Wisconsin Department of Natural Resources/Air Monitoring
Quality Assurance Project Plan for PurpleAir Sensor Study
QAPP 111.0

Revision 1.0
Final – September 19, 2025

By the signatures below, the Wisconsin Department of Natural Resources/Air Monitoring certifies that the information contained in this document is complete and accurate at the time of submittal to EPA Region 5

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Review and Revision History				
Revision	**Review/ Revision**	**Individual**	**Date**	**Comments**
0	NA	Jason Treutel	01/10/20	Initial Version
0.1	Review	Jamie Gauthier	1/25/2023	Minor updates and added final study details to body (*in draft form).* Additional appendices to include current PurpleAir deployments.
1	Revision	Jamie Gauthier	9/19/2025	Added in current PurpleAir deployments and changed language to past for the original project.

Review – Individual assigned has read document and provided suggestions on potential areas where updates may be needed and has evaluated the importance of making a revision.

Revision – Updates to document have been made and have gone through the review and approval process. If only a limited amount of changes have been made, note in the comments column.

A.2 Table of Contents

A.3 Overview

A.3.1 Disclaimers

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A.3.2 Definitions & Acronyms

Term	Definition
AQI	Air Quality Index
ARP	American Rescue Plan
DNR	Wisconsin Department of Natural Resources
EPA	United States Environmental Protection Agency
FEM	Federal Equivalent Method
FLEX	Updated version of the PA-II Low-cost portable laser particle counter which measures PM_{10}, $PM_{2.5}$ and $PM_{1.0.}$
FRM	Federal Reference Method
LMA-WI	Love My Air Wisconsin – works alongside schools to provide real time air quality data collected by low-cost sensors. DNR has 2 sensors on the website as part of the ARP project.
MATC	Milwaukee Area Technical College
PA-II	Low-cost portable laser particle counter which measures PM_{10}, $PM_{2.5}$ and $PM_{1.0.}$
PurpleAir	Manufacturer of the PA-II and FLEX
PM_{10}	Particulate matter 10 microns or smaller
$PM_{2.5}$	Particulate matter 2.5 microns or smaller
$PM_{1.0}$	Particulate matter 1.0 microns or smaller
QA	Quality Assurance
QAC	Quality Assurance Coordinator
QAPP	Quality Assurance Project Plan

Term	Definition
QC	Quality Control
QMP	Quality Management Plan
SOP	Standard Operating Procedures
T640/T640X	FEM used by DNR at study monitoring sites

