

LAFARGE CANADA INC.

AMBIENT AIR QUALITY MONTHLY REPORT

NOVEMBER 2019

DECEMBER 18, 2019



WSP



**AMBIENT AIR
QUALITY MONTHLY
REPORT
NOVEMBER 2019
LAFARGE CANADA INC.**

PROJECT NO.: 171-00556-00
DATE: DECEMBER 18, 2019

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December 18, 2019

LAFARGE CANADA INC.
Highway 1A
Exshaw, AB T0L 2C0

Attention: Janet Brygger

Dear Ms. Brygger

Subject: Ambient Air Quality Monthly Report – November 2019

The operational uptime for all analyzers and meteorological sensors was 100% at the Lagoon station in November excluding TSP. The TSP analyzer had 99.9% uptime for November due to one hour of equipment malfunction on November 13th at 14:00. There were no exceedances of the 24-hour TSP Alberta Ambient Air Quality Objectives (AAAQOs), the 24-hour PM_{2.5} AAAQOs, nor the 1-hour PM_{2.5} AAAQG in November at the Lagoon monitoring location.

The Windridge station was taken out of operation beginning April 8th as a result of construction work for flood mitigation along Exshaw Creek. The monitor at this station is expected to be re-installed sometime in 2020, after the completion of the construction work.

FireSmart began work in the Exshaw/Bow Valley area in late November. The work is planned to continue well into the spring of 2020.

Data collected at all of the GRIMM monitors are considered Industrial Ambient Monitors and are meant for assessing the performance of Lafarge Exshaw's Fugitive Dust Control Best Management Practices – Program; the GRIMM monitors are not Air Monitoring Directive (AMD) compliant. The operational uptime at all 3 monitors was as follows: 93.3% at the West GRIMM due to 48-hours of dryer pump failure, 100% at the Berm GRIMM, and 80.8% at the Entrance GRIMM due to vacuum pump failure and equipment malfunction. The West GRIMM monitor recorded zero exceedances of the 24-hour TSP AAAQG and the 24-hour PM_{2.5} AAAQG. The Berm GRIMM had 12 exceedances of the TSP guideline and one exceedance of the 1-hour PM_{2.5} guideline. The Entrance GRIMM monitor recorded 13 and zero exceedances for the 24-hour TSP AAAQG and 24-hour PM_{2.5} AAAQG, respectively. High particulate levels and exceedances at the Berm and Entrance monitors are likely influenced by flood mitigation work along Exshaw creek which is producing fugitive dust near the monitors. CP rail work at the 1A highway, Lafarge spur, was conducted over the month of November; this work also created fugitive dust which could impact the entrance monitor.

I certify that I have reviewed and verified this report and that the information is complete, accurate and representative of the monitoring results, reporting timeframe and the specified analysis, summarization and reporting requirements.

Sincerely,

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December 18, 2019

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APPROVED¹ BY (*must be reviewed for technical accuracy prior to approval*)



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Date

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A DATA & CALIBRATION REPORTS

1 INTRODUCTION

This report summarizes the ambient air quality and meteorological data collected at the Lagoon, Windridge, and GRIMM monitors in Exshaw, AB. The station is operated by WSP on behalf of Lafarge Canada Inc. (Lafarge) and is a requirement of Lafarge's Approval 1702-02-04. This report contains data collected between November 1, 2019 and November 30, 2019.

This monthly report was prepared by Dylan Weyell, Junior Air Quality Specialist with WSP, on behalf of Lafarge and was reviewed by Tyler Abel, Team Leader of Environmental Management in the Vancouver Region at WSP.

1.1 EXSHAW CREEK FLOOD MITIGATION

Due to flood mitigation construction at Exshaw creek (Figure 1-1), the Windridge monitor was taken out of operation and removed from the site on April 8, 2019. The monitoring station will be re-installed after the completion of construction in 2020.

Dust created from the flood mitigation work has the potential to impact particulate matter concentrations at the remaining stations.



Figure 1-1 Photo of Flood Mitigation Construction at Exshaw Creek

2 NOVEMBER 2019 REPORT SUMMARY

This summary section provides the pertinent details on data collected and maintenance/calibration activities at each of the monitoring locations. The monitoring results for the stations are described in further detail in their corresponding sections. Maximum hourly concentrations are shown for all particulate matter size fractions, but there are no Alberta Ambient Air Quality Objectives (AAAQO) for 1-hour PM concentrations. The exceedances reported for 1-hour PM_{2.5} are those above the 1-hour PM_{2.5} Alberta Ambient Air Quality Guidelines (AAAQG).

2.1 LAGOON STATION

Table 2-1 Lagoon station data summary

Parameter	Data Completeness (%)	1-Hour Average		24-hour Average	
		Maximum Concentration	Exceedances of AAAQO or AAAQG	Maximum Concentration	Exceedances of AAAQO
NO ₂ (ppb)	100.0	29.0	0	16.3	-
SO ₂ (ppb)	100.0	14.5	0	6.1	0
PM _{2.5} (µg/m ³)	100.0	20.9	0 ¹	8.4	0
PM ₁₀ (µg/m ³)	100.0	206.6	-	38.8	-
TSP (µg/m ³)	99.9	282.2	-	73.0	0
Temperature (°C)	100.0	11.2	-	8.7	-
Wind Speed (km/hr) /Direction (Degrees)	100.0	56.2/W	-	40.9/WSW	-
Precipitation (mm)	100.0	1 ²	-	11.25 ³	-

¹Any exceedances reported for 1-hour PM_{2.5} are over the guideline level (AAAQG) of 80 µg/m³.

²Maximum Daily Total Accumulation of Precipitation (mm)

³Monthly Total Accumulation of Precipitation (mm)

Data Quality Notes:

- There were no exceedances of the 24-hour PM_{2.5} AAAQO.
- There were no exceedances of the 1-hour PM_{2.5} AAAQG.
- There were no exceedances of the 24-hour TSP AAAQO.

Calibration/Maintenance Notes:

- The all analyzers and meteorological sensors excluding TSP had 100% of uptime for the month of November
 - The TSP analyser had 99.9% uptime for the month of November due to one hour of equipment malfunction on November 13th at 14:00
-

2.2 WEST GRIMM

The GRIMM monitors are Industrial Ambient Monitors meant to aid Lafarge in assessing the performance of their Fugitive Dust Control Best Management Practices – Program (FDCCBMP-P). The AAAQO are used as Guidelines to evaluate the performance of the FDCCBMP-P; however, these Industrial monitors are not Alberta Air Monitoring Directive (AMD) compliant and not required to show compliance with the AAAQO.

Table 2-2 West station data summary

Parameter	Data Completeness (%)	1-Hour Average		24-hour Average	
		Maximum Concentration	Exceedances of Guidelines	Maximum Concentration	Exceedances of Guidelines
PM _{2.5} ($\mu\text{g}/\text{m}^3$)	93.3	16.6	0*	10.6	0
PM ₁₀ ($\mu\text{g}/\text{m}^3$)	93.3	31.4	-	12.9	-
TSP ($\mu\text{g}/\text{m}^3$)	93.3	737.9	-	51.5	0

* Any exceedances reported for 1-hour PM_{2.5} are over the guideline level (AAAQG) of 80 $\mu\text{g}/\text{m}^3$.

Data Quality Notes:

- There were no exceedances of the 24-hour PM_{2.5} AAAQG.
- There were no exceedances of the 1-hour PM_{2.5} AAAQG.
- There were no exceedances of the 24-hour TSP AAAQG.

Calibration/Maintenance Notes:

- The analyzer had 93.3% uptime for the month of November due to dryer pump failure from November 18th at 16:00 to November 20th at 15:00.
-

2.3 BERM GRIMM

The GRIMM monitors are Industrial Ambient Monitors meant to aid Lafarge in assessing the performance of their FDCCBMP-P. The AAAQO are used as Guidelines to evaluate the performance of the FDCCBMP-P; however, these Industrial monitors are not Alberta Air Monitoring Directive (AMD) compliant and not required to show compliance with the AAAQO.

Table 2-3 Berm station data summary

Parameter	Data Completeness (%)	1-Hour Average		24-hour Average	
		Maximum Concentration	Exceedances of Guidelines	Maximum Concentration	Exceedances of Guidelines
PM _{2.5} ($\mu\text{g}/\text{m}^3$)	100.0	113.5	1*	19.2	0
PM ₁₀ ($\mu\text{g}/\text{m}^3$)	100.0	1025.0	-	168.5	-
TSP ($\mu\text{g}/\text{m}^3$)	100.0	3698.8	-	644.5	12

* Any exceedances reported for 1-hour PM_{2.5} are over the guideline level (AAAQG) of 80 $\mu\text{g}/\text{m}^3$.

Data Quality Notes:

- There were no exceedances of the 24-hour PM_{2.5} AAAQG.
- There was one hour exceeding the 1-hour PM_{2.5} AAAQG.
- There were 12 days exceeding the 24-hour TSP AAAQG.

Calibration/Maintenance Notes:

- The analyzer had 100% uptime for the month of November.

2.4 ENTRANCE GRIMM

The GRIMM monitors are Industrial Ambient Monitors meant to aid Lafarge in assessing the performance of their FDCBMP-P. The AAAQO are used as Guidelines to evaluate the performance of the FDCBMP-P; however, these Industrial monitors are not Alberta Air Monitoring Directive (AMD) compliant and not required to show compliance with the AAAQO.

Table 2-4 Entrance station data summary

Parameter	Data Completeness (%)	1-Hour Average		24-hour Average	
		Maximum Concentration	Exceedances of Guidelines	Maximum Concentration	Exceedances of Guidelines
PM _{2.5} ($\mu\text{g}/\text{m}^3$)	80.8	42.3	0*	17.9	0
PM ₁₀ ($\mu\text{g}/\text{m}^3$)	80.8	517.3	-	111.2	-
TSP ($\mu\text{g}/\text{m}^3$)	80.8	3503.3	-	597.7	13

* Any exceedances reported for 1-hour PM_{2.5} are over the guideline level (AAAQG) of 80 $\mu\text{g}/\text{m}^3$.

Data Quality Notes:

- There were no exceedances of the 24-hour PM_{2.5} AAAQG.
- There were no exceedances of the 1-hour PM_{2.5} AAAQG.
- There were 13 days exceeding the 24-hour TSP AAAQG.

Calibration/Maintenance Notes:

- The analyzer had 80.8% uptime for the month of November due to vacuum pump failure occurring from November 1st at 1:00 to November 5th at 14:00. Further, the Entrance GRIMM experienced unexpected malfunctions scattered throughout the month of November which contributed to the 80.8% uptime.

3 LAGOON STATION

The Lagoon trailer contains NO_x, SO₂, TSP, PM₁₀, and PM_{2.5} analyzers as well as meteorological sensors, and is shown in Figure 3-1. An ambient air quality station has been at this location since 2002, providing a long-term data record for air quality in the Exshaw area.

This section provides a summary of the monitoring activities for the Lagoon ambient air quality station, including: a table of instrumentation (Table 3-1), a data summary table (Table 3-2), site visit notes, a wind rose (Figure 3-2) and tables and graphs illustrating the monitoring results for November 2019.

All of the monitors comply with Alberta Environment and Parks Air Monitoring Directive (2016).

3.1 OPERATIONAL SUMMARY

A summary of the station operation for the month is provided in Table 3-1.

Table 3-1 Instrumentation List at the Lagoon Station

Parameter Measured	Equipment Description	Notes
PM_{2.5} Concentrations	MetOne BAM-1020 FRM Continuous Particulate Monitor	The PM _{2.5} monitor was calibrated on November 14 th . The monitor had 100% uptime in November.
PM₁₀ Concentrations	MetOne BAM-1020 Continuous Particulate Monitor	The PM ₁₀ monitor was calibrated on November 14 th . The monitor had 100% uptime in November.
TSP Concentrations	MetOne BAM-1020 Continuous Particulate Monitor	The TSP monitor was calibrated on November 14 th . The monitor had 99.9% uptime in November due to one hour of equipment malfunction on November 13 th at 14:00.
Oxides of Nitrogen	TEI 42C	The monitor was calibrated on November 18 th . The monitors had 100% uptime in November.
Sulphur Dioxide	Teledyne API 102A	The monitor was calibrated on November 18 th . The monitor had 100% uptime in November.
Precipitation	MetOne 130 Rain/Snow Gauge	The monitor had 100% uptime in November.
Wind Speed	MetOne Wind Sensor	The monitors had 100% uptime in November.
Wind Direction		

Ambient Temperature	MetOne Ambient Temperature Sensor	The monitor had 100% uptime in November.
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Figure 3-1 Inlets on the top of WSP's Lagoon monitor

3.2 MONITORING RESULTS AND TRENDS

The following wind rose (Figure 3-2) illustrates the frequency of wind speed by wind direction for the month of November 2019. The wind rose indicates that the winds predominantly came from the west and west-northwest directions, with lighter winds that came from the east.

Table 3-2 summarizes the hourly, daily, and monthly concentrations recorded in November 2019.

Figure 3-3 graphically illustrates the time series for hourly concentrations as well as wind speed and direction, while Figure 3-9 shows daily average concentrations recorded during November 2019 for the pollutants listed in Table 3-2. Additionally, Figure 3-4 to Figure 3-8 show the histograms of the hourly concentrations of NO₂, SO₂, PM_{2.5}, PM₁₀, and TSP measured at the Lagoon station.

Dust created from the flood mitigation work (section 1.1) has the potential to impact the monitored particulate matter concentrations in the airshed, including at the Lagoon station. However, there were no exceedances of the 24-hour TSP (100 µg/m³) AAAQO, the 24-hour PM_{2.5} (29 µg/m³) AAAQO, nor the 1-hour PM_{2.5} AAAQG.

