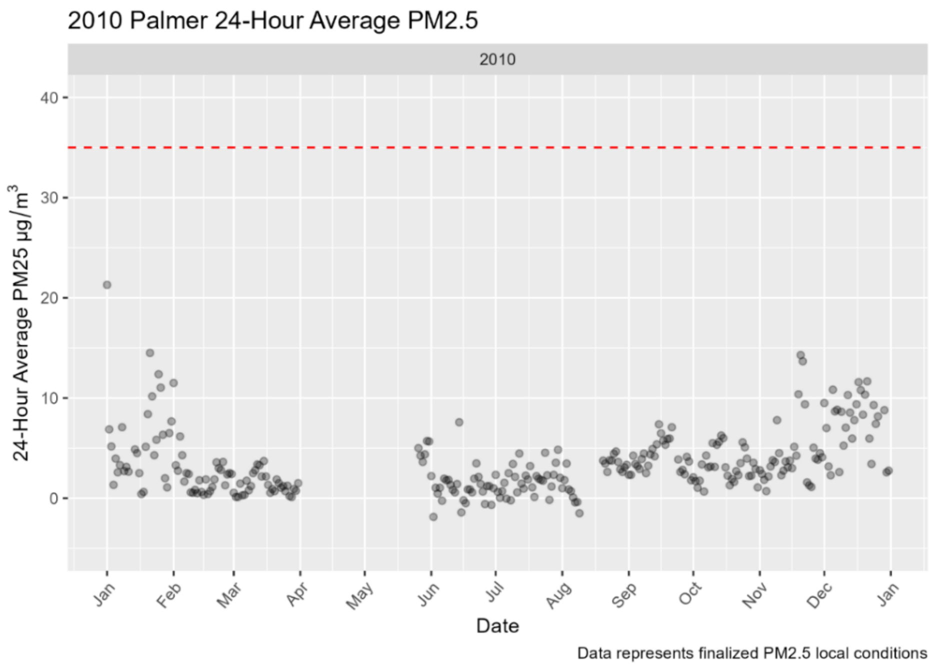

Figure 23. *24-hour average of $PM_{2.5}$ in 2010, Palmer. Maximum value: 21.3 µg/m^3. The red line is the NAAQS of 35 µg/m^3.*

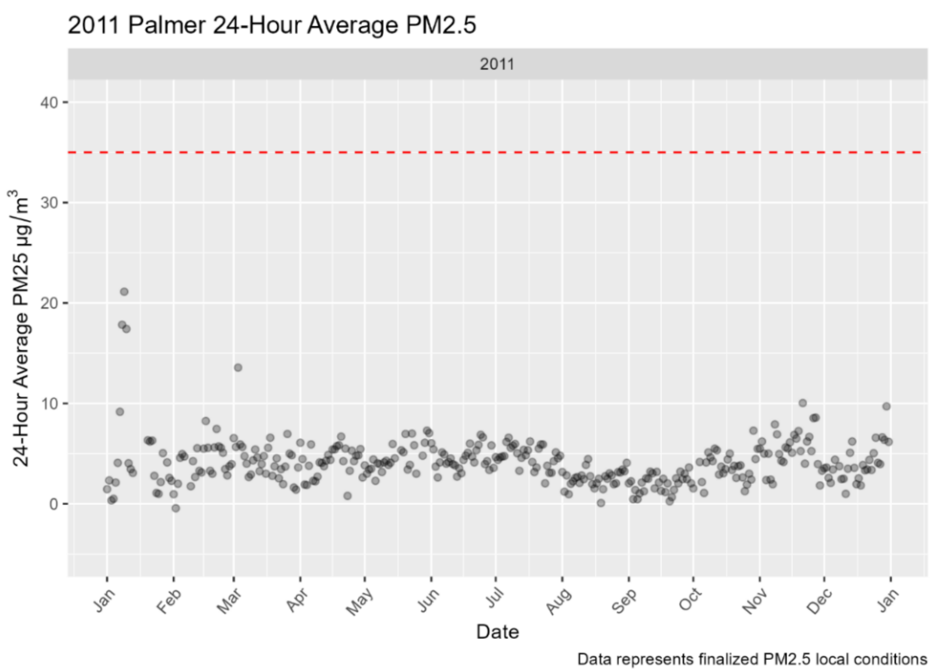

Figure 24. *24-hour average of $PM_{2.5}$ in 2011, Palmer. Maximum value: 21.1 µg/m^3. The red line is the NAAQS of 35 µg/m^3.*

