2020
Annual Data Quality Report

Monitoring and Laboratory Division
Quality Management Branch

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Annual Data Quality Report

California Air Resources Board's
Primary Quality Assurance Organization

Prepared by:

Quality Management Branch
Monitoring and Laboratory Division
California Air Resources Board

January 2022

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Acronyms and Abbreviations	Definitions
AAQS	Ambient Air Quality Standard
APCD	Air Pollution Control District
AQDA	Air Quality Data Action
AQMD	Air Quality Management District
AQS	Air Quality System
ARD	Air Resources District
BAAQMD	Bay Area Air Quality Management District
BAM	Beta Attenuation Method
CAN	Corrective Action Notification
CARB	California Air Resources Board
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CV	Coefficient of Variation
FEM	Federal Equivalent Method
FRM	Federal Reference Method
FRV	Flow Rate Verification
ID	Industrial Monitor
MQO	Measurement quality objective
NO_2	Nitrogen Dioxide
NPS	National Park Service
OAQPS	Office of Air Quality Planning and Standards
O_3	Ozone
Pb	Lead
PEP	Performance Evaluation Program
PM	Particulate Matter

$PM_{2.5}$	Particulate matter with aerodynamic diameter ≤2.5 µm
PM_{10}	Particulate matter with aerodynamic diameter ≤10 µm
POC	Parameter Occurrence Code
ppb	Parts per billion
ppm	Parts per million
PQAO	Primary Quality Assurance Organization
QAPP	Quality Assurance Project Plan
QC	Quality control
QMB	Quality Management Branch
QMP	Quality Management Plan
SCAQMD	South Coast Air Quality Management District
SDCAPCD	San Diego County Air Pollution Control District
SLAMS	State and Local Air Monitoring Station Network
SO_2	Sulfur Dioxide
SPM	Special Purpose Monitors
TSP	Total suspended particulates
TEOM	Tapered element oscillating microbalance
U.S. EPA	U.S. Environmental Protection Agency
VSCC	Very Sharp Cut Cyclone

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Appendices

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Executive Summary

The Code of Federal Regulations (CFR) defines the California Air Resources Board (CARB) as one of seven primary quality assurance organizations (PQAO) in California responsible for monitoring air pollutants and assessing data quality. The purpose of this report is to provide ambient air quality data producers and users with a centralized review of the data quality within CARB's PQAO with respect to criteria defined by measurement quality objectives (MQO).

The MQOs reviewed include data capture (amount of ambient data reported), precision (the degree of mutual agreement among individual measurements of the same property), bias/accuracy (the degree of agreement between an observed value and an accepted known or reference value), and the amount of precision and bias/accuracy data collected and reported. The criteria by which the assessments are made are mostly dictated in CFR[1] and are listed in Appendix A of this report. Appendix B provides details on the instruments/samplers that did not meet certain criteria. The U.S. Environmental Protection Agency (U.S. EPA) has designated CARB, the Bay Area Air Quality Management District (BAAQMD), South Coast Air Quality Management District (SCAQMD), San Diego County Air Pollution Control District (SDCAPCD), National Park Service (NPS), Morongo Band of Mission Indians, and Pechanga Band of Luiseño Indians as their own PQAOs. Where appropriate, comparisons of results to BAAQMD, SCAQMD, and SDCAPCD and the national average[2] are made. It is important to note that this assessment is solely based on data available in U.S. EPA's Air Quality System (AQS). PQAOs may have collected certain precision and/or bias/accuracy data that were not uploaded to AQS; in some cases, that particular data were not federally required to be uploaded.

The gaseous criteria pollutants assessed include: carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2). The ambient data capture rate represents the percentage of ambient data collected and uploaded to AQS compared to the total amount of data possible. For gaseous pollutants, one-point quality control (1-pt QC) precision checks (mostly automated) are performed by the monitoring organizations to confirm the instrument's ability to respond to a known concentration of gas. Precision represents the degree of variability among the 1-pt QC checks. These checks are also used to assess bias/accuracy for each instrument via comparing the instrument response to a reference gas.

Precision for most particulate matter (PM_{10} and $PM_{2.5}$) samplers is assessed via collocated sampling whereby two identical or equivalent samplers are operated side-

[1] Title 40 CFR Appendix A to Part 58.
[2] National average includes state, county, district, National Park Service, and tribal sites, including those in California.

by-side.[3] Bias for PM samplers is assessed by using the routine flow rate verifications performed by site operators. Total $PM_{2.5}$ bias for a PQAO is also assessed through the Performance Evaluation Program (PEP) run by the U.S. EPA. Accuracy for both gaseous instruments and PM samplers is further verified by CARB's performance evaluation audit program using through-the-probe audit techniques on gaseous instruments and checking flow rates on particulate samplers.

The ambient data capture rate and the accompanying precision and accuracy data for 2020 from both gaseous instruments and PM samplers are summarized below, followed with recommendations. Note that due the COVID-19 pandemic, following the guidance on priorities from U.S. EPA[4], CARB focused auditing activities after mid-March 2020 on ozone and PM. Therefore, the discussion of gaseous audits within this Executive Summary applies to ozone only.

The statistics reported in this report are intended as assessment tools for the data producers and users to identify areas where program improvements can be made to achieve all MQOs set by U.S. EPA or the data producers themselves. Although CFR criteria for precision and accuracy are generally applied and evaluated at the PQAO level, assessments at the district or site level may differ and can be important as well. However, it is important to note that when certain CFR criteria are not met, it does not necessarily mean that the corresponding air quality data should not be used, but rather, the data should be used with the knowledge of the quality behind it. The 2020 ambient data in AQS for CARB's PQAO have been certified and are considered suitable for comparison to federal standards.

As all data in this report come from AQS, data producers are encouraged to review their monitoring networks to ensure that it accurately reflects the number of sites/samplers operating and that all required ambient, precision, and accuracy data collected are continually reported to AQS in a timely manner (within 90 days of the end of each quarter per CFR).

Gaseous Instruments

Key findings and recommendations pertaining to gaseous instruments are highlighted below.

- Ninety-seven percent of the gaseous instruments operating under CARB's PQAO achieved the ambient data capture rate of at least 75 percent in 2020, with 94 percent also achieving CARB's goal of at least 85 percent data capture.
- Ninety-nine percent of the gaseous instruments operating under CARB's PQAO reported at least 75 percent of the required QC checks submitted to AQS.

[3] Collocated sampling is required for all PM samplers, except continuous PM_{10}
[4] See Appendix C on communication between CARB and U.S. EPA

Most met the revised critical criteria (on percent and absolute difference) for individual QC checks, set by U.S. EPA,[5,6] starting in March 2019.
- CFR precision and bias/accuracy criteria (from 1-pt QC checks) were met at the PQAO level on an annual basis.
- Performance audit data of ozone analyzers indicate that, except for a few instruments, CARB's PQAO met the audit criteria. This finding is consistent with the bias information obtained from the 1-pt QC checks.

Recommendation – Gaseous Program

- Although MQOs associated with the gaseous instruments were met at the PQAO level, there were a few instances of analyzers not meeting the MQO (e.g., ambient data capture rate, submittal of required QC checks, etc.). Monitoring agencies should investigate why these objectives were not met for each analyzer in their respective jurisdictions and develop corrective actions, if appropriate, to meet them in subsequent years.

PM Samplers

Key findings and recommendations pertaining to PM samplers are highlighted below.

- Ninety-six percent of the particulate samplers operating under CARB's PQAO achieved the ambient data capture rate of at least 75 percent in 2020, with 93 percent also achieving CARB's goal of at least 85 percent data capture.
- As indicated in CARB's *Annual Network Plan Covering Operations in 25 California Air Districts, July 2021,*[7] CARB's PQAO continued meeting the minimum 15 percent collocation requirement.
- For the five PM_{10} and 16 $PM_{2.5}$ pairs of collocated samplers that were present within CARB's PQAO, all reported at least 75 percent of the required precision data in 2020 – an improvement compared to 2019.
- For PM_{10}, with the exception of one geographic area, the precision criteria was met in CARB's PQAO (as well as in other California PQAOs).
- For $PM_{2.5}$, CARB met the precision criteria at the PQAO level for three of seven methods of collection, with overall precision results slightly improving compared to previous years.
- Almost all PM_{10} and $PM_{2.5}$ samplers reported flow rate verification data to AQS, and the results indicate that the PM network exhibited low bias.

[5]https://www3.epa.gov/ttnamti1/files/ambient/pm25/qa/APP_D%20validation%20template%20version%2003_2017_for%20AMTIC%20Rev_1.pdf
[6]https://www3.epa.gov/ttn/amtic/files/policy/Tech_Memo_%20for_%201-pt_QC.pdf
[7]2021 Annual Network Plan (ca.gov)

- The audit accuracy data indicates that CARB's PQAO met CARB criteria for flow rate audits. This finding is consistent with the bias information from the routine flow rate verification data.
- Total $PM_{2.5}$ bias for CARB's PQAO, via the Performance Evaluation Program conducted by U.S. EPA based on mass samples, shows low bias, consistent with results determined via flow rate verification and audits.

Recommendations – PM Program

- In terms of precision, coefficient of variation (CV) values among some collocated $PM_{2.5}$ samplers remain high in 2020 within CARB's PQAO and generally on a national basis. CARB has explored the potential causes behind low $PM_{2.5}$ precision and will continue tracking the issues that might impact precision amongst PM samplers in collaboration with U.S. EPA.

- There were instances of samplers not meeting the MQOs (e.g., ambient data capture rate, flow rate verifications, etc). Monitoring agencies should investigate why these objectives were not met for each sampler in their respective jurisdictions and develop corrective actions, if appropriate, to meet them in subsequent years. An overall evaluation indicates that PM-related issues at the districts within CARB's PQAO were largely due to resource constraints imposed by COVID-19 related restrictions.

It is noteworthy that 2020 was an unusual year. In spite of resource constraints imposed by the COVID-19 pandemic, for the most part, CARB's PQAO and other PQAOs in California managed to meet the MQOs and continued improving over previous years' results. Precision results in 2020 remain comparable to 2019. Performance audits conducted at various locations for gases confirm the accuracy of the monitors; similarly, flow rate audits performed on particulate monitors confirm the accuracy of the monitors based on flow rate verifications. Overall, California's monitoring network as a whole performed exceptionally well despite the limitations during the COVID-19 pandemic.

I. INTRODUCTION

The California Air Resources Board (CARB) is the governmental agency delegated under State law with the authority and responsibility for collecting ambient air quality data as directed by the federal Clean Air Act of 1977 and Clean Air Act Amendments of 1990. CARB and local air pollution control agencies operate ambient monitoring stations throughout the State. As stated in the Code of Federal Regulations (CFR), the U.S. Environmental Protection Agency (U.S. EPA) has designated CARB, the Bay Area Air Quality Management District (BAAQMD), South Coast Air Quality Management District (SCAQMD), San Diego County Air Pollution Control District (SDCAPCD), National Park Service (NPS), Morongo Band of Mission Indians, and Pechanga Band of Luiseño Indians as their own PQAOs. This report will focus on four PQAOs: CARB, BAAQMD, SCAQMD, and SDCAPCD.

A PQAO is a local air district, or a coordinated aggregation of such organizations that is responsible for a set of stations that monitors the same pollutants and for which data quality assessments can logically be pooled. Each criteria pollutant sampler/monitor at a monitoring station in the State and Local Air Monitoring Station (SLAMS) Network must be associated with one, and only one, PQAO.[8]

Factors defining a PQAO include:

- Operation by a common team of field operators according to a common set of procedures.
- Use of a common quality assurance project plan or standard operating procedures.
- Common calibration facilities and standards.
- Oversight by a common quality assurance organization.
- Support by a common management, laboratory, or headquarters.

The purpose of this report is to provide ambient air quality data producers and users with a centralized review of the data quality within CARB's PQAO. Specifically, data from instruments measuring criteria gaseous and particulate pollutants are compared to measurement quality objectives (MQO). Where appropriate, comparisons to the national average and other PQAOs in California are also made. (The national average includes agencies defined as "state," "county," "district," "National Park Service," or "tribal.

[8] Samplers may also be identified as Special Purpose Monitors (SPM) or Industrial (ID) monitors. There are a limited number of SPM and ID monitors in California. The statistics reported in this report are predominantly the result of SLAMS monitors but also include a small number of SPM and ID monitors as well.

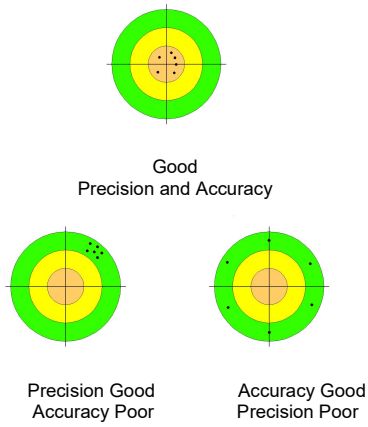
II. QUALITY ASSURANCE

Quality assurance is an integrated system of management activities that involves planning, implementing, assessing, and assuring data quality through a process, item, or service that meets users' needs for quality, completeness, and representativeness. Known data quality enables users to make judgments about compliance with air quality standards, air quality trends, and health effects based on sound data with a known level of confidence.

Quality assurance is composed of two main activities: quality control (QC) and quality assessment. QC is composed of a set of internal tasks performed routinely at the instrument level that ensures accurate and precise measured ambient air quality data. QC tasks address sample collection, handling, analysis, and reporting. Examples include calibrations, routine service checks, chain-of-custody documentation, duplicate analyses, development and maintenance of standard operating procedures, and routine preparation of QC reports.

Quality assessment is a set of external, quantitative tasks that provide certainty that the QC system is satisfactory and that the stated quantitative programmatic objectives for air quality data are met. Staff independent of data generators performs these external tasks, which include conducting regular performance audits, on-site system audits, inter-laboratory comparisons, and periodic evaluations of internal QC data.

The objective of quality assurance is to provide accurate and precise data, minimize data loss due to malfunctions, and to assess the validity of the air monitoring data to provide representative and comparable data of known precision and accuracy. The illustration to the right shows the relationship between precision and accuracy.



Precision is a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. It is a random component of error and is estimated by various techniques using some derivation of the standard deviation.

Bias is the systematic or persistent distortion of a measurement process which causes error in one direction. It is determined by estimating the positive and negative deviation from the true value as a percentage of the true value. When a certain bias is

detected, the measurement process is said to be "inaccurate." The term "bias" is used to describe accuracy in CFR.[9] In this report, the two terms are used interchangeably.

Precision is based on 1-pt QC checks for gaseous instruments and paired measurements from collocated samplers for particulate matter (PM). For precision, the statistic is the upper bound of the coefficient of variation (CV), which reflects the highest estimate of the variability in the instrument's measurements. The 1-pt QC checks for gaseous instruments are also used to estimate bias. For PM, bias can be estimated from flow rate verifications; however, only flow rate verifications from continuous PM_{10} analyzers are required to be uploaded to AQS. Available tools for assessing precision and bias are summarized in Appendix A of this report (while details on cases where the criteria for precision or bias are not met can be found in Appendix B). Detailed descriptions of the CV and the bias estimator, including the formulae behind the calculations, can be found in U.S. EPA's *Guideline on the Meaning and the Use of Precision and Bias Data Required by 40 CFR Part 58 Appendix A*.

Accuracy of the instruments is further validated or assessed by the through-the-probe performance audits conducted via the CARB annual performance evaluation program for gaseous pollutants or via the semi-annual flow rate audits for PM. Appendix A lists CARB's audit performance criteria, which were developed to closely match the National Performance Audit Program.[10] Starting in 2020, CARB no longer audits gaseous instruments outside of its PQAO.

Consistent with the goals of assessing precision and accuracy of the instruments/samplers, this report also assesses the amount of ambient air quality data produced by the instruments or samplers. Depending on the sampling frequency of each respective instrument or sampler, data capture is compiled as a percentage of the ambient data collected over the total amount of data possible.

Air Quality Data Actions (AQDA) are key tools used by the Quality Management Branch (QMB) of the Monitoring and Laboratory Division to identify and correct issues which would adversely affect the quality of the ambient data generated by the samplers. An AQDA is initiated by CARB auditors upon a failed audit. After an AQDA has been issued, an investigation into the causes of the failure will determine an outcome on the affected data. The data in question can be affected in three ways: released, corrected, or invalidated. Data that are released meet compliance criteria and can be used in all aspects of decision making. In some cases, data are flagged with qualifier codes as they are released. Corrected data pertains to when a calculated correction value is applied, rendering the data as meeting the established control criteria. Invalidated data are considered not for record, meaning the data set will not be utilized in any designation, enforcement, or regulatory decisions. As such, null

[9] https://www.ecfr.gov/cgi-bin/retrieveECFR?gp=1&SID=cd262bfedc5072c4808c47832bf484bb&ty=HTML&h=L&n=40y6.0.1.1.6&r=PART%20-%2040:6.0.1.1.6.7.1.3.34#ap40.6.58.0000_0nbspnbspnbsp.a

[10] https://www.epa.gov/amtic/national-performance-audit-program-npap-gaseous-monitoring

codes are associated with invalidated data. Outside of the AQDA process, data could also be flagged if monitoring agencies determine and U.S. EPA concurs that the collected data were influenced by an exceptional or natural event. Additionally, there are informational flags that do not impact the usage of the data.

The implementation of a comprehensive corrective action system throughout CARB's PQAO is an essential component for improving data quality and facilitating continuous process improvement. The Corrective Action Notification (CAN) process documents issues that impact, or potentially impact, data quality, completeness, storage, or reporting. The goal of the CAN process is to investigate, correct, and reduce the recurrence of these issues. As such, the CAN process will identify issues not addressed by AQDAs, improve data quality, and help ensure compliance with state, federal, and local requirements.

CARB's Quality Assurance Program is outlined in a five-volume Quality Assurance Manual, which guides the operation of the quality assurance programs used by CARB, local air districts, and private industry in California. The five-volume Quality Assurance Manual is available at http://www.arb.ca.gov/aaqm/qa/qa-manual/qa-manual.htm.

There are more than 250 air monitoring sites among the four California PQAOs operating in 15 separate air basins in California. Within CARB's PQAO, there are 21 local air districts operating sites under CARB's guidance. Information about each air monitoring station audited by QMB is available at https://ww3.arb.ca.gov/qaweb/siteinfo.php.

III. DATA QUALITY - STATISTICAL SUMMARY RESULTS

The results are presented for two groups of pollutants: gases and particulate matter. For each group, the amount of ambient data collected (or captured) is discussed first, followed by an assessment of the quality behind the data. Statistical results presented in this report reflect the current information in AQS, with the exception of 2020 data, which is also updated to reflect corrections of data quality issues noted in Appendix B. These minor changes to 2020 data are not reflected in AQS since the data have already been certified and changing the data would require recertification. Data for 2018 and 2019 directly reflect the current information in AQS, and as such, they will reflect changes that occurred to past data since the 2019 Annual Data Quality Report was prepared. For example, "begin" and "end" dates for monitors may have been corrected, and parameter or method codes may have been updated to reflect the correct status of monitors in AQS. These changes may result in 2018 or 2019 data that differ from those published in the 2019 report.

A. Gaseous Criteria Pollutants

The gaseous pollutants assessed in this report are carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2).

Ambient Data Capture: Data capture, as described in this report, is derived from the AQS completeness report AMP 430. The calculated number in AMP 430 represents the average of the monthly data capture rates for the calendar year and may not always be indicative of whether the 75 percent regulatory completeness requirement[11] is met for a particular pollutant, considering the operational period in the year. Note that while this report focuses on the federal requirement of a minimum data capture rate of 75 percent, CARB's goal is to have at least 85 percent of the data in AQS.

Table A1 presents the percentage of instruments that reported at least 75 percent of the possible ambient data for each gaseous pollutant for each PQAO. Table A2 displays similar information for each local air district operating within CARB's PQAO. Monitoring sites within each geographic area may be operated by the district, CARB, or both. As shown in the tables, a small number of instruments within CARB's PQAO reported a data capture rate of less than 75 percent.