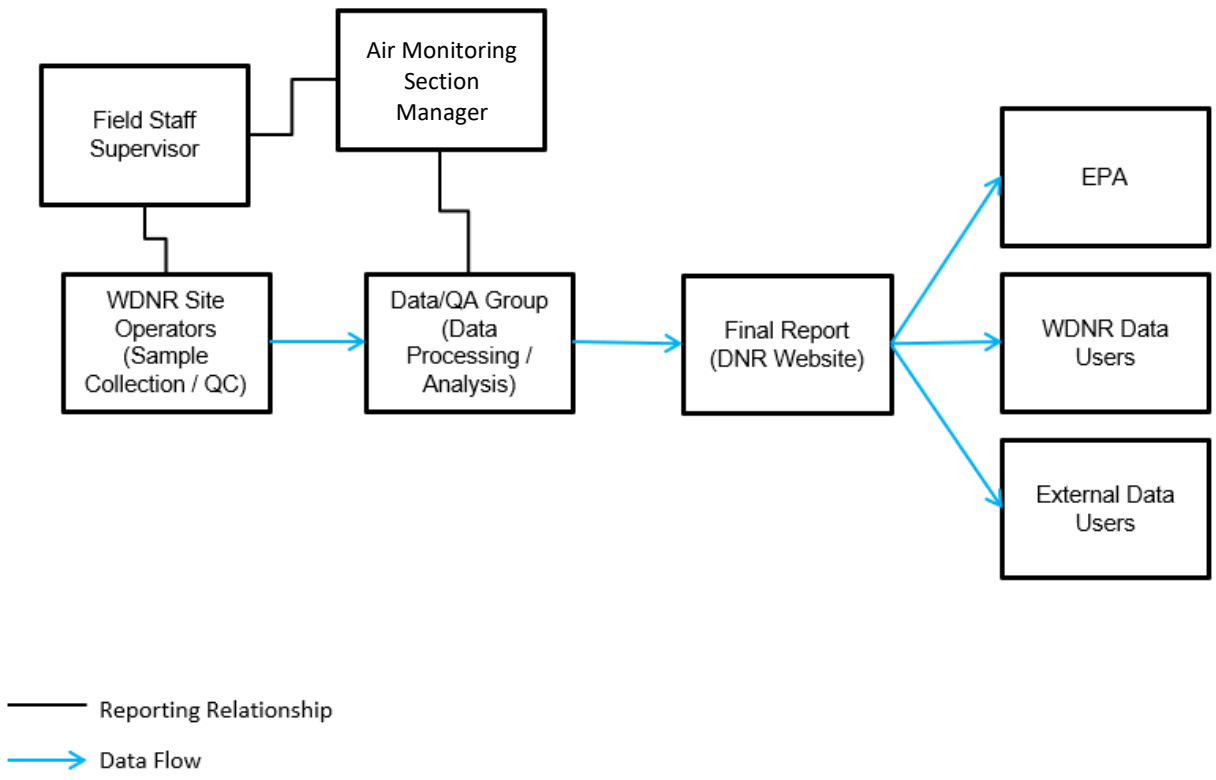
A.3.3 Distribution List

- Quality Assurance Office – US EPA Region 5
- Air Management Program Director - DNR
- Air Monitoring Section Manager - DNR
- Air Monitoring Quality Assurance Coordinator (QAC) – DNR [controlled copy]
- Air Monitoring Section Members - DNR

To contact the current employees in these roles, use the DNR staff directory available here.

A.4 Project/Task Organization

A.4.1 Organization Chart



A.4.2 Roles/Responsibilities

- Air Monitoring Section Manager is responsible for the creation and leadership of the project charter; management of Air Monitoring Data/QA staff; equipment purchasing approvals; delegation of authority to stop/resume work, primary EPA liaison
- Field Staff Supervisor is responsible for the management of DNR air monitoring site operators, equipment purchasing
- The DNR site operators are assigned as primary leads for each DNR-operated site and are responsible for routine data collection, QC checks, instrument maintenance
- The data/quality assurance (QA) Group is involved in many aspects of the network outside of site operations including data processing and analysis, quality control (QC) review, management of documentation structure and systems including QC records, documentation such as quality management plans (QMP), quality assurance project plans (QAPPs), and standard operating procedures (SOPs)
- The EPA is a potential audience for the final report; EPA provides guidelines on the use of sensors and sensor data
- The DNR data users include those involved in public outreach and are responsible for assisting with the development of a sensor study webpage where the data and assessment report may be housed for public use
- External data users may access the final report as a public record and may use it in cooperation with, or independent of, DNR for a variety of purposes including scientific research, issue advocacy or health-related studies

A.5 Problem Definition/Background

Low-cost air quality sensors are popular for personal use, research and to augment regulatory networks. Low-cost sensors provide data for more locations with smaller time intervals and at a much lower cost than regulatory methods. While the data from sensors are not designed to be used for regulatory purposes, they may be of sufficient quality to be used for qualitative purposes and potentially for quantitative purposes if data uncertainty is properly understood and communicated. There have been advancements in the technology and measurement principles which has allowed sensor companies to have federal equivalent method (FEM) sensors on the market, meaning that their sensor measurements are equivalent to the regulatory monitors, but not used for regulatory purposes.

