Iowa Annual Data Review 2014 – Manganese

Table of Contents

Contents

Summary

Iowa Department of Natural Resources (DNR) Manganese Monitoring

In December of 2008, *USA Today* published a list of schools with elevated risk due to air toxics emissions. Schools near Griffin Pipe Products in Council Bluffs were on this list because of manganese emissions from Griffin Pipe. In 2009, EPA funded a study in response to the *USA Today* risk assessment. The methodology for EPA's "School Air Toxics Study" included adoption of health effects benchmarks to evaluate monitoring results. For manganese, EPA suggested a long-term "non-cancer" reference concentration (RFC) of 50 ng/m^3. EPA indicated that monitoring sites that experienced levels above this threshold would be the focus of ongoing monitoring and the development of a mitigation strategy.[1, 2] Recently, EPA has relaxed its health effects/mitigation benchmark for manganese to 300 ng/m^3.[3,4]

In 2011, DNR added manganese analysis at its lead monitoring site near Griffin Pipe (Appendix A). Average levels at the site in 2011, 2012, and 2013 were (104 ±53) ng/m^3, (95 ±16) ng/m^3 and (79 ±14) ng/m^3, respectively.[5,6,7] Griffin Pipe announced its intention to suspend production indefinitely in March of 2014[8], and the average manganese concentration in 2014 dropped to (44 ± 6) ng/m^3. This report includes a detailed analysis of the 2014 data.

In 2010 and 2012, violations of the National Ambient Air Quality Standards for lead were recorded at the Griffin Pipe monitoring site.[9] DNR recently completed a State Implementation Plan (SIP) to mitigate these violations.[10] This plan includes measures to pave and regularly sweep haul roads at the Alter Metal Recycling facility adjacent to Griffin Pipe. It is expected that these measures will reduce ambient manganese levels near Griffin Pipe by eliminating the re-entrainment of deposited manganese-laden dust by truck traffic.

1 *USA Today: "The Smokestack Effect; Toxic Air and America's Schools"*
2 *Quality Assurance Project Plan For the EPA School Air Toxics Monitoring Program*
3 *Experiences with Next Generation Technologies, Motria Caudill, PhD --EPA Region 5*
4 *ATSDR MRL list*
5 *Iowa DNR 2011 Manganese Report*
6 *Iowa DNR 2012 Manganese Report*
7 *Iowa DNR 2013 Manganese Report*
8 *KETV: Griffin Pipe goes to skeleton crew*
9 *Iowa Lead Design Values 2010-2012*
10 *State Implementation Plan Lead Non-Attainment Council Bluffs, Iowa*

Additional Information

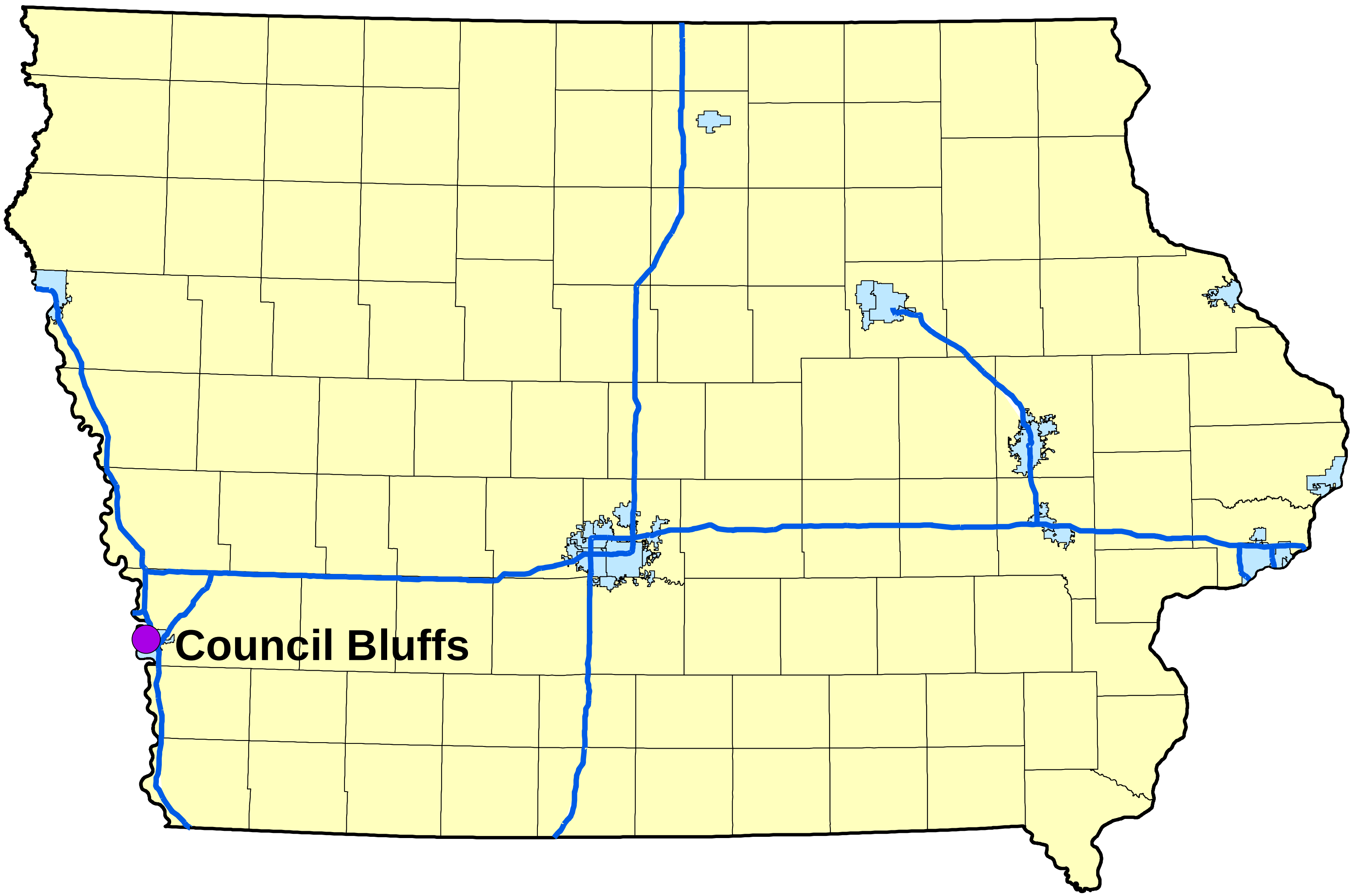
Additional details on the manganese sampling conducted in Iowa during 2014 are indicated below.