Historically in November, the average number of 24-hour TSP AAAQO exceedances and 24-hour PM_{2.5} AAAQO exceedances are both zero. The maximum number of 24-hour AAAQO exceedances was 2 days in 2010 for TSP, and 0 days from 2010-2018 for PM_{2.5}.

Table 3-2 Summary of November 2019 data at Lagoon

Parameter	Guideline / Objectives		Station	Exceedances		Monthly		1-hour				24-hour		Operational Time (Percent)	
	1-hr	24-hr		1-hr	24-hr	Minimum	Average	Maximum Concentration/Meteorological Variable	Day	Hour	Wind Speed (km/hr)	Wind Direction (degrees)	Maximum Concentration/Meteorological Variable	Day	
NO ₂ (ppb)	159	-	Lagoon	0	-	0.4	7.9	29.0	29	19	6.7	252.2	16.3	29	100.0
SO ₂ (ppb)	172	48	Lagoon	0	0	0.0	1.8	14.5	15	9	37.3	302.9	6.1	12	100.0
PM _{2.5} (µg/m ³)	80	29	Lagoon	0	0	0.0	4.5	20.9	25	10	12.5	304.4	8.4	5	100.0
PM ₁₀ (µg/m ³)	-	-	Lagoon	-	-	0.0	16.9	206.6	16	23	39.0	268.4	38.8	11	100.0
TSP (µg/m ³)	-	100	Lagoon	-	0	0.0	24.8	282.2	16	23	39.0	268.4	73.0	11	99.9
Temperature (°C)	-	-	Lagoon	-	-	-19.2	-2.2	11.2	8	14	28.0	272.3	8.7	17	100.0
Wind Speed (km/hr)/Direction (degrees)	-	-	Lagoon	-	-	1.6	21.0	56.2/W	17	1	56.2	261.2	40.9/WSW	23	100.0
Precipitation (mm)	-	-	Lagoon	-	-	0.0	0.0	1.0	26	9	5.3	268.7	11.3		100.0

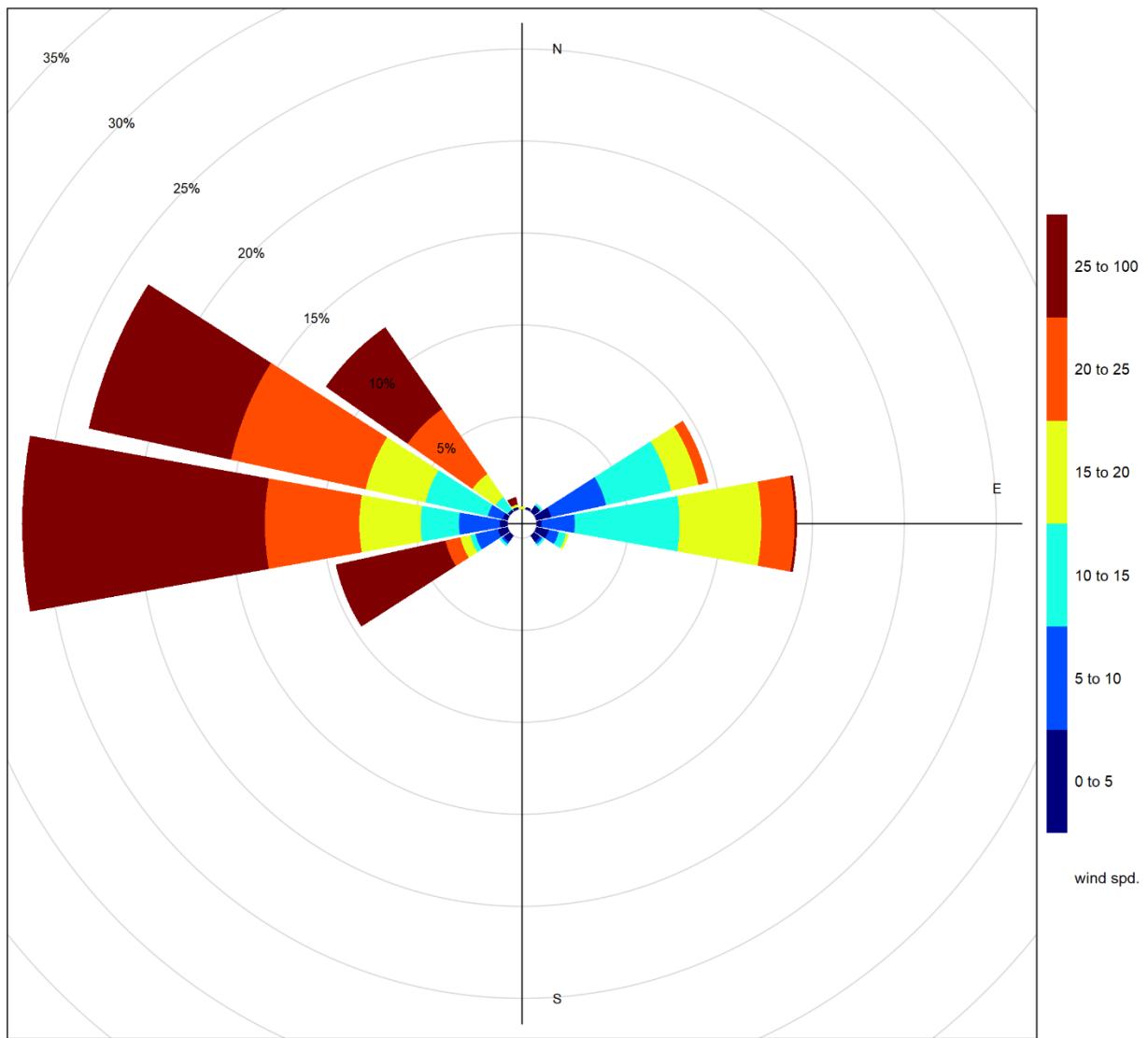


Figure 3-2 November 2019 wind rose from the Lagoon Station

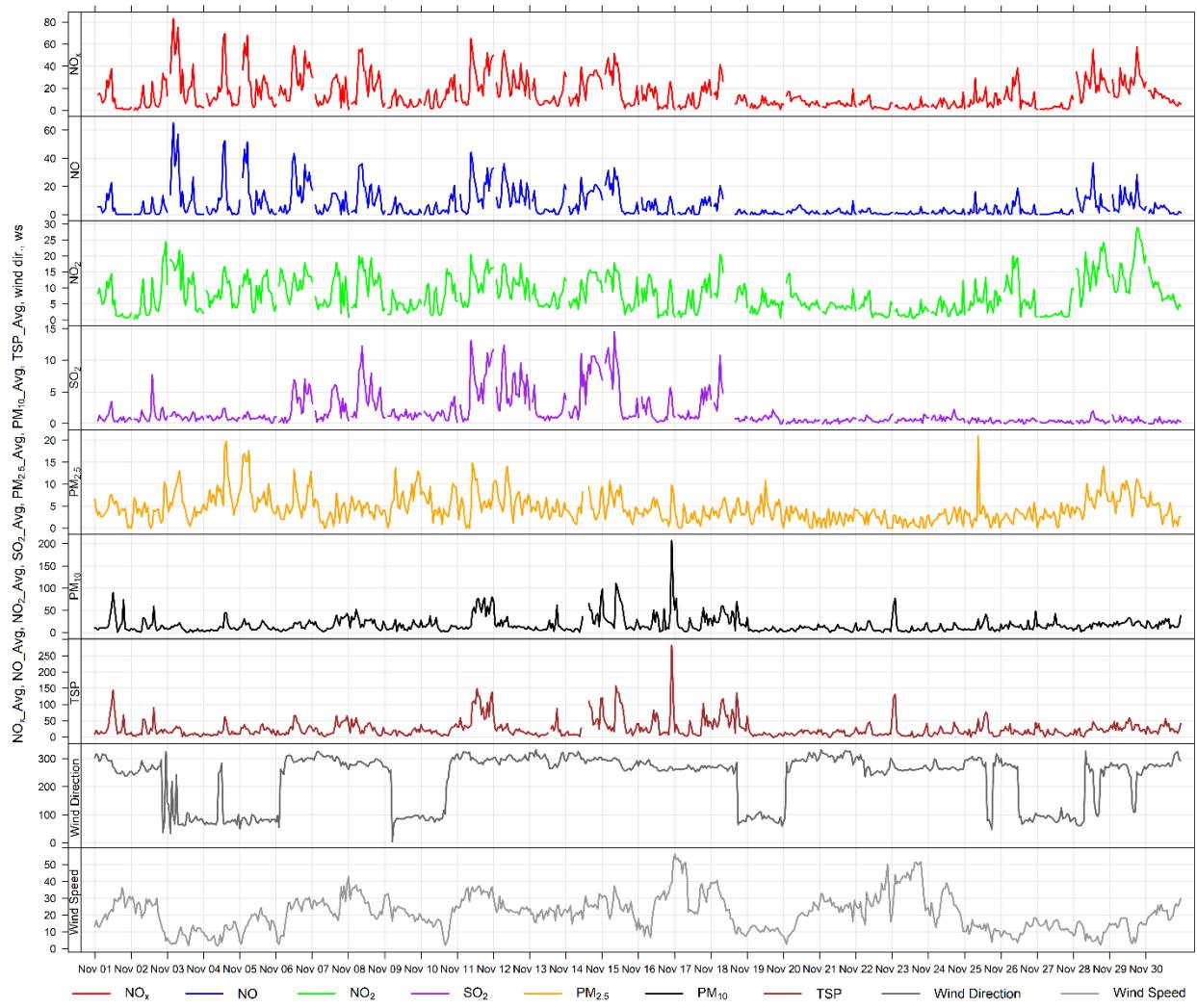


Figure 3-3 1-hour concentrations of NO_x, SO₂, particulate matter, wind direction and wind speed at the Lagoon station

