Confederated Tribe of the Colville Reservation
Ambient Air Quality Monitoring Program

QUALITY ASSURANCE PROCEDURES
FOR THE
BETA ATTENUATION MONITOR

July, 2023
Version 1 Revision 1

Colville Confederated Tribes
Environmental Trust
1 Colville Street
Nespelem, WA 99155

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Acronyms and Abbreviations

ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
CAA	Clean Air Act
CCT	Colville Confederated Tribes
CV	coefficient of variation or sample standard deviation divided by mean
CFR	Code of Federal Regulations
COC	chain of custody
DQA	data quality assessment
DQOs	data quality objectives
EPA	Environmental Protection Agency
FEM	Federal equivalent method
MQOs	measurement quality objectives
MSR	management system review
NAAQS	National Ambient Air Quality Standards
NIST	National Institute of Standards and Technology
OAQPS	Office of Air Quality Planning and Standards
PM10	particulate matter $\leq$ 10 microns
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
RPD	relative percent difference
SOP	standard operating procedure
Tribes	the "Colville Tribes"
T_a	temperature, ambient or actual
TSA	technical system audit
TSP	total suspended particulate
V_a	air volume, at ambient or actual conditions

The Colville Tribes' Environmental Trust hereby adopts **Part II** of the Colville Air Monitoring Quality Assurance Project Plan.

01/24/2024

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1.0 PROJECT ORGANIZATION

1.1 The Role of the Colville Air Program

Colville incorporates quality assurance activities as an integral part of their program, gathering environmental data from work in the field, from their own data analysis and reporting, and from any consulting and contractor laboratories which they may use. The following sections list the responsibilities of the Colville air quality staff.

Colville Air Quality Program Manager (AQPM)

The Air Quality Program Manager has overall responsibility for managing the Colville air monitoring program, and is responsible for establishing QA policy and for resolving QA issues identified through the AQ program. Major QA-related responsibilities include:

- Assuring that Colville maintains this QAPP and ensures adherence to the document by staff, and where appropriate, outside contractors and consultants;
- Reviewing and implementing this QAPP, upon EPA approval;
- Ensuring that reviews, assessments and audits are scheduled and completed, and at times, conducting or participating in these QA activities;
- Serving as the program QA liaison with EPA regional QA Managers or QA Officers and the EPA regional Project Officer.

The AQPM is also responsible for carrying out the work in the field and ensuring that the data they gather meet the requirements of this QAPP. Their responsibilities include:

- Participating in training and certification activities;
- Verifying that all required QA activities are performed and that measurement quality standards are met as required in this QAPP;
- Following all manufacturer's specifications;

1.2 The Role of EPA Region 10 Staff

EPA's Region 10 Office is responsible for the following activities in support of this program:

- Reviewing, providing assistance with, and approving this QAPP;
- Responding to requests for technical and policy information and interpretations;

- Evaluating quality system performance through technical systems audits, performance evaluations and network reviews, as appropriate for each grant and the tribal air office; and

- Making available the technical and quality assurance information developed by EPA to the tribal agencies, and making the tribe aware of any unmet quality assurance needs of the tribal agencies;

1.3 Role of Contractor

Contractor will provide technical support services to the Colville Tribes, under a year to year **Services Contract, Appendix A**. Services to be provided include:

- Provide On-Site Technical Assistance with Equipment Set-Up. Contractor will provide scheduled on-site visits to the Colville Tribes monitoring station, to provide technical assistance to the Colville Air Program staff in setting up the housing facility for the BAM 1022, putting the BAM into operation, and setting up the telemetry system for the BAM.

- Provide Technical Assistance and Training in Equipment Operation and Maintenance Procedures. Contractor will assist the Colville air quality staff in developing, understanding and performing the required operation and maintenance procedures for the BAM 1022, per manufacturer's specifications and in accordance with this QAPP.

- Assist with Quality Control Procedures. Contractor will train Colville's Air Quality Program Manager in performing regular quality control procedures.

- Perform Quarterly Quality Assurance Audits. Contractor will work with Colville staff to conduct four quality assurance audits, once each quarter. The audit will be performed on the BAMs operated by Colville, at the Nespelem and Inchelium locations. If the audit shows that the Colville sampler is outside of ±7% agreement, then Contractor will assist Colville in performing a flow calibration before the next sample run.

- Documenting deviations from established procedures and methods, assessing and reporting data quality, and flagging suspect data.

2.0 BACKGROUND

The principal pollutants, also called criteria pollutants, are: particulate matter (PM2.5, PM10), sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead. In 1970, the Clean Air Act (CAA) was signed into law. The CAA and its amendments provide the framework for all pertinent organizations to protect air quality. This framework provides for Colville's monitoring of PM2.5.

The objectives of the Colville air program are to:

- Determine ambient air quality conditions within the Colville Reservation airshed;
- Assess air quality relative to the national primary and secondary 24 hour ambient air quality to determine if regulatory monitoring is necessary;
- Provide baseline monitoring in the region to inform residents.

3.0 PROJECT DESCRIPTION

3.1 Methods

Colville will use a Beta-Attenuation Monitor (BAM), which incorporates the analysis of mass per cubic meter of air volume as an internal component of the instrument. These automated instruments do not require the use of a laboratory or the analysis of a filter.

This instrument manufactured by MetOne, model number 1022, measures particulate, 2.5 micron and smaller size, mass concentration in ambient air and is used in accordance with manufacturer instructions (Met One Instruments, BAM-1022 Particulate Monitor Operation Manual, 2000). The method used is the Beta Attenuation Monitor. This QAPP addresses the configuration and operation of the instrument for PM2.5.

3.2 Schedule

Operation of the BAM 1022 and collection of data samples will begin by June, 2024. Measurements will be collected on a continuous basis.

3.3 Sampling Location

The location selected for the BAM sampler is representative of air that members of the Colville community are breathing, as it is situated near tribal homes, office buildings, a tribal school and community service buildings. It is representative of the neighborhood scale of monitoring, as described in 40 CFR 58 Appendix E. There are two major sources located within the general area represented by the monitoring location. Colville Tribes operates 2 non-regulatory 1022s. Map of locations are attached, please see Appendix D. Degrees-minutes-seconds are as follows:

- Inchelium: The site is located at 48°17’48.80"N and 118°12'08.98"W
- Nespelem: The site is located at 48°09'55.15"N and 118°59'03.04"W

3.4 Quality Objectives and Criteria for Measuring Data

Measurement quality objectives (MQOs) are the translation of the DQOs into parameters that are directly measurable. The MQOs are set so that if they are met, the data user can assume that the DQOs have been met. MQOs are designed to evaluate and control various phases (sampling, preparation, and analysis) of the measurement process. Information regarding these objectives and their use can be found in the US EPA's Quality Assurance Handbook, Volumes I and II. MQOs can be defined in terms of the following data quality indicators:

- Accuracy
- Precision
- Bias
- Representativeness
- Detection Limit
- Completeness
- Comparability

The objective (goal) for the precision uncertainty of the flow rate of this automated equipment is a relative percent difference (RPD) between the external flow rate transfer standard and the actual instrument flow rate of 7% or less for every check. The objective for overall accuracy, which includes both bias and imprecision, is 10%. The accuracy is estimated at least once each quarter using a manufacturer-supplied check device that assesses instrument response to a known signal (transmittance for BAM using a foil calibration factor verification kit). The manufacturer specifications for the BAM unit are more stringent than these objectives. The **BAM Operation Manual**, **Appendix C**, table 7, lists an accuracy (total error) for a 24 hour measurement of + 3 μg/m3 for concentrations less than 100 μg/m3.

The specific methods for calculating their values for the measurement quality objectives (MQOs) of accuracy (total estimated error) and precision are described in sections 14 and 24. The MQOs are consistent with those used by the US EPA and the air quality community, as described in the US EPA Quality Assurance Manual, Vol. II Part 1, (EPA-454/R-98-004, August 1998) commonly termed the "Redbook" for general quality system and audit requirements, and 40 CFR 58 Appendix A for nomenclature, frequency and type of instrument checks, and data reporting.

Various parts of the 40 CFR have identified acceptance criteria for some of these attributes as well as the EPA Quality Assurance Handbook, Vol. II, Part II. In theory, if these MQOs are met, measurement uncertainty should be controlled to the levels required by the DQO. Table 3.1 lists the MQOs for the PM measurements.