One of the popular particulate matter low-cost sensors is produced by PurpleAir. The original PurpleAir sensor purchased by the DNR in 2019, the PA-II, is a dual laser air sensor that uses a fan to draw ambient air past a pair of Plantower PMS5003 laser sensors, which count particles to bin them in six size fractions between 0.3 and 10 µm in diameter. The particle counts are put through a proprietary algorithm to calculate particulate concentrations at size fractions of 1.0, 2.5 and 10 µm. Temperature and relative humidity sensors inside the housing of the sensor are incorporated to help provide information on potential meteorological effects on the data. Temperature reads slightly higher than ambient due to being within the sensors housing.

An updated version of the original PurpleAir sensor PA-II is the FLEX. It includes a pair of Plantower PMS6003 laser sensors accompanied with pressure, temperature and humidity sensors

and a Bosch Sensor BME688 gas sensor. Additionally, the PurpleAir FLEX has a built-in SD card for data logging and a real-time clock for offline data capture, as well as an LED light that displays different colors associated with air quality index (AQI) information, allowing the user to see AQI at a glance. The FLEX Plantower sensors are modular and can easily be replaced.

PurpleAir hosts a website that provides a data display where data from the sensors are updated in real time. There is a widespread and robust network of PurpleAir sensors across the U.S. and the world.

The PA-II and FLEX sensors have been evaluated by independent organizations and have been found to have a high precision within the methodology and good correlation to Federal Reference Method (FRM) and FEM equipment. Despite this good correlation, the relationship is typically biased higher than the regulatory method and results in poor agreement with FRM/FEM methods out of the box. This is a known limitation of the PurpleAir and other sensors.

Independent studies have been completed, which show that when correction factors are applied to data produced by PurpleAir sensors, the data is in closer agreement when compared to data produced by FRM/FEM methods. These correction factors are essentially regression models used to approximate FRM/FEM values based on sensor data input. Different studies have produced substantially different correction factors, raising concerns with regional or seasonal impacts that the correction factors have developed to date. There are multiple options for correction factors included on the PurpleAir map that a data user can apply.

Meteorological conditions (specifically relative humidity) have been found to impact data produced by particulate sensors including the PA-II and FLEX. Wisconsin has monthly variability in weather that can be drastic, often influenced regionally from the effects of the Great Lakes. With the widespread use and popularity of PurpleAir sensors, the DNR developed its own correction factor for PurpleAir sensors that can be applied to data collected within the state. The study performed in 2019 included locating a PA-II sensor to collect data at four sites across the state for 12 months. A statewide, seasonal and regional correction factor were calculated with the data collected and considered for use with the PurpleAir data. The DNR determined a single statewide correction factor is appropriate for Wisconsin.

Objectives for the PA-II study include:

- Assessment of precision among PA-II sensors to evaluate periods of sensor collocation
- Assessment of correlation between PA-II and FEM data at DNR-operated sites
- Assessment of accuracy of PA-II data compared to FEM data at DNR-operated sites
- Development of a statewide correction factor for PA-II data and assessment of any changes in the accuracy of corrected versus uncorrected values compared to FEM data at DNR operated sites
- Comparison of site-based versus statewide correction factors to determine the sensitivity of correction factors to Wisconsin regional weather patterns
- Comparison of seasonal derived versus statewide correction factors to determine the sensitivity of correction factors to Wisconsin seasonal weather patterns

A.6 Project/Task Description

The DNR's study of the PA-II sensor was intended to include the following activities:

