Review of 2014-2016 Eliot, Maine Air Quality Monitoring Study

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Region 1

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1.0 Introduction

In partnership with the Town of Eliot, Maine, the Maine Department of Environmental Protection (MEDEP), the United States Environmental Protection Agency (EPA) and the New Hampshire Department of Environmental Services (NHDES) began ambient monitoring of sulfur dioxide (SO_2) in Eliot, Maine in October of 2014. Monitoring was agreed to by all parties in order to better understand the dispersion of SO_2 emissions from the nearby Eversource Energy (formally known as Public Service of New Hampshire) Schiller Station power plant, located in Portsmouth, New Hampshire. Concerns about the power plant's emissions arose following EPA's promulgation of a 1-hour SO_2 National Ambient Air Quality Standard (NAAQS) in 2010. Data from the nearby NHDES monitoring station on Peirce Island indicated the Portsmouth area was meeting the 1-hour SO_2 NAAQS, however air dispersion modeling conducted by Wingra Engineering on behalf of the Sierra Club suggested that some locations in the area surrounding Schiller Station may not be meeting the 1-hour SO_2 NAAQS. The Sierra Club modeling data suggested that large portions of Eliot, Maine may have concentrations in exceedance of the 1-hour SO_2 NAAQS caused by Schiller Station. Due to concerns raised by this modeling, the Town of Eliot filed a petition in 2013 pursuant to Section 126 of the Clean Air Act (CAA) alleging 1-hour SO_2 NAAQS violations within the town's political boundary caused by Schiller Station.[1] The Town of Eliot used the Sierra Club modeling as its technical justification for the claim of NAAQS violations. In 2014, the Town of Eliot, EPA, MEDEP and NHDES agreed to place an ambient SO_2 monitor in Eliot to measure actual SO_2 concentrations with the intent of further investigating the possibility that violations of the 1-hour SO_2 NAAQS were occurring. From October 24, 2014 to April 1, 2016, ambient SO_2 concentration data was collected in Eliot by a continuous monitor.

2.0 Background

In consultation with the Town of Eliot, MEDEP, and NHDES, EPA Region 1 led efforts to identify a preferred monitoring location. As part of this process, EPA carefully examined the modeling results provided by Sierra Club for potential areas of maximum impact from Schiller Station (see Figure 1). Modeling indicated high concentrations of SO_2 in an area surrounding Schiller Station (resulting from the phenomenon known as building downwash[2]), at Mount Agamenticus (located 16 km north-northeast of Schiller Station), and along two parallel bands passing through Eliot in a southwest-to-northeast direction. A location in Eliot and the two bands of high concentrations was sought for this monitoring effort. EPA, MEDEP and NHDES mapped and ground searched this area for an appropriate location. While much of this area was heavily wooded, a relatively new residential development on Sawgrass Lane in Eliot, located

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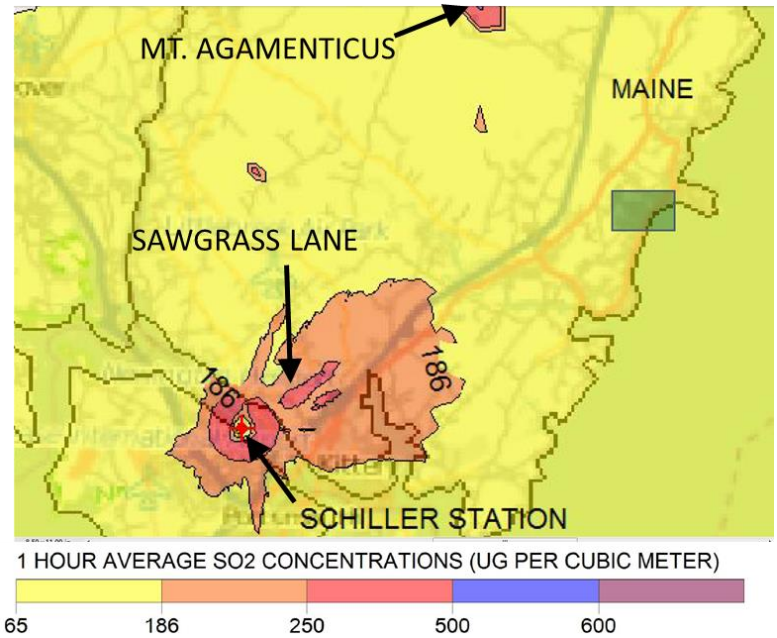
[1] EPA has not made a determination pursuant to Section 126(b) of the Clean Air Act whether to grant or deny the CAA Section 126 petition submitted by the Town of Eliot.

[2] In short, building downwash is caused by airflow patterns near buildings, which can result in a wake area during certain wind conditions. Emissions from nearby release points can be higher in the building wake area than in similar areas without buildings. See Schulman et al (2000) for a more in-depth description of building downwash and a mathematical formulation to simulate its effects. (Lloyd L. Schulman , David G. Strimaitis & Joseph S. Scire (2000). Development and Evaluation of the PRIME Plume Rise and Building Downwash Model, Journal of the Air & Waste Management Association, 50:3, 378-390, DOI: 10.1080/10473289.2000.10464017.)

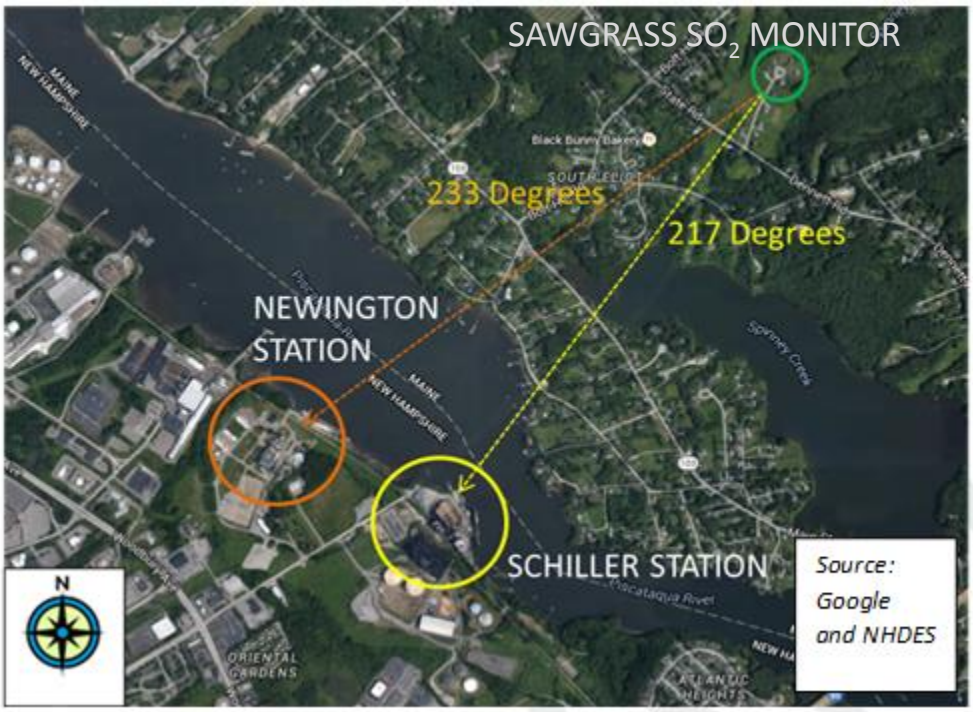
within one of the parallel bands of predicted maximum impact, provided a relatively non-wooded area for location of the monitor, and included a monitoring-friendly cul-de-sac. The center of the cul-de-sac was only a few meters from a Sierra Club modeling receptor that ranked in the 99th percentile in terms of SO_2 concentrations. EPA worked with the Town of Eliot to secure permission to site the SO_2 monitor within the cul-de-sac on Sawgrass Lane (Sawgrass SO_2 Monitor).

Figure 1: Sierra Club Dispersion Modeling Results for Schiller Station



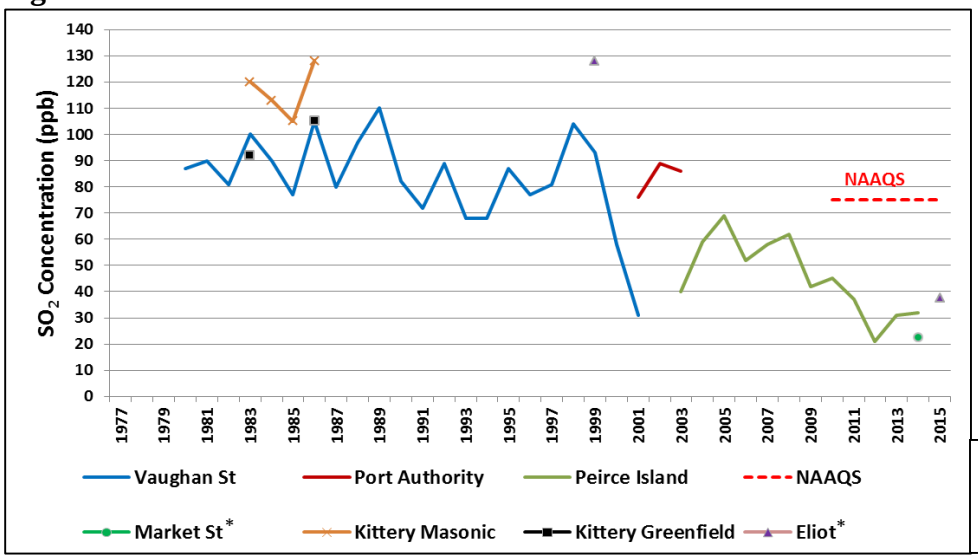
The Sawgrass SO_2 Monitor is located 1.1 miles to the northeast of Schiller Station, with a compass heading from the monitor to the Schiller Station of 217 degrees, and a 233 degrees compass heading from the monitor to nearby Newington Station, an oil- and natural gas-fired electric generating unit also owned and operated by Eversource Energy. (See Figure 2)

Figure 2: Locations of Sawgrass SO_2 Monitor in relation to Schiller and Newington Stations



NHDES has been continuously monitoring SO_2 in the Portsmouth area since 1980, and MEDEP has monitored SO_2 in the nearby town of Kittery, Maine for a brief period in the mid-1980s. Prior to the 2010 1-hour SO_2 NAAQS, all previous SO_2 monitoring data demonstrated compliance with the previously-applicable 3-hour, 24-hour, and annual NAAQS. The general monitoring pattern in Portsmouth and Kittery saw some inter-annual variations, but generally showed a flat trend from 1980 to about 2000. Figure 3 provides annual 99th percentile 1-hour SO_2 concentrations observed at the various monitoring stations in the Portsmouth-Kittery area between 1977 and 2015. See Figure 4 for a map of the area monitors. Vaughan St., Market St., Port Authority, and Peirce Island monitors were located within Portsmouth, New Hampshire, and the Masonic Temple and Greenfield monitors were located in Kittery, Maine. The monitor labeled Eliot was temporary SO_2 monitoring that was briefly conducted by NHDES in 1999.

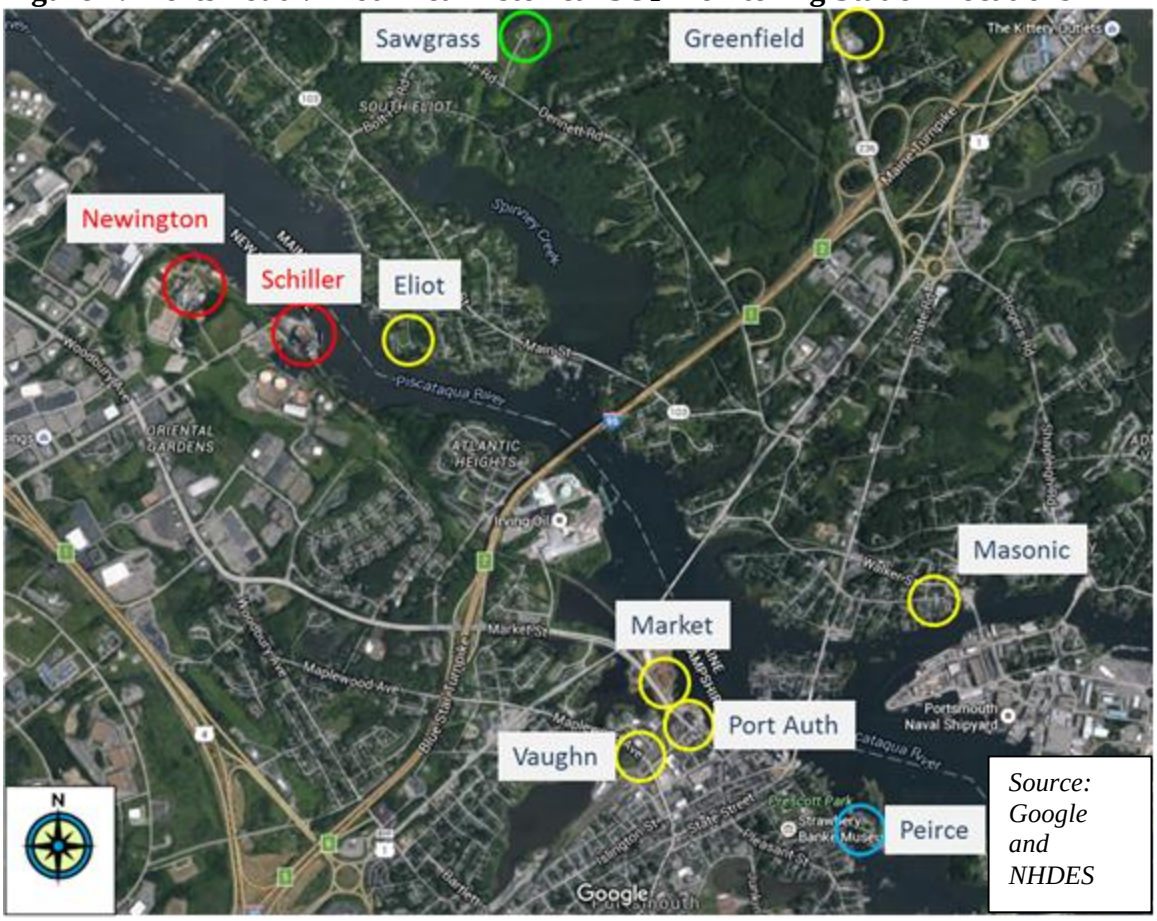
Figure 3: Annual 99th Percentile 1-Hour SO_2 Concentrations - Portsmouth Area



