



Technical Evaluation of Sensor Technology (TEST) Program

*APIS Sensor
2019 – 1st Quarter*



Introduction and Sensor Profile

This analysis report is focused on assessing the performance of the APIS sensor as a part of the District's Technical Evaluation of Sensor Technology (TEST) Program. The APIS sensor uses an active flow and sample control system calibrated to NIST Traceable Standards that measures CO, NO, NO₂, and O₃. The APIS sensor also measures temperature, pressure, and relative humidity.

Background and Approach of Evaluation Test

In December of 2019, two APIS sensors (APIS 1 and APIS 2) were installed at the San Joaquin Valley Air Pollution Control District Bakersfield-Muni air monitoring site to compare the sensor performance to regulatory gaseous analyzers. The data sets compare gaseous data from each APIS sensor to that of the regulatory gaseous data that is collocated at the District site. The scatter plots and time series graphs below show how the datasets compare for hourly values.

Overview of Analysis Findings from Current Period

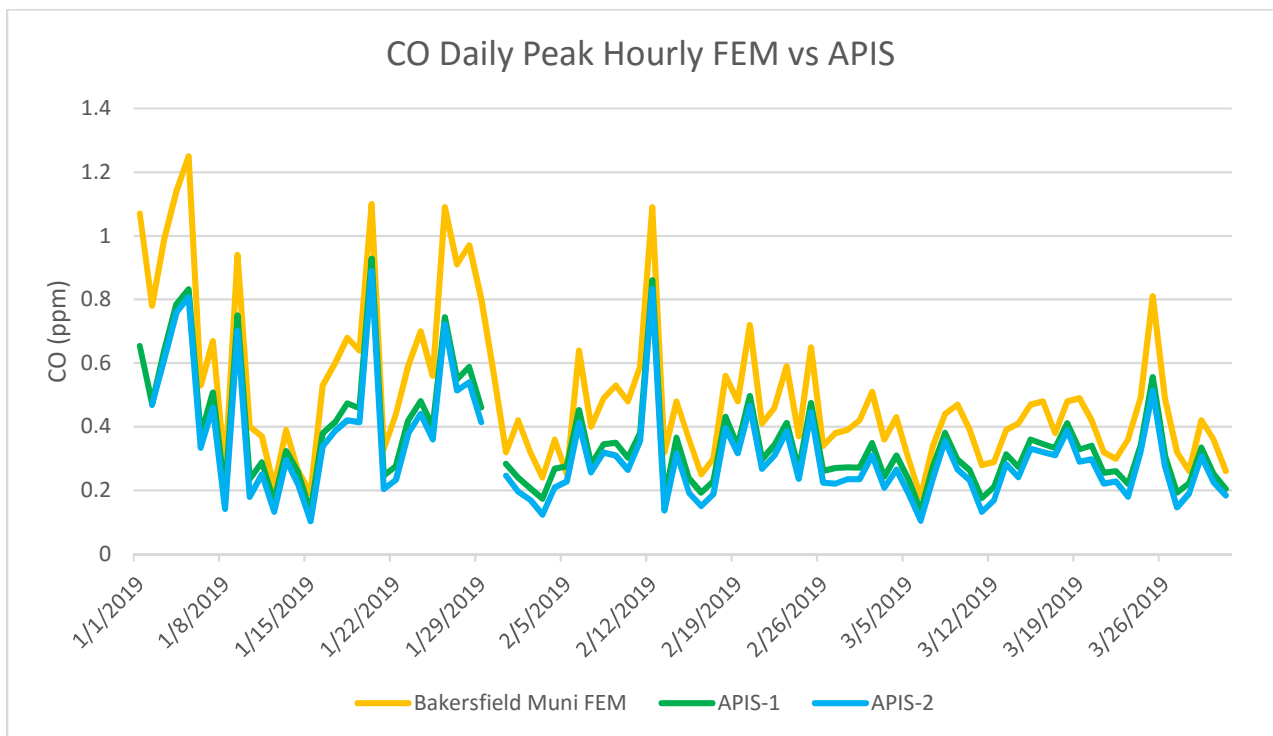
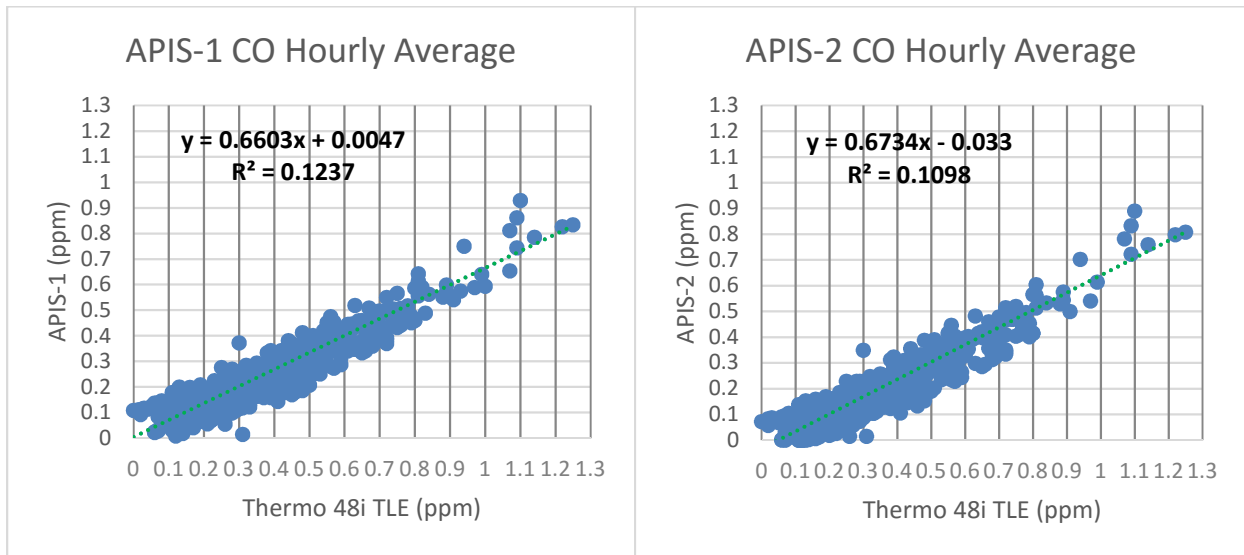
The analysis for this report covers the time period of January 2019 through March 2019 (2019 – 1st quarter). During this this period, hourly data was removed from the calculation of bias and average concentrations when either the APIS sensor or regulatory monitor did not have a valid sample. For the daily peak line graphs, all available data is shown for each collocated analyzer and sensor.

