Standard Operating Procedures
Data Management

Air Quality Division

Air Monitoring
&
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Program

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Any mention of equipment manufacturers, instrument or equipment model numbers, commercial vendors or suppliers does not represent an endorsement by the State of Alaska or the Department of Environmental Conservation.
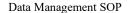
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1. PURPOSE & SCOPE

This document shall establish standard operating procedures (SOP) for the data management of continuous, and filter-based monitoring data, either collected by the Alaska Department of Environmental Conservation (DEC) or subject to a regulatory review by DEC.

2. APPLICABILITY

This document describes the basic components of data management including the procedures to review, validate, report, and archive ambient air quality data in accordance with federal regulations and EPA quality assurance/quality control (QA/QC) requirements. This document is specific to the Department's use of the DR DAS and Agilaire data acquisition systems, and the DEC in house AirTools Data Warehouse. This document is generic in that it does not address pollutant specific data validation tables and procedure since those are spelled out in the separate instrument/pollutant SOPs.

This document shall serve as:

- the SOP document for data management of all State and Local Air Monitoring Station (SLAMS) and National Core site (NCore) data
- the SOP document for data management of all special purpose monitoring stations (SPMS) performed by DEC or other local air pollution control agencies.
- the SOP document for data management of all special studies performed by DEC.

This SOP document, at the date of issuance, represents the latest information on data management in regards to federal regulations as published in *Title 40 of the Code of Federal Regulations (Parts 50, 52, 53, and 58)* and EPA requirements as listed in the *EPA Quality Assurance Handbook for Air Pollution Measurements, Volume II, Ambient Air Monitoring Program, January 2017,* https://www.epa.gov/amtic/ambient-air-monitoring-quality-assurance-guidance-documents.

3. DATA ACQUISITION COMPONENTS

3.1   Agilaire AirVision

DEC uses the Data Management System (DMS) developed by Agilaire LLC known as AirVision. AirVision polls instrument data from a data acquisition system developed by Agilaire LLC using the Model 8872 data logger known as AV-Trend, in 1-minute, 5-minute and 1-hour averages. Each data logger collects data from each analyzer digitally using a MODBUS communication protocol via TCP/IP or via a RS-232 connection. All meteorological data is collected from analog instruments and converted to digital, stored on the Model 8872 data logger, and averaged. All real-time data collected can be reviewed on the data logger using the AV-Trend program.

In the event the data logger fails to collect data from the analyzers, the analyzers internal data logging feature is used to recall stored concentration values when prompted to recreate data points that were missed during the time the data logger failed to collect data from the analyzers. Under normal operations, the data logger continuously polls each analyzer and records the values collected from all established channels as raw concentrations. For instruments that provide hourly data, (i.e., MET One BAM 1020) the data logger processes a poll request. The instrument response is monitored by the datalogger with a preconfigured file format that translates the data for users to understand using the AV-Trend program. For instruments that are direct polled instruments, AirVision processes a poll request directly with the instrument. The instrument response is monitored by AirVision with a preconfigured file format that translate the data for users to understand using AirVision. The data loggers do not collect data from direct polled instruments. Program staff can view and edit the station's 1-min and 1-hr average data using their PC workstation through an AirVision client interface window.

AirVision utilizes an Automatic Data Validation Processor or ADVP which runs in conjunction with the 1-hour polling task. The ADVP feature monitors data collected from each respective site and runs predetermined validation rules to ensure bad data is screened before it is made available to the public. If a parameter is found out of tolerance based on the set conditions in ADVP, the data will be flagged according to the conditions set. If any manual edits are performed from a Level 1, 2, or 3 reviewer, AirVision will mark the data point with an "E" flag and track each change made.

Data review and validation is conducted in AirVision and is described in more detail in the Data Validation SOP (http://dec.alaska.gov/air/air-monitoring/standard-operating-procedures/).

3.2   Lab LIMS

DEC uses a commercial Laboratory Information Management System (LIMS) from Measurement Technologies Laboratory (MTL). The MTL Filter Weighing System (FWS) is a comprehensive set of hardware and software components which automates the weighing of filter media and handling of associated data. The Fairbanks lab is using version 4.9.2- 10 APR 2019 currently (October 2019). In 2021 a second lab with a similar MTL FWS was established in the Juneau office. This lab uses the same LIMS software, version XXX. Both labs will continuously weigh filters used in the sampling process, so that either system is ready to take over all filter weighing activity should one lab experience equipment malfunctions or other outages. The software and hardware will be updated as suggested by MTL. The hardware includes the MTL's robotic auto handler, microbalance, environmental monitor, barcode reader, and optional static meter.