Histogram of Hourly NO₂ Readings

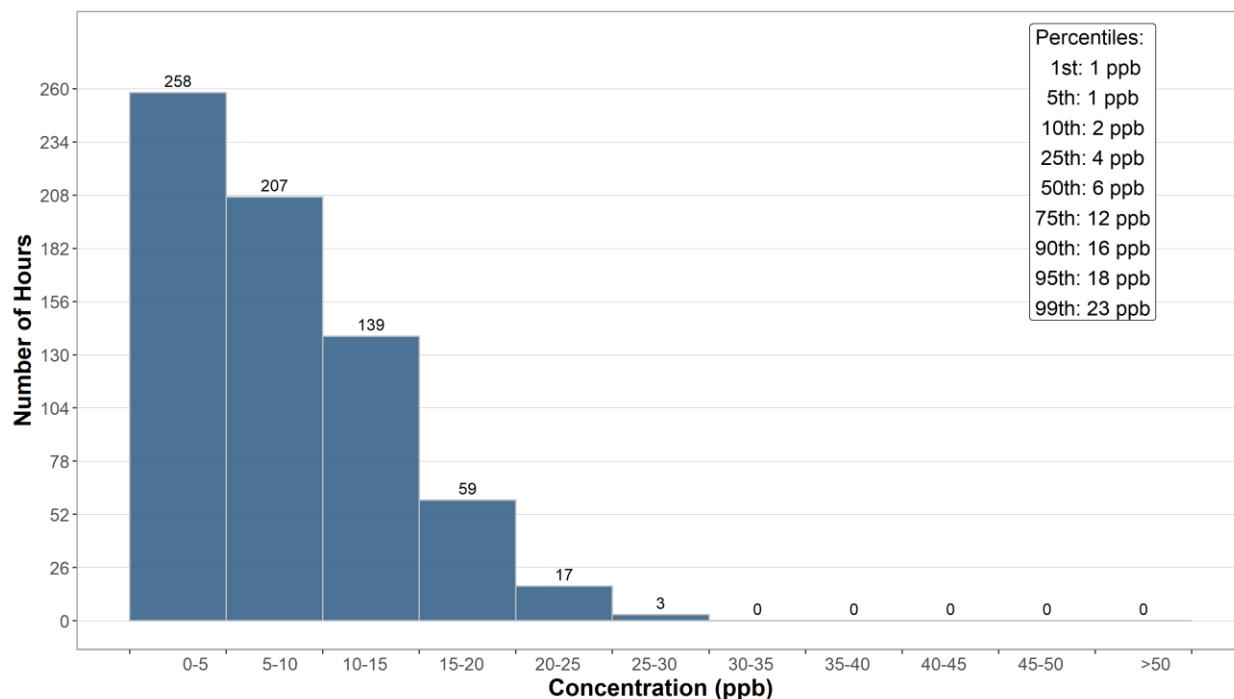


Figure 3-4 Histogram of hourly NO₂ concentrations at the Lagoon station

Histogram of Hourly SO₂ Readings

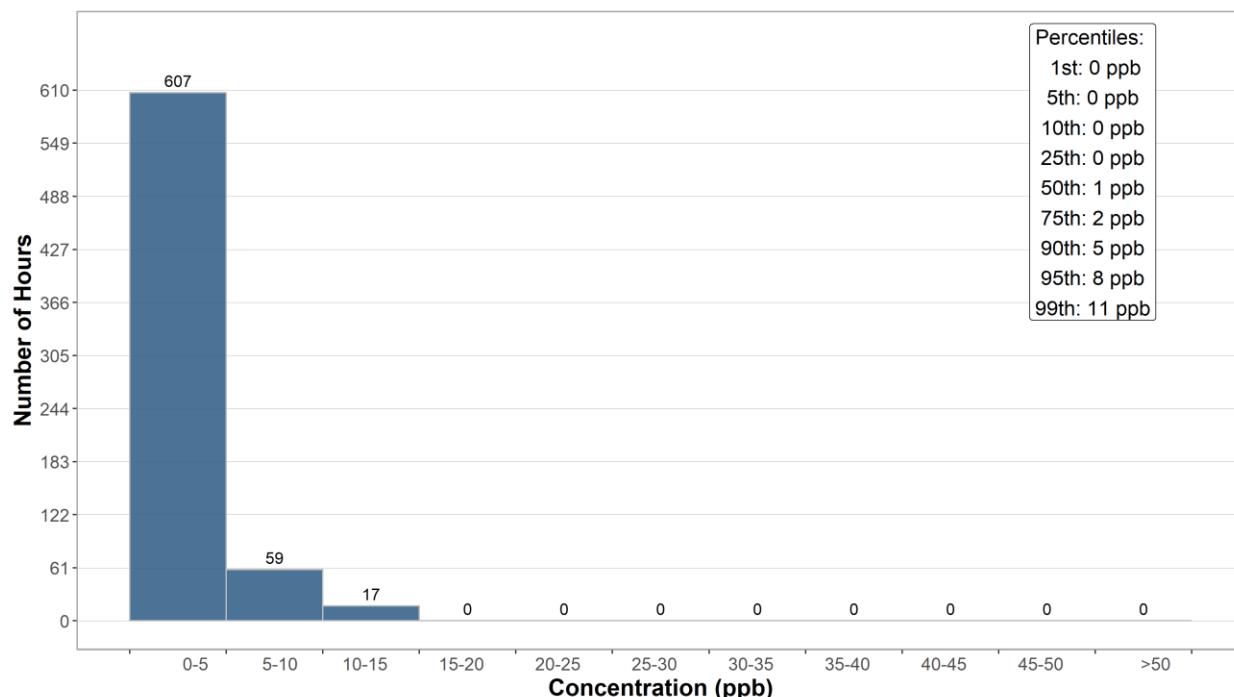


Figure 3-5 Histogram of hourly SO₂ concentrations at the Lagoon station

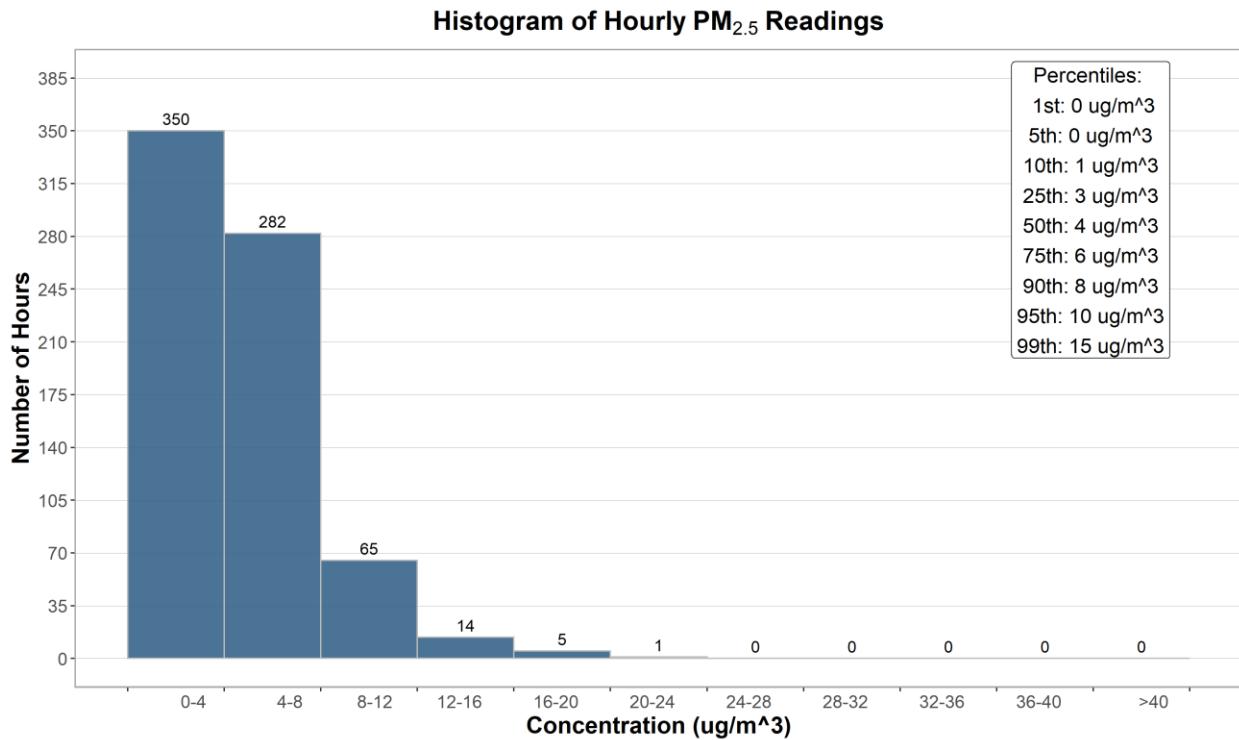


Figure 3-6 Histogram of hourly PM_{2.5} concentrations at the Lagoon station

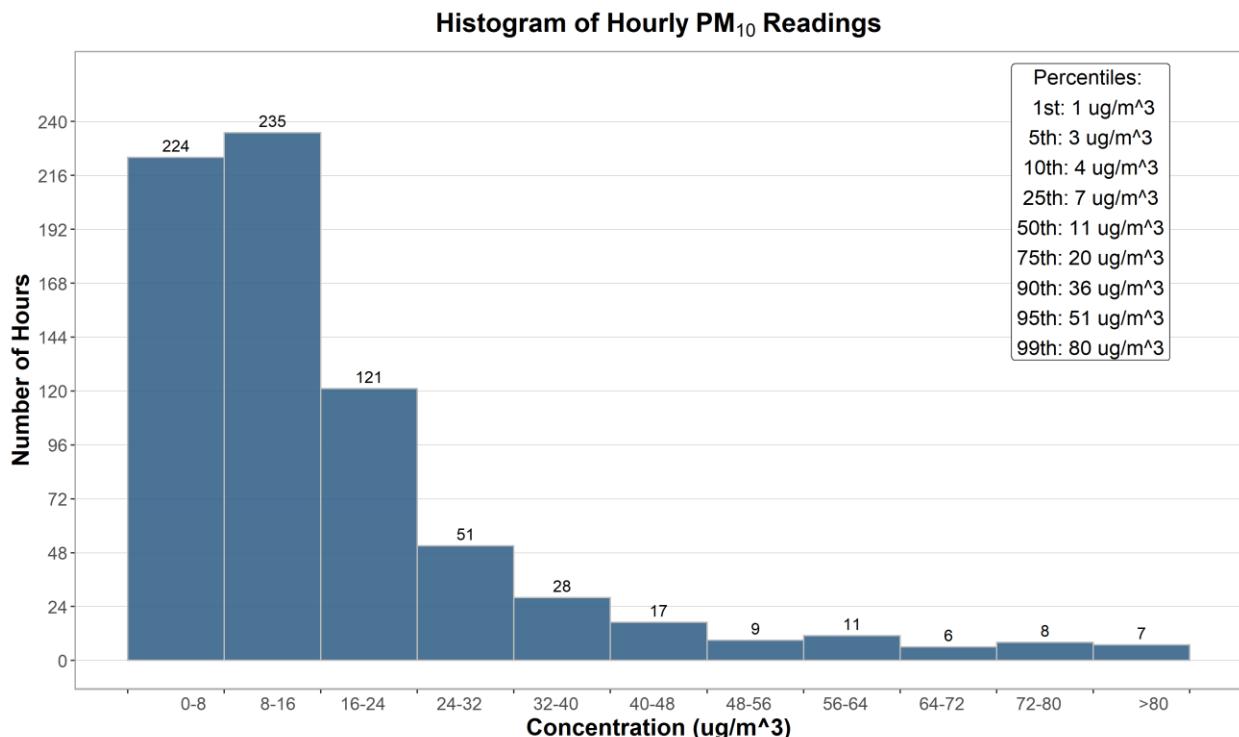


Figure 3-7 Histogram of hourly PM₁₀ concentrations at the Lagoon station

Histogram of Hourly TSP Readings

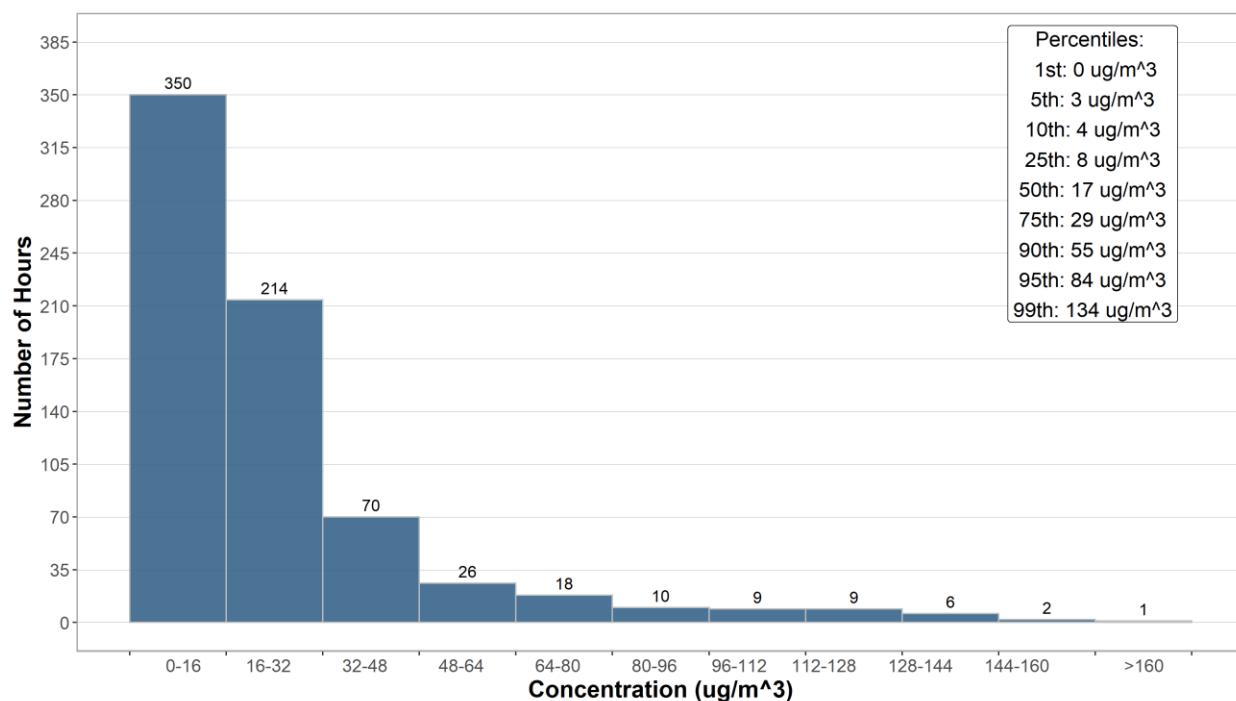


Figure 3-8 Histogram of hourly TSP concentrations at the Lagoon station

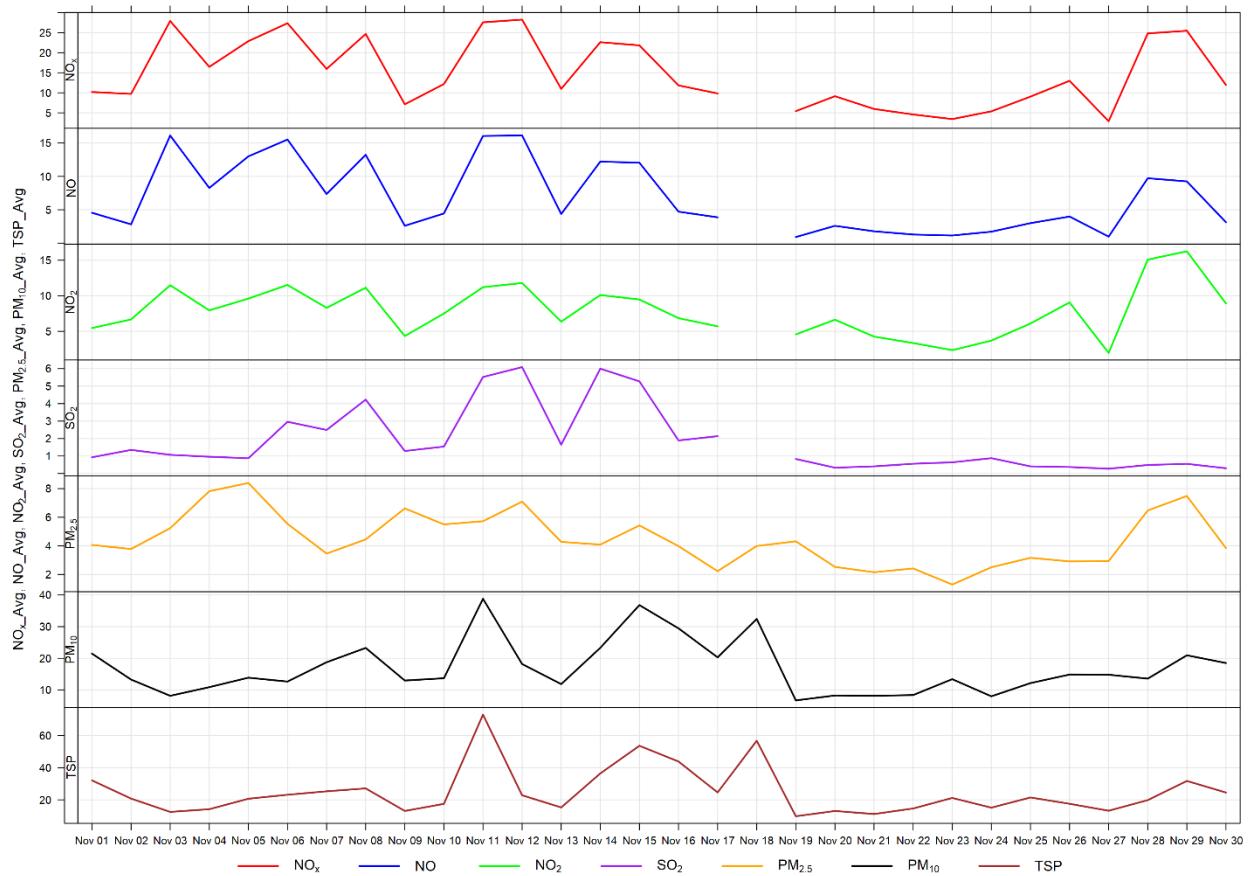


Figure 3-9 24-hour concentrations of NO_x, SO₂, and particulate matter at the Lagoon monitor

Figure 3-10 through Figure 3-12 show the variation in concentrations over various time averaging periods for PM, SO₂ and NO_x. The particulate matter plot in Figure 3-10 shows that PM₁₀ and TSP concentrations shows a diurnal pattern associated with Lafarge operations, daytime emissions from traffic and other activities. The diurnal patterns also follow the diurnal pattern of higher wind speeds during the daytime hours.