Table 3.1
PM Measurement Quality Objectives for Automated (Continuous) Beta-Attenuation Monitor and Equipment

Requirement	Frequency	Acceptance Criteria	Reference
Reporting Units	All data	Micrograms/cubic meter ($\mu g/m^3$)	40 CFR 50.7
Calibration of air office's external flow rate transfer standard used by air office to routinely verify flow rate of monitor	Purchased at beginning of program, and sent to MetOne for recalibration	Calibration certificate must show that the flow rate is within 2% of the standard used by the calibrator, and that their standard is traceable to NIST	40 CFR 53.3 (B) (2)
Lower limit of detection	Ongoing	1 µg/m3 over a 24-hour period	
Completeness	Calculate each quarter	75%	40 CFR 58 Appendix A
Verification of sampler's clock	Once per month	±5 minutes of external clock	
Verification of the sampler's flow rate	One-point check of flow rate with the external flow rate transfer standard at least once a month, per new federal requirements.	Flow rate of sampler must be within 7% relative percent difference (RPD) of the flow rate shown by the transfer standard, and within 10% RPD of the design flow rate.	40 CFR 58 Appendix A section 3.2.3 and "QA Guidance for Continuous PM Analyzers," (memo from USEPA QA Branch, 11/3/95
Verification of sampler's temperature and pressure	At least one time per month	Sampler's temp should be within 2º of the temp read by an external thermometer Sampler pressure should be within 10mm hg of the pressure read by an external barometer	
External audit of sampler flow rate, using a flow rate transfer standard other than the one routinely used by the air office to verify sampler's flow rate.	Once every six months.	Each flow rate assessment must agree with the external flow rate transfer standard to within 15%, and preferably closer	40 CFR 58 Appendix A
Self-check conducted using the automatic internal membrane	Ongoing conducted automatically by the instrument	Error code produced and recorded in the log if the expected counts are not within 5% of the specifications (or see owner's manual)	See owner's manual

3.5 Special Training Requirements/Certification

The Colville Air staff participates in training as the primary means of program education. If new people should begin work at the tribal air office, they would be assigned to work with an experienced staff person, read this QAPP, SOPs and other documents and resources within the program to gain experience and knowledge of their duties. It is also advisable to be comfortable with calling the instrument vendor and maintaining a relationship with someone from the technical assistance department of the vendor.

In addition, all staff involved in this program will be given their own copies of this QAPP and the SOPs and guidance referenced in this QAPP. Sufficient time (at least 16 hours) will be provided by management to the personnel directly involved in this project (including field technicians) to read and understand this and all the referenced documents.

The Colville air staff will also monitor the availability of training courses offered by EPA's Air Pollution Training Institute and Region X facilities, Northern Arizona University's Institute for Tribal Environmental Professionals (ITEP), Washington Department of Ecology, the equipment vendors, and private consulting firms. When appropriate, staff members may be enrolled in one or more training courses offered by these institutions.

4.0 DOCUMENTATION AND RECORDS

The Colville Air Program is committed to fully document all activities relating to data collection, analysis, validation, and reporting. The custody documentation requirements outlined below will ensure that the disposition and location of the data records are known, and that the data are legally defensible.

All field quality control (QC) procedures, instrument malfunctions, on-site repairs and maintenance, and out of control conditions are recorded on standard forms and kept in site logbooks. Site logbooks are numbered and labeled with applicable dates and site identification. All standard forms are retrieved from monitoring sites on a monthly basis by the site operator, duplicated and copies returned to the appropriate monitoring site and reinserted in the site logbook. The original forms are reinserted in an annual logbook with all forms from all sites for that year, and kept in a secure cabinet in the tribal office. The Director of the Colville Environmental Trust is responsible for oversight of the collection and maintenance of all field records.

Primary data collection from Colville's continuous PM site is accomplished with a data logger. The data logger (internal to the BAM) will be polled every month using a portable laptop computer. When the telemetry or modem system is operational, data will

be pulled on a continuous, 24-hr basis. Each time information from the sampler is downloaded, the person doing so will note this on the chain of custody record form. (Section 7 describes chain of custody procedures.) When continuous flow chart records, data forms, and other data records are moved, recorded, or any parameters altered, detailed information about what happened is recorded on the site or operator's logbook, the chain of custody form, and, if a measurement or calibration/verification conducted, on a field data sheet.

The PM data, charts, and other data records are analyzed and validated at least once per month by Colville's Air Quality Manager. Once validated and the data entered, the data are stored electronically on our in-house computer and are backed-up onto a CD-ROM disk. The Air Quality Manager, with technical assistance from contractors, is also responsible for the configuration, operation and management of the data acquisition system, configures the modems connecting the sites and programs the site data loggers, and is also responsible for processing, compiling, analyzing and reporting the data collected.

All the information will be kept for 3 years after it is gathered. However, if any litigation, claim, negotiation, audit or other action involving the records has been started before the expiration of the 3-year period, the records are retained until completion of the action and resolution of all issues which arise from it, or until the end of the regular 3-year period, whichever is later.

(Note: Data transmittal occurs whenever information is transferred from one person or location to another or copied, by hand or electronically, from one form to another. Some examples of data transmittal are copying raw data from a notebook onto a data entry form for keying into a computer file and electronic transfer of data over a telephone or computer network. The Air Resource Specialist will be assigned the task of making a random selection of at least five percent of the data during each quarter that has been transmitted from one form to another, checking its accuracy. This check and the results will be documented in the records for data validation.)

5.0 SAMPLING DESIGN

This section describes the rationale for the locations of the measurements, the frequency of sampling, the types of samplers used at each site, and the location and frequency of the performance evaluations. The network design components comply with the recommendations in 40 CFR Part 58 Section 58.13, Appendix A and Appendix. D. Siting criteria comply with 40 CFR Part 58 Appendix E.

5.1 Project Schedule

This project involves measuring PM concentrations at two locations, using the BAM 1022.

Table 5.1. Schedule of Sampling-Related Activities

Activity	Due Date	Comments
Order samplers	Complete as of 10/05/23	
Receive samplers	Complete as of 11/05/23	
Install sampler at Colville Nespelem & Incheluim	To be Completed by 6/1/2024	
Begin routine sampling at Colville Nespelem & Inchelium	Sampling to be begin 6/1/24	
Report routine data to AIRS-AQS	Ongoing - due within 90 days after end of quarterly reporting Period	
Performance Evaluations	Informal evaluations are ongoing; formal evaluations occur annually	
Review internal and external QA reports	Ongoing	Needed to determine which, if any, samplers fail QC limits.
Primary network review	Annually	Evaluate reasonableness of siting, frequency, number of samplers.
Evaluate location of samplers	Annually	At time of network review.

6.0 SAMPLING METHODS

Colville will be collecting air quality data on for the Colville Reservation, gathering information to compare with future measurements and for non-compliance purposes. This method provides for measurement of the mass concentration of particulate matter having an aerodynamic diameter less than or equal to a nominal 2.5 micrometers (PM2.5) in ambient air over a 24 hour period, and in turn, may be used to assess AQI and if regulatory monitoring is needed. Non-FEM samplers with sharp cut cyclones (SCC) replacing very sharp cut cyclones (VSCC) will be used as the monitor for collection of data. The sampler shall be installed with adherence to procedures, guidance, and

requirements detailed in U.S.EPA QA guidance documents, the sampler manufacturers operation manual; the tribal air office's field SOPS; and this QAPP.

6.1 Method Overview

A modified inlet, originally developed for the dichotomous sampler, is used as the sampling inlet for the PM2.5 BAM. The inlet achieves proper particle size separation at a sampling rate of 16.7 L/min, the design flow rate of the instrument. The inlet employs an omnidirectional cyclone fractionator, which allows the particles to enter from any angle of approach. An angular impetus is imparted to the particle motion via the eight, evenly-spaced entrance vanes. As the particles enter the inlet, they follow the fluid stream lines along the lower radius and enter the cyclone fractionator through the vane system. Particles are removed on the oiled surfaces of the inner collection tube. The transmitted particles then enter the middle tube, where the flow direction is altered. A final turn is made giving the particles a downward trajectory to the collection filter. On this path a sharp cut cyclone is employed, this cyclone differs from the very-sharp cut in that it is non-regulatory.

A low-activity, low energy carbon-14 radioactive source is mounted into the fixture positioned beneath the filter tape. In no case should the front (top) surface of the source or source fixture be touched. Should the source laminate become scratched, the radioactive material may leak. A damaged source must be returned for disposal and replacement. The radioactive source has the following characteristics: (1) an isotope of ^{14}C, (2) an activity of <100 μCi, (3) a half-life of 5,730 yr, (4) a maximum energy of 155KeV, and (5) a laminate-sealed impervious housing. The long half-life of carbon-14 precludes the need for recalibration and replacement of the source. The use of the fast-response, low noise semiconductor detector makes it possible to use a low activity, low energy beta source. Carbon-14 also has the added advantage of being a pure beta emitter without residual gamma radiation.

The instrument operates essentially as a radiation detector, and the number of beta particles stopped by the filter tape is proportional to the amount of PM deposited on the filter. This is almost the opposite of to the way a smoke detector works, although most smoke detectors use Americium-241 as the radioactive source. When the smoke gets thick enough, the detector notices that it has stopped detecting radiation and triggers an alarm. In this case, the number of betas detected is proportional to the “thickness” of the PM that has been collected. The more PM that has been detected, the fewer betas can pass through.

