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Subject: Georgia EPD Correspondence for RFC 26002 – Modification Requests for Federal Equivalent Methods (FEM) Monitors

To Whom It May Concern:

The Georgia Environmental Protection Division (Georgia EPD) appreciates the opportunity to provide the following correspondence pertaining to the Request for Correction (RFC) submitted by the NAAQS Regulatory Review & Rulemaking Coalition (NR3 Coalition) on January 6, 2026.

The Federal Reference Method (FRM) for measuring $PM_{2.5}$ involves the collection of a 24-hour sample on a filter that is weighed before and after the collection. The FRM method, which directly measures mass on the filter and is gravimetrically analyzed, is considered the "gold standard". EPA has approved the use of Federal Equivalent Methods (FEMs) for measuring $PM_{2.5}$. The Teledyne T640/T640x is an FEM that continuously measures $PM_{2.5}$ by using light scattering.

Most health studies considered for setting the annual and daily $PM_{2.5}$ National Ambient Air Quality Standards (NAAQS) were based on FRM measurements in the field, not Performance Evaluation Program (PEP) FRM measurements or FEMs. As a result, any bias in the FRM measurements in the field will be translated into biases in the $PM_{2.5}$ NAAQS. For example, if the FRM measurements in the field were biased 10% low, the resulting $PM_{2.5}$ NAAQS will be set 10% lower than it would have been if it had been based on unbiased $PM_{2.5}$ measurements. As a result, the goal of the FEM should be to match the FRM measurements in the field (even if they are biased low) since they were used to set the NAAQS, rather than match the PEP FRM measurements (which have fewer biases) since PEP FRMs were <u>not</u> used to set the NAAQS. To do otherwise would add additional biases into the determination of attainment and nonattainment with the $PM_{2.5}$ NAAQS.

Since 2017, Georgia EPD has incorporated continuous Teledyne T640 and T640x $PM_{2.5}$ samplers throughout our network. While the T640 FEM instruments have the benefit of near real-time air quality reporting to the public, the Teledyne T640/T640x samplers have an inherent high bias in the levels of $PM_{2.5}$ concentrations reported as compared to the manual filter-based FRM $PM_{2.5}$ samplers. Georgia EPD has evaluated the Teledyne T640/T640x performance at length and examined multiple ways that the Teledyne T640/T640x could be adjusted to be more comparable to the FRM. Georgia EPD submitted documentation exploring three different ways that the data

could be adjusted (see Attachment 1). The calculated bias adjustment factors are based on analysis of annual data, quarterly data, and a hi/low calculation of the data collected by Georgia EPD from 2018-2022. The initial recommendation presented by Georgia EPD was to use an adjustment factor of 0.82 (for all $PM_{2.5}$ concentrations regardless of concentration and ambient temperature) to produce the data closest to the FRM data and reduce the inherent bias in the Teledyne T640 data.

After this examination of the data by Georgia EPD, Teledyne/EPA released an algorithm that was applied directly to the software to adjust current and historical $PM_{2.5}$ data. The alignment factor calculations implemented in the new T640/T640x software are shown in Table 1.

Table 1. T640/T640x data adjustment criteria (ambient temperature and $PM_{2.5}$ concentration requirements) for applying the Teledyne/EPA correction factors.

Data Adjustment Criteria	Correction Factor Applied
Ambient T ≤ 20 ° C **i)** raw T640/x raw PM value ≤ 10 µg/m^3 **ii)** raw T640/x raw PM value > 10 µg/m^3	**Ambient T ≤ 20 ° C** **i)** multiply T640/x data by 0.813233 **ii)** subtract 1.861 ➔ (T640/x raw PM – 1.861)
Ambient T > 20 ° C **i)** raw T640/x raw PM value ≤ 5 µg/m^3 **ii)** raw T640/x raw PM value > 5 µg/m^3	**Ambient T > 20 ° C** **i)** multiply T640/x data by 0.813233 **ii)** subtract 0.925 ➔ (T640/x raw PM – 0.925)

Figure 1 displays the expected adjustment needed based on the EPA/Teledyne algorithm in order for the T640 FEM to match the FRM as a function of FEM concentration vs. the actual adjustment needed for the T640 FEM to match the FRM. Ideally, the data would fall along the blue line for data collected when the temperature is ≤20 ºC, and along the red line for data collected when the temperature >20 ºC. However, when applying this temperature dependent adjustment algorithm, the actual FEM adjustments needed to match the FRM data are significantly higher than the adjustment produced by the Teledyne/EPA algorithm, especially when the FEM measurements are greater than 10 µg/m^3.

