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South Carolina State Ports Authority – Continuous Air Monitoring Station for the Wando Welch Terminal

Q1 2015 Quarterly Report and Annual Summary

April 2015

South Carolina State Ports Authority - Continuous Air Monitoring Station for the Wando Welch Terminal

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1. Introduction

1.1 Scope

ARCADIS U.S., Inc. (ARCADIS) was contracted in late December 2010 to provide Continuous Air Monitoring Services to the South Carolina State Ports Authority (SCSPA) at the Wando Welch Terminal in Mt. Pleasant, SC. ARCADIS has followed through on the planned schedule and activities since that award. The major accomplishments were to complete the Quality Assurance Plan (QAP), purchase the instruments, complete the site setup, and then to begin acquiring data. This report is the 16th quarterly data report (fourth quarterly report in year four of operations) and presents the data summaries requested by SCSPA and described in the work scope. The data acquisition was started on May 6, 2011 in line with the court mandated start date. This report encompasses a period corresponding to data taken during the period from January 1, 2015 through March 31, 2015, and includes a summary of the fourth year of operations.

1.2 Project Description

SCSPA requested a system to provide ambient air quality data including particulate matter less than 2.5 microns ($PM_{2.5}$), SO_2, and NO_2 for a period of 5 years at the Wando Welch Terminal of the port of Charleston. ARCADIS will maintain the monitoring instruments, stock consumables such as filters and calibration gases, and order spare parts such that downtime will be minimized. ARCADIS has established standard operating procedures to perform daily downloads and to provide Level 1 data validation for the resulting data. This monitoring project setup was relatively straightforward and has proven to be reliable and is generating valid high quality data suitable for use in dispersion modeling or other potential purposes.

The QAP is updated periodically to reflect improvements to the basic operating procedures or to document changes in the air quality standards. An update was performed on September 20, 2012, following the annual maintenance program and an on-site audit by the S.C. Department of Health and Environmental Control (conducted June 14-15, 2012) to reflect actual procedures at the end of the first year of operation. An update was also performed on October 17, 2013, to reflect changes to the National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$. This QAP is written consistent with the current ambient air quality standards for PM, NO_X and SO_2 as defined by the U.S. Environmental Protection Agency.

The location selected for sampling and the sampling equipment has proven to be well-suited for the project as it is centrally located to the port activities and is influenced by local sources and meteorological conditions. Although this is not a typical fence line site, it has shown high value in permitting the evaluation of port activities and related air quality effects. ARCADIS has been able to remotely access the control computer and reliably interact with the instruments. The instruments are very responsive to events such as container handling equipment and the morning openings of the front gates to entering truck traffic. These patterns can be reviewed in the archived data any time in the future.

2. Quarterly Results

The 24-hr daily averages for $PM_{2.5}$, NO, NO_2, NO_X, and SO_2 and the maximum daily values for NO_2 (1-hr average) and SO_2 (1-hr and 3-hr average) for this period are shown in Table 2-1. No exceedances were indicated this quarter. Quarterly statistics showing averages, minimums and maximums for all parameters are summarized in Table 2-2, with the corresponding NAAQS shown in Table 2-3. 24-hr averages for all constituents are also shown graphically in Figure 2-1. Maximum 1-hr averages for NO_2 and SO_2 are shown in Figure 2-2. Statistics are broken down by months and summarized in Table 2-4.

Statistics for the third monitoring year are broken down by months and summarized in Table 2-4. Annual summaries are provided in Figures 2-3 and 2-4 showing the monthly averages for all constituents and the daily maximum 1-hr averages for NO_2 and SO_2 averaged across the respective month.

