Continuous PM-2.5 and Meteorological Monitoring Project on the Tribal Reservation

Quality Assurance Project Plan

Prepared by
Confederated Tribes of the
Coos, Lower Umpqua & Siuslaw Indians
Department of Natural Resources
1245 Fulton Avenue
Coos Bay, Oregon

Version: 2.0

February 2016

1. QUALITY ASSURANCE PROJECT PLAN IDENTIFICATION AND APPROVAL

The following Quality Assurance Project Plan for the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians Air Quality Program's monitoring project is hereby recommended for approval and commits the Department of Natural Resources to follow the protocols described within.

Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians

Signature: Mark Ingersoll Date: 2/17/2016

Mark Ingersoll, Tribal Council Chairman

Signature: Date: 2/17/16

Alexis Barry, Tribal Administrator

Signature: Date: 02/17/16

Margaret Corvi, Director, Department of Natural Resources

U. S. Environmental Protection Agency, Region 10

Signature: Date: 3/7/16

Chris Hall, Air QA Reviewer

Signature: K. Carre Date: 2/19/16

Kris Carre, Project Officer

2. TABLE OF CONTENTS

2.1 LIST OF TABLES & MAPS

3. DISTRIBUTION LIST

Upon approval of the QAPP a copy will be distributed to the following.

Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians

Mark Ingersoll, Tribal Council Chairman
Alexis Barry, Tribal Administrator
Margaret Corvi, Director, Department of Natural Resources

U.S. Environmental Protection Agency, Region 10

Chris Hall, Air QA Reviewer
Kris Carre, Project Officer

Oregon Department of Environmental Quality

Christine Svetkovich, Tribal Liaison

4. PROJECT/TASK ORGANIZATION

4.1 Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians

As a sovereign federally recognized Tribal Government, the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians have both the rights and responsibilities with respect to the management and protection of the natural resources within the Tribes' Ancestral Territory and current tribal holdings. To exercise these rights and responsibilities, the Tribal Council authorized the establishment, within the Tribal Administration, of the Department of Natural Resources (DNR). The Environmental Division is one of the divisions of the DNR. The mission of the Environmental Division is to research, monitor, assess, manage, use, conserve, protect, and restore the natural resources of the Confederated Tribes' Ancestral Territory consistent with tribal values.

The Air Quality Program (AQP) is a component of the Environmental Division. The primary goals of the AQP are to protect tribal member health and resources from ambient and indoor air pollution sources. In an effort to accomplish these goals, the AQP is working with the United States Environmental Protection Agency Region 10 (EPA) to establish tribal air management authority under the Tribal Authority Rule within the Federal Clean Air Act (CAA) (as amended). In conjunction with AQP development efforts, the AQP has secured grant funding from EPA under Section 103 of the CAA to develop and operate continuous Particulate Matter 2.5 (PM 2.5) and meteorological monitoring projects in accordance with this Quality Assurance Project Plan (QAPP), as written. The AQP is responsible for coordinating all aspects of the monitoring project (quality assurance, instrument maintenance, data collection, and data processing) and works with the Tribal Environmental Exchange Network (TREX) (http://trexwww55.ucc.nau.edu) to implement data management, data formatting in accordance with the EPA's Air Quality System (AQS) data submittal process, and develop web display capabilities.

The following DNR staff are responsible for the successful operation of the AQP's monitoring project.

AQP Staff

Director of the DNR

- Manage and oversee the development and successful operation of the AQP.
- Prepare and review budgets, contracts, grants and proposals.
- Secure funding for the AQP.

Air Quality Specialist (or alternate Environmental Staff as designated)

- Follow the EPA-approved QAPP and Standard Operation Procedures (SOP) for data collection and management
- Collect, verify, and report on air quality and meteorological data collected
- Install, operate, and maintain monitoring equipment and site
- Attend capacity building trainings that increase air quality monitoring skills

4.2 U.S. Environmental Protection Agency, Region 10

The EPA is providing grant funding for this monitoring project under the authority of Section 103 of the Clean Air Act. EPA's role for this monitoring project is to provide technical assistance and project oversight so that grant tasks are completed in accordance to identified grant timelines. The EPA project officer will directly receive a copy of all the data collected by the program as well as any other required reports.

<u>EPA Region 10 Staff</u>

Project Officer

- Monitor the activities and completion of grant objectives
- Provide technical assistance as needed
- EPA point of contact for tribal staff

Quality Assurance Officer

- Review, comment, and provide approval for the QAPP and SOPs for the monitoring project
- Provide technical assistance and suggestions to improve the monitoring project

4.3 Outside Data Auditor

The AQP will contract with an audit services as described in Section 7.1.3.

6. BACKGROUND AND PROJECT DEFINITION

Background

The Federal Clean Air Act (CAA) regulates air emissions from area, stationary, and mobile sources within the United States. The CAA authorizes the EPA to establish National Ambient Air Quality Standards (NAAQS) to protect public health and the environment. The goal of the CAA was to set and achieve NAAQS in every state by 1975. The setting of maximum pollutant standards was coupled with directing the states to develop state implementation plans (SIP's) applicable to appropriate industrial sources in the state. The Act was amended in 1977 primarily to set new goals and timelines for achieving attainment of NAAQS since many areas of the country had failed to meet the deadlines. The 1990 amendments to the Clean Air Act in large part were intended to meet unaddressed or insufficiently addressed problems such as acid rain, ground-level ozone, stratospheric ozone depletion, and air toxics. EPA has established the NAAQS which sets the limits for six criteria pollutants. These pollutants include: Particulate Matter [$PM_{2.5 \text{ or}}$ PM_{10}], Sulfur Dioxide [SO_2], Carbon monoxide [CO], Nitrogen Oxide [NO_x], Ozone [O_3], and Lead [Pb]). Based on emission sources, Hazardous Air Pollutants (HAP) may be an air pollution concern and quantified. Below, Table 5.1 lists each criteria pollutant and the current limits established by EPA.

Table 6.1 EPA's National Ambient Air Quality Standards (NAAQS)

Pollutant		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide		primary	8-hour	9ppm	Not to be exceeded more than once per year
			1-hour	35ppm	
Lead		primary and secondary	Rolling 3 month average	0.15 ug/m^3	Not to be exceeded
Nitrogen Dioxide		primary	1-hour	100 ppb	98th percentile of 1-hour daily maximum concentration, averaged over 3 years
		primary	Annual	53 ppm	Annual Mean
Ozone		primary and secondary	8-hour	0.075 ppm	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution	PM 2.5	primary	Annual	12 ug/m^3	Annual mean, averaged over 3 years
		secondary	Annual	15 ug/m^3	Annual mean, averaged over 3 years
		primary and secondary	24-hour	35 ug/m^3	98th percentile, averaged over 3 years
	PM 10	primary and secondary	24-hour	150 ug/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide		primary	1-hour	75 ppb	99th percentile of 1=hour daily maximum concentrations, averaged over 3 years
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

Source: http://www.epa.gov/air/criteria.html

Ambient air quality monitoring is designed to focus on documenting air pollutants of concern. To identify air pollutants of concerns, an Air Quality Assessment is usually completed prior to a monitoring project.

Projects funded by the EPA that generate environmental data are required to have an EPA-Approved QAPP completed prior to any data collection. The purpose of a QAPP is to document how Quality Assurance (QA) and Quality Control (QC) activities will be followed during the project's data collection and processing efforts. The following QAPP describes project methods, establishes data quality objectives, and defines data quality assurance and control for the AQP's monitoring project. The QAPP is intended to serve as the primary guidance document for properly implementing the monitoring project's QA & QC requirements, provide detailed operational procedures for the measurement process, and includes a compilation of QA requirements, procedures, and guidelines that are applicable to air pollution and meteorological measurements systems. The QAPP is designed to achieve a high percentage of valid data samples (>95%) while maintaining integrity and accuracy. Required monitoring program duties will be conducted by AQP staff with a focus on quality assurance in the field, laboratory, and data processing.

QA is a system of management activities designed to ensure that the data produced by the operation will be of the type and quality needed and expected by the data user. QC defines the procedures implemented to assure that acceptable precision, bias, completeness, representiveness[1], and comparability are obtained and maintained in the generated data set. Quality control procedures, when properly executed, ensure that data meets or exceeds the minimally acceptable quality criteria established to assist management in making confident decisions. It is the policy of the DNR to implement a QA program and QC procedures to assure that data of known and acceptable precision, bias, completeness, comparability, and representiveness are collected in all environmental monitoring projects.

Precision, bias, completeness, comparability, and representiveness are the principle Data Quality Indicators (DQI) that provide qualitative and quantitative descriptions used in interpreting the degree of acceptability of data. Establishing acceptance criteria for these DQIs sets quantitative goals for the quality of data generated in the analytical measurement process.

Of the five principal DQIs, precision and bias are the quantitative measures, representiveness and comparability are qualitative, and completeness is a combination of both qualitative and quantitative measures.

Accuracy is a combined metric that represents the closeness of an individual measurement, or the average of a number of measurements, to the true value. Components of accuracy are random error, represented by the metric precision, and systematic error, represented by the metric bias. These error components result from sampling and analytical operations.