Figure 3-11 shows the variation of SO₂ over various time periods. SO₂ concentrations patterns are dependent on the timing of the highest SO₂ concentrations recorded in the month because in general SO₂ concentrations are very low. Figure 3-12 shows the variation of NO_x, NO and NO₂, with the peak of all three pollutants occurring in the early morning. This may be indicative of a peak in traffic.

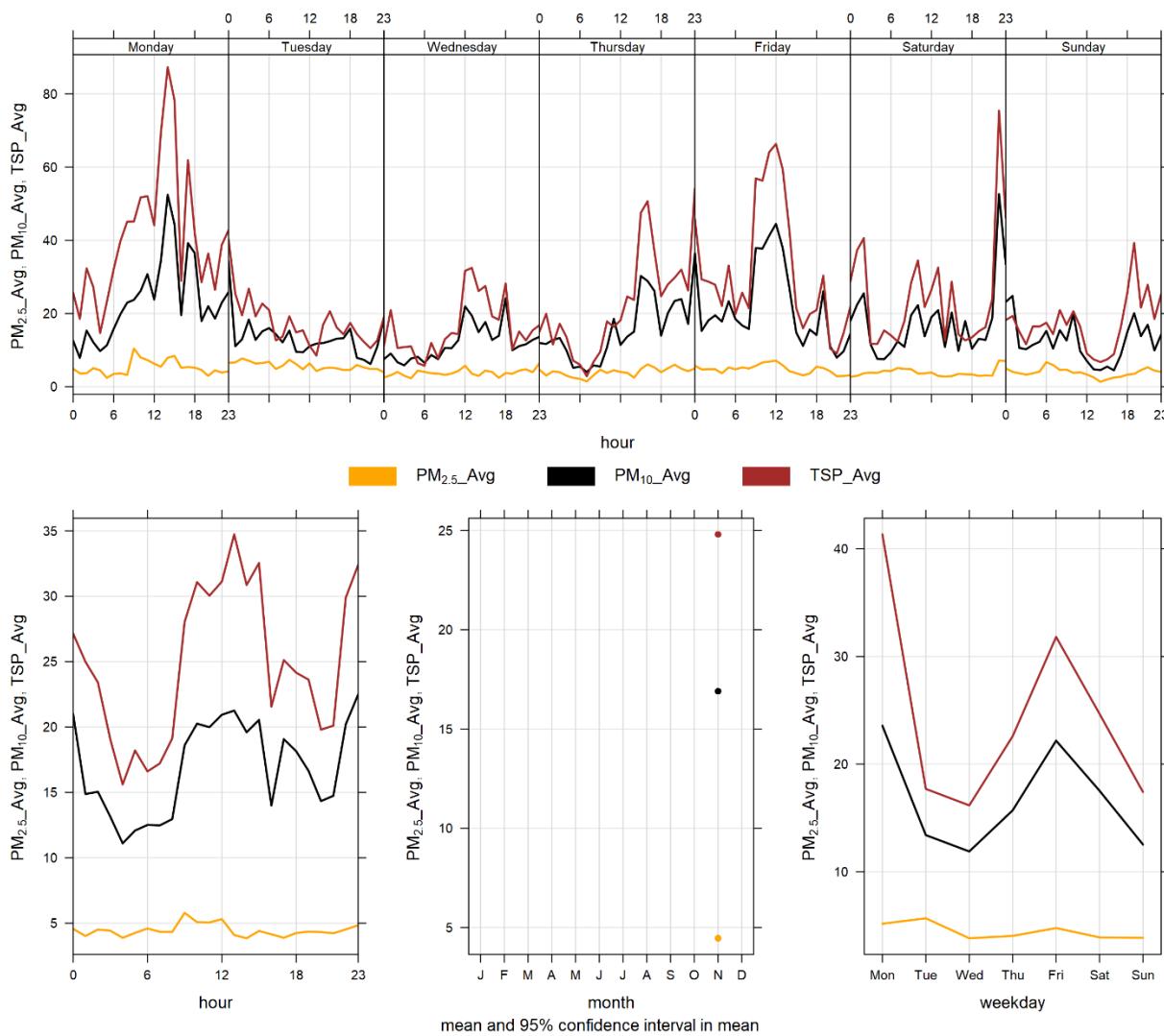


Figure 3-10 Lagoon monitor particulate matter time variation

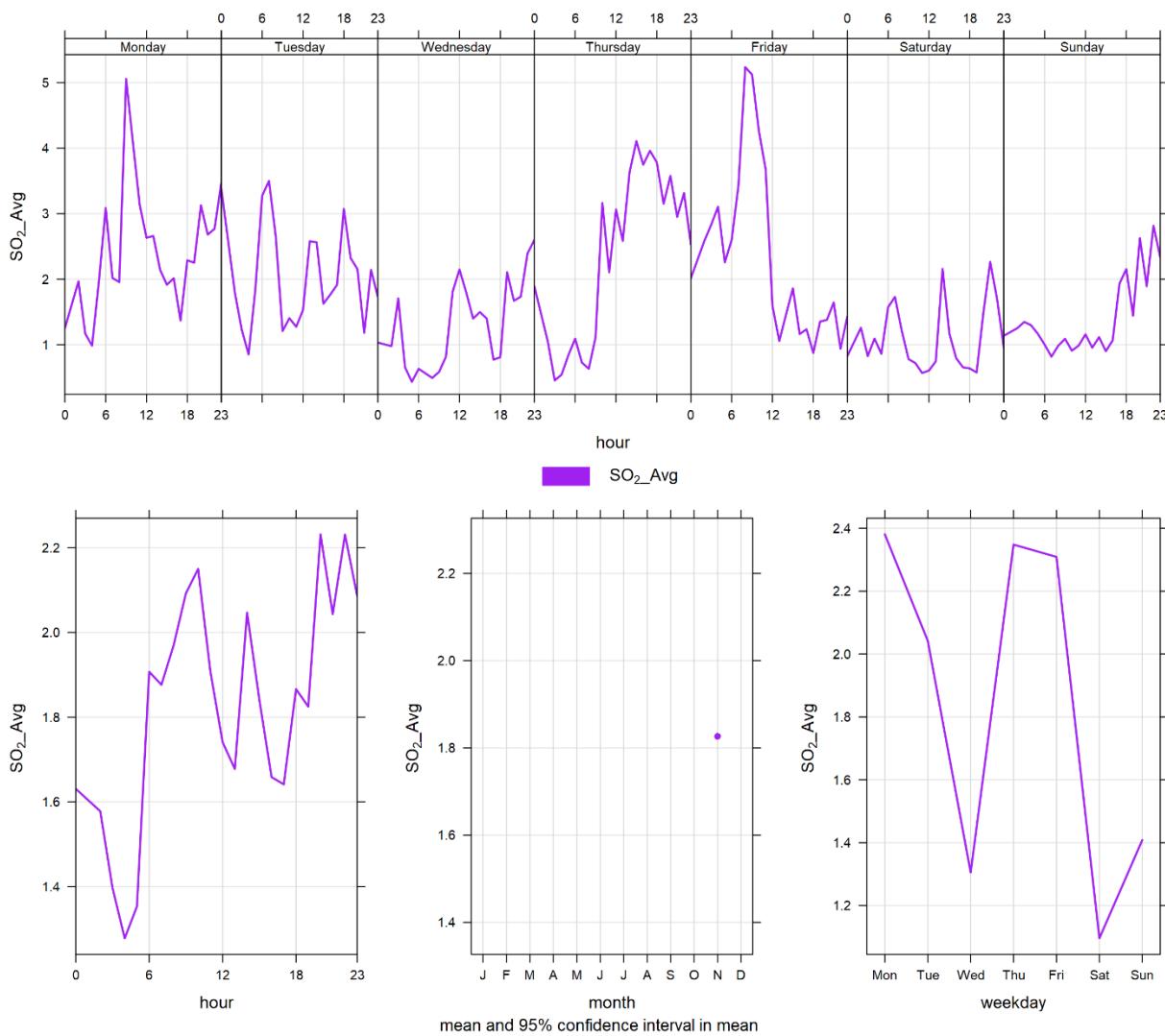


Figure 3-11 Lagoon monitor SO₂ time variation

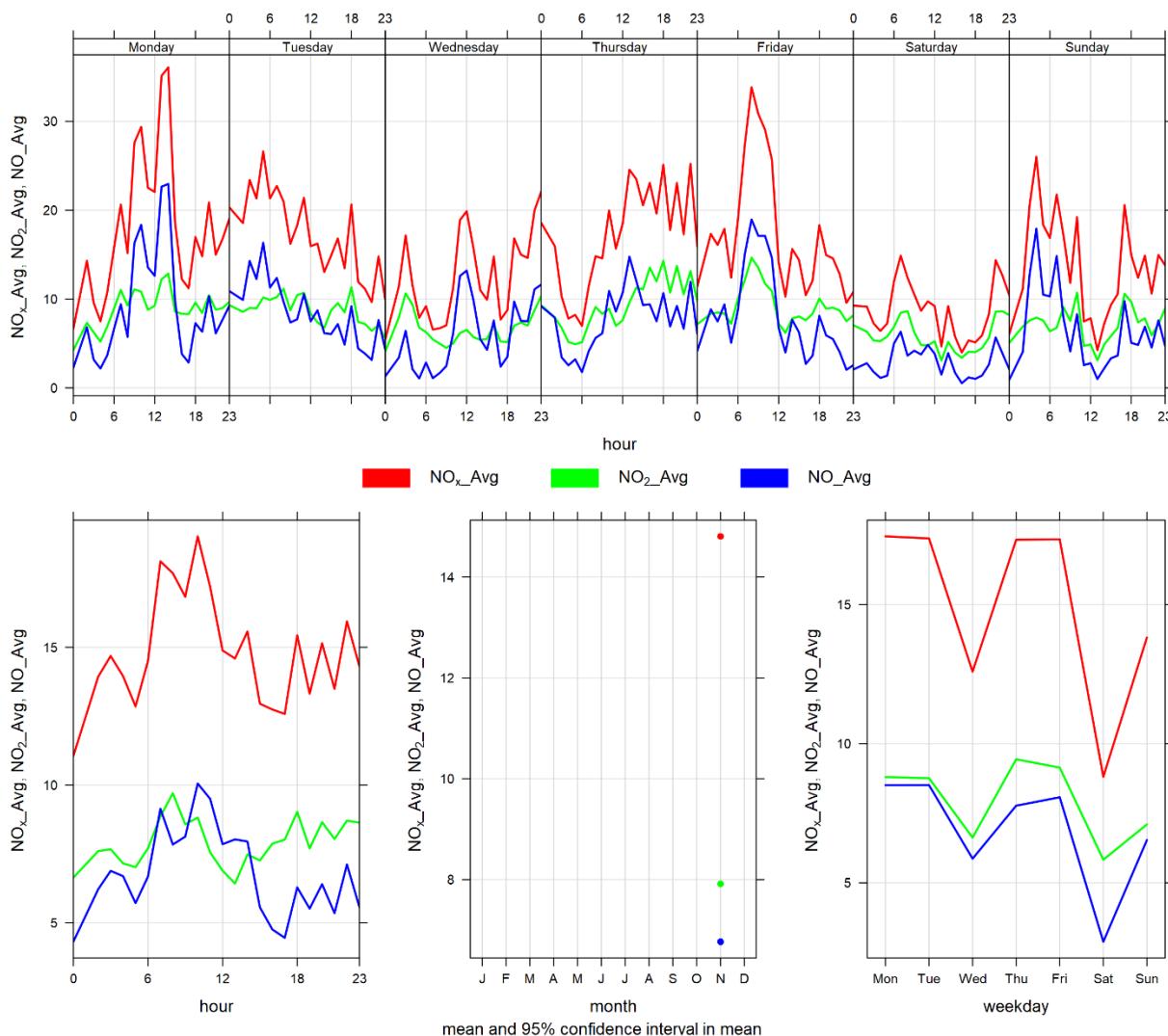


Figure 3-12 Lagoon monitor NO_x time variation

4 WEST INDUSTRIAL GRIMM

4.1 OPERATIONAL SUMMARY

A summary of the station operation for the month is provided in Table 4-1.

Table 4-1 Instrumentation List at the West monitoring location

Parameter Measured	Equipment Description	Notes
PM_{2.5}, PM₁₀, TSP Concentrations	GRIMM 365 Continuous Particulate Monitor	The monitors had 93.3% uptime in November due to dryer pump failure from November 18 th at 16:00 to November 20 th at 15:00.

4.2 MONITORING RESULTS AND TRENDS

The West GRIMM was installed in its current location in order to monitor “background” PM concentrations since the predominant wind pattern is from west to east in the valley. Table 4-2 summarizes the monthly concentrations, and the maximum 1-hour and 24-hour concentrations recorded over the course of the month. This is an industrial monitor that is not Alberta Air Monitoring Directive (AMD) compliant and is not required to show compliance with the AAAQO.