Table A1. Ambient Gaseous Pollutant Data Capture Results

Pollutant	PQAO	Year	Number of Instruments	Number of Instruments Reporting ≥ 75% Ambient Data Capture	% of Instruments Reporting ≥ 75% Ambient Data
CO	CARB	2020	18	18	100
		2019	19	18	95
		2018	22	22	100
	BAAQMD	2020	16	16	100
		2019	16	16	100
		2018	17	17	100
	SCAQMD	2020	25	24	96
		2019	26	26	100
		2018	26	25	96
	SDCAPCD	2020	2	2	100
		2019	2	2	100
		2018	2	2	100
	NATIONAL	2020	206	198	96
		2019	225	217	96
		2018	228	218	96

[11] 40 CFR Part 50 states that the ambient data from a given instrument or sampler must be at least 75% complete in a calendar year to be included in making regulatory decisions, e.g. attainment of AAQS. California also defines data "completeness" using 75%. However, unlike the federal definition, California factors in the high season of the pollutant in the completeness criteria (e.g., only high ozone months are considered for ozone standard).

Table A1 (cont'd). Ambient Gaseous Pollutant Data Capture Results

Pollutant	PQAO	Year	Number of Instruments	Number of Instruments Reporting ≥ 75% Ambient Data Capture	% of Instruments Reporting ≥ 75% Ambient Data
NO_2	CARB	2020	40	40	100
		2019	48	46	96
		2018	49	48	98
	BAAQMD	2020	18	18	100
		2019	18	18	100
		2018	19	19	100
	SCAQMD	2020	29	29	100
		2019	28	28	100
		2018	26	25	96
	SDCAPCD	2020	9	9	100
		2019	8	8	100
		2018	7	7	100
	NATIONAL	2020	370	362	98
		2019	374	358	96
		2018	370	356	96
O_3	CARB	2020	100	95	95
		2019	102	94	92
		2018	100	99	99
	BAAQMD	2020	20	20	100
		2019	20	19	95
		2018	21	21	100
	SCAQMD	2020	29	29	100
		2019	28	28	100
		2018	28	28	100
	SDCAPCD	2020	7	7	100
		2019	7	7	100
		2018	6	6	100
	NATIONAL	2020	927	910	98
		2019	955	930	97
		2018	983	949	97

Table A1 (cont'd). Ambient Gaseous Pollutant Data Capture Results

Pollutant	PQAO	Year	Number of Instruments	Number of Instruments Reporting ≥ 75% Ambient Data Capture	% of Instruments Reporting ≥ 75% Ambient Data
SO_2	CARB	2020	9	9	100
		2019	13	13	100
		2018	15	14	93
	BAAQMD	2020	9	9	100
		2019	9	9	100
		2018	9	9	100
	SCAQMD	2020	4	4	100
		2019	5	5	100
		2018	5	5	100
	SDCAPCD	2020	1	1	100
		2019	1	1	100
		2018	1	1	100
	NATIONAL	2020	321	316	98
		2019	351	342	97
		2018	358	347	97

- Further details on CARB's PQAO instruments not reporting ≥ 75% ambient data can be seen in Appendix B.
- Source: Air Quality System, AMP 430 Data Completeness Report, run September 2020, except as noted in Appendix B.
- National average includes state, county, district, National Park Service, and tribal sites, including those in California.
- Results reflect current information in AQS from September 2020, including changes to past data since the 2019 Annual Data Quality Report. Therefore, results for 2019 and 2018 might differ from those in the 2019 DQ report.

Table A2. 2020 Ambient Gaseous Pollutant Data Capture Results for Local Air Districts Within CARB's PQAO

Pollutant	Geographic Area	Monitoring by (District=D, CARB=C, or Both=B)	Number of Instruments	Number of Instruments Reporting ≥ 75% Ambient Data	% of Instruments Reporting ≥ 75% Ambient Data
CO	Antelope Valley AQMD	D	1	1	100
	Butte County AQMD	C	1	1	100
	Great Basin Unified APCD	D	1	1	100
	Imperial County APCD	C	1	1	100
	Mojave Desert AQMD	D	2	2	100
	Monterey Bay ARD	D	1	1	100
	North Coast Unified AQMD	D	1	1	100
	Sacramento Metropolitan AQMD	D	2	2	100
	San Joaquin Valley Unified APCD	B	6	6	100
	Santa Barbara County APCD	B	2	2	100
NO_2	Antelope Valley AQMD	D	1	1	100
	Butte County AQMD	C	1	1	100
	Feather River AQMD	C	1	1	100
	Imperial County APCD	B	2	2	100
	Mojave Desert AQMD	D	3	3	100
	Monterey Bay ARD	D	1	1	100
	North Coast Unified AQMD	D	1	1	100
	Placer County APCD	C	1	1	100
	Sacramento Metropolitan AQMD	B	5	5	100
	San Joaquin Valley Unified APCD	B	17	17	100
	San Luis Obispo County APCD	D	2	2	100
	Santa Barbara County APCD	B	2	2	100
	Ventura County APCD	D	2	2	100
	Yolo-Solano AQMD	C	1	1	100

Table A2 (cont'd). 2020 Ambient Gaseous Pollutant Data Capture Results for Local Air Districts Within CARB's PQAO

Pollutant	Geographic Area	Monitoring by (District=D, CARB=C, or Both=B)	Number of Instruments	Number of Instruments Reporting ≥ 75% Ambient Data	% of Instruments Reporting ≥ 75% Ambient Data
O_3	Amador County APCD	C	1	1	100
	Antelope Valley AQMD	D	1	1	100
	Butte County AQMD	C	2	2	100
	Calaveras County APCD	C	1	1	100
	Colusa County APCD	C	1	1	100
	Eastern Kern APCD	C	2	2	100
	El Dorado County AQMD	C	3	2	67*
	Feather River AQMD	C	2	2	100
	Glenn County APCD	C	1	1	100
	Great Basin Unified APCD	D	1	1	100
	Imperial County APCD	B	4	2	50*
	Lake County APCD	D	1	1	100
	Mariposa County APCD	C	1	1	100
	Mendocino County AQMD	D	1	1	100
	Mojave Desert AQMD	B	6	6	100
	Monterey Bay ARD	D	5	5	100
	North Coast Unified AQMD	D	1	1	100
	Northern Sierra AQMD	B	1	1	100
	Northern Sonoma County APCD	D	1	0	0*
	Placer County APCD	B	5	5	100
	Sacramento Metropolitan AQMD	B	6	6	100
	San Joaquin Valley Unified APCD	B	23	23	100
	San Luis Obispo County APCD	B	7	7	100
	Santa Barbara County APCD	B	8	7	88*
	Shasta County AQMD	D	3	3	100
	Siskiyou County APCD	D	1	1	100
	Tehama County APCD	B	2	2	100
	Tuolumne County APCD	C	1	1	100
	Ventura County APCD	D	5	5	100
	Yolo-Solano AQMD	B	3	3	100

Table A2 (cont'd). 2020 Ambient Gaseous Pollutant Data Capture Results for Local Air Districts Within CARB's PQAO

Pollutant	Geographic Area	Monitoring by (District=D, CARB=C, or Both=B)	Number of Instruments	Number of Instruments Reporting ≥ 75% Ambient Data	% of Instruments Reporting ≥ 75% Ambient Data
SO_2	Great Basin Unified APCD	D	1	1	100
	Imperial County APCD	C	1	1	100
	Mojave Desert AQMD	D	2	2	100
	North Coast Unified AQMD	D	1	1	100
	Sacramento Metropolitan AQMD	D	1	1	100
	San Joaquin Valley Unified APCD	C	1	1	100
	San Luis Obispo County APCD	B	1	1	100
	Santa Barbara County APCD	D	1	1	100

- *Further details on CARB's PQAO instruments not reporting ≥ 75% ambient data can be viewed in Appendix B.
- Source: Air Quality System, AMP 430 Data Completeness Report, run September 2020, except as noted in Appendix B.

Precision and Bias: 1-pt QC checks (mostly automated) are performed by the monitoring organizations to confirm the instrument's ability to respond to a known concentration of gas. The degree of variability in each of these measurements is computed as the precision of that instrument's measurements. For precision, the statistic defined in Title 40, CFR Part 58 Appendix A, is the upper bound of the coefficient of variation (CV), which reflects the highest tolerable variability in the data. This CV upper bound is not to exceed 7 percent for O_3, 10 percent for CO and SO_2, and 15 percent for NO_2.

These 1-pt QC checks are also used to estimate the bias inherent in the sampling system associated with each instrument. Appendix A to Part 58 outlines how bias is calculated based on 1-pt QC checks for gaseous pollutants. The bias estimator is the upper bound on the mean absolute value of the percent differences between the instrument's response and the true value of the gas concentration. A sign (positive/negative) is applied when the 25th and 75th percentiles are of the same sign. In other words, when at least 75 percent of the differences are all positive or negative, the bias estimate has a sign. Otherwise, the bias is denoted with "±." For bias, the CFR criteria are: ±7 percent for O_3, ±10 percent for CO and SO_2, and ±15 percent for NO_2.[12] A detailed description of the bias estimator, including the formulae behind the calculations, can be found in U.S. EPA's *Guideline on the Meaning and the Use of*

[12]The MQO goal for NO_2 was established in guidance in 2006 as 10% and was updated in 2014 to 15%. The goal of 15% was established in regulation in 2010. Prior to 2010, there was no goal in regulation.

Precision and Bias Data Required by 40 CFR Part 58 Appendix A. Note that starting in 2019, 1-pt QC checks were subjected to the "prescribed range" requirements by EPA[13]; only those meeting such requirements were used in AQS to assess precision and bias.

Bias estimates are further verified via the through-the-probe performance audits. CARB acceptance criteria for performance audits were: ±10 percent for O_3 (with warning at ±7 percent) and ±15 percent for CO, NO_2, and SO_2 (with warning at ±10 percent) for each audit point. CARB's policy is to audit all local air districts' sites within its PQAO each year. Non-CARB'S PQAOs are responsible for performing their own audits as part of the annual performance evaluation program.

CFR requires that the 1-pt QC checks be performed at least once every two weeks on each automated instrument, which translates to a minimum of 26 checks per year for an instrument that operates year-round. During data certification, U.S. EPA flags instruments that do not have at least 75 percent of the required QC checks in AQS; thus, 75 percent is the criterion used in Table A3. A complete listing of all MQOs set forth by U.S. EPA under Title 40 CFR and the Quality Assurance (QA) Handbook Volume II can be found in Appendix A of this report.

For gaseous pollutants required by 40 CFR (CO, NO_2, O_3, and SO_2), CARB's PQAO (as well as other California PQAOs) met the precision and bias criteria in 2020, as shown in Table A3. Information for years 2018 and 2019 are provided for a historical perspective. Three-year averages for each PQAO are also included. In general, 2020 precision data are consistent with those in the previous two years. In addition, the required number of QC checks was achieved at most stations. Table A3 includes the number of instruments with at least 75 percent of the required QC data reported for 2020.

[13] https://www3.epa.gov/ttn/amtic/files/policy/Tech_Memo_for_1-pt_QC.pdf

Table A3. 2018-2020 Gaseous Pollutant Instrument Precision and Bias Results

Pollutant	PQAO	Year	Number of Instruments	Number of Instruments with ≥ 75% of Required Q/C checks	Upper Bound of Coeff of Variation	CFR Criteria for Precision Met?	Bias	CFR Criteria for Bias Met?
CO	CARB	2020	18	17	8.96	Yes	± 4.49	Yes
		2019	21	13	4.00	Yes	± 3.19	Yes
		2018	22	0	3.64	Yes	± 2.71	Yes
		Avg			5.91	Yes	± 3.37	Yes
	BAAQMD	2020	16	1	3.30	Yes	± 3.55	Yes
		2019	16	1	3.02	Yes	+ 3.64	Yes
		2018	17	0	1.90	Yes	± 1.41	Yes
		Avg			2.14	Yes	± 1.71	Yes
	SCAQMD	2020	25	25	3.70	Yes	± 2.50	Yes
		2019	27	27	3.44	Yes	± 2.44	Yes
		2018	26	26	4.67	Yes	± 3.16	Yes
		Avg			4.07	Yes	± 2.68	Yes
	SDCAPCD	2020	2	2	2.87	Yes	± 2.35	Yes
		2019	2	2	2.90	Yes	± 2.59	Yes
		2018	2	2	3.90	Yes	± 3.56	Yes
		Avg			3.20	Yes	± 2.71	Yes
	NATIONAL	2020	231	194	3.82	Yes	± 3.71	Yes
		2019	247	190	4.21	Yes	± 3.88	Yes
		2018	255	242	3.79	Yes	± 3.66	Yes
NO_2	CARB	2020	40	40	5.14	Yes	± 3.94	Yes
		2019	50	44	4.97	Yes	± 4.03	Yes
		2018	50	48	5.17	Yes	± 4.07	Yes
		Avg			5.09	Yes	± 3.99	Yes
	BAAQMD	2020	18	17	2.21	Yes	± 1.79	Yes
		2019	NDA*	NDA	NDA	NDA	NDA	NDA
		2018	19	19	1.94	Yes	± 1.46	Yes
		Avg			2.09	Yes	± 1.60	Yes
	SCAQMD	2020	29	29	4.68	Yes	± 3.74	Yes
		2019	29	29	5.64	Yes	± 4.05	Yes
		2018	26	26	6.06	Yes	± 4.48	Yes
		Avg			5.48	Yes	± 4.05	Yes

Table A3 (cont'd). 2018-2020 Gaseous Pollutant Instrument Precision and Bias Results

Pollutant	PQAO	Year	Number of Instruments	Number of Instruments with ≥ 75% of Required Q/C checks	Upper Bound of Coeff of Variation	CFR Criteria for Precision Met?	Bias	CFR Criteria for Bias Met?
NO_2	SDCAPCD	2020	9	9	4.19	Yes	± 3.23	Yes
		2019	8	8	4.52	Yes	± 3.49	Yes
		2018	7	7	3.98	Yes	- 4.51	Yes
		Avg			4.60	Yes	± 3.60	Yes
	NATIONAL	2020	417	398	4.17	Yes	± 4.34	Yes
		2019	427	361	4.36	Yes	± 4.52	Yes
		2018	417	400	4.62	Yes	± 4.55	Yes
O_3	CARB	2020	100	99	2.68	Yes	± 2.68	Yes
		2019	106	97	2.80	Yes	± 2.20	Yes
		2018	104	104	2.62	Yes	± 1.99	Yes
		Avg			2.70	Yes	± 2.70	Yes
	BAAQMD	2020	20	20	1.47	Yes	± 1.17	Yes
		2019	NDA*	NDA	NDA	NDA	NDA	NDA
		2018	21	21	1.50	Yes	± 1.18	Yes
		Avg			1.49	Yes	± 1.17	Yes
	SCAQMD	2020	29	29	2.22	Yes	± 1.69	Yes
		2019	29	29	2.18	Yes	± 1.98	Yes
		2018	28	28	2.32	Yes	± 1.83	Yes
		Avg			2.25	Yes	± 1.82	Yes
	SDCAPCD	2020	7	7	1.76	Yes	± 1.56	Yes
		2019	7	7	1.94	Yes	± 1.73	Yes
		2018	6	6	2.20	Yes	± 1.89	Yes
		Avg			1.90	Yes	± 1.66	Yes
	NATIONAL	2020	1,095	1,067	2.17	Yes	± 2.09	Yes
		2019	1,108	1,031	2.15	Yes	± 2.07	Yes
		2018	1,122	1,103	2.34	Yes	± 2.14	Yes

Table A3 (cont'd). 2018-2020 Gaseous Pollutant Instrument Precision and Bias Results

Pollutant	PQAO	Year	Number of Instruments	Number of Instruments with ≥ 75% of Required Q/C checks	Upper Bound of Coeff of Variation	CFR Criteria for Precision Met?	Bias	CFR Criteria for Bias Met?
SO_2	CARB	2020	9	9	3.50	Yes	± 2.52	Yes
		2019	14	11	3.10	Yes	± 2.81	Yes
		2018	15	14	3.48	Yes	± 2.68	Yes
		Avg			3.40	Yes	± 2.63	Yes
	BAAQMD	2020	9	1	2.02	Yes	+ 2.05	Yes
		2019	9	1	1.81	Yes	+2.12	Yes
		2018	9	9	1.95	Yes	± 1.57	Yes
		Avg			2.04	Yes	± 1.65	Yes
	SCAQMD	2020	4	4	2.96	Yes	± 2.62	Yes
		2019	5	5	5.37	Yes	± 3.59	Yes
		2018	5	5	5.89	Yes	± 3.13	Yes
		Avg			5.00	Yes	± 2.85	Yes
	SDCAPCD	2020	1	1	2.08	Yes	- 7.83	Yes
		2019	1	1	2.44	Yes	- 8.16	Yes
		2018	1	1	3.74	Yes	- 9.17	Yes
		Avg			2.68	Yes	- 8.16	Yes
	NATIONAL	2020	379	352	3.25	Yes	± 3.13	Yes
		2019	395	361	3.05	Yes	± 3.18	Yes
		2018	402	381	3.18	Yes	± 3.31	Yes

- CFR limits for precision (CV): 7% for O_3, 15% for NO_2, 10% for CO and SO_2; for bias: ± 7% for O_3, ± 15% for NO_2, ± 10% for CO and SO_2. Both are based on QC checks required to be performed every two weeks, and U.S. EPA AMP 600 report flags instruments that do not have at least 75% of the required QC checks.
- Further details on CARB's PQAO instruments not meeting these criteria can be viewed in Appendix B.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run September 2020.
- National average includes state, county, district, National Park Service, and tribal sites, including those in California; note: discrepancies may exist in Number of instruments listed in Table A3 compared to Table A1 due to different report sources, AMP256 and AMP430.
- Results reflect current information in AQS, including changes to past data since the 2019 Annual Data Quality Report. Therefore, results for 2019 and 2018 might differ from those in the 2019 DQ report.
- *NDA=No data available. For Bay Area, some 2019 and 2020 QC checks performed outside of prescribed range indicated that the data were of acceptable quality such that Bay Area certification was accepted by EPA (discussed at 2021 TSA); the QC check levels were adjusted to meet the prescribed range for O_3 and NO_2 in mid to late 2020 and for CO and SO_2 in mid 2021.

Table A4 displays precision data for each local air district within CARB's PQAO in which sites are operated, with CV averaged across sites within each district. Monitoring sites within these areas may be operated by the district, CARB, or both. As shown in the table, all districts met the CV requirement and had very few instruments with less than 75 percent of required QC data reported.

In order to provide decision makers with data of known quality, U.S. EPA provides a web-based tool for assessing data quality in terms of three data quality indicators in graphical format. Graphs in U.S. EPA's tool[14] provide detailed information on precision (CV), bias, and the number of 1-pt QC checks performed at each monitoring station in a given year.

