



Technical Evaluation of Sensor Technology (TEST) Program

*APIS Sensor
2019 – 2nd 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-Municipal Airport 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

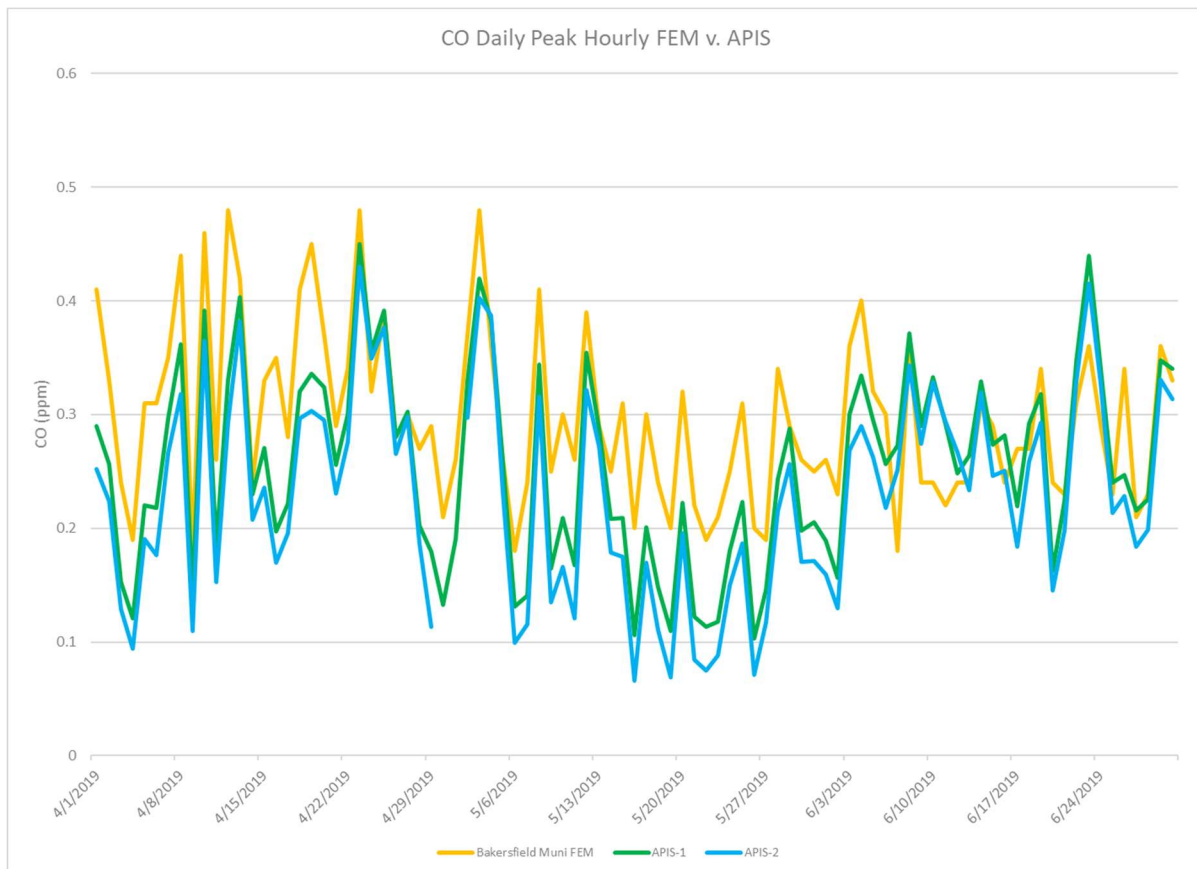
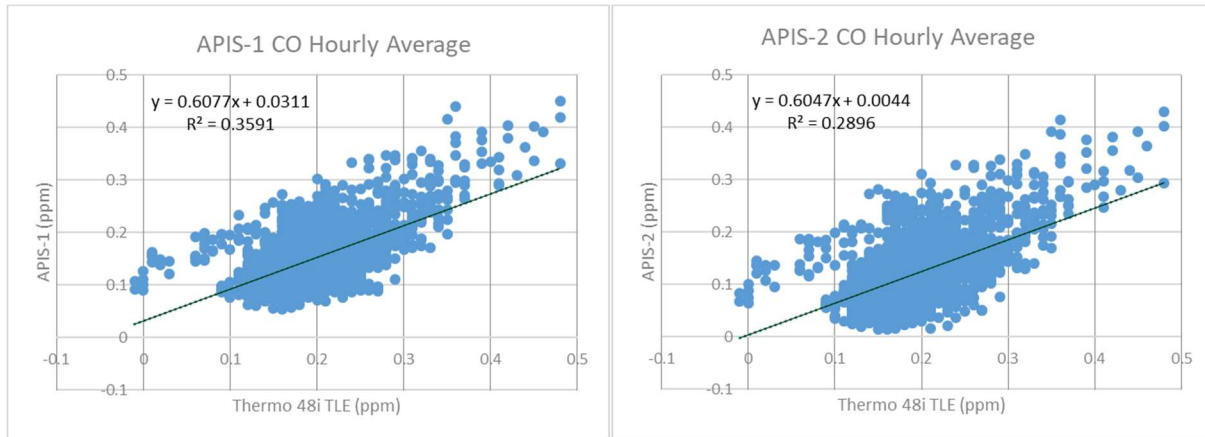
The analysis for this report covers the time period of April 2019 through June 2019 (2019 – 2nd quarter). During this this period, hourly data was removed from the calculation of bias and average concentrations when either the APIS sensor or regulatory monitor did not have a valid sample. For the daily peak line graphs, all available data is shown for each collocated analyzer and sensor.