Source: MEDEP and NHDES

** Represents maximum concentration for partial year rather than 99th percentile.*

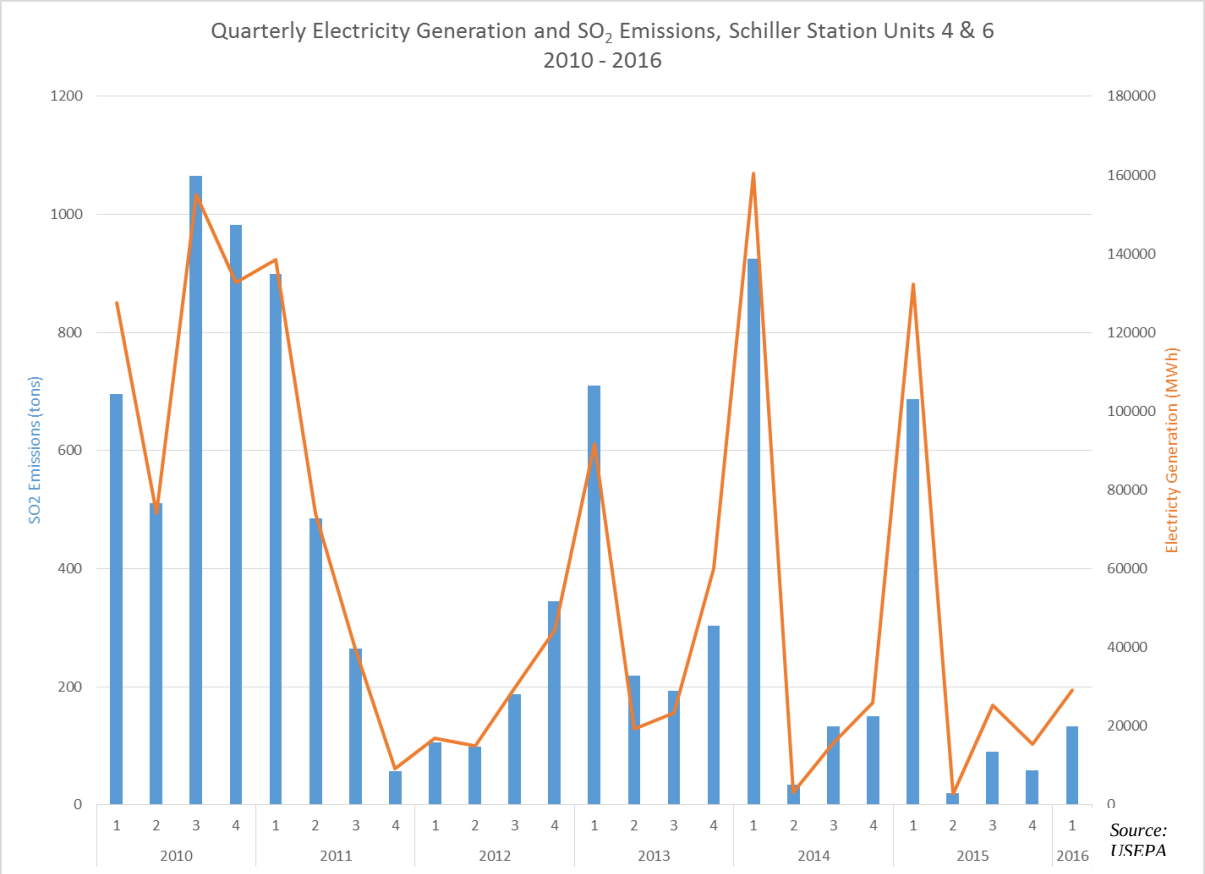
Figure 4: Portsmouth/Eliot Area Historical SO_2 Monitoring Station Locations



Source: Google and NHDES

Since about 2000, measured SO_2 concentrations in Portsmouth declined to concentrations well below the 2010 1-hour NAAQS. In December of 2006, Schiller Station Boiler #5 was converted from coal to wood fuel which reduced its SO_2 emissions and accounted for some of the decrease in SO_2 emissions from Schiller Station. Boiler #5 still retains its ability to burn coal, but has not done so since it initiated wood-burning operations. Schiller's Boiler #4 and #6 continue to burn coal as their primary fuel. Utilization of Schiller's coal-fired boilers has decreased significantly over the past 5 years. Prior to 2011, Schiller Station operated at or near maximum capacity for the majority of the year. Since 2011, Schiller's coal units have seen a steep dip in utilization, resulting in a marked decrease in SO_2 emissions. Quarterly electricity generation and SO_2 emissions since 2010 are provided in Figure 5. Utilization of the coal units is most often observed in the winter months, representing quarters four and one.

Figure 5: Schiller Units 4 & 6 Quarterly Electricity Generation (MWh) and SO_2 Emissions (tons) from 2010 to 2016



3.0 Applicable Regulatory Requirements

The 1-hour SO_2 NAAQS was promulgated by EPA in 2010 to protect human health with an adequate margin of safety based on the latest available epidemiological data. The 2010 SO_2 NAAQS includes a primary and a secondary standard, but the main focus is on the primary version that is protective of human health. The primary standard evaluates a daily maximum 1-

hour averaging period for SO_2. The secondary standard relies on a daily maximum 3-hour averaging period for SO_2 to protect human welfare (wildlife and environmental concerns). A violation of the 2010 1-hour SO_2 NAAQS would occur when the 3-year average of the annual 99th percentile of daily 1-hour maximum SO_2 concentrations exceeds 75 parts per billions (ppb). To violate the secondary SO_2 NAAQS, more than one observed concentration exceeding 500 ppb needs to occur in a calendar year.

On August 22, 2013, the Town of Eliot filed a CAA Section 126 petition with EPA claiming that Schiller Station was causing violations of the primary 2010 1-hour SO_2 NAAQS based on the modeling provided by Sierra Club. Section 126 of the CAA requires EPA to respond to a petition within 60 days of receipt by a notice and comment rulemaking process. EPA's review of the petition revealed legal and technical questions which required further analysis and consideration. EPA issued a notice on November 8, 2013, that determined that 60 days is insufficient time to complete the technical, other analysis and notice-and-comment process required for our review of the petition. The notice therefore extended EPA's deadline for responding to the petition pursuant to the authority provided by CAA section 307(d)(10).[3] During EPA's regular updates with Eliot town officials regarding the status of EPA's action on the pending petition, the town expressed interest in monitoring actual SO_2 concentrations within Eliot. EPA reached out to MEDEP and NHDES to determine if either state air agency had adequate resources to support a monitoring study with Eliot. The states agreed to participate and support the effort. EPA acted as the liaison between Eliot and the states as the monitoring effort commenced.

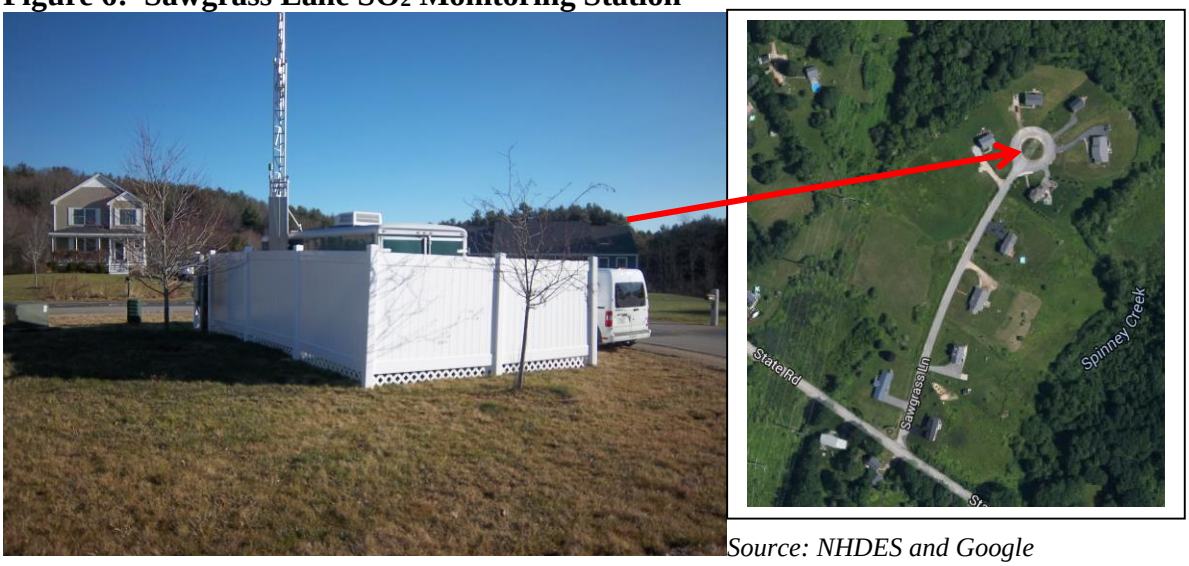
4.0 Air Quality Monitoring

4.1 Sawgrass SO_2 Monitor

Once permissions were secured to place a monitor in the Sawgrass Lane cul-de-sac, MEDEP and NHDES prepared the site for the installation of the temporary Sawgrass SO_2 Monitor. The monitoring station was located in the center of the cul-de-sac and was connected to nearby electrical utilities (Figure 6). The station was originally equipped with two SO_2 monitors, a weather station to measure wind direction and wind speed, calibration equipment, a data logger, and telecommunications equipment (see Figure 7). MEDEP and NHDES worked with one another to validate the data. Through a set of automated reports and websites MEDEP, NHDES and the Town of Eliot made the data available for stakeholders. MEDEP submitted the data to the Air Quality System (AQS), EPA's air quality monitoring data collection system. Additional detail on the monitoring station is provided in Appendix A of this report. All monitoring activities for this project were conducted in accordance with EPA-approved procedures and quality assurance measures. The Sawgrass SO_2 Monitor operated continuously from October 24, 2014 to April 1, 2016.

[3] *See*, "Extension of Deadline for Action on the Section 126 Petition From Eliot, Maine." 78 FR 67036, November 8, 2013

Figure 6: Sawgrass Lane SO_2 Monitoring Station



Source: NHDES and Google

Figure 7: Sawgrass Lane Monitoring Station Equipment

Source: NHDES

The station consisted of an insulated 16 ft. Wells Cargo Trailer with a 30 ft. crank up aluminum tower. Inside, the station equipment included an SO_2 monitor (API T100U, API T100 and/or Thermo 43C SO_2 monitors), an automated gas dilution quality control check system (TECO model 111and API model 700), and a digital data logger and cellular modem system (ESC model 8832 & Sixnet model BT6000).

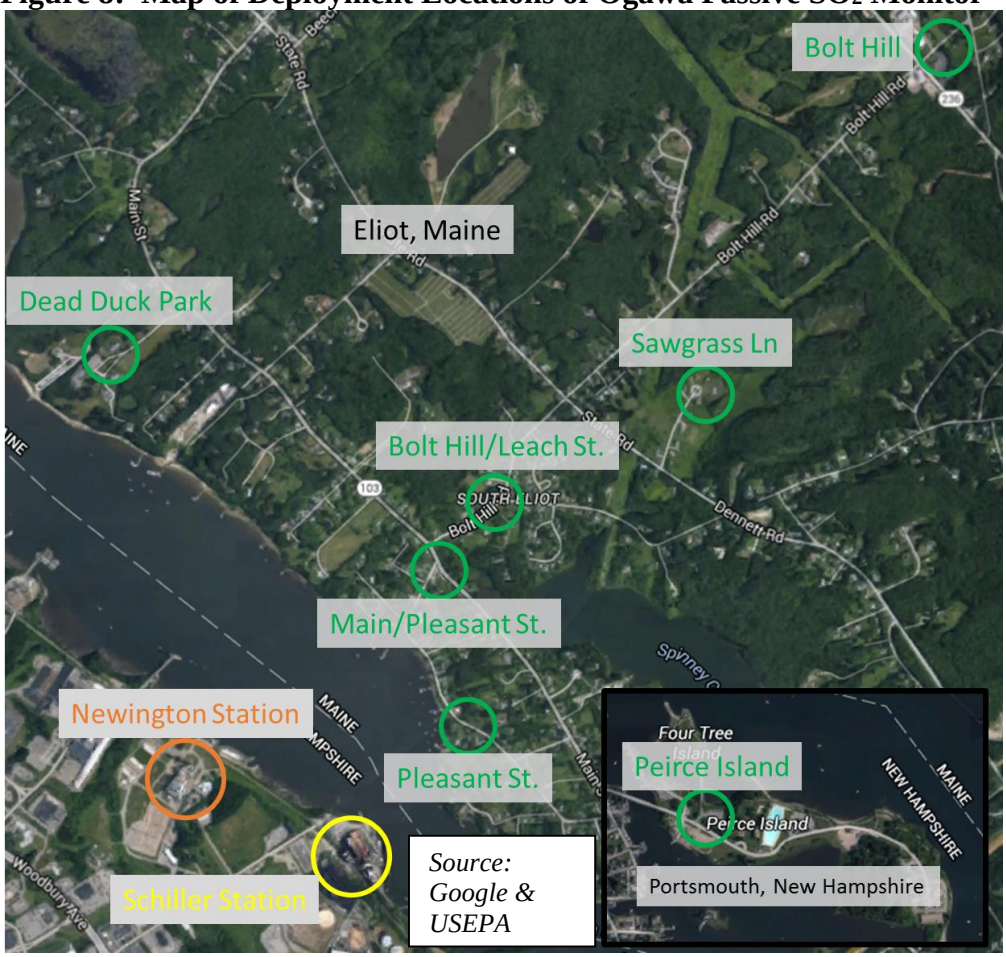
4.2 Passive Sampling and Mobile Monitoring

In addition to the Sawgrass SO_2 Monitor, EPA Region 1 deployed passive samplers and a mobile monitoring van in targeted locations in the Eliot area on select days when elevated SO_2 concentrations were predicted. Beginning in the spring of 2015, Eversource Energy informed NHDES of expected runtime at Schiller Station. Depending on wind and weather conditions, as

well as available staff resources, EPA deployed the passive samplers and/or the mobile monitoring van at predetermined locations downwind from Schiller Station to collect additional SO_2 measurements in the Eliot area. These supplemental monitoring efforts were conducted in an attempt to assess the appropriateness of siting the air quality monitor at Sawgrass Lane, which was based on the considerations described in Section 2 of this report.

Ogawa-brand passive SO_2 samplers were deployed as a network consisting of seven sites throughout Eliot, Maine and Portsmouth, New Hampshire (including two Ogawas co-located at the Sawgrass SO_2 Monitor and Peirce Island, respectively). A map of deployment locations is provided in Figure 8. Deployment was conducted in a manner consistent with the manufacturer's recommended operating procedures[4]. When deployed, Ogawas were placed at approximately 2-3 meters above ground level. Monitors were housed in open-air shelters with solid roofs to shield them from rain or snow during the deployment period. The shelters were placed facing the predominant wind direction. Figure 9 and 10 depict an Ogawa monitor in a laboratory setting and an Ogawa deployed within its open-air shelter.