Figure 4-1 and Figure 4-2 show the hourly and daily PM_{2.5}, PM₁₀ and TSP concentrations recorded over the month. There were no exceedances of the 24-hour TSP guideline (100 µg/m³) nor the 24-hour PM_{2.5} guideline (29µg/m³).

Historically in November, the average number of 24-hour TSP AAAQG exceedances is one, while the 24-hour PM_{2.5} AAAQG exceedances is zero. The maximum number of 24-hour AAAQG exceedances was 5 days in 2012 for TSP, and 1 day in 2012 for PM_{2.5}.

Table 4-2 Summary of November 2019 data at the West GRIMM

Parameter	Guideline		Station	Exceedances		Monthly		Maximum 1-hour				Maximum 24-hour		Operational Time (Percent)	
	1-hr	24-hr		1-hr	24-hr	Minimum	Average	Maximum Concentration	Day	Hour	Wind Speed (km/hr)	Wind Direction (degrees)	Maximum Concentration	Day	
PM_{2.5} (µg/m³)	80	29	West	0	0	0.2	3.0	16.6	4	16	14.1	72.8	10.6	4	93.3
PM₁₀ (µg/m³)	-	-	West	-	-	0.3	3.8	31.4	5	15	24.5	85.9	12.9	4	93.3
TSP (µg/m³)	-	100	West	-	0	0.2	5.4	737.9	5	15	24.5	85.9	51.5	5	93.3

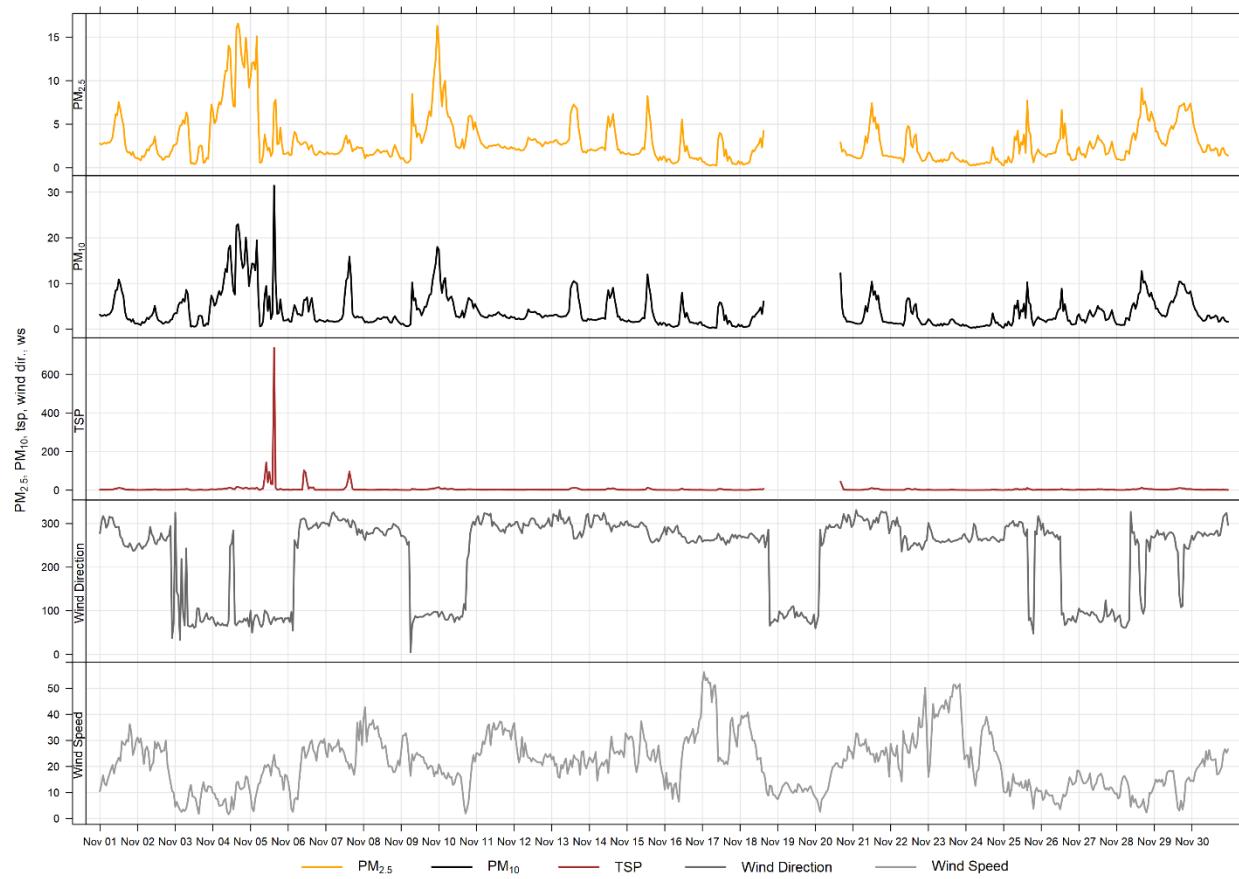


Figure 4-1 1-hour particulate matter concentrations at the West monitor

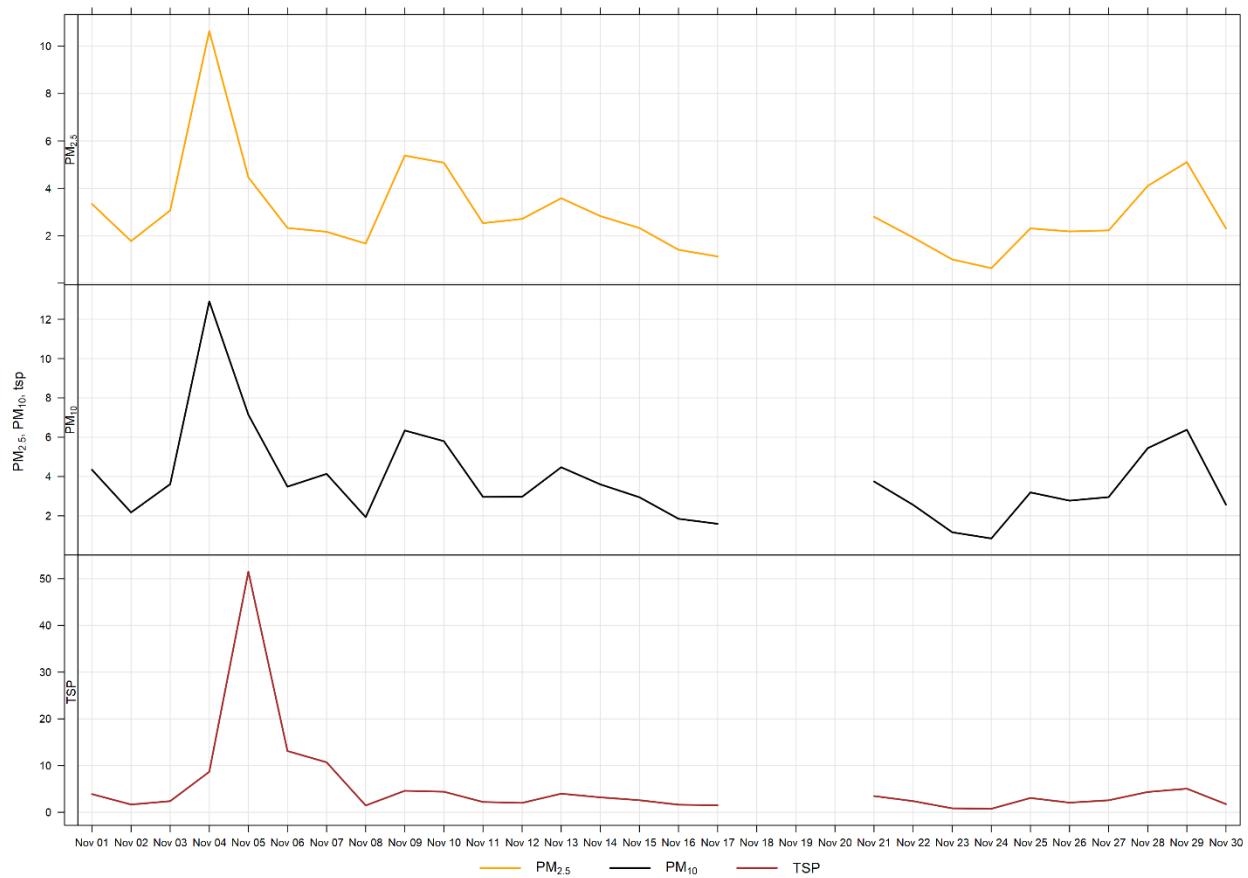


Figure 4-2 24-hour particulate matter concentrations at the West monitor

Figure 4-3 illustrates the hourly PM concentrations recorded at the West monitor, averaged over different time periods. The plot across the top shows the variation of PM over the course of a week, while the bottom three plots show the changes in PM over the course of a day, month and weekday, respectively. Figure 4-3 is based on data collected during November 2019 and indicates a diurnal relationship that could be due to the proximity of the West monitor to the highway. As the monitor is generally ‘up-wind’ of the facility, the daily variations in PM are more likely a result of higher traffic volume during daylight hours than specific Lafarge operations.

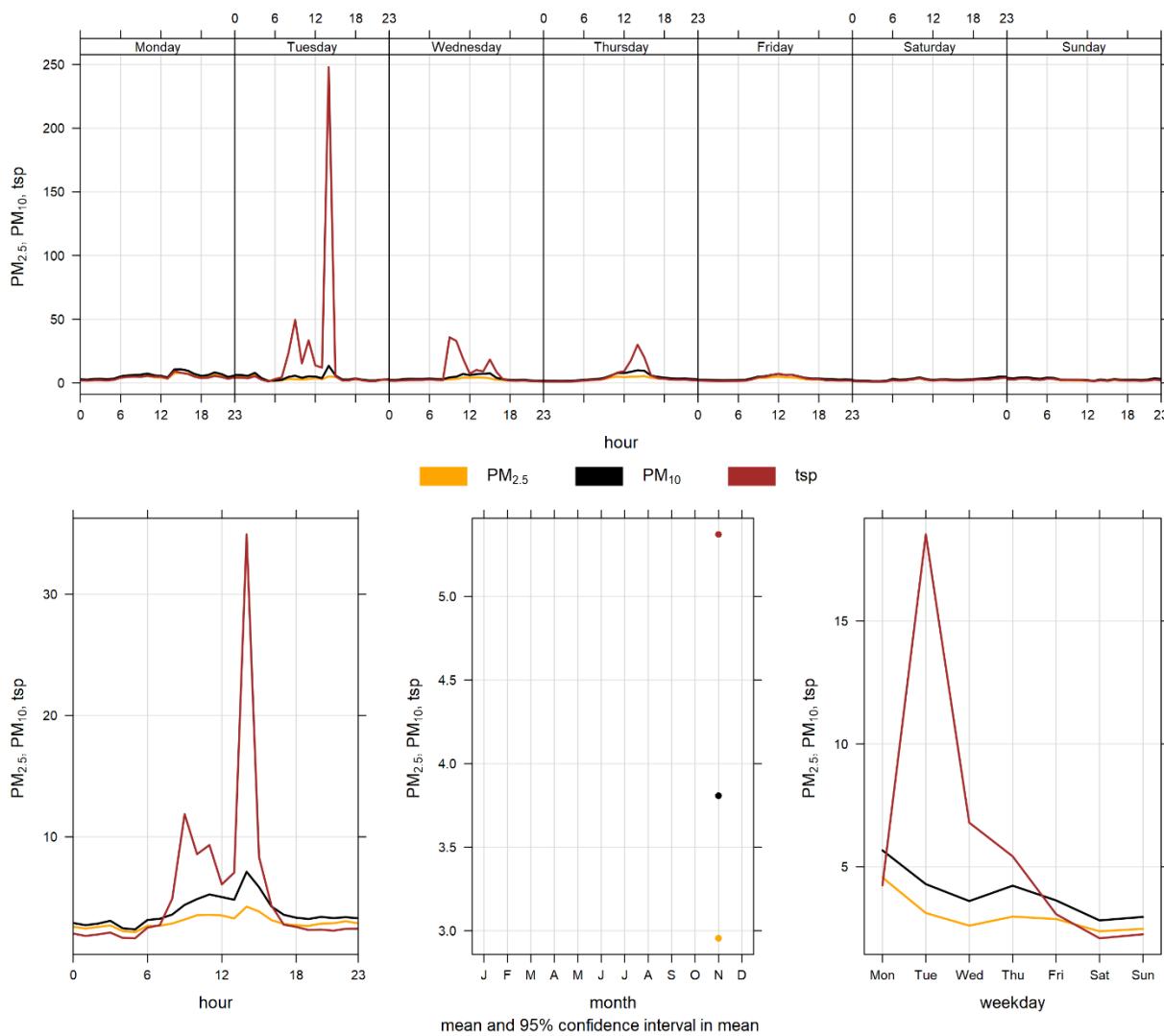


Figure 4-3 **West particulate matter time variation**

5 BERM INDUSTRIAL GRIMM

5.1 OPERATIONAL SUMMARY

A summary of the station operation for the month is provided in Table 5-1.

Table 5-1 Instrumentation List at the Berm monitoring location

Parameter Measured	Equipment Description	Notes
PM_{2.5}, PM₁₀, TSP Concentrations	GRIMM 365 Continuous Particulate Monitor	The monitors had 100% uptime in November.

5.2 MONITORING RESULTS AND TRENDS

The Berm monitor was placed at its current location as a result of the dispersion modelling conducted for the facility in 2009. Figure 5-1 and Figure 5-2 show the hourly and daily PM_{2.5}, PM₁₀ and TSP concentrations recorded over the month. Table 5-2 summarizes the monthly concentrations, and the maximum 1-hour and 24-hour PM concentrations recorded during the month, and Table 5-3 summarizes the recorded exceedances. This is an industrial monitor that is not Alberta Air Monitoring Directive (AMD) compliant and is not required to show compliance with the AAAQO.

