Appendix R. Expanded Analyses of SO_2 and CO Criteria Pollutants

As discussed previously, none of the criteria pollutants had exceedances of their respective NAAQS levels. However, for completeness, whether or not any temporal or spatial trends or any correlations with the various meteorological parameters appeared to exist was investigated.

The daily SO_2 concentration averages do not even approach the 24-hour NAAQS level with the highest concentration roughly a factor of 10 below that standard (Figure R.1). There is no 24-hour NAAQS for CO and the graph of individual data points did not indicate any meaningful trends so this data is not shown. Graphical illustrations of the criteria pollutant concentrations averaged over various time frames as compared to the most appropriate NAAQS are also included. The annual SO_2 concentration average, which was only measured at the BTRS monitor, is nowhere close to the annual primary NAAQS level (Figure R.2). The maximum 1-hour CO concentration, which again was only measured at the BTRS monitor, is much lower than the 1-hour primary NAAQS level and is even well below the 8-hour primary NAAQS level (Figure R.3).

The presence or absence of any apparent trends over the year of the study, broken up into monthly and weekly time frames, was investigated. No meaningful trends were apparent with SO_2 so only the monthly averages is presented here (Figures R.4). The monthly CO averages were highest in December, July, and August potentially indicating increased holiday travel traffic as CO is emitted by mobile sources, in addition to, other processes of combustion (Figure R.5). The graph of the weekly CO averages was included as well. It shows the CO concentrations increasing in July and remaining elevated until early September (around the time school starts up following the summer break) and then the CO concentration jumps up again around Thanksgiving time and remains elevated to Christmas time (Figure R.6). To determine if different weekday to weekend trends were present during these higher CO weeks, the weekday to weekend concentration averages for each of the high CO time periods was also investigated (data not shown). Interestingly, it was found that the increased CO weeks during the summer months were due to increases during the week, with the weekday concentration average roughly 20% higher than the weekend concentration average, but the increased CO weeks during the winter months were due to increases over the weekend, with the weekday concentration average roughly 9% lower than the weekend concentration average. This potentially indicates that the increased holiday travel during the summer is throughout the entire week while the increased holiday travel during the winter is primarily over the weekends.

Because the criteria pollutants are measured as 1-hour average concentrations, whether or not any potential temporal trends were apparent over the different hours of the day was also able to be investigated. The individual daily SO_2 trends (2 weeks worth of which is shown in Figure R.7) do not indicate any apparent meaningful trend(s) but the pooled SO_2 concentration trendline showed an increase in concentration starting in the early morning hours and peaking midday before steadily decreasing until the evening hours when the concentration trendline leveled off (Figure R.8). The individual daily CO

trends (2 weeks worth of which is shown in Figure R.9) do indicate a general trend of increasing concentrations in the early morning hours which then decrease in the evening hours. However, when the 6 months of data are pooled together and the short-term influences from the hourly variations in meteorological conditions are diminished, a different underlying trend became apparent. The CO concentration trendline showed a fairly rapid increase in the early morning and a slightly less rapid decrease throughout the remaining morning hours before leveling off around midday. Then, a slower buildup of CO concentrations was observed starting during the time of the afternoon rush hour in the early evening hours (but peaking at a lower concentration level than that of the morning increase) before leveling off then slowly decreasing over the nighttime hours (Figure R.10). This trend in CO concentrations could be explained by the combination of mobile source emissions and atmospheric conditions. Atmospheric inversions develop over the nighttime hours but well after the afternoon rush hour traffic has dissipated, therefore, the increase in concentration during the evening hours is not as great as in the morning when the rush hour traffic at that time is combined with the lingering atmospheric inversion. Atmospheric inversions create a ceiling or cap above the lower air mass by preventing convection mixing of the lower and upper atmospheres. Normally, lower air mass gets warmed by the Earth, which has been heated by the solar radiation, then rises. As the morning proceeds, both the morning rush hour dissipates and the solar radiation heating the Earth's surface breaks up the inversion resulting in the decrease observed throughout the later morning hours into midday.

