UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of State Air Partnerships Research Triangle Park, NC 27711

MEMORANDUM

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SUBJECT: Interlaboratory Results of the 2025 Mega PE Speciation Event

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Background

The Mega Performance Evaluation (Mega PE) program is a supplemental study designed to evaluate the performance of laboratories routinely analyzing particulate matter having an aerodynamic diameter less than or equal to a nominal 2.5 µm ($PM_{2.5}$) speciation samples as part of the $PM_{2.5}$ Chemical Speciation Network (CSN) through the analysis of blind PE filter samples generated by EPA's Office of State and Air Partnership (OSAP). The 2025 Mega PE concluded in Fall 2025 with six laboratories participating: Research Triangle Institute (RTI), University of California, Davis (UCD), Desert Research Institute (DRI), California Air Resources Board (CARB), South Coast Air Quality Management District (SCAQMD), and Bay Area Air Quality Management District (BAAQMD). All program activities were conducted by EPA staffs, including flow checks, sample collection, maintenance of the sampling apparatus, and results comparison.

Sample Collection

Blind PE samples were prepared by OSAP at EPA's campus in Research Triangle Park, NC for four separate analyses: anion/cation analysis by ion chromatography (IC), carbon by thermal optical analysis (TOA), metals analysis by x-ray fluorescence (XRF), and total mass analysis by gravimetric weighing. For each analysis type, sets of collocated ambient air filter samples were collected over a sufficiently long period intended to be to ensure that filter loadings exceeded method detection limits (MDLs) within the CSN (typically 24-48 hours per sampling event). Samples were collected in June and July 2025. Due to unforeseen weather conditions during this year's sampling period, the ambient concentrations of the filter samples were closer to participating lab's MDLs than expected. Future sampling procedures will be adjusted to ensure that the filter loadings consistently exceed the MDLs as required for reliable quantification.

The system used for generating collocated sample filters was designed and fabricated at OSAP in RTP and collects up to 32 collocated samples simultaneously while maintaining 5% precision between

sample channels. Precision was verified through flowrate checks performed at each cyclone inlet before and after each sampling event. Photos of the sampling system are shown below in Figures 1 and 2.

Figure 1. One of four sampling manifolds on the 32-cyclone collocated PE sampler at OSAP in RTP, NC.

Figure 2. PE Sampling system consisting of 32 $PM_{2.5}$ cyclones on four sampling manifolds and one dedicated pump (pump-box in the foreground)

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Test laboratories were instructed to follow CSN sample receiving and analytical procedures to conduct the following analyses on the PE samples:

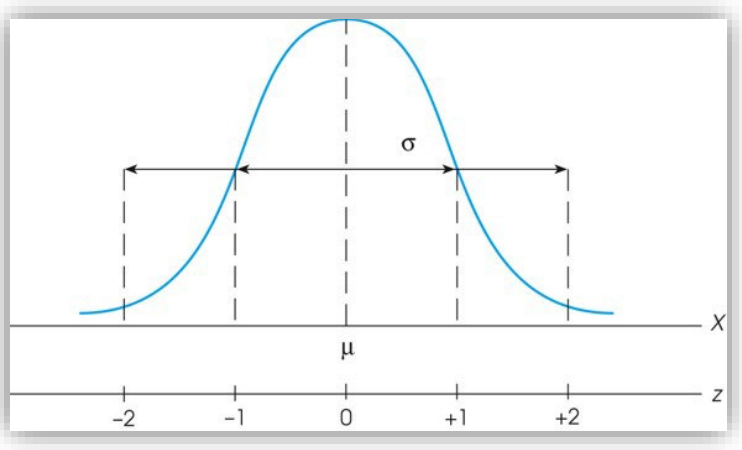
- Anion and Cation Analysis by Ion Chromatography (IC): three Nylon® filter samples and three Nylon® filter blanks (all labs except UCD).
- Carbon by Thermal Optical Analysis (TOA): three quartz filter samples and three quartz filter blanks (all labs except RTI).
- Elemental analysis by X-Ray Fluorescence (XRF): three 47mm Teflon® filter samples and three 47mm Teflon® filter blanks (all labs).
- Total mass analysis by gravimetric weighing: three 47mm Teflon® filter samples, three 47mm Teflon® filter blanks, and one metal check weight (all labs except CARB).

Data Analysis

OSAP does not have its own speciation laboratories and is unable to provide referee measurements for any analysis except for total mass by gravimetric weighing. Since lab results for IC, TOA, or XRF analyses could not be evaluated against a reference value or referee lab result, OSAP evaluated each result through a comparison against the results of other participating labs. Raw values from results submitted as either "ND" (not detected) were not included in the statistical analysis. Values labeled as "NA" (not analyzed) indicate that the test laboratory did not conduct an analysis for that parameter.