2019 - 1st quarter was dominated by an active weather pattern where good dispersion conditions brought low ambient gaseous concentrations. As the plots below show, APIS data was biased higher than the District's regulatory data during this period for all pollutants except for O₃, which was biased lower than the regulatory data for both APIS sensors.

Site Specific Analysis of APIS Sensor Performance

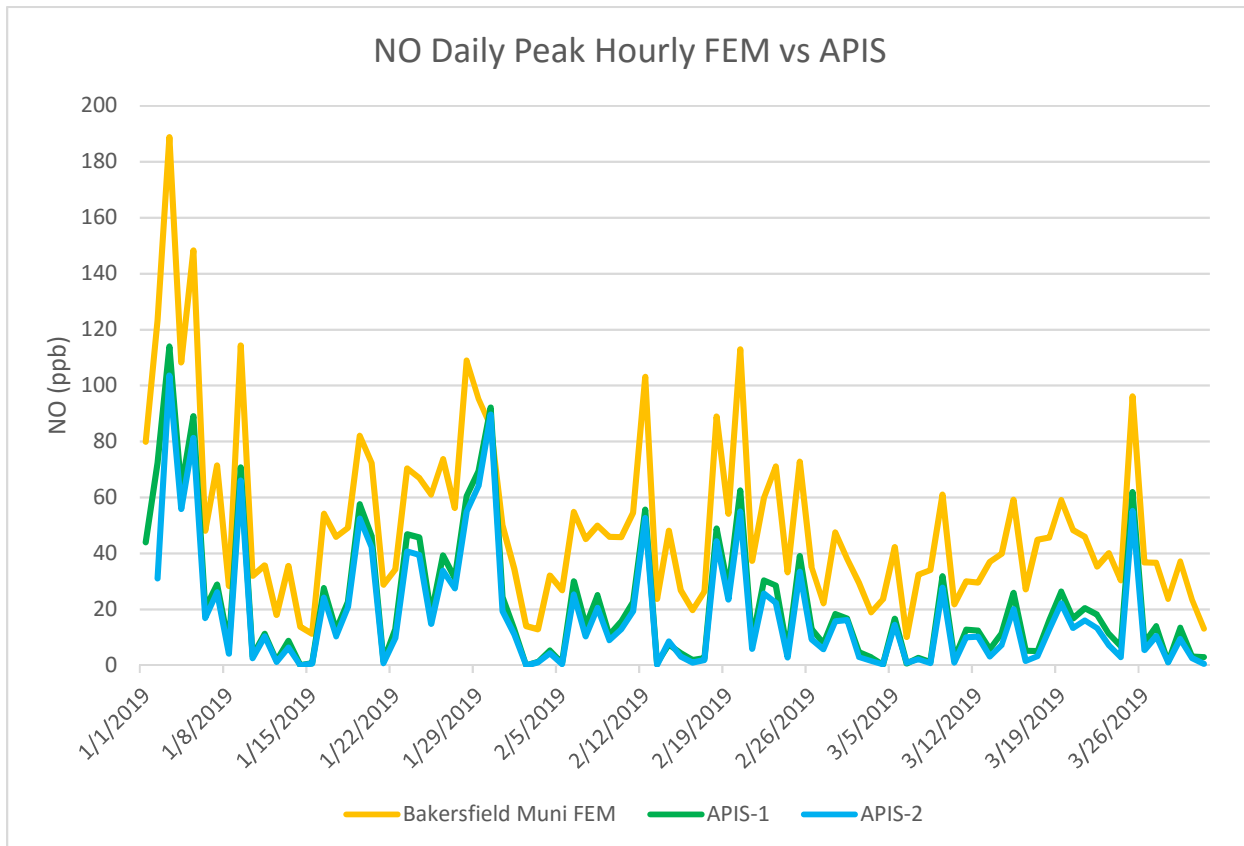
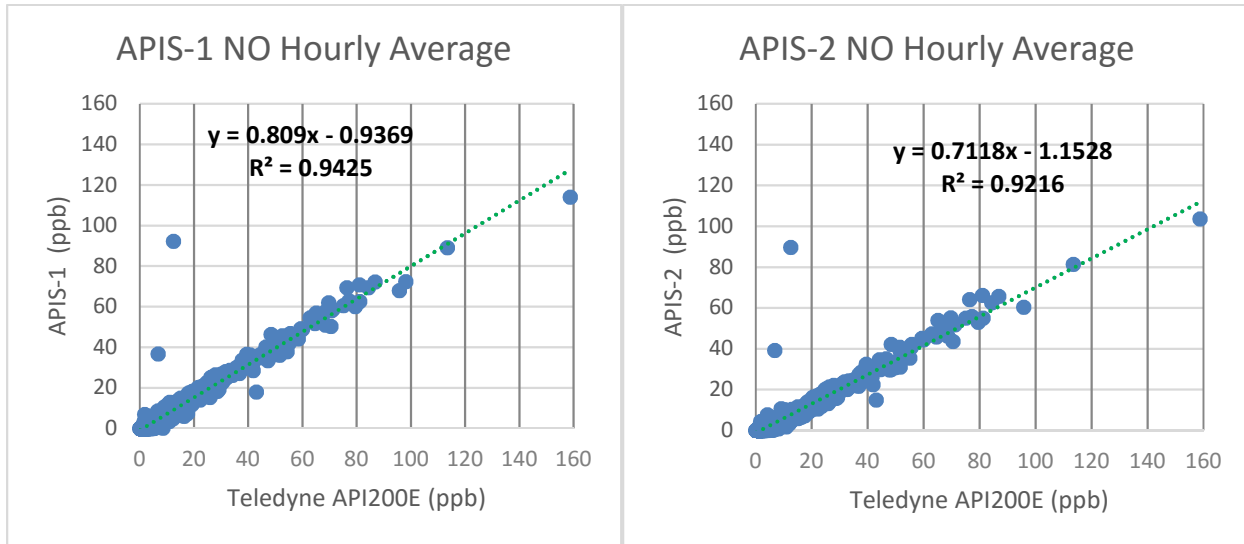
Carbon Monoxide (CO)