- Field
    - Purchased five PA-II sensors with Wi-Fi capability
    - Developed operation procedures for the sensors including setup, operation and data acquisition
    - Performed an initial collocation study which included deploying all five PA-II sensors at the Appleton monitoring site for seven days
    - Deployed sensors to four DNR monitoring sites for 2019 to compare against T640 and T640X data for $PM_{2.5}$; did not compare against T640X data for PM_{10}
        - Appleton (T640) (x2)
        - Eau Claire (T640)
        - Madison East (T640)
        - Waukesha (T640X) (initial location of primary PA-II vs. collocated PA-II)
    - Moved the spare PA-II sensor used for collocation to each of the monitoring sites for periods of at least seven days throughout the course of the one-year deployment to evaluate continuing precision.
    - Performed final collocation study by re-deploying all five PA-II sensors at the Appleton monitoring site for seven days.
- QA/Data
    - Performed initial assessment of within-method collocation (PurpleAir vs. PurpleAir)
    - Developed data gathering/cleaning methods and tools for interpreting the data
    - Developed a statewide correction factor based on one year of data collection
    - Performed final assessment of within-method (PurpleAir vs. PurpleAir) collocation; characterized any changes in sensor precision over one year of operation
    - Assessed regional correction factors versus statewide correction factor based on full year of data
    - Assessed statewide seasonal correction factors versus the statewide correction factor based on a full year of data
- Communication and Outreach
    - Developed a report summarizing the data and assessments from the PA-II study
    - Developed materials for citizen science projects regarding setup of PurpleAir sensors and considerations for designing an independent monitoring study
    - Shared Data collected during the 2019 project with EPA, which was used in their nationwide correction factor that is currently included on the PurpleAir map

A.7 Quality Objectives and Criteria

The DNR's study of PurpleAir sensors included evaluation of precision within the method and evaluation of correlation and accuracy versus regulatory FEMs. Correction factors were developed for the study which included separate correction factors for each site and season to assess regional and seasonal differences. The three correction factors, regional, seasonal and statewide, were compared against each other and it was determined that a single year-round

statewide correction factor was the best option for the PurpleAir data collected in Wisconsin. The image below shows the correction calculation and comparison between all three calculated slope and intercept factors.

PAc = PA * Slope + Intercept

Type	Slope	Intercept
statewide	0.5140	1.8304
appleton	0.5668	1.1882
eau_claire	0.4698	2.4493
madison_e	0.4697	1.7169
waukesha	0.5170	2.1206
01_winter	0.4896	2.7182
02_spring	0.4975	2.0540
03_summer	0.6093	0.7733
04_fall	0.4873	1.8478

A.7.1 Sensor Precision

Precision of the PA-II sensors were evaluated to provide information regarding the degree of variability that is typical both within a sensor (comparing channel A to channel B) as well as among different sensors (comparing collocated sensors). Both types of comparisons were made before and after the study. Short-term collocations took place throughout the study, as a spare PA-II sensor was transported across the state to collocate with the four permanent PurpleAir sensors.

Within-method precision assessments were made based on 24-hour daily data:

- Comparison of daily A versus B channel data for each sensor
- Comparison of sensor 1, 2, 3, 4 and 5 versus the sensor average for A channel only, B channel only, and A/B channel average (minimum of four sensors with valid data to make the comparison)
- Determination of any trend in collocation assessment over the course of the one-year study (before, during, after)
- Determination of any time-based effects on trends in collocation assessment by repeating assessment using 1-hour data

A.7.2 Assess Data Screening Rules

The DNR developed business rules to screen the data. These rules loosely followed the EPA screening rules inspired by the A/B channel thresholds (e.g., when preliminary review of sensor A/B data show instances of channel disagreement).

A.7.3 Sensor / Regulatory Method Correlation and Accuracy

The assessment of the PurpleAir data versus regulatory instruments used daily averages because the PM standards are based on daily measurements; however, shorter time frames such as hourly were also examined. These comparisons include assessments of both the correlation and accuracy of the sensor versus regulatory data. These assessments were performed on different

data subsets as described in following sections.

- Correlation was assessed by comparing PA-II daily and hourly averages versus T640/T640X daily and hourly averages
    - Daily averages were compared if data from both sources were ≥ 75% complete (75% of possible hourly averages are complete)
    - Hourly averages were compared if data from both sources were ≥ 75% complete
        - PurpleAir sensors data used the average of the A and B channels (A+B)/2 when available and substituted data from either channel when one was missing

- Accuracy was assessed by comparing direct difference and percent difference
    - Direct difference used PA-II – Regulatory for complete daily and hourly averages
    - Percent difference used (PA-II – Regulatory)/Regulatory for complete daily and hourly averages where both values were greater than or equal to 3.0 ug/m^3

A.7.4 Determine and Assess Statewide Correction Factor

The desired outcome of the study was to develop a statewide correction factor that could be used year-round. The DNR met this goal.

