



Technical Evaluation of Sensor Technology (TEST) Program

*APIS Sensor
2019 – 3rd Quarter
Final Report*



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 2018, 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

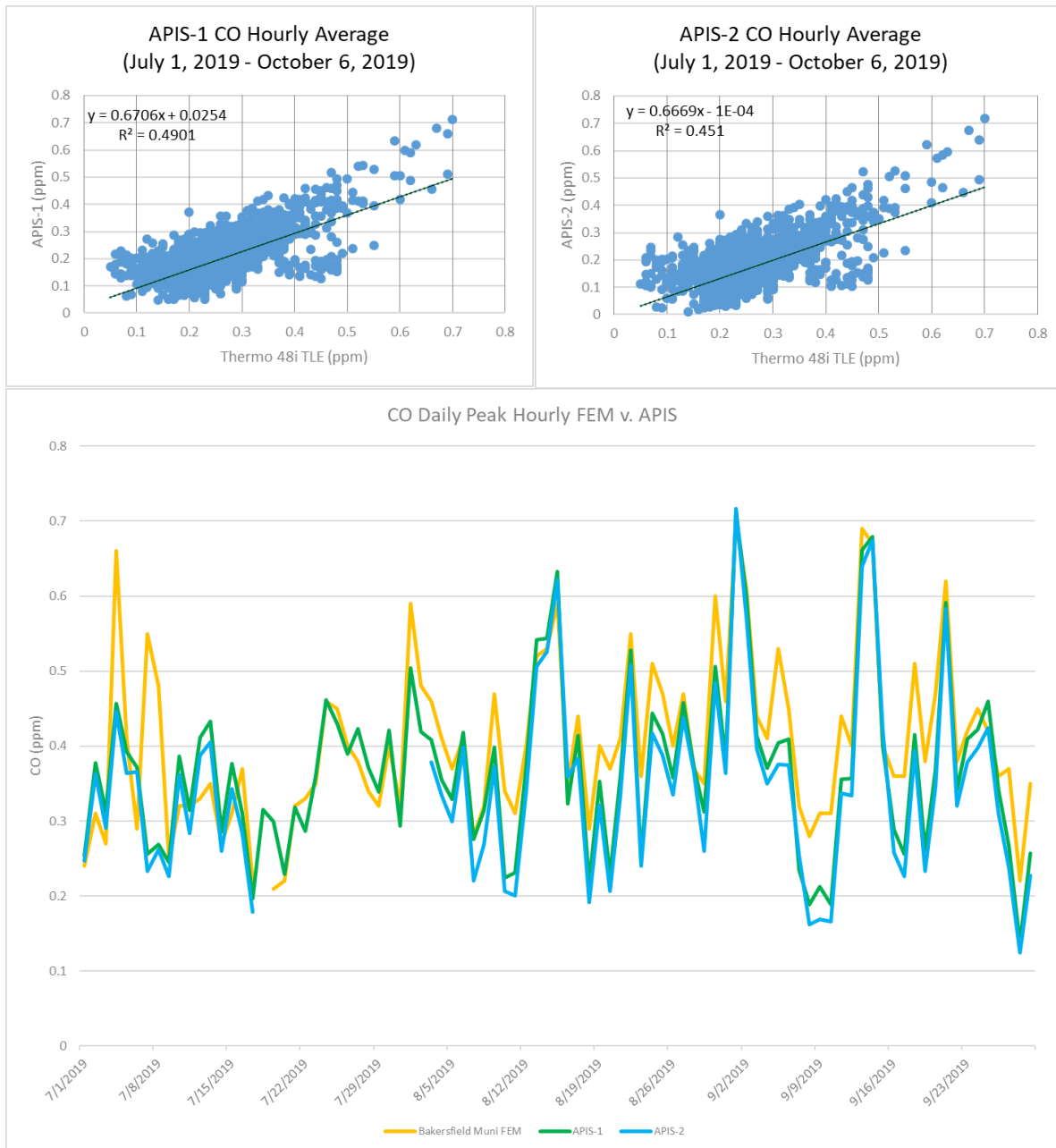
The analysis for this report covers the time period of July 2019 through October 6, 2019 (2019 – 3rd Quarter). The last valid data that APIS made available was through October 6, 2019 and the instruments were later removed from the site on February 25, 2020. During this period, hourly data was removed 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 3rd quarter of 2019 through October 6, 2019 were influenced by prolonged periods of high pressure over the region which caused an increase in temperatures and stability. A few low pressure systems moved through the area with gusty winds, especially on the west side and mountain passes in September into early October. These systems also brought an increase of onshore wind flows that helped decrease temperatures and resulted in improved dispersion. As the plots below show, APIS data was biased higher than the District's regulatory data during this period for all pollutants except CO for APIS 1 & 2 and NO₂ for APIS 1 which were biased lower than the regulatory data.