The data from the 2nd quarter of 2019 were impacted by a mixture of both troughs and ridges traversing the region. By June, periods of high pressure resided over the Valley causing increased stability and an increase in 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, CO APIS 1 & 2, NO APIS 1, and NO_x APIS 2, which were biased lower than the regulatory data.

Site Specific Analysis of APIS Sensor Performance

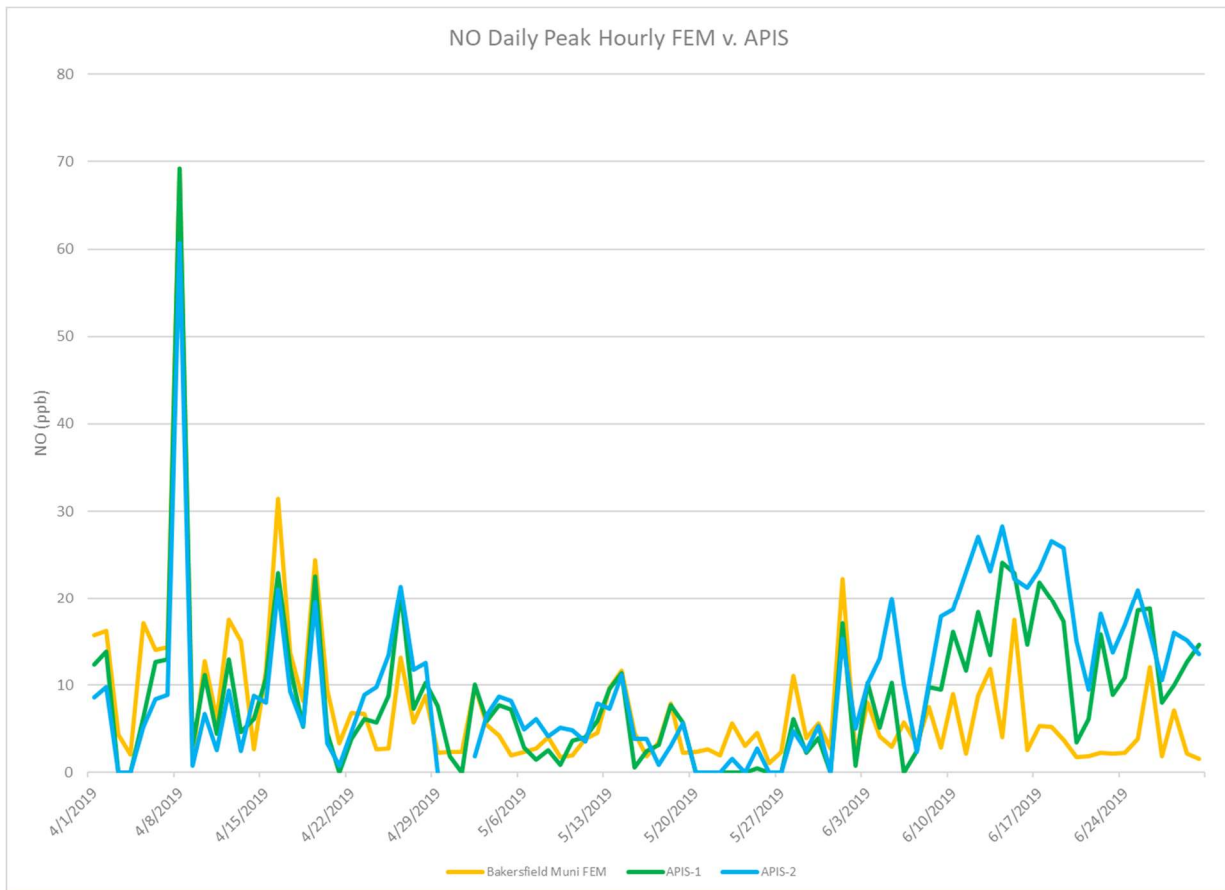
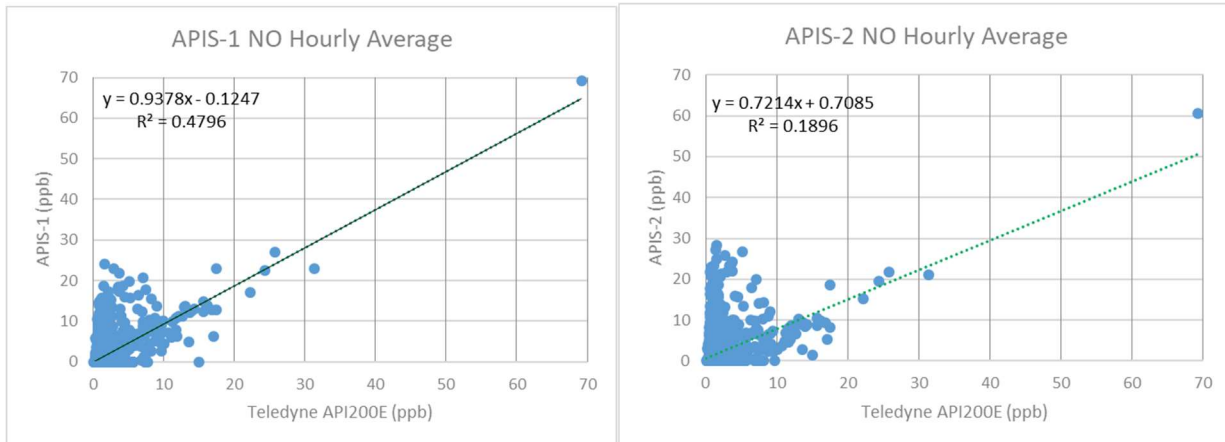
Carbon Monoxide (CO)