The long half-life of carbon-14 minimizes the need for recalibrating and replacing the beta source. During operation, the instrument continually runs internal diagnostic checks to ensure the proper operation of the source/detector system. The foil calibration feature is used by the operator to check the calibration of the instrument and, if necessary, to

change the calibration constant (attenuation coefficient), using a calibration foil provided by the manufacturer. The instructions for this feature are in the Operator's Manual or Manual Addendum.

6.2 Support Facilities for Sampling Methods

Table 6.2 lists the supplies that are available to the Colville Air Program Manager.

Table 6.2 Support Facility Supplies

Item	Minimum Quantity	Notes
Field log book	1 per sampler	
Sampler Operations Manual	1 per model	
PM Sampler SOP	1	
Filter paper (part #460130)	2	Or of the type specified in the sampler manual; must replace every 60 days (BAM-1022-9800 Rev. B pg. 75)
Pump service kit (part #680820)	1	Or of the type specified in the sampler manual; must be replaced every two years (BAM-1022-9800 REV. B PG. 75)
Replacement beta detector	1	As needed; consult with manufacturer or sales rep
Site Dependent Equipment and Consumables		
Item	Minimum Quantity	Notes
Tools	1 box	Screw drivers, fitted wrenches, etc.
Lap Top Computer	1	
Disk	2 or more	
Data Download Cable	1	Downloading mechanism (to be determined)

6.3 Sampling/Measurement System Corrective Action

Corrective action measures may be taken to ensure the data quality objectives are attained. There is the potential for many types of sampling and measurement system corrective actions. Table 6.3 is a list of the expected problems and corrective actions needed.

Table 6.3 Field Corrective Actions

Item	Problem	Action	Notification
Power	Power interruptions	Check Line Voltage	Notify utility company if necessary
Power	Power to sampler, but sampler not working	Check power in series connection.	Notify utility company if necessary
Sample Flow Rate Verification	Out of Specification	1) Remove sampled filter. 2) Replace with clean filter. If still out of range, check power connections and flow routes on equipment for leaks. Replace air pump. Verify sampler flow.	Document in Logbook. Notify manager.
Data Downloading	Data will not transfer	Document key information on sample logbook. If downloading using a PC: Check cable connection from PC to data logger and download again	Document all storage attempts and failures. Notify manager

7.0 SAMPLE HANDLING

In the case of continuous instruments that do not involve filter collection, sample custody is data custody. We will take extreme care and allow for adequate time in downloading data, verifying correct download, copying and naming electronic files, transferring data, and data entry. Figure 7.1 represent chain of custody forms that will be used to track the stages of data handling throughout the data collection operation. Although entries on this form will be made by hand, the information will be entered into the computer database, where an electronic record will be kept (see Data Management).

Figure 7.1
CHAIN OF CUSTODY RECORD

Date	Operator Name	Saved onto disk name	Data File Name	Number of Records (N)	Date/time of Record #1	Date of Record #N	Notes

Data transfer into database file

Date	Operator Name	Data File Name transferred from	Number of Records (N)	Date/time of Record #1	Date of Record #N	Notes

8.0 ANALYTICAL METHODS

The collection of accurate and meaningful PM concentrations is intimately related to proper flow control. Flow control provides an accurate denominator for the calculation of mass concentrations, whether, PM2.5, PM10 or TSP is being measured, and maintains the design flow rate of the PM10 fractionating element so that it operates at the specific air velocities for which it was intended. The Critical Flow Device (CFD), a critical flow system requiring no periodic calibration, is used as a flow control device for the instrument. The critical flow orifice within the CFD is sized specifically for use with only one type of filter medium (i.e., either glass fiber or Teflon®) to provide the flow rate necessary for proper particle size selection by the SCC and PM10 inlets. Each instrument is calibrated at the factory, and an instrument-specific flow coefficient constant is supplied with each unit for accurately calculating the flow rate during operation. This constant is entered into the instrument's battery-backed random access memory (RAM) at the factory and duplicated on a label affixed to the instrument panel. In the event of battery failure, the user must re-enter the constant into RAM (see Section 10.3.1). The flow rate through the filter tape is continuously monitored during operation by the micro-controller board. Atmospheric pressure is measured with an electronic pressure transducer when the pump is off between sampling periods. The stagnation pressure (i.e., the absolute pressure downstream from the filter medium) is measured while the vacuum pump is operating during the sampling cycle. The microcomputer outputs the flow rate and the average values of temperature and pressure for the sampling period.

9.0 QUALITY CONTROL REQUIREMENTS

Quality control (QC) is the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements. In this case, QC activities are used to ensure that measurement uncertainty can be estimated and is less than the measurement quality objectives so that the DQOs can be met.

Day-to-day quality control is implemented with various check samples or instruments that are used for comparison. The measurement quality objectives tables in Section 7 contain a list of these QC checks as well as other requirements for the PM Program. Various types of QC checks have been inserted at phases of the data operation to assess and control measurement uncertainties. Table 6.4 summarizes the field QC checks. The following information provides some additional descriptions of these QC activities, how they will be used in the

evaluation process, and what corrective actions will be taken when they do not meet acceptance criteria.

Table 6.4 Field QC Checks

Requirement	Frequency	Acceptance	Reference
Self test	Every site visit, at least every two weeks	No error codes	BAM owner's manual (BAM-1022-9800 Reb. B, 2001) pg. 31 and 32
Instrument stability test with internal membrane	Every hour	If results are not within 5% of the factory-set value (0.830 mg/cm2) an error message is logged	BAM owner's manual (BAM-1022-9800 Reb. B, 2001) pg. 54, pg. 21
Zero testing with blank filter paper	At beginning and end of each sample period (hour)	If the difference between the first and second count of the blank filter paper exceeds the factor set value (-0.005 to –0.018 mg/cm2)	BAM owner's manual (BAM-1022-9800 Reb. B, 2001), pg. 54, pg. 21
Instrument stability test with foil calibration kit	Monthly	+ 7% of target value	BAM owner's manual (BAM-1022-9800 Reb. B, 2001), pg. 76
Flow rate verification	At least once each month, or if flow rate is stable and documented as stable over at least three months, at least once each quarter	+ 7% of the transfer standard reading	

9.1 Flow **Checks** Every Two Weeks

Because of the high cost of providing a collocated PM analyzer, flow checks are used instead to assess precision. A one-point check of each PM analyzer's normal operating flow rate will be made at least once each month. If a precision check is made in conjunction with any other type of instrument adjustment, it must be made prior to the adjustment. This flow check should be made at different times

of day, days of week, and before and after routine service and adjustments. The percent differences between the actual and the indicated flow rates are used to assess the precision of the monitoring data.

9.2 Calculations for Flow Rate Check Results - Percent **Difference**

The percentage difference (d_i) for a single flow rate check (or audit) is calculated using Equation 1, where X_i, represents the external transfer standard flow rate (known, or "true" value) and Y_i represents the instrument's indicated flow rate. This same equation is used for many purposes, such as recording the instrument response to known counts from a calibration foil. In that case, the counts expected from the foil (see manual addendum for the foil) is used as the known or "true" value, or X_i. When the calculation is used for flow rate, and repeated external verifications have shown the flow rate to be stable, this calculation is merely the difference between the analyzer set point flow rate and the external flow meter result, divided by the external flow meter result, multiplied by 100 to obtain a percentage. The lower case i represents the number of the check (so for example the check conducted March 1 could be called i=1, the check conducted March 28 could be called i=2, and so on.

$$d_i = \frac{Y_i - X_i}{X_i} \text{ x } 100 \qquad \text{Equation 1}$$

9.3 Control Charting of Percent Differences

The results of the single point flow rate checks will be plotted on a control chart (see Fig. 9.1) as soon as possible. The date will be on the x-axis and the % difference (from Equation 1) will be plotted on the y-axis. If the % difference is greater than 7%, the result will be flagged "FR" and the cause for the large difference will be investigated.