Site Specific Analysis of APIS Sensor Performance

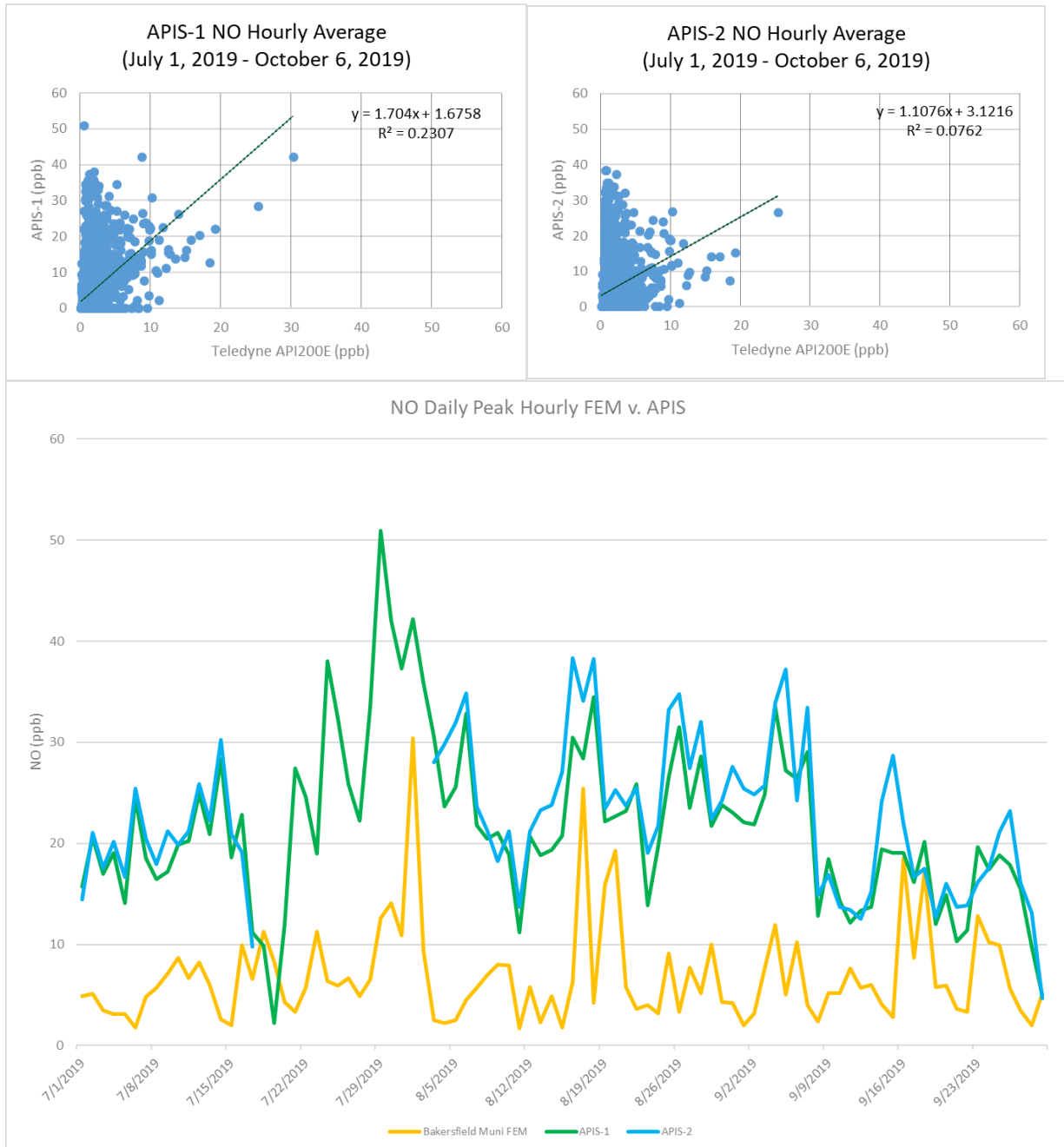
Carbon Monoxide (CO)

For the hourly CO averages, the APIS 1 sensor had a 0.059 ppm low bias over the FEM sensor and the APIS 2 sensor had a 0.087 ppm low bias over the FEM sensor during the 2019- 3rd Quarter.