Value Scoring

Interlaboratory comparison was performed by calculating the average and standard deviation of the analytical results from each sampling event and analysis type, which were then used to calculate a z-score for each filter result except for total mass (see section "Total Mass Results" for more detail). Each *z*-score indicates how many standard deviations (σ) an analytical result (*x*) lies from the mean (μ) of all laboratory results of that target compound and sampling event. The *z*-score can then be compared to a normal distribution curve to compare individual results to a "normal" population. The absolute value of *z* represents the distance between the raw score and the population mean in units of the standard deviation, as shown in Figure 3 below. Z-scores were calculated using separate averages and standard deviations for each sample event and filter type:



$$z = \frac{x - \mu}{\sigma}$$

Figure 3. Relationship between *z*-score and standard deviation in a normal distribution:

Where:

- *z is the z-score;*
- *x is the value of the individual analytical result;*
- *μ is the population mean across all laboratories for that analyte; and*
- *σ is the standard deviation of the population mean of that analyte.*

Z-scores range from -3 σ (falling to the far left of the distribution curve) to +3 σ (falling to the far right of the distribution curve). For this study:

- The analytical result is satisfactory when the absolute value of z, *ABS(z)*, is < 2 (95% of z-scores are expected to fall in this range for normally distributed data).
- The analytical result is considered questionable when ABS(z) is between 2 to 3 (result should be investigated by the laboratory).
- The analytical result is unsatisfactory when ABS(*z)* > 3 (result should be investigated by the laboratory).

Cation/Anion Results

For cation and anion analysis by IC, filters were extracted and analyzed by each participating lab for select cations: ammonium (NH_4^+), potassium (K^+), sodium (Na^+), and anions sulfate ($SO4^{2-}$), nitrate (NO_3^-), and chloride (Cl^-). The z-score result from each filter's ion analysis, in addition to the average measurement for sample and blank filters, are included in Table 1. Note that Cl^- was not reported by CARB. Measurements below the test lab's detection limit are reported as "ND" and measurements not analyzed by the test lab are reported as "NA". As shown in red, several z-scores exceeded 2 for multiple compounds on sample filters analyzed by DRI and BAAQMD, and one z-score exceeded 3 for sulfate on a sample filter analyzed by DRI.

Table 1. Cations and Anions by IC: Z-Score Results Per Filter.

IC Z-Score Results for Sample Filters							
Test Lab	**Filter ID**	**Ammonium**	**Chloride**	**Nitrate**	**Potassium**	**Sodium**	**Sulfate**
RTI	N15	1.35	-0.48	0.18	0.11	-0.27	0.21

RTI	N4	-0.26	-0.09	0.64	0.24	-0.03	0.18
RTI	N3	0.43	0.11	0.80	0.47	0.08	0.26
RTI	N2	0.50	-0.32	0.15	0.14	-0.25	0.27
RTI	N1	-0.02	1.17	0.80	1.42	0.96	0.29
DRI	N16	-2.36	-2.03	-4.15	ND	-2.95	-4.49
DRI	N5	-0.72	1.03	-0.27	-0.03	1.05	-0.16
DRI	N6	-0.37	1.08	-0.35	0.18	1.23	-0.29
DRI	N7	-0.50	-0.79	-0.72	-1.11	-0.57	-0.11
DRI	N8	-0.76	0.62	-0.29	-0.25	0.95	-0.35
CARB	N18	1.42	NA	0.17	-0.65	-0.43	0.64
CARB	N19	1.18	NA	-0.17	-0.91	-0.64	0.64
CARB	N20	1.15	NA	-0.73	-0.78	-0.46	0.69
CARB	N21	1.42	NA	0.32	-0.47	-0.47	0.71
CARB	N22	1.77	NA	0.99	-0.44	-0.20	0.40
SCAQMD	N9	-0.49	1.89	0.27	0.19	1.67	0.38
SCAQMD	N10	-0.55	-0.47	0.40	-0.59	0.10	0.31
SCAQMD	N11	0.54	-0.85	-0.14	-1.70	-0.38	0.45
SCAQMD	N13	-0.03	-0.74	-0.18	-0.92	-0.18	0.45
SCAQMD	N14	0.33	-0.65	-0.12	-1.15	-0.14	0.64
BAAQMD	N25	-1.03	1.96	0.75	2.69	2.39	-0.13
BAAQMD	N26	-0.74	-0.50	0.95	0.60	-0.44	-0.19
BAAQMD	N27	-0.20	-0.10	0.87	1.85	-0.10	-0.11
BAAQMD	N28	-1.13	-0.39	-0.24	0.58	-0.47	-0.30
BAAQMD	N29	-0.94	-0.44	0.05	0.53	-0.47	-0.35
Avg Conc.	**ug/filter**	**1.40**	**3.03**	**4.85**	**0.97**	**4.33**	**21.71**
Std Dev Conc.	**ug/filter**	**0.58**	**1.30**	**0.66**	**0.27**	**1.36**	**4.21**