The software includes data collection, statistical process controls, and quality assurance measures. Balance readings and environmental conditions are automatically collected and stored by the software, eliminating human effort and error. The analytical microbalance is linked to a computer and acquires filter weights, continuous weighing chamber temperature and percent relative humidity (RH) electronically through the MTL LIMS. All out-of-tolerance conditions are flagged and reported by the software.

Filter sampling metadata is downloaded from particulate monitors on-site and sent to the lab with the appropriate sample filter paperwork. Site operators work closely with the lab staff to schedule shipments of pre- and post-weighed filters in order to meet or exceed validation table requirements.

Gravimetric laboratory staff export directly from the LIMS system and send data to site operators for further review. Site operators will work with the gravimetric laboratory staff to resolve any irregularities or issues that arise. The QA Officer and data analysts are available for consultation during this process (see Data Validation SOP for more detail, in progress). The analyst uses a laboratory QC notebook in addition to the LIMS electronic database to record all QC data including the microbalance calibration and maintenance information, routine internal QC checks of mass reference standards, laboratory, field and lot filter blanks, and external QA audits. The gravimetric laboratory SOP (http://dec.alaska.gov/air/air-monitoring/standard-operating-procedures/) includes details.

3.3   Websites

DEC's AirVision database is the source of near real-time data for several websites including AirNow, and the Fairbanks North Star Borough (FNSB) and DEC websites. AirVision service, FTP Import/Export, sends the data to AirNow Tech for conversion to the air quality index (AQI) and then the AirNow web display. AirNow uses the NowCast for calculating the pollutant normalized AQI. Different acquisition timing for state and local distribution methods causes AirNow to refresh data at 40 minutes past the hour to include the entire United States. ADEC's AQ near real-time monitoring website requests raw data from the AirVision database via the partner license. FNSB uses the service to populate their website. For ADEC's real-time website, ADEC chose to use AirNow's NowCast formula (see Appendix A) for calculating the AQI to minimize public confusion. The site is compatible with mobile devices, includes site information and pictures. The home screen that loads when the user initially navigates to the page shows a basemap with color-coded site icons. The color scheme corresponds to the displayed AQI legend and the NowCast categories. New data is available for the website approximately 7 minutes past the hour and the most recent AQI value is displayed on the basemap. The Site Information shows a site photo, coordinates, AQI average values used for the AQI category, and most recent hourly concentration for the various monitored pollutants. The Historical Data Concentration shows the current day's hourly concentrations on a time-series plot, organized alphabetically. Additional daily time-series plots are available via a

dropdown calendar. DEC has not opted to use AirNow's forecast capabilities. Instead, a DEC contractor has developed a model specific to the Fairbanks/North Pole PM$_{2.5}$ serious nonattainment area. It is updated yearly to keep up with changes to the monitoring network. The 'AQ Alert Model' as it's called is being transitioned over to in-house programming starting in 2019. The DEC meteorologist has worked closely with the contractor and FNSB staff to provide timely advisories coordinated with DEC compliance actions.

DEC: https://dec.alaska.gov/Applications/Air/airtoolsweb/Advisories/

AirNow: https://www.airnow.gov/

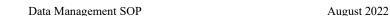FNSB: http://data.fnsb.us/airquality/AQNearRealTime

Import/Export FTP is part of Agilaire's data acquisition suite. This service resides on the central Juneau Server (DECJNUAQMON2). Left running continuously, it sends a comma delimited file (AQCSV) every hour (15 minutes after the hour) to AirNowTech for the AirNow update (approximately 40 minutes after the hour).

3.4   Data Analysis and Reporting Tool (DART)

Chemical Speciation Network sampling occurs at the NCore site in Fairbanks, Alaska (02-090-0034) and the Hurst Road site in North Pole, Alaska (02-090-0035). EPA-contracted laboratories upload analytical results and field instrument data in batches for review before submission to AQS. Currently the University of California Davis (UCD) has been contracted for the speciation analysis and data management. They developed a platform called the Data Analysis Reporting Tool (DART) that is housed on the Sonoma Technology AirNowTech website (https://dart.airnowtech.org/). DEC reviews batch data for accuracy and reasonableness in the AirNow Tech DART database using Approval Mode. Comments are submitted to the laboratory using DART before the end of a set review period and considered by UCD for incorporation into the dataset before final posting to AQS. DART staff load the raw data while DEC is responsible for loading flow check, blank and audit results to AQS.