- Correction factor development of an assessment based on 24-hour daily data
    - Assigned data to two groups
        - Training data set – 75-90% of scheduled data
        - Test data set – 25-10% of scheduled data
            - Test data was taken from across all sites and seasons (e.g., stratified random sample across sites and seasons)
    - Assessed training and test data sets for sensor versus FEM agreement
        - Determined average of the daily differences
        - Determined standard deviation of the daily differences
    - Developed correction factor using training data set
        - Linear regression of sensor versus FEM data
    - Assessed correction factor
        - Compared observed FEM versus corrected sensor data for both training data and test data sets
            - Determined average of the daily differences
            - Determined standard deviation of the daily differences

A.7.5 Determine and Assess Site-Based Correction Factors

It is understood that particulate characteristics may vary from location to location. To determine if a statewide correction factor is appropriate, site-based correction factors were developed and compared to the statewide correction factor to determine if results were sufficiently different (≥ 10%) to warrant separate regional correction factors.

- Correction Factor assessment for regional variability
    - For sufficient sample sizes (> 50% complete for a month of the study, with a minimum of ten samples per stratum), the training and test data groups from A.7.4 were used, but data from the sites were kept separate

        - Developed site-specific correction factors using site-specific training data sets using the techniques from A.7.4
    - Assessed site-specific correction factors by applying the site-specific correction to both the site-specific training and test data sets
        - Determined average of the daily differences
        - Determined standard deviation of the daily differences
    - Assessed the statewide correction factor for each site
        - Determined average of the daily differences calculated in A.7.4 (by site), for both training and test data sets
        - Determined standard deviation of the daily differences calculated in A.7.4 (by site), for both training and test data sets
    - Compared the averages of the site-level daily differences and standard deviations from the statewide and site-based correction factors. Determined if and how differences between observed and predicted averages varied between approaches.

A.7.6 Determine and Assess Seasonal-Based Correction Factors

It is understood that particulate characteristics may vary from season to season. Season-based correction factors were developed at the statewide level and compared to the statewide correction factor based on a full year of data to determine if results are sufficiently (≥ 10%) different to warrant separate seasonal correction factors.

- Correction Factor assessment for seasonal variability
    - For sample sizes deemed sufficient (>50% complete for a month or the study, with a minimum of ten daily and 30 hourly samples per stratum), the training and test data groups from A.7.4 were used but seasonal data were kept separate; otherwise, the test data group was not separated out
        - Season-specific correction factors were developed using season-specific testing data sets and the techniques from A.7.4
    - Assessed season-specific correction factors by applying the season-specific correction to the season-specific test data sets
        - Determine average of the daily differences
        - Determine standard deviation of the daily differences
    - Assessed the full-year correction factor for each season
        - Determine average of the daily differences calculated in A.7.4 (by season), for both training and test data sets
        - Determine standard deviation of the daily differences calculated in A.7.4 (by season), for both training and test data sets
    - Compared the averages of the season-level daily differences and standard deviations from the full-year and seasonal correction factors. Determine if and how differences between observed and predicted vary between approaches.

A.8 Special Training/Certification

PurpleAir sensors are used by the general public while receiving a basic level of support from the

PurpleAir manufacturer. The DNR site operators install, operate and maintain the sensors throughout the duration of the project(s).

Training requirements varied depending on the role being performed.