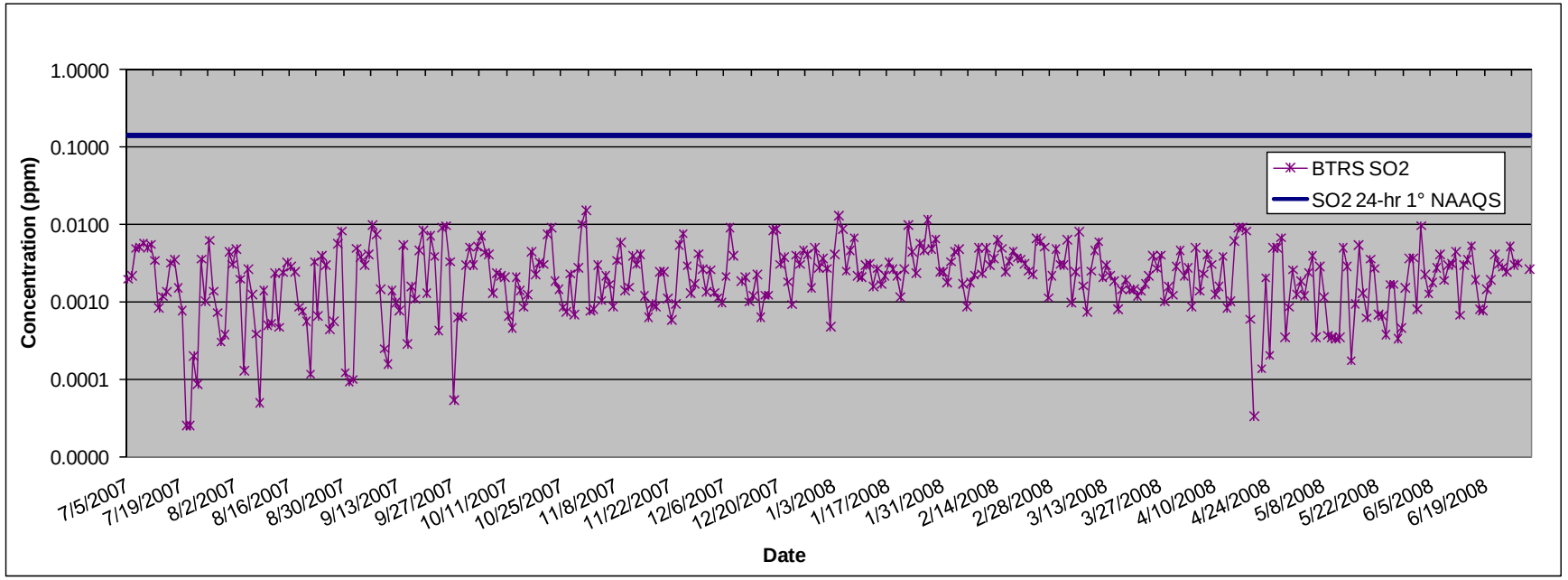

Figure R.1. Weekly Trends of SO_2 Daily Average Concentrations. The concentrations are presented using the logarithmic scale because of the substantial differences between the concentration of the SO_2 24-hour NAAQS concentration as compared to the concentration range for SO_2 resulting in a line graph when the normal scale was used where observing how the BTRS SO_2 concentration trendline tracked was not as easy to see.