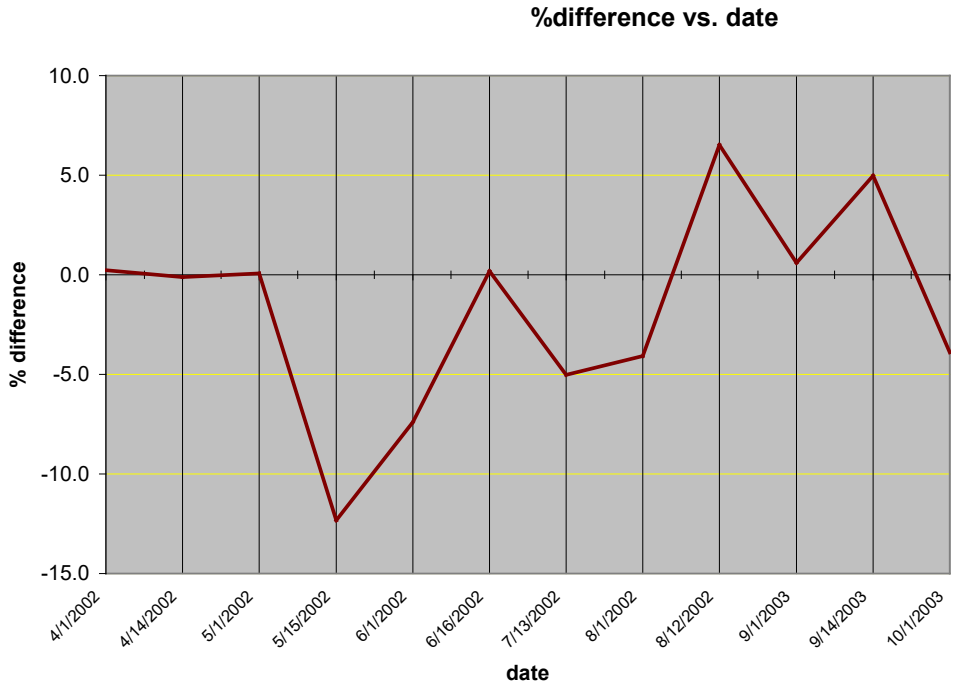
Figure 9.1: Example data and control chart for flow rate checks

Control chart of single-point flow rate checks

data:

date	indicated FR	measured FR	%difference	flag if >7%
4/1/2002	16.67	16.63	0.2	
4/14/2002	16.65	16.67	-0.1	
5/1/2002	16.67	16.66	0.1	
5/15/2002	16.66	19	-12.3	FR
6/1/2002	16.67	18	-7.4	FR
6/16/2002	16.7	16.67	0.2	
7/13/2002	16.67	17.55	-5.0	
8/1/2002	15.99	16.67	-4.1	
8/12/2002	16.67	15.65	6.5	
9/1/2003	16.77	16.67	0.6	
9/14/2003	16.67	15.88	5.0	
10/1/2003	16.02	16.67	-3.9	

The y-axis in the chart is the % difference from the above ta and calculated using equation 1.



9.4 Average Percent Difference

The average percent difference, d, for the sampler over any period of time (generally each quarter and year) is calculated using equation 2, where n is the number of flow checks during the time period. This equation represents calculating the average of the flow check results during the time period, where n is the total number of valid flow rate checks, and the lower case i is each check. This is the average of all the percent differences measured during the time period.

$$d = \frac{1}{n}\sum_{i=1}^{n} d_i$$ Equation 2

The average percent difference during each quarter will be calculated and reported to project management.

9.5 Instrument Stability Check

The manufacturer provides a calibration verification kit that is separate from the analyzer unit and can be used to assess the unit's response to a "known" value that is stable over time. This foil should be used at least every month when the project is new, when new personnel are trained and until they are familiar with the unit, after the unit is moved or repaired, or whenever any question arises about the stability of its response. The analysis of the standard check results can be done using the same analyses that were conducted for the flow rate checks. The first step is to calculate the percent difference between the "known" or "target" value and the instrument response by calculating the percent difference between the two (Equation 1).

The second step is to plot the % difference every time the stability check is made, using the same format as in the control chart shown in Figure 9.1. After at least ten such stability checks, the user can assess when the instrument is operating as it should, and when it is out of "control". The manufacturer states in the addendum to the owner's manual how far the instrument response should drift before the user is concerned. These limits are plotted on the control chart. For example, if the limits are 7% of the "known" value, then a horizontal line at the "known" plus seven percent is drawn on the chart as the upper control limit, and a line at the "known" minus seven percent is drawn as the lower control limit.

9.6 Flow Rate Audits Conducted by an External Auditor

The accuracy discussion of the owner's manual addendum describes the flow rate audit for automated samplers. Audits can consist of exactly the same type of checks that are conducted internally, such as flow rate checks described in section 14.1, with two major differences. The first difference is that the person conducting the audit (e.g., Colville contractor) is not part of the organization that is routinely collecting the data. The second

difference between the routine flow rate checks and an external audit is that the flow rate transfer standard (or other type of standard for another type of audit) is NOT the same transfer standard as the tribal office's transfer standard that they use for the routine monthly flow rate checks.

The audit is made by measuring the analyzer's normal operating flow rate using a certified flow rate transfer standard. The flow rate standard used for auditing MUST NOT be the same flow rate standard used to calibrate the analyzer. However, both the calibration standard and the audit standard may be referenced to the same primary flow rate or volume standard. The tribal air office will report the audit (as shown on the transfer standard) flow rate and the corresponding flow rate indicated or assumed by the sampler. The results are calculated in the same way as shown in section 9.2 for the routine monthly flow rate checks.

9.7 Corrective Action

The automated sampler accuracy goal for invalidating data is a % difference of +15% of the audit standard's flow rate (use Equation 1). If the flow rate shown by the instrument is not within 7 percent of that shown by the standard, the sample operator will check the sampling instrument to determine what could be causing the abnormal flow rate. A re-audit will be conducted immediately if possible or scheduled as soon as possible. If the second audit is still unacceptable, a multi-point calibration followed by a one-point verification is required. Routine data, back to an acceptable audit or the most recent multi-point calibration, will be flagged and reviewed to determine validity (see Section 23). In addition, one would expect that the routine flow rate verification checks that are conducted at least every month would indicate some drift. If a review of the flow rate calibration verification check data does not show a problem, there is a potential that one or both of the flow rate standards need to be recertified.

If other routine instrument performance checks indicate that the instrument is not operating within specifications or the limits in table 9.1, the owner's manual "troubleshooting" section describes corrective action. All corrective action is documented in the site notebook and on the monthly QC sheets, as well as being reported to management.

9.8 Control Charts

Control charts will be used by Colville staff. They provide a graphical means of determining whether various phases of the measurement process are in statistical control. The tribal air office will use control charts for all ongoing checks of instrument and system operation. Table 9.2 indicates which QC samples will be control charted. An example control chart is shown in Figure 9.1. The control charts will be used as an "early

warning system" to evaluate trends in instrument operation. As soon as a chart is completed, they will be filed and archived.

Table 9.2 Control Charts

QC Check	Plotting technique
Flow rate calibration verification check	The difference between the measured flow rate and the flow rate transfer standard. The percent difference is plotted on the vertical axis, date plotted on the horizontal x-axis. Different plots are made for each instrument.
Flow rate audit	Difference between instrument reading and transfer standard plotted on y-axis, date on x-axis.
Standard Verification	The difference between the "known" value and the instrument reading will be calculated using Equation 1 and plotted on a control chart, with date or check # on the x-axis.

9.9 Background Determination (Mass Offset)

It is recommended that the BAM 1022 undergo a background test upon initial deployment and annually thereafter. The tribal air office will perform a zero filter background test and set the mass offset outdoors in ambient air during stable weather conditions.

Additional information is included with the instructions that accompany the BX-302 Zero Filter Kit. The following is a brief set of instructions for performing the 72-hour test:

1. Ensure that the BAM 1022 has been calibrated and that leaks are not present.
2. Go to the Operate menu and select Stop Sample to stop the current sample.
3. Remove the size selective inlet(s) from the sample tube and install the zero filter. BX-302 Zero Filter Assembly
4. Verify that the zero filter leak valve is in the open position.
5. Go to the Setup menu and select Calibration.
6. Set the Background value to zero.
7. Exit the Background menu, go to the Operate menu, select Start Sample, and begin sampling.
8. After no less than 76 hours, retrieve the BAM 1022 hourly concentration data. Confirm that the monitor ran without disruption. If errors, power outages or maintenance occurred, the test will have to be restarted.
9. Calculate the average of the most recent 72 hourly PM concentrations. Record this value.
10. Calculate the new Mass Offset value determining the negative of the 72 hour average calculated in Step 9. For example, if the 72 hour mean = 1.07 µg /m3, the new Mass Offset would be -1.07 µg/m3. Since all Background values are entered in units of mg/m3, you would round to the fourth decimal place and use -0.0011 mg/m3.
11. Return to the Setup menu and select Calibration.
12. Enter the new background value.
13. Go to the Operate menu and select Stop Sample to stop the current sample, if the

monitor is still sampling.
14. Remove the zero filter from the inlet tube and install the size selective inlet(s)
15. Resume normal sampling.

10.0 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

This section discusses the procedures used to verify that all instruments and equipment are maintained in sound operating condition and are capable of operating at acceptable performance levels. All instrument inspection and maintenance activities will be documented in the Colville's field operations SOPs.

10.1 Initial testing

The PM sampler selected for use by Colville will not be operated as a federal equivalent method (FEM), but assumed to be of sufficient quality for the data collection operation. Testing of FEM equipment is accomplished by U.S. EPA through the procedures described in 40 CFR Part 53. Prior to field installation, Colville will assemble and run the samplers at the office, adhering to the pre-operational check procedures in the operating manuals. The Air Quality Managaer will perform instrument self-checks and stability checks as described in the User's manual for the instrument, as well as flow-rate verification checks.If any of these checks are out of specification, Colville will contact the vendor for initial corrective action. Background mass determination will be conducted to ensure performace acceptance. If the sampling instrument meets the acceptance criteria, it will be assumed to be operating properly. These tests will be documented and filed as described in Section 9.