Table A4. 2020 Gaseous Pollutant Instrument Precision Results for Local Air Districts Within CARB's PQAO

Pollutant	Geographic Area	Monitoring by (District=D, CARB=C, or Both=B)	Number of Instruments	Number of Instruments with ≥ 75% of Required QC checks	Upper Bound of Coefficient of Variation
CO	Antelope Valley AQMD	D	1	1	2.99
	Butte County AQMD	C	1	1	4.36
	Great Basin Unified APCD	D	1	1	2.33
	Imperial County APCD	C	1	1	2.54
	Mojave Desert AQMD	D	2	2	3.54
	Monterey Bay ARD	D	1	1	3.54
	North Coast Unified AQMD	D	1	1	2.67
	Sacramento Metropolitan AQMD	D	2	2	1.39
	San Joaquin Valley Unified APCD	B	6	5	7.22
	Santa Barbara County APCD	D	2	2	8.09
NO_2	Antelope Valley AQMD	D	1	1	4.12
	Butte County AQMD	C	1	1	6.20
	Feather River AQMD	C	1	1	5.20
	Imperial County APCD	B	2	2	3.88
	Mojave Desert AQMD	D	3	3	4.16
	Monterey Bay ARD	D	1	1	2.08
	North Coast Unified AQMD	D	1	1	2.81
	Placer County APCD	C	1	1	4.53

[14] https://www.epa.gov/outdoor-air-quality-data/single-point-precision-and-bias-report

Table A4 (cont'd). 2020 Gaseous Pollutant Instrument Precision Results for Local Air Districts Within CARB's PQAO

Pollutant	Geographic Area	Monitoring by (District=D, CARB=C, or Both=B)	Number of Instruments	Number of Instruments with ≥ 75% of Required QC checks	Upper Bound of Coefficient of Variation
NO_2	Sacramento Metropolitan AQMD	B	5	5	3.45
	San Joaquin Valley Unified APCD	B	17	17	4.01
	San Luis Obispo County APCD	D	2	2	2.76
	Santa Barbara County APCD	D	2	2	2.82
	Ventura County APCD	D	2	2	4.14
	Yolo-Solano AQMD	C	1	1	3.92
O_3	Amador County APCD	C	1	1	1.78
	Antelope Valley AQMD	D	1	1	3.61
	Butte County AQMD	C	2	2	2.53
	Calaveras County APCD	C	1	1	2.14
	Colusa County APCD	C	1	1	3.02
	Eastern Kern APCD	C	2	1	1.50
	El Dorado County AQMD	C	3	3	2.69
	Feather River AQMD	C	2	2	1.81
	Glenn County APCD	C	1	1	2.52
	Great Basin Unified APCD	D	1	1	3.87
	Imperial County APCD	B	4	4	2.70
	Lake County APCD	D	1	1	1.50
	Mariposa County APCD	C	1	1	1.81
	Mendocino County AQMD	D	1	1	3.29
	Mojave Desert AQMD	B	6	6	2.30
	Monterey Bay ARD	D	5	5	2.08
	North Coast Unified AQMD	D	1	1	2.56
	Northern Sierra AQMD	B	1	1	3.11
	Northern Sonoma County APCD	D	1	0	NDA*
	Placer County APCD	B	5	5	2.06
	Sacramento Metropolitan AQMD	B	6	6	3.53
	San Joaquin Valley Unified APCD	B	23	23	1.92
	San Luis Obispo County APCD	B	7	7	1.40

Table A4 (cont'd). 2020 Gaseous Pollutant Instrument Precision Results for Local Air Districts Within CARB's PQAO

Pollutant	Geographic Area	Monitoring by (District=D, CARB=C, or Both=B)	Number of Instruments	Number of Instruments with ≥ 75% of Required QC checks	Upper Bound of Coefficient of Variation
O_3	Santa Barbara County APCD	B	8	8	2.23
	Shasta County APCD	D	3	3	3.16
	Siskiyou County APCD	D	1	1	2.62
	Tehama County APCD	B	2	2	2.29
	Tuolumne County APCD	C	1	1	3.16
	Ventura County APCD	D	5	5	1.33
	Yolo-Solano AQMD	B	3	3	3.28
SO_2	Great Basin Unified APCD	D	1	1	1.39
	Imperial County APCD	C	1	1	5.63
	Mojave Desert AQMD	D	2	2	2.95
	North Coast Unified AQMD	D	1	1	1.90
	Sacramento Metropolitan AQMD	D	1	1	2.41
	San Joaquin Valley Unified APCD	C	1	1	1.10
	San Luis Obispo County APCD	D	1	1	2.26
	Santa Barbara County APCD	D	1	1	3.06

- AQMD – Air Quality Management District
- APCD – Air Pollution Control District
- *NDA: no data available from AQS
- CFR Limit for precision CV: 7% for O_3, 15% for NO_2, 10% for CO and SO_2, based on QC checks required to be performed every two weeks, and U.S. EPA AMP 600 report flags instruments that do not have at least 75% of the required QC checks.
- Further details on CARB's PQAO instruments not meeting these criteria can be viewed in Appendix B.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run September 2020.

An Assessment of Individual 1-pt QC checks for Gases: In March 2018, U.S. EPA revised QA Handbook Volume II, Appendix D, Measurement Quality Objectives and Validation Templates with updated criteria for assessing individual 1-pt QC checks against the following criteria: < ±7.1% (percent difference) or < ±1.5 ppb difference, whichever is greater, for O_3; < ±10.1% (percent difference) for CO; < ±15.1% (percent difference) or < ±1.5 ppb difference, whichever is greater, for NO_2; and < ±10.1% (percent difference) or < ±1.5 ppb difference, whichever is greater, for SO_2. CARB and some district-operated sites perform more frequent QC checks than required by U.S. EPA. Note that some of the exceedances are associated with ambient data being affected by issues identified through the AQDA process, separate from the individual QC checks not meeting the criteria. Table A4-1 presents results on individual QC checks at the PQAO level. Table A4-2 breaks down CARB's PQAO statistics by district. Overall, the vast majority of QC checks from 2020 meet the criteria.

Table A4-1. 2020 1-Point Gaseous QC Checks, by PQAO – Individual Assessment

Pollutant	PQAO	Number of Instruments	Number of QC Checks Performed	Number of QC Checks Meeting Criteria	% of QC Checks Meeting Criteria
CO	CARB	18	2,469	2,330	98.0%
	BAAQMD	16	2,339	2,339	100.0%
	SCAQMD	23	8,980	8,908	99.2%
	SDCAPCD	2	102	102	100.0%
NO_2	CARB	40	9,301	9,287	99.9%
	BAAQMD	18	2,774	2,672	96.3%
	SCAQMD	27	10,512	10,498	99.9%
	SDCAPCD	8	434	432	99.5%
O_3	CARB	100	20,280	20,179	97.8%
	BAAQMD	20	3,069	3,069	100.0%
	SCAQMD	29	10,543	10,501	99.6%
	SDCAPCD	7	341	341	100.0%
SO_2	CARB	9	1,381	1,377	99.7%
	BAAQMD	9	1,379	1,379	100.0%
	SCAQMD	4	1,425	1,420	99.6%
	SDCAPCD	1	51	46	90.2%

- Source: Air Quality System, AMP 251 QA Raw Assessment Report, run September 2020, except as noted in Appendix B.

Table A4-2. 2020 Gaseous Pollutant 1-pt QC checks – Individual Assessment for Local Air Districts Within CARB's PQAO

Pollutant	Geographic Area	Number of Instruments	Monitoring by (District=D, CARB=C, or Both=B)	Number of QC Checks Performed	Number of QC Checks Meeting Criteria	% of QC Checks Meeting Criteria
CO	Antelope Valley AQMD	1	D	49	49	100.0%
	Butte County AQMD	1	C	224	223	99.6%
	Great Basin Unified APCD	1	D	49	49	100.0%
	Imperial County APCD	1	C	234	234	100.0%
	Mojave Desert AQMD	2	D	99	98	99.0%
	Monterey Bay Unified APCD	1	D	51	51	100.0%
	North Coast Unified AQMD	1	D	110	110	100.0%
	Sacramento Metropolitan AQMD	2	D	325	325	100.0%
	San Joaquin Valley Unified APCD	6	B	726	605	83.3%
	Santa Barbara County APCD	2	D	602	586	98.3%
NO_2	Antelope Valley AQMD	1	D	49	49	100.0%
	Butte County AQMD	1	C	245	245	100.0%
	Feather River AQMD	1	C	245	245	100.0%
	Imperial County APCD	2	B	274	274	100.0%
	Mojave Desert AQMD	3	D	143	143	100.0%
	Monterey Bay Unified APCD	1	D	51	51	100.0%
	North Coast Unified AQMD	1	D	112	112	100.0%
	Placer County APCD	1	C	228	228	100.0%
	Sacramento Metropolitan AQMD	4	B	790	788	99.7%
	San Joaquin Valley Unified APCD	17	B	5250	5247	99.9%
	San Luis Obispo County APCD	2	D	698	698	100.0%
	Santa Barbara County APCD	2	D	608	599	98.5%
	Ventura County APCD	2	D	356	356	100.0%
	Yolo-Solano AQMD	1	C	252	252	100.0%

Table A4-2 (cont'd). 2020 Gaseous 1-pt QC checks – Individual Assessment for Local Air Districts Within CARB's PQAO

Pollutant	Geographic Area	Number of Instruments	Monitoring by (District=D, CARB=C, or Both=B)	Number of QC Checks Performed	Number of QC Checks Meeting Criteria	% of QC Checks Meeting Criteria
O_3	Amador County APCD	1	C	353	353	100.0%
	Antelope Valley AQMD	1	D	48	47	97.9%
	Butte County AQMD	2	C	584	583	99.8%
	Calaveras County APCD	1	C	361	361	100.0%
	Colusa County APCD	1	C	366	366	100.0%
	Eastern Kern APCD	1	C	279	279	100.0%
	El Dorado County AQMD	3	C	709	706	99.6%
	Feather River AQMD	2	C	453	453	100.0%
	Glenn County APCD	1	C	340	336	98.8%
	Great Basin Unified APCD	1	D	53	33	62.3%*
	Imperial County APCD	4	B	329	315	95.7%
	Lake County APCD	1	D	51	51	100.0%
	Mariposa County APCD	1	C	205	205	100.0%
	Mendocino County AQMD	1	D	46	46	100.0%
	Mojave Desert AQMD	6	B	572	572	100.0%
	Monterey Bay Unified APCD	5	D	259	259	100.0%
	North Coast Unified AQMD	1	D	117	116	99.1%
	Northern Sierra AQMD	1	D	32	32	100.0%
	Northern Sonoma County APCD	1	D	NDA	NDA	NDA
	Placer County APCD	5	B	365	364	100.0%
	Sacramento Metropolitan AQMD	6	B	986	981	99.5%
	San Joaquin Valley Unified APCD	23	B	7,050	7,043	99.9%
	San Luis Obispo County APCD	7	D	2,498	2,498	100.0%
	Santa Barbara County APCD	9	D	2,232	2,217	99.3%
	Shasta County AQMD	3	D	126	110	87.3%
	Siskiyou County APCD	1	D	28	28	100.0%
	Tehama County APCD	2	B	244	242	99.2%
	Tuolumne County APCD	1	C	350	343	98.0%
	Ventura County APCD	5	D	900	899	99.9%
	Yolo-Solano AQMD	3	B	344	341	99.1%

Table A4-2 (cont'd). 2020 Gaseous 1-pt QC checks – Individual Assessment for Local Air Districts within CARB's PQAO

Pollutant	Geographic Area	Number of Instruments	Monitoring by (District=D, CARB=C, or Both=B)	Number of QC Checks Performed	Number of QC Checks Meeting Criteria	% of QC Checks Meeting Criteria
SO_2	Great Basin Unified APCD	1	D	49	49	100.0%
	Imperial County APCD	1	C	251	247	98.4%
	Mojave Desert AQMD	2	D	95	95	100.0%
	North Coast Unified AQMD	1	D	113	112	99.1%
	Sacramento Metropolitan AQMD	1	D	115	115	100.0%
	San Joaquin Valley Unified APCD	1	C	42	42	100.0%
	San Luis Obispo County APCD	1	D	363	363	100.0%
	Santa Barbara County APCD	1	D	353	353	100.0%

- Criteria for individual QC checks are: < ±7.1% (percent difference) or < ±1.5 ppb difference, whichever is greater, for O_3; < ±10.1% (percent difference) for CO; < ±15.1% (percent difference) or < ±1.5 ppb difference, whichever is greater, for NO_2; and < ±10.1% (percent difference) or < ±1.5 ppb difference, whichever is greater, for SO_2.
- *In-station calibrator malfunction; issue is being addressed by the district.
- Source: Air Quality System, AMP 251 QA Raw Assessment Report, run September 2020, except as noted in Appendix B.

Individual QC checks are to be conducted within the prescribed ranges: 0.005 to 0.08 ppm for O_3, NO_2, and SO_2; 0.5 to 5 ppm for CO. Starting in January 2019, QC checks that fall out of the prescribed range are flagged in AQS in order to reflect the Federal Register notice, Volume 81, No. 59, published on March 28, 2016. QC checks conducted within the prescribed range for each PQAO are presented in Table A4-3. Table A4-4 breaks down CARB's PQAO statistics by district. All agencies are reminded that the updates to AQS regarding 1-pt QC check requirements became effective on January 1, 2020. Additional notifications were published on the AMTIC website on 5/5/2016[15] and the October 2018 QA Eye article.[16]

[15] https://www.epa.gov/sites/production/files/2018-02/documents/tech_memo_for_1-pt_qc.pdf
[16] https://www.epa.gov/sites/default/files/2020-09/documents/publication_23.pdf

ATable A4-3. 2020 Gaseous 1-pt QC checks – Individual Assessment on Prescribed Range, by PQAO

Pollutant	PQAO	Number of Instruments	Number of QC Checks Performed	Number of QC Checks Within Prescribed Range	% of QC Checks Within Prescribed Range
CO	CARB	18	2,469	2,401	97.6%
	BAAQMD	16	2,339	156	6.7%*
	SCAQMD	23	8,980	8,908	99.2%
	SDCAPCD	2	102	102	100.0%
NO_2	CARB	40	9,301	9,233	99.4%
	BAAQMD	18	2,774	2,220	80.0%
	SCAQMD	27	10,512	10,452	99.4%
	SDCAPCD	8	434	434	100.0%
O_3	CARB	100	20,280	20,222	99.8%
	BAAQMD	20	3069	2,580	84.1%
	SCAQMD	29	10,543	10,487	99.5%
	SDCAPCD	7	341	341	100.0%
SO_2	CARB	9	1,381	1,359	99.6%
	BAAQMD	9	1,379	179	13.0%*
	SCAQMD	4	1,425	1,391	97.6%
	SDCAPCD	1	51	51	100.0%

- Prescribed ranges: 0.005 to 0.08 ppm for O_3, NO_2, and SO_2; 0.5 to 5 ppm for CO. The QC check gas concentration selected within the prescribed range should be related to the monitoring objectives for the monitor. If monitoring at an NCore site or for trace level monitoring, the QC check concentration should be selected to represent the mean or median concentrations at the site. If the mean or median concentrations at trace gas sites are below the MDL of the instrument the agency can select the lowest concentration in the prescribed range that can be practically achieved. If the mean or median concentrations at trace gas sites are above the prescribed range the agency can select the highest concentration in the prescribed range.
- *Bay Area QC checks: some 2019 and 2020 QC checks performed outside of prescribed range indicated that the data were of acceptable quality such that Bay Area certification was accepted by EPA (discussed at 2021 TSA); the QC check levels were adjusted to meet the prescribed range for O_3 and NO_2 in mid to late 2020 and for CO and SO_2 in mid 2021.
- Source: Air Quality System, AMP 251 QA Raw Assessment Report, run September 2020, except as noted in Appendix B.

Table A4-4. 2020 Gaseous 1-pt QC checks – Individual Assessment on Prescribed Range for Local Air Districts Within CARB's PQAO

Pollutant	Geographic Area	Number of Instruments	Monitoring by (District=D, CARB=C, or Both=B)	Number of QC Checks Performed	Number of QC Checks Within Prescribed Range	% of QC Checks Within Prescribed Range
CO	Antelope Valley AQMD	1	D	49	49	100.0%
	Butte County AQMD	1	C	224	224	100.0%
	Great Basin Unified APCD	1	D	49	49	100.0%
	Imperial County APCD	1	C	234	234	100.0%
	Mojave Desert AQMD	2	D	99	99	100.0%
	Monterey Bay Unified APCD	1	D	51	51	100.0%
	North Coast Unified AQMD	1	D	110	93	84.5%
	Sacramento Metropolitan AQMD	2	D	325	317	97.5%
	San Joaquin Valley Unified APCD	6	B	726	683	94.1%
	Santa Barbara County APCD	2	D	946	946	100.0%
NO_2	Antelope Valley AQMD	1	D	49	49	100.0%
	Butte County AQMD	1	C	245	245	100.0%
	Feather River AQMD	1	C	245	245	100.0%
	Imperial County APCD	2	B	274	274	100.0%
	Mojave Desert AQMD	3	D	143	143	100.0%
	Monterey Bay Unified APCD	1	D	51	51	100.0%
	North Coast Unified AQMD	1	D	112	112	100.0%
	Placer County APCD	1	C	228	228	100.0%
	Sacramento Metropolitan AQMD	4	B	790	750	94.9%
	San Joaquin Valley Unified APCD	17	B	5,250	5,250	100.0%
	San Luis Obispo County APCD	2	D	698	698	100.0%

Table A4-4 (cont'd). 2020 Gaseous 1-pt QC checks – Individual Assessment on Prescribed Range for Local Air Districts Within CARB's PQAO

Pollutant	Geographic Area	Number of Instruments	Monitoring by (District=D, CARB=C, or Both=B)	Number of QC Checks Performed	Number of QC Checks Within Prescribed Range	% of QC Checks Within Prescribed Range
NO_2	Santa Barbara County APCD	2	D	1167	1144	98.0%
	Ventura County APCD	2	D	356	351	98.6%
	Yolo-Solano AQMD	15	C	252	252	100.0%
O_3	Amador County APCD	1	C	353	353	100.0%
	Antelope Valley AQMD	1	D	48	48	100.0%
	Butte County AQMD	2	C	584	584	100.0%
	Calaveras County APCD	1	C	361	361	100.0%
	Colusa County APCD	1	C	366	366	100.0%
	Eastern Kern APCD	1	C	279	279	100.0%
	El Dorado County AQMD	3	C	709	709	100.0%
	Feather River AQMD	2	C	453	453	100.0%
	Glenn County APCD	1	C	340	340	100.0%
	Great Basin Unified APCD	1	D	53	53	100.0%
	Imperial County APCD	4	B	329	329	100.0%
	Lake County APCD	1	D	51	51	100.0%
	Mariposa County APCD	1	C	205	205	100.0%
	Mendocino County AQMD	1	D	46	46	100.0%
	Mojave Desert AQMD	6	B	572	568	99.3%
	Monterey Bay Unified APCD	5	D	259	259	100.0%
	North Coast Unified AQMD	1	D	117	117	100.0%
	Northern Sierra AQMD	1	D	32	32	100.0%
	Northern Sonoma County APCD	1	D	NDA	NDA	NDA
	Placer County APCD	5	B	365	365	100.0%
	Sacramento Metropolitan AQMD	6	B	986	941	95.4%

Table A4-4 (cont'd). 2020 Gaseous 1-pt QC checks – Individual Assessment on Prescribed Range for Local Air Districts Within CARB's PQAO

Pollutant	Geographic Area	Number of Instruments	Monitoring by (District=D, CARB=C, or Both=B)	Number of QC Checks Performed	Number of QC Checks Within Prescribed Range	% of QC Checks Within Prescribed Range
O_3	San Joaquin Valley Unified APCD	23	B	7,050	7,050	100.0%
	San Luis Obispo County APCD	7	D	2,498	2,498	100.0%
	Santa Barbara County APCD	9	D	2,232	2,232	100.0%
	Shasta County AQMD	3	D	126	126	100.0%
	Siskiyou County APCD	1	D	28	28	100.0%
	Tehama County APCD	2	B	244	244	100.0%
	Tuolumne County APCD	1	C	350	350	100.0%
	Ventura County APCD	5	D	900	891	99.0%
	Yolo-Solano AQMD	3	B	344	344	100.0%
SO_2	Great Basin Unified APCD	1	D	49	49	100.0%
	Imperial County APCD	1	C	251	251	100.0%
	Mojave Desert AQMD	2	D	95	95	100.0%
	North Coast Unified AQMD	1	D	113	113	100.0%
	Sacramento Metropolitan AQMD	1	D	115	114	99.1%
	San Joaquin Valley Unified APCD	1	C	42	42	100.0%
	San Luis Obispo County APCD	1	D	363	363	100.0%
	Santa Barbara County APCD	1	D	353	332	97.3%

- Source: Air Quality System, AMP 251 QA Raw Assessment Report, run September 2020, except as noted in Appendix B.