Figure 2 displays the Teledyne T640 FEM 24-hour $PM_{2.5}$ concentrations that have been corrected by the Teledyne/EPA adjustment algorithm compared to the FRM concentrations from January 1, 2021, through July 31, 2023 (shown in orange). Ideally, the best fit regression line for the adjusted FEM data and the 1:1 line should overlap each other. In this example, the best fit regression line is well above the 1:1 line indicating the FEM measurements adjusted with the Teledyne/EPA algorithm are biased high compared to the FRM measurements. If the Teledyne T640 FEM 24-hour $PM_{2.5}$ concentrations are instead multiplied by a single adjustment value of 0.813233, the data aligns much more closely with the FRM data (shown in purple).

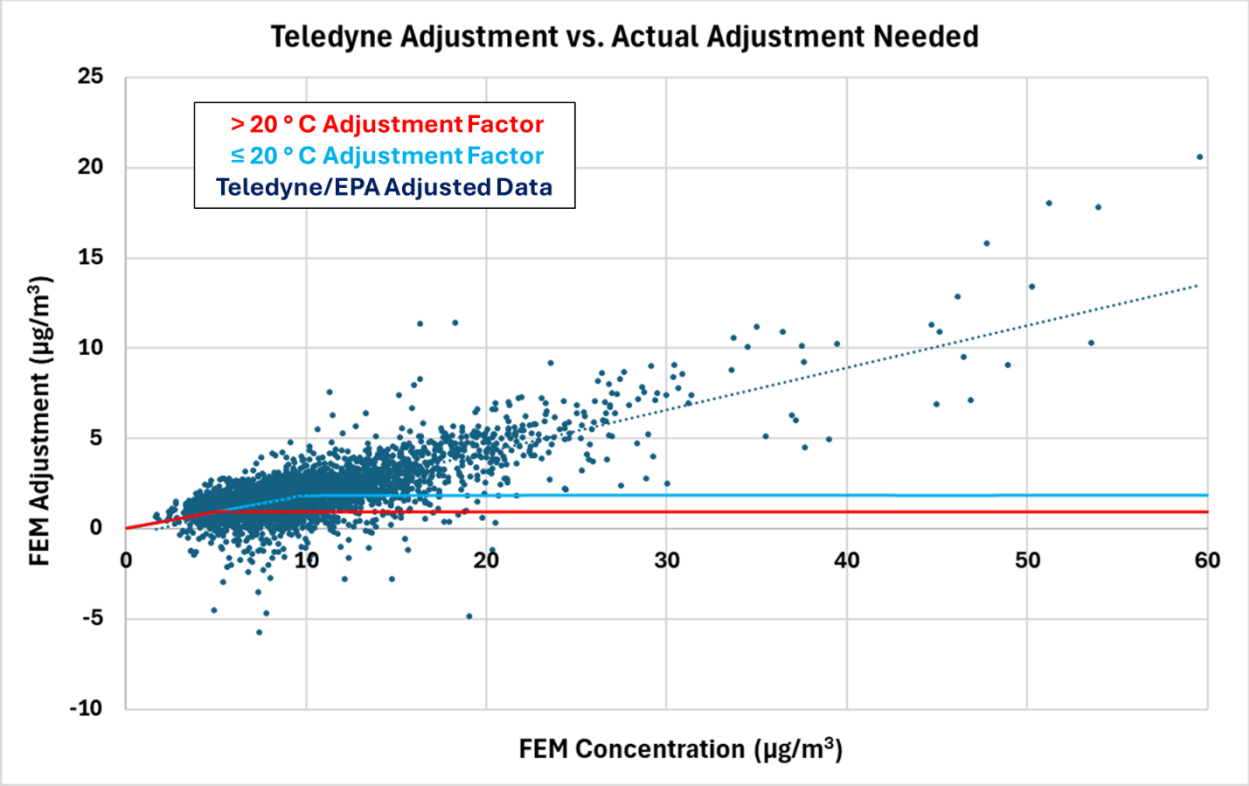

Figure 1. Comparison of the expected adjustment needed using the Teledyne/EPA adjustment algorithm to the actual adjustment needed to match the FRM. Red (above 20 °C) and blue (below 20 °C) lines correspond to the temperature dependent correction factors. The actual adjustment needed to match the FRM data is shown in navy with the best fit regression line superimposed.