The specific requirements of these five DQIs are established beforehand, on a project by project basis, so that the goals of each project are met. The goal is to locate and eliminate or minimize bias, so the data collected show the true conditions of the area being sampled. This includes

[1] Representiveness is defined as a measure of the degree to which data accurately and precisely represent a selected characteristic of a monitored system.

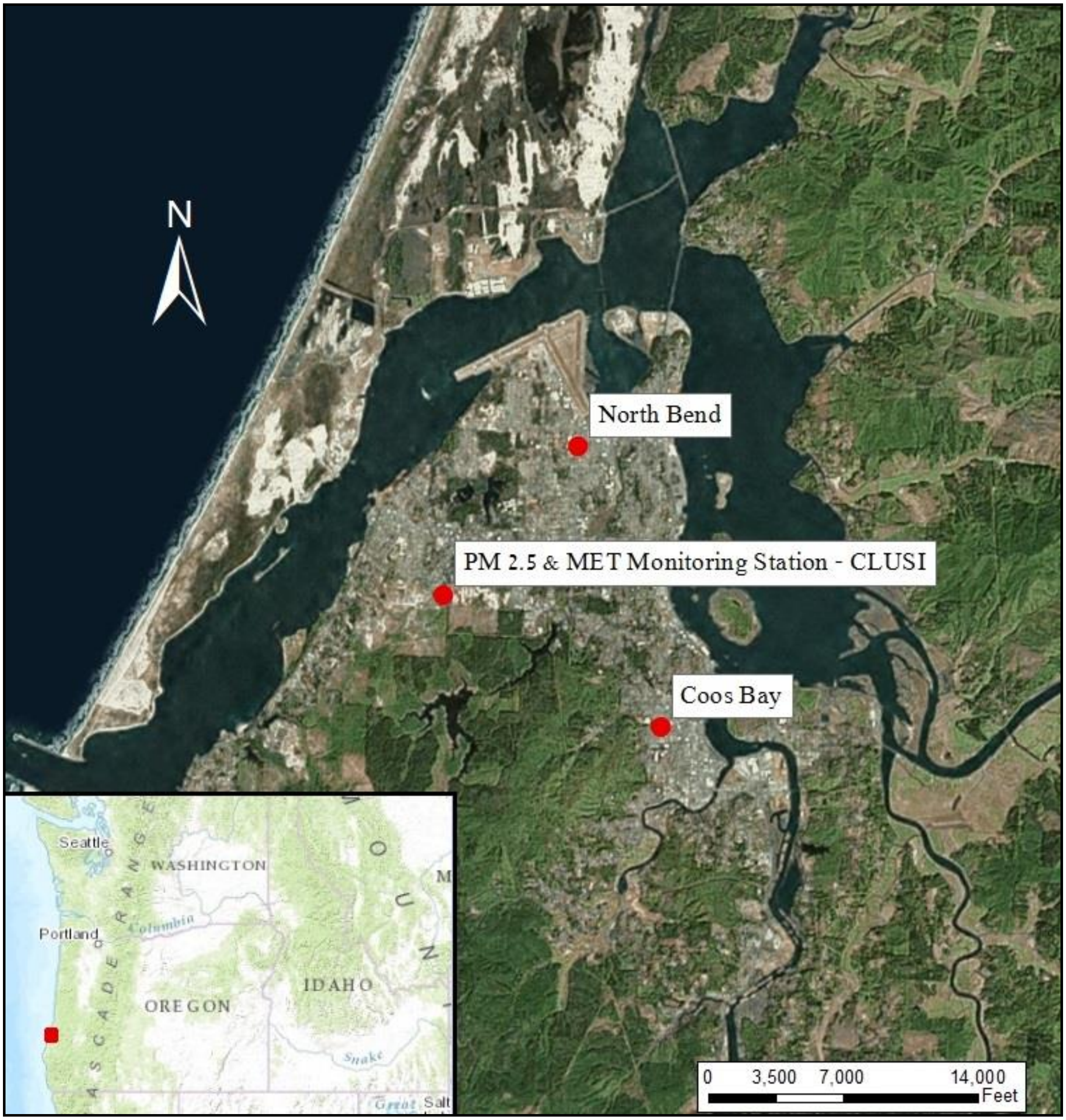
consideration of station location criteria, spatial scales, monitoring objectives, climatic change, source configuration, and duration of study.

Project Definition

EPA approval of this updated QAPP will maintain Particulate Matter (PM-2.5) and meteorological monitoring projects at the air quality site on tribal lands near Coos Bay, OR. The data collected during the project will be used to establish ambient baseline of PM-2.5 conditions on tribal lands, provide the Tribes' and public with near real time air quality information, and provide EPA Region 10 with data to assist in Federal Air Rules for Reservation's burn ban decisions. The data collected will be viewable online at http://trexwww55.ucc.nau.edu/cgi-bin/daily_summary.pl?cams=1036 on the TREX Network hosted by IPS Meteostar (http://wxweb.meteostar.com).

The monitoring station, Radar Hill, is located just south of the Tribal Administration building located at 1245 Fulton Avenue, Coos Bay, OR (43°22'55.19"N, 124°15'49.39"W). The approximate elevation at the monitoring station is 270 feet. The following maps show the location of the monitoring site.

Map 5.1. Aerial of Coos Bay/North Bend, Oregon with Monitoring Station



Map 5.2. Location of Monitoring Station near Coos Bay, Oregon on Tribal Lands

Map 5.3. Location of Monitoring Station near Coos Bay, Oregon on Tribal Lands - TOPO

5. PROJECT / TASK DESCRIPTION

The objective of the AQP at Radar Hill is to document baseline ambient PM-2.5 and meteorological conditions on tribal lands near Coos Bay, OR. The data collected for this project is available near real time online using the TREX website (http://trexwww55.ucc.nau.edu/cgi-bin/daily_summary.pl?cams=1036).

5.1 Instruments/Monitors

This monitoring project will document baseline ambient PM-2.5 and meteorological conditions on tribal lands using a Radiance Research M903 Integrating Nephelometer and Met One Instruments, Inc. meteorological sensors. All the hardware and software for this project is capable of providing near real time data. The nephelometer estimates the scattering coefficient of light (bscat) caused by aerosols and gases in the ambient air. The light scattered from an internally tube-mounted flashing light source is integrated from 5 to 175º deflection and measured by a photodiode detector at the opposite end of the tube. The meteorological station consists of a 10 meter meteorological weather tower that measures wind speed and direction, temperature and humidity, solar radiation, barometric pressure, and rainfall.

5.2 Description of Work

The following list describes the work required for the monitoring project:

- Identify and secure monitoring site
- Identify sampling frequency and scale
- Establish recording equipment, procedures, and software
- Establish data and report format, content, and schedules
- Collect ambient $PM_{2.5}$ and meteorological data at site
- Meet or exceed quality objectives and criteria
- Follow standard operating procedures for equipment
- Perform preventative maintenance on all equipment
- Conduct instrument calibrations, zero, and span, and precision and accuracy evaluations
- Submit QA/QC data to EPA’s AQS

5.3 Field Activities

Field activities at the Radar Hill monitoring site are important to ensure data integrity for the monitoring project. AQP staff will conduct activities that support successful operation and maintenance of the nephelometer and meteorological equipment. Field activities include periodic preventative maintenance and servicing of the equipment at the monitoring site. Operational servicing activities include recording pertinent field data and performing calibration and audit of the equipment at the monitoring site. Audits, calibrations and verifications will be conducted as specified by the equipment requirements. Maintenance is conducted according to the schedule and audits are conducted annually as shown in Table 6.1. Data are transmitted directly to a local computer via a ZENO 3200 data logger and simultaneously sent to the TREX server. Data checks occur weekly and validations monthly by AQP staff via the LEADS IPS Meteostar system to ensure proper flagging for proposed AQS submission.

Table 6.1. Instrument maintenance and Data Management

Item	Weekly	Quarterly	Semi- Annually
Verify that displays on all instruments have values that are reasonable for current meteorological and air quality conditions.	X[2]		
Perform zero/span checks on PM-2.5 monitor.	X		
Check instruments for insects, dust, etc., and clean as necessary.		X	
Audit meteorological instruments. Calibrate/ Repair / replace as needed (based on audit findings).			X[2]
Audit $PM_{2.5}$ nephelometer. Calibrate/ Repair / replace as necessary. (based on audit findings).[3]			X[1]

Field measurements are described in Table 6.2 below. All measurements are collected in English units. The ZENO data logger collects information every 2 seconds and combines it into 5-

1. Standard Operating Procedures CTCLUSI $PM_{2.5}$ Data Collection
2. Standard Operating Procedures CTCLUSI Meteorological Data Collection
3. Weekly verifications on any AQP equipment may justify audits, calibrations, repairs beyond what is specified in this table.

minute averages. The LEADS system polls the data logger every 15 minutes retrieving three 5-minute packets of information. This information is then combined into 1-hour averages. The one-hour averages are posted on the publicly-available web-pages. The original 5-minute data are available for manual validation via LEADS IPS Meteostar software.