For the hourly CO averages, the APIS 1 sensor had a 0.086 ppm low bias over the FEM sensor and the APIS 2 sensor had a 0.119 ppm low bias over the FEM sensor during the 2019-1st quarter.



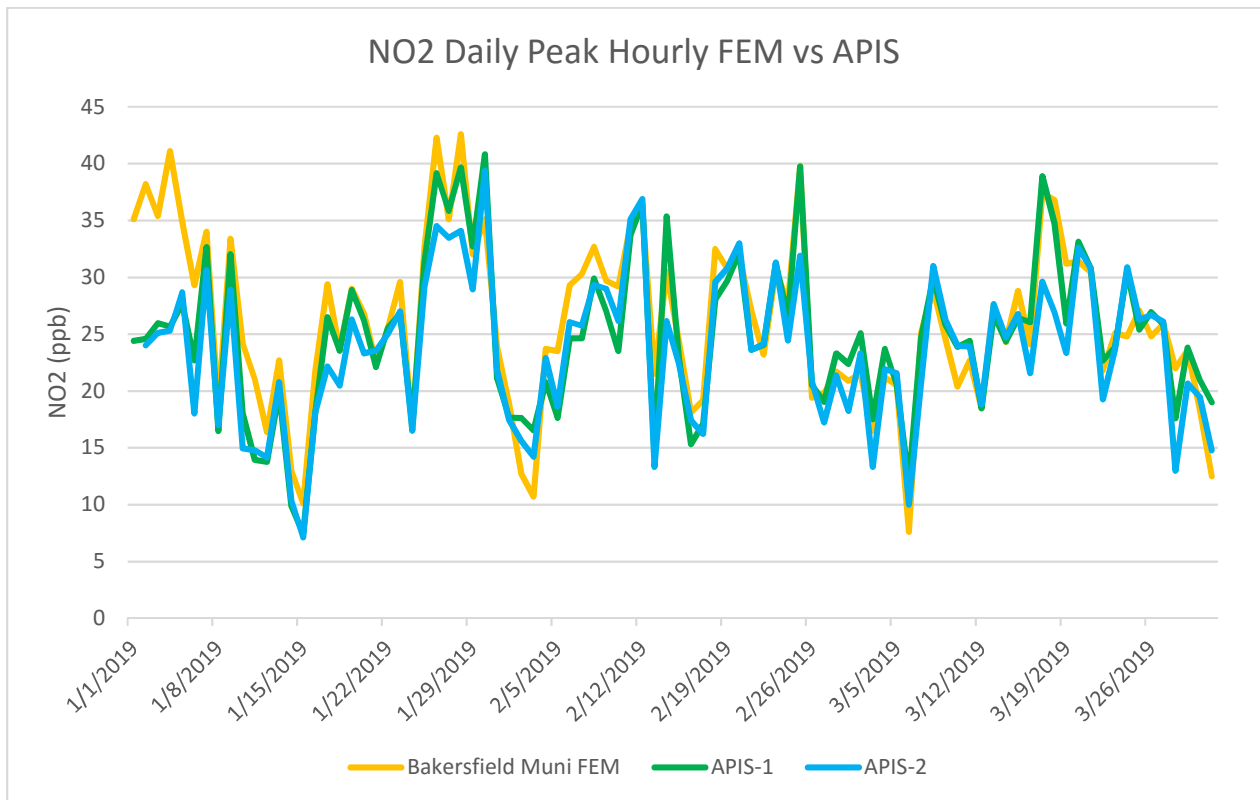
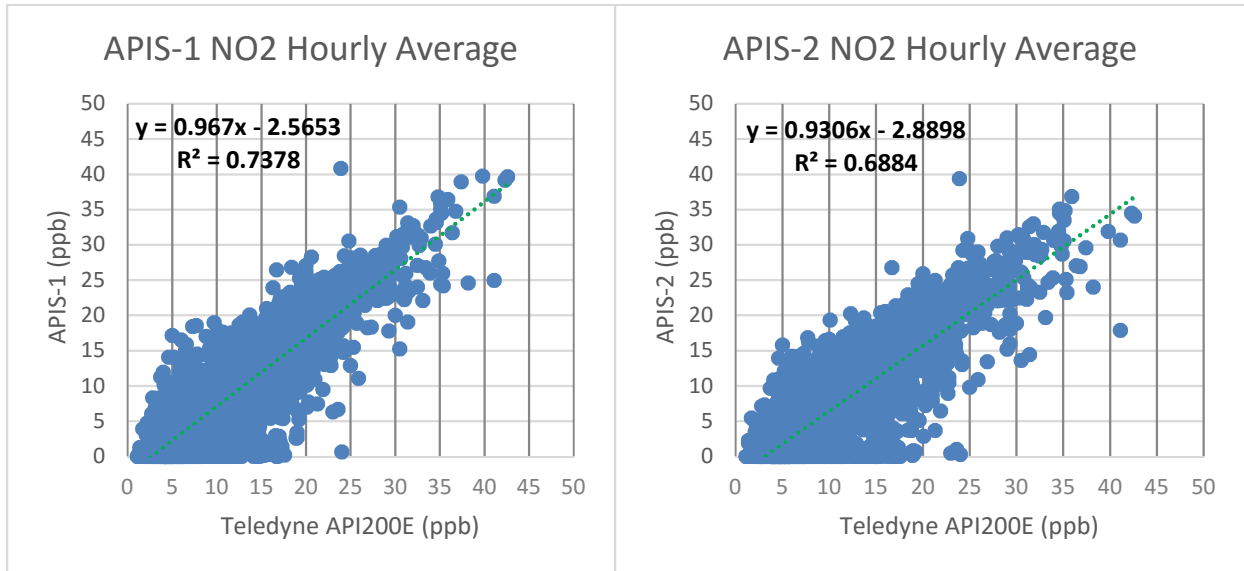
Nitrogen Oxide (NO)