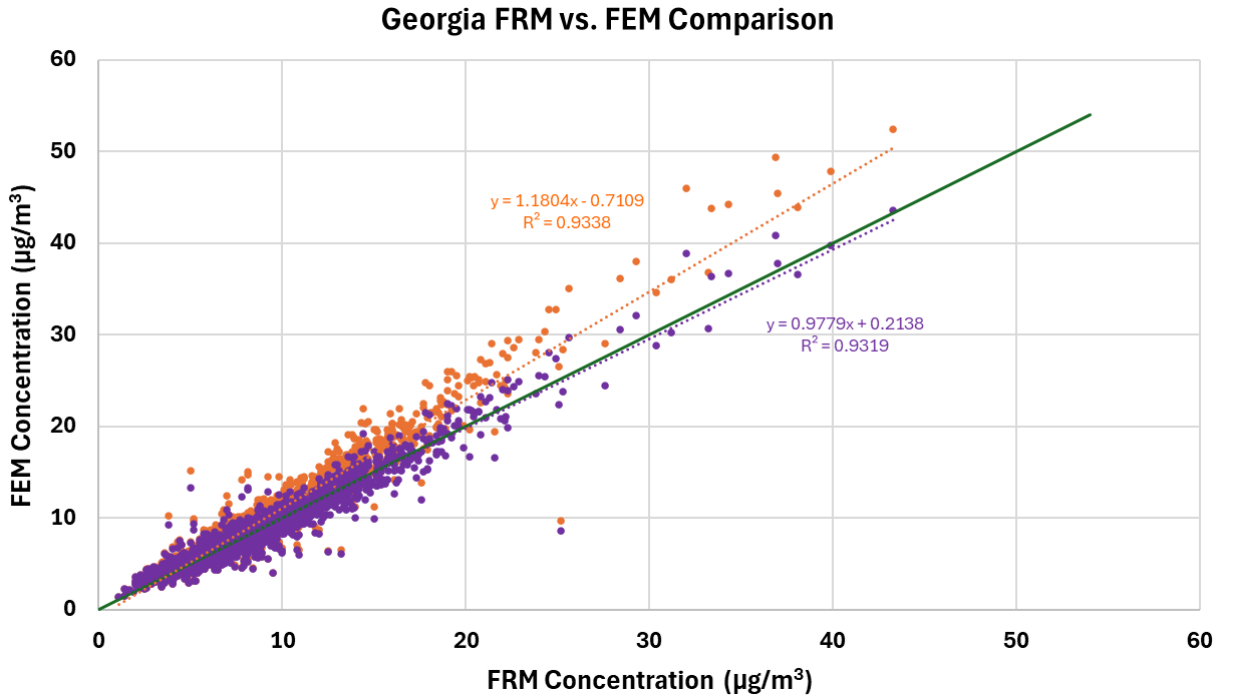

Figure 2. Comparison of Georgia EPD FEM data (T640/x) corrected with Teledyne/EPA algorithm (orange) vs. Georgia EPD single correction factor method (purple). For reference, a 1:1 line is shown in dark green as the expected trend line when comparing FEM and FRM data. Dotted lines represent the best fit regression line for each of the correction methods.