Definitions

- *Data Capture*. The data capture rate is defined as the ratio of the number of samples taken (including scheduled and valid substitute samples) divided by the number of scheduled samples in each calendar quarter. EPA data analysis guidelines usually require 75% data completeness across each sampling quarter.

- *Precision Data*. Precision data are reported for the total number of collocated pairs of samples collected. Precision statistics shown in this report have been calculated according to current methodology outlined in *40 CFR Part 58, Appendix A* using the methodology applicable to collocated filter samplers. (See Appendix B)

Manganese Monitoring Network – 2014



Site ID	Site Label	City	Address	County
191550011	Council Bluffs, Griffin Pipe	Council Bluffs	8th Avenue and 27th	Pottawattamie

Table of Contents

Concentration Summary (ng/m^3)

Site / Pollutant	Council Bluffs, Griffin Pipe
Manganese	44 (±6)

The value indicated is the average concentration measured in 2014.
The value in parentheses represents the variance in concentration as calculated from the 95% Confidence Interval for the mean.

2011-2014 Manganese Concentration Summary Chart

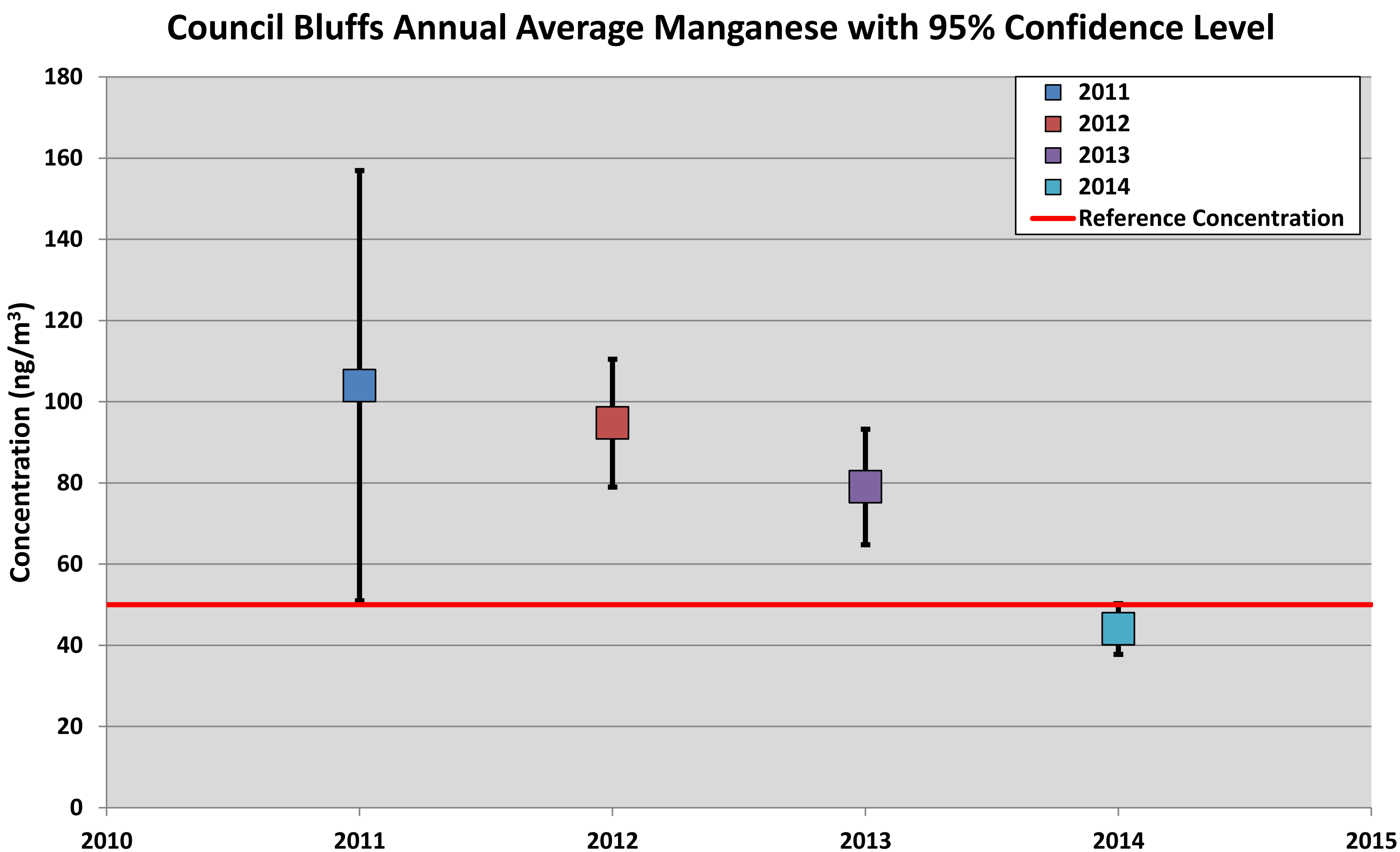


Chart depicting the average concentration of airborne manganese for each year and the uncertainty. Longer error bars mean greater uncertainty. The error bars are much shorter for 2012 - 2014 which implies less uncertainty in the annual average.