Table 2-1. 24-Hour Averages and NAAQS daily maximums

24-hour Averages						Daily Max 1-hr Avg.		Daily Max 3-hr Avg.
Date	$PM_{2.5}$ ($\mu g/m^3$)	NO (ppb)	NO_2 (ppb)	NO_X (ppb)	SO_2 (ppb)	NO_2 (ppb)	SO_2 (ppb)	SO_2 (ppb)
1/1/15	16.16	0.13	4.10	4.20	0.34	16.80	1.39	0.76
1/2/15	12.02	8.61	13.27	21.87	0.43	32.14	1.41	1.05
1/3/15	5.70	3.71	5.58	9.29	0.14	25.71	1.57	0.61
1/4/15	4.16	0.73	1.36	2.06	0.08	8.57	1.25	0.06
1/5/15	6.87	12.87	14.33	27.19	0.48	24.97	2.16	1.81
1/6/15	9.46	25.79	18.83	44.61	0.42	31.92	2.95	0.99
1/7/15	9.43	13.38	15.06	28.42	0.39	28.14	0.86	0.70
1/8/15	5.84	6.93	9.81	16.73	0.20	25.66	2.07	0.96
1/9/15	8.94	12.65	19.95	32.59	1.86	33.62	7.01	2.87
1/10/15	10.10	0.94	4.96	5.86	0.49	10.38	3.27	1.65
1/11/15	6.99	0.03	2.26	2.20	0.21	4.57	0.79	0.48
1/12/15	9.52	44.49	19.39	63.85	0.11	41.15	2.12	0.71
1/13/15	5.51	7.62	9.39	16.99	0.21	18.21	2.00	0.38
1/14/15	6.43	8.26	7.77	16.01	0.16	16.27	2.13	0.71
1/15/15	3.46	9.46	11.27	21.34	0.25	24.66	2.39	0.82

24-hour Averages						Daily Max 1-hr Avg.		Daily Max 3-hr Avg.
Date	$PM_{2.5}$ ($\mu g/m^3$)	NO (ppb)	NO_2 (ppb)	NO_X (ppb)	SO_2 (ppb)	NO_2 (ppb)	SO_2 (ppb)	SO_2 (ppb)
1/16/15	7.24	10.71	14.55	25.15	0.00	23.07	0.01	0.00
1/17/15	8.95	0.65	4.53	4.74	0.00	16.56	0.00	0.00
1/18/15	8.11	5.49	13.41	18.66	0.00	33.40	0.02	0.01
1/19/15	7.30	12.38	18.69	30.93	0.10	34.24	0.77	0.44
1/20/15	9.36	14.77	17.80	32.32	0.39	33.87	1.18	0.70
1/21/15	14.44	14.19	23.74	37.71	0.58	46.85	1.35	1.00
1/22/15	15.76	6.91	12.00	18.69	0.10	24.04	0.26	0.22
1/23/15	8.69	6.43	10.09	16.30	0.03	25.98	0.22	0.08
1/24/15	4.75	6.99	9.71	16.55	0.06	20.22	0.20	0.10
1/25/15	7.81	3.76	8.16	11.56	0.38	17.46	2.08	1.06
1/26/15	6.65	9.40	11.67	20.91	0.14	25.93	0.47	0.33
1/27/15	7.65	7.80	13.27	21.04	0.38	23.05	1.15	0.90
1/28/15	9.94	10.68	16.69	27.34	0.90	31.57	1.80	1.63
1/29/15	11.23	23.21	20.96	44.16	0.41	44.67	2.33	1.62
1/30/15	9.29	6.32	10.72	17.02	0.42	21.06	1.15	0.78
1/31/15	6.23	0.74	5.38	6.10	0.16	18.85	0.40	0.32
2/1/15	15.92	1.30	6.35	7.65	0.06	22.00	0.31	0.22
2/2/15	6.72	4.93	7.47	12.40	0.13	15.77	0.62	0.36
2/3/15	8.90	9.59	14.48	24.07	0.24	33.53	1.37	0.83
2/4/15	8.28	8.18	15.58	23.76	0.10	32.39	0.38	0.25
2/5/15	9.67	6.59	10.83	17.42	0.31	25.77	0.82	0.64
2/6/15	8.97	5.47	11.69	17.14	0.50	26.08	2.39	1.17
2/7/15	12.01	14.07	15.30	29.35	0.40	32.32	2.65	1.14
2/8/15	5.27	0.52	3.83	4.34	0.22	8.75	1.47	0.82
2/9/15	9.73	23.19	22.96	46.15	0.21	43.63	0.54	0.42
2/10/15	5.69	4.64	7.83	12.46	0.07	13.03	0.40	0.17
2/11/15	7.33	5.57	10.42	15.97	0.44	16.26	2.04	1.32
2/12/15	*	9.26	12.38	21.63	0.25	25.56	0.92	0.52
2/13/15	*	4.93	10.80	15.70	0.14	29.76	0.42	0.32