IC Z-Score Results for Blank Filters

Test Lab	**Filter ID**	**Ammonium**	**Chloride**	**Nitrate**	**Potassium**	**Sodium**	**Sulfate**
RTI	NB1	ND	-0.88	-0.81	-1.51	-0.78	ND
RTI	NB2	ND	1.44	-0.23	1.48	1.65	ND
RTI	NB3	ND	-0.55	-0.56	-1.20	-0.45	ND
DRI	NB4	ND	1.64	-0.01	-0.16	1.78	ND
DRI	NB5	ND	1.21	-0.32	ND	1.30	ND
DRI	NB6	ND	-0.80	ND	ND	-0.87	ND
CARB	NB10	ND	ND	ND	ND	ND	ND
CARB	NB11	ND	ND	ND	ND	-0.60	ND
CARB	NB12	ND	ND	ND	1.22	1.57	ND
SCAQMD	NB7	ND	ND	ND	ND	-0.69	ND
SCAQMD	NB8	ND	ND	-0.87	ND	-0.73	ND
SCAQMD	NB9	ND	ND	ND	ND	-0.37	ND
BAAQMD	NB13	ND	-0.40	1.38	0.26	-0.34	-0.02
BAAQMD	NB14	ND	-0.48	1.29	0.30	-0.42	1.01

BAAQMD	NB15	ND	-0.49	1.39	0.22	-0.44	-0.99
Avg Conc.	**ug/filter**	**ND**	**2.633**	**0.832**	**0.582**	**2.163**	**2.203**
Std Dev Conc.	**ug/filter**	**ND**	**1.799**	**0.279**	**0.205**	**1.401**	**0.004**

Carbon Results

Carbon analysis by TOA was conducted by test laboratories for organic carbon (OC), elemental carbon (EC), total carbon (TC) and carbon subfractions (OC1-OC4, EC1-EC3, and OP) reported within the CSN. Note, the carbon concentrations on the Mega PE filters are low and close to the MDLs for several carbon fractions and participating laboratories. Z-score results from each filter's TOA analysis, in addition to the average measurement for sample and blank filters, are included in Table 2. Measurements below the test lab's detection limit are reported as "ND" and measurements not analyzed by the test lab are reported as "NA". As shown in red, one z-score exceeded 3 for OC3 on a sample filter analyzed by CARB, and several z-scores exceeded 2 for multiple carbon parameters analyzed on sampled filters by DRI, CARB, and SCAQMD. One z-score exceeded 2 for OC3 on a blank filter analyzed by BAAQMD.**Table 2.** Carbon analysis by TOA: Values and Z-Score Results Per Filter.