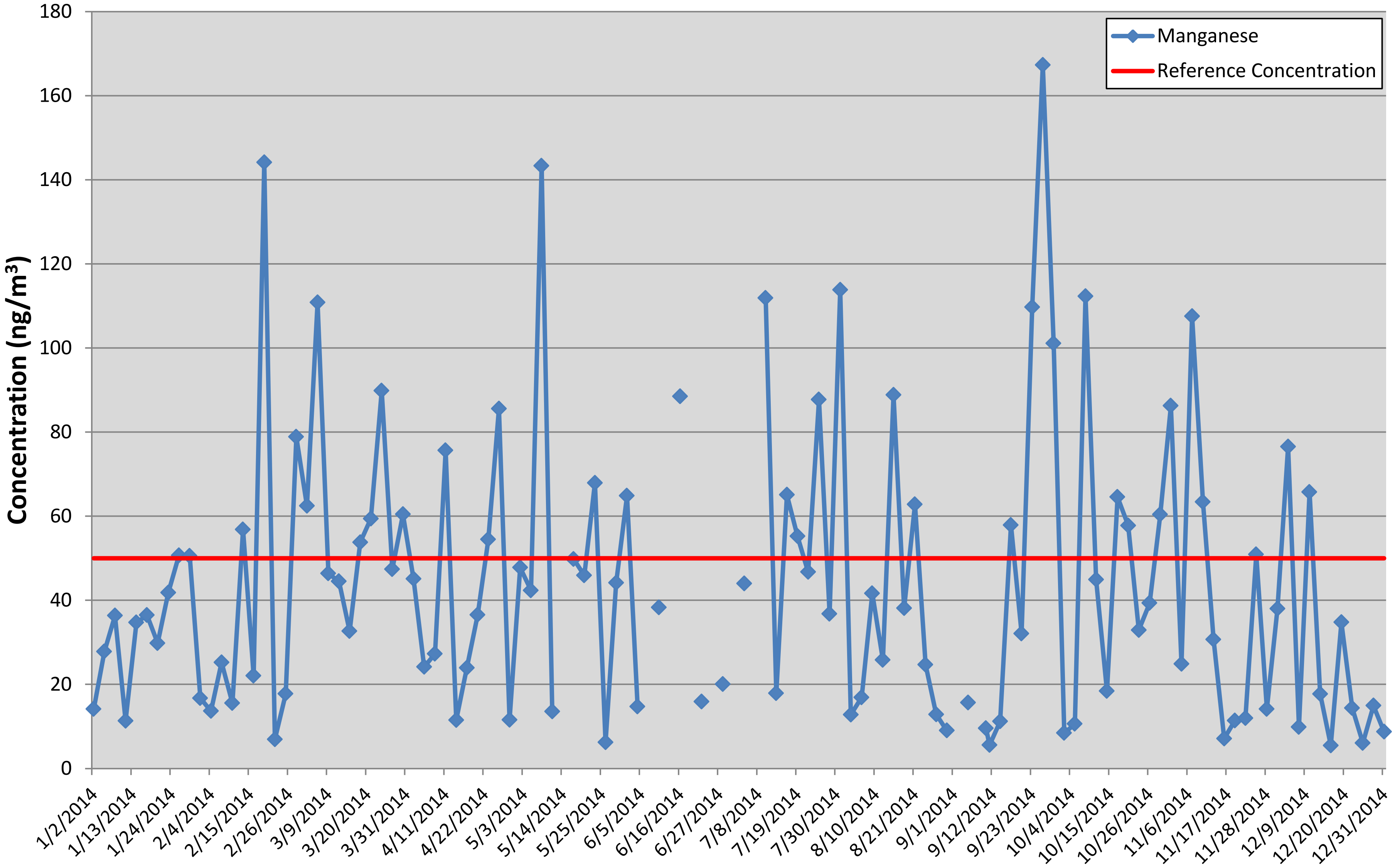
2014 Percent Manganese Data Capture

Council Bluffs, Griffin Pipe
93%

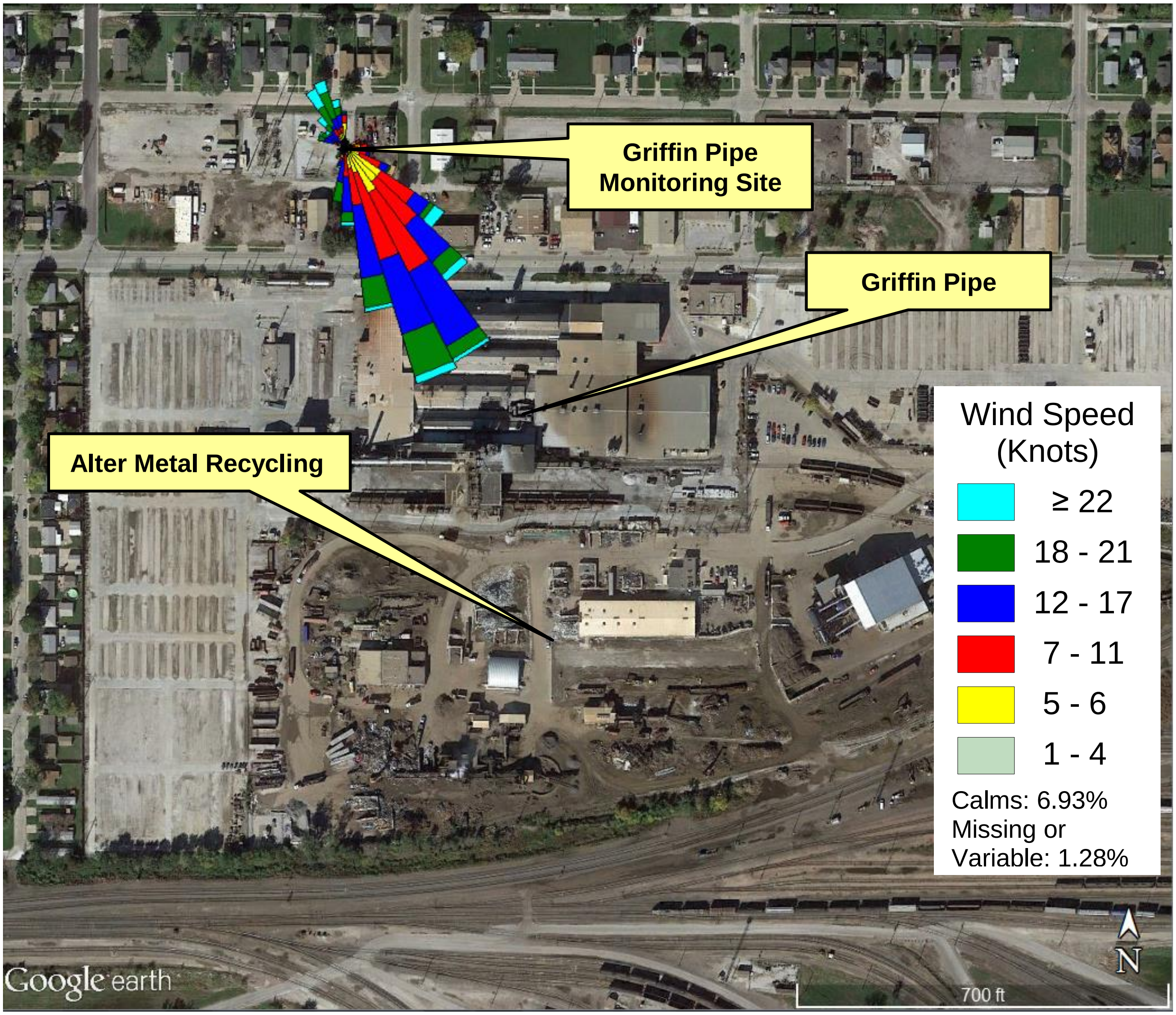
2014 Annual Manganese Precision Statistics

Number of Pairs	Upper 90% Confidence Limit
56	20%

Manganese Levels Recorded in 2014 at the Griffin Pipe Monitoring Site in Council Bluffs