24-hour Averages						Daily Max 1-hr Avg.		Daily Max 3-hr Avg.
Date	$PM_{2.5}$ ($\mu g/m^3$)	NO (ppb)	NO_2 (ppb)	NO_X (ppb)	SO_2 (ppb)	NO_2 (ppb)	SO_2 (ppb)	SO_2 (ppb)
2/14/15	*	1.01	6.35	7.34	0.46	18.06	1.67	0.99
2/15/15	*	1.30	4.85	6.14	0.64	25.31	1.63	1.10
2/16/15	*	2.91	10.77	13.68	0.47	23.02	1.31	0.98
2/17/15	*	7.91	10.34	18.24	0.40	28.98	0.92	0.74
2/18/15	*	12.71	14.06	26.76	0.61	31.80	2.74	1.57
2/19/15	*	7.09	10.41	17.49	0.48	18.80	0.68	0.63
2/20/15	*	5.90	9.86	15.73	0.73	18.01	1.41	0.91
2/21/15	*	3.10	7.34	10.38	0.33	16.15	0.73	0.59
2/22/15	*	0.27	3.49	3.65	0.24	9.11	0.66	0.50
2/23/15	*	13.70	12.68	26.34	0.11	30.59	0.40	0.20
2/24/15	*	5.01	11.12	16.11	0.22	19.65	1.27	0.72
2/25/15	6.83	6.69	11.94	18.63	0.51	18.31	1.56	1.30
2/26/15	5.22	6.38	10.86	17.19	0.45	21.84	1.40	0.96
2/27/15	10.46	3.14	9.29	12.35	0.46	16.96	2.44	1.88
2/28/15	11.38	0.26	3.28	3.36	0.38	6.00	1.25	0.97
3/1/15	8.84	0.13	3.40	3.34	0.11	5.72	0.47	0.32
3/2/15	9.30	11.53	10.32	21.76	0.09	22.10	0.80	0.28
3/3/15	9.88	2.61	9.88	12.40	0.02	19.54	0.18	0.06
3/4/15	10.50	8.33	8.35	16.65	0.06	21.23	0.55	0.25
3/5/15	8.01	9.18	9.02	18.14	0.08	15.98	0.57	0.40
3/6/15	5.31	3.12	7.38	10.46	0.06	18.38	0.47	0.23
3/7/15	8.83	1.44	5.82	7.25	0.20	21.46	0.77	0.36
3/8/15	9.19	3.86	10.71	14.57	0.37	31.46	1.55	1.10
3/9/15	13.40	74.30	25.03	99.31	0.36	71.07	2.39	1.52
3/10/15	6.31	20.22	12.46	32.64	0.03	34.86	0.22	0.15
3/11/15	5.90	12.25	8.93	21.16	0.07	20.77	0.41	0.19
3/12/15	6.79	3.20	7.40	10.60	0.03	19.38	0.40	0.13
3/13/15	8.76	1.81	6.44	8.24	0.01	16.21	0.09	0.03
3/14/15	9.08	2.31	4.41	6.69	0.01	9.02	0.29	0.10

24-hour Averages						Daily Max 1-hr Avg.		Daily Max 3-hr Avg.
Date	$PM_{2.5}$ ($\mu g/m^3$)	NO (ppb)	NO_2 (ppb)	NO_X (ppb)	SO_2 (ppb)	NO_2 (ppb)	SO_2 (ppb)	SO_2 (ppb)
3/15/15	4.64	3.42	8.58	11.99	0.18	24.94	1.17	0.67
3/16/15	8.58	13.97	16.99	30.95	0.17	31.53	0.56	0.29
3/17/15	11.77	6.70	15.84	22.53	0.48	34.84	1.74	1.24
3/18/15	10.77	2.46	7.26	9.70	0.04	17.37	0.23	0.15
3/19/15	8.36	3.01	10.05	13.04	0.01	29.13	0.17	0.06
3/20/15	8.65	6.67	13.12	19.78	0.24	20.87	1.68	0.94
3/21/15	8.47	1.35	4.83	6.18	0.02	14.15	0.35	0.12
3/22/15	6.17	0.24	2.09	2.30	0.01	10.23	0.30	0.10
3/23/15	5.02	2.33	6.81	9.11	0.02	17.37	0.48	0.16
3/24/15	8.25	3.36	6.81	10.17	0.03	16.44	0.44	0.15
3/25/15	9.97	4.03	6.71	10.74	0.02	19.41	0.34	0.11
3/26/15	5.15	12.55	13.45	25.98	0.08	28.83	0.48	0.19
3/27/15	5.62	8.48	11.37	19.85	0.06	24.47	0.62	0.29
3/28/15	6.40	5.07	8.83	13.89	0.14	19.95	1.10	0.79
3/29/15	4.58	0.37	2.25	2.60	0.16	5.97	0.82	0.51
3/30/15	8.66	7.25	14.72	21.94	0.07	29.80	0.23	0.17
3/31/15	11.59	16.05	20.41	36.46	0.16	36.30	0.51	0.46

* Instrument failure.