There were 12 and 0 exceedances of the 24-hour TSP (100 µg/m³) and 24-hour PM_{2.5} (80 µg/m³) guidelines, respectively. Elevated TSP concentrations this month could be associated with Exshaw Creek flood mitigation construction activities.

Historically during the month of November, the Berm monitor records an average of 16 and 1 exceedances of the 24-hour TSP and PM_{2.5} guidelines, respectively. The maximum number of TSP exceedances recorded during November occurred in 2011 where there were 23 days that exceeded the guideline. On the other hand, the maximum number of PM_{2.5} exceedances in November occurred in 2017 & 2018, where there were 3 days that exceeded the guideline.

It should also be noted that the GRIMM monitors become more conservative in the reported PM concentrations as the size fraction increases. The PM_{2.5} size fraction has been shown to match other regulatory approved PM_{2.5} monitors, but the TSP concentrations recorded by the GRIMM tend to be higher than regulatory approved monitors (Levelton, 2015).

The Berm monitor is located along a ridge at the edge of the Lafarge property and is in an area where on-site trucks drive through site, which can create fugitive dust. Quarry blasting also has the potential to impact short term PM immediately following a blast.

High particulate levels and exceedances at the Berm monitor are likely influenced by flood mitigation work along Exshaw creek which is producing fugitive dust near the monitors. CP rail work at the 1A highway, Lafarge spur, was conducted over the month of November; this work also created fugitive dust which could impact the entrance monitor.

Table 5-2 Summary of November 2019 data at the Berm GRIMM

Parameter	Guideline		Station	Exceedances		Monthly		Maximum 1-hour				Maximum 24-hour		Operational Time (Percent)	
	1-hr	24-hr		1-hr	24-hr	Minimum	Average	Maximum Concentration	Day	Hour	Wind Speed (km/hr)	Wind Direction (degrees)	Maximum Concentration	Day	
PM _{2.5} (µg/m ³)	80	29	Berm	1	0	0.2	5.3	113.5	1	19	36.2	254.9	19.2	1	100.0
PM ₁₀ (µg/m ³)	-	-	Berm	-	-	0.2	30.1	1025.0	1	19	36.2	254.9	168.5	1	100.0
TSP (µg/m ³)	-	100	Berm	-	12	0.1	126.0	3698.8	1	19	36.2	254.9	644.5	1	100.0

Table 5-3 Days exceeding the Guideline for TSP or PM_{2.5} at the Berm Monitor

Date	TSP (ug/m ³)	PM _{2.5} (ug/m ³)	Average Wind Direction (degrees)	Average Wind Speed (km/hr)	Average RH (%)	Root Cause (Provided by Lafarge)
Berm						
2019-11-01	644.5	-	269.4	23.4	50.1	High wind event; Dust, possibly from flood mitigation work
2019-11-02	239.4	-	263.4	22.7	51.5	High wind event; Dust, possibly from flood mitigation work
2019-11-07	141.8	-	299.8	26.4	57.9	High wind event; Dust, possibly from flood mitigation work
2019-11-11	417.8	-	300.0	32.6	59.4	High wind event; Dust, possibly from flood mitigation work
2019-11-14	161.8	-	302.1	23.9	65.3	High wind event; Dust, possibly from flood mitigation work
2019-11-15	268.8	-	283.6	25.2	58.7	High wind event; Dust, possibly from flood mitigation work
2019-11-16	369.8	-	266.8	24.5	47.6	High wind event; Dust, possibly from flood mitigation work
2019-11-17	468.7	-	264.7	36.5	45.8	High wind event; Dust, possibly from flood mitigation work

2019-11-18	138.2	-	270.8	23.0	37.8	High wind event; Dust, possibly from flood mitigation work
2019-11-22	139.8	-	263.4	28.9	46.1	High wind event; Dust, possibly from flood mitigation work
2019-11-23	223.8	-	263.1	40.9	43.9	High wind event; Dust, possibly from flood mitigation work
2019-11-24	151.7	-	265.4	25.4	47.4	High wind event; Dust, possibly from flood mitigation work
Total # of Exceedances	12	0				
Maximum # of Exceedances (November)	23 (2011)	3 (2017, 2018)				
Average # of Exceedances (November)	16	1				
Minimum # of Exceedances (November)	12 (2015)	0 (2010, 2013, 2016)				

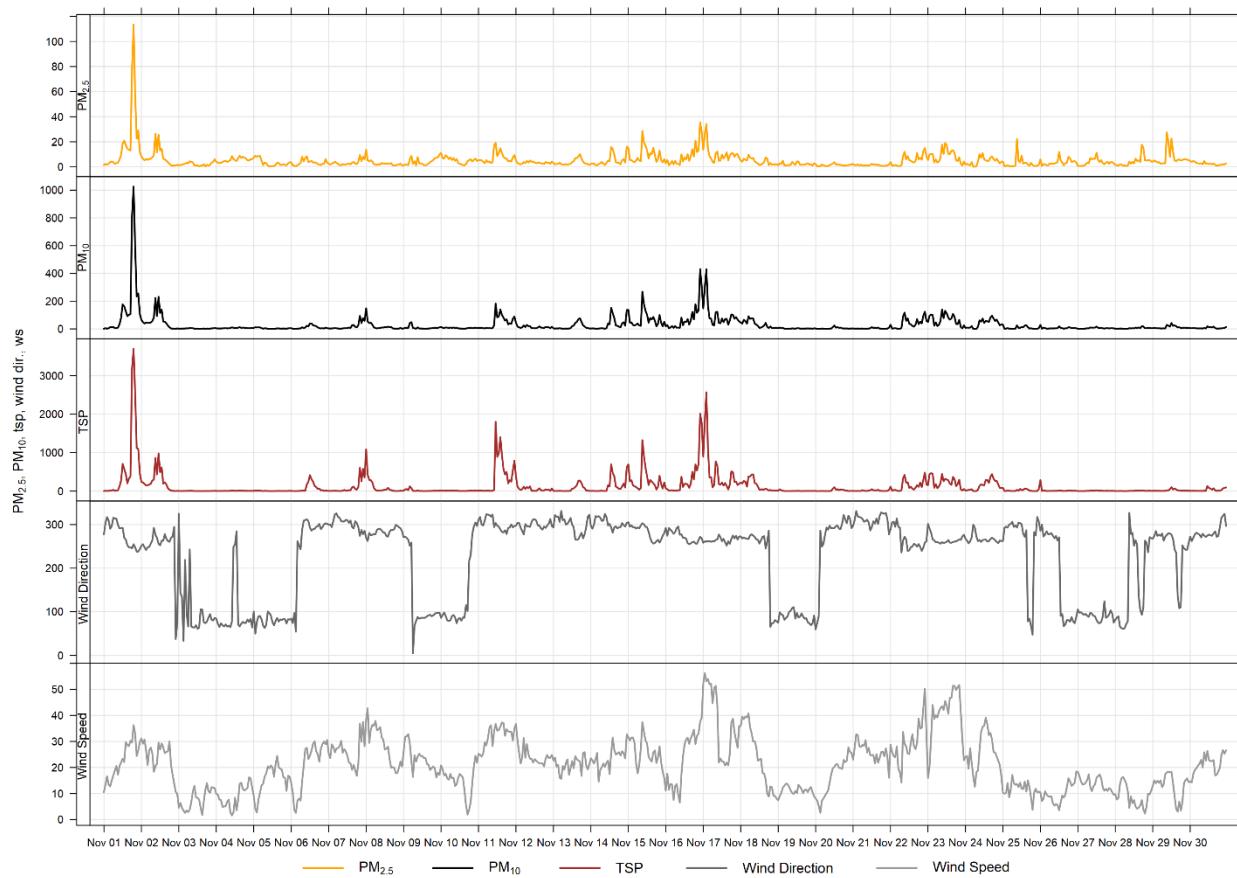


Figure 5-1 1-hour particulate matter concentrations recorded at the Berm monitor

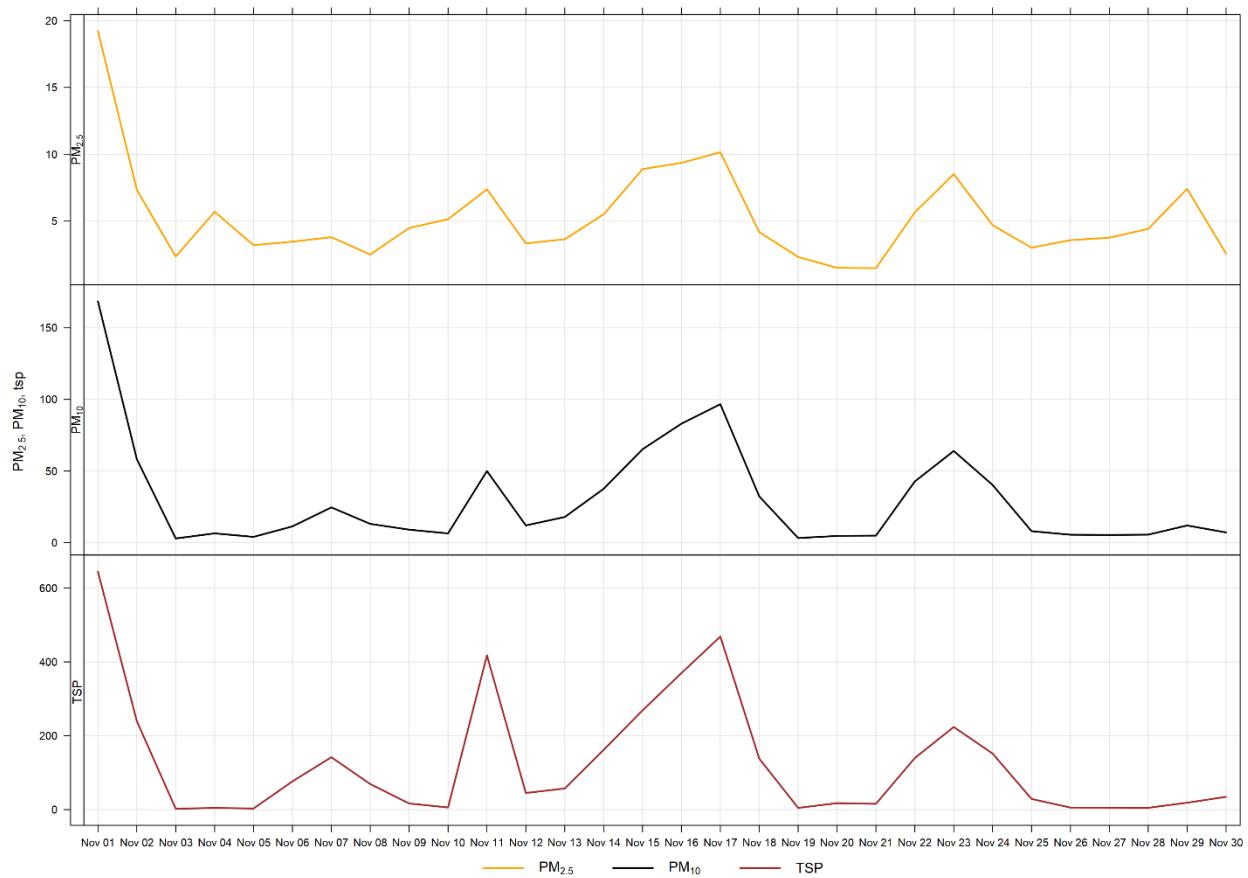


Figure 5-2 24-hour particulate matter concentrations recorded at the Berm monitor

Figure 5-3 shows the wind rose for the 12 days of TSP exceedances recorded this month. The wind rose shows that the winds predominantly came from the west direction.

Figure 5-4 shows the variation of PM recorded at the Berm monitor over various time averaging periods. The Berm monitor diurnal pattern, similar to the Windridge and Lagoon stations, is associated with Lafarge operations, but also daytime emissions from traffic and other activities in Exshaw, such as the flood mitigation work that is currently underway.