For the hourly CO averages, the APIS 1 sensor had a 0.047 ppm low bias over the FEM sensor and the APIS 2 sensor had a 0.075 ppm low bias over the FEM sensor during the 2019-2nd quarter.



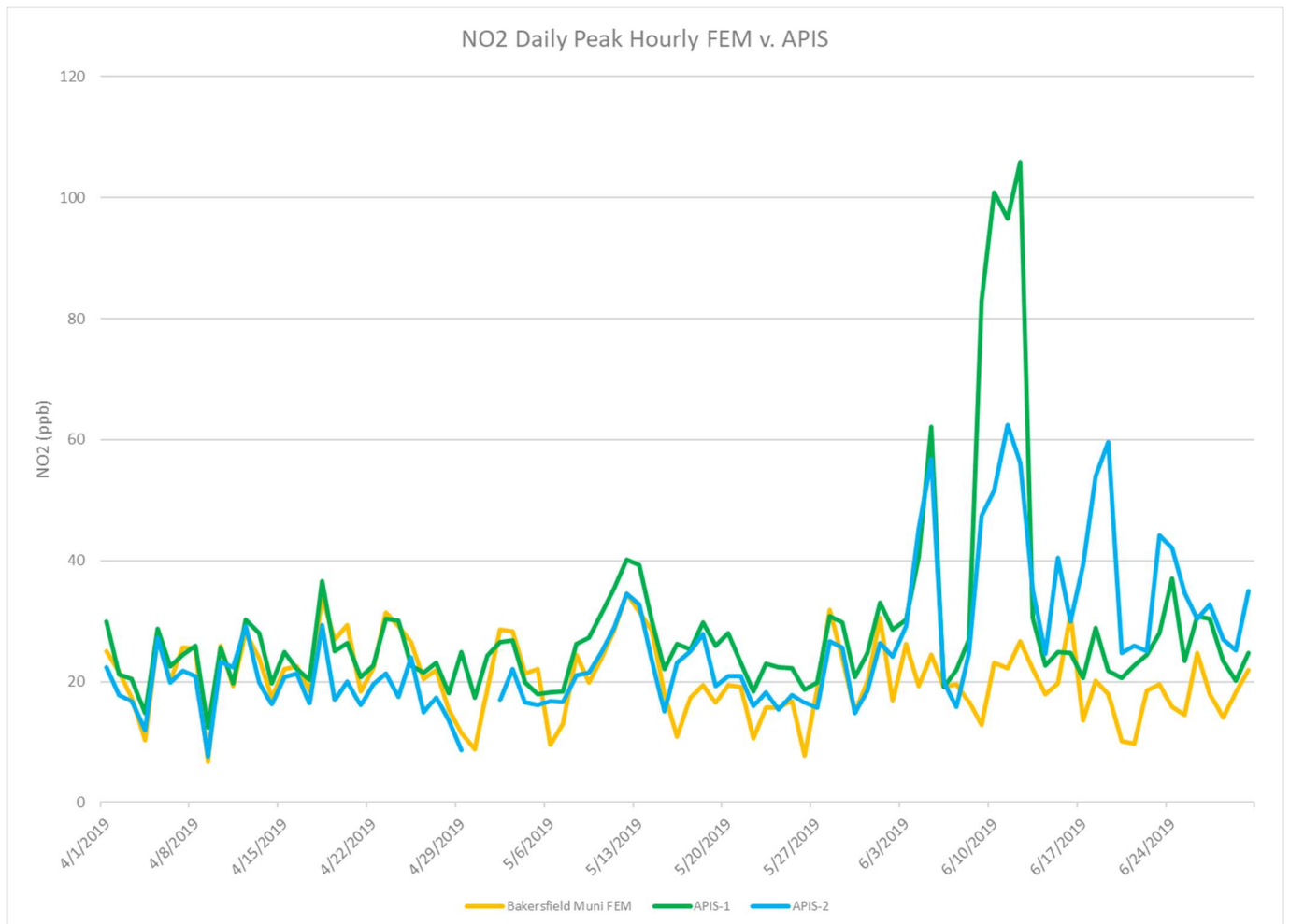