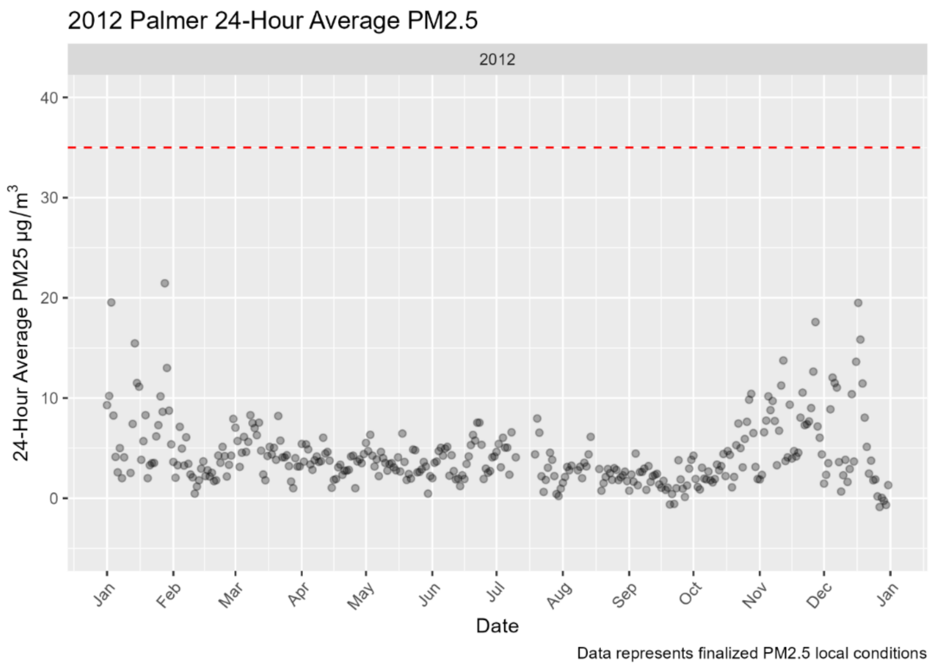

Figure 25*. 24-hour average of $PM_{2.5}$ in 2012, Palmer. Maximum value: 21.5 µg/m^3. The red line is the NAAQS of 35 µg/m^3.*

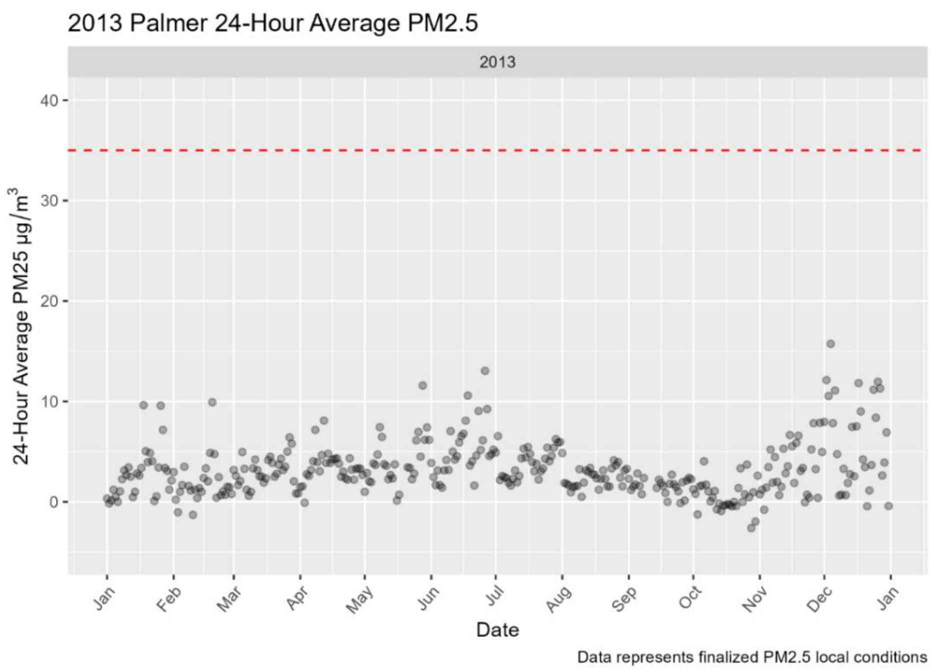

Figure 26*. 24-hour average of $PM_{2.5}$ in 2013, Palmer. Maximum value: 15.7 µg/m^3. The red line is the NAAQS of 35 µg/m^3.*