Table 2-2. Quarterly Statistics

24-hour Averages						Daily Max 1-hr Avg.		Daily Max 3-hr Avg.
Date	**$PM_{2.5}$ ($\mu g/m^3$)**	**NO (ppb)**	**NO_2 (ppb)**	**NO_X (ppb)**	**SO_2 (ppb)**	**NO_2 (ppb)**	**SO_2 (ppb)**	**SO_2 (ppb)**
Average	8.43	8.04	10.61	18.60	0.25	23.55	1.13	0.64
Minimum	3.46	0.03	1.36	2.06	0.00	4.57	0.00	0.00
Maximum	16.16	74.30	25.03	99.31	1.86	71.07	7.01	2.87

Table 2-3. National Ambient Air Quality Standards

Pollutant	**Primary/ Secondary**	**Averaging Time**	**Level**	**Form**
NO_2	Primary	1-hour	100 ppb	98th Percentile, averaged over 3 years
	Primary and Secondary	Annual	53 ppb (1)	Annual Mean
SO_2	Primary	1-hour	75 ppb (2)	99th Percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year
$PM_{2.5}$	Primary	Annual	12 $\mu g/m^3$	Annual mean, averaged over 3 years
	Secondary	Annual	15 $\mu g/m^3$	Annual mean, averaged over 3 years
	Primary and Secondary	24-hour	35 $\mu g/m^3$	98th Percentile, averaged over 3 years

(1) The official level of the annual NO2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

(2) Final rule signed June 2, 2010. The 1971 annual and 24-hour SO2 standards were revoked in that same rulemaking. However, these standards remain in effect until one year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