Figure 8: Map of Deployment Locations of Ogawa Passive SO_2 Monitor



[4] Recommended Operating Procedure for Monitoring Ground- Level Ozone, NO_2 and SO_2 Using Passive Sampling Devices and Analysis by Ion Chromatography, Revision, April 2005. Ogawa USA. http://ogawausa.com/

Figure 9: Ogawa Passive Sampler Used in Eliot/Portsmouth Monitoring Efforts

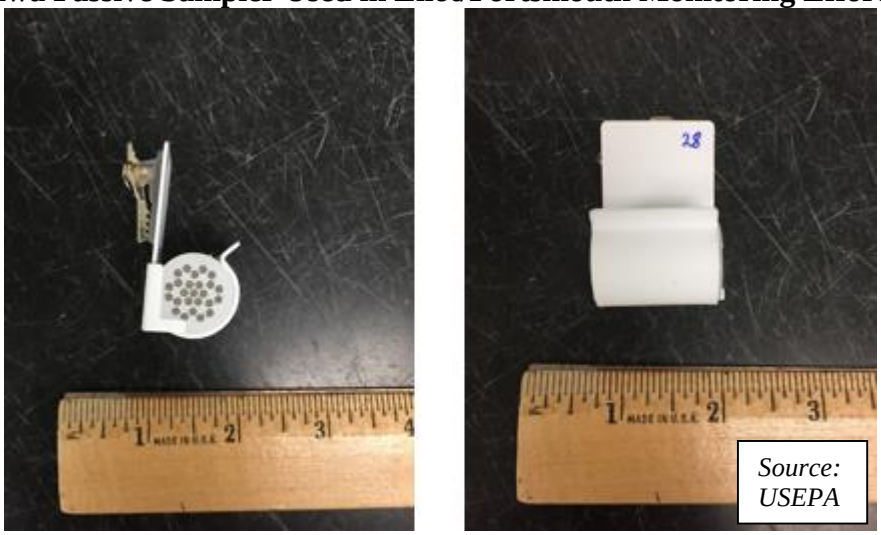


Figure 10: Ogawa Passive Sampler Deployed in its Shelter at Main/Pleasant St. Location (yellow circle added)

A chain of custody procedure was followed, including from the time of deployment to the time of shipment to RTI, Inc. for laboratory analysis. Samplers were deployed for a time period of 24 hours, which, upon analysis by RTI, Inc., yielded an average 24-hour SO_2 concentration for a specific deployment location. While the 24-hour averaging period cannot be directly compared to the 1-hour averaging period measured at the Sawgrass SO_2 Monitor or the Peirce Island monitor, the advantage of the using Ogawa samplers was their low-cost and ability to provide

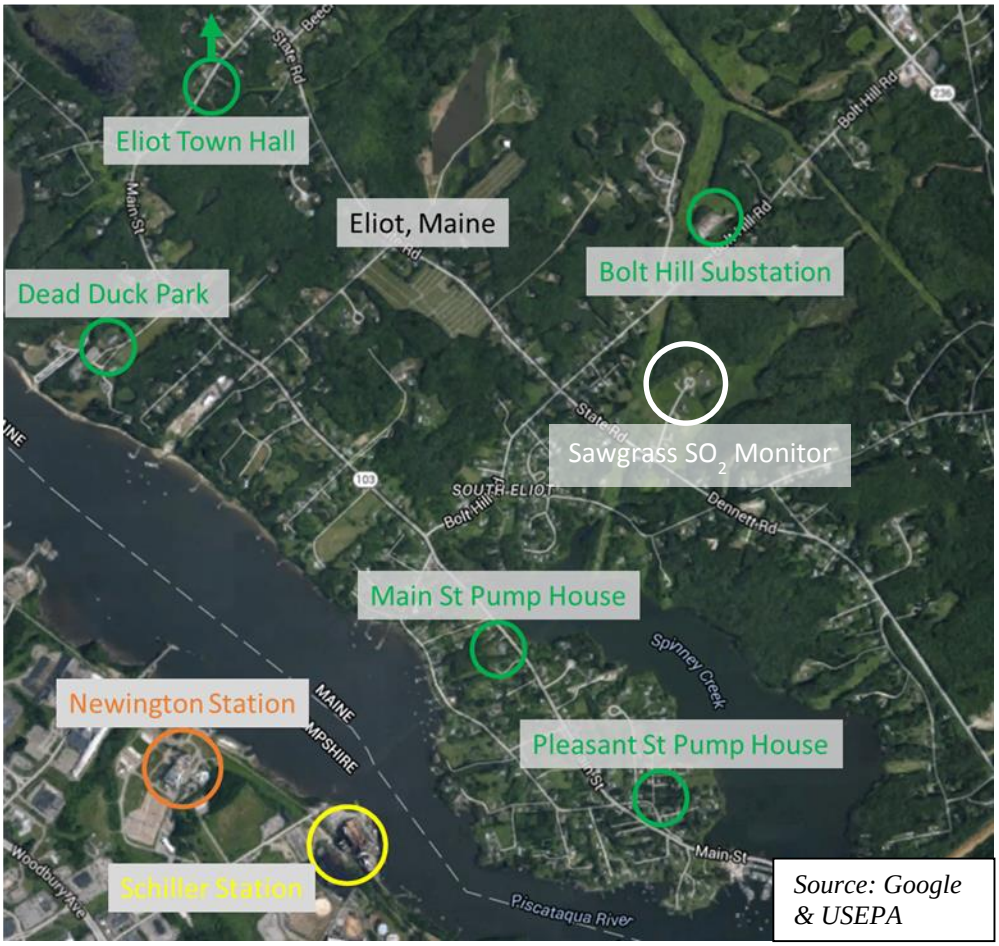
simultaneous measurements across several locations. By siting samplers at the Sawgrass SO_2 Monitor and the Peirce Island monitor, comparisons between the sites could be made for any differences in observed concentrations.

An EPA-owned van equipped with continuous SO_2 monitoring equipment was also deployed to measure SO_2 concentrations at various locations throughout Eliot on days when higher SO_2 concentrations were predicted. Monitoring equipment installed in the van was equivalent to that installed at the Sawgrass SO_2 Monitor and consisted of a Thermo 43i-TLE Federal Reference/ Equivalent Method SO_2 monitor. Photos of the van and the monitoring equipment are provided in Figure 11. A sampling probe was affixed to the roof of the van during deployment, and engine exhaust was vented away from the probe. Figure 12 provides locations where the van-based SO_2 monitoring was conducted. Monitoring locations were chosen by local wind speed, wind direction, and real-time concentrations being measured via the onboard monitoring equipment. By measuring SO_2 for short durations (up to three hours) at a number of locations with the high quality/high resolution monitoring equipment, one could compare those values with those observed at the Sawgrass SO_2 Monitor during the same time period.

Figure 11: EPA Van Used to Conduct High Quality/High Resolution SO_2 Monitoring in Eliot, Maine

Source: USEPA

Figure 12: Map of Deployment Locations of Van-Based High Quality/High Resolution SO_2 Monitoring in Eliot, Maine



Source: Google & USEPA

5.0 Study Results and Discussion

Data summarized in this report was collected for a period just over 17-months from October 24, 2014 through April 1, 2016.

5.1 Sawgrass SO_2 Monitor and Other Nearby Monitoring Data Summaries

As shown in Table 1, the highest 1-hour SO_2 concentration at the Sawgrass SO_2 Monitor in Eliot was 37.7 ppb measured on January 8, 2015. The highest concentrations observed during the same 17-month period at SO_2 monitoring stations located at Peirce Island (located in Portsmouth, New Hampshire) and Londonderry, New Hampshire were 30.2 ppb and 9.2 ppb, respectively. As stated previously in this report, the 1-hour SO_2 NAAQS is 75 ppb. There were no 3-hour averaging periods that approached the 500 ppb secondary standard.

Table 1: Summary of Sawgrass/Peirce Island/Londonderry 1-Hour SO_2 Concentrations (ppb) – October 24, 2014 - April 1, 2016

	Sawgrass	Peirce Island	Londonderry
Maximum	37.7	30.2	9.2
99th Percentile	25.8	22.1	5.7
Average	1.8	3.2	1.4
Number of Days >10 ppb	20	33	0

Figures 13 through 19 each display a 2-month interval from late October 2014 to December 2015 and Figure 20 displays a 3-month interval from Jan 2016 to April 2016 of 1-hour SO_2 monitoring data measured at the Sawgrass SO_2 Monitor (referred to as Eliot), Peirce Island monitoring station (referred to as Portsmouth), and the Londonderry monitoring station. The orange dotted line represents the 75 ppb threshold for the 1-hour SO_2 NAAQS. As summarized above, no exceedances of the NAAQS were observed during the monitoring period. Additional analyses of the monitoring data are provided in Appendix B.

Figure 13: October 24 through December 31, 2014 Running 1-Hour SO_2 Concentrations

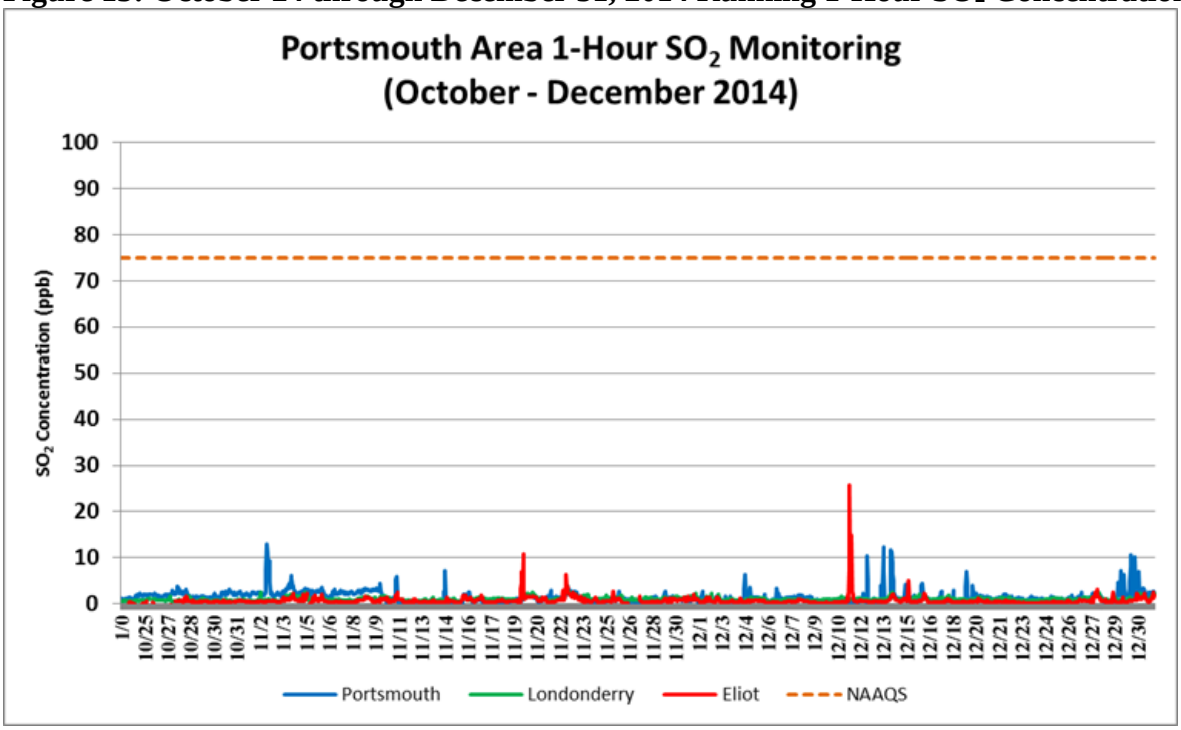


Figure 14: January 1 through February 28, 2015 Running 1-Hour SO_2 Concentrations