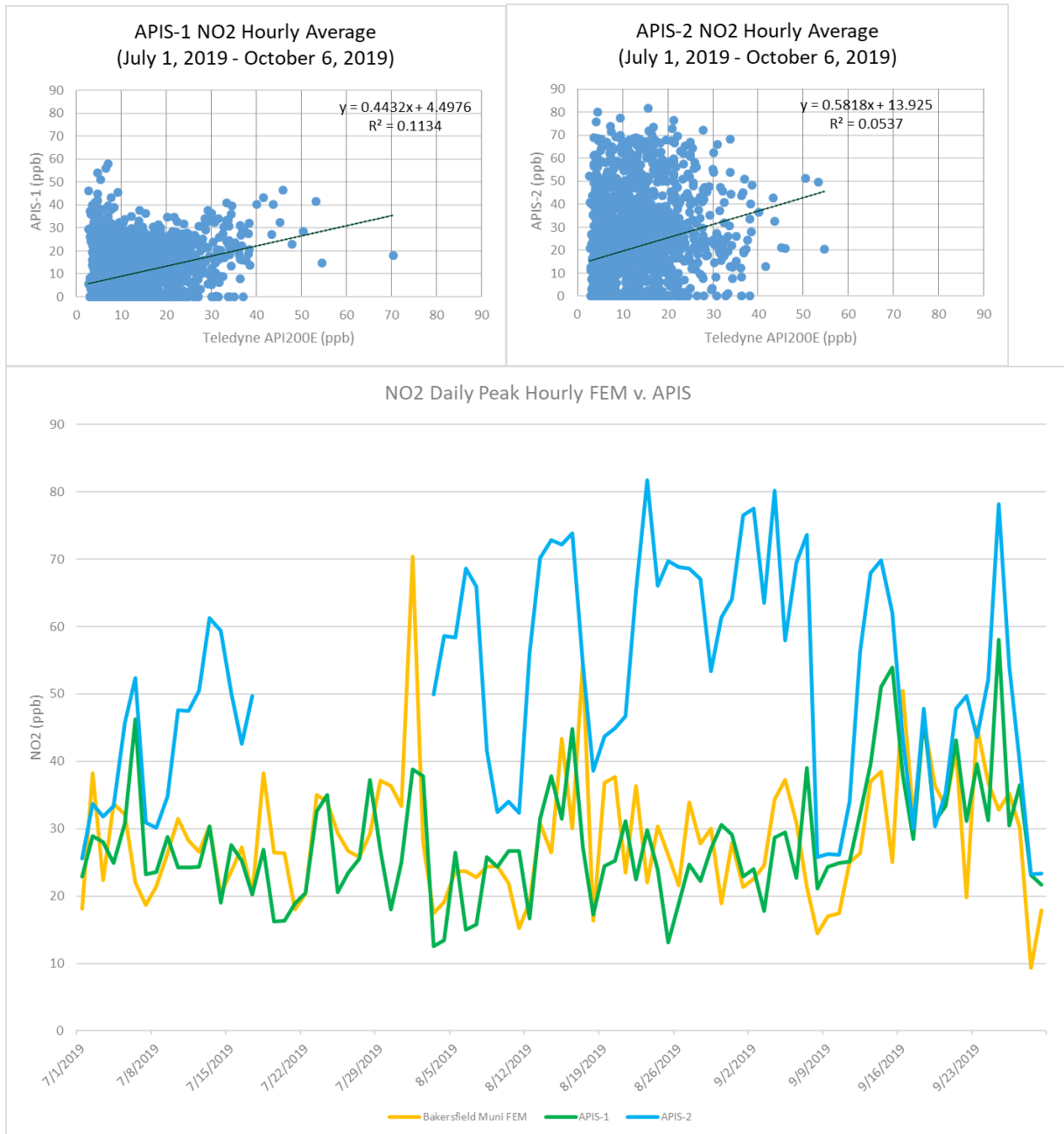
Nitrogen Oxide (NO)

For the hourly NO averages, the APIS 1 sensor had a 2.7 ppb high bias and the APIS 2 sensor had a 3.3 ppb high bias during the 2019 3rd quarter.