Upon initial receipt of any new, repaired, or replaced PM sampler, field support staff will perform a multi-point flow rate verification on the sampler flow rate to determine if initial performance is acceptable. Once the sampler flow rates are accepted, the field personnel performs the verifications at the frequency specified in Section 14 (table 14.1).

Monthly Data and QC check sheets (see Figure 10.1) will be submitted to the Director of Environmental Trust Department monthly to ensure QA/QC checks are being performed per scheduled frequencies.

Figure 10.1: Monthly Data and QC Sheet

Date:_____Site Name:_____

Sampler Make, Model & ID#: FEM#:

Date, time, and initials of person conducting the check	Requirement	Frequency	Acceptance	Result (note date/time if any error codes reported, their date, and comments)	Flow rate (l/m) shown on the sampler	Total volume shown on the sampler since the beginning of the last sampling period/ hour and data of the beginning of the last sampling period	Notes, including field conditions, possible reason for error codes
	Self test	Every site visit, at least every two weeks	No error codes				
			Use external datalogger if you want to record all the error codes				
	Instrument stability test with internal membrane	Every hour	If results are not within 5% of the factory-set value an error message is logged				

	Zero testing with blank filter paper	At beginning and end of each sample period (hour)	If the difference between the first and second count of the blank filter paper exceeds the factory set value				
	Instrument stability test with foil calibration kit	Monthly	± 7% of target value				
	Flow rate verification	At least once each month	± 7% of the transfer standard reading to check, 10% to invalidate				

Signature of person reviewing and approving the monthly QC Check Sheet:_____date:_____

Signature of person reviewing and approving the data entry of this QC sheet:_____date:_____

(Note: extra rows are for additional checks that may be performed; if they are not performed during the month the site operator should write N/A in the space.)

10.2 Preventive Maintenance

There are many activities necessary for a successful field program. Table 10.2 describes the appropriate maintenance checks of the PM samplers and their frequency.

Table 10.2
Maintenance checks of the PM samplers and their frequency

Item	Maintenance Frequency	Location Maintenance Performed
BAM 1022	Weekly Inspection/As-Needed	On-Site
Background Determination	Annually	On-Site

11.0 INSTRUMENT CALIBRATION AND FREQUENCY

11.1 Flow Rate-Standards

An orifice device is used to calibrate and check flow rates on the BAM 1022. This program uses a Delta-Cal flow device (NIST-traceable primary volume flow standard) to certify that standards are met.

The field equipment and calibration instruments will follow the calibration and recertification scheduled as listed in Table 11.1.

Table 11.1
List of instrument and their calibration frequencies.

Instrument	Frequency
ASI/GMW sampler Orifice Transfer Standards	Biannual (every 6 months) or if verification check fails
Automated (continuous) PM Monitor Bio-Dry Gas Meter	Biannual or if verification check fails
Calibration Standard Bios-Dry Gas Meter Calibration Standard Orifice Transfer Standards	Biannual or if verification check fails

The flow rate standard apparatus used for flow-rate calibration (transfer standard) has its own certification and is NIST-traceable. The tribal air office is responsible for ensuring

that the transfer standard is recertified by a qualified laboratory to within 2% over the expected range of ambient temperatures and pressures at which the flow-rate standard is used. The flow rate standard will be re-calibrated as necessary (may be annually). The calibration certificate shows the results of the calibration, summarizes how it was performed, and shows when it is next due. The certificate is filed with the instrument documents.

The actual frequency with which this re-certification process must be completed depends on the type of flow rate standard – some are much more likely to be stable than others. Colville will maintain a control chart (a running plot of the difference or % difference between the flow-rate standard and the NIST-traceable primary flow-rate or volume standard) for all comparisons. In addition to providing excellent documentation of the certification of the standard, a control chart also gives a good indication of the stability of the standard. If the two standard-deviation control limits are close together, the chart indicates that the standard is very stable and could be certified less frequently. The minimum re-certification frequency is once per year. On the other hand, if the limits are wide, the chart would indicate a less stable standard that will be recertified more often. In addition, field staff that conducts field calibrations will track changes from re-certification to re-certification to assure that performance is not compromised.

All of these events, as well as sampler and calibration equipment maintenance will be documented in field data records and notebooks and annotated with the flags described in Appendix M of 40 CFR Part 50, the manufacturer's operating instruction manual and any other flags listed in Section 22. Notebooks will normally be located in the office when not in use, or kept secure with the field operator (in locked vehicle) when not being referred to in the office for review or data validation.

12.0 SUPPLIES & CONSUMABLES INSPECTION/ACCEPTANCE REQUIREMENTS

Table 12.1 Critical Supplies and Consumables

Area	Item	Description	Vendor	Model Number
Instrument	Battery			
Instrument	Fuses			
Instrument	CD-ROM	R-W	Purchase	
All	Low-lint wipes	4.5" x 8.5" Cleaning Wipes	Kimwipes	34155

12.1 Acceptance Criteria

Acceptance criteria must be consistent with overall project technical requirements. Some of the acceptance criteria are specifically detailed in 40 CFR Part 50. Other acceptance criteria such as observation of damage due to shipping can only be performed once the equipment has arrived on site.

12.2 Tracking and Quality Verification of Supplies and Consumables

Tracking and quality verification of supplies and consumables have two main components. The first is the need of the end user of the supply or consumable to have an item of the required quality. The second need is for the purchasing department to accurately track goods received so the payment or credit invoices can be approved. In order to address these two issues, the following procedures outline the proper tracking and documentation procedures to follow:

- Staff will perform a brief inspection of the packages as they are received from the courier or shipping company. The shipper will be notified if there are any obvious problems with a receiving shipment such as a crushed box or wet cardboard.
- The package will be opened, inspected and contents compared against the packing slip. Supply/consumable will be inspected.
- If there is a problem with the equipment or supply, note it on the packing list, notify the supervisor of the receiving area and immediately call the vendor.
- If the equipment/supplies appear to be complete and in good condition, sign and date the packing list.
- Notify appropriate personnel that equipment/supplies are available and stock equipment/supplies in appropriate pre-determined area.
- For supplies, consumables, and equipment used throughout the air program, document when these items are changed out. If available, include all relevant information such as model, lot number, and serial number.

13.0 DATA ACQUISITION REQUIREMENTS

This section addresses data not obtained by direct measurements. This includes both outside data and historical monitoring data. The policies and procedures described in this section apply both to data acquired through the Colville Air Program and to information previously acquired and from outside sources.

13.1 Chemical and Physical Properties Data

Chemical and physical properties data and conversion constants are often required in the processing of raw data into reporting units. This type of information that has not already been specified in the monitoring regulations will be obtained from nationally and internationally recognized sources. The following sources may be used in the PM program without prior approval: National Institute of Standards and Technology (NIST); ISO, IUPAC, ANSI, and other widely–recognized national and international standards organizations; U.S. EPA, the current edition of standard handbooks such as physical constants or conversions.

13.2 Geographic Location

Another type of data that will commonly be used is geographic information, for identifying the location of sampling sites on the Colville Reservation.

13.3 Historical Monitoring Information

Historical monitoring data and summary information derived from previous data may be used in conjunction with current monitoring results to calculate and report trends in pollutant concentrations. In calculating historical trends, it is important to verify that historical data are fully comparable to current monitoring data. If different methodologies were used to gather the historical data, the biases and other inaccuracies must be described in trends reports based on that data. Direct comparison of PM with historical total suspended particulate data will not be reported or used to estimate trends.

13.4 External Monitoring Data Bases

It is the policy of this program that no data obtained from any other organization or agency shall be used in creating published reports or regulatory actions unless the data were collected under a QA program that meets the requirements of 40 CFR Part 58. Data from the U.S. EPA AQS database may be used in published reports with appropriate caution. Care must be taken in reviewing/using any data that contain flags or data qualifiers. If data is flagged, such data shall not be utilized unless it is clear that the data still meets critical QA/QC requirements. It is impossible to assure that a data such as AQS is completely free from errors including outliers and biases, so caution and skepticism is called for in comparing tribal data from other reporting agencies as reported in AQS. Users should review available QA/QC information to assure that the external data are comparable with tribal measurements and that the original data generator had an acceptable QA program in place.

13.5 Meteorological Data from Other Sources

Meteorological data are gathered from other sources such as the U.S. Weather Service to provide information required when developing monitoring sites, computing corrections needed to convert form standard conditions to local conditions, and to support analysis and modeling efforts. These data are not reported to AQS and are clearly identified when used for assessment and modeling efforts.

14.0 DATA MANAGEMENT

This section describes the data management operations pertaining to PM measurements by Colville. It provides the requirements for how the data are transferred from the sampler into the database and how the data are reported. These operations include data recording, validations, calculations, transmittal, analysis, storage, and retrieval.