3.5   Air Quality System (AQS)

AQS is the final repository for data that has completed the data review process and has been certified for submission to EPA. Continuous and semi-continuous data, validated filter-based and other manual method data, and all relevant QC data that have been through the third level validation process are uploaded to the AQS system via flat files. Data submission occurs monthly but the EPA ultimately requires quarterly submission deadlines. Flat files store data in a plain text format with one record per line of text. Each piece of data associated with a recorded is delimited by a bar (or "pipe All AQS flat files, regardless of provenance, are saved in text format and uploaded to AQS through the Exchange Network Service (ENS) platform. Submission files can contain multiple sites and/or analytes if they are smaller than the maximum upload size of 1 GB in the ENS system. The Program AQS coordinator or a data

analyst also documents Exceptional Events in AQS and subsequently links them to the appropriately flagged exceptional event data. The AQS Submitter will write a letter to the EPA Region 10 Quality Assurance Coordinator and CC the EPA Region 10 Senior Air Monitoring Specialist, the AMQA Program Manager, the QA Officer, and the Field Operations Manager when data submission is complete and explaining any data that falls below 75% data capture. If there is any data that was not submitted on time it will also be addressed in this letter with an estimate of when the data will be reported to AQS. The signed letter and copies of the AMP251 and 430 reports will be emailed to all recipients on or before the submission deadline.

4. DATA ARCHIVES

4.1 DR DAS – Envista ARM

Until Summer of 2021, DEC used the DR DAS data acquisition system (DAS) to collect and store data from continuous monitoring instruments located around the state. After transitioning to the Agilaire AirVision database, DEC decided to archive all data collected and stored in the DR DAS Envista database prior to the calendar year 2021. The Envista database is housed on a virtual server managed by the Database Section of the State's Office of Information Technology (OIT).

Envista ARM (Air Resource Manager) is an application installed on staff computers that allows users to interface with the Envista database. ARM allows users to access, analyze, review, and validate data stored in the database. Multiple reports provide options for viewing and analyzing data for individual monitoring parameters from specific stations. The Envista database serves as the data archive for the AMQA monitoring network from 2008 through 2020.

4.2 Air Tools Data Warehouse

The data warehouse is an Air Online Service (AOS) module built into DEC's in-house AirTools database to augment the Envista ARM database for air monitoring. It contains QC attachments that do not 'fit' into the Envista database. These include: site photos, audit reports, flow check reports, data narratives, and reference device information including NIST certifications among others. AQS required metadata, Exceptional Events Waiver Requests (EEWR) and unusually formatted data that did not load into Envista easily (Table 1-1) are stored in the warehouse for archiving. The AirTools database is backed up nightly with the backups being retained for 5 days.

Table 1: Categories in AirTools database

Type	Category	Relevant instruments	Description
Data management, validation and verification	QC Audit	all particulate analyzers	done in Excel
	Gaseous audit	all gaseous analyzers	done in Excel
	Pb strip audit	TSP or Hi-Vol	done in Excel
	QC check	all particulate analyzers	done in Excel
	Zero Air	Met-One BAM	done in Excel
	Configuration	Met-One BAM	not in use
	TEOM configuration	TEOM	not in use
	Calibration	all analyzers	done in Excel
	Reference Device Certification	all	From manufacturer, CARB
	ZPS	all gaseous	currently automating (into Envista), will be phased out
	Met audit	all meteorological parameters	done in Excel
	Site Log	all sites	handwritten on-site logbook
	Filter field log	all Partisol 2000i and 2025i	
	DAS download comparison	all	done in Excel now included in 2nd level review
	1st level data narrative	all	Archived; not in current use 2019 forward
	2nd level review	all	includes data narrative, validation tables, etc
	Filter Lab QC	all Partisol 2000i and 2025i	Juneau filter lab, Chester Labs & Fairbanks automated weighing system
	Corrective Action	all	Phased out; now included in 2nd level review
	Shelter Temperature	all	Phased out; now included in 2nd level review
	Speciation: Chain of Custody	URG and SASS	copies of all relevant paperwork
Reports	Exceptional Events Waiver Request	submitted to EPA	EEWR box checked
	Letters	to and from EPA	EEWR box checked
	Annual Report	all	Site data reports
	Network Plan	all	annual
	Network Assessment	all	5-year
Photos	Site		
	East In		
	East Out		
	North In		
	North Out		
	West In		
	West Out		
	South In		
	South Out		

5. DATA REQUESTS

5.1 Preliminary Data

Self-retrieval of raw monitoring data is available for the public 30 days back from the current date on the AMQA real-time monitoring data website (https://dec.alaska.gov/air/air-monitoring/alaska-air-quality-real-time-data). However, final data that has been through the QC process should be used whenever possible and must always be used for peer review published research and white papers.