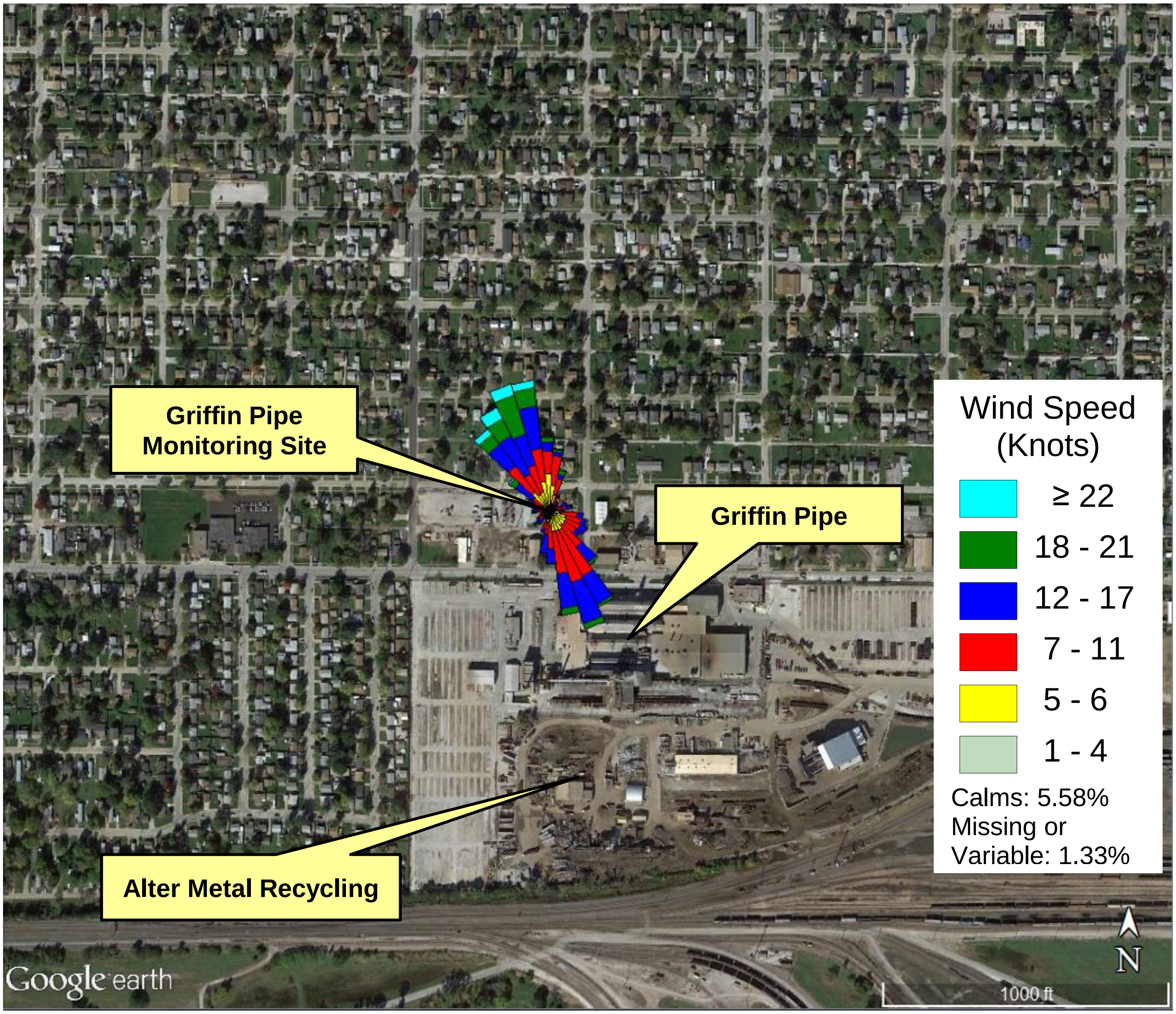


Wind Rose for Days with High Manganese Concentrations



Wind rose depicting primary wind directions and speeds on days where average manganese concentrations were at or above the level of the EPA reference concentration of 50 ng/m^3. The rose shows winds to be primarily southeasterly on days when these high levels occurred. A comparison of these winds, the yearly wind rose and a summary of how the roses are calculated can be found in Appendix C.

Wind Rose for Days with Low Manganese Concentrations



Wind rose depicting primary wind directions and speeds on days where manganese concentrations remained below the level of the EPA reference concentration of 50 ng/m^3. The rose shows winds to be primarily north and northwesterly on days when average concentrations remain below 50 ng/m^3. A comparison of these winds, the yearly wind rose and a summary of how the roses are calculated can be found in Appendix C.