All sampling data will be entered into the tribal air database through either manual entry, electronic transfer from the field, or both. Data is organized and filed as shown in Table 14.1. The database runs on the office's desktop computer.

14.1 Data Download

Colville's BAM 1022 data will be transferred directly to an office file. The data loggers will be polled every month using portable laptop personal computers. The data is copied onto CD-ROM Disks (identical files in case of disk failure on one) in the field using a laptop computer. When the site operator is in the office, the data file is copied from one of the disks into the office database.

14.2 Data Recording

Chain of custody sheets will be used, along with the field notebook, to record all data transfer activities in the field. A copy of the chain of custody sheet is shown in Figure 7.1 and the chain of custody record, on which is recorded the names of the files, who transferred them, etc., is shown in Figure 7.1. Verification of the data entered is discussed in the following section.

14.3 Data Validation

Data validation involves checking that data processing operations have been carried out correctly and monitoring the quality of the field operations. Condition flags never internally overwrite numerical data stored in the database. Flags denoting error conditions or QA status are saved as separate fields in the database, so that it is possible to recover the original data.

The following validation functions are incorporated into the database to ensure quality of data entry and data processing operations:

- **Range Checks** – almost all monitored parameters have simple range checks programmed (you need to state if this is in the data logger or if you are doing this by hand when you enter the data or if your database does it for you). For example, valid times must be between 00:00 and 23:59, summer temperatures must be between 10 and 50 degrees Celsius, etc. The person entering the data has the option of correcting the entry or overriding the range limit. The specific values used for range checks may vary depending on season and other factors. Since these range limits for data input are not regulatory requirements, they may be adjusted from time to time to better meet quality goals.
- **Completeness Checks** – when the data sheets are entered any blank entries must be okayed by the site operator with the notation "N/A" so that the person entering the data knows that it is valid.
- **Correct Data Entry** – when the chain of custody sheets and monthly QC sheets are entered by hand into the computer database the paper copies are kept on hand before being filed. After data entry, the sections of the file in the computer are printed, and a person other than the person who performed the data entry must verify that the data were entered correctly. Their signature on the sheet indicates that the data have been reviewed and compared with the information in the computer and found to be correct. At this point the paper copies are filed.
- **Internal Consistency and Other Reasonable Checks** - when the data are evaluated and interpreted for internal reports the person conducting the evaluation checks to see if the data are as expected for the site and season and instrument
- **Statistical Data Checks** – when the data are evaluated statistics such as the mean and range for each site and season are calculated. If there are unexpected high or low values or the statistics are not as expected the person conducting the evaluation of the data will investigate.

Table 14.1 Validation Check Summaries

Type of Data Check	Electronic Transmission and Storage	Checked "by hand," field by field	Checked by the computer database as the data are entered
Data Parity and Transmission Protocol Checks	X		
Date and Time Consistency		X	
Completeness of Required Fields		X	
Range Checking		X	
Correct data entry		X	
Statistical Outlier Checking		X	
Manual Inspection of Charts and Reports		X	

14.4 AQS Submittal

Colville will report all PM ambient air quality data and information specified by the AQS Users Guide (Volume II, Air Quality Data Coding, and Volume III, Air Quality Data Storage), coded in the -AQS format. Such air quality data and information will be fully screened and validated and will be submitted directly to the -AQS via electronic transmission, in the format of the -AQS, and in accordance with the quarterly schedule. The specific quarterly reporting periods and due dates are shown in the Table 14.2.

Table 14.2 Data Reporting Schedule

Reporting Period	Due Date
January 1 – March 31	June 30
April 1 – June 30	September 31
July 1 – September 20	December 31
October 1- December 31	March 31

14.5 Data Reduction

Examples of data summaries include:

- Average PM concentration for a station or set of stations for a specific time period
- Accuracy (total error), bias, and precision statistics
- Data completeness reports based on numbers of valid samples collected during a specified period

When routine data screening programs are run, the following data are recorded in the database:

- Values of screening limits (e.g., upper and lower acceptance limits for each parameter)
- Numerical value of each data item flagged and the flag applied

All backups will be retained so that any audit trail information can be retrieved for at least three years.

14.6 Data Analysis

Colville will implement the data summary and analysis requirements contained in 40 CFR Part 58, Appendix A. It is anticipated that as the program develops, additional data analysis procedures may be developed. The following specific summary statistics will be tracked and reported for the PM network:

- Single sampler bias (based on external performance audits and internal performance evaluations)
- Single sampler precision (based on flow rate checks)
- Network-wide bias and precision (based on flow rate performance audits and performance evaluations)
- Data completeness

14.7 Data Flagging – Sampler Qualifiers

A simple qualifier or a result qualifier consists of three or four alphanumeric characters which act as an indicator that the data value (a) did not produce a numeric result, (b) produced a numeric result but it is qualified in some respect relating to the type or validity of the result, or (c) produced a numeric result but for administrative reasons is not to be reported. Qualifiers will be used both in the field and in the office to signify data that may be suspect due to contamination, special events, or failure to meet QC limits. The sampling instrument will generate some flags. Qualifiers will be noted in the site notebook and on chain of custody sheets with additional explanations in the comment section.

14.8 Data Storage and Retrieval

Data archive policies are shown in Table 14.3

Table 14.3 Data Archive Policies

Data Type	Medium	Location	Retention Time	Final Disposition
Chain-of-custody forms	Hardcopy	office	3 years	Discarded
Field Notebooks	Hardcopy	Site	3 years	NA
PM Database	Electronic (on-line)	Tribal air office	5 years	NA

The PM data reside on a database in the Colville's air quality office. This dedicated computer hardware/software has the following specifications:

- Processor
- Operating System
- Memory
- Storage
- Backup
- Database software
- Security

Security of data in the PM database is ensured by the following controls:

- Password protection on the database that defines levels of access to the data
- Regular password changes (quarterly for continuing personnel; passwords for personnel leaving will be cancelled immediately)
- Independent password protection on all dial-in lines

15.0 ASSESSMENTS AND RESPONSE ACTIONS

The results of assessments indicate whether the control efforts are adequate or need to be improved. Documentation of all quality assurance and quality control efforts implemented during the data collection, analysis, and reporting phases is important to data users, who can consider the impact of these control efforts on the data quality. Both qualitative and quantitative assessments of the effectiveness of these control efforts will identify those areas most likely to impact the data quality and to what extent.

In order to ensure the adequate performance of the quality system, Colville will perform (or receive technical assistance in performing) the following assessments:

- Network Reviews

- Systems Audits
- Field Performance Audits
- Data Quality Assessments

15.1 System Audits

A system audit is a thorough and systematic onsite qualitative audit, where facilities, equipment, personnel, training, procedures, and record keeping are examined for conformance to the QAPP. An outside contracted environmental service provider will conduct the system audit either as a team or as an individual auditor. The auditor will perform three system audit activities that can be accomplished separately or combined:

- Field
  - Data management – Information collection, flagging, data editing, security, upload
  - Key personnel to be interviewed during the audit are those individuals with responsibilities for: planning, field operations, QA/QC, data management, and reporting. To ensure uniformity of the system audit, an audit checklist will be used.
  - The auditor will send a copy of the final system audit report to EPA Region X. Any corrective action taken will be included in the report.

- Post-Audit Activities. The major post-audit activity is the preparation of the system audit report. The report will include:

  - Audit title and any other identifying information
  - Audit team leaders, audit team participants and audited participants
  - Background information about the project, purpose of the audit, dates of the audit, particular measurement phase or parameters that were audited, and a brief description of the audit process
  - Summary and conclusions of the audit and corrective action required
  - Attachments or appendices that include all audit evaluation and audit finding forms
  - To prepare the reports, the audit team will meet and compare observations with collected documents and results of interviews and discussions with key personnel. Expected QA Project Plan implementation is compared with observed accomplishments and deficiencies and the audit findings are reviewed in detail. The system audit report will be submitted to the appropriate departments or agencies.
  - If the departments or agencies have written comments or questions concerning the audit report, the Audit Team will review and incorporate them as appropriate, and subsequently prepare and resubmit a report in final form following receipt of the written comments. The report will include an agreed-upon schedule for corrective action implementation.

- Follow-up and Corrective Action Requirements.
  - The auditor and the audited organization may work together to solve required corrective actions. The audited organization has 30 days to respond to the follow-up and corrective action requirements in the system audit report. The auditor reviews the audited organization's responses to the follow-up and corrective action and works with the audited agency to resolve any discrepancies.

15.2 Field Performance Evaluations

Field performance evaluations reveal how the data are handled, what judgments were made, and whether uncorrected mistakes were made. The audits will be performed twice per year and will be part of the system audit. The audits will have the same reporting/corrective action requirements as the system audit. Audits for Colville will be conducted by an independent contractor.