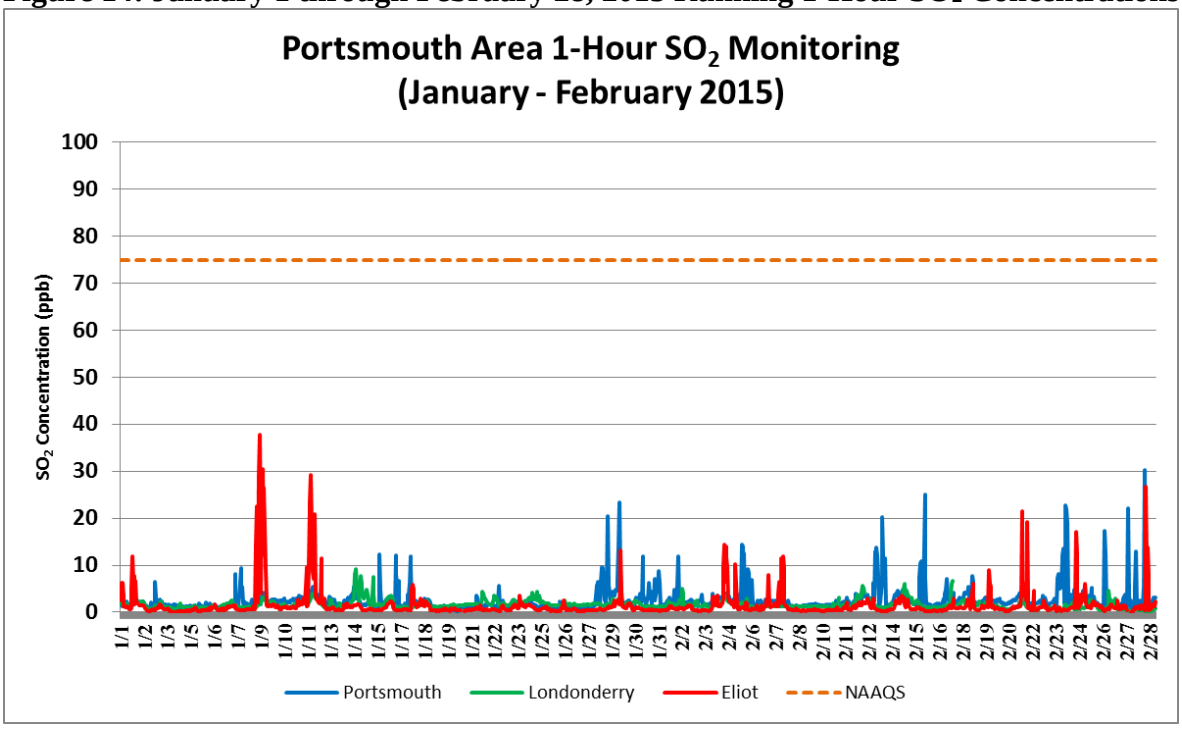


Figure 15: March 1 through April 30, 2015 Running 1-Hour SO_2 Concentrations

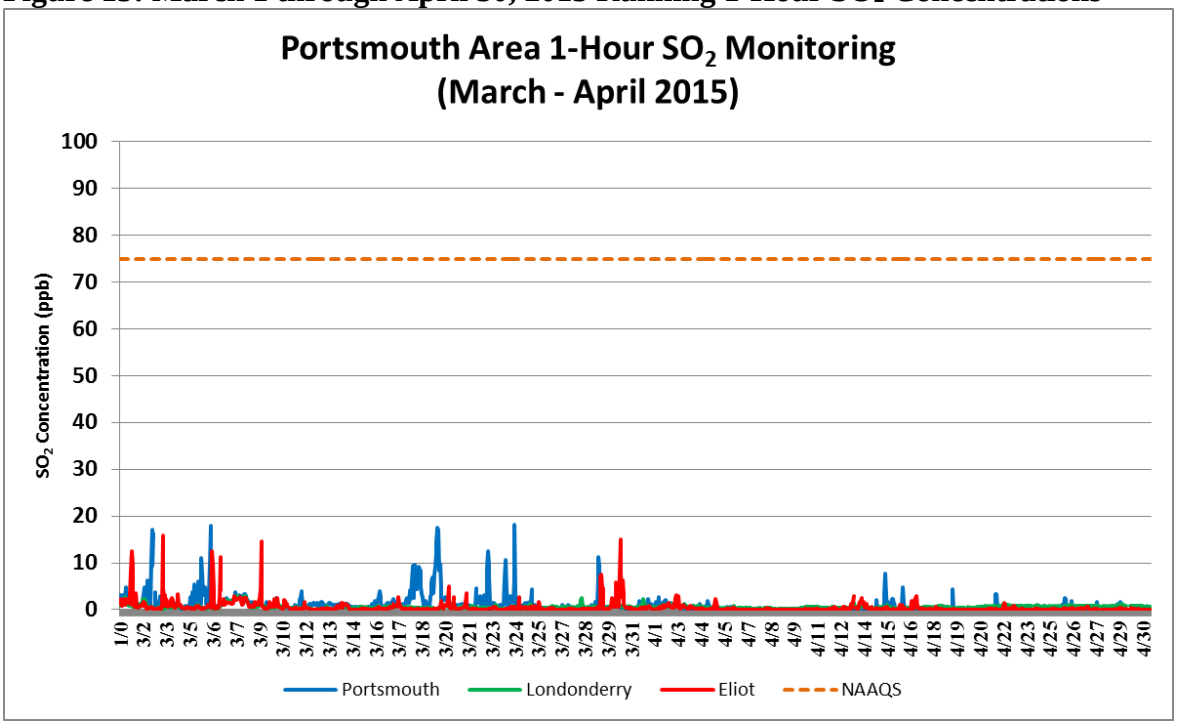


Figure 16: May 1 through June 30, 2015 Running 1-Hour SO_2 Concentrations

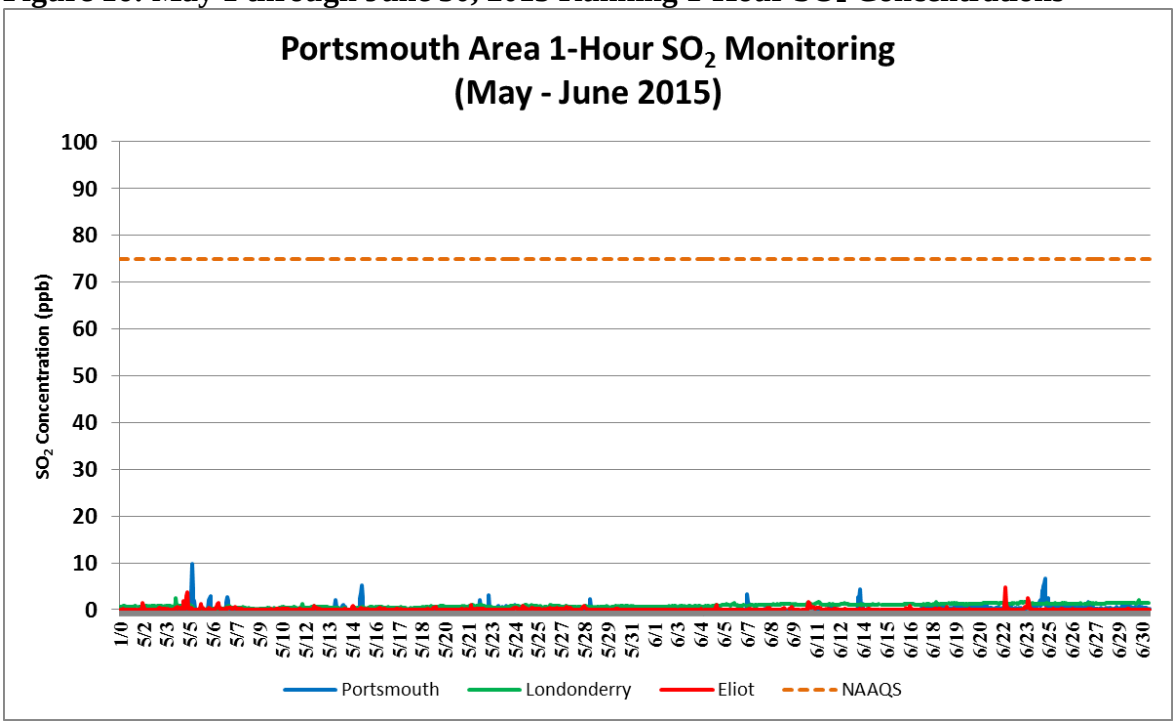


Figure 17: July 1 through August 31, 2015 Running 1-Hour SO_2 Concentrations

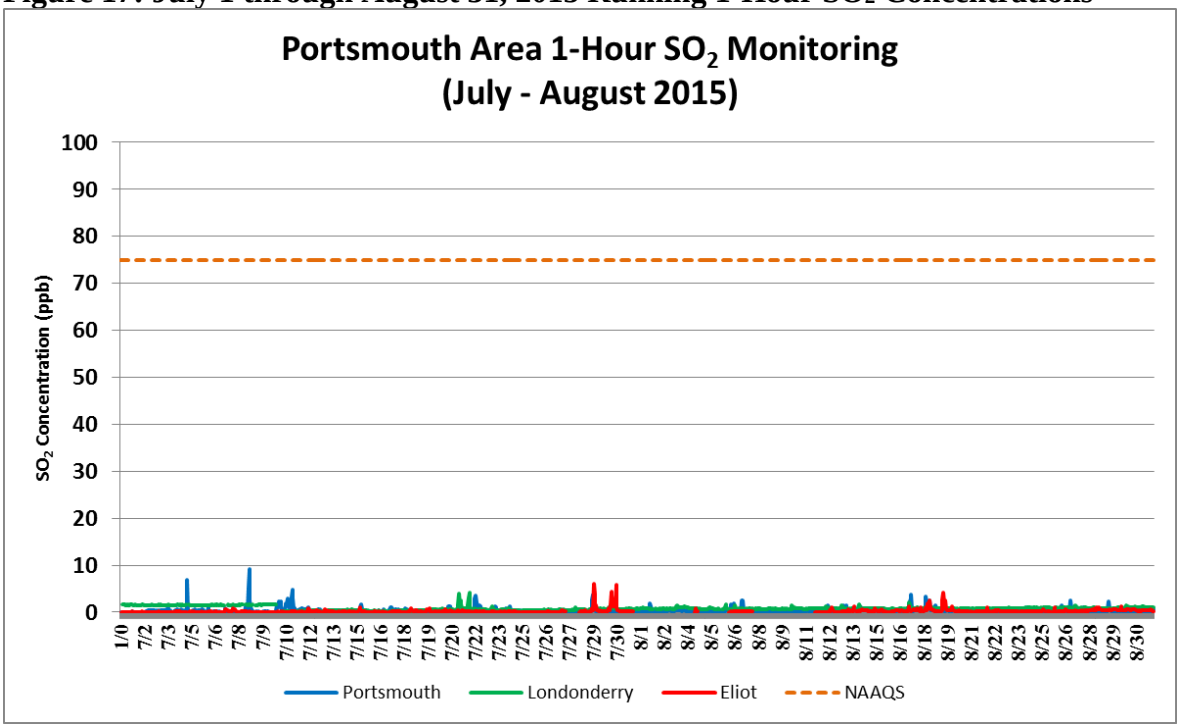


Figure 18: September 1 through October 31, 2015 Running 1-Hour SO_2 Concentrations

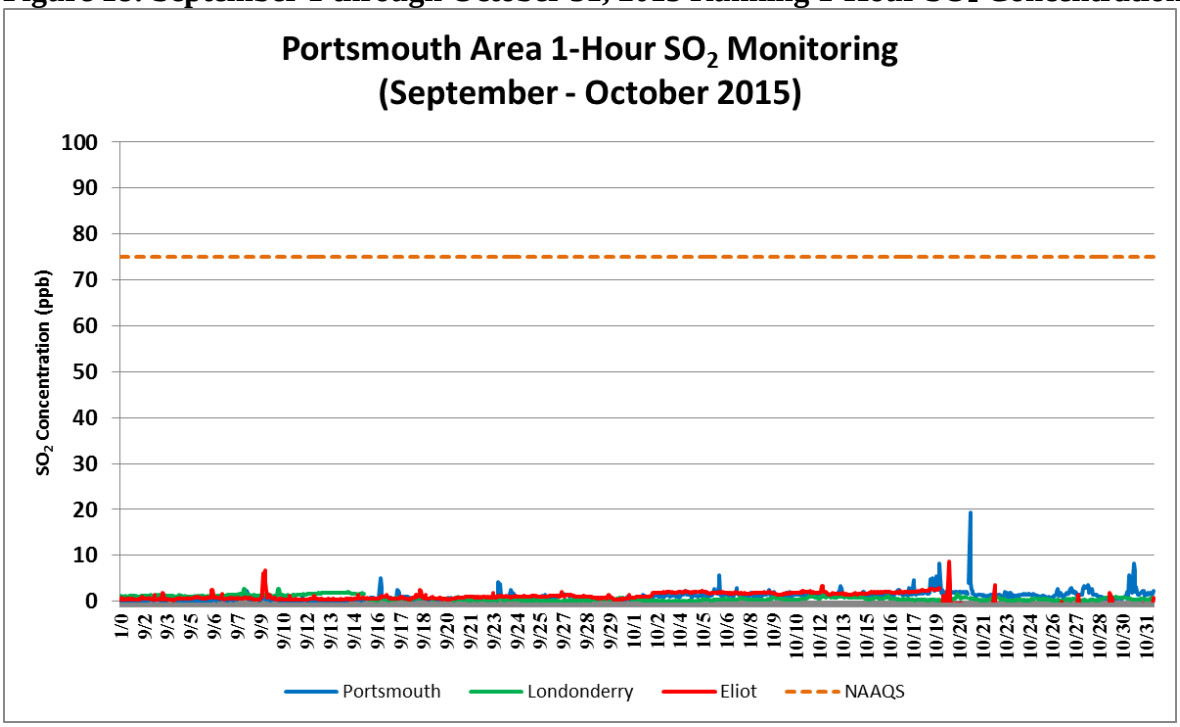


Figure 19: November 1 through December 31, 2015 Running 1-Hour SO_2 Concentrations

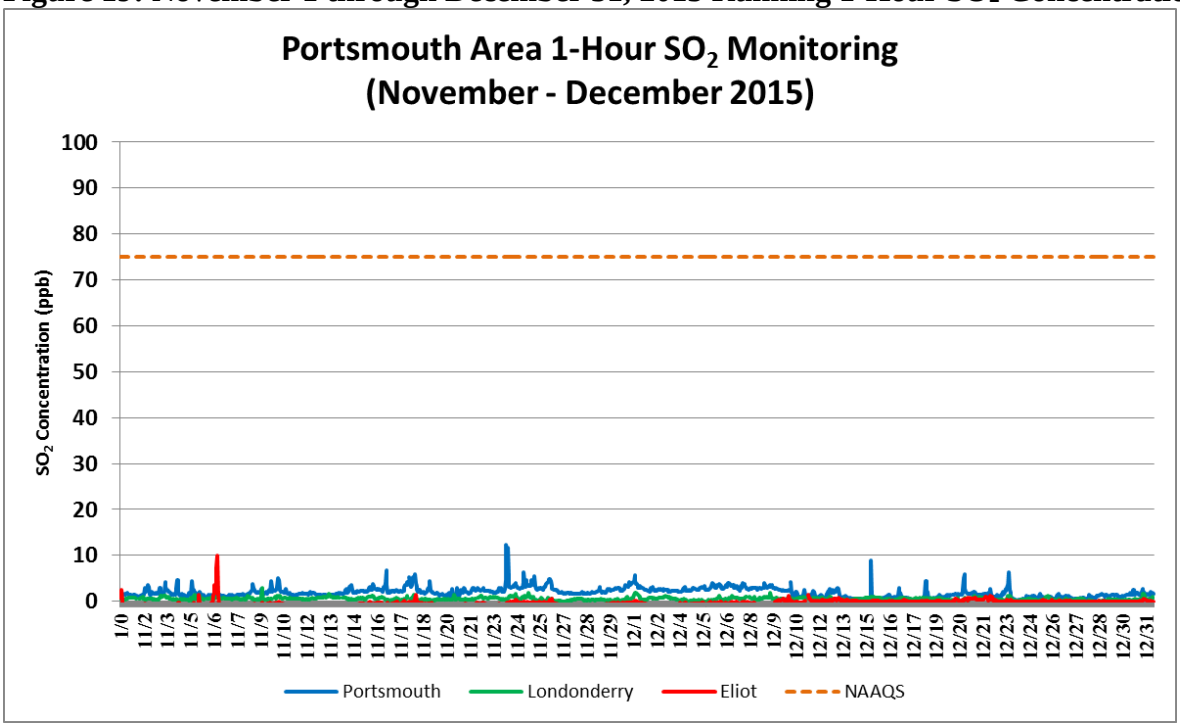
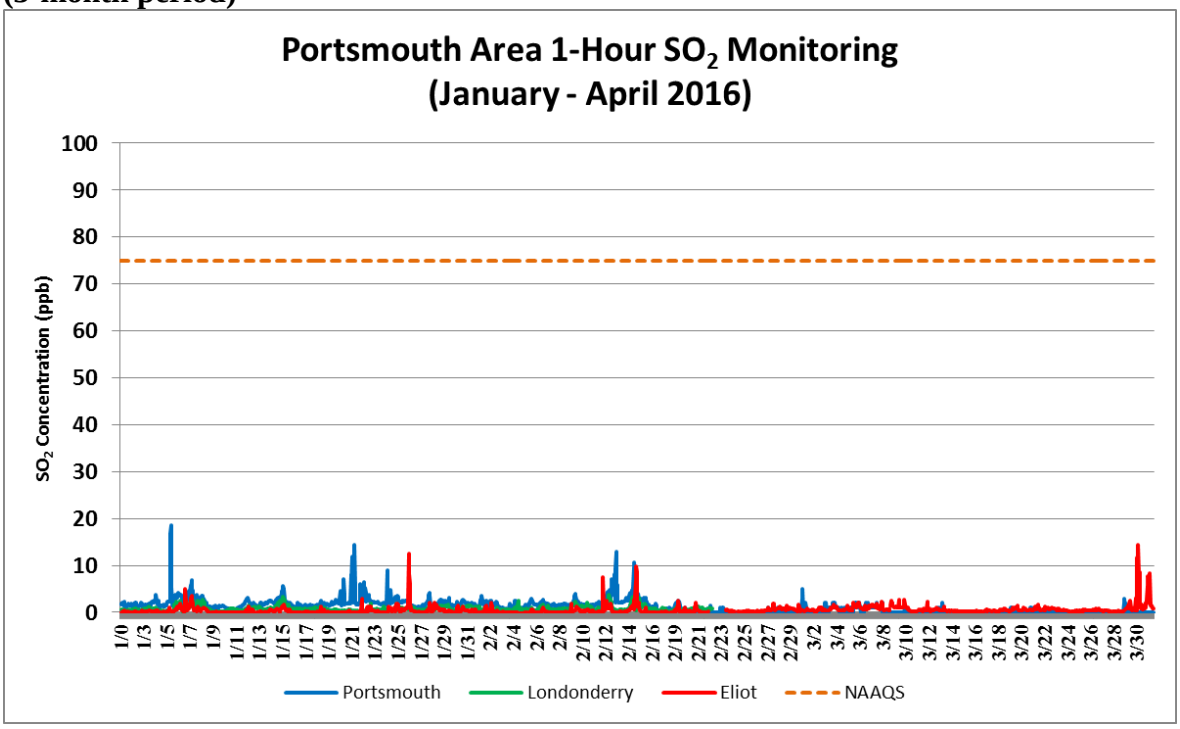