Table 6.2. Parameters, Frequency, Units, and Comments

Parameter	Frequency	Units	Comment
Date	Collected by the ZENO data logger every 2 seconds for 5-minute and 1-hour averages	Month/Day/Year	
Time	Collected by the ZENO data logger every 2 seconds for 5-minute and 1-hour averages	Hour: Minutes AM or PM	Pacific Standard Time
PM-2.5	Collected by the ZENO data logger every 2 seconds for 5-minute and 1-hour averages.	$\mu g/m^3$	
Temperature	Collected by the ZENO data logger every 2 seconds for 5-minute and 1-hour averages	Degrees (F)	
Solar Radiation	Collected by the ZENO data logger every 2 seconds for 5-minute and 1-hour averages	Langleys per minute	
Barometric Pressure	Collected by the ZENO data logger every 2 seconds for 5-minute and 1-hour averages	Millibars	
Wind Speed	Collected by the ZENO data logger every 2 seconds for 5-minute and 1-hour averages	Miles / Hour	
Wind Direction	Collected by the ZENO data logger every 2 seconds for 5-minute and 1-hour averages	Compass direction in degrees	
Precipitation	Collected by the ZENO data logger every 2 seconds for 5-minute and 1-hour averages	Inches (cumulative for relevant interval)	
Relative Humidity	Collected by the ZENO data logger every 2 seconds for 5-minute and 1-hour averages	Percent relative humidity	

In addition, to the basic measurements listed in Table 6.2, the software calculates the following additional parameters, listed in Table 6.3.

Table 6.3. Calculated Parameters

Parameter	Units	Definition
Resultant Wind Speed	Miles per hour	5-minute wind speeds and directions for the hour are converted into a single hourly vector. Resultant wind speed is the magnitude of this vector.
Resultant Wind Direction	Degrees	5-minute wind speeds and directions for the hour are converted into a single hourly vector. Resultant wind direction is the direction of this vector.
Maximum Wind Gust	Miles per hour	Peak wind speed during the hour.
Standard Deviation of Horizontal Wind Direction	Degrees	A measure of the variability of the direction from which the wind is blowing.

For monthly summaries of each parameter, the software calculates the following summary statistics:

- Maximum value
- Second highest value
- Minimum value
- Average value
- Standard deviation
- Data capture (data completeness)

6.4 Laboratory Activities

The nephelometer and meteorological data does not require laboratory or chain of custody handling procedures. Data handling is completely automated. Data are automatically backed up through routine IPS MeteoStar server back-ups.

6.5 Project Assessment Techniques

An assessment is an evaluation process used to measure the performance or effectiveness of a project and its elements. As used here, "assessment" is an all-inclusive term used to denote any of the following: audit, performance evaluation, Management Systems Review (MSR), peer review, inspection, or surveillance. Section 18 discusses the details of the assessments.

6.6 Project Records

AQP staff will establish and maintain procedures for the timely preparation, review, approval, issuance, use, control, revision, and maintenance of documents and records. The categories and types of records and documents which are applicable to document control for ambient air quality information are presented in Table 6.4. Information on key documents in each category is explained in more detail in Section 9.

Table 6.4. Critical Documents and Records

Categories	**Record/Document Types**
Site Information	Network descriptions Site characterization files Site maps Site pictures
Environmental Data Operations	Quality Assurance Project Plans (QAPP) Standard Operating Procedures (SOP) for equipment used Field and laboratory notebooks Inspection/maintenance records
Raw Data	Any original data (routine and quality control data) including data entry forms
Data Reporting	Air quality index reports Data/summary reports EPA's Air Quality System Database via TREX. Website: http://trexwww.ucc.nau.edu/
Data Management	Data algorithms Data management plans/flowcharts $PM_{2.5}$ data Data management systems
Quality Assurance	Good laboratory practices Network reviews Control charts Data quality assessments Quality assurance reports System audits Response/corrective action reports Site audits

6. DATA AND MEASUREMENT QUALITY OBJECTIVES AND CRITERIA

This QAPP is designed for ambient baseline PM-2.5 and meteorological monitoring at the Radar Hill, the Tribes' air monitoring site. Any other special project, monitoring, or assessment beyond the scope of this monitoring project will require different procedures depending on the purpose and objectives of the project.

The specific written procedures or methodologies for operating instruments and handling data must be adhered to by any individuals, firms, or agencies producing air quality data for this specific project.

6.1 Data Quality Objectives

This section provides a description of the Data Quality Objectives (DQO) for the ambient air quality monitoring program. DQO are qualitative and quantitative statements that clarify the intended use of the data, define the type of data needed, and specify the tolerable limits on the probability of making a decision error due to uncertainty in the data.

6.1.1 Intended Use of Data

- Establish a quantifiable baseline of $PM_{2.5}$ concentrations and meteorological conditions on tribal lands near Coos Bay, OR.
- Monitor and understand the dynamic concentrations of $PM_{2.5}$.
- Evaluate $PM_{2.5}$ compliance with the NAAQS and Federal Air Rules for Reservations (FARR) Burn Bans.
- Activate emergency burn bans that prevent or reduce impacts from air pollution episodes.
- Provide $PM_{2.5}$ data upon which long term control strategies can be reliably developed.
- Observe and document $PM_{2.5}$ pollution trends on tribal lands near Coos Bay, OR.
- Provide a database for tribal members and the public to access air pollution trends locally

6.1.2 Type of Data Needed

Ambient $PM_{2.5}$ and meteorological data will be collected for this monitoring project.

6.1.3 Tolerable Error Limits

EPA utilized the Data Quality Objectives (DQO) process (see: *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, EPA/600/R-96/055, September 1994) to specify tolerable limits on the probability of making a decision error due to uncertainty in the data. This establishes limits on the probability of coming up with false positive or false negative error. A false positive error is encountered when the data indicate that an emissions limit have been exceeded when in fact, due to errors in the data, it has not been exceeded. Alternately, a false negative error is encountered when the data indicate that no emissions limit has been exceeded when in fact, due to errors in the data, an emissions limit has been exceeded. The AQP will establish an acceptable precision of 10%, as measured by coefficient of variation, and an acceptable bias of ± 10%. By controlling precision and bias at these levels, the decision error probability limit will be 5%.

The AQP will determine the monitoring project's data precision and bias by contracting audit services from one of the following organizations; Oregon Department of Environmental Quality, Lane Regional Air Protection Agency, qualified private air quality monitoring audit service, qualified staff from another Tribal AQP, or TREX. The AQP will work with the selected audit service and schedule audits for the nephelometer and meteorological equipment as specified in Table 6.1.

6.2 Measurement Quality Objectives

The quality of the data must be evaluated and controlled to ensure that it is maintained within the established acceptance criteria. Measurement Quality Objectives (MQOs) are designed to evaluate and control various phases (sampling, preparation, analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQO's. The MQO's and acceptance criteria for this project are the same as the monitoring equipment's specifications. The following are the specifications for the Radiance Research PM-2.5 Nephelometer and meteorological equipment.

Radiance Research PM 2.5 Nephelometer Specifications

Measurement	
Parameter	Light scattering extinction coefficient
Ranges	0 to > 1 km^{-1}
Lower Detection	< 0.004 km^{-1} (1 x $10^{-6}m^{-1}$) at 30 sec average
Outputs	4 Analog (0 to 5 VDC) and RS 232 serial, Baud Rate selectable, 9600, 4800, 2400, 1200
Time Constant Adjustable	2 sec. to several minutes
Measurement Characteristics	
Principle	Integrating nephelometer
Electronics	Computer based, MD68HC11 at 8 MHz
Operating Parameters	Diagnostics through serial port 3 sets of default operating parameters selected with panel switches
Optics No Lenses	Reference brightness measurement and chopper stabilized span. Chopper rate adjustable (typical, 20% duty cycle)
Wavelength	475 nm
Pressure	Microsoft absolute, 1%
Temperature	Thermistor, 0.2%
Rh	Vaisala, 2%

Met One Instruments Meteorological Equipment Specifications

See **Table A.3.1** within Standard Operating Procedures for Meteorological data collection systems for meteorological equipment specifications.

6.2.1 General Data Quality Objectives

- Data shall be of a known and documented quality. The level of quality required for each specific monitoring project shall be established during the initial planning stages of the project and will depend upon the data's intended use.

- Data shall be comparable and shall be produced in a similar and scientific manner.

- Data shall be representative of the parameters being measured with respect to time, location, and the conditions from which the data are obtained. The use of the standard methodologies contained in the QAPP should ensure that the data generated are representative.

Ideally, a 95% confidence of both precision and bias should be maintained with a ±15% difference or better between the actual amount of an introduced parameter (to a measurement system) and the indicated response of the measurement system.

The QAPP must be dynamic to continue to achieve its stated goals as techniques, systems, concepts, and project objectives evolve.

6.2.2 Specific Data Quality Objectives

- Determine whether or not the primary and secondary 24-hour NAAQS for particulate matter (measured as $PM_{2.5}$) of 35 μg/m^3 are exceeded.

- Determine whether or not the primary and secondary NAAQS for particulate matter (measured as $PM_{2.5}$) of 15 μg/m^3 (annual arithmetic mean) are exceeded.

- Provide near real-time PM 2.5 and meteorological monitoring data for baseline monitoring assessment.

6.3 Network Scale

Representiveness is defined as a measure of the degree to which data accurately and precisely represent a selected characteristic of a monitored system. Support in achieving Representiveness is provided through adhering to the guidelines provided in:

- 40 CFR Part 58, Appendix D (Network Design for State and Local Air Monitoring Stations [SLAMS], National Air Monitoring Stations [NAMS], and Photochemical Assessment Monitoring Stations [PAMS]).