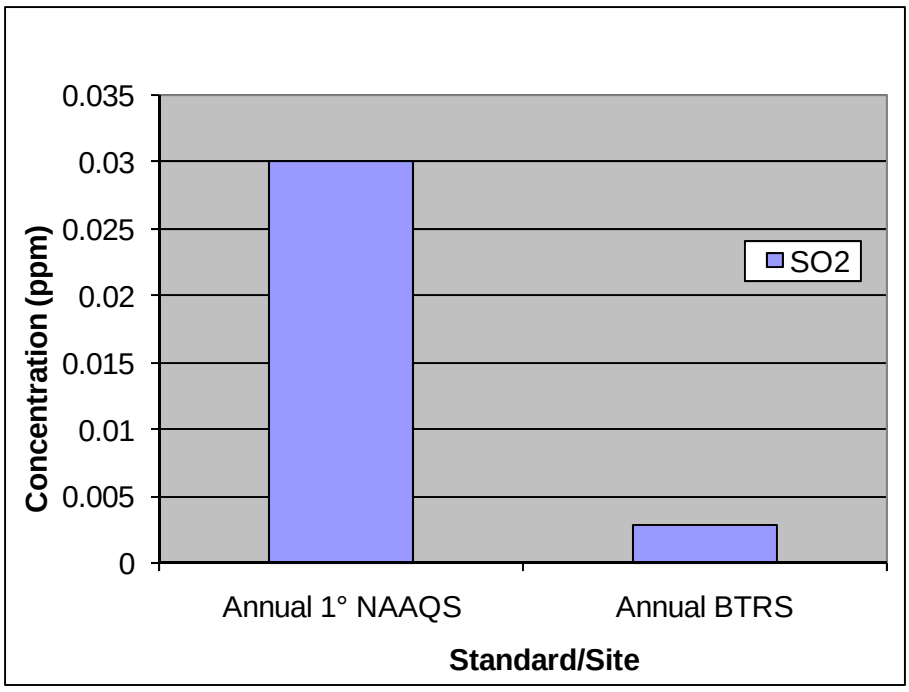

Figure R.2. BTRS Annual SO_2 Concentration Average Versus the SO_2 Annual Primary NAAQS Concentration.

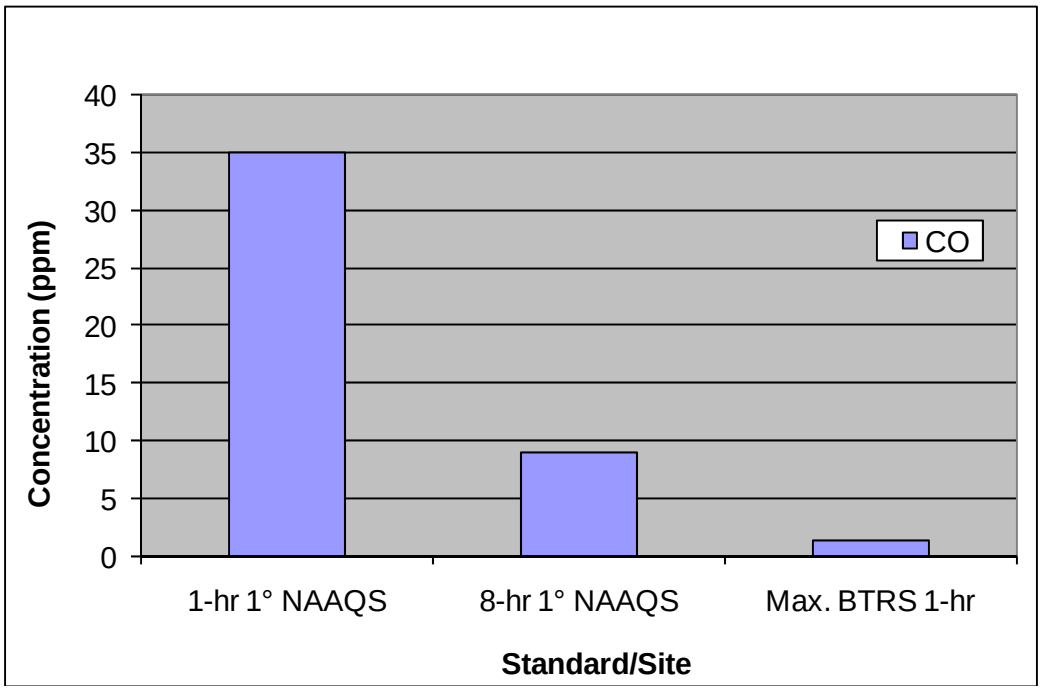

Figure R.3. BTRS Maximum 1-hour CO Concentration Average Versus the CO 1-hour and 8-hour Primary NAAQS Concentrations.