TOA Z-Score Results for Sample Filters

Test Lab	Filter ID	EC1	EC2	EC3	ECTR	ECTT	OC1	OC2	OC3	OC4	OCTR	OCTT	TCTC
DRI	Q10	-0.60	0.46	ND	-0.80	-0.25	-0.52	-0.66	-0.35	-0.41	-0.32	-0.59	-0.32
DRI	Q31	1.37	0.13	ND	0.55	2.58	0.32	-1.10	-0.41	-0.95	-0.56	-0.84	-0.22
DRI	Q6	-1.65	-0.97	ND	-0.82	-0.64	-0.97	-1.06	-0.12	-1.98	-1.15	-1.23	-1.00
DRI	Q7	-1.32	0.64	ND	-0.13	-0.35	-0.95	-1.07	-0.32	-0.16	-0.80	-0.83	-0.56
DRI	Q9	1.34	-1.09	ND	-0.51	-0.58	-1.00	-0.86	0.28	-0.67	-0.13	-0.34	-0.10
CARB	Q17	ND	ND	ND	ND	ND	ND	ND	0.30	ND	-0.40	-0.41	-0.32
CARB	Q18	ND	ND	ND	ND	ND	ND	ND	1.53	ND	0.97	0.17	1.27
CARB	Q19	ND	ND	ND	ND	ND	ND	ND	1.62	ND	0.30	0.17	0.28
CARB	Q20	ND	ND	ND	ND	ND	ND	ND	0.62	ND	0.62	0.63	0.72
CARB	Q21	ND	ND	ND	ND	ND	ND	ND	3.02	ND	2.61	2.20	2.29
UCD	Q1	0.34	-0.67	ND	ND	ND	-0.74	0.21	-0.92	0.46	0.32	-0.36	-0.27
UCD	Q2	0.31	-1.03	ND	ND	0.15	-0.90	-0.36	-1.33	0.16	-0.43	-1.20	-0.87
UCD	Q3	1.44	-0.45	ND	ND	-0.04	-0.89	-0.49	-1.13	1.30	0.19	-0.68	-0.37
UCD	Q5	0.82	-0.70	ND	ND	-0.51	ND	-0.60	-1.57	0.20	-0.55	-1.22	-0.97
UCD	Q22	1.41	-0.38	ND	ND	-0.36	ND	-0.42	-1.21	0.68	0.03	-0.77	-0.50
SCAQMD	Q11	-0.19	ND	ND	-0.69	ND	ND	ND	-0.18	ND	-1.40	ND	-1.18
SCAQMD	Q12	-0.90	ND	ND	-1.27	ND	ND	ND	-0.47	ND	-1.46	ND	-1.35
SCAQMD	Q13	0.93	-1.66	ND	0.63	ND	ND	ND	0.05	2.28	-0.38	ND	-0.05
SCAQMD	Q15	-1.20	ND	ND	-1.62	ND	ND	ND	-0.21	-0.09	-1.40	ND	-1.38
SCAQMD	Q16	0.45	ND	ND	-0.65	ND	ND	ND	-0.47	1.39	-0.99	ND	-0.84
BAAQMD	Q25	0.24	1.12	0.71	0.52	ND	0.97	1.23	0.56	0.12	1.51	1.38	1.47
BAAQMD	Q26	-0.63	1.17	ND	0.83	ND	1.17	1.23	0.16	-0.48	0.94	0.97	1.06
BAAQMD	Q27	-0.50	1.74	ND	1.52	ND	1.54	1.48	0.06	-0.43	1.01	1.18	1.26

BAAQMD	Q28	-1.07	0.59	ND	0.85	ND	0.87	1.15	0.05	-1.22	0.44	0.56	0.66
BAAQMD	Q29	-0.58	1.08	-0.71	1.60	ND	1.10	1.35	0.46	-0.17	1.03	1.21	1.30
Avg Conc.	**ug/cm²**	**0.341**	**0.357**	**0.002**	**0.384**	**0.125**	**0.109**	**0.875**	**1.934**	**0.717**	**3.845**	**4.217**	**4.159**
Std Dev Conc.	**ug/cm²**	**0.085**	**0.092**	**0.000**	**0.129**	**0.072**	**0.099**	**0.223**	**0.349**	**0.084**	**0.489**	**0.596**	**0.599**
TOA Z-Score Results for Blank Filters													
ZSCORES	**Filter ID**	**EC1**	**EC2**	**EC3**	**ECTR**	**ECTT**	**OC1**	**OC2**	**OC3**	**OC4**	**OCTR**	**OCTT**	**TCTC**
DRI	QB4	ND	ND	ND	ND	ND	-1.31	0.00	-0.34	ND	-0.83	-0.83	-0.83
DRI	QB5	ND	ND	ND	ND	ND	ND	-0.59	-0.54	ND	-1.08	-1.08	-1.08
DRI	QB6	ND	ND	ND	ND	ND	ND	-0.41	-0.47	ND	-1.00	-1.00	-1.00
CARB	QB10	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.76	0.76	0.78
CARB	QB11	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.74	0.74	0.74
CARB	QB12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
UCD	QB1	ND	ND	ND	ND	ND	ND	-0.94	-0.68	ND	ND	ND	ND
UCD	QB2	ND	ND	ND	ND	ND	ND	-0.90	-0.53	ND	ND	ND	ND
UCD	QB3	ND	ND	ND	ND	ND	ND	-0.94	-0.45	ND	ND	ND	ND
SCAQMD	QB7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND
SCAQMD	QB8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND
SCAQMD	QB9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND
BAAQMD	QB13	ND	0	ND	-0.48	ND	-0.18	0.98	0.48	-0.35	-0.01	-0.01	-0.01
BAAQMD	QB14	ND	ND	-0.71	-0.67	ND	1.01	1.52	2.49	1.13	1.71	1.71	1.71
BAAQMD	QB15	ND	ND	0.71	1.15	ND	0.47	1.28	0.04	-0.78	-0.30	-0.29	-0.30
Avg Conc.	**ug/cm²**	**ND**	**0.002**	**0.003**	**0.003**	**ND**	**0.044**	**0.109**	**0.357**	**0.047**	**0.781**	**0.782**	**0.783**
Std Dev Conc.	**ug/cm²**	**ND**	**ND**	**0.001**	**0.001**	**ND**	**0.023**	**0.069**	**0.363**	**0.057**	**0.510**	**0.510**	**0.511**