Figure 20: January 1 through April 1, 2016 Running 1-Hour SO_2 Concentrations (3-month period)



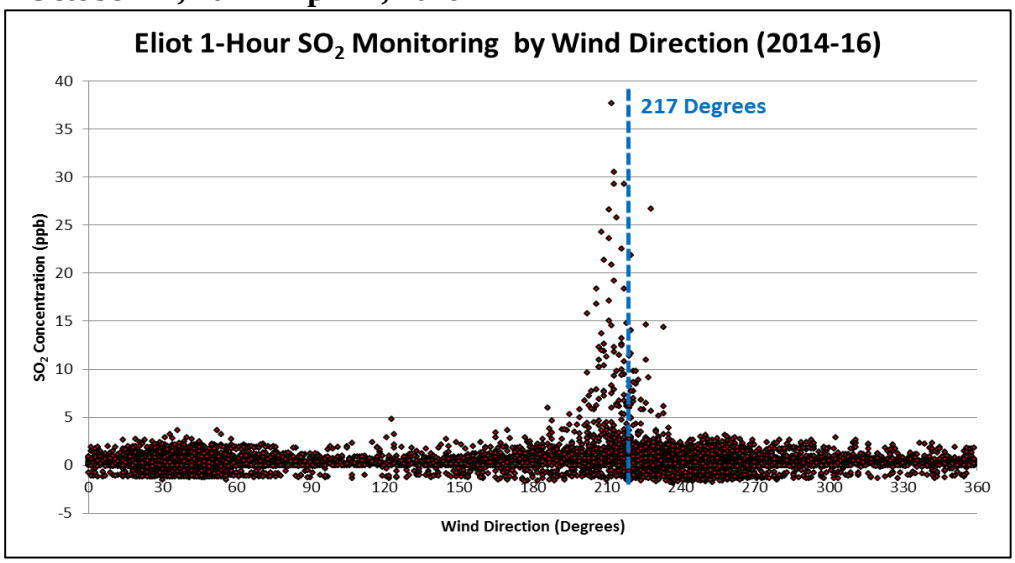
As noted before in Figure 2, the compass heading from the Sawgrass Lane monitor to Schiller Station is 217 degrees and to Newington Station is 233 degrees. This information is useful when comparing measured concentrations with wind direction information. If a pattern appears where elevated SO_2 concentrations occur with wind directions from 217 degrees, then there is an increased probability that Schiller Station is contributing to the elevated SO_2 observations.

Figure 21 displays all 1-hour SO_2 concentrations and corresponding wind directions observed between October 2014 and April 2016 from the Sawgrass SO_2 Monitor. A pattern appears where increased 1-hour SO_2 concentrations occur when wind directions are approximately 217 degrees. This information suggests that during the study period, Schiller Station contributed to the highest SO_2 concentration levels measured at the Sawgrass SO_2 Monitor, but not to a level where the NAAQS was being exceeded.

<u>Note Regarding Wind Directions:</u>

Wind direction information provided in this report is based on averages of instantaneous values. By nature, winds vary in direction and speed from moment to moment and should be interpreted as a guide and not as proof or disproof that upwind sources are affecting downwind locations. However, consistent patterns can strongly suggest such connections.

Figure 21: Hourly SO_2 Concentrations at Sawgrass SO_2 Monitor (Eliot) by Wind Direction – October 24, 2014 - April 1, 2016

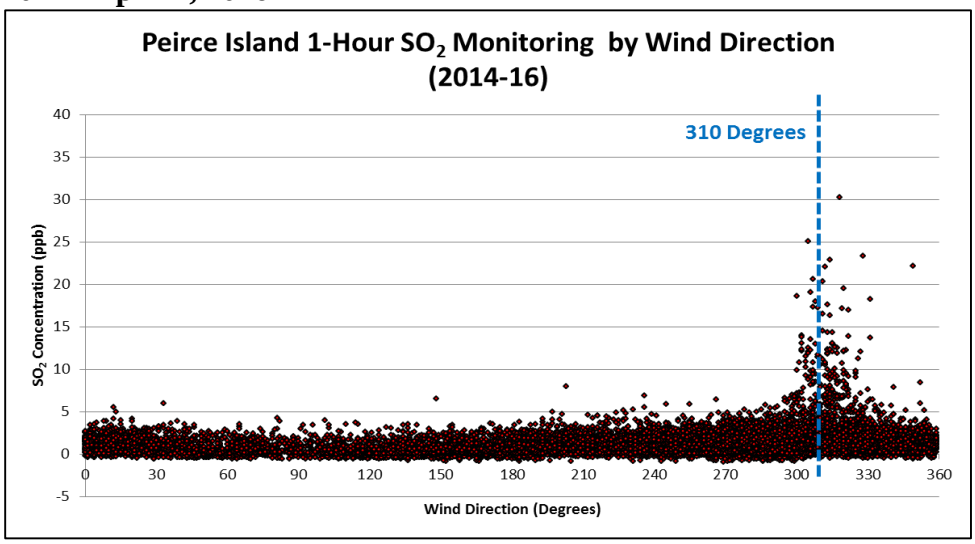


This same analysis can be conducted for other locations. Figures 22 and 23 show 1-hour SO_2 concentrations plotted by corresponding wind directions for Peirce Island and Londonderry, respectively. From the Peirce Island monitor to Schiller Station, the compass heading is 310 degrees. A distance of approximately 2.5 miles separates the two points. From the Londonderry monitor, Schiller Station has a heading of approximately 60 degrees and Merrimack Station has a heading of approximately 340 degrees. The Londonderry monitor is approximately 34 miles from Schiller Station and approximately 20 miles from Merrimack Station.[5]

The Peirce Island monitor shows increased SO_2 concentrations clustering when wind directions have a heading of approximately 310 degrees, which aligns with the direction of Schiller Station. Triangulating this information with the findings in Figure 15 for the Sawgrass SO_2 Monitor leads to the conclusion that there is no other significant source of SO_2 emissions besides Schiller Station, except for possibly nearby Newington Station.

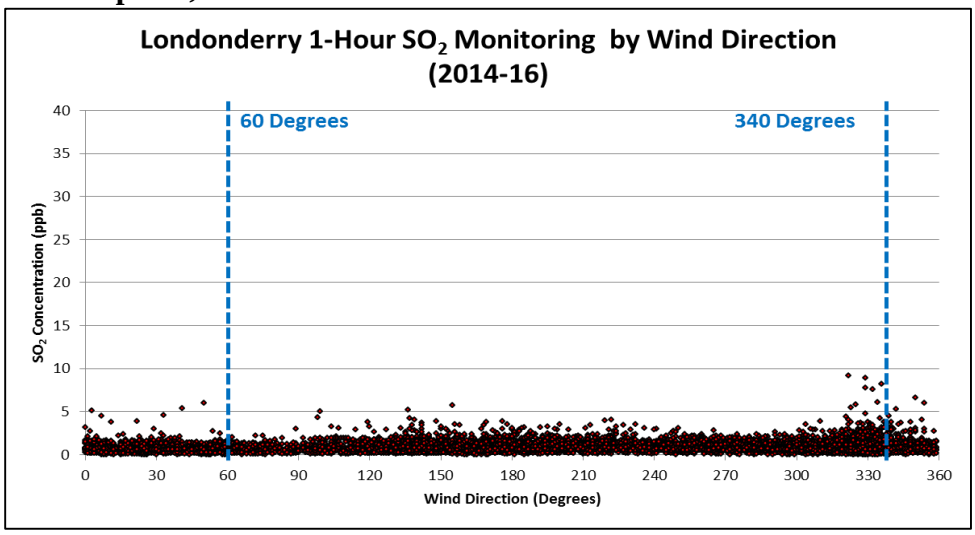
[5] Merrimack Station is a fossil fuel-fired electricity generating facility that has two utility boilers that primarily burn bituminous coal and the two combustion turbines that primarily burn fuel oil or jet fuel. Merrimack is located in Bow, New Hampshire and is also owned and operated by Eversource Energy.

Figure 22: Hourly SO_2 Concentrations at Peirce Island by Wind Direction – October 24, 2014 - April 1, 2016



Data for Londonderry shows an indistinguishable affect from Schiller Station as there is no notable concentration peak corresponding to winds coming from 60 degrees. However, there is a small cluster of slightly elevated SO_2 concentrations corresponding with winds coming from 340 degrees, which correspond with the direction of the town of Bow and Merrimack Station.

Figure 23: Hourly SO_2 Concentrations at Londonderry by Wind Direction – October 24, 2014 - April 1, 2016



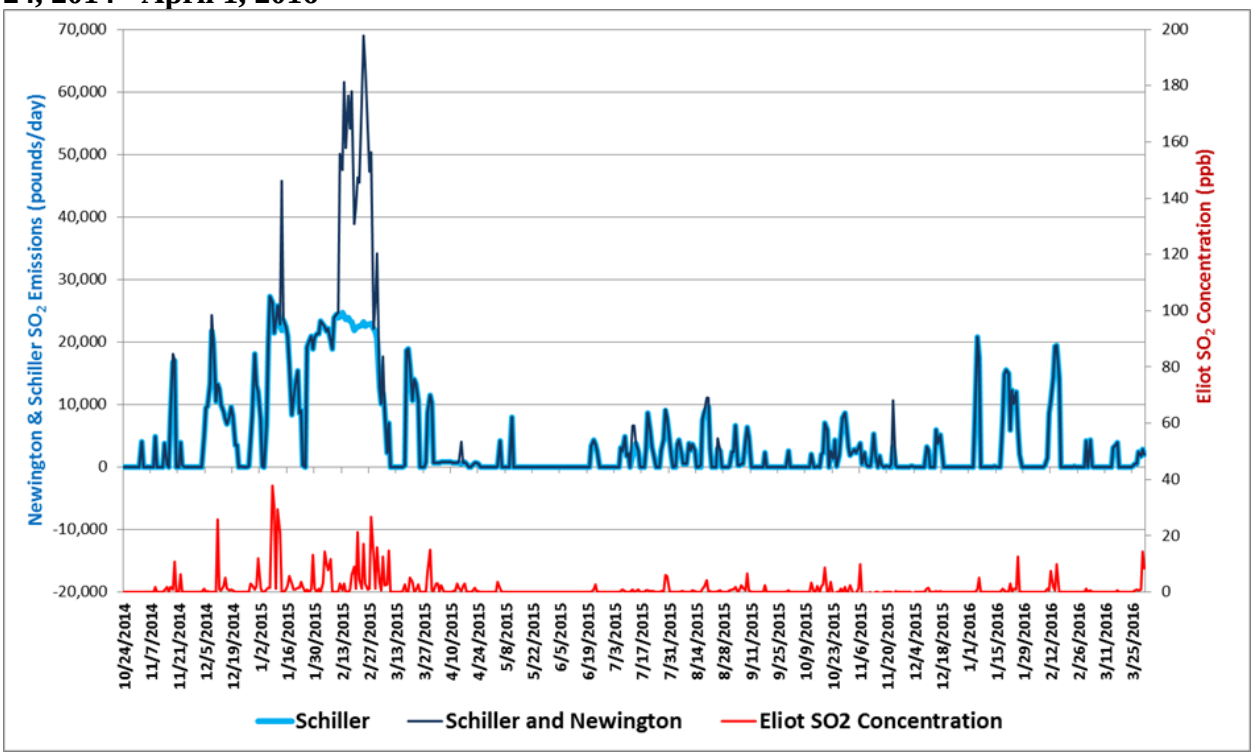
A separate analysis was conducted comparing SO_2 concentrations at area monitors during periods when Schiller Station and nearby Newington Station were operating *and* winds were coming from the direction of the power plants. For this assessment, power plant emissions data was obtained from the EPA Clean Air Markets Database and refined to include only time periods in which Schiller Station or Newington Station were emitting SO_2. SO_2 concentration data from the Sawgrass SO_2 Monitor and Peirce Island were then isolated to time periods when winds came

from the direction of the power plants (i.e., 217 degrees +/- 45 degrees from the Sawgrass SO_2 Monitor and 310 degrees +/- 45 degrees to Peirce Island to encompass, conservatively, all emissions coming from Schiller Station and/or Newington Station).