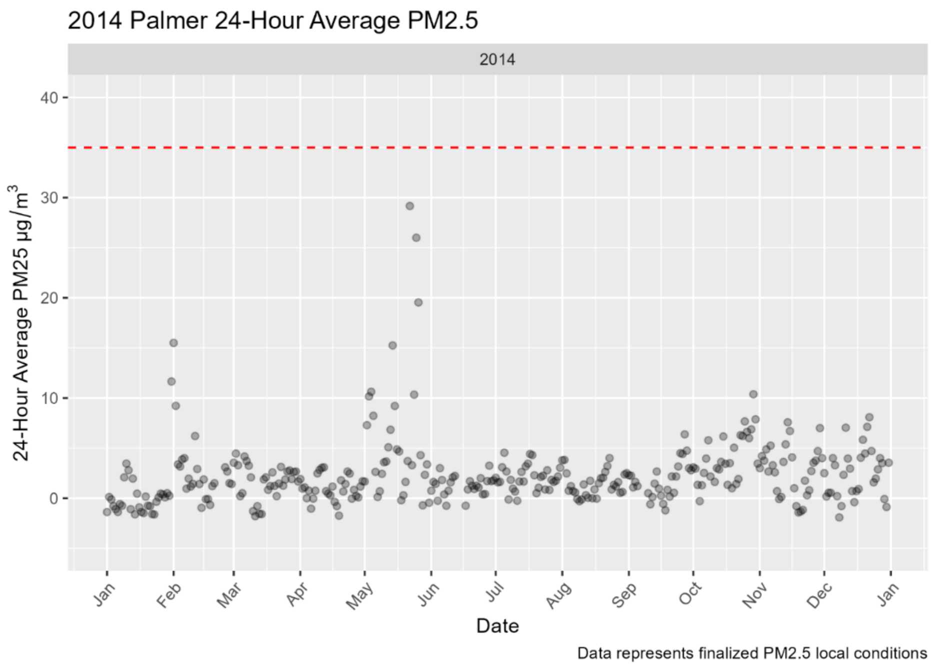

Figure 27. *24-hour average of $PM_{2.5}$ in 2014, Palmer. Maximum value: 29.2 µg/m^3. The red line is the NAAQS of 35 µg/m^3. Three days have been flagged as exceptional events due to smoke from the Funny River and Tyonek Fires.*