Elemental Results

Elemental analysis by XRF was conducted by UCD, RTI, DRI, CARB, SCAQMD, and BAAQMD . UCD provided elemental measurements from two XRF systems that have been and are currently used for CSN elemental analysis, designated as “UCD-PAN” and “UCD-Bruk”, respectively. Ten elements most often measured above the MDL within CSN were selected to evaluate the interlaboratory comparison. Note that for several elements, the average sample concentrations and blank concentrations are within ± 1 standard deviation, meaning the sample concentrations are not statistically different from the blank concentration (e.g., Zn, Mn, etc.). The z-score result from each filter’s XRF analysis, in addition to the average measurement for sample and blank filters, are included in Table 3. Measurements below the test lab’s detection limit are reported as “ND”. As shown in red, several z-scores exceeded 2 for multiple parameters on sample filters analyzed by UCD-Bruk, UCD-PAN, and DRI. One z-score exceeded 2 on a blank filter analyzed by UCD-PAN. No z-scores exceeded 3 for elemental analysis.

Table 3. Elemental analysis by XRF: Z-Score Results Per Filter.

XRF Z-Scores Results for Sample Filters											
Test Lab	**Filter ID**	**Aluminum**	**Calcium**	**Chlorine**	**Iron**	**Manganese**	**Potassium**	**Silicon**	**Sodium**	**Sulfur**	**Zinc**
RTI	T8103980	-1.26	-0.52	-0.62	-0.44	-0.93	-0.13	0.27	1.32	0.18	-0.75
RTI	T8103982	-1.25	-0.70	-0.62	-0.76	-0.64	-0.02	-0.17	0.90	0.42	-0.74
RTI	T8103987	-1.29	-0.74	-0.59	-0.83	-0.75	-0.03	-0.23	0.34	-0.63	-0.68
RTI	T8103992	-1.26	-0.84	-0.59	-0.79	-1.03	-0.23	-0.15	1.19	-0.55	-0.67
DRI	T8103967	-1.43	2.77	ND	-0.54	-0.40	-1.81	-1.38	ND	1.19	-0.35
DRI	T8103991	-1.78	1.17	ND	-0.43	ND	-1.78	-1.38	ND	-0.04	-0.25
DRI	T8103996	-0.89	2.58	ND	-0.24	ND	-2.12	-1.20	0.72	1.04	-0.26
DRI	T8103981	-1.61	2.26	ND	-0.28	0.98	-1.30	-1.49	0.93	1.71	-0.19
CARB	T8103963	1.19	0.02	ND	-0.42	ND	0.38	0.28	ND	1.75	-0.03
CARB	T8103972	0.59	-0.21	ND	-0.28	ND	0.02	1.09	ND	0.99	-0.26
CARB	T8103971	0.53	-0.37	ND	-0.53	ND	0.08	-0.01	ND	1.00	-0.23
CARB	T8103989	0.77	-0.29	ND	-0.35	-0.29	0.18	0.51	ND	0.93	ND
UCD-Bruk	T8103993	-0.30	-0.74	1.70	2.41	ND	-0.34	-1.42	-1.14	0.38	2.38
UCD-Bruk	T8103970	-0.36	-0.37	1.80	2.41	-0.04	-0.24	-1.37	-0.88	0.08	2.21
UCD-Bruk	T8103994	-0.36	-0.46	1.74	2.16	-0.04	-0.45	-0.79	-0.84	-0.03	2.38
UCD-Bruk	T8103995	-0.36	-0.46	1.74	2.16	-0.04	-0.34	-1.56	-1.17	-0.32	2.29
UCD-PAN	T8103993	0.86	-0.74	-0.62	0.23	0.74	1.96	0.65	ND	-0.91	-0.29
UCD-PAN	T8103970	0.53	-0.19	-0.42	0.08	1.53	1.75	1.17	ND	-1.61	-0.54
UCD-PAN	T8103994	0.34	-0.65	-0.59	0.57	1.53	1.75	0.69	1.51	-0.15	-0.29
UCD-PAN	T8103995	0.50	-0.19	-0.55	-0.02	2.32	1.64	0.65	ND	-1.96	-0.54
SCAQMD	T8103964	0.50	-0.46	ND	-0.67	ND	0.08	0.74	ND	-0.79	-0.38
SCAQMD	T8103969	0.44	-0.65	ND	-0.86	ND	-0.13	0.17	ND	-0.91	-0.46
SCAQMD	T8103983	0.25	0.18	ND	-0.52	ND	0.18	1.17	ND	-0.62	-0.21
SCAQMD	T8103988	0.56	-0.10	-0.42	-0.47	ND	0.81	1.80	ND	-0.85	-0.29
BAAQMD	T8103979	1.02	-0.65	-0.52	-0.57	-0.83	-0.24	-0.17	-0.88	0.03	-0.54
BAAQMD	T8103976	1.29	-0.10	-0.46	-0.37	-0.83	0.28	0.50	-0.47	1.19	-0.46
BAAQMD	T8103986	1.39	-0.28	-0.49	-0.47	-0.83	-0.24	-0.02	-0.84	0.26	-0.38
BAAQMD	T8103977	1.42	0.73	-0.49	-0.17	-0.44	0.28	1.65	-0.69	-1.78	-0.46
Avg Conc.	**ug/cm²**	**0.090**	**0.023**	**0.020**	**0.040**	**0.003**	**0.031**	**0.070**	**0.048**	**0.176**	**0.011**
Std Dev Conc	**ug/cm²**	**0.033**	**0.011**	**0.031**	**0.020**	**0.003**	**0.010**	**0.021**	**0.027**	**0.017**	**0.012**
XRF Z-Score Results for Blank Filters											
Test Lab	**Filter ID**	**Aluminum**	**Calcium**	**Chlorine**	**Iron**	**Manganese**	**Potassium**	**Silicon**	**Sodium**	**Sulfur**	**Zinc**
RTI	P7340416	ND	ND	ND	ND	-1.04	ND	-1.23	-1.12	ND	ND
RTI	P7340419	ND	ND	ND	ND	-0.93	ND	-0.94	ND	ND	ND
RTI	P7340421	ND	ND	ND	-0.89	-0.93	ND	ND	1.47	ND	ND
DRI	P7340425	ND	ND	ND	-0.69	ND	ND	-0.28	ND	ND	ND
DRI	P7340423	ND	ND	ND	ND	ND	ND	-0.28	ND	ND	ND
DRI	P7340420	ND	ND	ND	-0.64	ND	ND	ND	ND	ND	ND
CARB	P7340406	ND	ND	ND	ND	ND	ND	-0.36	ND	ND	ND