Figure 24 displays this analysis graphically for the Sawgrass SO_2 Monitor, comparing power plant daily SO_2 emissions from Schiller Station and a combination of Schiller Station and Newington Station with daily maximum SO_2 concentrations measured at the Sawgrass SO_2 Monitor when winds came from 217 degrees +/- 45 degrees. Schiller Station SO_2 emissions are shown in blue and the combined SO_2 emissions from Schiller Station and Newington Stations are shown in black. The majority of the combined SO_2 emissions came from Schiller Station although there were two distinct periods where Newington Station emitted a significant amount of SO_2 (January 13, 2015 and a period from February 12 through March 6, 2015). These spikes in Newington SO_2 emissions do not appear to significantly influence the Sawgrass SO_2 Monitor. The maximum SO_2 concentration of 37.7 ppb in Eliot occurred when only Schiller Station was in operation. Additional monitoring vs power plant emission information is provided in Figures B3, B4, and B5 in Appendix B.

Newington Station has a tall stack (413 feet) which results in superior plume rise characteristics and dispersion of stack gases. These characteristics lead to less downwashing of emissions and thus a reduced impact on nearby ground level SO_2 concentrations. Newington also operates very infrequently; its average annual capacity factor since 2012 is 3.1% per year. When the Sawgrass SO_2 Monitor was operational, Newington ran most consistently in February 2015. Despite this uptick in utilization, Newington's additional SO_2 emissions did not significantly elevate observed concentrations at the Sawgrass SO_2 monitor or Peirce Island.

Figure 24: Daily SO_2 Emissions at Schiller and Newington on Days with Wind Direction of 217 degrees +/- 45 degrees and Resulting Sawgrass SO_2 Monitor Observations – October 24, 2014 - April 1, 2016



Note: Eliot SO_2 concentrations are presented for only when the winds came from the direction of Schiller Station and when it was in operation.

Table 2 summarizes the maximum and average SO_2 concetrations measured at the Sawgrass SO_2 Monitor and the Peirce Island monitor when either Schiller Station or Newington Station were in operation and the winds came from the general direction of the power plants. While the maximum observed concentrations during the study periods of late October 2014 and April 2016 occurred when the power plants (one or both) were in operation, there are a significant number of periods when monitored concentrations were low during power plant operations and the winds came from the direction of the power plant. Average concentrations were 2.7 ppb at the Sawgrass SO_2 Monitor and 4.3 ppb at Peirce Island. Between late October 2014 and April 2016, there were 22 days when the Sawgrass SO_2 Monitor observed concentrations greater than 10 ppb SO_2, and 33 days when the Peirce Island monitor observed concentrations greater than the same 10 ppb.

Table 2: Summary of Portsmouth/Eliot 1-Hour SO_2 Concentrations (ppb) When Schiller Station and/or Newington Station Were in Operation and Wind Direction Was From the Power Plants – October 24, 2014 - April 1, 2016

	Sawgrass SO_2 Monitor	Peirce Island SO_2 Monitor
Maximum	37.7	30.2
Average	2.6	4.0
Number of Days >10 ppb	22	33

Note: In operation includes days where Schiller Station emits more than 100 pounds of SO_2 per day and/or Newington emits more than 10 pounds SO_2 per day.

Figure 25 compares the 22 days when the Sawgrass SO_2 Monitor measured concentrations greater than 10 ppb with corresponding daily emissions from Schiller Station. The days are sorted from highest to lowest monitored SO_2. All 22 days occurred during cold weather periods between November 6th and March 30th of their respective year.

Figure 25: Days above 10 ppb at the Sawgrass SO_2 Monitor when Schiller Station was Operating – October 24, 2014 - April 1, 2016

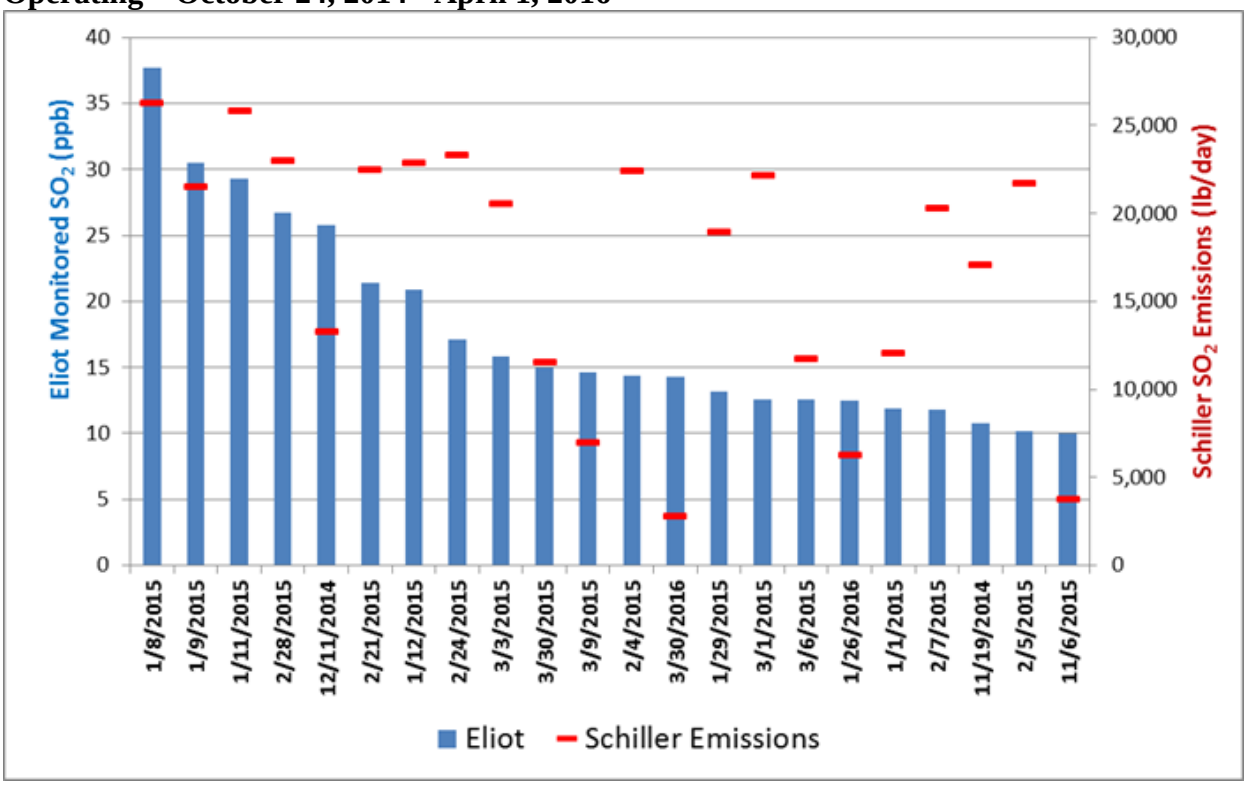


Figure 26 compares the 33 days when the Peirce Island monitor measured concentrations greater than 10 ppb with corresponding daily emissions from Schiller Station. Again, the days are sorted from highest to lowest monitored SO_2. All 33 days occurred during cold weather periods between October 21st and March 29th of their respective year.

Figure 26: Days above 10 ppb at Peirce Island when Schiller Station was Operating – October 24, 2014 - April 1, 2016

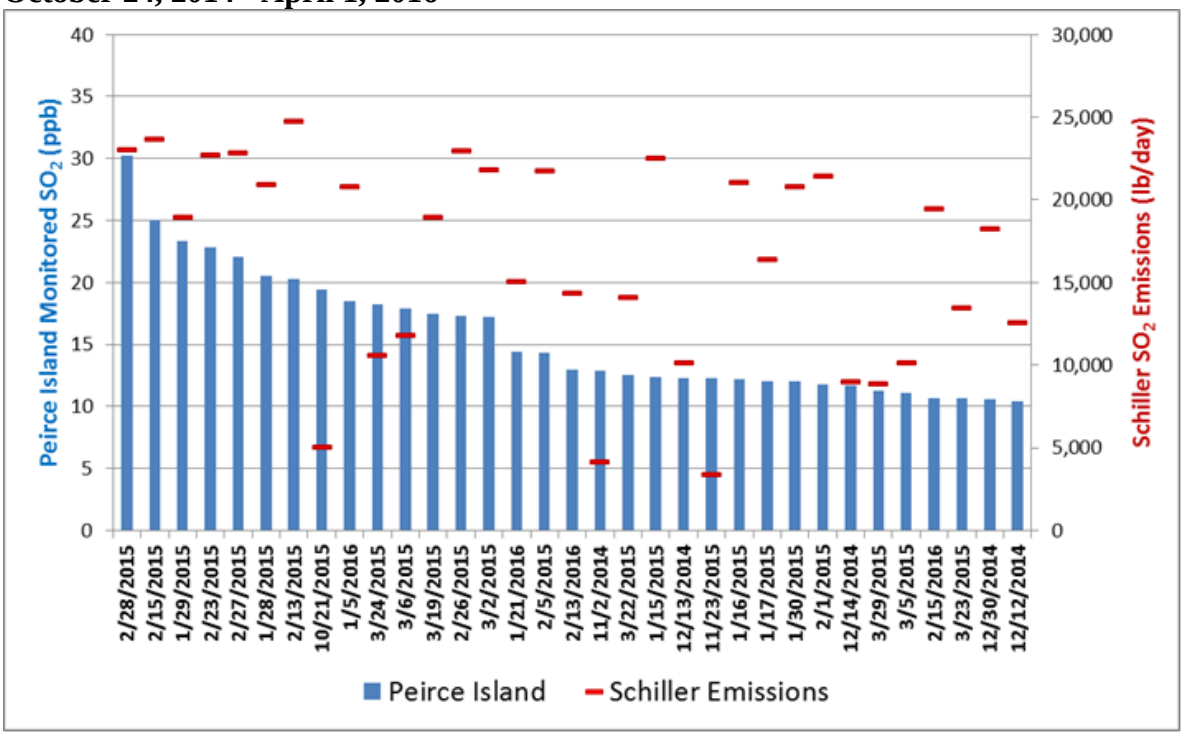


Table 3 summarizes concentrations at the Sawgrass SO_2 Monitor and the Peirce Island SO_2 monitor when neither Schiller Station nor Newington Station were in operation. Data in this table considers only SO_2 concentrations measured when winds came from the general direction of the power plants to provide a direct comparison to data in Table 2. Maximum and average SO_2 concentrations were lower, and there were no days with observations greater than 10 ppb SO_2.

Table 3: Summary of Portsmouth/Eliot 1-Hour SO_2 Concentrations (ppb) When Schiller Station and/or Newington Station Were Not In Operation and Wind Direction Was From the Power Plants – October 24, 2014 - April 1, 2016

	Sawgrass SO_2 Monitor	Peirce Island SO_2 Monitor
Maximum	3.2	6.8
Average	0.6	1.6
Number of Days >10 ppb	0	0

Note: The phrase "not in operation" refers to days where both Schiller Station emitted less than 100 pounds of SO_2 per day and Newington emitted less than 10 pounds SO_2 per day.

Table 4 provides similar information to Table 3 except SO_2 concentrations were considered regardless of wind direction. Again, SO_2 concentrations were lower than when the power plants were in operation and there were no days with observations greater than 10 ppb.

Table 4: Summary of Portsmouth/Eliot 1-Hour SO_2 Concentrations (ppb) When Schiller Station and/or Newington Station Were Not In Operation and Without Regard for Wind Direction – October 24, 2014 - April 1, 2016

	Sawgrass SO_2 Monitor	Peirce Island SO_2 Monitor
Maximum	3.6	6.8
Average	0.8	1.8
Number of Days >10 ppb	0	0

Note: The phrase "not in operation" refers to days where both Schiller Station emitted less than 100 pounds of SO_2 per day and Newington emitted less than 10 pounds SO_2 per day.

Data collected in this study supports a connection between Schiller Station SO_2 emissions with SO_2 concentrations measured at the Sawgrass SO_2 Monitor and the Peirce Island monitor. The maximum SO_2 concentrations measured at each monitoring station occurred when Schiller Station was in operation and winds came from the direction of the power plant. Newington Station was not operating when the Sawgrass SO_2 Monitor recorded its maximum concentration of 37.7 ppb, but it was operating when Peirce Island recorded its maximum concentration of 30.2 ppb. There are numerous periods when the power plants were operating and measured SO_2 concentrations remained low (below 10 ppb) even when the winds at the monitoring station came from the direction of the power plants. Thus, not every day of power plant operation results in elevated SO_2 concentrations, and no elevated SO_2 concentrations exceeded the 1-hour SO_2 NAAQS.

5.2 Passive Sampling and Mobile Monitoring Data Summaries

Ogawa passive samplers were deployed on three separate instances at the pre-determined seven locations, including co-locations at the Sawgrass SO_2 Monitor and the Peirce Island monitor. A duplicate passive sampler was also deployed at either the Sawgrass SO_2 Monitor or the Peirce Island monitor. Deployment of the passive samplers was based on instances when Schiller Station was expected to be operational, the wind direction was from the direction of the power plant, and staffing resources permitted. Ogawa samplers were deployed on March 6-7, 2015; April 2-3, 2015; and January 5-6, 2016. The Town of Eliot was informed of each of these deployments, as were NHDES and Maine MEDEP. Table 5 provides a summary of concentrations observed at the deployment locations on the deployment dates.

Due to the lack of frequency in deployment and the 24-hour averaging period in lieu of a 1-hour averaging period, the supplemental passive monitoring effort only offers a snapshot of on-the-ground conditions for a relatively long averaging period when compared to the continuous monitoring conducted at the Sawgrass SO_2 Monitor and the Peirce Island monitor. However, despite the limited nature of the data, observations can be made from the results. The Sawgrass sampler recorded the highest reading during the April 2-3, 2015 deployment, while the Main/Pleasant St. sampler recorded the highest reading on the March 6-7, 2015 deployment, and the Pleasant St. sampler recorded the highest reading on the January 5-6, 2016 deployment. Overall, 24-hour average concentrations were extremely low at all the samplers on each deployment.