Accuracy Validation via Performance Audits: To further validate bias estimates from 1-pt QC checks, CFR requires that independent performance audits be conducted and the average percent differences be evaluated against pre-determined criteria. COVID-19 Notably for 2020, the audit program was fully functional from January through mid-March before being curtailed for the remainder of the year under the constraints imposed by the COVID-19 pandemic. Following the guidance on priorities from the March 30th U.S. EPA memo (see details in Appendix C), the program was abbreviated to continuing in accordance with the federal mandate for PM and ozone only. All ozone monitors received an annual assessment, and audits during this period were not completed for CO, NO_2 and SO_2 gaseous monitors as a result of the regional stay-at-home order.

Table A5 summarizes the 2020 performance audit results for the gaseous criteria pollutants. Accuracy is represented as an average percent difference, which is the arithmetic mean of the combined differences from the known value of all the individual audit points. Audit results show that, in general, all audited gaseous instruments met CARB criteria for bias at the PQAO level. Table A6 shows performance audit data for local air districts within CARB's PQAO.

Performance audit results of ozone analyzers and available data of other gaseous instruments in 2020 corroborate what the QC checks revealed: that CARB's PQAO is providing accurate data for all gaseous pollutants. The average percent differences at the PQAO level were well below the audit criteria (±10 percent for ozone, ±15 percent for other gases) for all gaseous pollutants. This fact is further strengthened by the small number of audits that did not meet CARB performance audit criteria.

Table A5. 2020 Results for Performance Audits of Gaseous Pollutant Instruments

Pollutant	PQAO	Number of Instruments	Number of Instruments Audited	Number of Audits Not Meeting CARB Criteria	Avg % Diff.
CO	CARB	18	6*	1	-1.94
	BAAQMD	16	16	0	1.51
	SCAQMD	25	25	1	0.16
	SDCAPCD	2	2	0	-0.43
NO_2	CARB	40	8*	1	-7.06
	BAAQMD	18	18	0	-1.22
	SCAQMD	29	29	0	0.60
	SDCAPCD	9	8	0	-1.49
O_3	CARB	100	97	1	-1.52
	BAAQMD	20	20	0	-0.66
	SCAQMD	29	29	0	2.11
	SDCAPCD	7	7	0	-3.03
SO_2	CARB	9	2*	0	0.66
	BAAQMD	9	9	0	-1.31
	SCAQMD	4	4	0	-1.52
	SDCAPCD	1	1	0	-4.82

- * During the COVID-19 pandemic, following the guidance on priorities from U.S. EPA, CARB focused auditing activities on ozone and PM after mid-March 2020. See Appendix C for details.
- The CARB performance audit criteria for 2020 were: ±10% for O_3 and ±15% for CO, NO_2, and SO_2 for each audit point, with additional absolute differences in EPA audit levels 1&2 (see Appendix A for details). Since the two lowest audit points for trace CO/SO_2 are EPA audit levels 1 & 2 and lowest audit point for ozone is EPA audit level 2, they were not subjected to the AQDA process and were excluded.
- Further details on CARB's PQAO instruments not meeting these criteria can be viewed in Appendix B. Only audits conducted by CARB were subjected to the AQDA process.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run September 2020.

Table A6. 2020 Results for Performance Audits of Gaseous Pollutant Instruments for Local Air Districts within CARB's PQAO

Pollutant	Geographic Area	Monitoring by (District=D, CARB=C, or Both=B)	Number of Instruments	Number of Instruments Audited	Avg % Diff.
CO	Antelope Valley AQMD	D	1	1	-4.62
	Butte County AQMD	C	1	0	NDA
	Great Basin Unified APCD	D	1	0	NDA
	Imperial County APCD	B	1	1	-4.48
	Mojave Desert AQMD	D	2	2	-0.71
	Monterey Bay ARD	D	1	0	NDA
	North Coast Unified AQMD	D	1	0	NDA
	Sacramento Metropolitan AQMD	D	2	0	NDA
	San Joaquin Valley Unified APCD	B	6	2	3.51
	Santa Barbara County APCD	D	2	0	NDA
NO_2	Antelope Valley AQMD	D	1	1	-7.76
	Butte County AQMD	C	1	0	NDA
	Feather River AQMD	C	1	0	NDA
	Imperial County APCD	B	2	2	-21.92
	Mojave Desert AQMD	D	3	2	-3.83
	Monterey Bay ARD	D	1	0	NDA
	North Coast Unified AQMD	D	1	0	NDA
	Placer County APCD	C	1	0	NDA
	Sacramento Metropolitan AQMD	B	5	0	NDA
	San Joaquin Valley Unified APCD	B	17	3	0.91
	San Luis Obispo County APCD	D	2	0	NDA
	Santa Barbara County APCD	B	2	0	NDA
	Ventura County APCD	D	2	0	NDA
	Yolo-Solano AQMD	C	1	0	NDA
O_3	Amador County APCD	C	1	1	-3.52
	Antelope Valley AQMD	D	1	1	9.49
	Butte County AQMD	C	2	2	-6.23
	Calaveras County APCD	C	1	1	-6.39
	Colusa County APCD	C	1	1	-0.83
	Eastern Kern APCD	C	2	2	1.75
	El Dorado County AQMD	C	3	3	-3.25
	Feather River AQMD	C	2	2	-2.14
	Glenn County APCD	C	1	1	0.11
	Great Basin Unified APCD	D	1	1	-0.97
	Imperial County APCD	B	4	4	1.08
	Lake County APCD	D	1	1	-3.03

Table A6 (cont'd). 2020 Results for Performance Audits of Gaseous Pollutant Instruments for Local Air Districts within CARB's PQAO

Pollutant	Geographic Area	Monitoring by (District=D, CARB=C, or Both=B)	Number of Instruments	Number of Instruments Audited	Avg % Diff.
O_3	Mariposa County APCD	C	1	1	-1.19
	Mendocino County AQMD	D	1	1	-3.15
	Mojave Desert AQMD	B	6	6	0.65
	Monterey Bay ARD	D	5	5	-1.44
	North Coast Unified AQMD	D	1	1	-3.52
	Northern Sierra AQMD	B	1	1	4.22
	Northern Sonoma County APCD	D	1	1	NDA*
	Placer County APCD	B	5	5	-0.12
	Sacramento Metropolitan AQMD	B	6	4	-0.65
	San Joaquin Valley Unified APCD	B	23	23	-2.20
	San Luis Obispo County APCD	B	7	7	-1.87
	Santa Barbara County APCD	B	8	7	-0.84
	Shasta County AQMD	D	3	3	-4.11
	Siskiyou County APCD	D	1	1	-3.29
	Tehama County APCD	B	2	2	-3.27
	Tuolumne County APCD	C	1	1	2.43
	Ventura County APCD	D	5	5	-0.52
	Yolo-Solano AQMD	B	3	3	-3.71
SO_2	Great Basin APCD	D	1	0	NDA
	Imperial County APCD	C	1	1	-1.78
	Mojave Desert AQMD	D	2	1	4.74
	North Coast Unified AQMD	D	1	0	NDA
	Sacramento Metropolitan AQMD	D	1	0	NDA
	San Joaquin Valley Unified APCD	C	1	0	NDA
	San Luis Obispo County APCD	B	1	0	NDA
	Santa Barbara County APCD	D	1	0	NDA

- The CARB performance audit criteria for 2020 were: ±10% for O_3 and ±15% for CO, NO_2, and SO_2 for each audit point, with additional absolute differences in EPA audit levels 1&2 (see Appendix A for details). Since the two lowest audit points for trace CO/SO_2 are EPA audit levels 1 & 2 and lowest audit point for ozone is EPA audit level 2, they were not subjected to the AQDA process and were excluded.
- Further details on CARB's PQAO instruments not meeting these criteria can be viewed in Appendix B.
- NDA=No data available. During the COVID-19 pandemic, following the guidance on priorities from U.S. EPA, CARB focused auditing activities on ozone and PM after mid-March 2020. See Appendix C for details.
- *Data not in AQS due to audit being conducted after monitoring stopped.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run September 2020.

B. Particulate Matter

Particulate matter (PM) monitoring is conducted using both manual and continuous type samplers. Manual samplers are operated on a one-in-six-day or one-in-three-day sampling schedule for PM_{10}, and a similar, or more frequent schedule, for $PM_{2.5}$. Continuous samplers report hourly values.

Similar to the discussion of gaseous pollutants, ambient data capture is discussed first, followed with an assessment of the quality of the data captured.

Ambient Data Capture: Data capture, as described in this report, is derived from the AQS completeness report AMP 430. The calculated number in AMP 430 represents the average of the monthly data capture rates for the calendar year and may not always be indicative of whether the 75 percent regulatory completeness requirement[17] is met for a particular pollutant. Note that while this report discusses the data capture rate of at least 75 percent, CARB's goal is to have at least 85% of the data in AQS.

Table B1 presents the percentage of samplers that reported an ambient data capture rate of at least 75 percent for each PQAO. Table B2 displays similar information for each local air district within CARB's PQAO in which a PM sampler was operated. As can be seen in these tables, very few PM samplers within CARB's PQAO failed to report at least a 75 percent data capture rate for the indicated ambient PM data. PM ambient data were well captured in 2020.

Precision and Bias: PM is subject to formal measurement quality objectives (MQOs) in federal and State regulations. Appendix A of this report lists the MQOs stated in CFR and U.S. EPA guidance. For all methods of collecting PM_{10} and $PM_{2.5}$, Title 40 CFR Part 58 Appendix A specifies using the upper bound of CV to assess precision. This CV upper bound is not to exceed 10 percent. Collocated sampling is required to assess precision for manual PM_{10} and both manual and continuous $PM_{2.5}$ sampling. Each PQAO is required to have a certain number of collocated sites to represent its monitoring network. From each pair of collocated samplers, a minimum of 75 percent of ambient data is required to be in AQS.

[17] 40 CFR Part 50 states that the ambient data from a given instrument or sampler must be at least 75% complete in a calendar year to be included in making regulatory decisions, e.g. attainment of AAQS. California also defines data "completeness" using 75%. However, unlike the federal definition, California factors in the high season of the pollutant in the completeness criteria (e.g., only high ozone months are considered for ozone standard).

Table B1. 2018-2020 Ambient PM Data Capture Results

Pollutant	PQAO	Year	Number of Samplers	Number of Samplers Reporting ≥ 75% Data Capture	% of Samplers Reporting ≥ 75% Data Capture
PM_{10}	CARB	2020	98	95	97
		2019	101	100	99
		2018	101	99	98
	BAAQMD	2020	8	8	100
		2019	8	8	100
		2018	8	8	100
	SCAQMD	2020	34	9	26*
		2019	34	33	97
		2018	34	34	100
	SDCAPCD	2020	4	4	100
		2019	4	4	100
		2018	5	5	100
	NATIONAL	2020	600	540	90
		2019	641	617	96
		2018	666	640	96
$PM_{2.5}$	CARB	2020	101	96	95
		2019	88	87	99
		2018	89	86	97
	BAAQMD	2020	21	21	100
		2019	22	22	100
		2018	22	22	100
	SCAQMD	2020	31	31	100
		2019	31	31	100
		2018	33	33	100
	SDCAPCD	2020	6	6	100
		2019	7	7	100
		2018	7	6	86
	NATIONAL	2020	1,118	1,028	92
		2019	1,170	1,139	97
		2018	1,199	1,157	96

- Further details on CARB's PQAO samplers not reporting ≥ 75% ambient data can be viewed in Appendix B.
- National average includes state, county, district, National Park Service, and tribal sites, including those in California.
- *Low count resulted from the cessation of FRM Hi-Vol filter-based sampling and lab analyses for part of March and all of the second quarter of 2020 due to COVID-19 restrictions.
- Source: Air Quality System, AMP 430 Data Completeness Report, run September 2020, except as noted in Appendix B.
- Results reflect current information in AQS, including changes to past data since the 2019 Annual Data Quality Report. Therefore, results for 2019 and 2018 might differ from those in the 2019 DQ report.

For continuous PM_{10} samplers, bias is assessed using the monthly flow rate verifications and comparing the absolute bias upper bound against CFR criterion of ±4 percent difference. Detailed calculations are explained in U.S. EPA's *Guideline on the Meaning and the Use of Precision and Bias Data Required by 40 CFR Part 58 Appendix A*[18]. Total bias for each PQAO is also assessed through the Performance Evaluation Program run by U.S. EPA.

The accuracy of all particulate samplers is assessed via the semi-annual flow rate audit by comparing the instrument's flow rate to a certified orifice (PM_{10} and TSP), or a calibrated mass flow meter (TEOM, $PM_{2.5}$, and BAM samplers) that is certified against a National Institute of Standards and Technology traceable flow device or calibrator. As listed in Appendix A of this report, CARB's 2020 performance criteria, based on the average percent difference during a semi-annual flow rate audit, were ±7 percent for PM_{10} Hi-Vol, and ±4 percent for PM_{10} Low-Vol and $PM_{2.5}$.

Precision of the data is based on the standard deviation of the percent differences of the mass concentrations of the two identical or equivalent collocated samplers. At low concentrations, precision based on the measurements of collocated samplers may be relatively poor. For this reason, collocated measurement pairs are selected for use in the precision calculations only when both measurements are equal to or above the following limits: (1) PM_{10} (Hi-Vol): 15 µg/m^3; (2) PM_{10} (Lo-Vol): 3 µg/m^3; and (3) $PM_{2.5}$: 3 µg/m^3. The collocated pairs of data that meet these limits are then used to calculate the upper bound of CV as an estimate of precision at each site. Title 40 CFR requires that this upper bound of the CV not exceed 10 percent for both PM_{10} and $PM_{2.5}$ at the PQAO level. A detailed description of CV, including formulae for calculating it, can be found in U.S. EPA's *Guideline on the Meaning and the Use of Precision and Bias Data Required by 40 CFR Part 58 Appendix A.*

[18] https://nepis.epa.gov/Exe/ZyPDF.cgi/P1006PKU.PDF?Dockey=P1006PKU.PDF

Table B2. 2020 Ambient PM Data Capture Results for Local Air Districts Within CARB's PQAO

Pollutant	Geographic Area	Monitoring by (District=D, CARB=C, or Both=B)	Number of Samplers	Number of Samplers Reporting ≥ 75% Data	% of Samplers Reporting ≥ 75% Data
PM_{10}	Antelope Valley AQMD	D	1	1	100
	Butte County AQMD	C	1	1	100
	Calaveras County APCD	C	1	1	100
	Colusa County APCD	C	1	1	100
	Eastern Kern APCD	B	4	4	100
	El Dorado County AQMD	C	1	1	100
	Feather River AQMD	C	1	1	100
	Glenn County APCD	C	1	1	100
	Great Basin Unified APCD	D	19	18	95
	Imperial County APCD	B	5	5	100
	Lake County APCD	D	3	3	100
	Mariposa County APCD	C	1	1	100
	Mendocino County AQMD	D	1	1	100
	Mojave Desert AQMD	D	5	5	100
	Monterey Bay ARD	D	2	2	100
	North Coast Unified AQMD	D	1	1	100
	Northern Sonoma County APCD	D	3	3	100
	Placer County APCD	C	1	1	100
	Sacramento Metropolitan AQMD	B	5	5	100
	San Joaquin Valley Unified APCD	B	21	21	100
	San Luis Obispo County APCD	D	7	7	100
	Santa Barbara County APCD	B	4	4	100
	Shasta County AQMD	D	3	3	100
	Tehama County APCD	D	1	1	100
	Ventura County APCD	D	2	2	100
	Yolo-Solano AQMD	D	3	1	33
$PM_{2.5}$	Antelope Valley AQMD	D	1	1	100
	Butte County AQMD	C	1	1	100
	Calaveras County APCD	C	1	1	100
	Colusa County APCD	C	2	2	100
	Eastern Kern APCD	B	3	3	100
	Feather River AQMD	C	2	2	100
	Great Basin Unified APCD	D	7	6	86
	Imperial County APCD	B	5	5	100
	Lake County APCD	D	1	1	100
	Mendocino County AQMD	D	2	2	100

Table B2 (cont'd). 2020 Ambient PM Data Capture Results for Local Air Districts Within CARB's PQAO

Pollutant	Geographic Area	Monitoring by (District=D, CARB=C, or Both=B)	Number of Samplers	Number of Samplers Reporting ≥ 75% Data	% of Samplers Reporting ≥ 75% Data
$PM_{2.5}$	Mojave Desert AQMD	D	2	2	100
	Monterey Bay ARD	D	6	6	100
	North Coast Unified AQMD	D	1	1	100
	Northern Sierra AQMD	D	6	4	67
	Placer County APCD	B	4	4	100
	Sacramento Metropolitan AQMD	B	10	9	90
	San Joaquin Valley Unified APCD	B	28	28	100
	San Luis Obispo County APCD	D	4	4	100
	Santa Barbara County APCD	B	4	4	100
	Shasta County AQMD	D	2	2	100
	Siskiyou County APCD	D	1	1	100
	Tehama County APCD	D	1	1	100
	Ventura County APCD	D	6	6	100
	Yolo-Solano AQMD	D	1	0	0

- Further details on CARB's PQAO samplers not reporting ≥ 75% ambient data can be viewed in Appendix B.
- Source: Air Quality System, AMP 430 Data Completeness Report, run September 2020, except as noted in Appendix B.

A discussion of collocated sampling for both PM_{10} and $PM_{2.5}$ can be found in CARB's *Annual Network Plan Covering Monitoring Operations in 25 California Air Districts, July 2021.*[19] As indicated there, CARB's PQAO continued meeting the 15 percent minimum collocation requirement in 2020 for both PM_{10} and $PM_{2.5}$. Table B3 shows the number of sites with collocated precision data reported in respective years. Note that due to limited data[20] for CARB's PQAO in 2020, lead (Pb) is not discussed herein.

Precision Results: For the reported collocated sites, CFR requires that 30 paired observations per year be collected from each site with collocated samplers operating the entire year. Table B3 displays precision percent completeness (measured as a percent of the collected samples over the required number of observations) in addition to the CV upper bound. Information for years 2018 and 2019 are provided for

[19] https://ww2.arb.ca.gov/sites/default/files/2021-07/2021%20Annual%20Network%20Plan_1.pdf

[20] There is one Pb monitor in the CARB'S PQAO, located at the Sacramento-Del Paso Manor. However, Pb collocation for NCore sites is addressed by U.S. EPA at the national level. Thus, CARB is not required to collocate for lead at the NCore sites.

historical perspectives. Three-year PQAO averages are also included. A few highlights include:

- For the five PM_{10} and 16 $PM_{2.5}$ pairs of collocated samplers that were present within CARB's PQAO, all reported at least 75 percent of the required precision data in 2020.
- For PM_{10}, with the exception of one geographic area, the CV was below 10 percent in CARB's PQAO (as well as other California PQAOs).
- For $PM_{2.5}$, CARB met the 10 percent CV requirement at the PQAO level for three of seven methods of collection (methods 143, 145 and 209) – an improvement over 2019 results. Overall, CV results are lower than those from previous years.