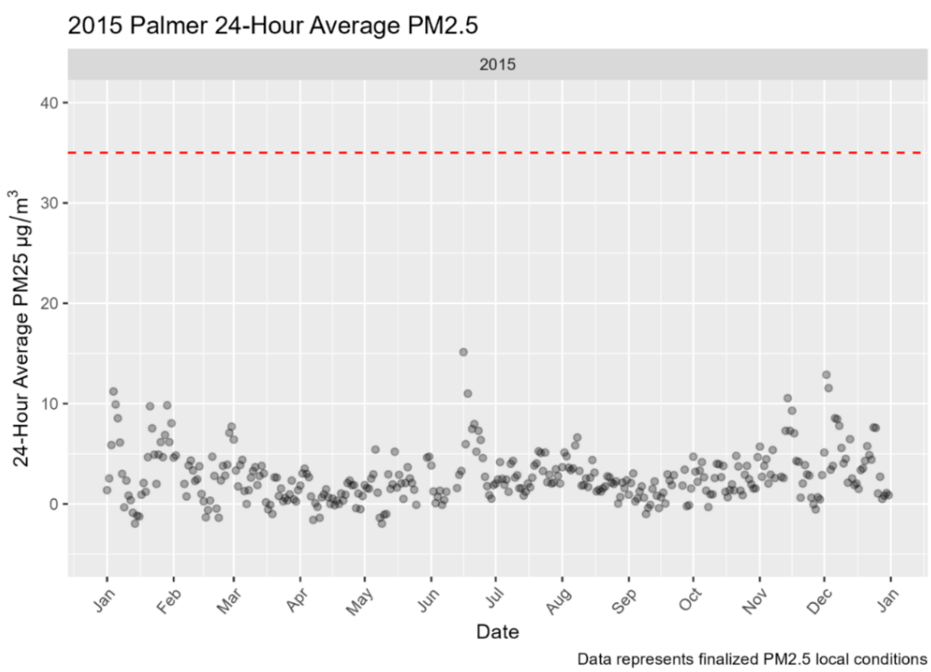

Figure 28. *24-hour average of $PM_{2.5}$ in 2015, Palmer. Maximum value: 15.1 µg/m^3. The red line is the NAAQS of 35 µg/m^3.*

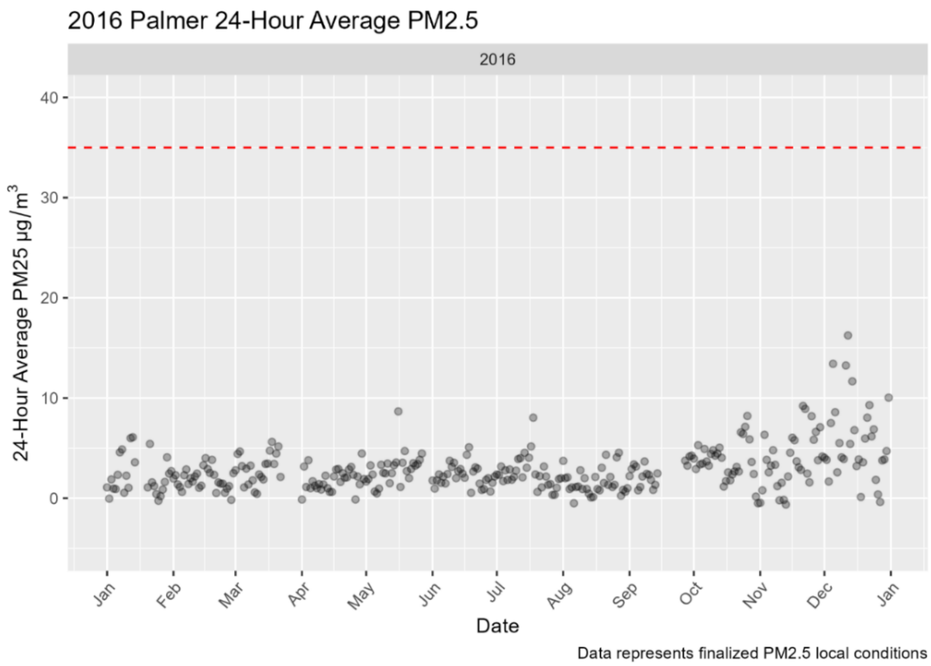

Figure 29. *24-hour average of PM2.5 in 2016, Palmer. Maximum value: 16.3 µg/m³. The red line is the NAAQS of 35 µg/m³.*