For the hourly NO averages, the APIS 1 sensor had a 2.1 ppb low bias and the APIS 2 sensor had a 2.8 ppb low bias during the 2019-1st quarter.



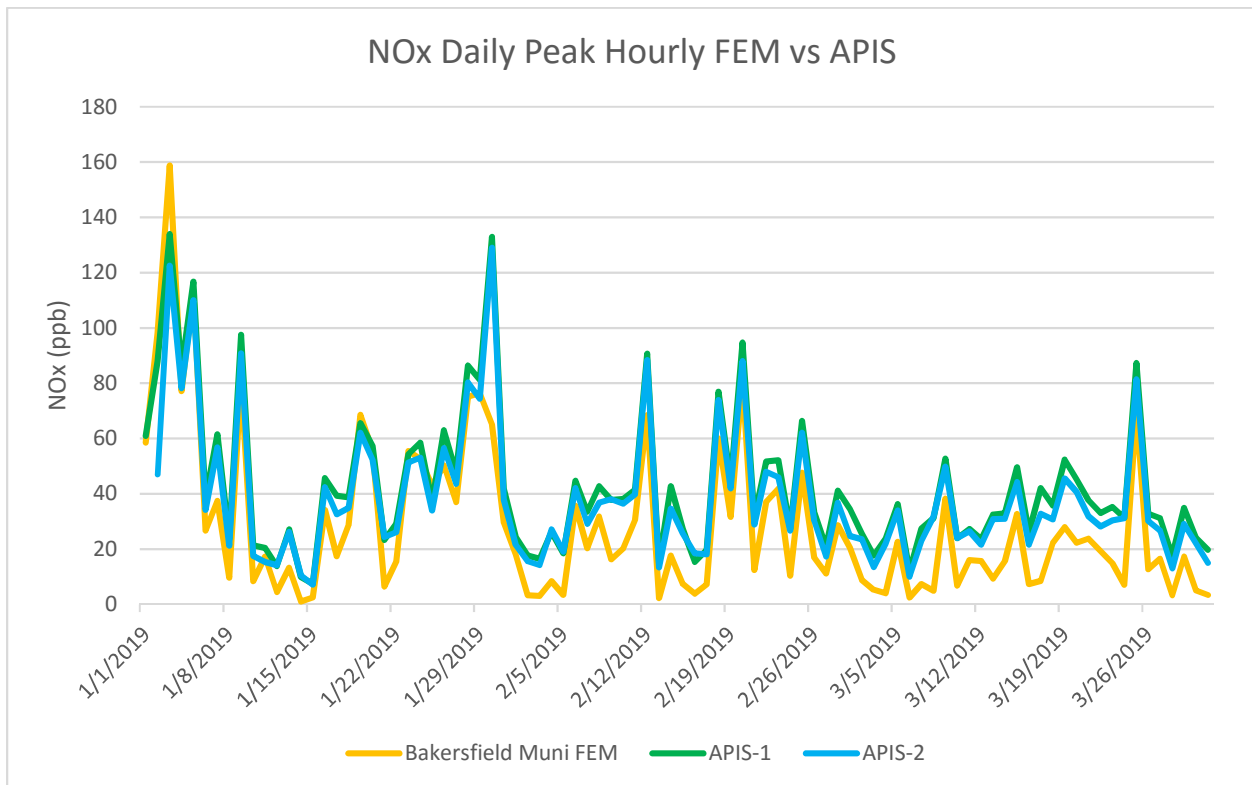
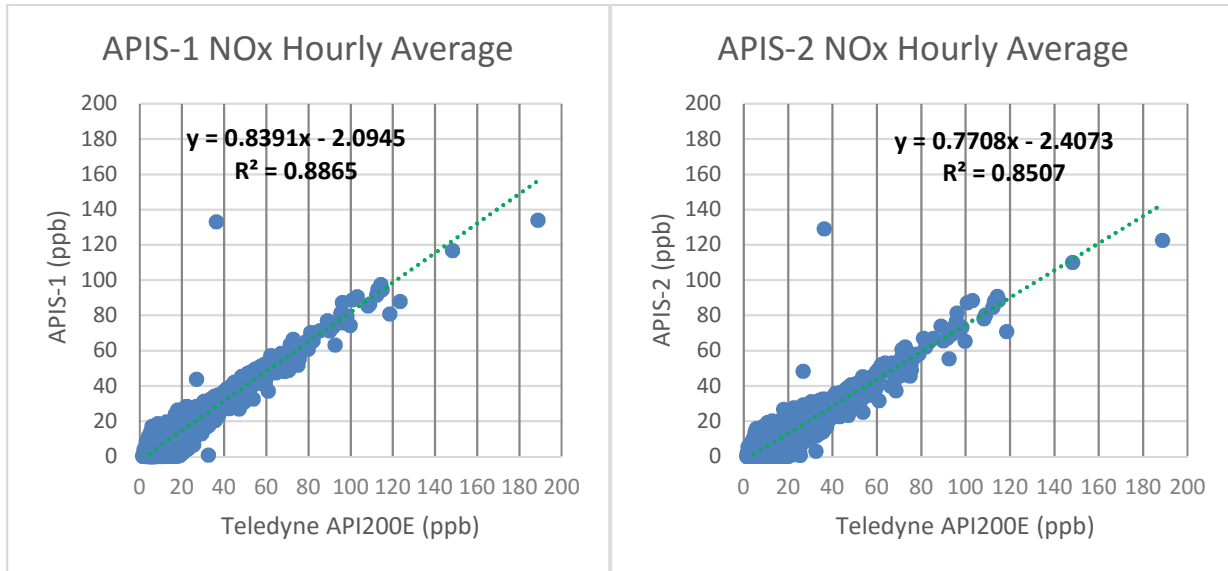
Nitrogen Dioxide (NO₂)

For the hourly NO₂ averages, the APIS 1 sensor had a 3.0 ppb low bias and the APIS 2 sensor had a 3.7 ppb low bias during the 1st quarter 2019 period.