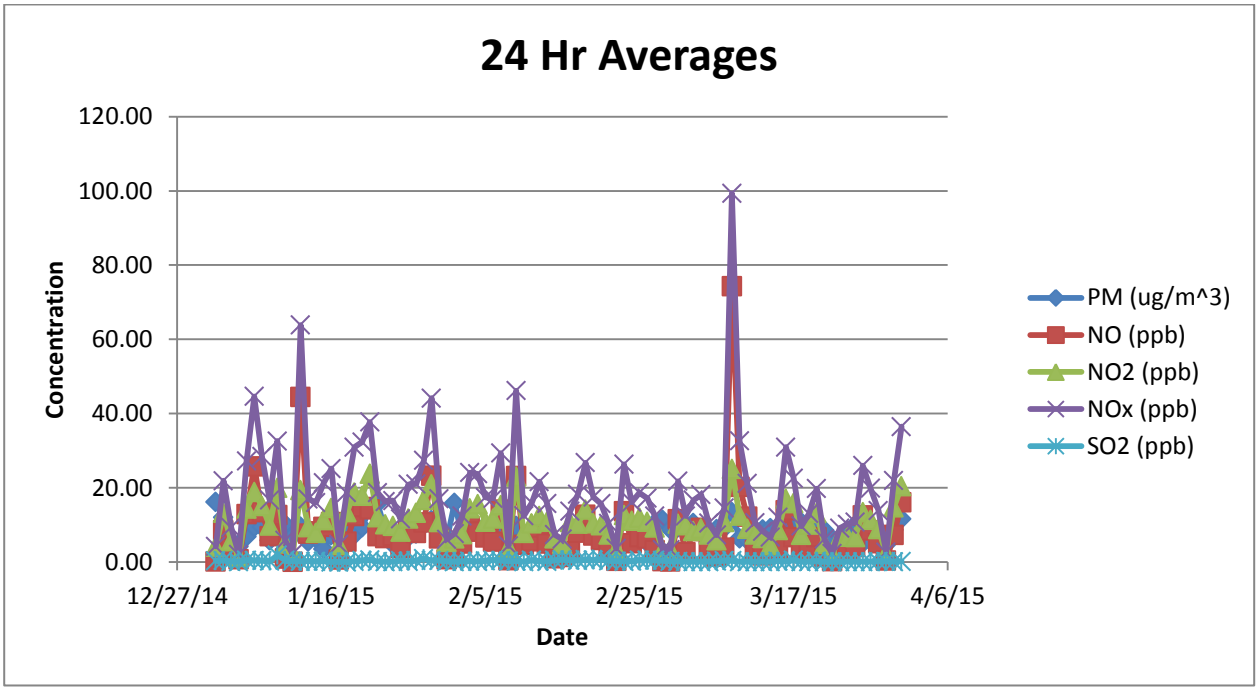

Figure 2-1. 24-hour Averages

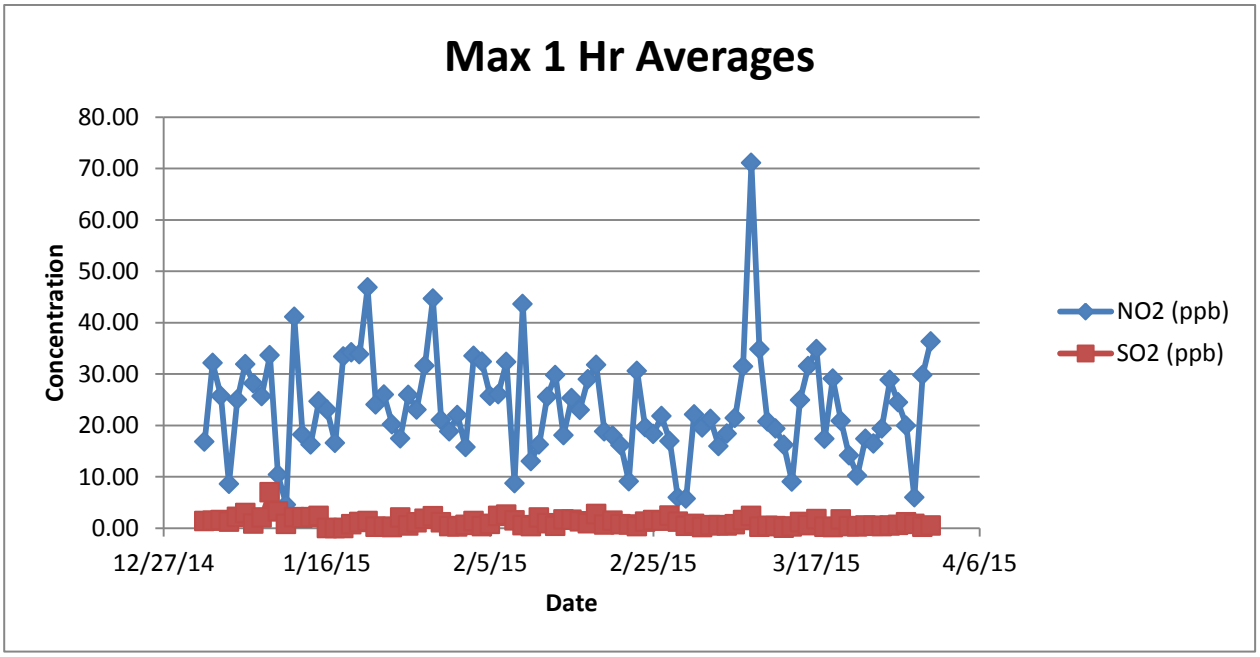

Figure 2-2. Max 1-hour Averages

Table 2-4. Monthly Statistics for All Four Quarters of the Third Monitoring Year

Monthly Averages						Monthly Daily Max 1-hr Avg.		Daily Max 3-hr Avg.
Month	**$PM_{2.5}$ ($\mu g/m^3$)**	**NO (ppb)**	**NO_2 (ppb)**	**NO_X (ppb)**	**SO_2 (ppb)**	**NO_2 (ppb)**	**SO_2 (ppb)**	**SO_2 (ppb)**
April 2014	10.17	5.98	8.90	14.85	0.39	24.23	2.81	1.57
May 2014	12.04	5.45	6.96	12.36	0.90	21.01	4.22	2.58
June 2014	8.98	4.84	5.92	10.38	0.58	16.04	3.33	1.70
July 2014	9.68	5.09	7.12	12.70	0.44	19.07	2.84	1.41
August 2014	11.29	4.37	6.71	11.05	0.71	16.05	3.68	2.05
September 2014	7.18	5.62	5.47	11.05	0.29	16.34	2.90	1.21
October 2014	9.63	10.46	11.07	21.51	0.97	26.69	3.95	2.27
November 2014	10.56	10.25	12.00	22.29	0.85	25.91	3.85	2.32
December 2014	10.51	13.84	12.00	25.77	0.89	25.00	3.36	2.01
January 2015	8.52	9.55	11.89	21.37	0.32	25.28	1.51	0.77
February 2015	8.83	6.27	10.23	16.48	0.34	22.41	1.23	0.79
March 2015	8.15	8.12	9.67	17.76	0.11	22.86	0.66	0.37

* 3-hr SO_2 averages were added to the calculations in July 2014.