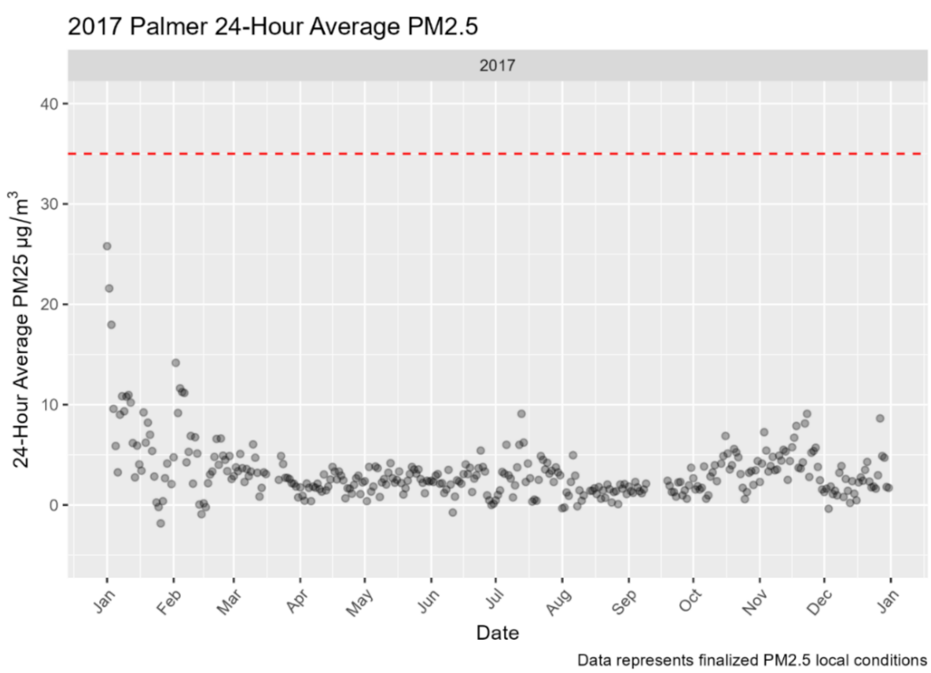

Figure 30. *24-hour average of PM2.5 in 2017, Palmer. Maximum value: 25.8 µg/m³. The red line is the NAAQS of 35 µg/m³.*

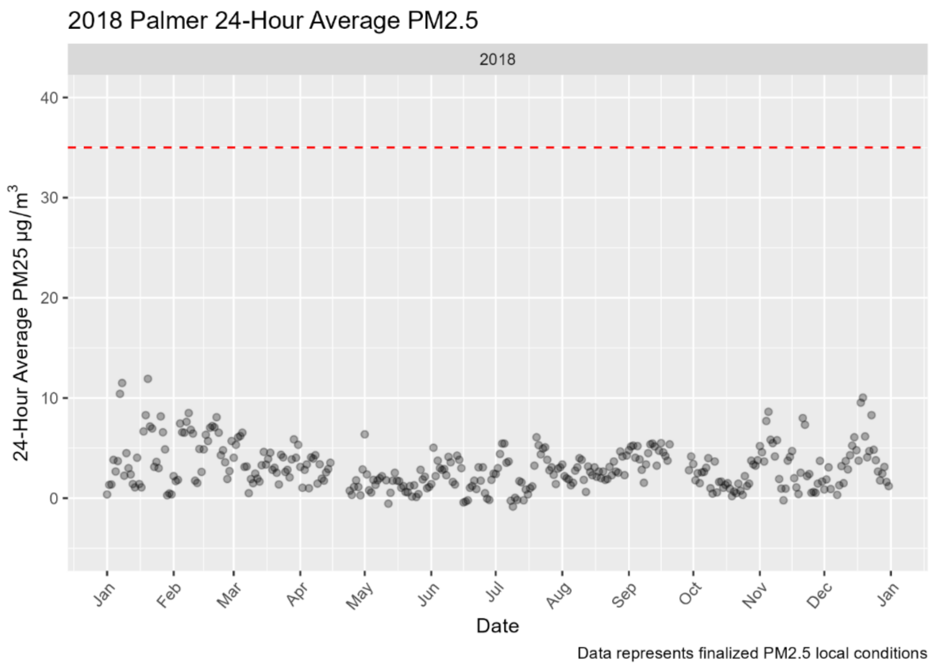

Figure 31*. 24-hour average of $PM_{2.5}$ in 2018, Palmer. Maximum value: 11.9 µg/m³. The red line is the NAAQS of 35 µg/m³.*