5.2 Final Data

Data requests for longer periods and for validated data are submitted to the AMQA Program via email or written request with a 5-business day turnaround. EPA's website API is now only in JSON format. Loading JSON data into Excel is a convoluted process that is difficult for the general public. For this reason, ADEC staff will download AQS data for most data requests. All legislative data requests are routed through the DEC Commissioner's office and forwarded to the AQ Division Director. These data are prepared by AMQA staff to provide flagging information and other metadata.

6. HARDWARE

To assure on-going data quality and avoid unnecessary data losses DEC updates air quality analyzers when new technology prompts or as instruments begin to fail as funding becomes available. The site server computers are replaced on a 5-year rotating schedule.

7. DEFINITIONS OF ACRONYMS

AMQA   Air Monitoring & Quality Assurance program within the Alaska Department of Environmental Conservation, Air Quality Division

ARM   Air Resources Manager

AQ   Air Quality

AQS   Air Quality System EPA database stores ambient air quality data

AOS   Air Online System is part of AQ's in-house web-based database

CFR   government abbreviation for "Code of Federal Regulation," which is used to reference federal regulations for example, 40 CFR 58 is the reference for Title 40, Code of Federal Regulations, Part 58

DART   Data Analysis Reporting Tool developed by the University of California Davis for management of the Chemical Speciation Network sampling data

DAS   common abbreviation for "data acquisition system," which for the purposes of this manual, represents a computer-based system that records and stores electronic signals from gaseous analyzers, and provides programmed functions to perform automated quality control checks

DBM   database manager

DEC   Alaska Department of Environmental Conservation

ENS   Exchange Network Services

EEWR   Exceptional Events Waiver Request

FNSB   Fairbanks North Star Borough

JSON   JavaScript Object Notation

LIMS   Laboratory Information Management System

MOA   Municipality of Anchorage

MTL FWS   Measurement Technologies Laboratory Filter Weighing System

NAAQS   government abbreviation for "National Ambient Air Quality Standards," which are air quality standards established in regulation under 40 CFR 50 to protect human health and the environment

NCore   an EPA program to establish a national multi pollutant monitoring network that integrates several advanced measurement systems for particles, pollutant gases and meteorology

NIST   National Institute of Standards and Technology

QA   Quality Assurance

QAPP   Quality Assurance Project Plan

QC   Quality Control

SLAMS   State and Local Air Monitoring Station

SOP   Standard Operating Procedure

SPM   Special Purpose Monitoring Station

EPA   United States Environmental Protection Agency

Appendix A: NowCast Formula

Computing the NowCast with the New Method

1. Compute the concentration range (max-min) over the last 12 hours. This tells us how much the air has changed.

> **Example 12-hour period**
>
> 50 80 75 90 82 53 64 74 21 10 16 13

2. Divide the range by the maximum concentration in the 12-hour period

> Scaled rate of change is 80/90.

3. Compute the weight factor by subtracting the scaled rate of change from 1. The weight factor must be between .5 and 1. The minimum limit approximates a 3-hour average. If the weight factor is less than .5 then set it equal to .5.

> Weight factor is $1 - 80/90 = .11$ → less than .5, so use .5

4. Multiply each hourly concentration by the weight factor raised to the power of how many hours ago the concentration was measured (for the current hour, the factor is raised to the zero power)

> $13*(.5)^0 + 16*(.5)^1 + 10*(.5)^2 + 21*(.5)^3 + 74*(.5)^4 + \ldots$

5. Compute the NowCast by summing these products and dividing by the sum of the weight factors raised to the power of how many hours ago the concentration was measured.

> $$\frac{13*(.5)^0 + 16*(.5)^1 + 10*(.5)^2 + 21*(.5)^3 + 74*(.5)^4 + \ldots}{(.5)^0 + (.5)^1 + (.5)^2 + (.5)^3 + (.5)^4 + \ldots}$$