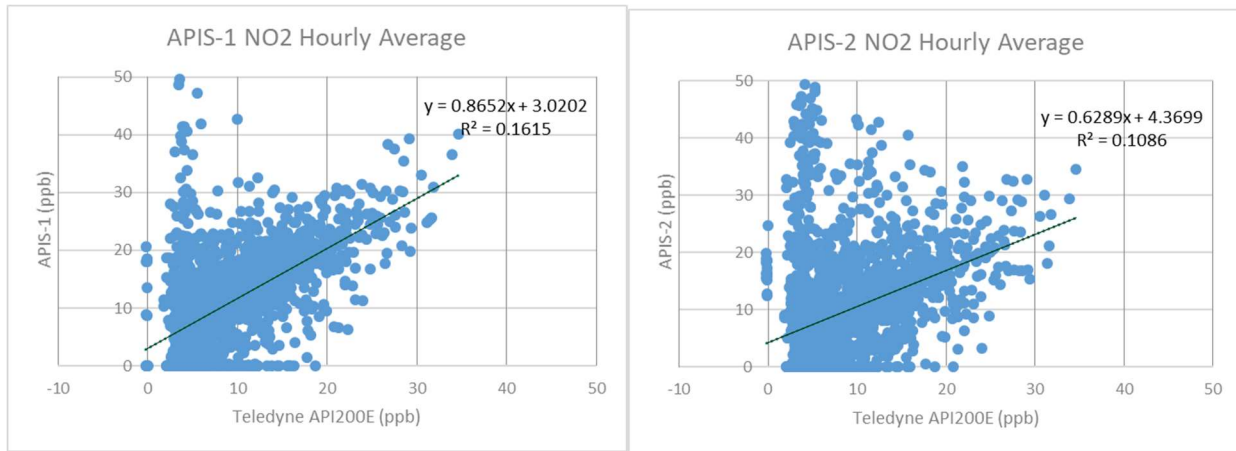
Nitrogen Oxide (NO)

For the hourly NO averages, the APIS 1 sensor had a 0.2 ppb low bias and the APIS 2 sensor had a 0.3 ppb high bias during the 2019-2nd quarter.