- 40 CFR Part 58, Appendix E (Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring).

Each monitor is assigned a scale of representiveness based on the definitions of 40 CFR Part 58, Appendix D.

Micro Scale - describes air volumes associated with area dimensions ranging from several meters up to about 100 meters (m).

Middle Scale - describes air volumes associated with area dimensions up to several city blocks in size with dimensions ranging from about 100 m to 500 m (0.5 kilometer [km]).

Neighborhood Scale - describes air volumes associated with an area of a city that has relatively uniform land use with dimensions in the 500 m to 4,000 m (0.5 to 4.0 km) range.

Urban Scale - describes air volumes within cities with dimensions on the order of 4,000 m to 50,000 m (4.0 km to 50 km). This scale would usually require more than one site for definitions.

Regional Scale - describes air volumes associated with rural areas of reasonably homogeneous geography that extends for tens to hundreds of kilometers.

7. TRAINING REQUIREMENTS

Ongoing education and training are integral to any monitoring project that strives to produce reliable and comparable data. Training is aimed at increasing the effectiveness of employees and their organization. As part of a QA program, 40 CFR Part 58, Appendix A requires the development of operational procedures for training.

Staff training will consist of required reading prior to implementation of QAPP requirements. Required reading shall include this QAPP and appendices, and the Standard Operating Procedures of the monitoring equipment employed for the project. All AQP staff are highly encouraged to pursue training opportunities whenever possible and as funding resources allow. Organizations that provide training opportunities include universities, Oregon Department of Environmental Quality- ODEQ (www.odeq.state.or.us) the Western Regional Air Partnership (www.wrapair.org), the Institute for Tribal Environmental Professionals- ITEP (http://www4.nau.edu/itep), Tribal Environmental Exchange Network- TREX (http://trexwww55.ucc.nau.edu/), and Region 10 EPA (http://yosemite.epa.gov/r10/tribal.NSF). Trainings will focus on the proper operation and maintenance of PM 2.5 and meteorological monitoring equipment and on data management and submittal into EPA's Air Quality System (AQS). ITEP and EPA provide training opportunities to properly manage and upload data into AQS. All AQP staff working on this project will have adequate training to perform the assigned functions as determined by the AQP Director.

7.1 Health and Safety Warnings

The health and safety hazards associated with operating the monitoring equipment are minimal. Below are the hazards listed in decreasing order of importance.

Nephelometer

- Asphyxiation by calibration gases. All gases used for span calibration of the integrating nephelometer are heavier than air and are capable of displacing the oxygen in a vehicle or workspace. This can occur if an accident breaks or opens the valve that closes the gas cylinder or a large flow of the calibration gas is used in a poorly vented space. Care should be taken when transporting the calibration gas cylinders to and from the monitor in a manner that minimizes the possibility of damaging or opening the gas cylinder valve.

- Calibration gas cylinders are pressurized tanks. The site operator must be careful when handling the tanks to prevent the tanks from tipping over. Gas cylinders that do not have a built-in base must be kept from tipping over.

- The integrating nephelometer contains high voltage circuits. The instrument should be unplugged from the power source and capacitors allowed to discharge before servicing the instrument.

Meteorological Equipment

- Proper techniques will be used when lowering and raising the meteorological tower.

- The data logger contains high voltage circuits, and should be unplugged from the power sources and capacitors allowed to discharge before servicing the instrument.

8. DOCUMENTATION AND RECORDS

The following information describes the AQP's documentation and records procedures for the monitoring project. The AQP will maintain the documents and records pertaining to data, data quality, and other records required. EPA required data submittals will be accomplished through EPA's Air Quality System (AQS, http://www.epa.gov/ttn/airs/airsaqs/index.htm) using the IPS MeteoSTAR LEADS system.

Quarterly progress reports are provided to the appropriate Project Officer for the duration of the relevant grant.

8.1 Information Included in the Reporting Package

8.1.1 Routine Data Activities

The AQP will maintain records in appropriate files that allow for the efficient archival and retrieval of records.

8.1.2 Data Submittal to EPA

The AQP will submit monitoring data into EPA's AQS through the IPS MeteoStar LEADS system.

8.2 Data Reporting Package Format and Documentation Control

8.2.1 Notebooks

Each field and laboratory staff will be responsible for obtaining appropriate field notebooks. These notebooks will be uniquely numbered and associated with the individual and/or a specific program. The notebooks will be used to record information about the site and laboratory operations as well as document routine operations.

Completion of data entry forms, associated with all routine environmental data operations, are required even when the field notebooks contain all appropriate and associated information required for the routine operation being performed.

Field Notebooks - Notebooks will be used for each sampling site, specific program, or individual. Each notebook should be hardbound and paginated. Appropriate data entry forms may be used instead of notebooks; however, these forms are not required for routine operations, inspection and maintenance operations, or SOP activities as long as the information is contained in a notebook.

8.2.2 Electronic Data Collection

All data transmittal is automated. Data are collected automatically from all sensors by the ZENO data logger and assembled into 5-minute averages. The IPS MeteoStar LEADS system polls the ZENO every 5 minutes and collects the 5-minute averages. The 5-minute averages are then combined into 1-hour averages for posting on the publicly available web pages. Detailed 5-minute and 1-hour data are available electronically for manual validation. Any editing is specifically documented directly in notes appended to the affected records and in the electronic mail accompanying the data transfer. Validated data may be transferred to the AQS data system using the LEADS software.

Accuracy of data transmittal is evaluated by the auditor during the course of comprehensive annual system audits.

8.3 Data Reporting Package Archiving and Retrieval

All information will be retained for three years from the date of collection. However, if any litigation, claim, negotiation, audit, or other action involving the records has been started before the expiration of the three-year period, the records will be retained until completion of the action and resolution of all issues which arise from it, or until the end of the regular three year period, whichever is later. The AQP will extend this time period and store records for three full years past the year of collection. For example, any data collected in calendar year 2003 will be retained until at least January 1, 2007.

9. MONITORING PROGRAM DESCRIPTION

The purpose of this section is to:

- Identify the Functions of the Monitoring project.
- Outline Monitoring Objectives.
- Establish the Criteria for Sampling Design and Monitoring Site Selection.

The primary function of the monitoring program is to generate a baseline documentation of PM-2.5 and meteorological conditions on tribal lands. Other functions include determining trends over time, developing algorithms based on historical air quality and other conditions which will forecast air quality, verifying air quality modeling programs, assist in the Federal Air Rules for Reservations (FARR) implementation, and correlating health effects to air quality.

Sampling network design and monitoring site selection comply with the following appendices of 40 CFR Part 58:

40 CFR Part 58, Appendix A - Quality Assurance Requirements for State and Local Air Monitoring Stations (SLAMS)

40 CFR Part 58, Appendix D - Network Design for State and Local Air Monitoring Stations (SLAMS) and National Air Monitoring Stations (NAMS).

40 CFR Part 58, Appendix E - Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring

9.1 Monitoring Objectives

- Determine the highest concentrations expected to occur in the area covered by the monitoring station.
- Determine representative concentrations in areas of high population density.
- Determine the impact of significant sources or source categories on ambient pollution levels.
- Determine general background PM-2.5 concentration levels.
- Determine the extent of regional pollutant transport among populated areas and in support of secondary standards.
- Determine the welfare-related impacts in rural and remote areas (such as visibility impairment and effects on health).

The AQP will utilize the network design criteria specified in 40 CFR Part 58, and establish the appropriate network configuration necessary to meet these objectives. The monitoring station monitor has been assigned as ***Background*** from the following monitoring objective designations:

- ***Population Exposure* -** the monitor is located in an area associated with high population density.

- ***Background* -** the monitor is located where manmade pollutant emissions are minimal.

- ***Transport* -** the monitor is located to measure pollutants transported from other areas.

- ***Maximum Concentration*** - the monitor is located where a high concentration of the pollutant is expected (often based on results of receptor models).

- ***Comparison Study* -** the monitor is located adjacent to other instrumentation measuring the same pollutant to compare different sampling/monitoring methodologies.

- ***Air Quality Index* -** the monitor provides data primarily for reporting to the Air Quality Index (previously called the Pollutant Standards Index).

Data collected within the monitoring network must be representative of the spatial area under each study. The goal of establishing a monitoring station is to match the spatial scale represented by the samples obtained with the spatial scale most appropriate for the monitoring objective of the station.

9.2 Site Selection

Selection of a monitoring site includes the following activities:

- Developing and understanding the monitoring objective and appropriate data quality objectives.
- Identifying the spatial scale most appropriate for the monitoring objective of the site.
- Identifying potential locations where the monitoring site could be placed.
- Identifying the specific monitoring site.

The AQP will adhere to the site selection criteria as specified in 40 CFR Part 58.

9.2.1 Site Location

Four criteria will be considered when evaluating potential sites. Monitoring sites should be oriented to measure the following (single or in combination as appropriate for the sampling objective):

- Impacts of known pollutant emission categories on air quality.
- Population density relative to receptor-dose levels, both short- and long-term.
- Impacts of known pollutant emission sources (area and point) on air quality.
- Representative air quality.