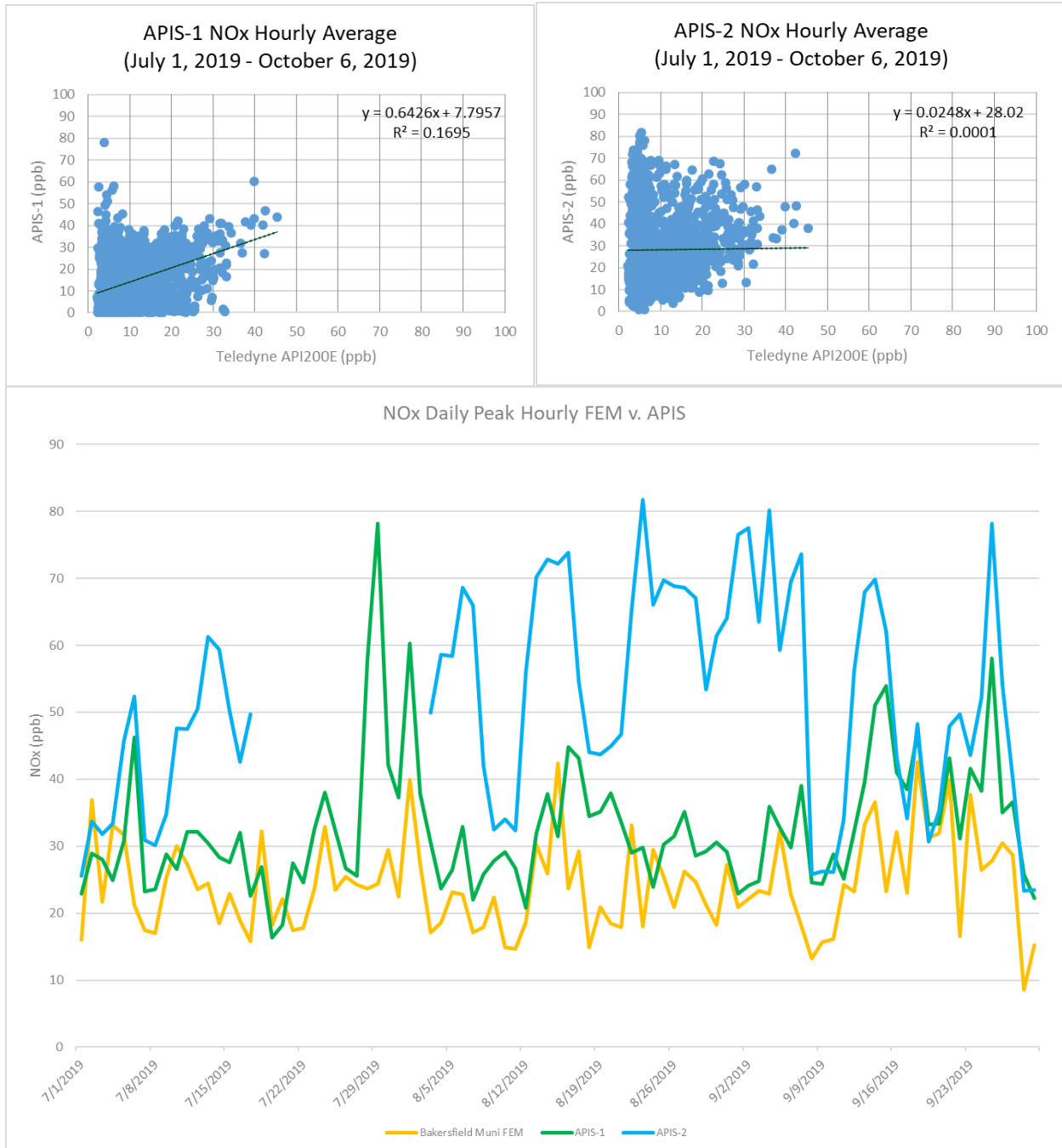
Nitrogen Dioxide (NO₂)

For the hourly NO₂ averages, the APIS 1 sensor had a 2.0 ppb low bias and the APIS 2 sensor had an 11.6 ppb high bias during the 2019 3rd quarter.