CARB	P7340410	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CARB	P7340415	ND	ND	ND	ND	ND	ND	1.00	ND	ND	ND
UCD-Bruk	P7340404	-1.40	ND	0.98	1.46	-0.22	ND	ND	-0.33	ND	0.83
UCD-Bruk	P7340411	-1.23	ND	1.14	1.71	ND	ND	ND	-1.15	ND	1.26
UCD-Bruk	P7340424	-1.34	ND	1.08	1.67	-0.22	-0.17	ND	-0.60	ND	1.09
UCD-PAN	P7340404	0.76	-0.27	-0.82	-0.12	0.87	0.83	0.33	ND	ND	-0.80
UCD-PAN	P7340411	0.59	ND	ND	-0.46	1.60	0.66	ND	ND	ND	ND
UCD-PAN	P7340424	0.53	1.76	ND	-0.16	0.87	1.49	2.45	ND	ND	ND
SCAQMD	P7340417	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SCAQMD	P7340418	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SCAQMD	P7340422	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BAAQMD	P7340412	0.81	-0.27	-0.75	-0.50	ND	-0.83	-0.13	0.21	ND	-0.80
BAAQMD	P7340413	0.47	-0.50	-0.82	-0.71	ND	-0.99	-0.13	1.31	ND	-0.80
BAAQMD	P7340414	0.81	-0.72	-0.82	-0.67	ND	-0.99	-0.43	0.21	ND	-0.80
Avg Conc.	**ug/cm²**	**0.054**	**0.004**	**0.026**	**0.022**	**0.004**	**0.007**	**0.011**	**0.010**	**ND**	**0.012**
Std Dev Conc.	**ug/cm²**	**0.018**	**0.004**	**0.031**	**0.023**	**0.003**	**0.006**	**0.007**	**0.004**	**ND**	**0.012**

Total Mass Results

Total mass analysis by gravimetric weighing was conducted by UCD, RTI, DRI, SCAQMD, and BAAQMD for sample and blank Teflon filters. Note that CARB did not analyze for total mass. Z-scores for total mass were not used since measurements from test labs can be directly compared against measurements observed by OSAP prior to sending to test labs. Evaluation criteria from EPA's $PM_{2.5}$ gravimetric round robin program were instead used to evaluate test lab performance for total mass (i.e. value is acceptable if absolute mass differences between the lab and OSAP are <0.030 mg for sample/blank filters and <0.003 mg for check weights). No filters had a measurement difference exceeding 0.030 mg, whereas one check weight (RTI) exceeded 0.003 mg.