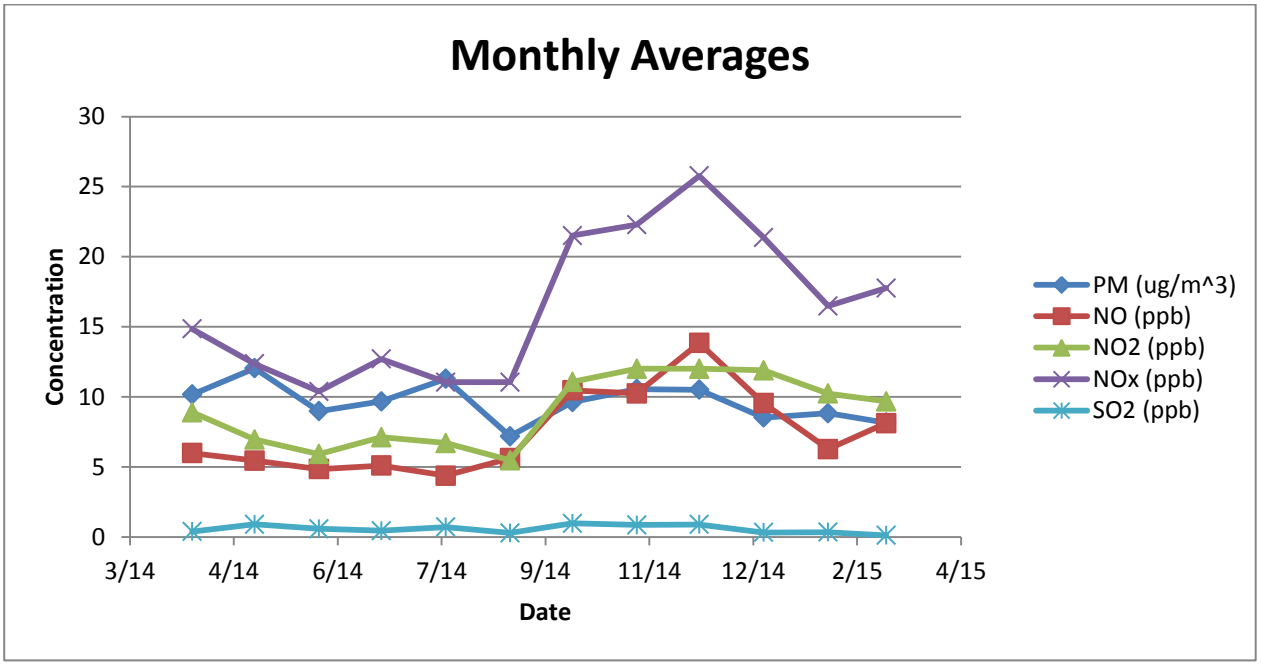

Figure 2-3. Monthly Averages

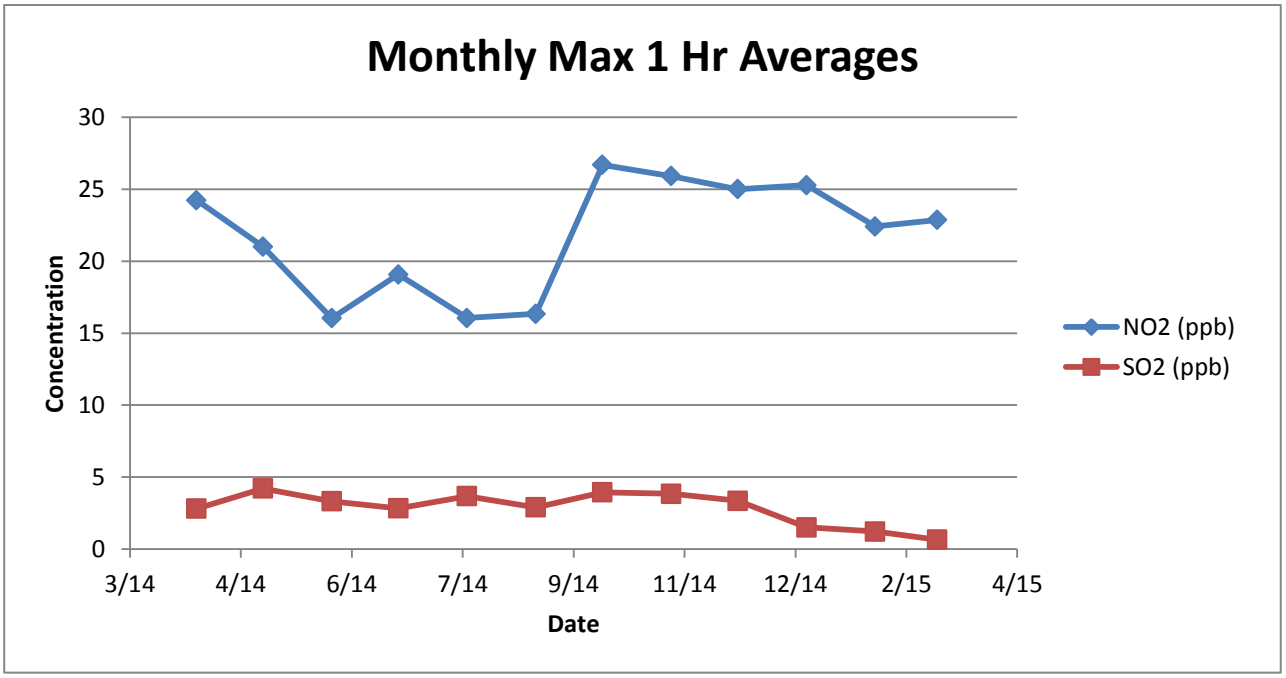

Figure 2-4. Monthly Max 1-hour Averages

2.1 Comparison to NAAQS

Pollutant levels for all measured components at the Wando Welch ambient air monitoring station are below the National Ambient Air Quality Standards (NAAQS). This report marks the four year anniversary of the Wando monitoring station. Many of the NAAQS levels are based on three-year averages. These values have been calculated from the Wando data for comparison to the standard.

2.1.1 NO_2

The primary standard for **NO_2** is 53 ppb (annual arithmetic average) or 100 ppb (3-year average of the 98th percentile of the daily maximum 1-hour average must not exceed 100 ppb). Table 2-4 and Figures 2-3 and 2-4 show that the monthly averages and monthly daily maximum 1-hr averages were below 53 ppb for this fourth year of monitoring (as they were for all previous years of monitoring). Table 2-5 presents the NO_2 NAAQS calculations for each standard.

Table 2-5. NO_2 NAAQS Calculations for Wando Welch Terminal

Pollutant	Primary/ Secondary	Averaging Time	Level	Form	Wando Welch
NO_2	Primary	1-hour	100 ppb	98th Percentile, averaged over 3 years	46 ppb
NO_2	Primary and Secondary	Annual	53 ppb	Annual Mean	Year 2: 8 ppb Year 3: 8 ppb Year 4: 9 ppb

2.1.2 SO_2