Manganese Raw Data 2014–Council Bluffs

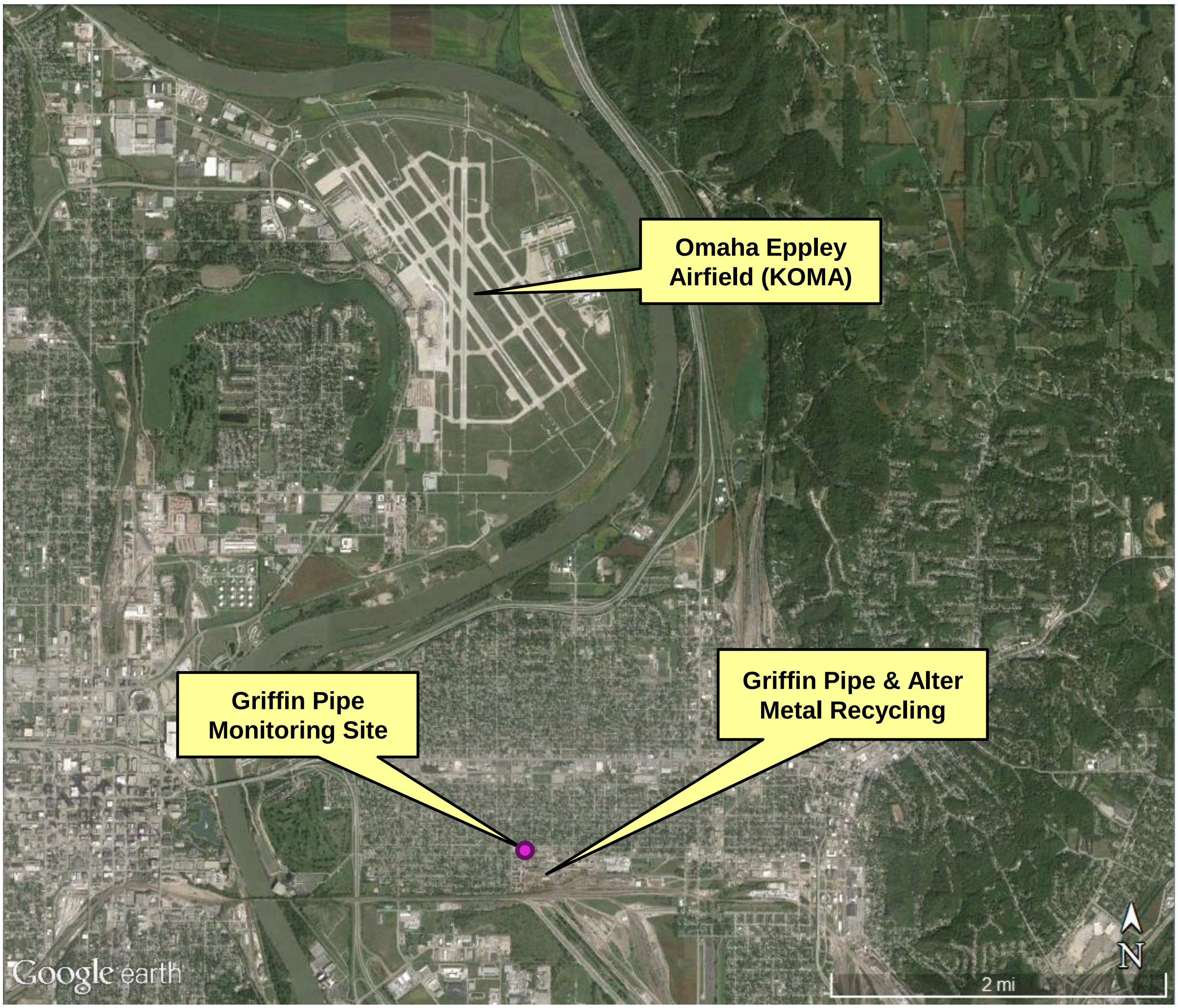
Date	Mn (ng/m^3)
1/2/2014	14.12
1/5/2014	27.78
1/8/2014	36.33
1/11/2014	11.34
1/14/2014	34.7
1/17/2014	36.45
1/20/2014	29.8
1/23/2014	41.8
1/26/2014	50.65
1/29/2014	50.53
2/1/2014	16.72
2/4/2014	13.64
2/7/2014	25.24
2/10/2014	15.53
2/13/2014	56.85
2/16/2014	22.05
2/19/2014	144.12
2/22/2014	6.93
2/25/2014	17.76
2/28/2014	78.86
3/3/2014	62.44
3/6/2014	110.82
3/9/2014	46.37
3/12/2014	44.49
3/15/2014	32.64
3/18/2014	53.78
3/21/2014	59.41
3/24/2014	89.84
3/27/2014	47.4
3/30/2014	60.44
4/2/2014	45.08
4/5/2014	24.15
4/8/2014	27.29
4/11/2014	75.63
4/14/2014	11.52
4/17/2014	23.94
4/20/2014	36.55
4/23/2014	54.46
4/26/2014	85.58
4/29/2014	11.53
5/2/2014	47.77

Date	Mn (ng/m^3)
5/5/2014	42.36
5/8/2014	143.3
5/11/2014	13.52
5/14/2014	
5/17/2014	49.8
5/20/2014	45.9
5/23/2014	67.91
5/26/2014	6.21
5/29/2014	44.15
6/1/2014	64.85
6/4/2014	14.7
6/7/2014	
6/10/2014	38.3
6/13/2014	
6/16/2014	88.49
6/19/2014	
6/22/2014	15.87
6/25/2014	
6/28/2014	20.05
7/1/2014	
7/4/2014	38.12
7/7/2014	
7/10/2014	111.92
7/13/2014	17.88
7/16/2014	65.07
7/19/2014	55.22
7/22/2014	46.71
7/25/2014	87.71
7/28/2014	36.76
7/31/2014	113.85
8/3/2014	12.8
8/6/2014	16.9
8/9/2014	41.64
8/12/2014	25.79
8/15/2014	88.83
8/18/2014	38.11
8/21/2014	62.82
8/24/2014	24.66
8/27/2014	12.87
8/30/2014	9.01
9/2/2014	

Date	Mn (ng/m^3)
9/5/2014	15.68
9/8/2014	
9/10/2014	8.09
9/11/2014	5.56
9/14/2014	11.19
9/17/2014	57.91
9/20/2014	32.08
9/23/2014	109.7
9/26/2014	167.33
9/29/2014	101.09
10/2/2014	8.36
10/5/2014	10.61
10/8/2014	110.65
10/11/2014	44.93
10/14/2014	18.15
10/17/2014	64.56
10/20/2014	53.24
10/23/2014	32.92
10/26/2014	39.33
10/29/2014	60.38
11/1/2014	81.02
11/4/2014	24.86
11/7/2014	107.53
11/10/2014	63.41
11/13/2014	27.98
11/16/2014	7.11
11/19/2014	10.45
11/22/2014	11.95
11/25/2014	46.96
11/28/2014	14.15
12/1/2014	35.11
12/4/2014	76.54
12/7/2014	9.17
12/10/2014	65.76
12/13/2014	17.72
12/16/2014	5.48
12/19/2014	34.76
12/22/2014	14.39
12/25/2014	6.06
12/28/2014	14.94
12/31/2014	8.73

Appendix A. Council Bluffs Monitoring Locations

Manganese data in this report was obtained from the Griffin Pipe Monitoring site located approximately 200 yards northwest of the main stack of the Griffin Pipe Products Company in Council Bluffs, Iowa. Meteorological data was collected at the KOMA Automated Weather Observing system (AWOS) site at the Eppley Airfield in Omaha, Nebraska. KOMA is approximately 3 miles NNW of the Griffin Pipe monitoring site.