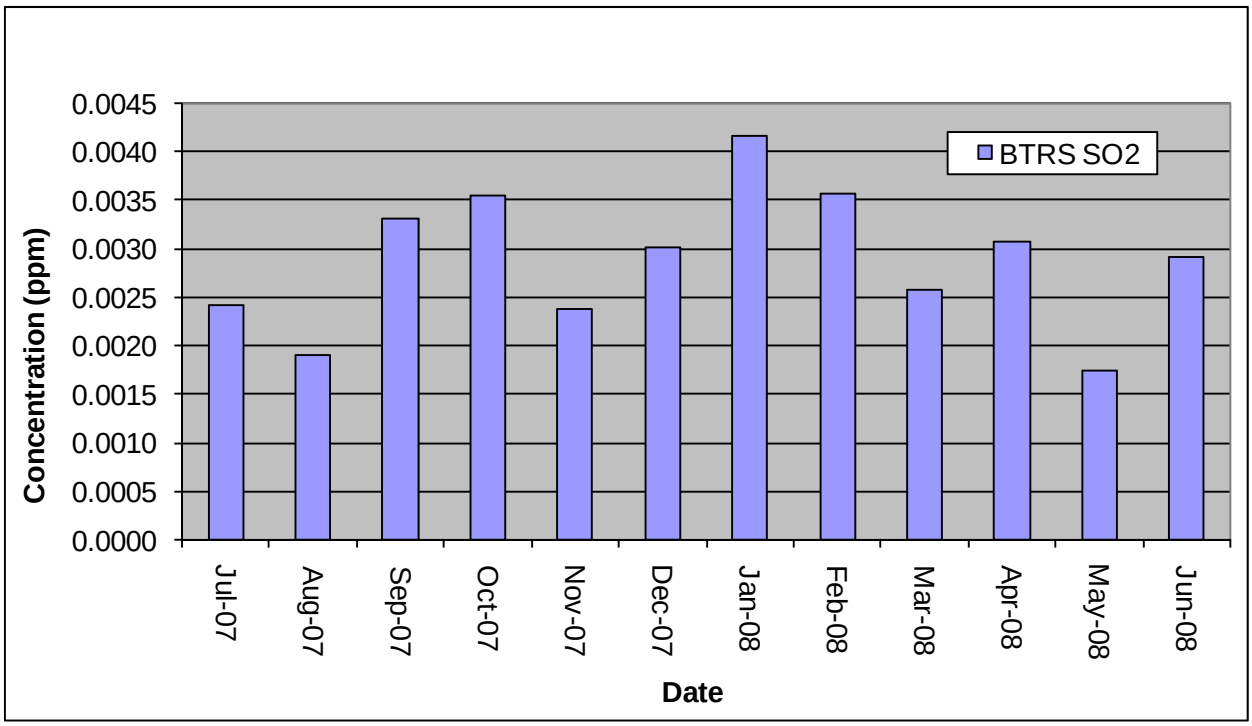

Figure R.4. Average SO_2 Concentrations at the BTRS Monitor for the Different Months of the Study Year.