APPENDIX D: Wasilla $PM_{2.5}$ ANNUAL 24-HOUR AVERAGES

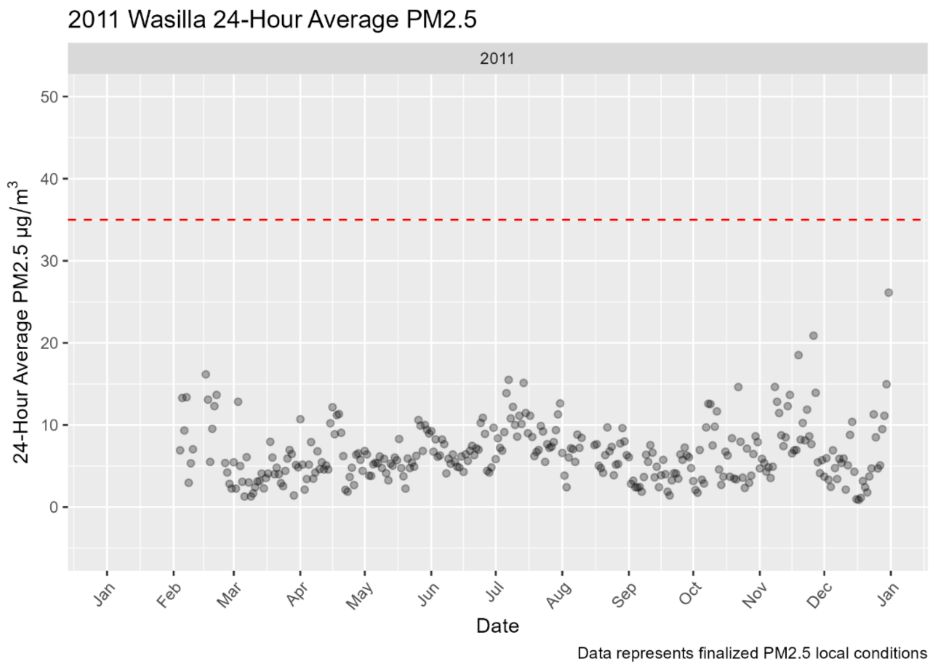

Figure 32. *24-hour average of $PM_{2.5}$ in 2011, Wasilla. Maximum value: 26.1 µg/m^3. The red line is the NAAQS of 35 µg/m^3.*

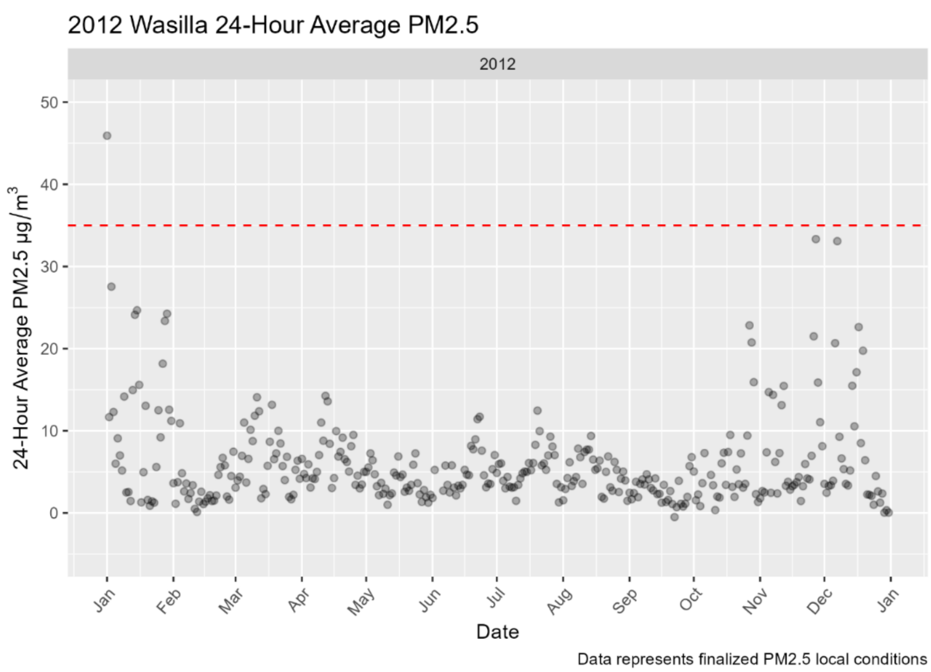

Figure 33. *24-hour average of $PM_{2.5}$ in 2012, Wasilla. Maximum value: 45.9 µg/m^3. The red line is the NAAQS of 35 µg/m^3.*