Table B3. 2018-2020 Precision Results Based on Available Collocated PM Samplers

Pollutant	PQAO	Year	Method Code	Number Pairs of Collocated Samplers Reported	% Precision Completeness	Upper Bound of Coefficient of Variation	CFR Criteria for Precision Met?
PM_{10}	CARB	2020	ALL	5	100	**20.02**	No
		2019	ALL	5	100	19.02	No
		2018	ALL	5	100	21.19	No
		Avg			100	19.60	No
	BAAQMD	2020	ALL	1	100	3.91	Yes
		2019	ALL	1	100	3.97	Yes
		2018	ALL	1	100	5.23	Yes
		Avg			100	3.99	Yes
	SCAQMD	2020	ALL	3	100	5.50	Yes
		2019	ALL	3	100	9.45	Yes
		2018	ALL	3	100	9.56	Yes
		Avg			100	8.46	Yes
	SDCAPCD	2020	ALL	1	100	3.10	Yes
		2019	ALL	1	100	5.09	Yes
		2018	ALL	1	100	3.32	Yes
		Avg			100	3.66	Yes
	NATIONAL	2020	ALL	83	98	8.76	Yes
		2019	ALL	97	99	10.53	No
		2018	ALL	114	98	9.24	Yes
$PM_{2.5}$	CARB	2020	143	1	82	3.05	Yes
		2019	143	1	100	3.23	Yes
		2018	143	1	93	3.64	Yes
		2020	145	4	92	4.83	Yes
		2019	145	4	87	8.27	Yes
		2018	145	4	71	11.40	No

Table B3 (cont'd). 2018-2020 Precision Results Based on Available Collocated PM Samplers

Pollutant	PQAO	Year	Method Code	Number Pairs of Collocated Samplers Reported	% Precision Complete-ness	Upper Bound of Coefficient of Variation	CFR Criteria for Precision Met?
$PM_{2.5}$	CARB	2020	170	7	100	**11.39**	No
		2019	170	7	100	12.03	No
		2018	170	6	100	17.15	No
		2020	181	1	100	**10.68**	No
		2019	181	1	100	11.07	No
		2018	181	1	100	15.98	No
		2020	204	1	100	**14.61**	No
		2019	204	3	100	12.80	No
		2018	204	3	100	9.91	Yes
		2020	209	1	100	7.88	Yes
		2019	209	1	13	16.06	No
		2018	209	Not collected	Not collected	Not collected	Not collected
		2020	238	1	100	**25.53**	No
		2019	238	1	100	13.99	No
		2018	238	1	100	21.82	No
	BAAQMD	2020	170	3	100	**10.53**	No
		2019	170	3	100	12.84	No
		2018	170	2	100	11.65	No
	SCAQMD	2020	143	1	100	2.26	Yes
		2019	143	1	100	3.09	Yes
		2018	143	1	100	3.24	Yes
		2020	145	3	100	6.10	Yes
		2019	145	3	100	5.40	Yes
		2018	145	3	100	6.88	Yes
		2020	155	1	20	1.83	Yes
		2019	155	1	100	4.48	Yes
		2018	155	2	100	5.09	Yes
	SDCAPCD	2020	145	Not collected	Not collected	Not collected	Not collected
		2019	145	1	100	2.98	Yes
		2018	145	1	100	3.66	Yes
		2020	545	1	100	2.86	Yes
		2019	545	1	70	7.92	Yes
		2018	545	Not collected	Not collected	Not collected	Not collected
	NATIONAL	2020	117	1	100	8.10	Yes
		2019	117	1	100	17.93	No
		2018	117	1	100	3.83	Yes
		2020	143	8	90	7.94	Yes
		2019	143	9	94	6.21	Yes
		2018	143	9	98	7.03	Yes

Table B3 (cont'd). 2018-2020 Precision Results Based on Available Collocated PM Samplers

Pollutant	PQAO	Year	Method Code	Number Pairs of Collocated Samplers Reported	% Precision Completeness	Upper Bound of Coefficient of Variation	CFR Criteria for Precision Met?
$PM_{2.5}$	NATIONAL	2020	145	92	96	9.54	Yes
		2019	145	100	97	7.94	Yes
		2018	145	126	99	9.27	Yes
		2020	170	53	98	**16.75**	No
		2019	170	60	97	15.00	No
		2018	170	62	99	16.93	No
		2020	181	2	100	**10.74**	No
		2019	181	3	100	10.33	No
		2018	181	3	100	11.62	No
		2020	204	2	100	**28.51**	No
		2019	204	4	100	14.94	No
		2018	204	7	98	16.80	No
		2020	238	20	98	**13.07**	No
		2019	238	16	87	13.45	No
		2018	238	9	90	13.59	No
		2020	545	5	100	8.29	Yes
		2019	545	5	93	6.99	No
		2018	545	2	54	4.87	Yes

- CFR Limit is a coefficient of variation of ≤ 10% for PM. Percent precision completeness is based on data collected from collocated samples. Further details on CARB's PQAO samplers not meeting these criteria can be found in Appendix B.
- Method 117 = R & P Model 2000 PM2.5 Sampler w/WINS; Method 118= R & P Model 2025 PM2.5 Sequential w/WINS; Method 120= Andersen RAAS2.5-300 PM2.5 SEQ w/WINS; Method 143= R & P Model 2000 PM2.5 Sampler w/VSCC; Method 145= R & P Model 2025 PM2.5 Sequential Air Sampler w/VSCC; Method 155=Thermo RAAS2.5-300 w/VSCC; Method 170= Met One BAM-1020 Mass Monitor w/VSCC; Method 181=Thermo TEOM 1400a FDMS, Method 204=Teledyne Model 602 Beta plus w/VSCC, Method 209=Met One BAM-1022 Real Time Beta Attenuation Mass Monitor, Method 238=T640X Mass Monitor, Method 545=Met One E-SEQ-FRM with VSCC.
- ***Bold underlined*** font indicates CV greater than 10% in 2020 while underlined normal font indicates CV greater than 10% in 2018 or 2019.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report (Collocation Summary), run September 2020.
- National average includes state, county, district, National Park Service, and tribal sites, including those in California.
- Results reflect current information in AQS, including changes to past data since the 2019 Annual Data Quality Report. Therefore, results for 2019 and 2018 might differ from those in the 2019 DQ report.

Table B4 breaks down the statistics displayed in Table B3 under CARB's PQAO by local air districts. Monitoring sites within these areas may be operated by the district, CARB, or both. All areas reported at least 75 percent of the required precision data. The upper bound CV was met in all districts for PM_{10} with the exception of Great Basin. However, the CV for $PM_{2.5}$ is exceeded at all districts with few exceptions. Sites with $PM_{2.5}$ CV upper bound below 10 percent are in the following districts: Imperial County APCD, Mojave Desert AQMD, Northern Sierra AQMD, Placer County APCD, Sacramento Metro AQMD, San Joaquin Valley APCD (for some sites, not all), and Ventura County APCD. In all instances except two, identical methods were collocated at the sites that achieved the CV criteria. Note that more collocated locations (though in slightly different areas) achieved the CV limit for $PM_{2.5}$ in 2020 compared to 2019.

Table B4. 2020 Precision Results for Districts within CARB's PQAO

Pollutant	Geographic Area	Method Code (Primary/ Secondary)	Monitoring by (District=D, CARB=C)	% Precision Completeness	Upper Bound of Coefficient of Variation (CV)
PM_{10}	Great Basin Unified APCD	All	D D	100 100	***12.09*** 9.36
	Sacramento Metro AQMD	All	D	100	4.60
	San Joaquin Valley APCD	All	D C	100 93	2.75 21.64
$PM_{2.5}$	Great Basin Unified APCD	181/145 238/145	D D	100 100	***10.68*** ***25.53***
	Imperial County APCD	145/145	C	93	2.93
	Mojave Desert AQMD	170/170	D	100	9.66
	Monterey Bay ARD	170/143	D	100	***13.40***
	Northern Sierra AQMD	145/145	D	83	*3.42*
	Placer County APCD	143/143	C	82	3.05
	Sacramento Metro AQMD	145/145	D	93	6.31
	San Joaquin Valley APCD	145/145 170/143 170/170 170/145 170/145 204/145 209/145	C C C D D D D	100 87 100 97 100 100 100	6.65 **12.50** **10.31** **12.36** 7.92 **14.61** 7.88
	Ventura County APCD	170/170	D	100	8.14

- CFR Limit for CV is 10% for PM. Further details on CARB's PQAO samplers not meeting these criteria can be viewed in Appendix B.
- ***Bold italicized*** font indicates CV greater than 10% in 2020.
- Method 143= R & P Model 2000 $PM_{2.5}$ Sampler w/VSCC; Method 145= R & P Model 2025 $PM_{2.5}$ Sequential Air Sampler w/VSCC; Method 155=Thermo RAAS2.5-300 w/VSCC; Method 170= Met One BAM-1020 Mass Monitor w/VSCC; Method 181=Thermo TEOM 1400a FDMS, Method 204=Teledyne Model 602 Beta plus w/VSCC, Method 209=Met One BAM-1022 Real Time Beta Attenuation Mass Monitor,Method 238=T640X Mass Monitor.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report (Collocation Detail Report), run September 2020.

It is noteworthy that the high CV problem exists at the national level as well as within the CARB'S PQAO. CARB has continued exploring the potential causes behind low $PM_{2.5}$ precision among some of the collocated $PM_{2.5}$ samplers within CARB's PQAO. The empirical analysis includes the evaluation of multiple years of data and a breakdown of results based on monitors that use federal reference (FRM) vs federal equivalent (FEM) methods. While no definitive source of the issue has been identified as a key contributing factor to the imprecision, monitoring agencies are encouraged to closely examine operational practices in order to help the PQAO achieve the precision criteria for PM. During technical system audits, operational practices or other factors that may influence the low precision are often examined.

In addition, CARB provided comments on the PM monitoring portions of 40 CFR Part 58 to U.S. EPA's Office of Air Quality Planning and Standards (OAQPS) in support of the draft PM Policy Assessment in 2019. Specifically, feedback included the challenges of meeting PM2.5 precision requirements and a recommendation to add flexibility to the FEM to FRM collocation requirement. OAQPS included this feedback in their development of the PM Policy Assessment. While OAQPS is not planning to include technical changes to parts 53 and 58 on the PM NAAQS proposal, they have also conducted a national analysis on PM2.5 method data quality information (including precision) that will inform the PM Policy Assessment.

Bias Results via Monthly Flow Rate Verifications: Starting in April 2018, flow rate verification data are required to be in AQS for all PM samplers. 2019 was the first year when this requirement was in effect for the entire 12-month period; hence, a 3-year average for 2018-2020 would not be appropriate. Bias results via the monthly flow rate verifications for all PM samplers in 2020 and for continuous PM_{10} samplers in 2018 and 2019 are shown in Table B5. Note that almost all of CARB's PM_{10} and $PM_{2.5}$ samplers reported FRV data to AQS in 2020 as well as 2019. In summary, the bias criteria of ± 7 percent for PM_{10} and ± 4 percent for $PM_{2.5}$ were met in each PQAO for which data are available. This finding is consistent across PQAOs with available data in the past three years.

Table B5. 2018-2020 PM_{10} and $PM_{2.5}$ Bias Results Based on Flow Rate Verifications

Pollutant	PQAO	Year	Type	Number of Samplers in Network	Number of Reported Flow Rate Verifications	Number of Required Flow Rate Verifications	Avg % Diff.	Bias (%)	CFR Criteria for Bias Met?
PM_{10}	CARB	2020	Hi-Vol	21	259	137	0.14	±3.90	Yes
		2019		22	229	142	0.40	±3.79	Yes
		2018		23	250	144	-0.10	±4.53	Yes
	BAAQMD	2020		7	0	24	NDA	NDA	NDA
		2019		6	0	28	NDA	NDA	NDA
		2018		8	0	27	NDA	NDA	NDA
	SCAQMD	2020		25	235	100	-0.43	±3.20	Yes
		2019		24	277	96	-0.66	±3.25	Yes
		2018		25	227	100	-0.68	±2.95	Yes
	SDCAPCD	2020		NDA	NDA	NDA	NDA	NDA	NDA
		2019		3	46	12	0.98	±2.48	Yes
		2018		4	48	16	0.94	±2.53	Yes
	CARB	2020	Low-Vol	77	1,411	899	-0.02	±1.04	Yes
		2019		81	1,377	912	-0.26	±1.12	Yes
		2018*		80	1,491	943	-0.24	±1.27	Yes
	BAAQMD	2020		1	0	12	N/A	N/A	N/A
		2019		1	0	12	N/A	N/A	N/A
		2018*		1	0	12	N/A	N/A	N/A
	SCAQMD	2020		9	150	108	-0.02	±1.39	Yes
		2019		11	185	111	0.26	±4.08	Yes
		2018*		9	168	108	-0.19	±2.11	Yes
	SDCAPCD	2020		4	57	48	0.23	±0.94	Yes
		2019		1	14	12	-0.42	±1.28	Yes
		2018*		1	12	12	0.97	±1.85	Yes

Table B5 (cont'd). 2018-2020 PM_{10} and $PM_{2.5}$ Bias Results Based on Flow Rate Verifications

Pollutant	PQAO	Year	Type	Number of Samplers in Network	Number of Reported Flow Rate Verifications	Number of Required Flow Rate Verifications	Avg % Diff.	Bias (%)	CFR Criteria for Bias Met?
$PM_{2.5}$	CARB	2020	All	101	1,718	1,057	0.00	±0.94	Yes
		2019	All	89	1,627	1,030	-0.16	±0.99	Yes
		2018	All	90	1,603	1,043	-0.13	±1.06	Yes
	BAAQMD	2020	All	21	12	252	0.50	±0.83	Yes
		2019	All	22	35	262	0.24	±1.21	Yes
		2018	All	22	33	249	0.16	±1.00	Yes
	SCAQMD	2020	All	31	398	361	-0.76	±1.53	Yes
		2019	All	31	412	372	-0.40	±1.60	Yes
		2018	All	34	458	390	-0.21	±1.18	Yes
	SDCAPCD	2020	All	6	81	72	-0.06	±1.08	Yes
		2019	All	7	106	79	-0.32	±1.10	Yes
		2018	All	7	99	74	-0.20	±1.13	Yes

- *Flow rate verifications available for continuous PM methods only in 2018 in this table.
- NDA=No data available in AQS.
- Three-year average not available since 2019 was the first year of full implementation for reporting of FRV data to AQS.
- CFR criteria for PM_{10} bias: ±7% (of standard) except for dichotomous samplers, which are subjected to ±4%, same as criteria for $PM_{2.5}$.
- Further details on CARB's PQAO samplers not uploading the required flow rate data can be viewed in Appendix B.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run September 2020.
- Results reflect current information in AQS, including changes to past data since the 2019 Annual Data Quality Report. Therefore, results for 2019 and 2018 might differ from those in the 2019 DQ report.
- † According to Bay Area AQMD, FRV were performed and were within the acceptable criteria, but they were not uploaded to AQS due to a lack of resources.

Accuracy Validation via Performance Audits: Since an accurate measurement of PM is dependent upon the flow rate, CARB and other PQAOs are required to conduct semi-annual flow rate audits on all PM samplers at each site. Such audits are to be conducted five to seven months apart on each sampler in a given calendar year. In addition, as explained earlier, PQAOs are also required to submit the continuous PM_{10} monthly flow rate verifications to AQS; in this case, bias estimates based on flow rate verifications are further verified using the semi-annual flow rate audit data.

For 2020, the performance audit program was fully functional from January through mid-March before being curtailed for the remainder of the year under the constraints imposed by the pandemic. Following the guidance on priorities from the March 30th U.S. EPA memo (see Appendix C), the program was abbreviated to continuing in accordance with the federal mandate for PM and ozone only. All PM monitors, with a few exceptions, received a semi-annual assessment. Unfortunately, not all PM assessments met the criteria of being five to seven months apart. A few PM audits for Lake County APCD and Sacramento AQMD could not have the second semi-annual flow rate audits performed as a result of the regional stay-at-home order.

Table B6 summarizes the 2020 performance audit results for PM samplers. The numbers of samplers as well as those that met the required number of audits in 2020 are displayed. (Two audits are required if a sampler operates more than seven months; one audit if less than seven months but more than three months, zero if less than three months.) The average percent difference between the sampler flow rates and the audit flow rates represents the arithmetic mean of the combined differences from the certified value of all the individual audit points for each sampler. Table B7 presents similar data for local air districts within CARB's PQAO. Note that in 2020, due to limited operations during the COVID-19 pandemic, some flow rate audits were not conducted five to seven months apart. There were also instances where the second audit could not be performed during the shutdown in December 2020. See Appendix B for details.

CARB conducts the semi-annual flow rate audits for most samplers operating within CARB's PQAO. In addition, certain local districts within CARB's PQAO were allowed to conduct their own audits in 2020, per the agreed-upon "Roles and Responsibilities" documents.[21] For example, Great Basin Unified APCD conducts one of the semi-annual flow rate audits for the sites operating within its jurisdiction. Non-CARB'S PQAOs are responsible for performing their own audits as part of the annual performance evaluation program.

Overall, the results of the audited samplers indicate that the PM samplers in the network were operating within CARB's and U.S. EPA's flow rate audit criteria. Flow rate audit results agree with bias estimates based on the flow rate verifications under CARB's PQAO, further validating that the PM samplers were operating accurately.

[21] https://arb.ca.gov/aaqm/qa/pqao/repository/rr_docs.htm

Table B6. 2020 Results for Particulate Sampler Performance Audits

Pollutant	Collection Method	PQAO	Number of Samplers	Number of Samplers Meeting Required Number of Audits	Number of Flow Rate Audits Not Meeting CARB Criteria *	Avg % Diff.
PM_{10}	Hi-Vol	CARB	21	21	2	2.08
		BAAQMD	7	7	0	1.97
		SCAQMD	25	7	0	0.52
		SDCAPCD	0	NDA	NDA	NDA
	Low-Vol**	CARB	77	76	3	-0.66
		BAAQMD	1	1	0	-0.24
		SCAQMD	9	8	0	0.10
		SDCAPCD	4	3	0	-0.36
$PM_{2.5}$	ALL	CARB	101	100	7	-0.35
		BAAQMD	21	20	0	0.42
		SCAQMD	31	31	0	-0.53
		SDCAPCD	6	4	0	-0.96

- *AQDAs were issued for audits not meeting criteria. Only audits conducted by CARB were subjected to the AQDA process. Only flow failures are included in this table.
- **Count of low-volume (Low-Vol) samplers includes continuous BAM samplers.
- Sites might be audited multiple times in a quarter (by different entities or due to re-audits.)
- CARB's flow rate audit criteria for 2020 were ±7% for PM_{10} Hi-Vol and ±4% for PM_{10} Low-Vol and $PM_{2.5}$. Further details on CARB's PQAO samplers not meeting these criteria can be found in Appendix B.
- NDA=No data available (due to no monitoring at SD).
- Further details on CARB'S PQAO samplers not meeting these criteria can be viewed in Appendix B.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run September 2020, except as noted in Appendix B.