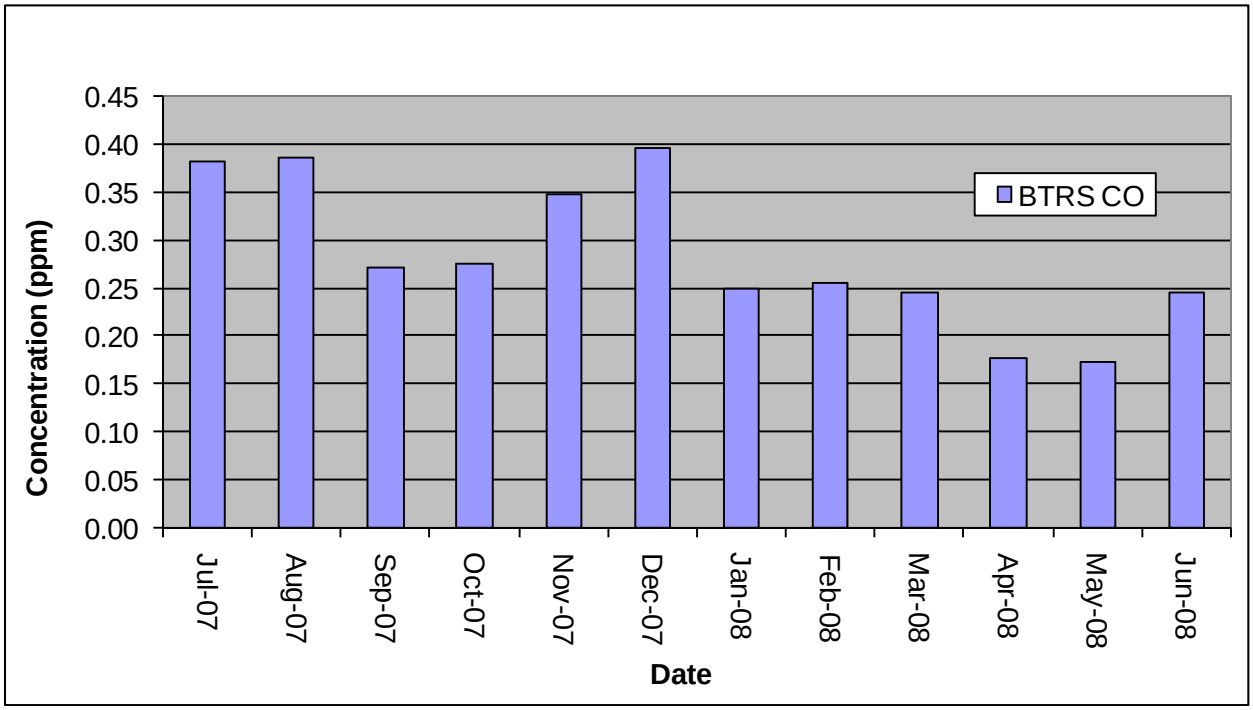

Figure R.5. Average CO Concentrations at the BTRS Monitor for the Different Months of the Study Year.

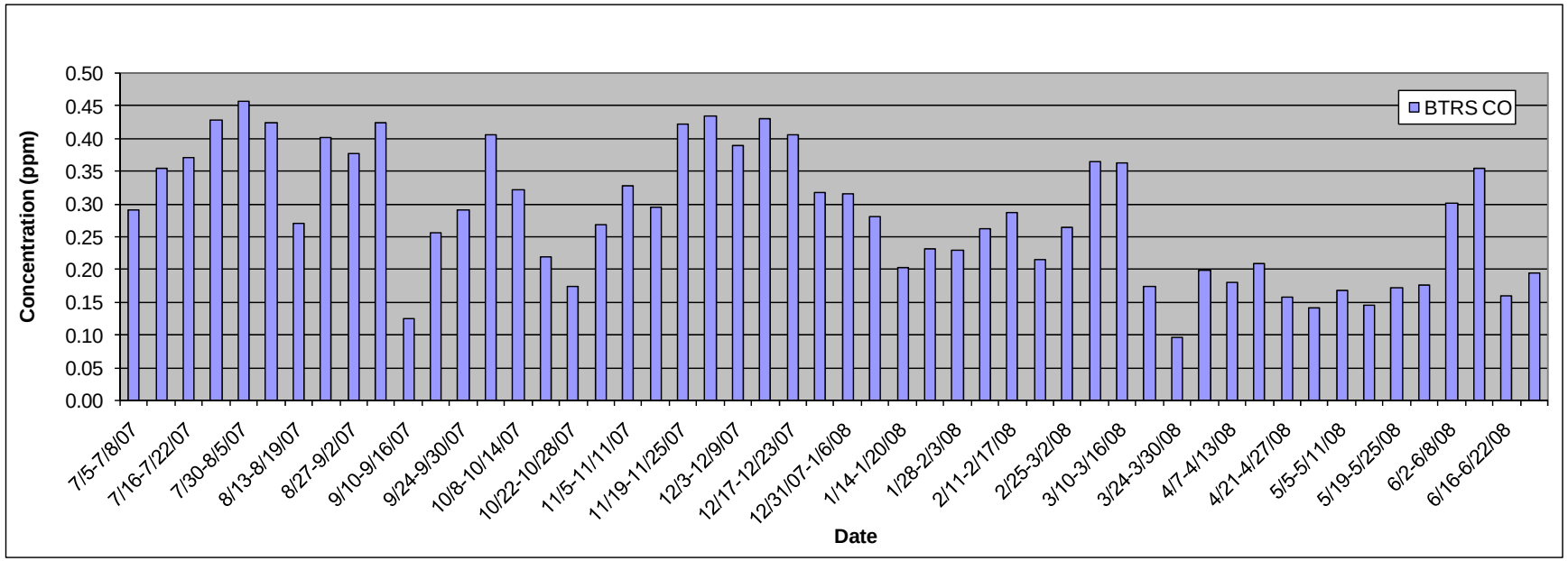

Figure R.6. Average CO Concentrations at the BTRS Monitor for the Different Weeks of the Study Year.