Table 5: 24-Hour SO_2 Concentrations (ppb) from EPA's Passive Monitoring Efforts

Deployment Location	Deployment Dates		
	March 6-7, 2015	April 2-3, 2015	January 5-6, 2016
Sawgrass	0.492	0.755	0.319
Sawgrass duplicate	0.953	0.555	N/A
Peirce Island	1.037	-0.132*	0.364
Peirce Island duplicate	N/A	N/A	0.383
Pleasant St.	1.482	0.642	1.248
Main/Pleasant St.	1.959	0.029	0.877
Bolt Hill/Leach St.	0.670	-0.039*	0.423
Bolt Hill Rd.	1.086	0.064	0.038
Dead Duck Park	0.527	-0.171*	0.082

**Note: The use of a field blank was employed during each deployment. The field blank was analyzed by RTI Inc., and the results were used to correct deployed samples for any measurement uncertainty, including, but not limited to, any SO_2 contamination. The negative value in this table is a result of the field blank correction factor.*

EPA deployed the mobile monitoring van on three days for roughly eight hours each day. The van was deployed on April 2, 2015, August 12, 2015, and February 10, 2016. Monitoring locations varied between the pre-determined monitoring sites. Monitoring was generally conducted at a location for one to three hours before moving to another location. As with the deployment of the passive samplers, van-based monitoring was deployed when Schiller Station was expected to be operational, the wind direction was from the direction of the power plant, and staffing resources permitted. This method of monitoring yielded no readings higher than 2 ppb, regardless of the deployment date or the location being monitored. Results were similar to those observed at the Sawgrass SO_2 Monitor and Peirce Island during the same time period.

6.0 Conclusions

This study was intended to evaluate actual "on the ground" SO_2 concentrations in the Town of Eliot, Maine and any impacts Schiller Station may have on local ambient SO_2 concentrations. A temporary monitoring site in Eliot was selected after considering the Town of Eliot's CAA section 126 petition and modeling analysis, a review of local topography, and permissions were secured from Eliot town officials.

The Sawgrass SO_2 Monitor began operation on October 24, 2014 and, after collecting over 17 months of data, air quality monitoring was discontinued on April 1, 2016. During this period, there were no exceedances of the 1-hour SO_2 NAAQS threshold of 75 ppb. The maximum 1-hour SO_2 concentration measured at the Sawgrass SO_2 Monitor was 37.7 ppb on January 8, 2015 when winds came from the direction of Schiller Station and the power plant was operating at near-maximum capacity. Compared to Schiller Station, the operations at the nearby Newington Station appear to have only a minor impact on SO_2 concentrations at the Sawgrass SO_2 Monitor and Peirce Island monitors, most likely due to the taller stack and superior plume rise. This

understanding is supported by low observed SO_2 concentrations at the Sawgrass SO_2 monitor and Peirce Island during periods when Newington operated on a more consistent basis in February 2015.

At times, the Sawgrass SO_2 Monitor was influenced by Schiller Station. Elevated concentrations were observed when the power plant was operating and the wind directions were from the station. However, concentrations remained low throughout the study period and no observation exceeded the 75 ppb 1-hour SO_2 NAAQS. Although supplemental monitoring in the Eliot area was limited, the evidence suggests the Sawgrass SO_2 Monitor was well positioned to observe influences from Schiller Station. Data collected during this study also suggests the impact of current levels of SO_2 emissions from Schiller Station is not causing conditions that would yield violations of EPA's 1-hour SO_2 NAAQS in Eliot, Maine.

APPENDIX A

Site Setup, Equipment and Quality Control for the Eliot Study

In coordination with the Town of Eliot, MEDEP and EPA Region 1, NHDES began setting up an air monitoring station in Eliot, Maine during the week of October 13, 2014. This station was located inside the inner cul-de-sac circle that marks the end of Sawgrass Lane. NHDES coordinated with Maine Central Power and MEDEP to get power to the site. The station consisted of an insulated 16 ft. Wells Cargo Trailer with a 30 ft. crank up aluminum tower (Met One model ED-10CU-FB). NHDES placed wind direction (Met One model 021C) and wind speed (Met One model 010C) sensors on a cross arm assembly (Met One model 191-1) on top of the tower. This meteorological system stayed in place throughout the entire study. NHDES audited the sensors upon installation and every 6 months for the duration of the study.

Within the station, NHDES installed an API T100U Trace Level SO_2 analyzer and calibrated it for NAAQS compliance to a 0-500 ppb scale utilizing a NIST traceable API 700EU calibrator and EPA-certified SO_2 gas. The following analyzers have produced SO_2 data for this study from the station: API T100U, API T100 and a Thermo 43C. NHDES set up an automated gas dilution quality control check system within the station that consisted of a certified cylinder of SO_2 gas, a zero air supply (TECO model 111) and a NIST traceable calibrator (API model 700). These automatic checks were performed every 4 days and consisted of zero, precision and span points being run through the SO_2 analyzer. The precision and span points were typically set around 70 ppb and 400 ppb, respectively. Upon installation, and every 6 months, DES performed calibrations or calibration checks on the active SO_2 analyzer at the station utilizing a NIST traceable API 700EU calibrator and EPA certified SO_2 gas. MEDEP performed audits on the active SO_2 analyzer on a semi-annual basis throughout the study period utilizing a NIST traceable API 700U calibrator with EPA certified SO_2 gas.

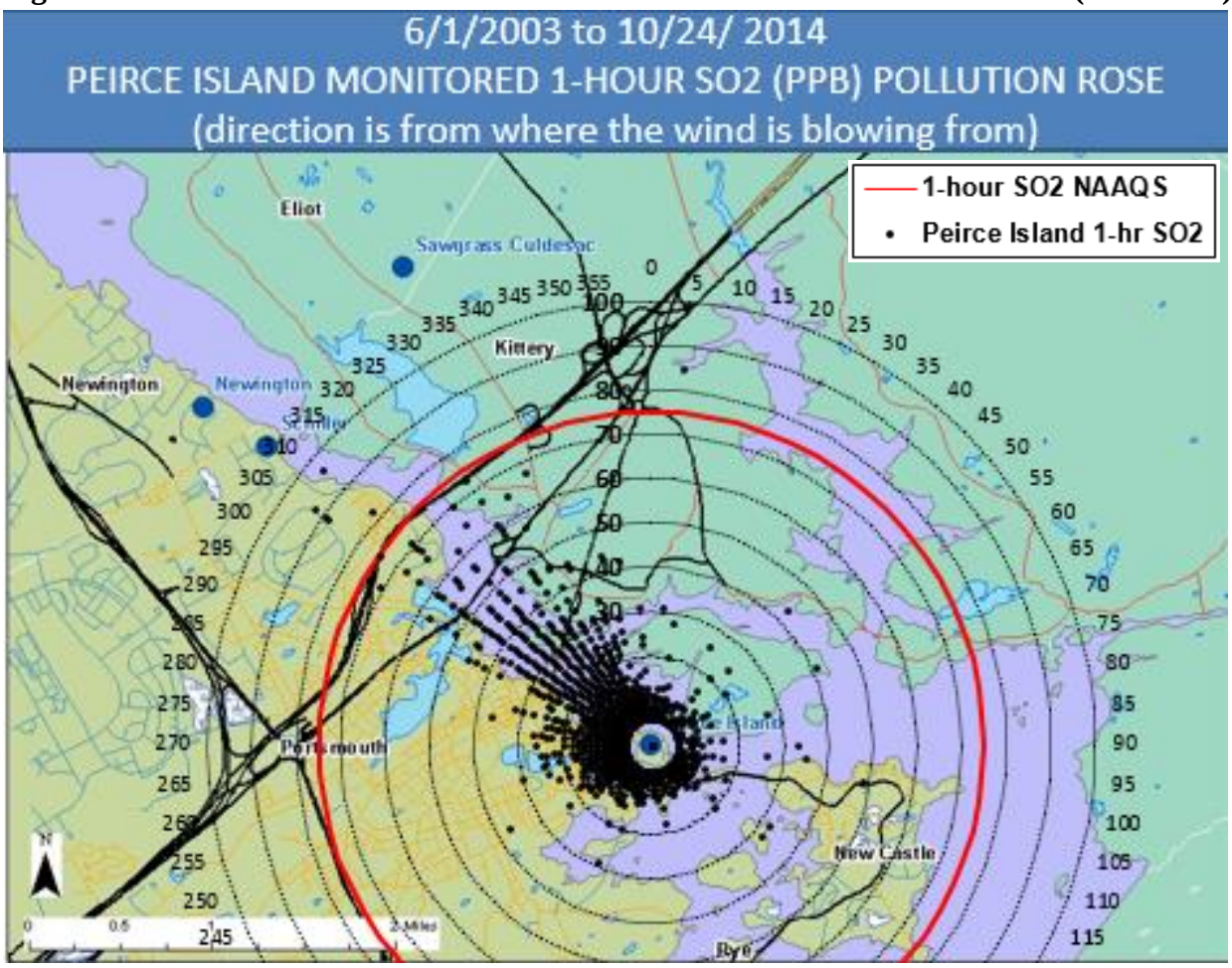
NHDES also installed a digital data logger (ESC model 8832) and a cellular modem (Sixnet model BT6000) in the station for the purpose of real-time hourly data retrieval via Verizon Wireless. MEDEP and NHDES retrieved data from the station through the Air Vision data acquisition software. MEDEP and NHDES worked in conjunction to validate the data. Through a set of automated reports and websites MEDEP, NHDES and the Town of Eliot made the data available for stakeholders to view. MEDEP submitted the data to EPA's Air Quality System (AQS).

APPENDIX B

Additional Data Analysis of Schiller Station and Newington Station Emissions and Impacts on Area SO_2 Monitors

This appendix contains new and historic data analyses for SO_2 emissions from Schiller Station and Newington Station and ambient SO_2 concentrations from the Peirce Island Monitor and the Sawgrass SO_2 Monitor. It should be noted that SO_2 emissions from both power plants and measured concentrations in the region have substantially decreased over the past decade

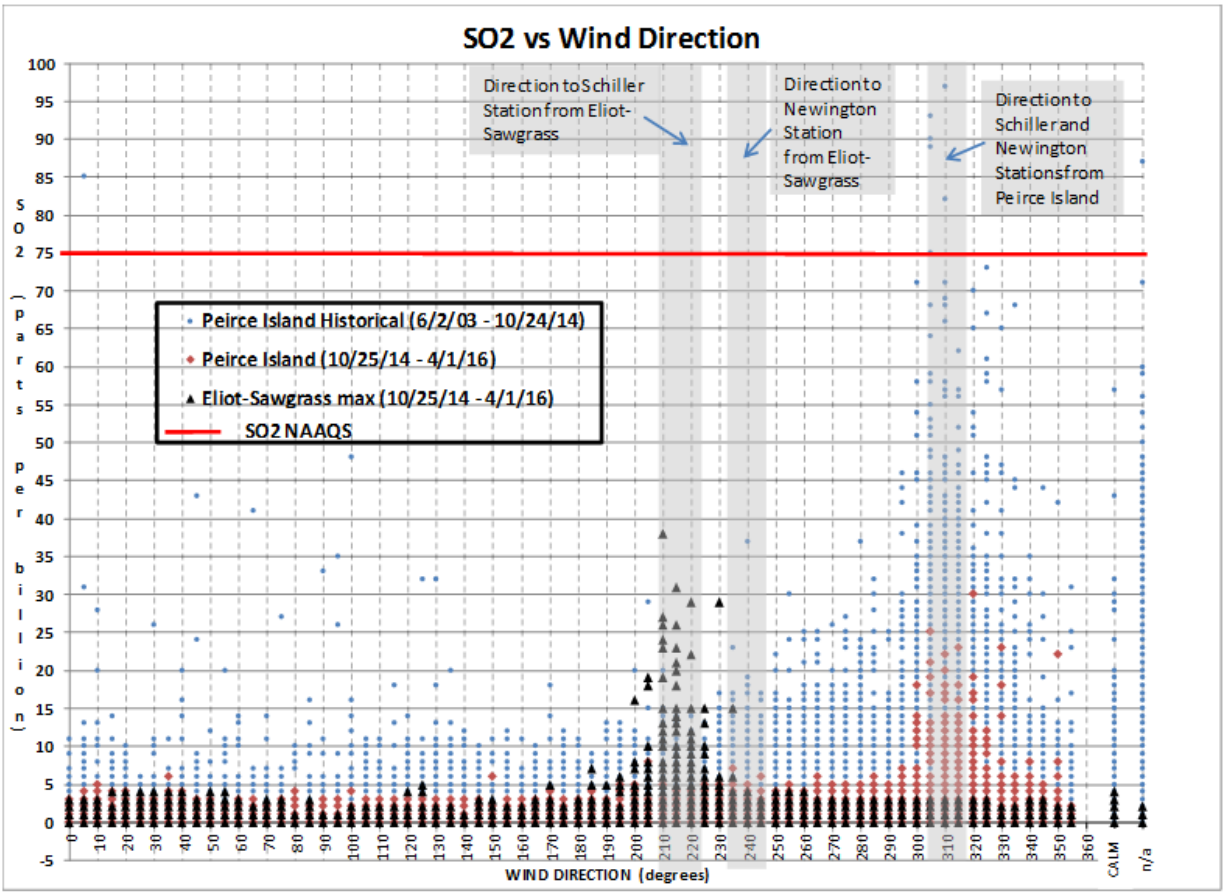
Figure B1: Wind Direction with Measured SO_2 Concentration at Peirce Island (2003-2014)



During periods of higher measured SO_2 concentrations measured at the Peirce Island monitor, the wind direction was often from the general direction of Schiller Station and Newington Station (which have an approximate heading of 310 degrees). At the Sawgrass SO_2 Monitor, the elevated SO_2 concentrations generally corresponded with a wind direction from Schiller Station (which has an approximate heading of 217 degrees). Elevated SO_2 concentrations when the