Georgia EPD examined the collocated FRM and Teledyne T640 FEM 24-hour $PM_{2.5}$ measurements that had been adjusted by the Teledyne/EPA algorithm on a nationwide scale (see Attachment 2, pages 2-3). The 2018-2023 data was compared, using 217 different monitoring sites, and 68,096 pairs of data. To evaluate the effectiveness of the Teledyne/EPA and Georgia EPD correction factors, the normalized mean bias (NMB) was calculated for the adjusted T640 data using the FRM as the reference value. Figure 3 shows the NMB for the Teledyne T640 data adjusted with the Teledyne/EPA adjustment algorithm, while Figure 4 shows the NMB for the Teledyne T640 adjusted with the Georgia EPD adjustment factor. When using the Teledyne/EPA data correction algorithm (as shown in Figure 3), a large number of sites still exhibit NMB >10% (red and dark red colors). However, using the Georgia EPD adjustment factor (as shown in Figure 4), only a few sites are in that same range with NMB >10% (red and dark red colors).

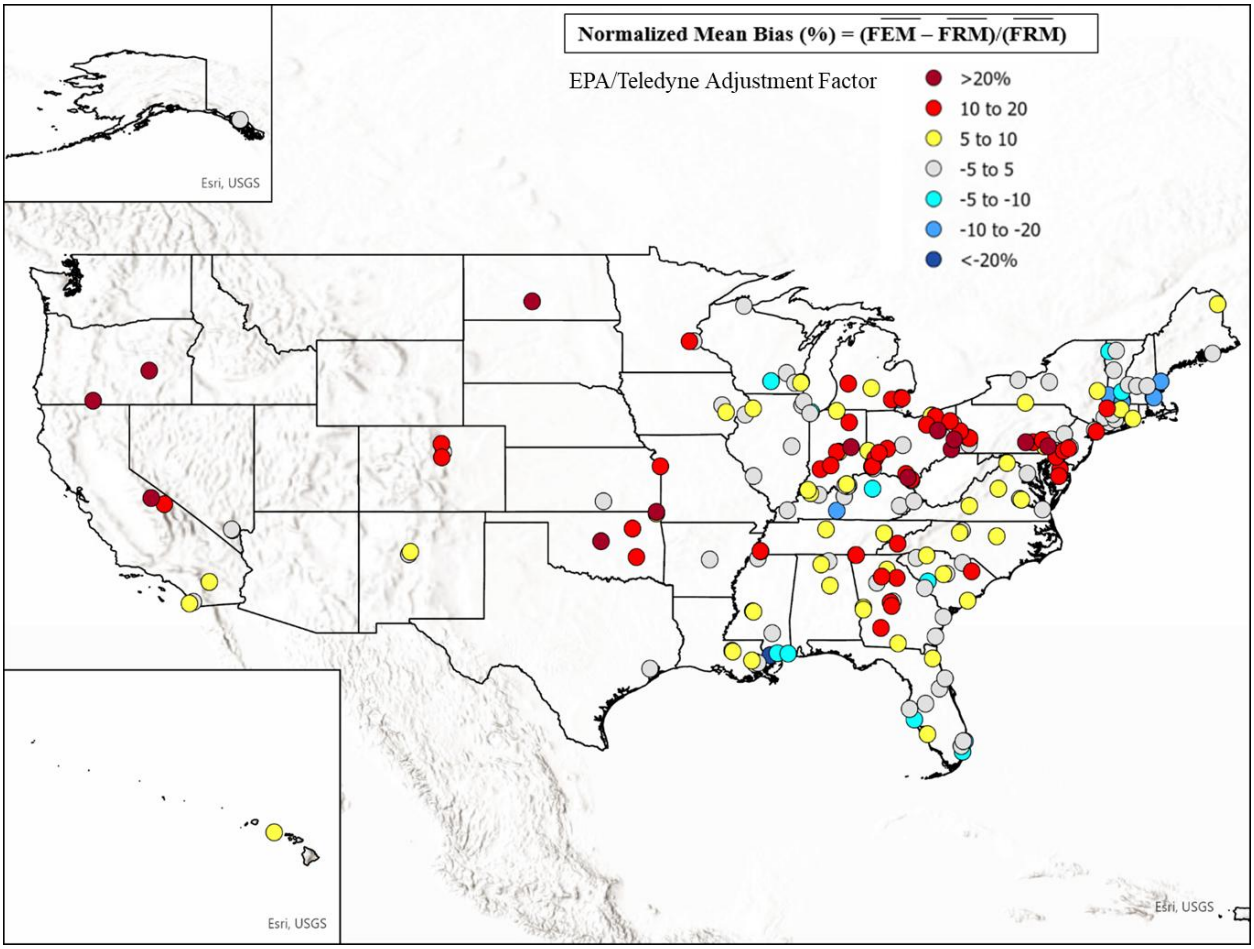

Figure 3. Map showing the normalized mean bias for the Teledyne/EPA adjustment algorithm.