Selection according to these criteria requires detailed information concerning the location of sources, geographic variability of ambient pollutant concentrations, meteorological conditions, and population density. Selection of the number, geographic locations, and types of sampling stations is, therefore, a complex process.

The sampling site selection process involves consideration of the following factors:

***Economics* -** The quantity of funding resources required to accomplish all data collection activities, including instrumentation, installation, maintenance, data retrieval, data analysis, QA, and data interpretation, will be established.

***Security* -** In some cases, a preferred location may have associated problems that compromise the security of monitoring equipment (i.e., high risk of theft, vandalism, etc.). If such problems cannot be remedied through the use of standard measures such as additional lighting, fencing, etc., then an attempt to locate the site as near to the preferred location as possible shall be made.

***Logistics* -** This process includes procurement, maintenance, and transportation of material and personnel for the monitoring operation. The logistics process requires full knowledge of all aspects of the data collection operation: planning, reconnaissance, training, scheduling, safety, staffing, procuring goods and services, communications, and inventory management.

Atmospheric Considerations **-** These considerations may include spatial and temporal variability of pollutants and their transport. Effects of buildings, terrain, and heat sources or sinks on air trajectories can produce localized anomalies of pollutant concentrations. Meteorology must be considered in determining the geographic location of a site as well as the height, direction, and extension of sampling probes. Evaluation of a local wind rose is essential to properly locate many monitoring sites (e.g., siting either to detect or avoid emissions from specific sources).

Topography **-** Evaluation of the local topography based upon land use maps, U.S. Geological Survey topographic maps, and other available resources must be completed. Minor and major topological features that impact both the transport and diffusion of air pollutants must be identified and evaluated. Minor features may consist of an adjacent tree-lined stream or tall structures either upwind or downwind of a point source, each of which may exert small influences on pollutant dispersion patterns. Major features include river canyons or deep valleys, mountain ranges, and large lakes. Major features significantly impact the prevailing wind patterns or create their own local weather such as katabatic or anabatic winds.

Overlap exists between all of the factors listed above. Consequently, a professional judgment procedure will be employed in order to successfully select appropriate sites that can provide the data necessary to accomplish the project’s stated objectives. In situations where the sites do not specifically meet the requirements necessary to obtain the project objectives, reevaluation of the project priorities may be necessary prior to the final monitoring site selection. Experience in the operation of air quality measurement systems; estimates of air quality, field, and theoretical studies of air diffusion; and considerations of atmospheric chemistry and air pollution effects make up the required expertise needed to select the optimum sampling site for obtaining data necessary to fulfill the monitoring objectives.

9.2.2 Monitor Placement

The placement of each monitor is generally determined by the defined monitoring objective. Monitors are thus usually placed according to potential exposure to pollution. Due to the various factors discussed above, tradeoffs are often necessary to locate a site for collection of optimally representative data. Final placement of a particular monitor at a selected site is dependent on physical obstructions and activities in the immediate area. Monitors must be placed away from obstructions such as trees and fences in order to avoid their effects on airflow. To prevent sampling bias, airflow around monitor sampling probes must be representative of the general airflow in the area. In addition, the availability of utilities (i.e., electricity and telephone services) is critical.

9.3 EQUIPMENT LOCATIONS

9.3.1 Meteorological Sensors

The location of the meteorological sensors varies greatly from parameter to parameter. Because of the variations, the location criteria are discussed below on a parameter-by-parameter basis. Meteorological sensors and equipment specifications are attached as **Appendix C**.

Instruments shall be mounted on booms at the top of or projecting horizontally from the tower. The booms shall be securely fastened to the tower and shall be strong enough so that they will not sway or vibrate in strong winds. Wind instruments shall be mounted on a boom so that the sensors are twice the maximum diameter or diagonal of the tower away from the tower. The boom shall project into the prevailing winds. Wind sensors shall be mounted on booms or cross arms so that a sensor’s wake does not impact adjacent sensors. Usually, this means mounting the sensors a minimum of 2 meters apart. If the wind sensors are to be mounted on top of a tower, they shall be mounted at a height and distance from the tower so that the diagonal distance between the sensor and the tower is equal to twice the maximum diameter or diagonal of the tower.

Temperature sensors and solar radiation sensors that are to be mounted on a boom shall be mounted on a boom with a length that is greater than the diameter of the tower at the height at which the boom is mounted. The temperature and solar radiation sensors shall always be mounted on the south side of a tower. Temperature sensors that are mechanically aspirated shall have a downward-facing shielding.

Below in Table 10.1 with the make and model of all meteorological monitoring equipment that will be used for this project.

Table 9.1 Sensor, Make, and Model of Meteorological Equipment

Sensor	Make	Model #
Wind Speed	Met One Instruments (http://www.metone.com)	Model 010C
Wind Direction	Met One Instruments (http://www.metone.com)	Model 020C
Temperature	Met One Instruments (http://www.metone.com)	Model 083E
Relative Humidity	Met One Instruments (http://www.metone.com)	Model 083E
Precipitation	Met One Instruments (http://www.metone.com)	300 Series
Barometric Pressure	Met One Instruments (http://www.metone.com)	Model 092
Solar Radiation	Met One Instruments (http://www.metone.com)	Model 095

9.3.2 Towers

The sensor should be securely mounted on a mast (tower or pole) that will not twist, rotate, or sway.

The tower shall be of an open grid-type construction and of sufficient strength (steel or other suitable material) to be lowered safely in order to install, service, and audit the sensors. A tower must be rigid enough to maintain all mounted instruments in proper alignment and orientation in high winds.

When instruments are located on a cross arm projecting out from the tower, the cross arm shall be securely fastened to the tower and shall be strong enough so that the sensors do not sway or vibrate in high winds. The sensors shall be securely fastened to the cross arm at a distance of two tower diameters or widths, measured from the edge of the tower to the sensor, to avoid any influence of tower-induced turbulence on the sensors. The cross arm shall be installed so that it is horizontally level and the sensors shall be installed so that they are vertical. The cross arm shall be mounted and aligned so that the wind direction sensor is correctly aligned.

9.3.3 Wind Velocity Sensors

If the wind sensors are to measure surface level winds, the sensors should be located on a 10-m tower in open terrain. Open terrain is defined as an area where the distance between the tower base and any obstruction is at least ten times the height of that obstruction above the instrument. This applies to manmade (buildings) and natural (trees, rocks, or hills) obstructions. All distances are to be measured from the edge of the obstruction nearest the tower. Trees and shrubs shall be measured from the outside edge of the crown or drip line, and not the trunk.

If the sensors (and tower) are to be located in areas of uneven terrain or terrain containing obstacles, refer to Table 10.2 for the limits for terrain variation and obstacle height near the tower.

Note: The issue with the air stations location in proximity to the structures around it, is on ongoing issue in relation to the wind sensors. Due to the Tribes limited amount if reservation and fee lands, it was determined that this location, though not perfect, was the best place for the station. It is the highest point in Coos Bay, and close to several of our tribal buildings and gathering locations. Another important reasoning is that a potential Title V emitter is in the process of getting its permits to set up right across the bay, which the Air State will be essential in monitoring the proposed facility's effect on air quality. The tribes do own a forested piece of land directly to the south of the air station, however we do not have the funding to clear the land and move the air station. Also the small forest is considered a Cultural Resource which makes clearing it a complicated issue.

Table 9.2 Limits on Terrain and Obstacles near Tower

Distance from Tower (m)	Slope, no Greater Than (%)	Maximum Obstruction or Vegetation Height (m)
0 – 15	± 2	0.3
15 – 30	± 3	0.5 – 1.0 (most vegetation <0.3)
30 – 100	± 7	3.0
100 – 300	± 11	10 x Ht *

9.3.4 Temperature and Humidity Sensors

Temperature and humidity sensors shall be mounted over an open plot of short grass or natural earth (not concrete or asphalt) at least 9 m in diameter. A height of 1.25 to 2 m above the ground surface is the standard height for mounting temperature and humidity sensors, but tower mounting, as is the case in most air pollution/meteorological monitoring applications, is also acceptable. Wherever the sensor is mounted, the height of the sensor should be measured and recorded.

The sensors shall be no closer to obstructions than a distance of four times the height differential between the height of the sensor and the height of the obstruction. This applies to both manmade and natural obstructions.

The distance shall be measured from the edge of the crown or dripline of the vegetation, not the trunk. The sensors shall be positioned at a minimum of 30 m from large paved areas (streets, parking lots, etc.), steep slopes, ridges, hollows, or bodies of standing water. Temperature probes shall be located so that they are not influenced by heat leakage from the shelter containing the electronics and recorders for the meteorological equipment.

9.3.5 Barometric Pressure Sensors

Barometric pressure sensors are usually mounted inside the shelter housing meteorological instruments and recorders since barometric pressure is not affected by indoor installations. The installation of the barometric pressure sensors inside the stable shelter environment protects the instruments from exposure to extreme climatological events that may impact the sensors or recorders. However, when a sensor is mounted inside a shelter, it should be placed inside the building on an interior wall, and removed from drafts from the heating/ventilating/air conditioning system, doors, and windows. The instrument should be mounted to minimize vibration and be vented to eliminate shelter interior pressurization.