Table B7. 2020 Results for Particulate Sampler Flow Rate Audits for Local Air Districts Within CARB's PQAO

Pollutant	Geographic Area	Monitoring by (District=D, CARB=C, or Both=B)	Number of Samplers	Number of Samplers not Audited	Number of Flow Rate Audits Not Meeting CARB Criteria	Avg % Diff.
PM_{10}	Antelope Valley AQMD	D	1	0	0	-1.12
	Butte County AQMD	C	1	0	0	0.18
	Calaveras County APCD	C	1	0	0	-0.39
	Colusa County APCD	C	1	0	0	-0.38
	Eastern Kern APCD	D	4	0	0	-1.15
	El Dorado County AQMD	C	1	0	0	-2.05
	Feather River AQMD	C	1	0	0	1.21
	Glenn County APCD	C	1	0	0	-0.68
	Great Basin Unified APCD	D	19	0	0	-0.80
	Imperial County APCD	D	5	0	0	-0.72
	Lake County APCD	D	3	0	0	-0.21
	Mariposa County APCD	C	1	0	0	-1.24
	Mendocino County AQMD	D	1	0	0	-1.21
	Mojave Desert AQMD	D	5	0	0	-0.97
	Monterey Bay ARD	D	2	0	0	-0.43
	North Coast Unified AQMD	D	1	0	0	-1.82
	Northern Sonoma County APCD	D	3	0	0	-0.29
	Placer County APCD	B	1	0	0	0.94
	Sacramento Metropolitan AQMD	B	5	0	0	2.49
	San Joaquin Valley Unified APCD	B	21	1*	0	0.43
	San Luis Obispo County APCD	D	7	0	0	-0.83
	Santa Barbara County APCD	B	4	0	0	-0.12
	Shasta County AQMD	D	3	0	0	4.31
	Tehama County APCD	D	1	0	0	2.61
	Ventura County APCD	D	2	0	0	-0.04
	Yolo-Solano AQMD	B	3	0	5	-0.32
$PM_{2.5}$	Antelope Valley AQMD	D	1	0	0	-1.40
	Butte County AQMD	C	1	0	0	1.27
	Calaveras County APCD	C	1	0	0	0.42
	Colusa County APCD	C	2	0	2	2.22
	Eastern Kern APCD	D	3	0	0	-1.41

Table B7 (cont'd). 2020 Results for Particulate Sampler Flow Rate Audits for Local Air Districts Within CARB's PQAO

Pollutant	Geographic Area	Monitoring by (District=D, CARB=C, or Both=B)	Number of Samplers	Number of Samplers not Audited	Number of Flow Rate Audits Not Meeting CARB Criteria	Avg % Diff.
$PM_{2.5}$	Feather River AQMD	C	2	0	0	1.09
	Great Basin Unified APCD	D	7	0	0	-0.68
	Imperial County APCD	D	5	0	0	0.00
	Lake County APCD	D	1	0	0	-1.01
	Mendocino County AQMD	D	2	0	0	-1.05
	Mojave Desert AQMD	D	2	0	0	-1.07
	Monterey Bay ARD	D	7	0	0	-0.16
	North Coast Unified AQMD	D	1	0	0	2.74
	Northern Sierra AQMD	D	6	0	1	-1.21
	Placer County APCD	B	4	0	1	-0.47
	Sacramento Metropolitan AQMD	B	10	0	0	-0.60
	San Joaquin Valley Unified APCD	B	27	1*	0	-0.31
	San Luis Obispo County APCD	D	4	0	0	-0.88
	Santa Barbara County APCD	B	4	0	0	0.01
	Shasta County AQMD	D	2	0	1	-0.12
	Siskiyou County APCD	D	1	0	1	-0.36
	Tehama County APCD	D	1	0	0	0.16
	Ventura County APCD	D	6	0	0	-0.11
	Yolo-Solano AQMD	B	1	0	1	-0.36

- *Further details on CARB's PQAO samplers not being audited or not meeting audit criteria can be viewed in Appendix B.
- CARB's flow rate audit criteria for 2020 were ±7% for PM_{10} Hi-Vol and ±4% for PM_{10} Low-Vol and $PM_{2.5}$. Only audits conducted by CARB were subjected to the AQDA process. Further details on CARB's PQAO samplers not meeting these criteria can be found in Appendix B. Only flow failures are included in this table.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run September 2020, except as noted in Appendix B.

Network Bias Results via PEP Audits: As noted earlier, $PM_{2.5}$ samplers are subjected to the national Performance Evaluation Program (PEP) audit program to assess "total bias" of the network. In general terms, a performance evaluation is a type of audit in which the quantitative data generated in a measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of the analyst or laboratory. In the case of the PEP, the goal is to evaluate total measurement system bias, which includes measurement uncertainties from both field and laboratory activities. Performance evaluations are performed on the SLAMS monitors annually within each PQAO. For PQAOs with less than 5 monitoring sites, five valid PEP audits are collected; for PQAOS with more than 5 sites, eight valid audits are required. A PEP audit is valid when both primary monitor and PEP audit concentrations are above 3 $\mu g/m^3$. Each year, every designated FRM or FEM monitor within a PQAO must: 1) have each method designation evaluated; and 2) have all FRM or FEM samplers subject to a PEP audit at least once every six years, which equates to approximately 15 percent of the sites audited each year. Results from 2020 PEP audits are presented in Table B8, with results from previous two years and 3-year average presented to assess trends. CARB's PQAO has low "total" bias in its $PM_{2.5}$ network in 2020 as well as over the 3-year period 2018-2020. Similar information for other PQAOs in California are also presented in Table B8. Since PEP is intended to evaluate the bias at the network level, no breakdown of results by district is presented.

Results from 2020 indicate the $PM_{2.5}$ network for CARB's PQAO has low total bias, consistent with the bias results that were evaluated via flow rate verifications and flow rate audits – an improvement over 2019 results.

Table B8. 2018-2020 Total Bias Results via PEP Audits

Pollutant	PQAO	Year	Number of Samplers	Number of Audits Required	Number of Audits Collected	% Complete	Bias
$PM_{2.5}$	CARB	2020	72	8	8	100	-1.20
		2019	70	8	7	88	-11.26
		2018	73	8	5	63	-6.32
		SUMMARY					-6.26
	BAAQMD	2020	17	8	9	100	-4.09
		2019	17	8	5	63	0.15
		2018	18	8	8	100	2.17
		SUMMARY					-0.59
	SCAQMD	2020	19	8	7	88	-5.78
		2019	19	8	7	88	-15.89
		2018	19	8	6	75	-5.60
		SUMMARY					-9.09
	SDCAPCD	2020	5	5	4	80	5.39
		2019	4	5	5	100	1.12
		2018	3	5	4	80	-5.74
		SUMMARY					0.26

- Number of samplers refers to monitors designated as "primary" in AQS.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run September 2020.
- Performance audit criteria: < ±10% for $PM_{2.5}$.

IV. CONCLUSIONS AND RECOMMENDATIONS

This report provides ambient air quality data producers and users with a centralized review of the data quality within CARB's PQAO with respect to MQOs. In addition, comparisons to other PQAOs in California and the national average are shown where appropriate.

Below are some highlights for 2020.

Gaseous Pollutants (CO, O_3, NO_2, and SO_2)

- Ninety-seven percent of the instruments operating under CARB's PQAO achieved the ambient data capture rate of at least 75 percent in 2020. Ninety-four percent also met CARB's goal of at least 85 percent data capture.
- Ninety-nine percent of the instruments operating within CARB's PQAO reported at least 75 percent of the required 1-pt QC checks for the gaseous pollutants. Individual QC checks were assessed according to the new critical criteria set in 2018, which were met by most instruments; monitoring organizations have been encouraged to closely monitor the ranges of these checks to ensure they are conducted within the prescribed ranges.
- All of the California PQAOs met the CFR criteria for precision and bias based on 1-pt QC checks.
- Based on data collected on ozone analyzers and limited data on other gaseous instruments, the performance audit acceptance criteria were met, on average, at the PQAO level for CARB's PQAO (as well as other PQAOs) with only a small number of analyzers not passing performance audit criteria. This validates the bias estimates based on 1-pt QC checks, which showed that the gaseous network generally exhibits a high level of accuracy.

<u>Recommendation – Gaseous Program</u>

- Although MQOs associated with the gaseous instruments were met at the PQAO level, there were a few instances of analyzers not meeting the MQO (e.g., ambient data capture rate, submittal of required QC checks, etc.). Monitoring agencies should investigate why these objectives were not met for each analyzer in their respective jurisdictions and develop corrective actions, if appropriate, to meet them in subsequent years.

Particulate Matter (PM_{10} and $PM_{2.5}$)

- Ninety-six percent of the particulate samplers operating under CARB's PQAO achieved the ambient data capture rate of at least 75 percent in 2020. Ninety-three percent also met CARB's goal of at least 85 percent data capture.

- As indicated in CARB's *Annual Network Plan Covering Operations in 25 California Air Districts, July 2021*, CARB's PQAO continues to meet the minimum collocation requirement.
- For the five PM_{10} and 16 $PM_{2.5}$ pairs of collocated samplers that were present within CARB's PQAO, all reported at least 75 percent of the required precision data in 2020.
- For PM_{10}, with the exception of one geographic area, the CV was below 10 percent in CARB's PQAO (as well as other California PQAOs).
- For $PM_{2.5}$, CARB met the 10 percent CV requirement at the PQAO level for three of seven methods of collection (methods 143, 145 and 209), as shown in Table IV-1. Overall, precision results are slightly improving compared to previous years.

Table IV-1. 2020 Precision Assessment for $PM_{2.5}$ Methods Used by CARB

PQAO	Method 143	Method 145	Method 170	Method 181	Method 204	Method 209	Method 238
CARB	✓	✓	X	X	X	✓	X
BAAQMD	-----	-----	X	-----	-----	-----	
SCAQMD	✓	✓	-----	-----	-----	-----	
SDCAPCD	-----	**NDA**	-----	-----	-----	-----	

Dashed marks (----) = method not applicable to PQAO; X = No; and ✓ = Yes. NDA=No data available.

- Almost all PM_{10} and $PM_{2.5}$ samplers reported flow rate verification data to AQS, and the results indicate that the PM network exhibited low bias.
- Flow rate audit data indicate that CARB's PQAO met CARB criteria. This finding is consistent with the bias information from the routine flow rate verification data.
- PEP audits based on mass samples conducted indicate moderate total bias for the PM2.5 network, slightly higher than the bias results via flow rate verification and flow rate audits.

<u>Recommendations – PM Program</u>

- There were instances of samplers not meeting the MQOs (e.g., ambient data capture rate, submittal of required collocated measurements, etc). Monitoring agencies should investigate why these objectives were not met for each sampler in their respective jurisdictions and develop corrective actions, if appropriate, to meet them in subsequent years.

- In terms of precision, CV values among collocated $PM_{2.5}$ samplers remain somewhat high in 2020 within CARB's PQAO and generally on a national basis. CARB has continued exploring the potential causes behind low $PM_{2.5}$ precision among some of the collocated $PM_{2.5}$ samplers within CARB's PQAO. The empirical analysis includes the evaluation of multiple years of data and a

breakdown of results based on monitors that use federal reference vs federal equivalent methods. While no definitive source of imprecision has been identified, staff has begun a discussion with monitoring agencies to closely examine operational practices in order to help the PQAO achieve the precision criteria for PM. In addition, CARB provided comments on the PM monitoring portions of 40 CFR Part 58 to U.S. EPA's Office of Air Quality Planning and Standards (OAQPS) in support of the draft PM Policy Assessment in 2019. Specifically, feedback included the challenges of meeting PM2.5 precision requirements and a recommendation to add flexibility to the FEM to FRM collocation requirement. OAQPS included this feedback in their development of the PM Policy Assessment. While OAQPS is not planning to include technical changes to parts 53 and 58 on the PM NAAQS proposal, they have also conducted a national analysis on PM2.5 method data quality information (including precision) that will inform the PM Policy Assessment.

Summary of Results

In an effort to compare 2020 data quality results across geographic areas within California, results for both gases and PM are summarized in one composite Table IV-2. To make a fair comparison, we divided the geographic areas into three categories according to monitoring activities: 1) gas only; 2) gas and PM without collocation; and 3) gas and PM with collocation. Below are some key observations for CARB's PQAO in 2020:

- There are two areas that monitored gases only, and both achieved all MQOs.
- Among 19 areas that monitored gases and PM without collocation, 12 met all MQOs, 4 met MQOs for gases only, and 3 met MQOs for PM.
- Among nine areas that monitored gases and PM with collocation, one achieved all MQOs.

In Table IV-2, a green "Y" indicates that all monitors within a given geographic area have met the MQOs while a red "N" indicates otherwise. In some instances, one instrument may be responsible for several "N" marks due to its malfunctioning (details are in Appendix B). The reader should keep in mind that MQOs were developed to be evaluated at the PQAO level but can be used for informational purposes at the district level. It is noteworthy that 2020 was a unique year, and an overall evaluation indicates that PM-related issues at the districts within CARB's PQAO were largely due to resource constraints imposed by COVID-19 related restrictions.

Although CFR criteria for precision and accuracy are generally applied and evaluated at the PQAO level, assessments at the district or site level may differ and can be important as well. Therefore, data producers are strongly encouraged to review the site-level information and assess whether their data quality objectives are met. It is important to note that when certain CFR criteria are not met, it does not necessarily

mean that the corresponding air quality data should not be used, but rather, the data should be used with the knowledge of the quality behind it. Note that CARB has in place extensive SOPs and data review protocols through Quality Assurance Project Plans (QAPP) and Quality Management Plans[1] (QMP) as well as detailed processes to document deviations from critical criteria, including Air Quality Data Actions (AQDA) and Corrective Action Notifications (CAN). For objective checks which are found to be outside of the acceptance criteria, a weight of evidence evaluation will be performed as outlined in 40 CFR, Part 58, App. A. Per section 1.2.3, 'Failure to conduct or pass a required check or procedure, or a series of required checks or procedures, does not itself invalidate data for regulatory decision making. Rather, PQAOs and the U.S. EPA shall use the checks and procedures required in this appendix in combination with other data information, reports, and similar documentation that demonstrate overall compliance with Part 58. The 2020 ambient data in AQS for the CARB's PQAO have been certified and are considered suitable for comparison to federal ambient air quality standards.

The statistics presented in this report are intended as assessment tools for the data producers to identify areas where program improvements can be made to achieve all MQOs set by U.S. EPA or the data producers themselves. CARB has implemented a comprehensive corrective action system throughout CARB's PQAO which is expected to serve as an essential component for improving data quality and facilitating continuous process improvement. Specifically, CARB has developed the CAN process that can be used to document issues that impact or potentially impact data quality, completeness, storage, or reporting. The goal of the CAN process is to investigate, correct, and reduce the recurrence of these issues. As such, in conjunction with the CAN process, the information obtained from this report can be used to identify issues (not already identified by AQDAs), improve data quality, and ensure compliance with State, federal, and local requirements.

A complete listing of all references used in this report can be found in Appendix D.

[1] https://ww2.arb.ca.gov/our-work/programs/quality-assurance/qm-document-repository/quality-management-plans-and-quality

Table IV-2. Composite Table of Ambient Data and Quality Assurance Results (Both Gas and PM) for Local Districts Within CARB's PQAO

Results	Gaseous Instruments						PM Samplers					
Geographic Area*	Data Capture Rate	QC Checks Reported	Precision Criteria Met	Bias Criteria Met	O_3 Inst All Audited	Audited O_3 Met Criteria	Data Capture Rate	Precision Data Collocated Sites	Collocated Sites Met Criteria	Flow Rate Verification	Samplers Audited	Audited Samplers Met Criteria
Amador County	Y	Y	Y	Y	Y	Y	N/A	N/A	N/A	N/A	N/A	N/A
Antelope Valley	Y	Y	Y	Y	Y	Y	Y	N/A	N/A	Y	Y	Y
Butte County	Y	Y	Y	Y	Y	Y	Y	N/A	N/A	Y	Y	Y
Calaveras County	Y	Y	Y	Y	Y	Y	Y	N/A	N/A	Y	Y	Y
Colusa County	Y	Y	Y	Y	Y	Y	Y	N/A	N/A	Y	Y	N**
Eastern Kern	Y	Y	Y	Y	Y	Y	Y	N/A	N/A	Y	Y	Y
El Dorado County	N	Y	Y	Y	Y	Y	Y	N/A	N/A	Y	Y	Y
Feather River	Y	Y	Y	Y	Y	Y	Y	N/A	N/A	Y	Y	Y
Glenn County	Y	Y	Y	Y	Y	Y	Y	N/A	N/A	Y	Y	Y
Great Basin Unified	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	Y
Imperial County	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Lake County	Y	Y	Y	Y	Y	Y	Y	N/A	N/A	Y	Y	Y
Mariposa County	Y	Y	Y	Y	Y	Y	Y	N/A	N/A	Y	Y	Y
Mendocino County	Y	Y	Y	Y	Y	Y	Y	N/A	N/A	Y	Y	Y
Mojave Desert	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
Monterey Bay	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
North Coast	Y	Y	Y	Y	Y	Y	Y	N/A	N/A	Y	Y	Y
Northern Sierra	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	N
Northern Sonoma	N	N	Y	Y	Y	N	Y	N/A	N/A	Y	Y	Y
Placer County	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N**
Sacramento Metro	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y
San Joaquin Valley Unified	Y	N**	N	N	Y	Y	Y	Y	N†	Y	N	Y
San Luis Obispo	Y	Y	Y	Y	Y	Y	Y	N/A	N/A	Y	Y	Y
Santa Barbara County	N	Y	Y	Y	N	Y	Y	N/A	N/A	Y	Y	Y
Shasta County	Y	Y	Y	Y	Y	Y	Y	N/A	N/A	Y	Y	N
Siskiyou County	Y	Y	Y	Y	Y	Y	Y	N/A	N/A	Y	Y	N
Tehama County	Y	Y	Y	Y	Y	Y	Y	N/A	N/A	Y	Y	Y
Tuolumne County	Y	Y	Y	Y	Y	Y	N/A	N/A	N/A	N/A	N/A	N/A
Ventura County	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Yolo-Solano	Y	Y	Y	Y	Y	Y	N	N/A	N/A	N	Y	N

*Geographic Area: region covered by an air district. Sites within air district may be operated by district, CARB, or both.

Y = Met criteria; N/A = Not Applicable; N = Not all sites met criteria; **Impacted site operated by CARB; † = Impacted sites operated by both District and CARB.

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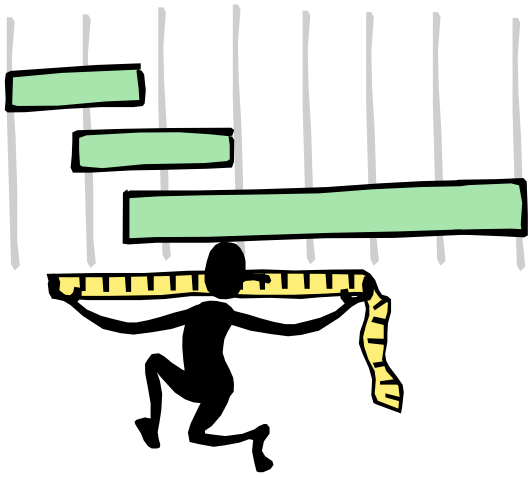
APPENDIX A

U.S. EPA's MEASUREMENT QUALITY OBJECTIVES

TOOLS FOR ASSESSING PRECISION AND BIAS/ACCURACY

CARB's PERFORMANCE AUDIT CRITERIA



U.S. EPA's Measurement Quality Objectives

Table 1. Ambient Air Monitoring Measurement Quality Samples

(Table A-2 in 40 CFR Part 58 Appendix A; QA Handbook Volume II Appendix D, March 2019)

Method	CFR Reference	Coverage (annual)	Minimum frequency	MQOs
Automated Methods				
One-Point QC: for SO_2, NO_2, O_3, CO	Section 3.2.1	Each analyzer	Once every 14 days	**O_3** 90% CL CV < 7.1% for Precision, 95% CL < ± 7.1% for Bias (< ±7.1% (percent difference) or < ±1.5 ppb difference, whichever is greater) **NO_2** 90% CL CV < 15.1% for Precision, 95% CL < ± 15.1% for Bias (< ±15.1% (percent difference) or < ±1.5 ppb difference, whichever is greater) **SO_2** 90% CL CV < 10.1% for Precision, 95% CL < ± 10.1% for Bias (< ±10.1% (percent difference) or < ±1.5 ppb difference, whichever is greater) **CO** 90% CL CV < 10.1% for Precision, 95% CL < ± 10.1% for Bias (< ±10.1% percent difference)
Annual performance evaluation for SO_2, NO_2, O_3, CO	Section 3.2.2	Each analyzer	Once per year	**O_3** < 10.1 % for each audit concentration **NO_2**, **SO_2**, **CO** < 15.1 % for each audit concentration
National performance audit program for SO_2, NO_2, O_3, CO	Section 2.4	20% of sites per year	Once per year	**O_3** < 10.1 % for each audit concentration **NO_2**, **SO_2**, **CO** < 15.1 % for each audit concentration
Flow rate verification PM_{10}, $PM_{2.5}$	Section 3.2.3	Each sampler	Once every month	PM_{10} < 10.1% of standard and design value $PM_{2.5}$ < 4.1% of standard and 5.1% of design value
Semi-annual flow rate audit PM_{10} Continuous, $PM_{2.5}$	Section 3.2.4	Each sampler	Once every 6 months	PM_{10} < 10.1% of standard and design value $PM_{2.5}$ < 4.1% of standard and 5.1% of design value
Collocated sampling $PM_{2.5}$	Section 3.2.5	15%	Every twelve days	CV < 10.1% of samples > 3.0 µg/m^3
PM Performance evaluation program $PM_{2.5}$	Section 3.2.7	1. 5 valid audits for primary QA orgs, with ≤ 5 sites 2. 8 valid audits for primary QA orgs, with > 5 sites 3. All samplers in 6 years	Over all 4 quarters	< ± 10.1% bias for values > 3.0 µg/m^3