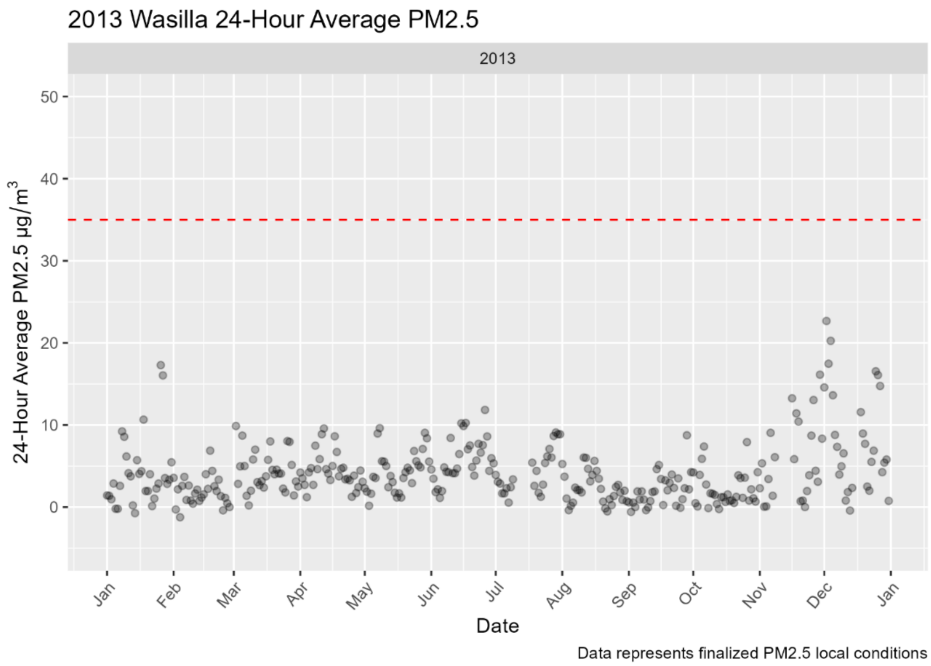

Figure 34. *24-hour average of $PM_{2.5}$ in 2013, Wasilla. Maximum value: 26.1 µg/m^3. The red line is the NAAQS of 35 µg/m^3.*

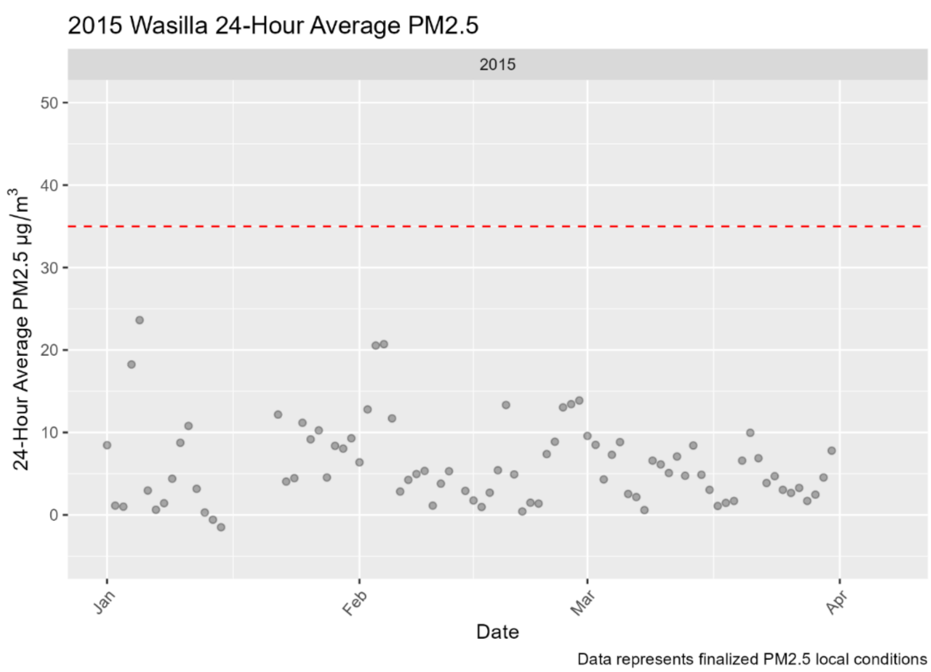

Figure 35. *24-hour average of $PM_{2.5}$ in 2015, Wasilla. Maximum value: 24.3 µg/m^3. The red line is the NAAQS of 35 µg/m^3. Data were only collected for the first quarter of 2015. The site was decommissioned on March 31.*