- The DNR QA/Data staff who analyzed PurpleAir data were familiar with the PurpleAir Sensor Study QAPP, PurpleAir data retrieval, data analysis tools and statistics
- The DNR Site Operators who operated PurpleAir sensors were familiar with the PurpleAir Sensor Study QAPP, PurpleAir sensor installation PurpleAir data retrieval, general siting criteria for collocation of particulate samplers found in 40 CFR Part 58.
- The DNR Field Lead was familiar with the PurpleAir Sensor Study QAPP, PurpleAir sensor installation, PurpleAir data retrieval, general siting criteria for collocation of particulate samplers found in 40 CFR Part 58

A.9 Documents and Records

The DNR creates and maintains documents per the DNRs Retention Disposal Authorization document and Documentation SOP.

A.9.1 QMP/QAPPs/SOPs

Final versions of the QMP, QAPPs and SOPs are maintained on an electronic file share (/airmon) which is accessible to DNR employees with access to the shared network. Control of these documents is managed by the air monitoring QAC or designee. Archived versions of retired documents follow the RDA.

When a new or revised document is finalized, it is sent as an attachment to all appropriate personnel, or a notification is sent advising staff as to where it may be accessed.

A.9.2 Data

A file share accessible by the Field Lead and QA staff was used to house the data and the resulting analysis tools, outputs and reports. This file share included:

- Raw data downloaded from PurpleAir sensors
- R programs used to aggregate and evaluate PurpleAir data
- R programs used to compare PurpleAir data with FEM data
- Data output from R programs
- Analysis documents in Excel

A.9.3 Reports

The final report summarizing the work from this project is included on the file share /airmon in addition to the DNR website for the public to access. The DNR Air Management Program Director approved the report linked on the DNR Air Monitoring website: Air Quality Monitoring | | Wisconsin DNR. The final report is located at: Wisconsin 2019 PurpleAir study report.

B. Data Generation and Acquisition

B.1 Sampling Process Design (Experimental Design)

Five PurpleAir PA II sensors were purchased and deployed to four sites following an initial seven-day collocation study. These sites are distributed across the state and have continuous FEM methods operating. The PurpleAir data was compared to data collected from the FEM instruments. The sites and collocated equipment as area listed below:

- Appleton – T640 (2)
- Eau Claire – T640
- Madison East – T640
- Waukesha – T640X

The sensors and the collocated FEMs sample on a continuous basis. Data is integrated and evaluated in daily and hourly averages. The project period consisted of site deployments lasting one full year at the four chosen locations.

A fifth sensor for QA purposes was initially located at the Waukesha site but then moved to the other sites throughout each quarter over the course of the project period to assess method precision.

B.2 Sampling Methods

The DNR uses T640/T640X samplers for regulatory data collection and did not require any alterations in operations. They follow the practices defined in the Low-Vol PM2.5 and PM10 – Filter Based and Continuous QAPP and T640X SOP.

PurpleAir sensors operate passively and do not require any operations activity beyond installation and data telemetry. Data was reviewed on a weekly basis to confirm each sensor's A and B channels were reading similarly. If a malfunction became apparent through the data, the sensor was physically inspected for any signs of damage or blockage. The Field Lead was responsible for communication and consultation with the PurpleAir manufacturer in any situation where a remedy was not readily apparent.

B.3 Sample Handling and Custody

The PurpleAir and T640 methods perform in situ measurements and did not produce any physical samples. No sample handling or chain of custody procedures were required.

B.4 Analytical Methods

The PurpleAir and T640 methods perform in situ measurements and did not produce any physical samples which require analysis.

B.5 Quality Control

T640 quality control follows the practices defined in the Low-Vol PM2.5 and PM10 – Filter Based and Continuous QAPP and T640X SOP. These practices include:

- Leak checks
- Flow, temperature and pressure verifications
- PMT verifications

The PurpleAir sensors do not have flow requirements. The sensor package includes a temperature and relative humidity sensor, but the particulate matter measurements are not dependent on these values.

PurpleAir A and B channel graphs were reviewed weekly to identify potential sensor failure. Temperature and relative humidity information were evaluated only to determine if the readings are sensical. The data from these sensors was used anecdotally to determine if there were temperature or relative humidity conditions that cause correlation and accuracy to improve or degrade.