Table 4. Total Mass by Gravimetric Weighing: Results Per Filter.

Filter ID	Filter Type	OSAP Result (mg)	Test Lab Result (mg)	Difference (mg)	Lab Assign
T2544853	Blank	402.504	402.499	-0.005	BAAQMD
T2544880	Blank	400.347	400.340	-0.007	BAAQMD
T2544854	Blank	399.561	399.537	-0.024	BAAQMD
88Y4	Check Weight	300.001	300.000	-0.001	BAAQMD
220415301	Sample	387.441	387.440	-0.001	BAAQMD
T2544865	Sample	407.565	407.561	-0.004	BAAQMD
T8636191	Sample	366.380	366.374	-0.006	BAAQMD
T2544899	Blank	402.315	402.328	0.013	DRI
T2544862	Blank	402.570	402.580	0.010	DRI
T2544900	Blank	397.142	397.151	0.009	DRI
MW15-15526	Check Weight	90.601	90.600	-0.001	DRI

T2544870	Sample	403.839	403.854	0.015	DRI
T8636180	Sample	370.580	370.587	0.007	DRI
220170522	Sample	365.751	365.755	0.004	DRI
T2544896	Blank	398.363	398.356	-0.007	RTI
T2544898	Blank	397.561	397.546	-0.015	RTI
T2544897	Blank	402.053	402.038	-0.015	RTI
892S	Check Weight	400.000	399.996	-0.004	RTI
T8630475	Sample	379.418	379.406	-0.012	RTI
220170521	Sample	364.589	364.576	-0.013	RTI
T2544867	Sample	399.331	399.317	-0.014	RTI
T2544875	Blank	402.366	402.365	-0.001	SCAQMD
T2544874	Blank	397.675	397.673	-0.002	SCAQMD
T2544872	Blank	406.408	406.405	-0.003	SCAQMD
892P	Check Weight	200.000	199.999	-0.001	SCAQMD
T750001	Sample	369.990	369.988	-0.002	SCAQMD
220170523	Sample	369.654	369.650	-0.004	SCAQMD
T8636181	Sample	370.234	370.228	-0.006	SCAQMD
T2544894	Blank	402.141	402.117	-0.024	UCD
T2544895	Blank	398.855	398.830	-0.025	UCD
T2544885	Blank	400.836	400.810	-0.026	UCD
892Q	Check Weight	200.006	200.004	-0.002	UCD
220170518	Sample	362.778	362.763	-0.015	UCD
T2544868	Sample	399.068	399.052	-0.016	UCD
T8636177	Sample	365.950	365.928	-0.022	UCD

Discussion

The results in the questionable z-score range for ion, carbon, and elemental analyses do not correlate with any sampler inlet/position, and flow checks conducted before and after each sample event confirm that filters from each sampling event were subject to uniform airflow and loading during sample collection (see Appendix). OSAP acknowledges that the low average concentrations reported for the Carbon-TOA and Metals-XRF sample filters were near the MDL for multiple test labs and that measurements at these lower levels are subject to additional uncertainty. Z-score deviations at these lower levels may not necessarily indicate analytical bias that warrants corrective action.

Upon investigation, UCD informed EPA that high Metals-XRF z-scores for Fe and Zn are likely due to a positive bias introduced through stainless steel and bronze backscattering when using the UCD-Bruk method. UCD is working to resolve this positive bias and noted that they have found success in mediating the positive bias by “blank correcting” the sample data (e.g. subtracting the mass routinely found on blank CSN filters from the sample filter’s analyzed mass reading). EPA asked test laboratories not to blank correct data for the 2025 Mega PE.

Findings from this Mega PE will be used by EPA in assessing irregular or questionable results from laboratories participating in the CSN and in validating the performance of the OSAP sampling apparatus in subsequent evaluations.

Appendix: OSAP flow-rate verification checks for Metals-XRF, Ions-IC, and Carbon-TOA sample filters used in the 2025 Mega PE.