U.S. EPA's Measurement Quality Objectives (cont'd)

		Manual Methods		
Collocated sampling PM_{10}, $PM_{2.5}$	3.3.1 and 3.3.5	15%	Every 12 days	CV < 10.1% of $PM_{2.5}$ samples > 3.0 µg/m^3 and of PM_{10} samples > 15.0 µg/m^3
Flow rate verification PM_{10} (low Vol), $PM_{2.5}$	3.3.2	Each sampler	Once every month	< 4.1% of standard and 5.1% of design value
Flow rate verification PM_{10} (High-Vol)	3.3.2	Each sampler	Once every quarter	< 10.1% of standard and design value
Semi-annual flow rate audit PM_{10} (low Vol), $PM_{2.5}$	3.3.3	Each sampler, all locations	Once every 6 months	< 4.1% of standard and 5.1% of design value
Semi-annual flow rate audit PM_{10} (High-Vol)	3.3.3	Each sampler, all locations	Once every 6 months	< 7.1% of standard and 10.1% of design value
Performance evaluation program $PM_{2.5}$	3.3.7 and 3.3.8	1. 5 valid audits for primary QA orgs, with ≤ 5 sites 2. 8 valid audits for primary QA orgs, with ≥ 5 sites 3. All samplers in 6 years	Over all 4 quarters	< ± 10.1% bias for values > 3.0 µg/m^3

Tools for Assessing Precision and Bias/Accuracy

Pollutant	Precision			Bias/Accuracy		
	1-pt QC Checks	Collocated Measurements		1-pt QC Checks	Flow Rate Verification	Performance Audits
Gaseous						
O_3, CO, NO_2, SO_2	✓			✓		annual
Continuous						
$PM_{2.5}$		✓			monthly	semi-annual
PM_{10}					monthly	semi-annual
Manual						
$PM_{2.5}$		✓			monthly	semi-annual
PM_{10} (high vol)		✓			quarterly	semi-annual
PM_{10} (low vol)		✓			monthly	semi-annual

CARB's Performance Audit Criteria (2020)

Instrument/Criteria	Control Limit	Warning
Carbon Monoxide, Nitrogen Dioxide, Sulfur Dioxide*	± 15%	± 10%
Ozone*	± 10%	± 7%
PM10 (Dichot, Continuous) PM10 (Filter Based Low Volume, Pb Low Volume)	± 10%	± 7%
PM10 (Filter Based High Volume)	± 7% of Transfer Standard ± 10% from Design flow rate	± 5%
PM10-2.5 (Filter Based Low Volume, PM coarse) PM10 (Filter Based Low Volume, Pb Low Volume)	± 4% of Transfer Standard ± 5% from Design flow rate	none
PM2.5 (Filter Based, Continuous)	± 4% of Transfer Standard ± 5% from Design flow rate	none
TSP (Pb High Volume)	± 7% of Transfer Standard	± 5%
Xontech 920/924 Toxic and Carbonyl samplers	± 10%	± 7%

* Audit levels 1 and 2 are subject to the following acceptance criteria based on U.S. EPA guidance:
  - For O3, SO2, and NO2: ± 1.5 ppb difference or ± 15 percent difference, whichever is greater.
  - For CO: ± 0.03 ppm difference or ± 15 percent difference, whichever is greater.

Note: Annual Performance Evaluations are operational criteria, and exceedances (especially at lower levels) do not automatically invalidate the data.

Criteria for Meteorological (MET) Sensors

Ambient Temperature	± 0.5° Celsius
Barometric Pressure	± 2.25 mm of Mercury (mmHg)
Wind Direction	≤ 5° combined accuracy and orientation error
Wind Direction (starting threshold)	≤ 0.5 m/s
Wind Speed	± 0.25 m/s between 0.5 and 5 m/s, and < 5% difference above 5 m/s (not to exceed 2.5 m/s difference)
Wind Speed (starting threshold)	≤ 0.5 m/s

Note: CARB does not audit relative humidity, solar radiation, and vertical wind speed.

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APPENDIX B

CARB's PQAO
DATA QUALITY ISSUES

Background

This appendix contains a listing of instruments/samplers that did not meet a particular measurement quality objective (MQO). These data are provided for informational purposes only, as most MQOs are assessed at the PQAO level.

Notably for 2020, the performance audit program was fully functional from January through mid-March before being curtailed for the remainder of the year under the constraints imposed by the pandemic. Following the guidance on priorities from the March 30th U.S. EPA memo (see Appendix C), the program was abbreviated to continuing in accordance with the federal mandate for PM and ozone only. All ozone monitors received an annual assessment and all PM monitors, with a few exceptions, received a semi-annual assessment. Unfortunately, not all PM assessments met the criteria of being five to seven months apart. Further, audits during this period were not completed for CO, NO2 and SO2 gaseous monitors as well as a few PM audits for Lake County APCD and Sacramento AQMD, as a result of the regional stay-at-home order. Therefore, CO, NO2 and SO2 gaseous monitors that were not audited in 2020 are listed towards the end of this Appendix.

Gases - Ambient Data Completeness <75% Reported					
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**	**(% Reported) Issue/Comment**
06-025-4003-1	Westmoreland	Imperial County APCD	Imperial County APCD	O_3 44201	(74%) Data null coded due to poor quality assurance throughout the year
06-025-4004-1	Niland	Imperial County APCD	Imperial County APCD	O_3 44201	(70%) Data null coded due to poor quality assurance throughout the year
06-097-1003-1	Healdsburg	Northern Sonoma AQMD	Northern Sonoma AQMD	O_3 44201	(14%) Site no longer in operation; closed officially on June 30. Only collected 80% of data in January while rest of data was flagged Poor Quality Assurance
06-017-0012-1	Echo Summit	El Dorado APCD	CARB	O_3 44201	(71%) Unable to reach site in April and May due to COVID-19 restriction
06-083-1021-1	Carpinteria	Santa Barbara APCD	Santa Barbara APCD	O_3 44201	(73%) Data null coded due to poor quality assurance throughout the year.
Gases - Precision/Bias 1-Point Checks <75% Reported					
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**	**(% Reported) Issue/Comment**
06-019-0011-3	Fresno Garland	San Joaquin Valley APCD	CARB	CO 42101	(0%) Monitor reported 100% of the required 1-Pt QC checks at 365 ppb. Checks below 500 ppb are flagged by AQS. Per CFR, 1-pt QC checks for trace gas monitor should be conducted at or near routine concentrations measured by the monitors.
06-097-1003-1	Healdsburg	Northern Sonoma AQMD	Northern Sonoma AQMD	O_3 44201	(0%) Site no longer in operation; closed on June 30, 2020. No QC checks performed.

Gases - Precision/Bias Exceeding Criteria					
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**	**Issue/Comment**
06-019-2016-1	Fresno-Foundry Park	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	CO 42101	Estimate for precision is 23.2% and for bias 23.4% (criteria for CO: 10.1% for precision and ±10.1% for bias)
Gases – Ozone Audits not Performed					
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**	**Issue/Comment**
06-067-0012-1	Folsom-Natoma Street	Sac Metro AQMD	Sac Metro AQMD	O_3 44201	Relocation; tried in Dec but got cancelled due to COVID-19 restriction.
06-067-5003-1	Sloughhouse	Sac Metro AQMD	Sac Metro AQMD	O_3 44201	Scheduled in Dec but got cancelled due to COVID-19 restriction.
06-083-1025-1	Las Flores Canyon	Santa Barbara APCD	Santa Barbara APCD	O_3 44201	Refinery shutdown, no access to site; Industrial site, CARB focused on regulatory sites
Gases – Audit Criteria or Critical Criteria Not Met					
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**	**Issue/Comment**
06-029-2012-1	Bakersfield	San Joaquin Valley APCD	San Joaquin Valley APCD	CO 42101	AQDA #8433 CO analyzer (serial # 1181410042) exceeded audit criteria at all four audit points (-48.9, -51.3, -72.5, and -125.6)
06-025-1003-1	El Centro	Imperial County APCD	Imperial County APCD	NO_2 42602	AQDA #8432 the NO2 analyzer (ID # 32535) exceeded audit criteria at all three audit points (-43.5, -49.4, and -24.0 percent) respectively.
06-097-1003-1	Healdsburg	Northern Sonoma AQMD	Northern Sonoma AQMD	O_3 44201	AQDA #8443 Municipal Airport site exceeded the allowable audit criteria at four audit points (16.8, 20.5, 42.3, and -48.6.

PM - Ambient Data Completeness <75% Reported					
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**	**(% Reported) Issue/Comment**
06-051-0005-4	Lee Vining	Great Basin Unified APCD	Great Basin Unified APCD	PM_{10} 81102	(70%) Sampler down from mid April to June and in August and September
06-113-1003-1	Woodland	Yolo-Solano AQMD	Yolo-Solano AQMD	PM_{10} 81102	(67%) No filters were sampled due to Hi-Vol motor being inoperative. Motor was replaced in August and samples resumed. See AQDAs #8435 and 8439.
06-095-3001-2	Vacaville	Yolo-Solano AQMD	Yolo-Solano AQMD	PM_{10} 81102	(36%) No filters were sampled due to Hi-Vol motor being inoperative. Motor was replaced in August and samples resumed. See AQDA #8440.
06-051-0005-4	Lee Vining	Great Basin Unified APCD	Great Basin Unified APCD	$PM_{2.5}$ 88101	(70%) Sampler down from mid April to June and in August and September
06-063-1006-1	Quincy	Northern Sierra AQMD	Northern Sierra AQMD	$PM_{2.5}$ 88101	(54%) The CARB laboratory suspended the shipment of filters due to COVID-19 restrictions. District not interested in operating a continuous monitor during shutdown.
06-057-1001-1	Truckee	Northern Sierra AQMD	Northern Sierra AQMD	$PM_{2.5}$ 88101	(57%) The CARB laboratory suspended the shipment of filters due to COVID-19 restrictions. District not interested in operating a continuous monitor during shutdown.

PM - Ambient Data Completeness <75% Reported					
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**	**(% Reported) Issue/Comment**
06-067-0015-1	Bercut	Sac Metro AQMD	Sac Metro AQMD	$PM_{2.5}$ 88101	(67%) Filter samples' temperature out of specs and did not collect samples late December, due to switch to continuous monitor
06-103-1003-1	Woodland	Yolo-Solano AQMD	Yolo-Solano AQMD	$PM_{2.5}$ 88101	(72%) The missing filters in January of 2020 were due to staff errors. The missing filters in December of 2020 were due to CARB shutting down their labs (COVID-19 restrictions).

PM Precision Criteria (CV Limit of 10%) Not Met					
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**	**Issue/Comment**
06-027-0002-1	White Mountain Research Station	Great Basin Unified APCD	Great Basin Unified APCD	PM_{10} 81102	CV = 12.09*
06-029-0014-1	Bakersfield-California Avenue	San Joaquin Valley Unified APCD	CARB	PM_{10} 81102	CV=21.64
06-027-0002-1	White Mountain Research Station	Great Basin Unified APCD	Great Basin Unified APCD	$PM_{2.5}$ 88101	CV = 25.53*
06-027-1003-3	Keeler-Cerro Gordo Road	Great Basin Unified APCD	Great Basin Unified APCD	$PM_{2.5}$ 88101	CV = 10.68*
06-031-0004-1	Corcoran-Patterson	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	$PM_{2.5}$ 88101	CV = 14.61
06-039-2010-3	Madera	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	$PM_{2.5}$ 88101	CV = 12.36
06-053-1003-2	Salinas	Monterey Bay ARD	Monterey Bay ARD	$PM_{2.5}$ 88101	CV = 13.40
06-077-1002-3	Stockton-Hazelton Street	San Joaquin Valley Unified APCD	CARB	$PM_{2.5}$ 88101	CV = 10.31
06-099-0005-3	Modesto-14th Street	San Joaquin Valley Unified APCD	CARB	$PM_{2.5}$ 88101	CV = 12.5

*High CV to be expected from a low count of paired concentrations above 3 ug/m^3.

PM – Flow Rate Verification (FRV)					
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**	**Issue/Comment**
06-027-1003-6	Keeler-Cerro Gordo Road	Great Basin Unified APCD	Great Basin Unified APCD	PM_{10} 81102	11 of 12 FRVs performed
06-027-1003-7	Keeler-Cerro Gordo Road	Great Basin Unified APCD	Great Basin Unified APCD	PM_{10} 81102	11 of 12 FRVs performed
06-095-3001-2	Vacaville	Yolo-Solano AQMD	Yolo-Solano AQMD	PM_{10} 81102	2 of 4 FRVs performed. Due to the COVID-19 pandemic, the District had low staffing levels and the required flow checks were not performed until the staff levels went up in August 2020. AQDA #8440 was issued and resolved.
06-103-1003-1	West Sacramento	Yolo-Solano AQMD	Yolo-Solano AQMD	PM_{10} 81102	2 of 4 FRVs performed. Due to low staffing issues because of the COVID-19 pandemic restrictions, some FRV could not be conducted.
06-103-2001-1	Woodland	Yolo-Solano AQMD	Yolo-Solano AQMD	PM_{10} 81102	2 of 4 FRVs performed. Due to low staffing issues because of the COVID-19 pandemic restrictions, some FRV could not be conducted.
06-057-1001-1	Truckee	Northern Sierra AQMD	Northern Sierra AQMD	$PM_{2.5}$ 88101	11 of 12 FRVs performed; sampler was shut down (unplugged) during May because of COVID-19 restrictions.
06-063-1006-1	Quincy	Northern Sierra AQMD	Northern Sierra AQMD	$PM_{2.5}$ 88101	9 of 12 FRVs performed; sampler was down for repairs and was eventually shipped back to Thermo Scientific as field operator was unable to make repairs in the field. It was out of commission for 3 months

PM – Flow Rate Verification (FRV)					
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**	**Issue/Comment**
06-071-0306-2	Victorville	Mojave Desert AQMD	Mojave Desert AQMD	$PM_{2.5}$ 88101	9 of 12 FRVs performed (some FRVs out of spec)
06-103-1003-1	West Sacramento	Yolo-Solano AQMD	Yolo-Solano AQMD	$PM_{2.5}$ 88101	5 of 12 FRVs (Due to low staffing issues because of the COVID-19 pandemic restrictions, some FRV could not be conducted)
PM – Audits not Performed					
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**	**Issue/Comment**
06-031-0004-8	Corcoran-Patterson	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	PM_{10} 81102	Only one audit performed due to site relocation
06-019-2016-3	Fresno-Foundry Park	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	$PM_{2.5}$ 88101	No audit performed due to QA audit team not being informed of sampler being added
PM – Audit Criteria or Critical Criteria Not Met					
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**	**Issue/Comment**
06-103-1003-1	West Sacramento	Yolo-Solano AQMD	Yolo-Solano AQMD	PM_{10} 81102	(AQDA #8434) Due to low staffing issues because of the COVID-19 pandemic restrictions, the HI-Vol motor that failed on 6/8/2020 was not replaced immediately. The motor was replaced and re-calibrated on 8/14/2020.
06-103-2001-1	Woodland	Yolo-Solano AQMD	Yolo-Solano AQMD	PM_{10} 81102	(AQDA #8435) Due to low staffing issues because of the COVID-19 pandemic restrictions, the HI-Vol motor that failed on 6/15/2020 was not replaced immediately. The motor was replaced and re-calibrated on 8/6/2020.

PM – Audit Criteria or Critical Criteria Not Met					
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**	**Issue/Comment**
06-103-2001-1	Woodland	Yolo-Solano AQMD	Yolo-Solano AQMD	PM_{10} 81102	(AQDA #8439) Due to the COVID-19 pandemic restrictions, the District had low staffing levels and the required flow checks were not performed until the staff levels went up in August 2020.
06-095-3001-2	Vacaville	Yolo-Solano AQMD	Yolo-Solano AQMD	PM_{10} 81102	(AQDA #8440) Due to the COVID-19 pandemic restrictions, the District had low staffing levels and the required flow checks were not performed until the staff levels went up in August 2020.
06-103-1003-1	West Sacramento	Yolo-Solano AQMD	Yolo-Solano AQMD	PM_{10} 81102	(AQDA #8441) Due to the COVID-19 pandemic restrictions, the District had low staffing levels and the required flow checks were not performed until the staff levels went up in August 2020.
06-103-2001-1	Woodland	Yolo-Solano AQMD	Yolo-Solano AQMD	$PM_{2.5}$ 88101	(AQDA #8438) Due to the COVID-19 pandemic, the District had low staffing levels and the required flow checks were not performed until the staff levels went up in August 2020. AQDA #8438 was issued and resolved.

PM – Audit Criteria or Critical Criteria Not Met					
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**	**Issue/Comment**
06-063-1010-4	Portola	Northern Sierra AQMD	Northern Sierra AQMD	$PM_{2.5}$ 88101	(AQDA #8446) The inaccurate pressure reading resulted in a failed flow audit at 15.69 LPM, exceeding the 16.67 LPM +/- 4% limit. The operator then re-calibrated the pressure sensor. A re-audit was performed and both pressure and flow passed. This sampler was last calibrated on 10-28-2020.
06-093-2002	Mt. Shasta	Siskiyou County APCD	Siskiyou County APCD	$PM_{2.5}$ 88101	(AQDA #8445) it was noted that the operator had not conducted a flow and leak verification on the BAM2.5,
06-011-1002-1	Colusa-Sunrise Blvd	Colusa County APCD	CARB	$PM_{2.5}$ 88101	(AQDA #8436) Thermo 2000i sampler (20112265) exceeded the allowable audit flow rate criteria by -4.6%.
06-011-1002-1	Colusa-Sunrise Blvd	Colusa County APCD	CARB	$PM_{2.5}$ 88101	(AQDA #8442) the Thermo 2000i (ID# 20112265) exceeded the allowable audit criteria for leak check (26 mmHg/min)
06-061-0006-1	Roseville	Placer County APCD	CARB	$PM_{2.5}$ 88101	(AQDA #8437) The primary R&P 2000i (ID#20112266) exceeded the allowable audit criteria for leak check with a value greater than 25 mmHg/min.