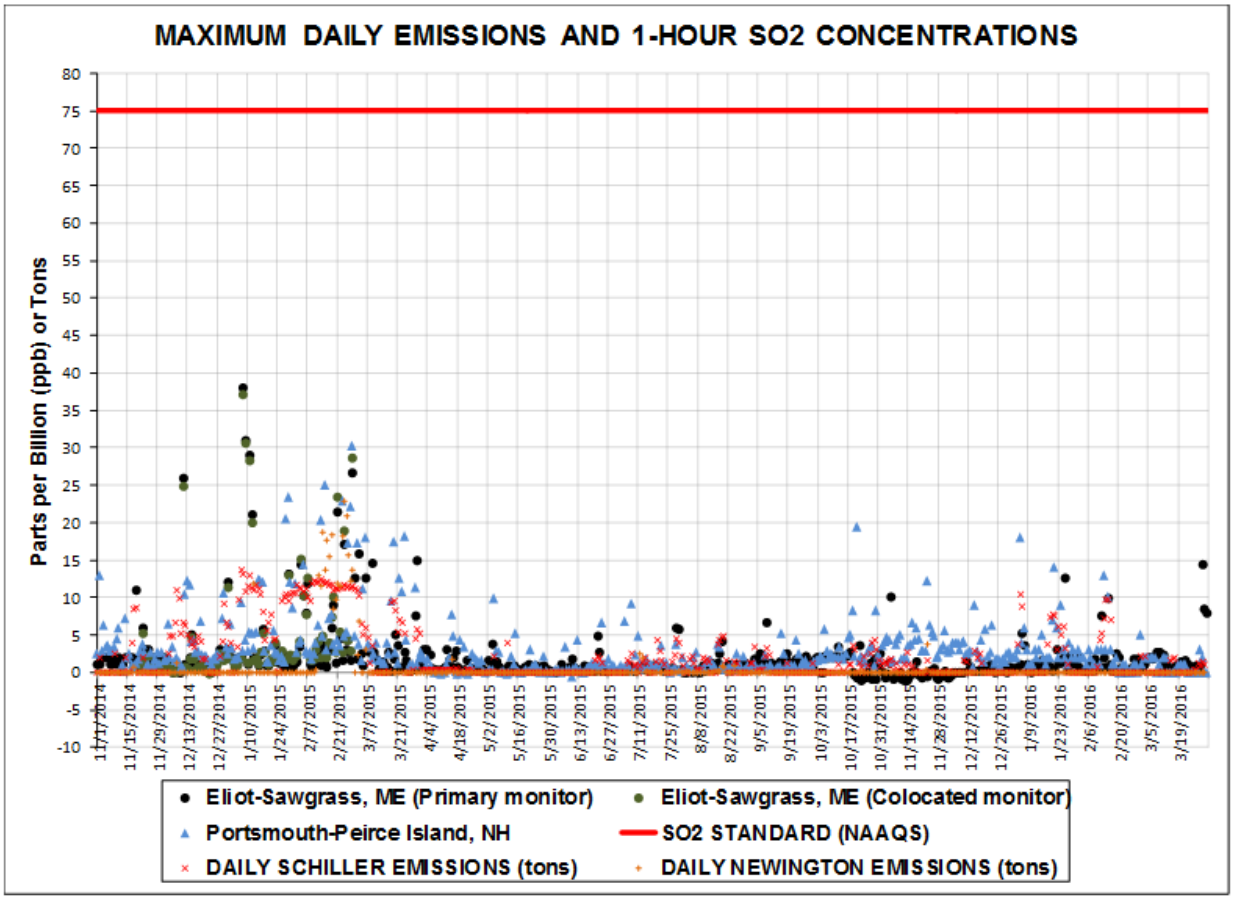
winds came from Newington Station to the Sawgrass SO_2 Monitor were not as high as those seen coming from the direction of Schiller Station.

Figure B2: Peirce Island and Sawgrass Monitored SO_2 Concentrations vs Wind Direction (Peirce Island 6/2/2003-4/1/2016 and Sawgrass 10/25/2014-4/1/2016)



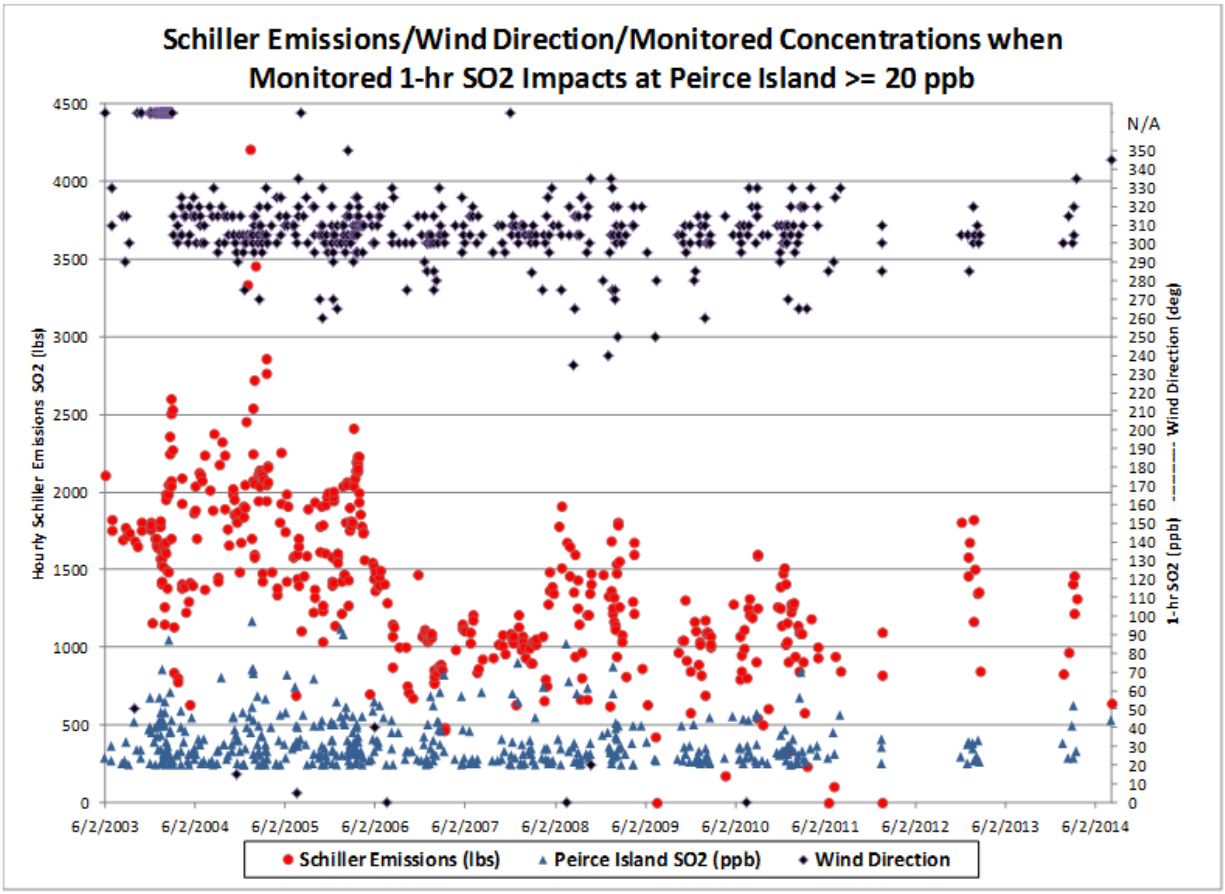
During the period that SO_2 monitoring was conducted at Sawgrass Lane, SO_2 emissions from Schiller Station appear temporally connected to those higher measured concentrations. The same holds true for higher concentrations measured at the Peirce Island monitor. In general, power plant SO_2 emissions were highest during the fall months of 2014.

Figure B3: Schiller and Newington Stations Emissions vs Peirce Island and Sawgrass Monitored Concentrations (SO_2 November 1, 2014 – April 1, 2016



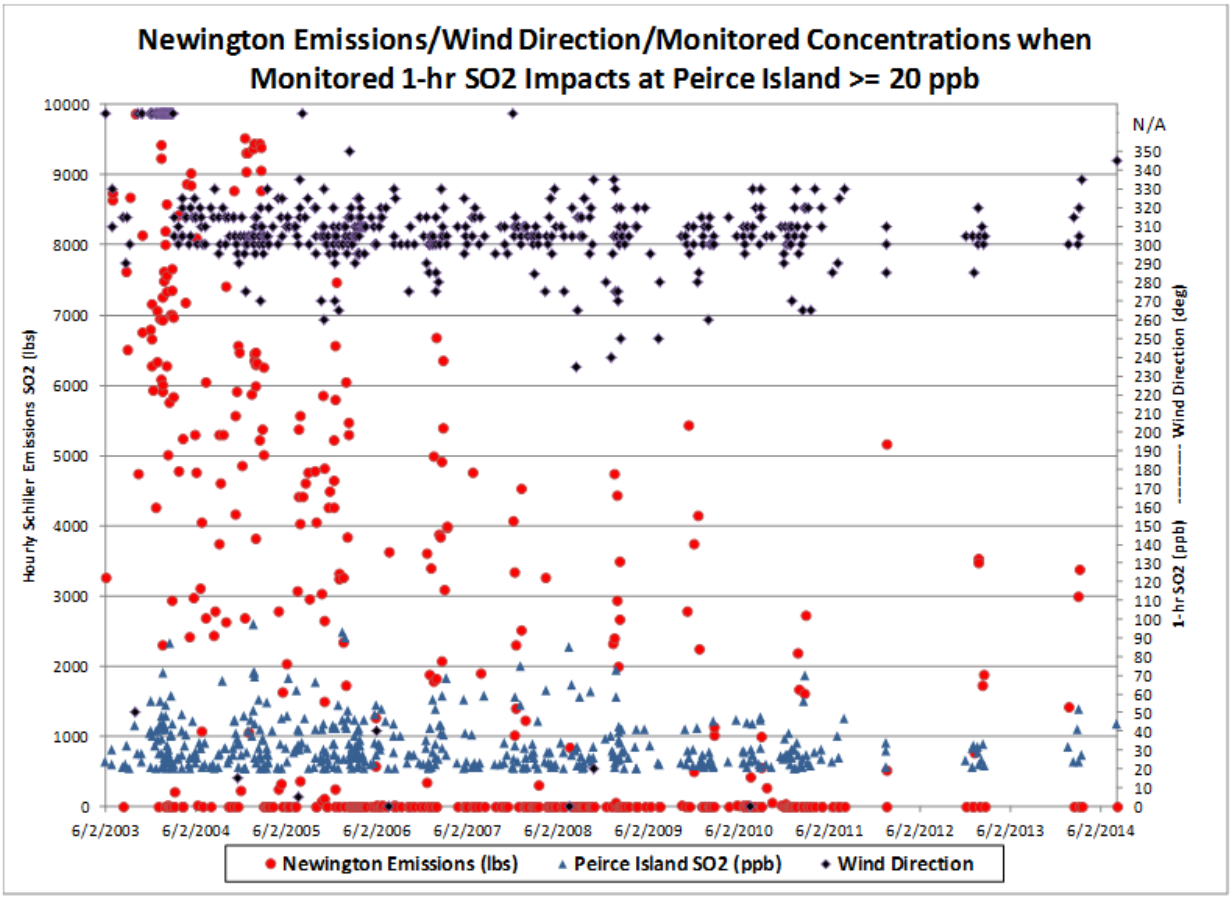
During periods when SO_2 concentrations were equal to, or higher than, 20 ppb at the Peirce Island monitor, the wind direction generally aligned to the direction of Schiller Station and the power plant was emitting SO_2 emissions.

Figure B4: Schiller Station SO_2 Emissions and Wind Direction when Peirce Island SO_2 Concentrations Measured Greater than 20 ppb (June 2, 2003 – June 2, 2014)



During periods when SO_2 concentrations were equal to, or higher than, 20 ppb at the Peirce Island monitor, the wind direction generally aligned to the direction of Newington Station, but the power plant was not always in operation or emitting any significant amounts of SO_2 emissions.

Figure B5: Newington Station SO_2 Emissions and Wind Direction when SO_2 Peirce Island SO_2 Concentrations Measured Greater than 20 ppb (June 2, 2003 – June 2, 2014)



APPENDIX C

Below is an August 2014 fact sheet on the then proposed Sawgrass SO_2 Monitor, which was used to inform nearby residents of the potential air quality monitoring efforts.

U.S. EPA New England **Q & A**

Q&A on the Location and Operation of an Air Quality Monitoring Station in Eliot, Maine

U.S. EPA | UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

At the request of the town of Eliot, the U.S. Environmental Protection Agency (EPA), the Maine Department of Environmental Protection (ME DEP), and the New Hampshire Department of Environmental Services (NH DES) are cooperatively proposing to site an air quality monitor in Eliot, Maine. The monitor will help facilitate a better understanding of local air quality influences associated with emissions from the Schiller Station power plant in Portsmouth, NH relative to the recently revised national ambient air quality standard for sulfur dioxide.

KEY CONTACTS:

DANA LEE
Town Manager of Eliot
(207) 439-1813
town.manager@eliotme.org

PATRICK BIRD
EPA New England Environmental Protection Specialist
(617) 918-1287
bird.patrick@epa.gov

What type of data will the air quality monitoring station be collecting?
The air quality monitoring station will measure concentrations of sulfur dioxide that may be in the air. The monitoring station will also be equipped with a 30-foot meteorological tower that will collect wind speed, wind direction, and outside temperature data.

How long will the air quality monitoring study be conducted?
The air quality monitoring study would be conducted for no more than one year. This would allow for air quality measurements during both the summer and winter, which is typically when Schiller Station is operating at its highest capacity.

Will the data be available to the public?
Yes. NH DES and ME DEP have the capability of obtaining monitoring data on an hourly basis. Upon request, each state agency can send compiled data to interested parties via email. The Town of Eliot intends to regularly post updated monitoring data on its website (www.eliot-maine.org). Monitoring data will also be available through EPA's Air Quality System Data Mart (www.epa.gov/ttn/airs/aqsdatamart).

What does the air quality monitoring station look like?
The air quality monitoring station is a 20-foot tow-behind trailer owned by the NH DES. The trailer would be located in the center of the cul-de-sac on Sawgrass Lane and connected to a nearby power supply. A 30-foot telescopic tower connected to the trailer will collect meteo-

continued >

Environmental Services

EPA United States Environmental Protection Agency

August 2014

rological data. The monitoring station will have negligible noise or traffic impacts on nearby residents. Air quality monitors operate with a slight hum, which should only be heard within a few feet of the trailer. State agency staff will visit the site routinely, but no more than once weekly between 8 am and 5 pm.

Where will the air quality monitoring station be located?
The air quality monitoring station would be located in the middle of the cul-de-sac on Sawgrass Lane in Eliot, Maine. The middle of the cul-de-sac is town-owned property with access to a power supply.

Why is the Sawgrass Lane location being proposed as the site to locate the air quality monitoring station?
The Sawgrass Lane location was chosen as the proposed site because of its proximity to Schiller Station, about 1.2 miles northeast of the power plant. EPA, ME DEP, NH DES, and Eliot town officials agree that based on the air quality modeling analysis provided by the Town of Eliot the proposed Sawgrass Lane site will be a good location for capturing the potential influences from Schiller Station when it is operating. Additionally, the area surrounding the proposed location is free of tall trees and structures, which is critical for any air quality monitoring site.

Who do I contact about the proposed location and operation of the air quality monitoring station in Eliot?
If you have additional questions about the proposed location and operation of the air quality monitoring station in Eliot, please contact Dana Lee, Town Manager of Eliot, Maine at 207-439-1813 or townmanager@eliotme.org, or Patrick Bird of EPA New England at 617-918-1287 or bird.patrick@epa.gov.