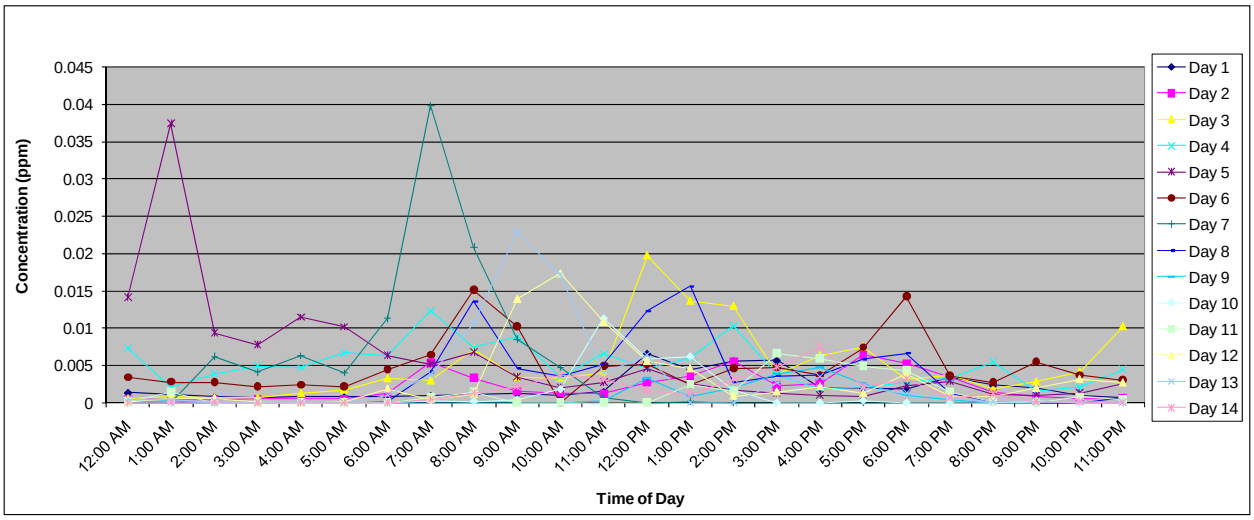

Figure R.7. Individual Data Point Measurements of SO_2 Concentrations for each Hour of the Day at the BTRS Monitor for the First Two Weeks of the Study Year.

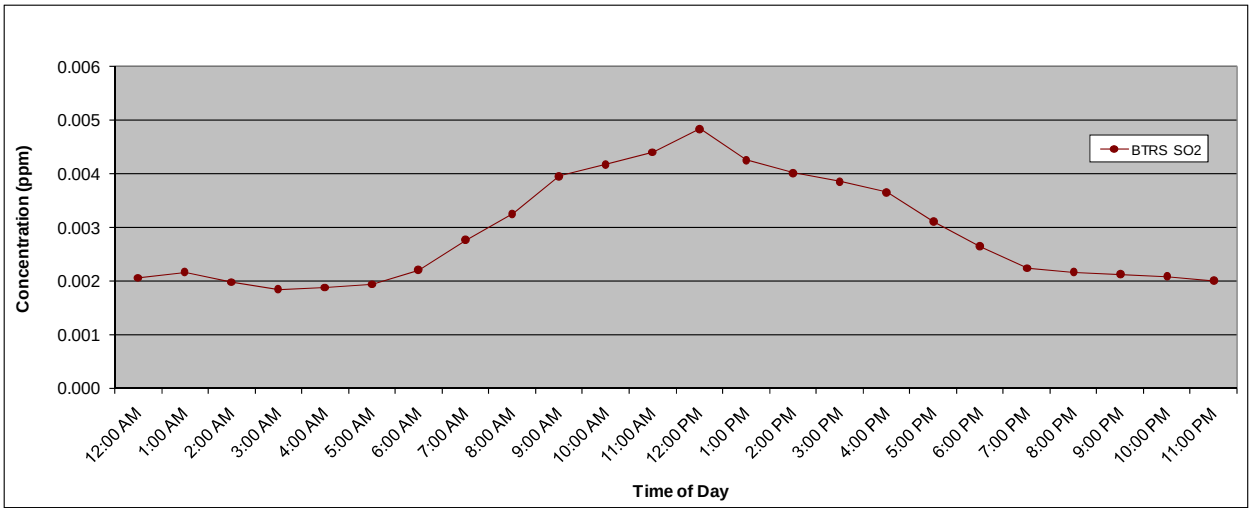

Figure R.8. Daily SO_2 Concentration Trends generated by Pooling Six Months of Concentration Measurements Data into a Combined Average of Concentrations for each Hour of the Day.