9.3.6 Solar Radiation Sensors

All solar or net radiation sensors must be positioned so they are horizontal. These sensors must have an unobstructed view of the sun during the entire year, from sunrise to sunset. They should not be positioned within 50 m of any light colored walls or sources of artificial light.

If net radiation is to be measured, the sensors shall be sited according to the siting criteria for temperature sensors unless a specific application is desired.

9.3.7 $PM_{2.5}$ Sensors

When monitoring for $PM_{2.5}$, it is important to select a site where the collected particulate mass is representative of the monitored area.

Optimum placement of the sampling inlet for $PM_{2.5}$ is at breathing height level. However, practical factors such as prevention of vandalism, security, and safety precautions must also be considered. Given these considerations, the sampler inlet for micro scale $PM_{2.5}$ monitors must be between 2 and 7 m above the ground. For middle or larger spatial scales the inlet must be 2 to 15 m above the ground.

If the sampler is located on a roof or other structure, there must be 2 meters separation from walls, parapets, penthouses, etc. No furnace or incineration flues should be nearby. Collocated samplers must be at least 2 m, but not greater than 4 m, away from each other.

Samplers should be located at least 20 m from the dripline of the nearest trees, but must be 10 meters from the dripline when it acts as an obstruction.

The sampler must be located away from obstacles such as buildings, so that the distance between the obstacle and the sampler is at least two times the height that the obstacle protrudes above the sampler.

There must be unrestricted airflow in an arc of at least 270° around the sampler. The predominant wind direction for the season with the greatest pollutant concentration potential must be included in the 270° unrestricted arc. If the sampler is to measure concentrations from a road or point source, there must be no obstructions between a road or point source, even when other spacing from obstruction criteria are met.

There are many factors to be considered in establishing a particulate sampling location. These include accessibility under all weather conditions, availability of adequate electricity, and the security of the monitoring personnel and equipment. The sampler must be situated where the operator can reach it safely despite adverse weather conditions. If the sampler is located on a rooftop, care should be taken that the operator’s personal safety is not jeopardized by a slippery roof surface. Consideration should also be given to the fact that routine operational procedures such as calibration, maintenance, and filter installation and recovery involve transporting supplies and equipment to and from the monitoring site.

The lack of suitable power source can often result in the loss of many samples because of power interruptions or fluctuations. To ensure that adequate power is available, consult the manufacturer’s instruction manual for the sampler’s minimum voltage and power requirements.

The security of the sampler depends mostly on the location. Rooftop sites with locked access and ground level sites with fences are common. In all cases, the security of the operating personnel as well as the sampler should be considered.

For this monitoring project, the AQP will place the PM 2.5 sampler in a small climate controlled shed at the base of the meteorological tower.

9.4 Rationale for the Ambient Air Quality Monitoring

The rationale for the monitoring project is to establish baseline PM 2.5 pollutant levels and associated meteorological conditions based on the findings and recommendations from the AQP's Tribal Air Quality Assessment Version 1.0.

10. SAMPLING METHODS REQUIREMENTS

10.1 Purpose

- Identify the sampling methods.
- Identify the procedures for collecting the required environmental samples.
- Describe the equipment to be used for the project.
- Describe necessary support facilities.
- Sample preservation requirements.
- Implementation requirements.
- Required materials include.
- Processes for preparing and decontaminating sampling equipment.
- Identify corrective actions necessary to reestablish network data integrity.
- Identify responsible parties to implement the corrective actions.
- Methods required to verify corrective action effectiveness.

10.2 Monitoring Technology/Methodology

10.2.1 Real-Time Ambient Air Monitoring PM-2.5

The Radiance Research Model M903 Integrating Nephelometer estimates the scattering coefficient of light (b_{scat}) caused by aerosols and gases in the ambient air. The Nephelometer measures b_{scat} caused by maintaining a steady ambient air flow rate through an optical tube. The tube contains a variable rate flash lamp with a wavelength limiting optical filter of 475nm. At the opposite end of the tube is a photodiode detector that measures light scattered by aerosols and gases in the tubes ambient air plus light reflected from the inside surfaces of the instrument's optical chamber. The inside reflective component is constant and corrected for by performing Zero and Span calibrations.

Directly across the optical tube is a second photodiode detector that measures the output level of light from the lamp. This compensates for any changes in the lamps brightness due to power supply changes, lamp aging, and dust on optical surfaces.

The Radiance Research Nephelometer is computer based with a menu driven display and toggle switches for control. A serial port is included with the instrument to communicate with an external computer. An internal Random Access Memory (RAM) with battery backup allows for data storage. A 9-pin connector labeled "analog output" can be utilized to collect nephelometer data on a separate datalogger. A constant speed exhaust fan, ensuring adequate airflow through the system. A purge port is included with the instrument to facilitate calibrations.

10.2.2 Electronic Data Collection

Nephelometer and meteorological sensor data are collected automatically every 2 seconds by the ZENO data logger, which compiles 5-minute averages. The LEADS system collects the 5-minute averages every 15 minutes and assembles them into 1-hour averages for website posting. 5-minute and 1-hour data are available for manual validation.

10.3 Support Facilities

The following describes the monitoring design and equipment to be used for this project.

10.3.1 Monitoring Station Design

The monitoring station design must encompass the operational needs of the equipment, and must also provide an environment that supports sample integrity, and allow the operator to safely service and maintain the equipment. Winter weather conditions must be considered during site selection in order to meet the station safety and serviceability requirements.

10.3.2 Ambient Air Sampler

The analyzer to be used is listed below in Table 11.1.

Table 10.1. $PM_{2.5}$ Ambient Air Quality Monitor

Criteria Pollutant	Model Designation	EPA Reference / Equivalence
$PM_{2.5}$	Radiance Research Model M903 Integrating Nephelometer	N/A

Table 11.2. Meteorological Monitoring Equipment

Sensor	Make	Model #
Wind Speed	Met One Instruments (http://www.metone.com)	Model 010C
Wind Direction	Met One Instruments (http://www.metone.com)	Model 020C
Temperature	Met One Instruments (http://www.metone.com)	Model 083E
Relative Humidity	Met One Instruments (http://www.metone.com)	Model 083E
Precipitation	Met One Instruments (http://www.metone.com)	300 Series
Barometric Pressure	Met One Instruments (http://www.metone.com)	Model 092
Solar Radiation	Met One Instruments (http://www.metone.com)	Model 095

10.4 Sampling/Measurement System Corrective Action

Corrective action measures will be taken to ensure the data quality objectives are attained. There are potentially many types of sampling and measurement system corrective actions. Table 11.2 and 11.3 details some expected problems and corrective actions needed for a well-run monitoring program.

Table 11.3. Nephelometer Field Corrective Actions

Routine site visit (daily)

If the unit is operational	If the unit is NOT operational
▪ Sign, date and comment in field data note book.	▪ Check flash lamp, verify if it is functioning ▪ Check power cord assembly, verify that all cords are plugged into the correct locations, refer to assemble photos ▪ Check fuse box or main breaker panel– check to make sure a fuse has not been switched off ▪ Check the 12 volt dc transformer - refer to assembly photos to make sure everything is attached appropriately ▪ Document to the field data note book ▪ Notify Supervisor

Routine site visit (weekly)

If the unit is operational and consistent	If the nephelometer data is consistently high or low, then
▪ Sign, date and comment in field data note book.	▪ If the wall scatter is greater than 75% then the water or other material has contaminated the optical tube and a cleaning will be necessary ▪ If cleaning doesn’t improve the wall scatter %, the optical alignment may need to be adjusted ▪ The O-rings may need to be changed at the dark trap and the lamp gasket. ▪ The internal optical chopper may need to be adjusted, check the chopper operation ▪ Document to the field data note book. ▪ Notify Supervisor.

Table 11.4. Meteorological Field Corrective Actions

Sensor	Supplier	Recommended Action and Frequency
Wind Speed	Met One Instruments (http://www.metone.com)	Trouble shoot after audit findings. Replace with calibrated spare sensor when the criteria of table 13.1 cannot be met.
Wind Direction	Met One Instruments (http://www.metone.com)	Trouble shoot after audit findings. Replace with calibrated spare sensor when the criteria of table 13.1 cannot be met.
Temperature	Met One Instruments (http://www.metone.com)	Trouble shoot after audit findings. Replace with calibrated spare sensor when the criteria of table 13.1 cannot be met.
Relative Humidity	Met One Instruments (http://www.metone.com)	Trouble shoot after audit findings. Replace with calibrated spare sensor when the criteria of table 13.1 cannot be met.
Precipitation	Met One Instruments (http://www.metone.com)	Trouble shoot after audit findings. Replace with calibrated spare sensor when the criteria of table 13.1 cannot be met.
Barometric Pressure	Met One Instruments (http://www.metone.com)	Trouble shoot after audit findings. Replace with calibrated spare sensor when the criteria of table 13.1 cannot be met.
Solar Radiation	Met One Instruments (http://www.metone.com)	Trouble shoot after audit findings. Replace with calibrated spare sensor when the criteria of table 13.1 cannot be met.