Filter ID	Start Sample Flow	End Sample Flow	Analysis	Lab Assign
Q1	6.81	6.50	Carbon-TOA	UCD
Q2	6.93	6.58	Carbon-TOA	UCD
Q3	6.92	6.60	Carbon-TOA	UCD
Q5	6.67	6.44	Carbon-TOA	UCD
Q6	6.71	6.39	Carbon-TOA	DRI
Q7	6.97	6.63	Carbon-TOA	DRI
Q9	6.78	6.44	Carbon-TOA	DRI
Q10	6.78	6.45	Carbon-TOA	DRI
Q11	6.98	6.65	Carbon-TOA	SCAQMD
Q12	6.94	6.62	Carbon-TOA	SCAQMD
Q13	6.86	6.53	Carbon-TOA	SCAQMD
Q15	6.92	6.59	Carbon-TOA	SCAQMD
Q16	6.80	6.48	Carbon-TOA	SCAQMD
Q17	6.88	6.66	Carbon-TOA	CARB
Q18	6.81	6.58	Carbon-TOA	CARB
Q19	6.69	6.47	Carbon-TOA	CARB
Q20	6.87	6.65	Carbon-TOA	CARB
Q21	6.87	6.67	Carbon-TOA	CARB
Q22	6.80	6.61	Carbon-TOA	UCD
Q25	6.87	6.61	Carbon-TOA	BAAQMD
Q26	6.76	6.54	Carbon-TOA	BAAQMD
Q27	6.62	6.41	Carbon-TOA	BAAQMD
Q28	6.87	6.65	Carbon-TOA	BAAQMD
Q29	6.71	6.53	Carbon-TOA	BAAQMD
Q31	6.82	6.61	Carbon-TOA	DRI
N1	6.84	6.68	Ions-IC	RTI
N2	6.86	6.70	Ions-IC	RTI
N3	6.91	6.76	Ions-IC	RTI
N4	6.73	6.57	Ions-IC	RTI
N5	6.81	6.65	Ions-IC	DRI
N6	6.61	6.44	Ions-IC	DRI
N7	6.93	6.82	Ions-IC	DRI
N8	6.67	6.52	Ions-IC	DRI
N9	6.76	6.63	Ions-IC	SCAQMD
N10	6.64	6.51	Ions-IC	SCAQMD
N11	6.89	6.77	Ions-IC	SCAQMD

N13	6.78	6.65	Ions-IC	SCAQMD
N14	7.02	6.90	Ions-IC	SCAQMD
N15	6.75	6.66	Ions-IC	RTI
N16	6.73	6.61	Ions-IC	DRI
N18	6.79	6.69	Ions-IC	CARB
N19	6.67	6.58	Ions-IC	CARB
N20	6.86	6.76	Ions-IC	CARB
N21	6.86	6.74	Ions-IC	CARB
N22	6.81	6.68	Ions-IC	CARB
N25	6.85	6.75	Ions-IC	BAAQMD
N26	6.71	6.61	Ions-IC	BAAQMD
N27	6.68	6.59	Ions-IC	BAAQMD
N28	6.89	6.79	Ions-IC	BAAQMD
N29	6.76	6.63	Ions-IC	BAAQMD
T8103993	6.68	6.74	Metals-XRF	UCD
T8103970	6.37	6.43	Metals-XRF	UCD
T8103994	6.56	6.61	Metals-XRF	UCD
T8103995	6.39	6.44	Metals-XRF	UCD
T8103992	6.37	6.41	Metals-XRF	RTI
T8103987	6.38	6.42	Metals-XRF	RTI
T8103982	6.41	6.45	Metals-XRF	RTI
T8103980	6.58	6.63	Metals-XRF	RTI
T8103981	6.51	6.56	Metals-XRF	DRI
T8103996	6.63	6.68	Metals-XRF	DRI
T8103991	6.57	6.62	Metals-XRF	DRI
T8103967	6.46	6.50	Metals-XRF	DRI
T8103964	6.45	6.49	Metals-XRF	SCAQMD
T8103969	6.42	6.46	Metals-XRF	SCAQMD
T8103983	6.63	6.67	Metals-XRF	SCAQMD
T8103988	6.56	6.61	Metals-XRF	SCAQMD
T8103963	6.50	6.55	Metals-XRF	CARB
T8103972	6.46	6.52	Metals-XRF	CARB
T8103989	6.60	6.65	Metals-XRF	CARB
T8103971	6.58	6.63	Metals-XRF	CARB
T8103979	6.58	6.61	Metals-XRF	BAAQMD
T8103976	6.80	6.84	Metals-XRF	BAAQMD
T8103986	6.61	6.66	Metals-XRF	BAAQMD
T8103977	6.62	6.67	Metals-XRF	BAAQMD