15.3 Data Quality Assessment

Measurement statistics and summaries will be calculated and reviewed for each quarter and year, as well as other time periods deemed relevant to Colville. For example, data summaries may be reviewed for each season, during periods of high winds, fires, traffic, or construction. In general, the data will be reviewed each month. The statistics described in section 14 will be calculated as well as the average PM concentration during the time period at each site, the range of valid concentrations measured, the times of the highest concentrations and the times of the lowest concentrations.

15.4 Documentation of Assessments

Table 20.1 Assessment Summary

Assessment Activity	Frequency	Personnel Responsible	Reporting/ Resolution
System Audits	To be determined	Colville and independent contractor	Tribe
Data Quality Assessment	1/year	Colville and independent contractor	Tribe

16.0 REPORTS TO MANAGEMENT

This section describes the quality-related reports and communications to management necessary to support PM network operations.

16.1 Quarterly Reports

Each quarter, Colville's Air Quality Manager will report the results of all quality control measurements that it has carried out during the preceding quarter and any actions taken as a result of those measurements. Required accuracy and precision data are to be reported on the same schedule as quarterly monitoring data submittals. The required reporting periods and due dates are listed in Table 16.1

Table 16.1 Quarterly Reporting Schedule

Reporting Period	Due on or Before
January 1 – March 31	June 30
April 1 – June 30	September 30
July 1 – September 30	December 31
October – December 31	March 31 (following year)

Air quality data submittal for each reporting period will be edited, validated, and entered into the AQS using the procedures described in the AQS Users Guide, Volume II, Air Quality Data Coding. Colville will be responsible for preparing the data reports, which will be reviewed by ETD before they are transmitted to EPA.

16.2 Technical System Audit Reports

Colville, through technical assistance from EPA, will perform Technical Systems Audits of their entire monitoring program. These audits are conducted by someone designated by Colville who is not directly involved in this program.

16.3 Control Charts

Control charts for instruments are updated after every new calibration or a chart is full. The person entering data in the chart is responsible for reviewing each control chart immediately after it is updated and for taking corrective actions whenever an out-of-control condition is observed. Control charts are to be reviewed at least quarterly by the Colville Air Quality Manager. Staff will provide quarterly summary information to the Director of the Environmental Trust Department. Control charts are also subject to inspection during audits and completed charts should be filed and kept indefinitely.

17.0 DATA REVIEW, VALIDATION AND VERIFICATION

This section describes how Colville will verify and validate the data collection operations associated with PM ambient air monitoring. Verification can be defined as confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. Validation can be defined as confirmation by examination and provision

of objective evidence that the particular requirements for a specified intended use are fulfilled.

17.1 Sampling Design

The objective of the sampling design is to represent the population of interest at adequate levels of spatial and temporal resolution.

17.2 Data Collection Procedures

System audits will be used to verify that the data collection activity is being performed as described in this QAPP and the SOPs. Deviations from the data collection activity will be noted in audit finding forms and corrected and reported to management. The use of QC checks that have been placed throughout the measurement process help validate the activities occurring at each phase. The review of QC data such as the performance evaluation, and the sampling equipment verification checks that are described in Section 14 can be used to validate the data collection activities. Any data that indicates unacceptable levels of bias or precision or a tendency (trend on a control chart) will be flagged and investigated.

17.3 Quality Control

This QAPP specifies the QC checks that are to be performed during data collection. These include the use of flow rate transfer standards and instrument checks, which provide indications of the quality of data.

Validation of QC procedures includes a review of the documentation of the corrective actions that were taken when QC checks failed to meet the acceptance criteria, and the potential effect of the corrective actions on the validity of the routine data. This review is conducted on an ongoing basis by Colville staff.

17.4 Calibration

Routine instrument performance checks are performed to ensure the calibration remains stable. The calibration certificate of the flow rate transfer standard will be kept in the instrument file and available during an audit. The calibration of the sampler itself is recorded in the paperwork received with the sampler, and the calibration factor is kept up to date by sending it to the manufacturer for re-calibration at approximately two year intervals. If a degradation of the calibration factor occurs, it will be obvious to the site operator because the routine instrument performance checks will indicate changes in the system. Any data that indicates unacceptable levels of bias or precision or a tendency (trend on a control chart) will be flagged and investigated. This investigation could lead

to a discovery of inappropriate calibration procedures, or equipment problems requiring corrective action. Validation would include the review of the documentation to ensure corrective action was taken as prescribed in the QAPP.

17.5 Data Reduction and Processing

System audits will be performed by an independent contractor to ensure the data reduction and processing activities described in this QAPP are being followed. As part of the audits of data quality, a number of data records chosen at random will be identified. All raw data files, including the following will be selected:

- Sampler download data
- Sampler calibration in effect during sampling period
- Corrective action procedures
- Data reduction and entry

This raw data will be reviewed and final concentrations will be calculated by hand to determine if the final values submitted are the same as those produced by hand calculations. The data will also be reviewed to ensure that associated flags or any other data qualifiers have been associated with the data and that appropriate corrective actions were taken.

18.0 VALIDATION AND VERIFICATION METHODS

Exceptional field events may occur and field activities may negatively affect the integrity of data files. In addition, some of the QC checks will fail to meet the requirements. Information on problems that affect the integrity of data is identified in the form of data qualifiers or flags. It is important to determine how these failures affect the routine data. This section describes the methods that will be used to evaluate the data.

A thorough review of the data will be conducted for completeness and data entry accuracy. All raw data (such as site and QC data) that is hand entered from data sheets will be double-checked. The entries are compared to reduce the possibility of entry and transcription errors. Once the data is entered into the database, the person evaluating the data will review the data for data outliers and data outside of acceptance criteria. These data will be flagged. All flagged data will be ‘re-verified’ by comparing the data sheets to the entry in the computer database. Details of these activities are discussed in Section 19.

Records of all invalid data files will be filed, including the original results. Information noted with the result includes a brief summary of why the data file was invalidated along with the associated flags. This record will be available on the database. At least one flag

will be associated with an invalid data file, that being the “INV” flag signifying invalid. Additional flags will usually be associated with the INV flag that helps describe the reason for this flag, as well as notes from the site operator.

18.1 Validation of Measurement Values

Certain criteria based upon the BAM 1022 owner’s manual, 40 CFR 58 Appendix A and site operator judgment have been developed that will be used to invalidate a data file or measurement. The data qualifiers and flags will be used to determine if individual data files, or results from a particular instrument will be invalidated. Flags may be used alone or in combination to invalidate results. Colville will keep record of the flags that resulted in invalidating a measurement or set of measurements. These will be reported to EPA Region X and will be used to ensure that Colville evaluates and invalidates data consistently from one time period to the next. All data invalidation will be documented.

All efforts will be made to take corrective actions, depending on the type of QC checks that were outside of acceptance criteria, to correct the problem. If the results remain outside the criteria, the routine results may be flagged invalid (INV) depending upon the specific acceptance criteria.

19.0 RECONCILIATION WITH USER REQUIREMENTS

Reconciliation with the data quality objectives (DQOs) involves reviewing both routine and QA/QC data to determine whether the DQOs have been attained and that the data is adequate for its intended use. This process is termed data quality assessment (DQA).

There are serious political, economic and health consequences of making such decision errors. Therefore, Colville will work with WADOE and EPA Region X to set limits on the probabilities of making incorrect decisions with these data. In order to set probability limits on decision errors, Colville will work to understand and control uncertainty. Uncertainty is used as a generic term to describe the sum of all sources of error associated with a measurement result.

The measurement quality objectives (MQOs) listed in Table 3.1 are the goals for measurement uncertainty that, if met, will achieve the overall data quality objectives for this project.

There are two components of measurement error. Systematic (or bias) errors cause results to be generally always high or always low. These errors are often caused by improper calibration or drift in an electronic or manual setting, or always doing something "wrong" that causes the result to be higher (or lower) than it should. Random (or precision) error causes results to be sometimes high and sometimes low, and it is

impossible to eliminate, because it is impossible to hit the bull's eye (get the exact right answer) every time, even with the best instruments available. The quality control measurements made in this program with this automated sampler estimate precision error of the flow rate and the bias of the constants in the sampler software (self-check, calibration verification, zero check). Total error, or accuracy, is estimated with the external audits.

19.1 Calculations for Precision

There are two Colville sites with a continuous (automated) PM sampler. At this site, the site operator records the indicated flow rate of the sampler at least every two weeks. This flow rate is compared to the set-point flow rate, by subtracting the indicated flow rate from the set-point flow rate and dividing this difference by the set-point flow rate, as shown in Equation 1 of section 9.2. If at any time, this difference (or percent difference if multiplied by 100) becomes greater than $\pm$ 0.07 (or $\pm$ 7%) then an investigation into the cause of the difference is made. The owner's manual "troubleshooting" section describes possible corrective actions. If corrective action is needed, an actual flow rate audit with an external flow rate transfer standard is conducted after the corrective action.