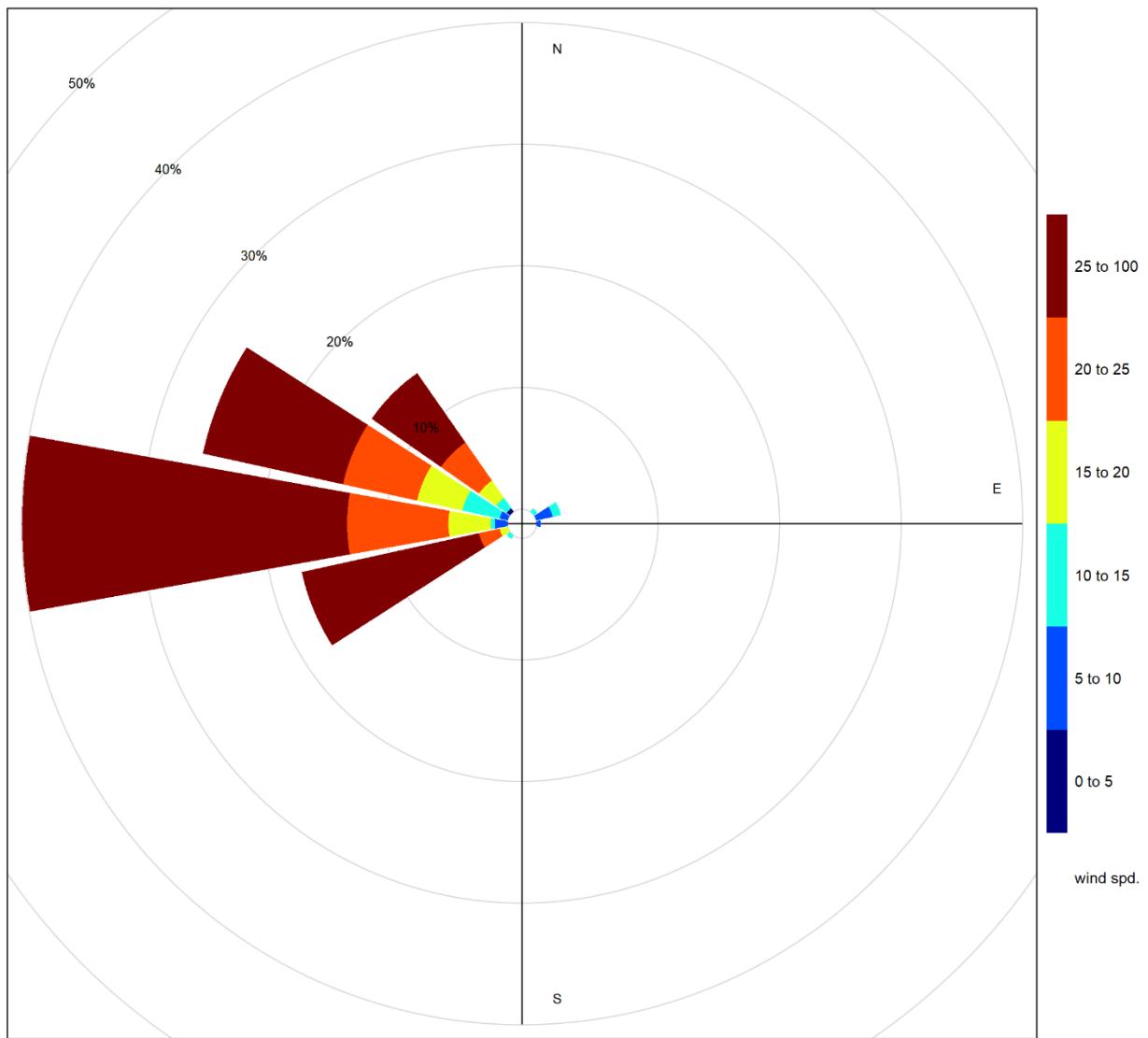


Figure 5-3 Wind rose for TSP exceedance days recorded at the Berm GRIMM

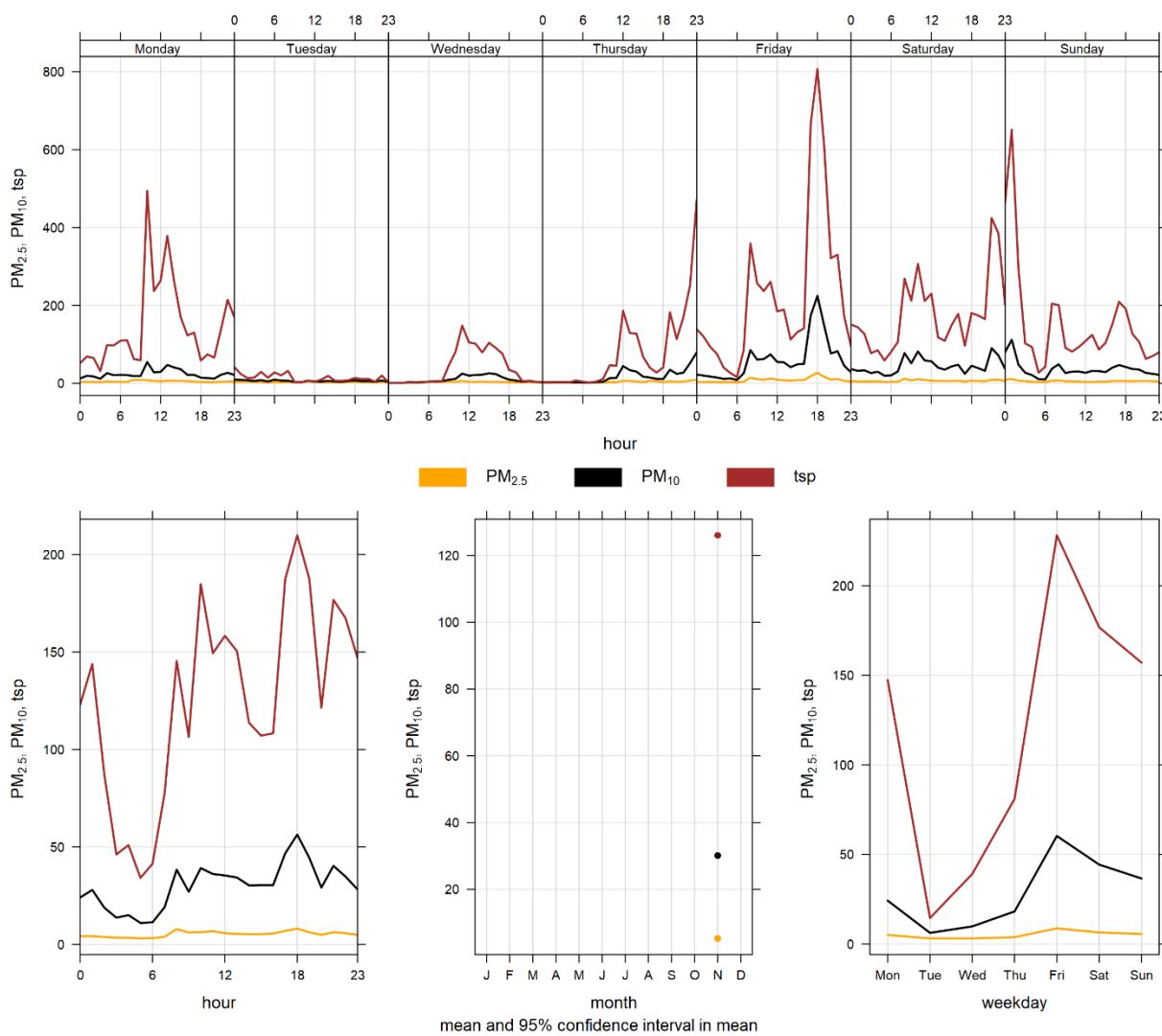


Figure 5-4 **Berm particulate matter time variation**

6 ENTRANCE INDUSTRIAL GRIMM

6.1 OPERATIONAL SUMMARY

A summary of the station operation for the month is provided in Table 6-1.

Table 6-1 Instrumentation List at the Entrance monitoring location

Parameter Measured	Equipment Description	Notes
PM_{2.5}, PM₁₀, TSP Concentrations	GRIMM 365 Continuous Particulate Monitor	The monitors had 80.8% uptime in November due to vacuum pump failure occurring from November 1 st at 1:00 to November 5 th at 14:00. Further, the Entrance GRIMM experienced unexpected malfunctions scattered throughout the month of November which contributed to the 80.8% uptime.

6.2 MONITORING RESULTS AND TRENDS

The Entrance monitor was placed at its current location as a result of dispersion modelling conducted in 2009. This area was indicated as being the area where the maximum PM concentrations were expected. Figure 6-1 and Figure 6-2 show the hourly and daily PM_{2.5}, PM₁₀ and TSP concentrations recorded over the month. Table 6-2 summarizes the monthly concentrations, and the maximum 1-hour and 24-hour PM concentrations recorded during the month. Table 6-3 summarizes the recorded exceedances. This is an industrial monitor that is not Alberta Air Monitoring Directive (AMD) compliant and is not required to show compliance with the AAAQO.

During November, there were 13 and zero exceedances of the 24-hour TSP (100 µg/m³) and PM_{2.5} (29 µg/m³) guidelines, respectively. Dust created from the flood mitigation work (section 1.1) has the potential to impact particulate matter concentrations and may have contributed to particulate at the Entrance monitor.

Historically, the Entrance monitor records an average of 15 and 0 exceedances of the 24-hour TSP and PM_{2.5} guidelines respectively, during the month of November. The maximum number of TSP exceedances recorded during November occurred in 2014 (25 days), while the minimum number of TSP exceedances recorded during November occurred in 2012 (1 day). On the other hand, the maximum number of PM_{2.5} exceedances in November was 2 days, occurring in 2013 & 2014.

It should also be noted that the GRIMM monitors become more conservative in the reported PM concentrations as the size fraction increases. The PM_{2.5} size fraction has been shown to match other regulatory approved PM_{2.5} monitors, but the TSP concentrations recorded by the GRIMM tend to be higher than regulatory approved monitors (Levelton, 2015).

The Entrance monitor is impacted by fugitive dust from plant activities, and high wind events. Trucks also pass near to the Entrance monitor as they enter and exit the Lafarge facility for loading and deliveries. Additionally, the monitor is closely located to Highway 1A. Traffic, particularly large trucks, can create dust while crossing over the railway tracks. This can all lead to the monitor recording high TSP concentrations, which are typically associated with fugitive dust sources. High particulate levels and exceedances at the Entrance monitor are likely influenced by flood mitigation work along Exshaw creek which is producing fugitive dust near the monitors. CP rail work at the 1A

highway, Lafarge spur, was conducted over the month of November; this work also created fugitive dust which could impact the entrance monitor, , as of November 25th, 2019 the repair is completed.

Figure 6-3 shows the wind rose for the 13 days that exceeded the TSP guideline. The wind rose indicates that the winds predominantly came from the west – northwest direction. High wind speeds were a primary factor for the TSP exceedances in November at the Entrance station. It is likely that the flood mitigation work had little impact on particulate concentrations at the Entrance monitor. Other sources, such as industry, traffic and rail may have contributed to these exceedances.

Table 6-2 Summary of November 2019 data at the Entrance GRIMM

Parameter	Guideline		Station	Exceedances		Monthly		Maximum 1-hour				Maximum 24-hour		Operational Time (Percent)	
	1-hr	24-hr		1-hr	24-hr	Minimum	Average	Maximum Concentration	Day	Hour	Wind Speed (km/hr)	Wind Direction (degrees)	Maximum Concentration	Day	
PM _{2.5} (µg/m ³)	80	29	Entrance	0	0	0.4	8.9	42.3	26	23	18.5	88.1	17.9	30	80.8
PM ₁₀ (µg/m ³)	-	-	Entrance	-	-	0.6	39.8	517.3	11	13	34.4	295.0	111.2	30	80.8
TSP (µg/m ³)	-	100	Entrance	-	13	0.5	129.5	3503.3	11	13	34.4	295.0	597.7	11	80.8

Table 6-3 Days exceeding the Guideline for TSP or PM_{2.5} at the Entrance Monitor

Date	TSP (ug/m ³)	PM _{2.5} (ug/m ³)	Average Wind Direction (degrees)	Average Wind Speed (km/hr)	Average RH (%)	Root Cause (Provided by Lafarge)
Entrance						
2019-11-06	189.2	-	297.5	21.1	72.7	TSP - High wind event
2019-11-07	274.6	-	299.8	26.4	57.9	TSP - High wind event
2019-11-11	597.7	-	300.0	32.6	59.4	TSP - High wind event
2019-11-12	181.4	-	298.0	24.0	67.5	TSP - High wind event
2019-11-13	161.4	-	297.3	21.1	64.5	TSP - High wind event
2019-11-14	187.9	-	302.1	23.9	65.3	TSP - High wind event
2019-11-15	201.9	-	283.6	25.2	58.7	TSP - High wind event
2019-11-16	109.5	-	266.8	24.5	47.6	TSP - High wind event
2019-11-18	108.0	-	270.8	23.0	37.8	TSP - High wind event
2019-11-21	181.2	-	311.3	26.2	66.2	TSP - High wind event
2019-11-22	132.9	-	263.4	28.9	46.1	TSP - High wind event
2019-11-25	127.7	-	301.4	11.7	62.0	TSP - Dust, possibly from flood mitigation work
2019-11-30	379.3	-	284.4	22.0	65.9	TSP - High wind event
Total # of Exceedances	13	0				

Maximum # of Exceedances (September)	25 (2014)	2 (2013, 2014)				
Average # of Exceedances (September)	15	0				
Minimum # of Exceedances (September)	1 (2012)	0 (2010, 2011, 2015, 2016, 2017, 2018)				