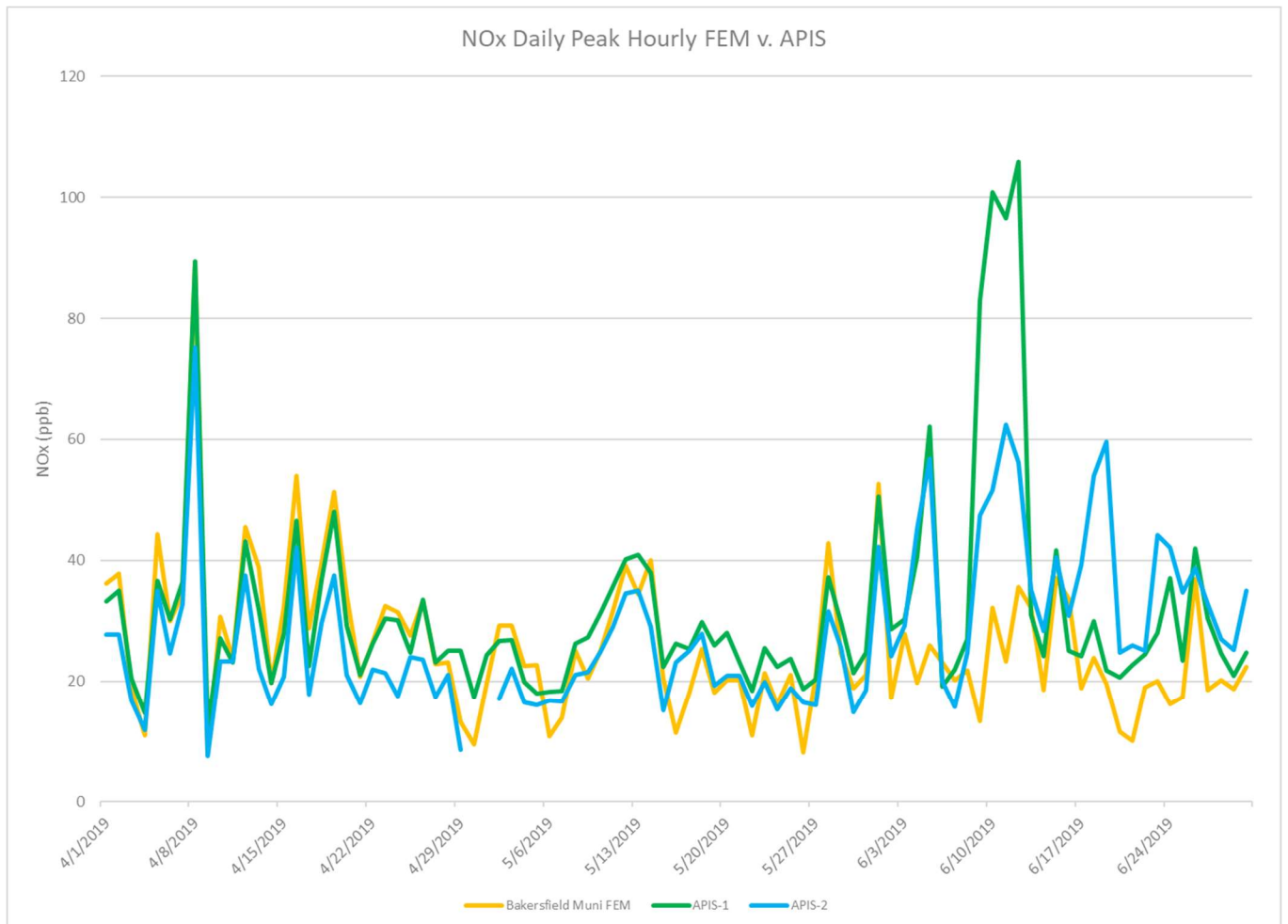
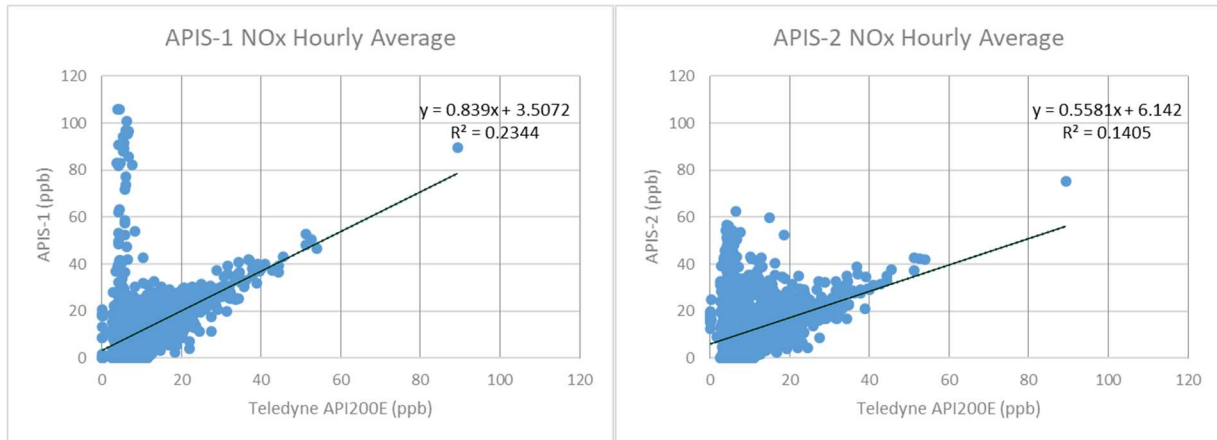
Nitrogen Dioxide (NO₂)