The results of these checks are plotted on a control chart (just as the side-by-side results from the manual method, except that for the continuous monitors the difference in flow rate divided by the set-point flow rate is plotted on the y-axis instead of $\mu g/m^3$).

19.2 Calculations for Accuracy

Accuracy for the continuous monitors is estimated via two methods. First, each sampler is audited at least once per year with a flow rate transfer standard. The difference between the indicated flow rate on the analyzer and the actual flow rate shown by the transfer standard is divided by the flow rate on the transfer standard. If this difference is greater than $\pm$0.07 ($\pm$7%) then there will be an investigation and possible flow rate recalibration.

Second, an annual (preferably conducted during a different season than the flow rate audit) performance assessment is conducted by an organization tasked to do so by Colville. This performance assessment consists of a side-by-side measurement using a separate monitor.

Finally, Colville will gather PM data for a minimum of three years, adhering to the requirements in this QAPP. The data will ultimately be used to make long-term decisions on the conditions affecting air quality and the operations of the air sampling device.

APPENDIX A:
CONTRACT FOR QA SERVICES AND TECHNICAL SUPPORT

1.0 **Objectives.** Through this agreement, Colville seeks to:

1.1 Identify the technical services that Colville will receive from the Contractor, and to establish contract terms for fair and reasonable compensation for these services; and

1.2 Establish a plan for enhancing the proficiency of tribal personnel engaged in operating Colville's air quality monitoring stations.

1.3 **Description of Work.** Contractor agrees to perform the following services under such terms and conditions as are set forth in this contract.

1.4 **Provide On-Site Technical Assistance with Equipment Set-Up.** Contractor will conduct on-site visits to the Colville monitoring station to support Colville staff in: a) preparing the housing facility for the BAM, b) putting the BAM into operation, and c) setting up the telemetry system for the BAM.

1.5 **Provide Technical Assistance and Training in Equipment Operation and Maintenance Procedures.** Contractor will assist the Colville Air Resource Specialist in initially performing the required operation and maintenance procedures for the BAM 1022, per manufacturer's specifications and in accordance with the Colville Quality Assurance Project Plan for the BAM. Contractor will provide support for staff to independently conduct Standard Operation Procedures (SOPs).

1.6 **Assist with Quality Control Procedures.** Contractor will assist Colville's Air Quality Manager in:

a) Performing and advising staff to complete scheduled quality control procedures;
b) Verifying that all required QA activities are performed and that measurement quality standards are met as required in the Colville QAPP;
c) Reviewing QA documentation as needed and providing answers to technical questions; and
d) Ensuring that reviews, assessments and audits are scheduled and completed.

1.7 Perform Quarterly Quality Assurance Audits. Contractor will work with Colville Air Quality Manager to perform quarterly quality assurance audits on the BAM 1022. If the audit shows that the Colville sampler is outside of the confidence intervals established in the Colville QAPP, the Contractor will assist Colville in performing a flow calibration before the next sample run. Contractor will review data to identify deviations from established procedures and methods, assessing and reporting data quality and flagging any suspect data.

APPENDIX B:
EPA'S SUPPLEMENTAL INTERIM GUIDANCE FOR QA OF CONTINUOUS PM ANALYZERS

November 3, 1995

Subject: Supplemental Interim Guidance for Quality Assessment of Continuous PM Analyzers
From: William J. Mitchell (MD-77B)
Frank F. McElroy (MD-77)
Quality Assurance Branch/AMRD

To: NAMS Coordinators, Regions 1 - 10
QA Coordinators, Regions 1 - 10
John Silvasi, Chief, and Joe Elkins
Monitoring & Quality Assurance Group, EMAD, OAQPS (MD-14)

Complete quality assurance and data quality assessment (PARS) procedures for continuous PM analyzers *(i.e*. beta gauges and the TEOM monitor) have not yet been developed. Interim procedures and guidance for these analyzers were issued by Memorandum, dated August 31, 1992. The interim procedure for precision assessment is now being changed to allow a simpler alternative technique that does not require an external flow rate standard. Accordingly, the following procedures and supplemental guidance supersede the previous (August 31, 1992) interim procedures. These new procedures should be used for SLAMS and NAMS monitoring networks, as a part of and in conjunction with other data quality assessment requirements specified in 40 CFR 58, Appendix A. These procedures may also be used in connection with PSD monitoring, along with other data quality assessment requirements specified in 40 CFR 58, Appendix B.

General quality assurance

Quality control procedures described in the Operation or Instruction manual associated with each method should be implemented as completely as feasible. The use of calibration foils (for beta gauges) or standard filters (for the TEOM®) that may be available from the instrument's manufacturer is encouraged to the extent possible. Special care should be given to checking and recording the operational parameters of the instruments, since it may not be possible to verify these parameters in data output reports to printers or data processing systems. The use of control charts for recording the operational parameters is encouraged for ongoing control of the measurement system.

Precision assessment

Because of the high cost of providing a collocated PM analyzer, flow checks are used instead to assess precision. Carry out a one-point check of each PM analyzer's normal operating flow rate at least once every two weeks. If a precision check is made in conjunction with a zero or span adjustment, it must be made prior to such zero and span adjustment. Randomization of the precision check with respect to time of day, day of week, and routine service and adjustments is encouraged where possible.

Standard procedure: Use a flow rate transfer standard as described in section 2.3.3 of Part 58, Appendix A to check the analyzer's normal flow rate. Care should be used in selecting and using the flow rate measurement device such that it does not alter the normal operating flow rate of the analyzer. Report the actual analyzer flow rate measured by the transfer standard and the corresponding flow rate measured, indicated, or assumed by the analyzer.

Alternative procedure: It is permissible to obtain the precision check flow rate data from the analyzer's internal flow meter *without the use of an external flow rate transfer standar*d, provided that (1) the flow meter is audited with an external flow rate transfer standard at least every 6 months, (2) records of at least the 3 most recent flow audits of the instrument's internal flow meter over at least several weeks[1] confirm that the flow meter is stable, reliable, and accurate to ±4%, and (3) the instrument and flow meter give no indication of improper operation. With suitable communication capability, the precision check may thus be carried out remotely. For this procedure, report the *set-point flow rate* as the "actual flow rate" along with the flow rate measured or indicated by the analyzer flow meter.

For either procedure, the percent differences between the actual and indicted flow rates are used to assess the precision of the monitoring data as described in section 5.1 of Appendix A (using flow rates in lieu of concentrations).

Accuracy assessment

Each calendar quarter, audit the flow rate of at least 25 percent of the SLAMS analyzers such that each analyzer is audited at least once per year. If there are fewer than four PM analyzers within a reporting organization, randomly re-audit one or more analyzers so that at least one analyzer is audited each calendar quarter. Where possible, EPA strongly encourages more frequent auditing, up to an audit frequency of once per quarter for each SLAMS analyzer.

The audit is made by measuring the analyzer's normal operating flow rate, using a flow rate transfer standard as described in section 2.3.3 of Part 58, Appendix A. The flow rate standard used for auditing must not be the same flow rate standard used to calibrate the analyzer. However, both the calibration standard and the audit standard may be referenced to the same

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[1] Initial flow meter audits could be carried out more frequently than every 6 months in order to meet this test more quickly.

primary flow rate or volume standard. Great care must be used in auditing the flow rate to be certain that the flow measurement device does not alter the normal operating flow rate of the analyzer. Report the audit flow rate and the corresponding flow rate indicated or assumed by the sampler. The percent differences between these flow rates are used to calculate accuracy as described in section 5.4.1 of Appendix A.

Additional Guidance

Portions of the guidance on flow rate standard devices and flow rate checks and audits for dichotomous PM samplers given in Section 2.10 of the Quality Assurance Handbook, Volume II (EPA-600/R-94/038b) are also applicable to flow rate checks of the continuous PM analyzers. Copies of Section 2.10 can be obtained from the ORD Publications Center (CERI) in Cincinnati (513-569-7562) or from the Quality Assurance Branch, or by downloading from EPA's OAQPS TTN AMTIC electronic bulletin board system. For the TEOM®, the *actual instrument flow rate* (nominally 3.0 liters/min) should be measured and reported for precision and accuracy. The total flow rate (nominally 16.7 liters/min) should be checked to verify that it is within the ±10% tolerance specified for the PM inlet, but total flow rates should *not* be reported for precision or accuracy.

Further, we strongly encourage the periodic checking of instrument response using calibration foils or other attenuation standards for beta gauges or accurately weighed "standard" filters for the TEOM®. Some PM analyzer manufacturers offer devices or kits for this purpose at nominal cost. The results from these response tests should be used to monitor instrument response and detect possible instrument malfunction. However, the results from these response checks using calibration foils or standard filters should *not* be reported as accuracy audits until definitive procedures for reporting these results are established.

APPENDIX C:
MetOne BAM 1022 Operation Manual
(Included in separate binder)

APPENDIX D:
BAM2.5 Site Location Maps