Appendix B. Precision Calculations

Let c_i^1 and c_i^2 represent two concentrations from a particular monitoring location taken on the same day. If both are greater than ten times the MDL, then they may be used to estimate the precision of the data at the sampling location as follows:

First compute the average:

$$\overline{c_i} = \frac{c_i^1 + c_i^2}{2}$$

And the mean difference:

$$d_i = \left(\frac{c_i^1 - c_i^2}{\overline{c_i}}\right) \cdot 100$$

Finally, compute the upper confidence limit in the usual way (See: 4.2.1 of 40 CFR Part 58, Appendix A.):

$$Upper\ 90\%\ Confidence\ Limit\ of\ CV = \frac{s}{\sqrt{2}} \cdot \sqrt{\frac{n-1}{X^{-1}(0.90, n-1)}}$$

Where s is the sample standard deviation of the mean difference (d_i), and X^{-1} represents the inverse of the chi-squared distribution.

Appendix C. Wind Rose Explanation and Comparison of Wind Data

The wind rose is a graphical representation of the frequency of a wind from a given direction at a given location. The longer the petal, the more frequently that location experienced winds from that direction.

The colors represent the percentage of time the winds are at a given speed from a direction. Calm winds are not shown on the wind rose. They are denoted at the bottom of the color legend to the right of a wind rose plot.

Wind data selected for this report consisted of all 2014 quality-controlled observations from the nearest Automated Surface Observing System (ASOS) site. The observations are stored on the National Climatic Data Center (NCDC) servers for download. Listed wind speeds are given in knots.

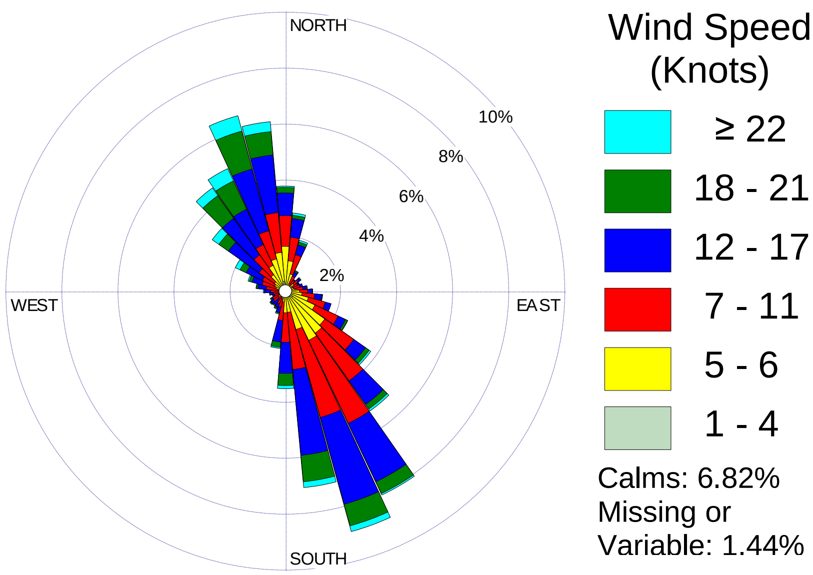


Figure 1: Yearly wind rose from the Omaha Eppley Airfield (KOMA) Automated Surface observing System (ASOS). Prevalent wind directions for the entire year range from the north and northwesterly along with south and southeasterly.

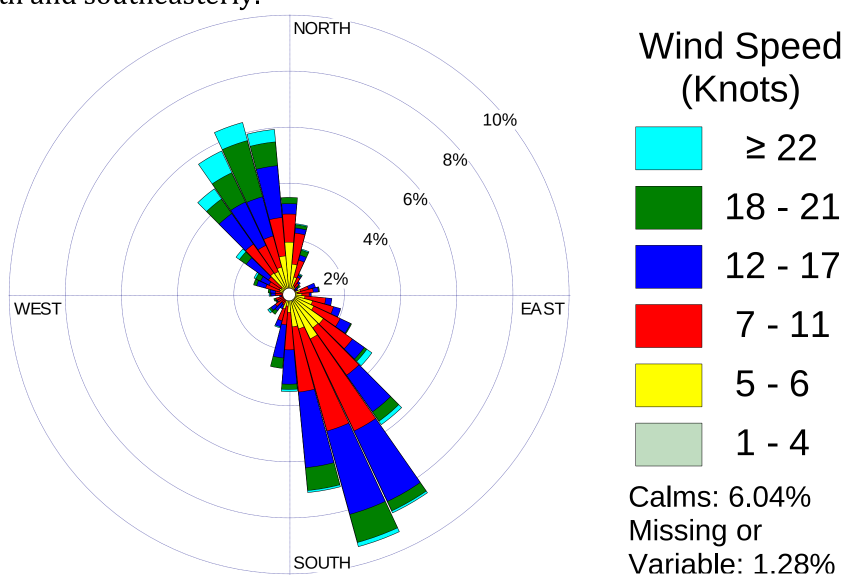


Figure 2: Wind rose from KOMA ASOS on days when manganese sampling occurred. The outputted rose is very similar to the rose representing an entire year's worth of wind data. This suggests that winds on sampling days are representative of and comparable to the whole year's wind data.

Data for the year 2014 was fed into a program that sorted through the dataset and selected the wind reading that was associated with the standard hourly observation time. Special observations were ignored because they may not be representative of the given time period. If winds were variable in direction they were also excluded from the data set.

Figure 1 represents the yearly wind rose from the ASOS site at Omaha Eppley Airfield (KOMA). The wind rose shows that the majority of the winds are from the north, northwest, south and southeast. Most of the wind speeds in a given year are less than seventeen (17) knots.