For the hourly NO₂ averages, the APIS 1 sensor had a 1.9 ppb high bias and the APIS 2 sensor had a 1.3 ppb low bias during the 2nd quarter 2019 period.



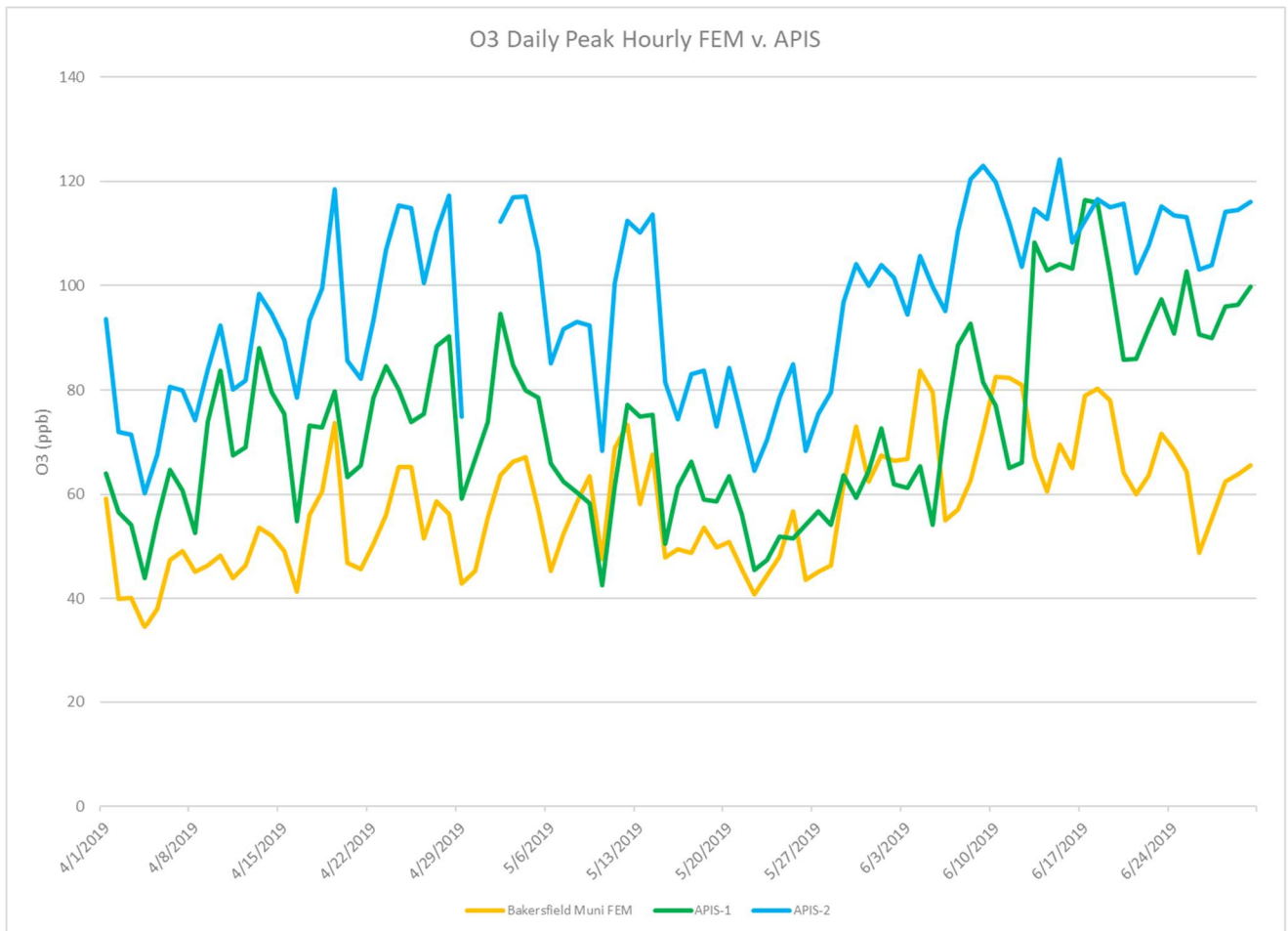
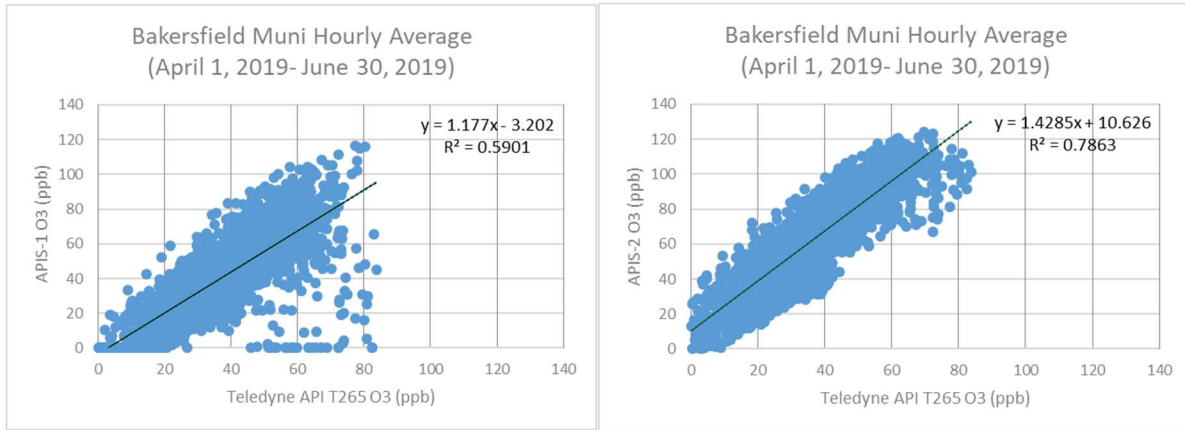
Oxides of Nitrogen (NO_x)

For the hourly NO_x averages, the APIS 1 sensor had a 2.0 ppb high bias and the APIS 2 sensor had a 11.6 ppb low bias during the 2nd quarter 2019 period.



Ozone (O3)

For the hourly O3 averages, the APIS 1 sensor had a 3.4 ppb high bias and the APIS 2 sensor had a 26.7 ppb high bias during the 2nd 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	0.2006	1.4043	8.2521	9.6568	37.3369
APIS 1 Avg	0.1528	1.1900	10.1241	11.5726	40.8539
APIS 2 Avg	0.1255	1.7238	9.5959	11.5655	64.1041
FEM 1-hr Max	0.48	69.2	34.6	89.3	83.7
APIS 1 1-hr Max	0.4504	69.1781	105.8768	105.8768	116.4364
APIS 2 1-hr Max	0.4300	60.6792	62.4440	75.1814	124.2221
APIS 1 1-hr R ²	0.3591	0.4796	0.1615	0.2344	0.5901
APIS-1 1-hr Slope	0.6077	0.9378	0.8652	0.839	1.177
APIS-1 1-hr Intercept	0.0311	-0.1247	3.0202	3.5072	-3.202
APIS 2 1-hr R ²	0.2896	0.1896	0.1086	0.1405	0.7863
APIS-2 1-hr Slope	0.6047	0.7214	0.6289	0.5583	1.4285
APIS-2 1-hr Intercept	0.0044	0.7085	4.3699	6.142	10.626