The primary standard for **SO_2** is 75 ppb (3-year average of the 99th percentile of the daily maximum 1-hour average must not exceed 75 ppb). The secondary standard for **SO_2** is 0.5 ppm (500 ppb; 3-hour average not to be exceeded more than once per year). Table 2-4 and Figures 2-3 and 2-4 show that the monthly averages and monthly daily maximum 1-hr averages were below 75 ppb for this fourth year of monitoring (as they were for all previous years of monitoring), and that the secondary standard was never exceeded. Table 2-6 presents the SO_2 NAAQS calculations for each standard.

Table 2-6. SO_2 NAAQS Calculations for Wando Welch Terminal

Pollutant	Primary/ Secondary	Averaging Time	Level	Form	Wando Welch
SO_2	Primary	1-hour	75 ppb	99th Percentile of 1-hour daily maximum concentrations, averaged over 3 years	17 ppb
SO_2	Secondary	3-hour	0.5 ppm (500 ppb)	Not to be exceeded more than once per year	2.32 ppb*

* Maximum since 7/14. Values were not calculated prior to this time.

2.1.3 $PM_{2.5}$

The primary standard for **$PM_{2.5}$** is 12.0 µg/m^3 (annual arithmetic average; 3-year average of the weighted annual mean $PM_{2.5}$ concentration must not exceed 12.0 µg/m^3) or 35.0 µg/m^3 (24-hour average; 3-year average of the 98th percentile of the 24-hour concentrations must not exceed 35.0 µg/m^3). The secondary standard for **$PM_{2.5}$** is 15.0 µg/m^3 (annual arithmetic average; 3-year average of the weighted annual mean $PM_{2.5}$ concentration must not exceed 15.0 µg/m^3). Table 2-4 and Figure 2-3 show the monthly averages never exceed 12.04 µg/m^3. Table 2-7 presents the $PM_{2.5}$ NAAQS calculations for each standard, and shows that the Wando Welch Terminal had no exceedances.