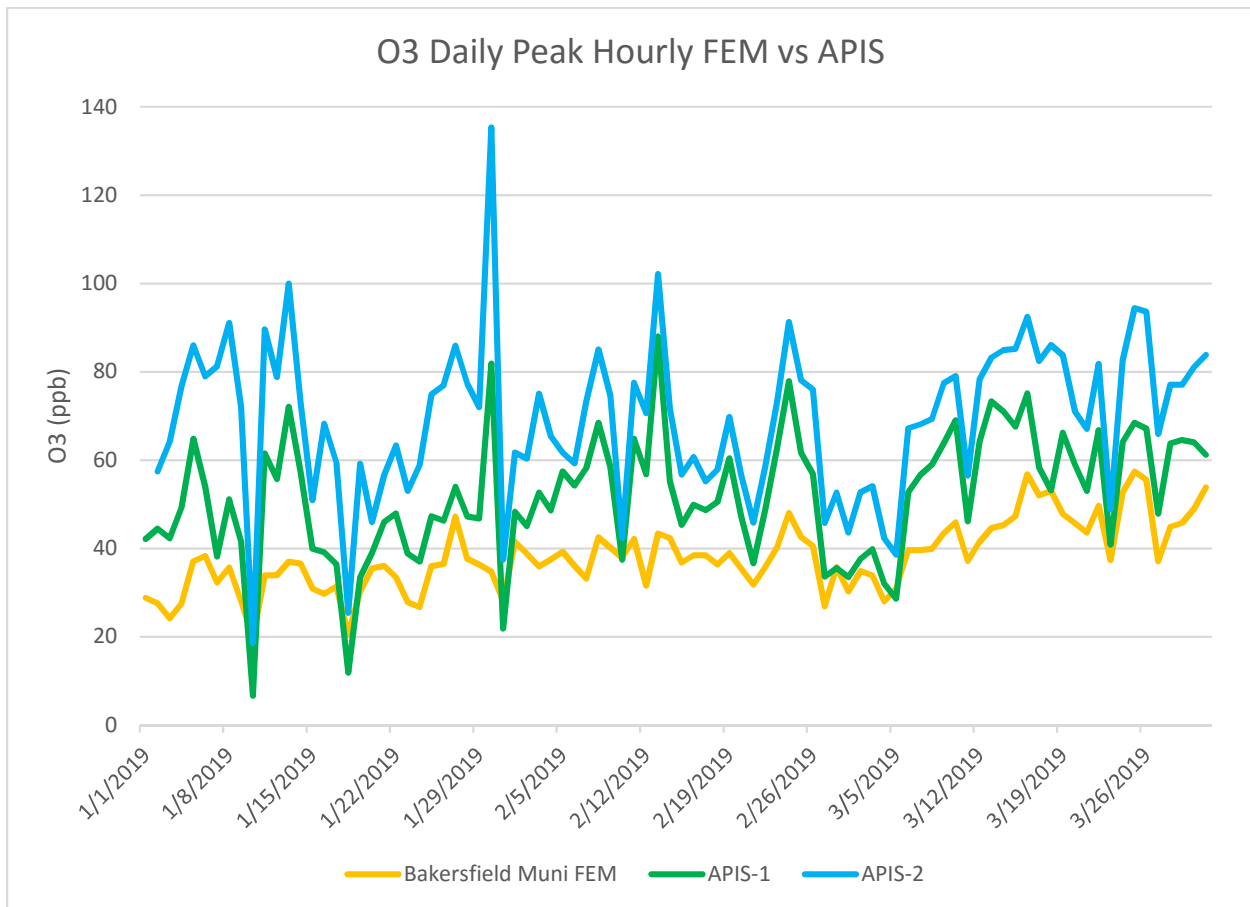
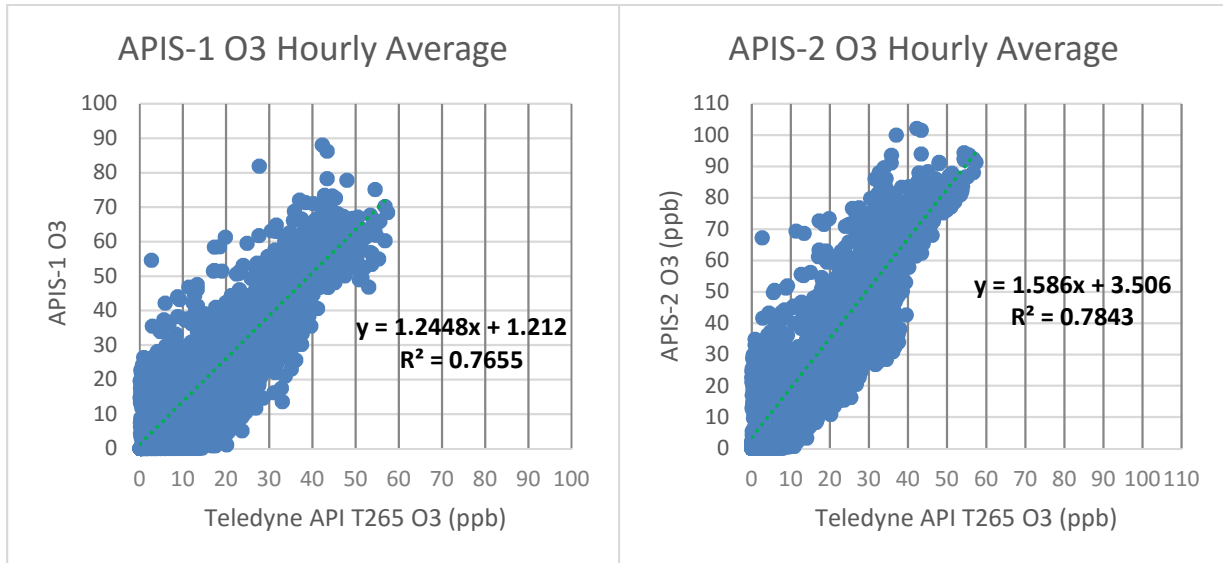
Oxides of Nitrogen (NOx)