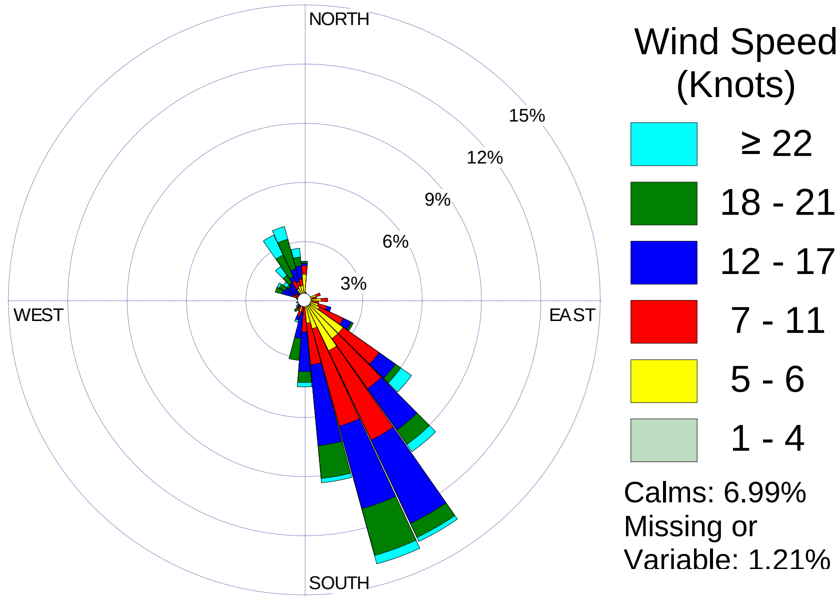


Figure 3: Wind rose from KOMA ASOS on days with high concentrations of manganese. Winds out of the south and southeast are dominant in this diagram which suggests the source is southeast of the monitor.

Figure 2 represents the wind rose on the 114 days in which successful manganese sampling occurred. Data for the wind direction, speed distribution, number of calm winds and missing data are similar to the entire set for 2014. This suggests that the wind data on days where manganese sampling occurred is likely to be representative of the winds throughout 2014.

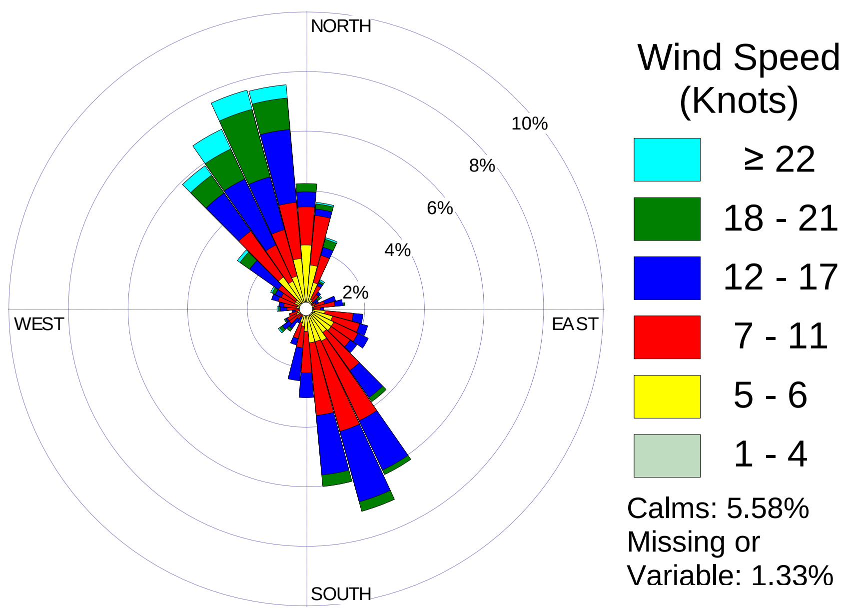


Figure 4: Wind rose showing wind directions and speeds on days when observed manganese concentrations were 50 ng/m^3 or less.

Figure 3 represents the wind rose on the 38 sampling days in which the level of the EPA reference concentration for manganese was exceeded. Over 60% of all recorded non-calm, non-variable and non-missing winds had directions out of the south and southeast on days where concentrations greater than 50 ng/m^3 were recorded.

Figure 4 shows a wind rose on the 76 sampling days in which manganese concentrations were 50 ng/m^3 or less.

The ratio of the number of low to high concentration days is larger than it was last year, consistent with a decreased source strength affecting the monitoring site.

The shape of the wind rose on high concentration days (Figure 3) is similar to last year, suggesting sources to the south and southeast. With stack emissions from Griffin pipe absent after May of 2014, we speculate that the persistent manganese signal originating from this direction is due to previously deposited manganese emissions that have been re-entrained.

The shape of the wind rose on low concentration days (Figure 4) is different than last year. There is now a significant fraction of days when manganese concentrations are less than 50 ng/m^3 with winds out of the south and southeast. This is consistent with the reduction of manganese emissions resulting from Griffin Pipe's shutdown in May of 2014. We speculate that the fugitive manganese emissions from the south and southeast are intermittent.

It is important to note that Figures 2 through 4 represent all hourly winds recorded on manganese sampling days. If the wind switches directions during the course of the day with an elevated manganese concentration, it is not possible to determine if the elevated levels originate from sources in one or both directions.