10.4.1 Sample Contamination Prevention

Real time analyzers, extraction systems, and all materials that contact the sample stream shall be constructed of inert materials. This criterion requires that systems be composed of chemically inert plastics, glasses, and stainless steels. Additionally, sampling systems are to be designed to prevent the condensation or entrapment of water and other solvents that would provide an environment for bacterial growth, the chemical alteration of sample gases and particles, and the entrapment of particulates and criteria pollutants.

10.4.2 Sample Volume

The supply of sample gases must exceed the combined volumetric draw for all sampling analyzers. This requirement will prevent the sample manifold from developing a vacuum and drawing air in from locations other than the sample port.

10.5 Analyzer Audits

Audits are performed according to the methodology required by EPA. For each specific method and sampler type, the method followed is according to the procedures outlined in the **Appendix A** and **Appendix B** included with this QAPP.

10.5.1 Auditing the Nephelometer

The Air Quality Specialist is required to perform a zero and span verification every two (2) weeks using the procedures outlined in the SOP included with this QAPP.

The nephelometer performance audit confirms the accuracy of the instrument calibrations. The audit assesses the data for accuracy and ensures the data integrity. The audit is performed at least two times per year by an audit contractor.

The following general procedure is performed for the audit:

1. Pre-inspection zero and span check with the station calibration gases.

2. The audit zero and span check with the Auditor's zero and span gases.

3. The Auditor compares the audit results with the station calibration results.

4. The Auditor files the proper report with a field annotated audit form(s).

10.5.2 Auditing the Meteorological Equipment

Semi-annual audits will be completed by an audit contractor. Necessary repairs, replacements are carried out by the manufacturer. Audit reports are maintained by the Air Quality Specialist and archived. The verifications performed and their limits and frequencies are described in Table 13.1.

11. ANALYTICAL METHODS REQUIREMENTS

This section will identify the equipment and analytical methods required to complete the analyses of the particulate matter samples. Where appropriate, the analytical methods will be identified by the regulatory citation, number, and date.

11.1 Purpose/Background

The Radiance Research Model 903 Nephelometer measures light scattering (b_{scat}) in an airflow that passes through the scattering chamber of the instrument. The measurement geometry has been designed so that the instrument reading is almost proportional to the light-scattering coefficient, which indicates the total amount of light scattered into all directions by the air sample in the scattering chamber. The nephelometer is typically calibrated to read zero when filled with particle-free air, so the readings are proportional to light scattering by particles (b_{scat}). A span gas, which has a larger scattering coefficient than air, is used to adjust the span of the nephelometer so the b_{scat} data are recorded directly in engineering units of m-1.

The nephelometer does not respond to light absorption by gases or particles. However, when it is hazy, the dominant cause of visibility impairment light scattering (b_{scat}) by fine particles. Therefore, nephelometer measurements provide a good measure of visibility impairment by haze. If the nephelometer has a size selective inlet, large particles, including drizzle, fog, and snow can be excluded so they do not interfere with the measurement of light scattering by particles smaller than the inlet cut point. On the other hand, nephelometers can be designed to admit fog or cloud particles into the scattering volume so the instrument signal includes light scattering by these particles.

The instruments used to gather meteorological data are self-contained and do not require any actual analyses by the operator other than the creation of daily, monthly and annual reports which are generated automatically using the IPS MeteoStar LEADS software and are available on the web. Special reports are generated from existing data bases as needed.

12. QUALITY CONTROL REQUIREMENTS

To assure the quality of data, two distinct and important interrelated functions must be performed. One function is the control of the measurement process through broad QA activities, such as establishing policies and procedures, developing DQOs, assigning roles and responsibilities, conducting oversight and reviews, and implementing corrective actions. The other function is the control of the measurement process through the implementation of specific quality control procedures, such as audits, calibrations, checks, replicates, routine self-assessments, etc.

Quality Control (QC) is the overall system of technical activities that measure the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer. QC activities are used to ensure that measurement uncertainty, as discussed in Section 7, is maintained within acceptance criteria for the attainment of the DQOs.

12.1 Quality Control Procedures

QC for the nephelometer is achieved through periodic maintenance, semi-annual audits, zero and span checks, and other verification techniques.

QC checks for the meteorological equipment are conducted both by the Air Quality Specialist and by the selected audit contractor during the course of semi-annual audits. Because the equipment is intended primarily for public information, it is calibrated on site by the Air Quality Specialist. Necessary repairs, replacements are carried out by the manufacturer. Audit reports are maintained by the Air Quality Specialist and archived. The verifications performed and their limits and frequencies are described in below in Table 13.1.

Table 12.1. Quality Control Verification Limits (Audit)

Sensor	Parameter	Acceptance Criteria	Frequency of Verification by Site Operator	METONE calibrations
Wind Speed	Speed Accuracy Starting threshold	→ At WS ≤ 5m/s (11.18mph) ±0.25m/s (0.56mph) → At WS > 5m/s (11.18 mph) ±5% 0.25m/s (0.56 mph)	6 months	Yearly, or as needed
Wind Direction	Accuracy Linearity Starting threshold	Orientation verified Input ±5° 0.5m/s (1.12mph)	6 months	Yearly, or as needed
Temperature	Accuracy	Input ±0.5°C (0.9°F)	6 months	Yearly, or as needed
Relative Humidity	Accuracy	± 5% RH[a]	6 months	Yearly, or as needed
Barometric Pressure	Accuracy	Input ± 1%	6 months	Yearly, or as needed
Precipitation	Accuracy	Input ± 10%	6 months	Yearly, or as needed
Solar Radiation	Accuracy	Zero when covered	6 months	Yearly, or as needed

12.1.1 Calibrations

Calibration is the process employed to verify and rectify an instrument's measurements in order to minimize deviation from a standard. This multiphase process begins with certifying a calibration or transfer standard against an authoritative standard. The sampling or analytical instrument's measurements are then compared to this calibration/transfer standard. If significant deviations exist between the instrument's measurements and the calibration/transfer standard's measurements, corrective action is implemented to rectify the analytical instrument's measurements.

Calibration requirements for field equipment are included within **Appendix A** and **Appendix B**.

12.1.2 Precision Checks

Precision is the measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. In order to meet the DQOs for precision, staff will ensure the entire measurement process is within statistical control. Various tools will be employed in evaluating and monitoring precision measurements. Periodically exercising instruments with zero and span checks, and monitoring data integrity with control charts will provide evidence of deviations from the required precision measurement. Precision requirements for the applicable instrumentation are found in the SOP of this QAPP and in the specific instruments' operations manuals.

12.1.3 Zero and Span Calibration

The procedures described should be used to determine the zero and span of the nephelometer. Since the loss of data is not a consideration during the acceptance tests, it is recommended that the calibration gases be left flowing for a long enough period of time that several 5-min averages are recorded for both the zero and the span. At the beginning of calibration, it was recommended that the factory settings for the zero and span not be changed unless two independent calibrations show that the zero is in error by more than 10 Mm-1 and the slope is in error by more than 20% when the ambient temperature is below 30°C (86°F).

Light scattering by a gas depends linearly on its density, so the temperature and pressure of the calibration gas in the scattering chamber are measured and the light-scattering coefficient of the gas under those conditions is calculated. These two data points define a straight line. The response of integrating nephelometers is typically linear, so the straight line is the calibration curve relating the instrument response to the light scattering in the sample chamber.

13.1.3a Zero Air (Particle Free)

Particle-free air can be obtained by passing ambient air through a filter. This air contains the ambient concentrations of water and CO2, which is desirable because they affect the light-scattering coefficient. The nephelometer will be calibrated to read zero when filled with particle-free air. Therefore, the particle-free air is sometimes called the "zero gas."

The nephelometer contains a temperature sensor. The signal processing electronics in the nephelometer calculates the light scattering by air at the measured temperature and subtracts the calculated value from the measured signal. Thus, the zero reading is automatically compensated for changes in ambient temperature. The ambient pressure is set by the user according to the site elevation, and remains constant.

13.1.3b Span Gas

The other calibration gas should have a higher light-scattering coefficient and produce an upscale reading. This gas is sometimes called the "span gas." The two best choices are CO2 and HFC 134a, also known by the DuPont trade name, SUVA. CO2 has the advantages that it is inexpensive, widely available, and its use causes negligible environmental effects, so generous flows of the calibration gas can be used to assure that the scattering chamber contains only the calibration gas. Calibrations can also be continued for many averaging times to evaluate instrument noise. The scattering coefficient of CO2 is a factor of 2.61 times greater than for particle-free air. SUVA has the advantage that it has a higher light-scattering coefficient, which is 7.35 times greater than for particle-free air.

12.2 Control Charts

Control charts will be used extensively. The charts will have a log all of the stations calibrations and the sensors potential variations or drifts in accuracy, as well as the sensors parameters for comparison. The charts then provide a graphical means of determining whether various phases of the measurement process are in statistical control. The control charts will be utilized as an "early warning system" to evaluate trends in precision and bias. They will be appropriately filed and archived.

13. EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

13.1 Purpose/Background

The purpose of this section is to discuss the procedures used to verify that all instruments and equipment are maintained and capable of operating at acceptable performance levels. All instrument inspection and maintenance activities must be documented and filed. See Section 9 for document and record details.

13.2 Testing

Prior to field installation, staff will assemble and run the ambient air sampler at the laboratory. The field operator will perform a zero and span calibration. If any of these checks are out of specification, staff will contact the vendor for initial corrective action. Once installed at the site, the field operator will again run the tests mentioned above. If the sampling instrument meets the acceptance criteria, it will be assumed to be operating properly.