PM – Audit Criteria or Critical Criteria Not Met					
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**	**Issue/Comment**
06-089-0004-1	Redding - Health Department	Shasta County AQMD	Shasta County AQMD	$PM_{2.5}$ 88101	(AQDA #8444) During the audit on 11-9-2020 it was found that the temperature sensor on the PM2.5 sampler produced values higher than the audit temperature standard

AQDA and CAN Issued by CARB		
Pollutant	**#AQDAs**	**CANs**
CO	1	0
NO_2	1	2
O_3	1	6
PM_{10}	5	5
$PM_{2.5}$	7 (5 due to flow failures)	5
SO_2	1	0

Manual Adjustments to Information Output from AQS					
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**	**Issue/Comment**
06-079-9001-1	OSO Flaco	San Luis Obispo APCD	San Luis Obispo APCD	PM_{10} 81102	SPM site (no priority for audit)
06-033-3002-1	Lakeport	Lake County AQMD	Lake County AQMD	PM_{10} 81102	2nd audit scheduled in 12/2020, cancelled due to COVID-19 restrictions.
06-033-3010-1	Anderson Springs	Lake County AQMD	Lake County AQMD	PM_{10} 81102	2nd audit scheduled in 12/2020, cancelled due to COVID-19 restrictions.
06-033-3011-1	Glenbrook	Lake County AQMD	Lake County AQMD	PM_{10} 81102	2nd audit scheduled in 12/2020, cancelled due to COVID-19 restrictions.
06-039-2010-1	Madera City	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	PM_{10} 81102	Two audits conducted in same quarter: full on 10/8/20, second on 11/19/20 for flows.
06-031-0004-1	Corcoran-Patterson	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	$PM_{2.5}$ 88101	Two audits performed in same quarter

Manual Adjustments to Information Output from AQS					
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**	**Issue/Comment**
06-031-0004-8	Corcoran-Patterson	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	$PM_{2.5}$ 88101	Two audits performed in same quarter
06-033-3002-1	Lakeport	Lake County AQMD	Lake County AQMD	$PM_{2.5}$ 88101	2nd audit scheduled in 12/2020, cancelled due to COVID-19 restrictions.
06-039-2010-1	Madera City	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	$PM_{2.5}$ 88101	Two audits performed in same quarter
06-039-2010-3	Madera City	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	$PM_{2.5}$ 88101	Two audits performed in same quarter
06-101-0003-1	Yuba City	Feather River AQMD	CARB	$PM_{2.5}$ 88101	No audits performed (site not-operational for entire year)

Gases – Audits Not Performed Due to COVID-19 Restrictions				
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**
06-007-0008-3	Chico East Ave	Butte County AQMD	CARB	CO 42101
06-019-0011-3	Fresno Garland	San Joaquin Valley APCD	CARB	CO 42101
06-019-2016-1	Fresno-Foundry Park	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	CO 42101
06-019-5001-1	Clovis-N Villa Ave	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	CO 42101
06-027-0002-1	White Mountain Research Station	Great Basin Unified APCD	Great Basin Unified APCD	CO 42101

Gases – Audits Not Performed Due to COVID-19 Restrictions				
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**
06-053-1003-1	Salinas	Monterey Bay ARD	Monterey Bay ARD	CO 42101
06-067-0006-1	North Highlands	Sac Metro AQMD	Sac Metro AQMD	CO 42101
06-067-0015	Bercut	Sac Metro AQMD	Sac Metro AQMD	CO 42101
06-083-1008-3	Santa Maria-S Broadway	Santa Barbara APCD	Santa Barbara APCD	CO 42101
06-083-2004-1	Lompoc	Santa Barbara APCD	Santa Barbara APCD	CO 42101
06-099-0005-3	Modesto-14th Street	San Joaquin Valley Unified APCD	CARB	CO 42101
06-019-0011-3	Fresno Garland	San Joaquin Valley APCD	CARB	SO_2 42401
06-023-1004-1	Eureka	North Coast AQMD	North Coast AQMD	SO_2 42401
06-027-0002-1	White Mountain Research Station	Great Basin Unified APCD	Great Basin Unified APCD	SO_2 42401
06-067-0006-1	North Highlands	Sac Metro AQMD	Sac Metro AQMD	SO_2 42401
06-071-1234-1	Trona	Mojave Desert AQMD	Mojave Desert AQMD	SO_2 42401
06-079-2004-1	Nipomo Guadalupe Rd	San Luis Obispo APCD	San Luis Obispo APCD	SO_2 42401
06-083-2004-1	Lompoc	Santa Barbara APCD	Santa Barbara APCD	SO_2 42401
06-019-0011-3	Fresno Garland	San Joaquin Valley APCD	CARB	SO_2 42401
06-007-0008-3	Chico East Ave	Butte County AQMD	CARB	NO_2 42602

Gases – Audits Not Performed Due to COVID-19 Restrictions				
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**
06-019-0242-1	Fresno Sky Park	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	NO_2 42602
06-019-2016-1	Fresno-Foundry Park	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	NO_2 42602
06-019-4001-1	Parlier	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	NO_2 42602
06-019-5001-1	Clovis	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	NO_2 42602
06-023-1004-1	Eureka	North Coast AQMD	North Coast AQMD	NO_2 42602
06-029-0007-1	Edison	San Joaquin Valley Unified APCD	CARB	NO_2 42602
06-029-6001-1	Shafter	San Joaquin Valley Unified APCD	CARB	NO_2 42602
06-031-1004-1	Hanford	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	NO_2 42602
06-039-0004-1	Madera Pump Yard	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	NO_2 42602
06-047-0003-1	Merced Coffee Rd	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	NO_2 42602
06-053-1003-1	Salinas	Monterey Bay ARD	Monterey Bay ARD	NO_2 42602
06-061-0006-1	Roseville	Placer County APCD	CARB	NO_2 42602
06-067-0006-1	North Highlands	Sac Metro AQMD	Sac Metro AQMD	NO_2 42602

Gases – Audits Not Performed Due to COVID-19 Restriction				
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**
06-067-0010-1	Sacramento T St	Sac Metro AQMD	CARB	NO_2 42602
06-067-0010-3	Sacramento T St	Sac Metro AQMD	CARB	NO_2 42602
06-067-0011-1	Elk Grove-Bruceville Rd	Sac Metro AQMD	Sac Metro AQMD	NO_2 42602
06-067-0015	Bercut	Sac Metro AQMD	Sac Metro AQMD	NO_2 42602
06-071-1234-1	Trona	Mojave Desert AQMD	Mojave Desert AQMD	NO_2 42602
06-077-1002-2	Stockton-Hazelton Street	San Joaquin Valley Unified APCD	CARB	NO_2 42602
06-077-3005-1	Tracy Airport	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	NO_2 42602
06-079-4002-1	Nipomo-Regional Park	San Luis Obispo APCD	San Luis Obispo APCD	NO_2 42602
06-079-8002-1	Atascadero	San Luis Obispo APCD	San Luis Obispo APCD	NO_2 42602
06-083-1008-1	Santa Maria-S Broadway	Santa Barbara APCD	Santa Barbara APCD	NO_2 42602
06-083-2004-1	Lompoc	Santa Barbara APCD	Santa Barbara APCD	NO_2 42602
06-099-0006-1	Turlock	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD	NO_2 42602
06-101-0003-1	Yuba City	Feather River AQMD	CARB	NO_2 42602
06-107-2002-1	Visalia	San Joaquin Valley Unified APCD	CARB	NO_2 42602
06-111-2002-1	Simi Valley	Ventura County APCD	Ventura County APCD	NO_2 42602

Gases – Audits Not Performed Due to COVID-19 Restriction				
Site ID	**Site Name**	**Geographic Area**	**Monitoring Agency**	**Pollutant**
06-111-3001-1	El Rio Mesa	Ventura County APCD	Ventura County APCD	NO_2 42602
06-113-0004-1	Davis	Yolo-Solano AQMD	CARB	NO_2 42602

APPENDIX C

COMMUNICATION BETWEEN CARB AND U.S. EPA REGARDING LIMITED OPERATIONS IN 2020 DUE TO COVID-19 PANDEMIC RESTRICTIONS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

March 30, 2020

To: EPA Regional Office Air Monitoring Leads

From: Richard A. Wayland, Director
Air Quality Assessment Division

Subject: EPA Input on Ambient Air Monitoring Priorities in the Absence of Monitoring Agency Priorities During COVID-19 Response

In response to questions from state, local, and tribal agencies concerning monitoring priorities during COVID-19, we are providing input to consider when balancing mission-essential functions of ambient air monitoring with local orders and the health and safety of employees.

While EPA considers all ambient air monitoring programs mission essential, we recognize the tremendous strain of the COVID-19 response. Therefore, where necessary, we propose that monitoring agencies set priorities based on health risk from air pollution in local communities where monitoring is conducted. In the absence of local priorities for maintaining monitoring sites, we offer a prioritized list of activities, noting that this does not necessarily take into consideration the unique nature of air quality in a particular area.

Highest Priority to continue operating to the extent possible:

- Ozone and $PM_{2.5}$ automated measurements.
- $PM_{2.5}$ Federal Reference Method (FRM) measurements identified as primary monitors or used as quality assurance (QA) monitors.
- Any other National Ambient Air Quality Standards (NAAQS) measurements (manual or automated) of high priority in that area.
  - This includes any monitor near or above the NAAQS or in an area seeking a clean data finding if recent years are below the level of the NAAQS.
  - This is most likely to include certain Pb and SO_2 monitors (e.g., an SO_2 monitor near an operating source).
- All other NAAQS gases (i.e., CO, NO_2, SO_2) that have automated quality control (QC) checks and continuous PM_{10} that can continue operation with little operator support.
- Air toxics measurements in communities known to have high risk or the potential for high risk from air toxics exposure.

High Priority to continue, if staff resources are available:

- All other NAAQS monitoring. This includes gas monitoring where automated checks are not available.
- National Air Toxics Trends Stations (NATTS) and all other air toxics measurements in communities not specifically considered to have high risk issues as referenced in highest priority above.

Supporting Measurements to continue, if staff resources are available in addition to above:

- Chemical Speciation Network (CSN).
- IMPROVE Protocol Sites.

Seasonal and Additional Measurements. Although still essential monitoring, we understand that agencies may need some relief. While these measurements are useful and required, it is less important to always have a complete data record every year for them:

- Photochemical Assessment Monitoring Stations (PAMS) measurements.
- NO_y.
- Other air toxics monitoring that is not in a community, not near a source, or not a NATTS station.

We encourage you to share these key points with your monitoring agencies and reassure them that we will continue to collect and respond to their questions and work closely with them during the COVID-19 response. We greatly appreciate your continued leadership and input. If you have specific questions, please reach out to Kristen Benedict and others in the OAQPS Ambient Air Monitoring Group.

January 22, 2021

Ms. Meredith Kurpius
Assistant Director, EPA Region 9, Air and Radiation Division
75 Hawthorne St., AIR-4
San Francisco, California 94105
kurpius.meredith@epa.gov

Dear Ms. Kurpius:

As you are aware, the California Air Resources Board's (CARB) Monitoring and Laboratory Division (MLD) is responsible for the operation and maintenance of ambient air quality and greenhouse gas monitoring networks, including related quality assurance, laboratory analysis, and community air monitoring programs. The purpose of this letter is to document the actions taken during 2020 to maintain those operations.

In March 2020, Governor Newsom issued a statewide stay-at-home order to protect the health and well-being of all Californians, and to establish consistency across the state in order to slow the spread of COVID-19. This state order directed all individuals living in the State of California to stay home or at their place of residence except as needed to maintain continuity of operations of the federal critical infrastructure sectors. In response to this order, CARB reduced its field and laboratory work to maintaining the State's ozone and PM2.5 monitoring programs. The continuation of these mission essential programs except where prohibited by state directives followed the United States Environmental Protection Agency (U.S. EPA) guidance memos issued on March 18, 2020 and March 30, 2020. Those memos highlighted that during an emergency or Continuity of Operations Plan (COOP), ambient air monitoring programs are a mission essential function and should continue unless state, local, or tribal directives prohibit their operation. The memos also noted the tremendous strain of the COVID-19 response, and where necessary, proposed that agencies set monitoring priorities based on health risk from air pollution in local communities.

In December 2020, in response to a surge in the level of community spread of COVID-19, Governor Newsom issued a regional stay-at-home order for regions with less than 15 percent intensive care unit availability. In response to this order, all State offices were directed to close for three weeks starting on Monday, December 7, 2020, which was extended to at least January 15, 2021. Those directives have since been extended until further notice. MLD received limited exceptions to this direction for purposes of maintaining critical air monitoring and laboratory functions, as well as on-site management.

Since March, CARB has continually worked to balance mission-essential functions of ambient air monitoring with current state and local orders and the health and safety of employees. As recommended in the U.S. EPA's March 18th, 2020 memo, CARB continued to operate the air monitoring networks to the best of our ability, while considering employee health and safety. Following the guidance of the prioritized list of activities provided in the March 30, 2020 memo from U.S. EPA, MLD continues to review and adjust operational activities as the situation and directives evolve. MLD continued non-field related activities such as planning, data analyses, report writing, and engagement with stakeholders through work from home protocols. The information below details the operational changes made by CARB in response to the March 2020 statewide stay-at-home order, as well as the recent regional stay-at-home order and resulting directive to close all State buildings.

Laboratory:

Due to the statewide stay-at-home order in March 2020, CARB's Northern Laboratory Branch (NLB) reduced its on-site laboratory operations and transitioned to working remotely whenever feasible. Program operations were suspended for the PM2.5 speciation, Toxics, Pesticides, GHG, Consumer Products, and Composite Wood programs. Only the PM2.5 and PM10 mass weighing programs continued as they were considered of highest priority and therefore allowed to continue despite COVID-19 directives. In July, NLB noticed an increase in PM2.5 samples arriving at the laboratory warm (> 4 °C). In most cases, this increase was attributed to unforeseen shipping delays resulting from delivery business services being affected by COVID-19. To reduce the number of invalid samples, staff implemented new field shipping procedures. Site operators were asked to return PM2.5 samples using next day air rather than ground shipping to ensure samples were received in a timely manner.

Because of the March stay-at-home orders, NLB developed a three phase plan to return-to-work. Phase I maintained PM2.5 and PM10 FRM programs including media shipping, sample receiving and log-in, sample analysis, and data reporting. All other programs were suspended with staff intermittently on-site to maintain instruments with the goal of protecting analytical assets (e.g., monitoring or replacing compressed gas cylinders, performing analytical standard checks, etc.). Phase I also included pick-up and delivery of work products for review or approval, and checking on laboratory health and safety requirements. Phase II built upon Phase I with the additional goals of clearing backlogs for all samples received in early 2020 and preparing instruments for future analysis (e.g., method detection limit verifications, control checks, media preparation, etc.). Phase III included all the above with the goal of resuming full work capacity to meet Federal, State, and client requirements. All plan phases required strict adherence to safety guidelines and established shift schedules to ensure staff wellbeing. At the start of December 2020, NLB was working on the transition from Phase II to Phase III.

In early December 2020, the new regional stay-at-home order and the resulting closure of all State offices, required CARB to further suspend all laboratory support (media shipment, sample receipt and log-in, analysis, and data reporting) with the exception of three sites for the PM2.5 program: Bakersfield – California, Bakersfield – Southeast (Planz), and Portola. These sites were deemed critical by the planning team due to upcoming SIP determinations. Notification was sent to air monitoring site operators, their management, and other agencies via NLB's Laboratory Information Management System distribution list, as well as with the CAPCOA air monitoring committee. Upon receiving this notification, several air monitoring agencies inquired about the process to retrieve samples that were already collected, but pending laboratory analysis. Considering the amount of time required to meet this request, CARB agreed to weigh all PM2.5 samples collected through the December 7, 2020 stay-at-home order. Districts were asked to immediately return any filters that had not yet been shipped to CARB for weighing. Recognizing that continuous instruments could be operated and collect data without reliance on NLB, CARB worked closely with all Districts to transition sites with filter based (FRM) samplers to continuous (FEM) monitors. This effort is further described below.

Going forward, support for the three selected sites will continue until the order is lifted, including shipment of filter media for future scheduled sampling dates, sample receipt and log-in, analysis, and data reporting. Media will not be shipped to any other PM2.5 sites or PM10 sites for future scheduled sampling dates while the current orders are in place. Currently, staff are again intermittently on-site to maintain instruments to protect analytical assets on set schedules. Once the order is lifted, staff will begin the process of pre-weighing and shipping filter media to all PM2.5 and PM10 sites, which will take approximately 2 to 3 weeks, and implementing Phase III of our return to operations plan.

Ambient Air Monitoring:

When the statewide stay-at-home order was issued in March 2020, CARB's Air Quality Surveillance Branch (AQSB) reduced select field operations. Field staff continued site visits and maintained monitoring site operations for ozone and PM. Site visits and monitoring site operations for all other continuous monitoring (NOx, CO, and SO2) were suspended, but equipment for these criteria pollutants remained operational and continued to report data. PM filters from FRM samplers continued to be collected and sent to the laboratory for analysis. Sample collection for toxics were suspended including VOC and GHG canisters, SASS filters (Ions, XRF metals, Wood Smoke, EC/OC, and PM2.5), and Xontech 924 filters (ICP-MS metals, carbonyls, Cr6+). The Chemical Speciation Network program continued with sample collection at Bakersfield and Fresno. District calibrations were temporarily suspended, but resumed beginning in October and all calibrations for calendar year 2020 were completed.

In response to the regional stay-at-home order issued in early December 2020, AQSB field staff modified the PM2.5 network to minimize the effects of reduced laboratory functions on collection of PM2.5 ambient data. With the exception of the Bakersfield-California, Bakersfield-Planz, and Portola sites, all PM2.5 FRM filter collection was discontinued and all non-FEM samplers were converted to FEM in early December. The Bakersfield-California, Bakersfield-Planz, and Portola sites continue to collect PM2.5 FRM filter data. CARB also worked with the Districts to replace all but two FRM PM2.5 monitors with FEM monitors to avoid data loss as much as possible. Those conversions were all completed by mid-December.

Quality Assurance:
Beginning in March, audits for the monitoring network continued with an abbreviated function. Following the guidance on priorities from the March 30, 2020 U.S. EPA memo, only the ozone and PM audits were conducted for the CARB PQAO. This permitted the audits to be performed by a single CARB staff person while adhering to the prescribed safety measures. All ozone monitors received an annual assessment and all PM monitors, with a few exceptions, received both semi-annual assessments. The exceptions occurred for a few PM audits for Lake County APCD and Sacramento AQMD, where monitors received only one semi-annual assessment as result of the recent regional stay-at-home order. Due to COVID-19 scheduling challenges, it was not possible for all PM assessments to meet the criteria of being five to seven months apart. Further, audits during this period were not completed for the CO, NO2, and SO2 gaseous monitors in order to reduce field exposures in accordance with State and regional directives.

Standards Laboratory:
Since March 2020, CARB's Standards Laboratory remained operational with the following changes:

- Prioritized ozone standards and PM2.5 equipment certifications per the directives provided in the March 30, 2020 U.S. EPA memo.
- Required clients to justify why their equipment was essential prior to providing service.
- Staggered scheduling of staff in the laboratory to perform essential certifications while adhering to the prescribed safety measures.
- Enacted strict scheduling of client equipment pick-up and drop-off to minimize contact.

It should be noted that the CARB Standards Laboratory had the only ozone Standards Reference Photometer operating in the U.S. during the first four months of the pandemic (April through July) and continued to provide services to its typical clients (California and several other western states). In response to the December regional stay-at-home order and the recent extension, the Standards Laboratory has suspended all certification services until further notice. Customers who currently have equipment in the laboratory or who are on the upcoming service schedule were contacted to coordinate pick up of equipment or to reschedule service. When the current orders are lifted, the Standards Laboratory will resume operations to support critical air monitoring activities.

All operations have been implemented while following personnel health and safety requirements and in accordance with the recommendations from the Centers for Disease Control and Prevention, California Environmental Protection Agency, CARB, and local public health department guidelines to ensure the safety of its employees, as well as being in line with the two U.S. EPA March 2020 memos.

The changes made to CARB MLD operations in response to the dynamic situation at hand have been made thoughtfully and deliberately to comply with the Governor's orders; to keep our employees and their families safe, keep California communities safe by reducing our on-site presence and reduce the risks to communities that are experiencing low ICU bed availability, and to support the mission essential function of operating the ambient air monitoring programs to the best of our ability. CARB has been able to keep its highest priority programs, ozone and PM2.5, up and running as suggested by the March 2020 memos. When further restrictions were required in December, CARB quickly substituted its FRM filter based samplers to continuous monitors, thereby allowing the ongoing collection of these important data. We anticipate further discussions regarding data quality and certification and will work with Region IX and our CARB colleagues to address any concerns. We also expect to have further discussions regarding monitoring operations in 2021 and what that may look like as we continue to make adjustments to ensure the safety of both CARB and District staff.

If you have any questions or wish to discuss further, please contact me at (916) 322-0960 or via email at Michael.miguel@arb.ca.gov.

Sincerely,

Mike Miguel

Michael Miguel, Assistant Division Chief
Monitoring Laboratory Division
California Air Resources Board

cc: Edie Chang, Deputy Executive Officer
California Air Resources Board

Michael Benjamin, Chief
Air Quality Planning and Support Division

Catherine Dunwoody, Chief
Monitoring and Laboratory Division

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APPENDIX D

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