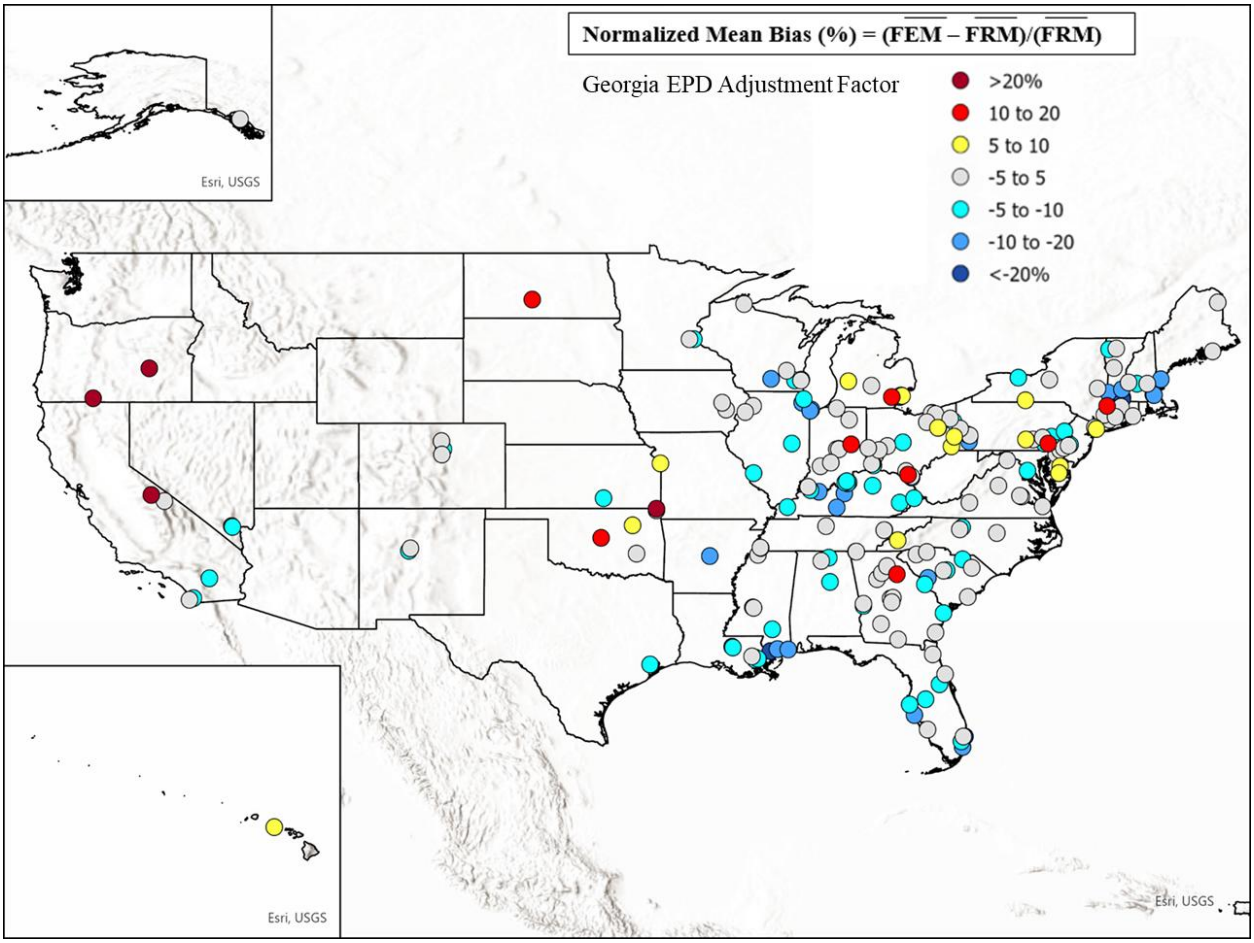

Figure 4. Map showing the normalized mean bias for the Georgia EPD single adjustment method.