B.6 Instrument/Equipment Testing, Inspection and Maintenance

T640 testing, inspection and maintenance followed the practices defined in the Low-Vol PM2.5 and PM10 – Filter Based and Continuous QAPP and T640X SOP.

The five PurpleAir sensors were collocated for seven days at the Appleton site prior to the start of the year-long study to determine if they are functioning properly and reading similarly out of the box. Sensors reported to the PurpleAir website as private network sensors for the duration of the project.

Once installed at individual sites the sensors were visually inspected on a monthly basis by site operators to ensure general cleanliness, since PurpleAir sensors are said to be maintenance free.

B.7 Instrument/Equipment Calibration and Frequency

T640 calibration activities followed the practices defined in the Low-Vol PM2.5 and PM10 – Filter Based and Continuous QAPP and T640X SOP.

PurpleAir sensors have no calibration requirements for normal operation and cannot be challenged by standards in a meaningful way. Collocation studies and the evaluation of the A and B channel agreement were the only way to gauge the performance of these sensors throughout the study. Collocation of all five sensors was conducted at the beginning and end of the study. The 5^{th} sensor was collocated at each of the four sites periodically throughout the yearlong study. A weekly check of A and B channel comparisons took place to observe any major pervasive channel disagreement, and indication of a sensor malfunction. Further analysis or investigation took place if any issues were known to be present.

B.8 Inspection/Acceptance of Supplies and Consumables

The PurpleAir equipment does not require any supplies and consumables. The T640 requires span dust that is purchased and inspected as part of normal operations.

B.9 Non-Direct Measurements

Limited meteorology data is obtained from the T640 or PurpleAir sensors. Additional meteorology information was obtained from onsite meteorological equipment or from nearby stations which are operated by the DNR or other entities.

B.10 Data Management

Data records for the T640s were generated throughout the collection and QA process. Data were generated by samplers, logged using an on-site or off-site computer program, transmitted to a central server database for review and processing and ultimately sent to AQS. Data retrieved from site loggers are reviewed on a periodic basis and again in detail during the monthly data review. Data submitted to AQS are reviewed upon submittal and again in detail during the annual data certification process. Any errors or data abnormalities detected are investigated and resolved.

Data records for PurpleAir are sent to the PurpleAir website in real time and were reviewed weekly on the PurpleAir website and downloaded monthly to a DNR file share. Precursory review of the data min/max information was done on a monthly basis. Data was reviewed as part of the correlation and accuracy analysis of this study.

Data screening rules were applied to the PurpleAir data for the duration of the project.

C Assessment and Oversight

C.1 Assessments and Response Actions

Preliminary method collocation data was be evaluated early in the study to help define expectations of precision and accuracy.

C.2 Reports to Management

This study was conducted for internal purposes. A final report was completed and shared with management at the conclusion of the study. The study results were shared with external entities by means of presentations and a final report.

D Data Validation and Usability

D.1 Data Review, Verification and Validation

The criteria used to review and validate data have been detailed in the above sections, predominantly in A.7 and B.5.

D.2 Verification and Validation Methods

[Reserved]

D.3 Reconciliation with User Requirements

[Reserved]

APPENDIX A: References

Quality Assurance Project Plan: $PM_{2.5}$ and Low Volume PM_{10} Networks QAPP 1.0

Standard Operating Procedure: TAPI T640X Particulate Monitor SOP 4.3

EPA Nationwide Correction Factor Study: PurpleAir $PM_{2.5}$ performance across the U.S.

APPENDIX B: Forms

[Reserved]

APPENDIX C: PurpleAir Sensor Study Deployments

Appendix C.1 2021 Longevity Study

Following the completion of the 2019 statewide PurpleAir study, two of the five PurpleAir sensors were used in a longevity study. Typically, the lifetime of the PurpleAir Sensor is two years, so this study was done to test how the sensors performed outside of that two-year window. The sensors were in place between April 2021 and September 2021. Initial analysis and observation showed that the sensors seemed to age well and show agreement during this period of sample collection. Further analysis is planned as resources and time allows.