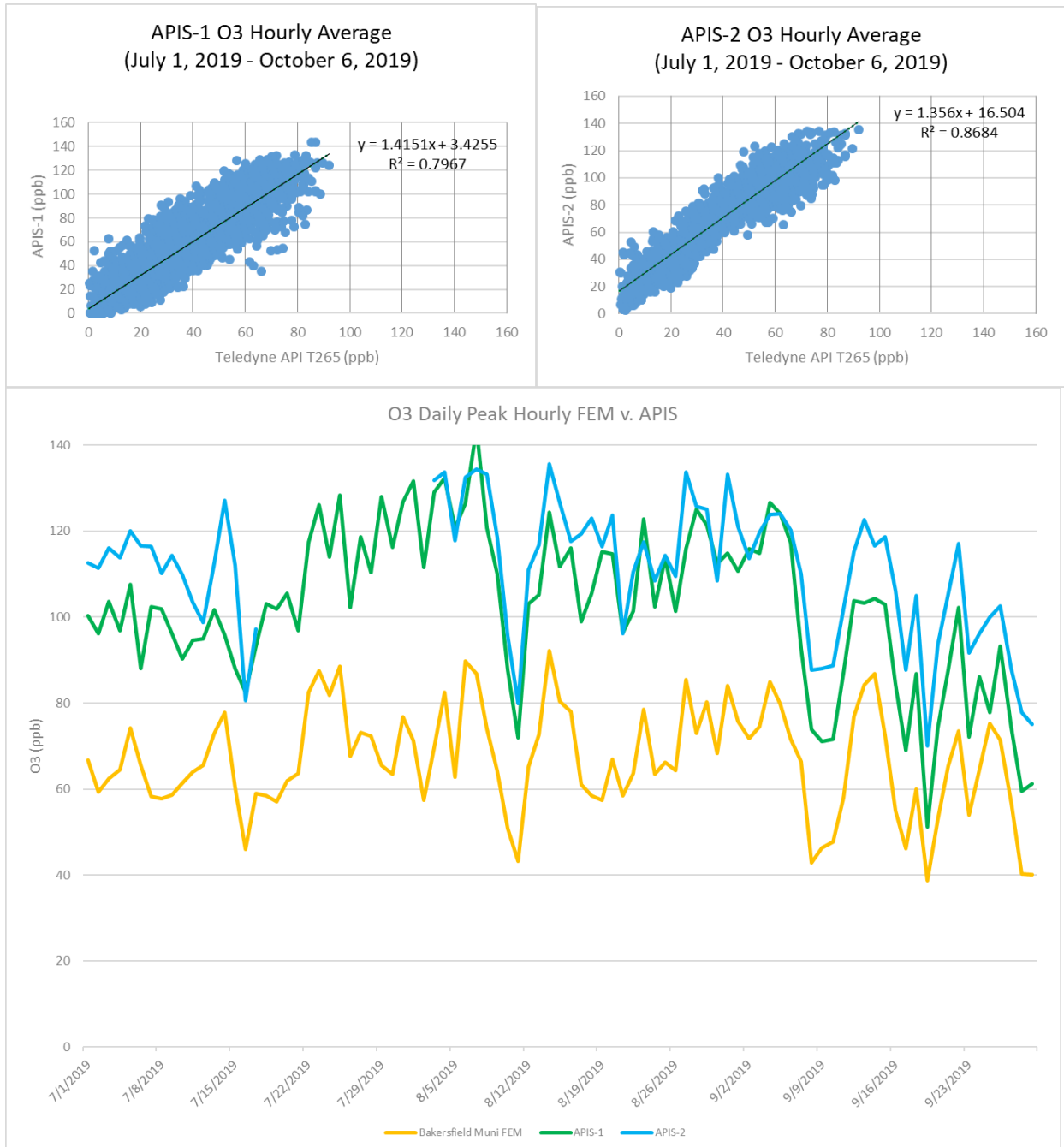
Oxides of Nitrogen (NOx)

For the hourly NOx averages, the APIS 1 sensor had a 4.1 ppb high bias and the APIS 2 sensor had an 18.0 ppb high bias during the 2019 3rd quarter.



Ozone (O3)

For the hourly O3 averages, the APIS 1 sensor had a 19.3 ppb high bias and the APIS 2 sensor had a 30.0 ppb high bias during the 2019 3rd quarter.



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	0.2566	1.4134	11.7352	10.3210	38.2965
APIS 1 Avg	0.1973	4.1572	9.75542	14.5517	57.3777
APIS 2 Avg	0.1741	4.7005	23.9211	28.9165	67.0110
FEM 1-hr Max	0.7	30.4	70.4	45.4	92.2
APIS 1 1-hr Max	0.7123	50.9226	58.0964	81.7056	143.8543
APIS 2 1-hr Max	0.7168	38.3163	81.7056	75.1814	135.6919
APIS 1 1-hr R ²	0.4901	0.2307	0.1134	0.1695	0.7967
APIS-1 1-hr Slope	0.6706	1.704	0.4432	0.6426	1.4151
APIS-1 1-hr Intercept	0.0254	1.6758	4.4976	7.7957	3.4255
APIS 2 1-hr R ²	0.451	0.0762	0.0537	0.0001	0.8684
APIS-2 1-hr Slope	0.6669	1.1076	0.5818	0.0248	1.356
APIS-2 1-hr Intercept	0	3.1216	13.925	28.02	16.504