The Teledyne T640/T640x User Manual requires the relative humidity (RH) Control Setpoint to be set at 35%. Due to the consistent high bias that has been seen between the T640 FEM and FRM measurements, Georgia EPD conducted an experiment at the Macon-Allied location, using an FRM, a T640 FEM, and an experimental T640 FEM (see Attachment 3, slides 31-67). The experimental T640 FEM had the RH Control Setpoint at 5%, while the official T640 FEM maintained the required RH Control Setpoint at 35%. To have a comprehensive evaluation of the differences in T640 FEM and FRM measurements under the varying RH Control Setpoint conditions, data from the Macon-Allied monitors were evaluated from January 2025 through July 2025. During this period, the T640 using the required 35% RH Control Setpoint had a normalized mean bias of 14.6%, while the experimental T640 (5% RH Control Setpoint) had a normalized mean bias of -15.0%. It was determined that the ideal RH Control Setpoint was somewhere between 5-35%; therefore, the RH Control Setpoint for the experimental T640 was changed from 5% to 20%. Results of this experiment are still being evaluated, but preliminary results show lower bias with a 20% RH Control Setpoint compared to the T640 using the required 35% RH Control Setpoint.

As a result, Georgia EPD decided that other T640s across Georgia's $PM_{2.5}$ network should also perform RH Control Setpoint experiments. Georgia EPD changed the RH Control Setpoint from the required 35% to either 10% or 20% based on the magnitude of the T640 FEM bias at each site. Table 2 list of site location, date, and RH (%) Control Setpoint**s** for the T640 experiments. Results of these experiments are still being evaluated.

Table 2. List of site location, date, and RH (%) Control Setpoints for the T640 experiments.

Site Name (ID)	Date of RH (%) Adjustment	Final Experimental RH Setpoint (%)
Albany (13-095-0007)	8/15/25	20
Columbus-Baker (13-215-0012)	8/15/25	20
Gainesville (13-139-0003)	8/15/25	10
Macon-Allied (13-021-0007)	1/28/25 7/29/25	5 20
Rossville (13-295-0004)	7/29/25	20
Gwinnett Tech (13-135-0002)	8/15/25	20
Sandersville (13-303-0001)	8/15/25	20
General Coffee (13-069-0002)	7/29/25	10

In the Request for Correction, the NR3 Coalition requested that EPA take nine actions to address the clear positive bias in the Teledyne monitoring data. Georgia EPD supports the recommendations in that request. Specifically, EPA should conduct a thorough independent review of the accuracy of the final modification factors and the operation of the Teledyne T640 and T640x and other FEM light scattering monitors. As part of this review, the T640/T640x User Manual requirement to set the relative humidity (RH) Control Setpoint at 35% should be re-evaluated and justified. Also, we request that state and local agencies who run these networks be invited to participate in the discussions of next step since these decisions have a direct impact on our budgets and our ability to meet the federal requirements.

Georgia EPD is now operating FRM samplers (assigned as primary) at almost all the locations where T640 FEM samplers (assigned as secondary) are operating to avoid reliance on the T640 FEM readings for comparison to the $PM_{2.5}$ National Ambient Air Quality Standards (NAAQS). The work that has been performed by Georgia EPD can be used to help identify ways to better operate the T640 monitors to produce usable, reliable $PM_{2.5}$ data. In support of this goal, Georgia EPD will gladly provide all the work that has been performed for this project comparing the FRM and T640 FEM data as well as examining the influence of RH Control Setpoints on measurement agreement between FRM and T640 FEM monitors.

As a state air monitoring agency, Georgia EPD has already invested a lot of time and resources to investigate these issues. This is a nationwide issue and there is still a significant amount of work needed to identify solutions that will work across the country; therefore, we ask that EPA and Teledyne provide additional support to help solve this important issue.

Thank you for the opportunity to provide input on this RFC. Please contact James Boylan at 470-524-0697 or James.Boylan@dnr.ga.gov if you have any questions or wish to discuss any of the recommendations described in these comments.

Sincerely,

James W. Boylan

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Chief, Air Protection Branch