Table 2-7. $PM_{2.5}$ NAAQS Calculations for Wando Welch Terminal

Pollutant	Primary/ Secondary	Averaging Time	Level	Form	Wando Welch
$PM_{2.5}$	Primary	Annual	12 µg/m^3	Annual mean, averaged over 3 years	9.7 µg/m^3
$PM_{2.5}$	Secondary	Annual	15 µg/m^3	Annual mean, averaged over 3 years	9.7 µg/m^3
$PM_{2.5}$	Primary and Secondary	24-hour	35 µg/m^3	98th Percentile, averaged over 3 years	19 µg/m^3

2.2 Specific Data Notes

Normal maintenance and instrument calibration procedures were performed several times this quarter. Additional notes can be found in the QA/QC Daily Comment Sheet summary shown in Table 3-1.

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3. Quality Assurance/Quality Control

QA/QC procedures applied to this project are described in a Quality Assurance Plan titled *Continuous Air Monitoring Station for the Wando Welch Terminal* (October 17, 2013, Revision 3).

3.1 Daily QC/Validation

According to the QAP prepared for this work, results were reviewed for anomalies and validated on a daily basis. These validations are recorded on QA/QC Daily Comment Sheets and are summarized in Table 3-1. This table contains a description of any anomalies that occurred over the past quarter along with a record of normal calibration and maintenance activities and the date of occurrence.

Table 3-1. QA/QC Daily Comment Sheet

Date	Comment
1/4/2015	Insufficient data 2:00 - 4:00 due to SO_2 calibration.
1/8/2015	Insufficient data 2:00 - 4:00 due to SO_2 calibration.
1/9/2015	Insufficient data 2:00 - 4:00 due to SO_2 calibration.
1/10/2015	Insufficient data 4:00 - 6:00 due to NOx calibration.
1/13/2015	Insufficient data 2:00 - 4:00 due to SO_2 calibration.
1/15/2015	PM instrument down from 13:00 - 23:00 due to maintenance.
1/16/2015	Insufficient data 2:00 - 4:00 due to SO_2 calibration.
1/17/2015	Insufficient data 2:00 - 4:00 due to SO_2 calibration.
1/18/2015	Insufficient data 2:00 - 4:00 due to SO_2 calibration.
1/20/2015	Insufficient data 2:00 - 4:00 due to SO_2 calibration.
1/21/2015	Insufficient data 4:00 - 6:00 due to NOx calibration.
1/23/2015	Insufficient data 4:00 - 6:00 due to NOx calibration.
1/26/2015	Insufficient data 4:00 - 6:00 due to NOx calibration.
1/29/2015	Insufficient data 14:00 - 15:00 due to system maintenance and audit.
2/1/2015	Insufficient data 4:00 - 6:00 due to NOx calibration.
2/5/2015	Insufficient data 4:00 - 6:00 due to NOx calibration.

Date	Comment
2/8/2015	Insufficient data 4:00 - 6:00 due to NOx calibration.
2/12/2015	PM data missing through 2/24/15 due to low filter roll.
2/15/2015	Insufficient data 2:00 - 4:00 due to SO_2 calibration.
2/21/2015	Insufficient data 4:00 - 6:00 due to NOx calibration.
2/27/2015	Insufficient data 2:00 - 6:00 due to SO_2 and NOx calibrations.
3/8/2015	Insufficient data 2:00 - 3:00 due to daylight savings time adjustment.

3.2 Quarterly Data Validation

The quarterly data were assessed as follows: 100% of the validated Quarter 4 data were flagged as "good". Percent completeness for Quarter 4 was calculated by dividing the number of hours flagged by the macro as "Insufficient Data" for any parameter by the total number of hours in the quarter. Percent completeness for Quarter 4 was 93.7%.

The QAP stated a completeness goal of 90% for $PM_{2.5}$, SO_2 and NO_X. The data collected from April 1, 2014 through March 31, 2015 exceeded this goal.

3.3 Equipment Calibration

As stated in the QAP, daily zero/span checks were performed on the gas analyzers (SO_2 and NO_2), and a full calibration is performed if any instrument does not pass the zero/span check. Calibration of the $PM_{2.5}$ monitor using the mass foil kit provided by the manufacturer was performed during the scheduled annual maintenance in June 2014. An automatic zero adjustment of the mass signal is performed at the start of a new measurement cycle following a filter change (every 8 hours).

3.4 Meteorological Data

The QAP stated a completeness goal of 90% for ambient temperature, relative humidity, wind speed, wind direction, and barometric pressure. The data collected from April 1, 2014 through March 31, 2015 exceeded this goal. The sensors were checked during the scheduled annual maintenance visit in June 2014 to ensure they were consistently providing accurate data.