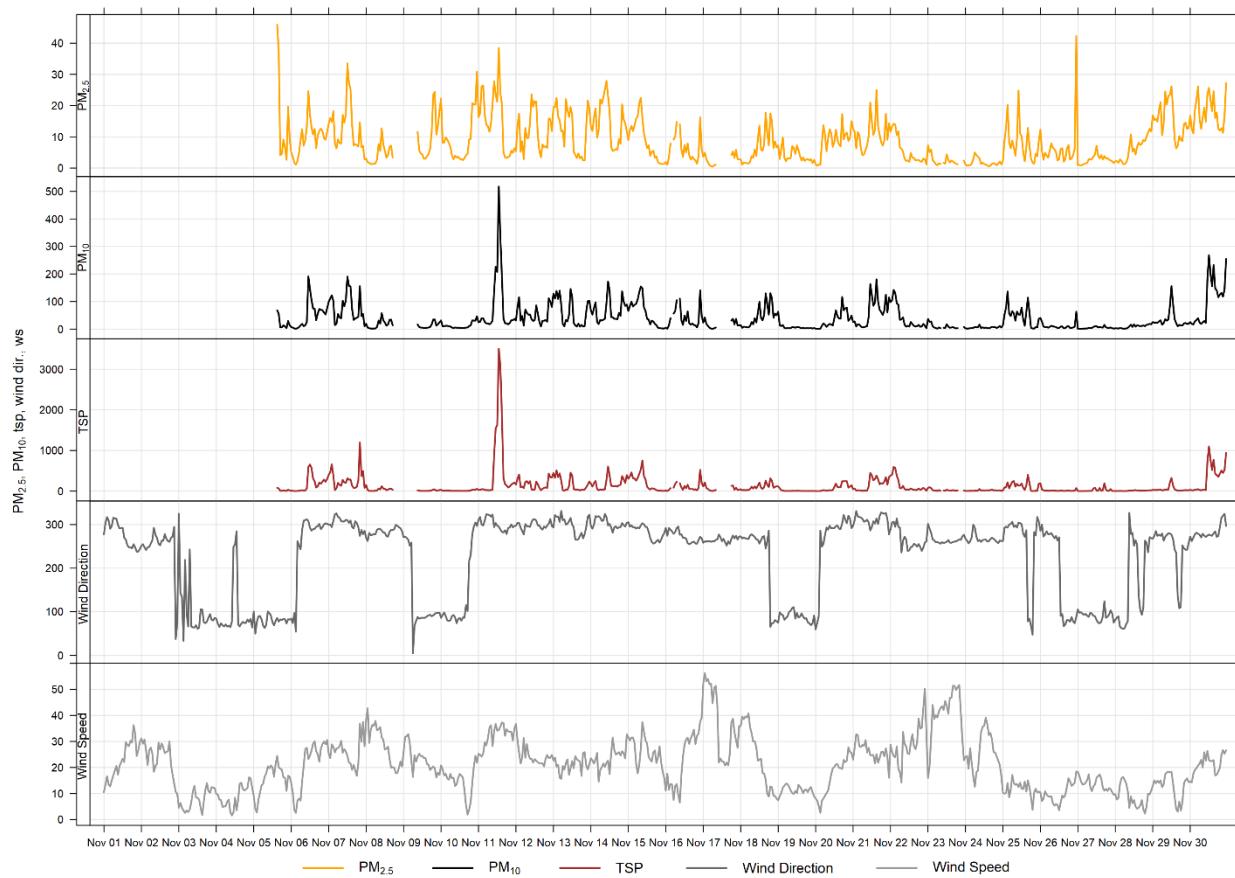


Figure 6-1 1-hour particulate matter concentrations recorded at the Entrance monitor

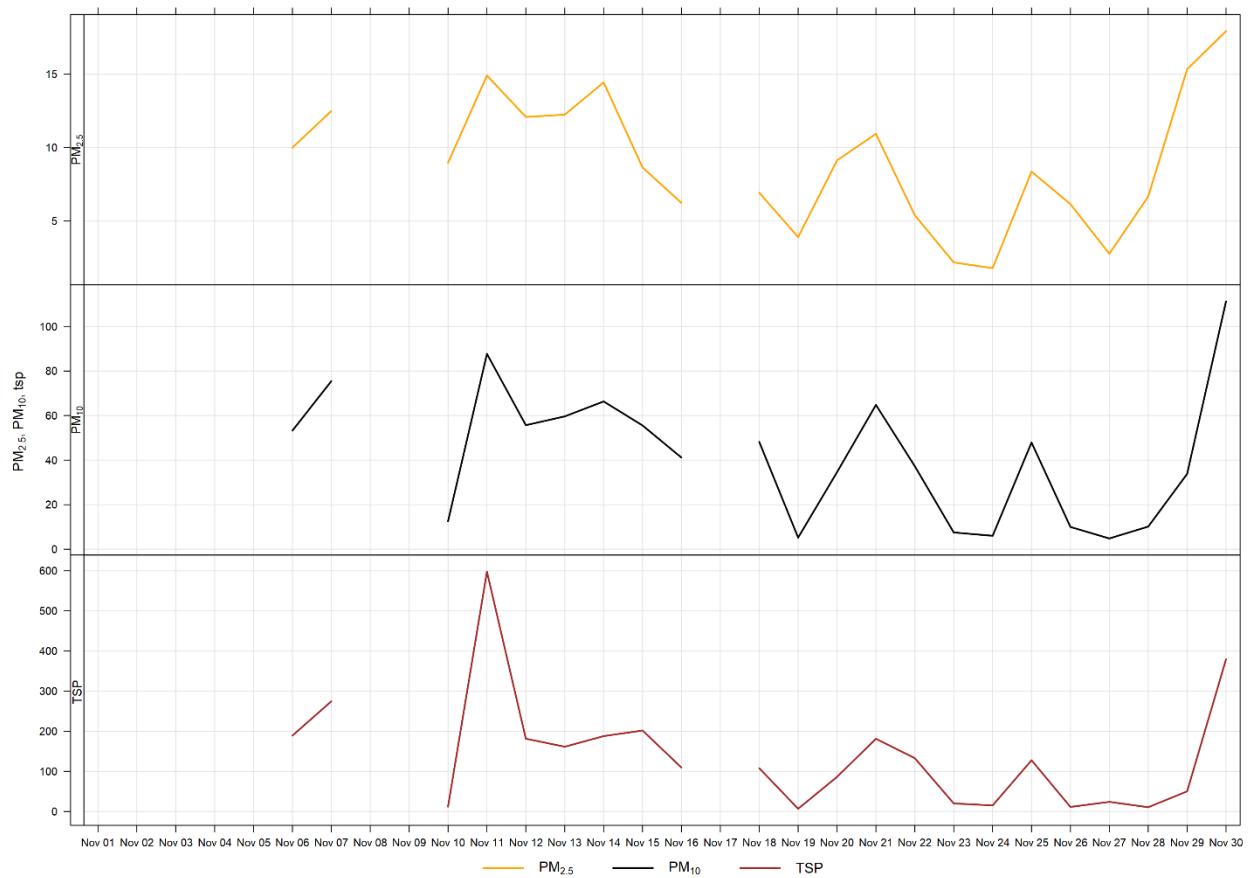


Figure 6-2 24-hour particulate matter concentrations at the Entrance monitor

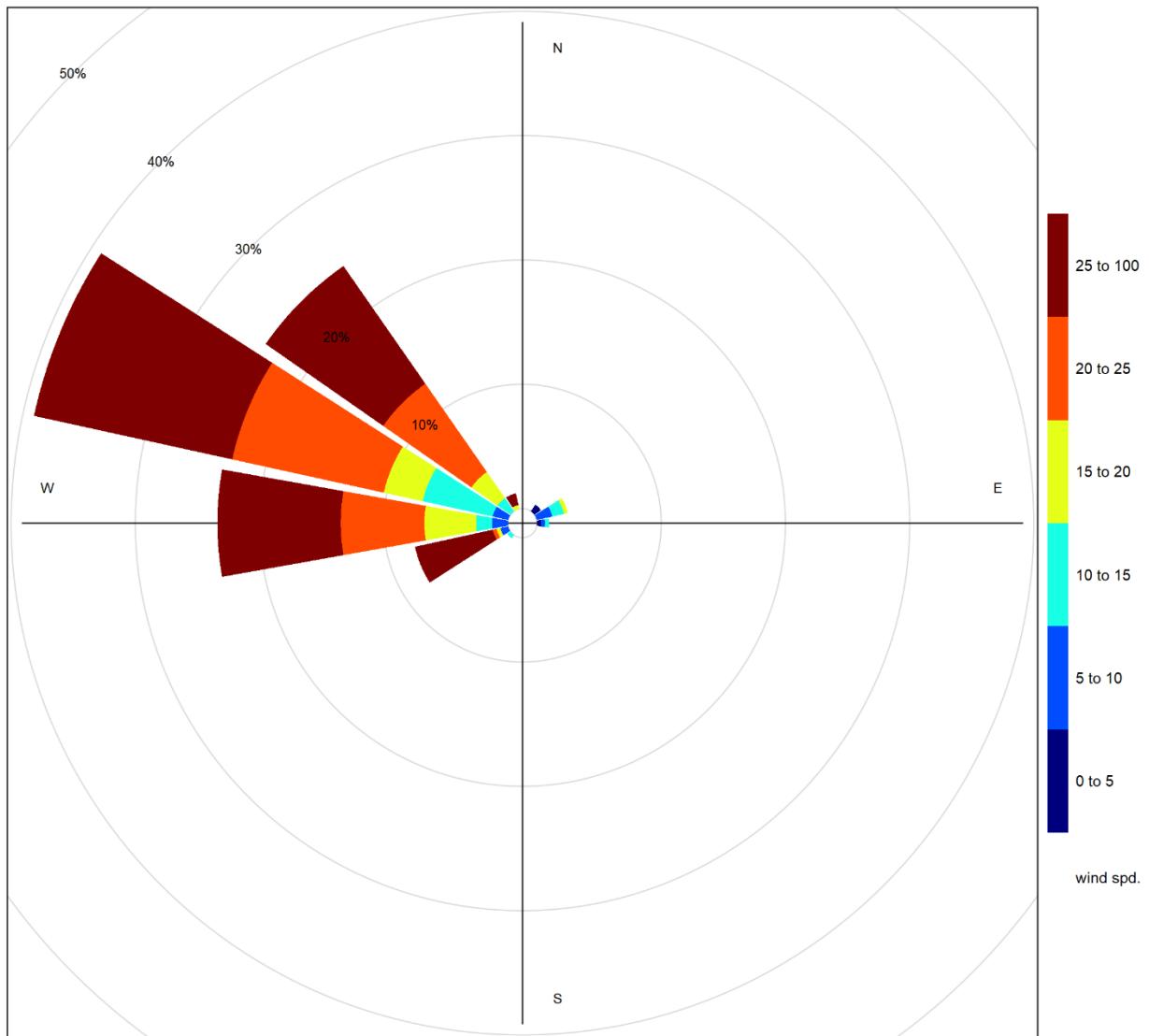


Figure 6-3 Wind rose for TSP exceedance days recorded at the Entrance GRIMM

Figure 6-4 illustrates the hourly PM concentrations recorded at the Entrance monitor, averaged over different time periods. The plot across the top shows the variation of PM over the course of a week, while the bottom three plots show the changes in PM over the course of a day, month and weekday, respectively. Figure 6-4 is based on data collected during November 2019. The diurnal pattern is likely more influenced by daytime traffic emission (from vehicles serving Lafarge as well as regular highway traffic) given its location near the highway entrance to Lafarge, but can also be influenced by the flood mitigation work currently underway, as well as industry and rail sources.

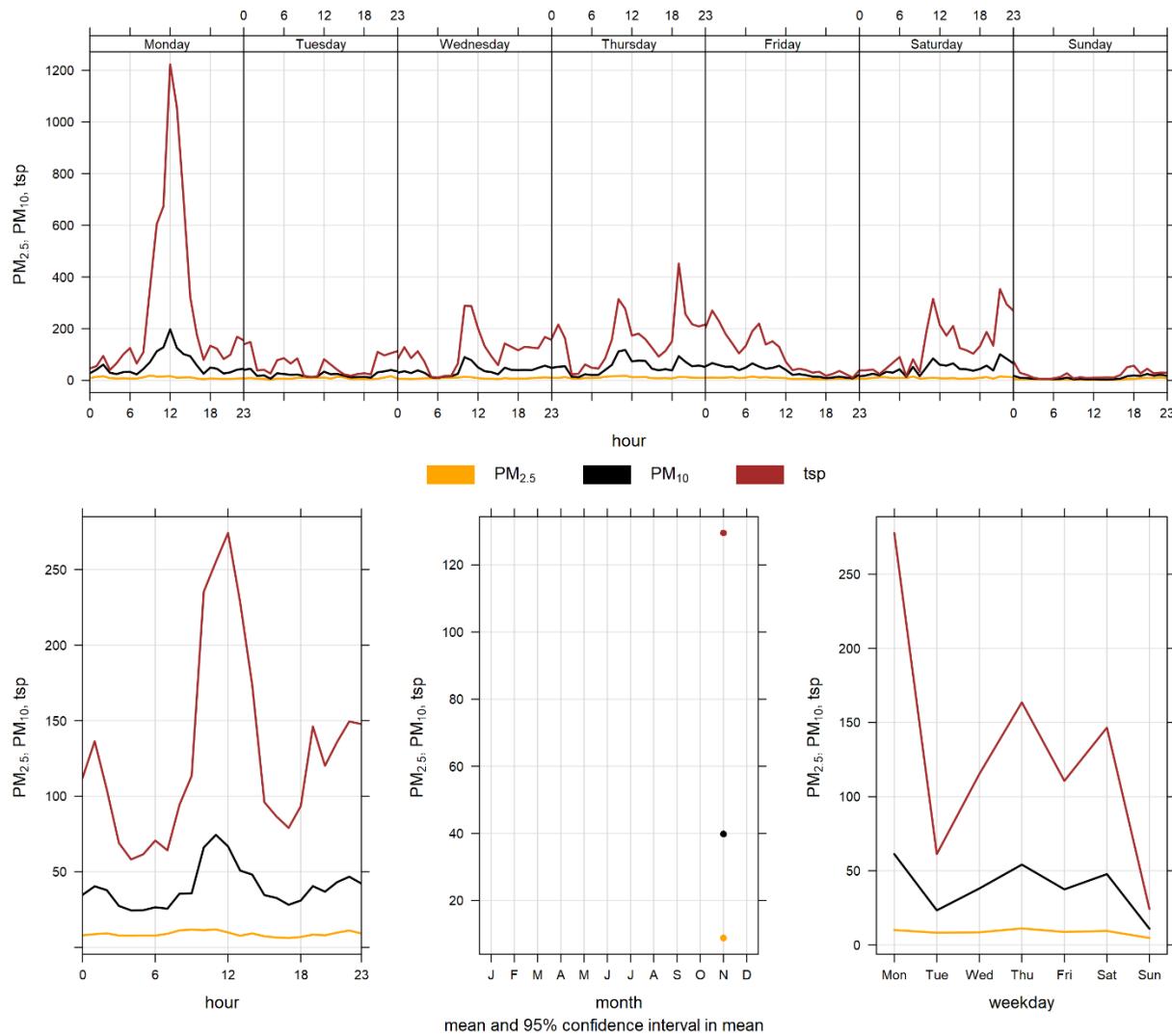


Figure 6-4 Entrance particulate matter time variation

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APPENDIX

A DATA & CALIBRATION REPORTS

APPENDIX