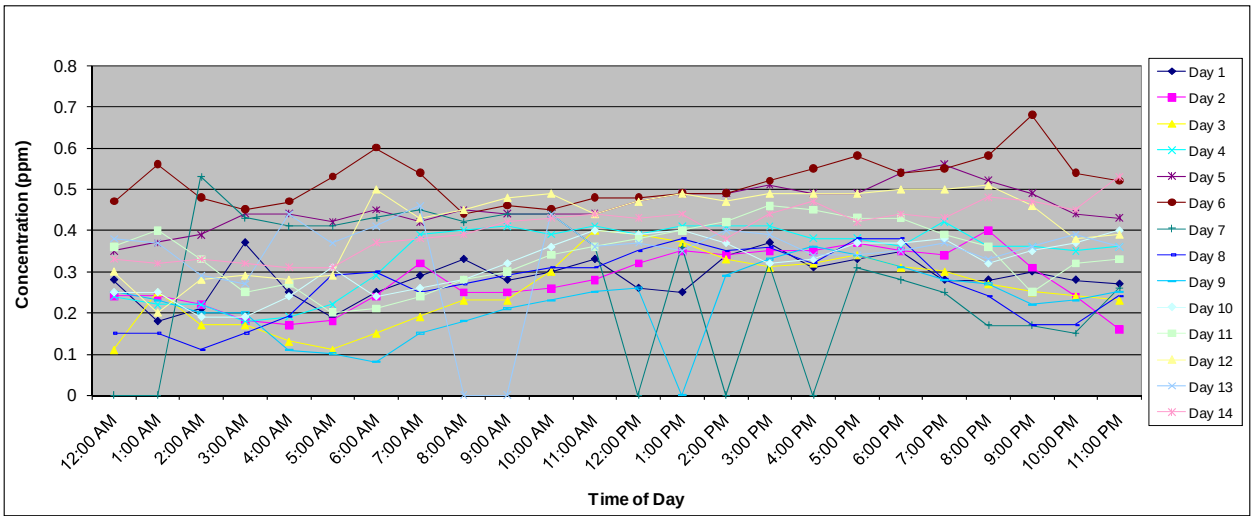

Figure R.9. Individual Data Point Measurements of CO Concentrations for each Hour of the Day at the BTRS Monitor for the First Two Weeks of the Study Year.

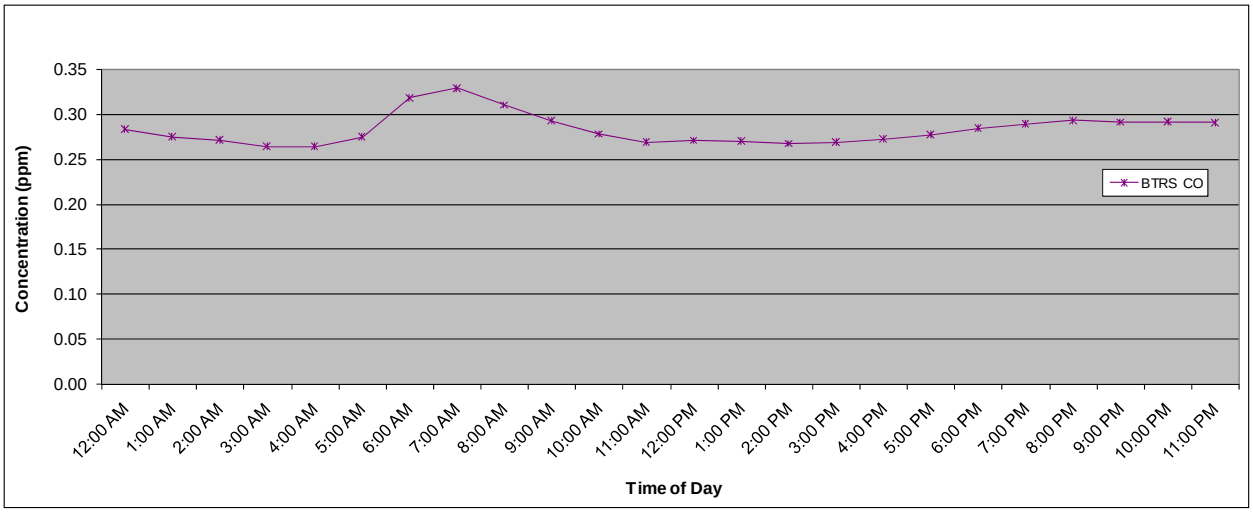

Figure R.10. Daily CO Concentration Trends generated by Pooling Six Months of Concentration Measurements Data into a Combined Average of Concentrations for each Hour of the Day.