Appendix C.2 2021/2022 PurpleAir PM1.0 Study

The Wisconsin DNR continues to learn about the PurpleAir sensors by collocating them with regulatory instruments across the state. In 2021/2022, the DNR had T640s set up to monitor $PM_{1.0}$. Those sites included: MAML (Mobile Air Monitoring Laboratory), Milwaukee 16th St. and Trout Lake. A combination of PA-II-SD and PA-II FLEX were deployed at these sites (Trout Lake (1 PA-II-SD), MAML (1 PA-II-SD), Milwaukee 16th St. (2 PA-II FLEX). The deployment started in October 2021 and sensors were planned to be located at these sites for at least one year. Due to the seasonality of the MAML, the deployment and collocation with the T640 occurred during April 2022-October 2022. The PurpleAir at the Trout Lake site was removed in March 2023. Milwaukee 16th St still hosts collocated PurpleAir sensors.

Unlike the 2019 study, WiFi was not available at any of the locations, so data was downloaded from the mini-SD card monthly by the site operators. During the visit, site operators connected the sensors to a mobile hotspot to verify the sensor was functioning. The brief connection would allow the sensor to be updated to the newest firmware and allow the operator to check parameters such as sensor agreement, temperature and RH sensor performance and verify the SD card correctly collected data.

Multiple sensors showed issues during their deployment, with many needing to be replaced due to sensor disagreement and SD card communication. Milwaukee 16th St. needed two sets of replacement sensors during the sensor deployment.

Data analysis will be done as time and resources allow.

Appendix C.3 Sensor Loan: Milwaukee Area Technical College

The DNR hosts collect students from the Milwaukee Area Technical College (MATC) in Milwaukee for air monitoring lab and site tours for many years with a goal of learning about instrumentation and air quality. In 2023, the DNR loaned two PurpleAir sensors used in the 2021 $PM_{1.0}$ study to faculty at MATC-Mequon to use with students to teach and study $PM_{2.5}$ monitoring. With access to these sensors, students had access to hands on learning opportunities focusing on siting, data collection and quality assurance without the high expense associated with regulatory equipment. The DNR has continued to loan these sensors to MATC for student use in each subsequent Fall semester.

Appendix C.4 ARP Milwaukee Monitoring Project: Microscale Ambient Air Monitoring with focus on Port of Milwaukee and Surrounding Communities (2023-2027)

The DNR received an American Rescue Plan (ARP) award in 2023 and began the Milwaukee Monitoring Project. The DNR Air Program, in partnership with EPA, Sixteenth Street Community Health Center (SSCHC) and other groups intend to determine local hotspots using regulatory and sensor-based community-scale monitoring combined with local emission inventory data that we already collect.

Five PurpleAir sensors were purchased for the project to be dispersed throughout the study area. One was located at Escuela Verde, which is a public charter school in Milwaukee, Wisconsin and within the study area. The PurpleAir sensor was installed in June 2024 on the building facing towards source pollution, including locomotive, parkway and riverine impacts. The location is away from direct roadway impacts. For the ARP Project, the DNR displays data collected by the sensors on the PurpleAir site and the Love My Air Wisconsin (LMA-WI) webpage. Students use the data collected by the PurpleAir sensor for class projects. Another PurpleAir sensor was installed at the Milwaukee Police Department (District 2) in March 2025, and a third placed at the Mitchell Park Horticultural Conservatory, locally known as the Domes (Summer 2025). The final two sensors are as of yet unlocated in the study area.

The projected end date for the project is in early 2027 and PurpleAir sensors will be deployed through the entirety of the project. The Milwaukee Port Project has allowed the DNR to work with community groups interested in air quality and partner with them to host the low-cost air quality sensors. Data from the PurpleAir will be analyzed and shared in a final report at the end of the project period.