For the hourly NOx averages, the APIS 1 sensor had a 5.1 ppb low bias and the APIS 2 sensor had a 6.6 ppb low bias during the 1st quarter 2019 period.



Ozone (O3)

For the hourly O3 averages, the APIS 1 sensor had a 6.2 ppb high bias and the APIS 2 sensor had a 15.7 ppb high bias during the 1st quarter 2019 period.



Statistical Summary

The following table provides a statistical summary of the data collected during the analysis period of this report.

Statistic	CO	NO	NO2	NOx	O3
FEM Avg	0.2665	6.0097	12.4232	18.4322	20.557
APIS 1 Avg	0.1806	3.9203	9.4523	13.3726	26.8084
APIS 2 Avg	0.1435	2.9804	8.6290	11.6095	36.4639
FEM 1-hr Max	1.25	158.8	42.6	188.8	57.4
APIS 1 1-hr Max	11.1088	113.9669	40.8218	133.9899	88.0372
APIS 2 1-hr Max	11.3152	103.5761	39.38	129.0286	135.3378
APIS 1 1-hr R ²	0.1237	0.9425	0.7378	0.8865	0.7655
APIS-1 1-hr Slope	0.6603	0.809	0.967	0.8391	1.2448
APIS-1 1-hr Intercept	0.0047	-0.9369	-2.5653	-2.0945	1.212
APIS 2 1-hr R ²	0.1098	0.9216	0.6884	0.8507	0.7843
APIS-2 1-hr Slope	0.6734	0.7118	0.9306	0.7708	1.586
APIS-2 1-hr Intercept	-0.033	-1.1528	-2.8898	-2.4073	3.506