13.3 Inspection

A discussion of the necessary inspections of various equipment and components is provided here. Inspections are subdivided into two sections: one pertaining to daily data reviewing issues and one associated with field activities.

13.3.1 Inspections of Field Items

There are several items that require periodically field inspection. These items are identified and procedures are presented in the applicable equipment SOPs and operations manuals.

Specific activities must be performed both before and after a Zero and Span calibration has been done to the nephelometer. These activities and the frequency at which they should be checked are listed in the SOP for the nephelometer included with this QAPP.

13.3.2 Field Maintenance Items

Field equipment will be maintained according to manufacturers' specifications, manuals, and the applicable SOP located in the indicated appendices:

APPENDIX A: Standard Operating Procedures for Meteorological Data Collection Systems

APPENDIX B: Operation Procedures for Radiance Research M903 Nephelometer

14. INSTRUMENT CALIBRATION AND FREQUENCY

14.1 Calibration of Laboratory/Field Equipment

The specific calibration procedures for the laboratory and field equipment can be found in the applicable SOPs and operation manuals.

14.2 Document Calibration Frequency

All calibrations, audits, and site inspections of any sort that have to do with the instrument or the site shall be documented in the site logbook. Any and all activity that occurs around the site such as small fires or site clean-up shall also be recorded in the field logbook. The site operator shall be the one in charge of making sure this happens accordingly.

Continued sensor stability is assessed through site visits, routine maintenance and verifications. If the performance of any sensor is out of the range specified or if the equipment is moved or damaged, verification is conducted to determine if the instrument is still operating within limits or if it should be sent to the manufacturer for calibration and/or repair. Verification by the Air Quality Specialist occurs every 6 months and by the selected audit contractor during semi-annual audits. Instruments are then calibrated as needed.

15. DATA MANAGEMENT

15.1 Purpose

The following section will identify the processes and procedures that are to be followed to acquire, transmit, transform, reduce, analyze, store, and retrieve data. These processes and procedures will maintain the data integrity and validity through application of the identified data custody protocols.

15.2 Data Recording

Site logbooks shall record site inspections, instrument maintenance, repair and replacement; 6 month instrument verifications and semi-annual audit, and instrument calibration, as described in Section 9.

Electronic downloaded data records are maintained in a database supported by IPS MeteoSTar. Any edits are documents with notes attached to the relevant records and are documented on hard copy.

15.3 Data Validation

The instruments deployed to document ambient PM-2.5 and meteorological conditions undergo periodic audits and calibrations as previously specified within the QAPP. These procedures are outlined in the appropriate SOPs attached as Appendix A and B. Performance audits, verifications, and calibrations ascertain the accuracy, precision, and repeatability of the instrument in performing its required function.

The AQP conducts periodic data screening of the downloaded data, reviews the data against the values listed in Table 16.1 below, and identifies missing data, unacceptable shifts in values and records the problems or errors encountered. The data verifications and reports are reviewed by the auditor and validated during annually system audits. Data on the IPS MeteoStar LEADS system are manually validated and flagged monthly.

TABLE 16.1. DATA SCREENING CRITERIA

Sensor	Screening Criteria for Investigation
Wind Speed	Between 0 & 44.7m/s (0 & 100mph) (any exceedances verified with nearby NWS station) Varies by more than 0.45m/s (1mph) for 3 consecutive hours Varies by more than 1.34m/s (3mph) for 12 consecutive hours
Wind Direction	Between 0° and 360° Varies by > 1° in 3 hours; and by >10° in 18 hours
Temperature	Exceedances of local records independently verified by nearby NWS station Changes do not exceed 5.5°C (10°F) from the previous hour Varies by more than 0.5°C (1°F) for 12 consecutive hours
Relative Humidity	Between 0 and 100% Varies by more than 1% from one hour to the next
Precipitation	Not greater than 0.25mm (1 inch) per hour Never greater 101mm (4 inches) per 24 hours
Barometric Pressure	Always between 850 and 890 mb Varies by 5mb in 3 hours
Solar Radiation	Daily peaks below 1.5 Langleys Night is at but not below 0 W/m^2
Nephelometer	Outside of the range 0.001 to 1.0 km^{-1}

15.4 Data Assessment

Data assessment is conducted on an ongoing basis, during daily validations and more extensive monthly validations, when reports are produced, when verifications are conducted, and during site visits. In general, the major criterion for data assessment is reasonableness. The data screening values in Table 8 are used as benchmarks for data reasonableness.

Data errors are evaluated during formal and informal instrument verifications. The percent difference between the “known” value and the instrument reading, prior to any adjustments, is used as an estimate of the measurement error from the time of the verification to the last previous verification.

Data completeness is determined for each parameter and expressed as a percentage. The data completeness goal is 90% for all parameters. Percent valid data are documented on the IPS MeteoStar LEADS system and represent a gauge of the amount of valid data obtained from a sensor compared with ideal conditions (24 hours per day, 365 days per year).

15.5 Data Transmittal

Sensor data capture is automated and recorded electronically at the site to the ZENO data logger and from there to the IPS MeteoStar server where the electronic records are maintained.

15.6 Data Storage and Retrieval

Site logbooks shall record site inspections, instrument maintenance, repair and replacement; 6 month instrument verifications and semi-annual audit, and instrument calibrations (as needed), are described in Section 9. Site logbooks, all associated forms, and reports are grouped by calendar year and kept a minimum of five years before archiving. All electronic data is stored on the IPS MeteoStar Server and routinely backed-up. All archived records are stored indefinitely at the Environmental Management Office or in storage procured specifically for this purpose.

Electronic downloaded data records are maintained in a database supported by IPS MeteoStar. Any edits are documents with notes attached to the relevant records and are documented on hard copy.

16. ASSESSMENTS AND RESPONSE ACTIONS

An assessment is the process used to measure the performance or effectiveness of the quality system, the Ambient Air Quality Monitoring Network and its sites, and various measurement phases of the data operation. In order to ensure the adequate performance of the air quality system, staff will perform and/or participate in the following assessments:

- Management Systems Reviews
- Network Reviews
- Data Quality Audits
- Data Quality Assessments
- Assessment Activities and Project Planning

16.1 Management Systems Review

A Management Systems Review (MSR) is a qualitative assessment of a data collection operation or organization. A MSR is employed to establish whether the prevailing quality management structure, policies, practices, and procedures are adequate to ensure data obtained are of the necessary type and quality to support the decision process.

A MSR of the monitoring program will be conducted if the Director suspects that DQOs are not being met for the program. The MSR will be conducted by a qualified contractor as funding allows and will use appropriate federal regulations and this QAPP to determine the adequate operation of the ambient air monitoring program and its related quality system. The contractor will report its findings to the tribal management within 30 days of completion of the MSR. The report will be filed appropriately. The Air Quality Specialist or an appointed representative will regularly monitor progress on corrective action(s).

16.2 Network Reviews/Assessments

Conformance with monitoring requirements as set forth in 40 CFR Part 58, Appendices D and E are determined through annual network reviews of the ambient air quality monitoring system, as required by 40 CFR Section 58.20(d). The review is used to determine if a particular air monitor is collecting adequate, representative, and useful data in pursuit of its air monitoring objectives. Additionally, the monitor review may identify needed modifications to improve the system or correct deficiencies.

Prior to implementing a monitoring review, significant data and information pertaining to the network will be compiled and evaluated. Such information might include:

- Network files (including updated site information and site photographs).
- AQS reports.
- Five year air quality summaries.
- National Weather Service summaries for the monitoring area.

Sensor Location Requirements. Applicable siting criteria for SLAMS are specified in 40 CFR Part 58, Appendix E. The on-site visit will consist of physical measurements and observations to determine compliance with the 40 CFR Part 58, Appendix E requirements, such as height above ground level, distance from trees, appropriate ground cover, etc. Since many of 40 CFR Part 58

Appendix E requirements will not change within one year, this check at each site will be performed every three years.

Prior to a site visit, the reviewer will obtain and review the following:

- The most recent hard copy of site description (including any photographs).
- Seasonal, pollutant-specific data identifying the greatest potential for high concentrations.
- Data describing predominant seasonal wind directions.

A checklist similar to the checklist used by the EPA regional offices during their scheduled network reviews will be used. This checklist can be found in the SLAMS/NAMS/PAMS Network Review Guidance, which is intended to assist the reviewers in determining conformance with 40 CFR Part 58, Appendix E. In addition to the items on the checklist, the reviewer will also perform the following tasks:

- Make sure the inlet is clean.
- Check equipment for missing parts, frayed cords, damage, etc.
- Record findings in field notebook and/or checklist.
- Take photographs/videotape in the eight directions (E, SE, S, SW, W, NW, N, and NE).
- Document site conditions with additional photographs/videotape.

In addition to the items included in the checklists, other subjects for discussion as part of the network review and overall adequacy of the monitoring program will include:

- Installation of new monitors.
- Relocation of existing monitors.
- Citing criteria problems and suggested solutions.
- Listing problems with data submittals and data completeness.
- Maintenance and replacement of existing monitors and related equipment.
- Quality assurance problems.

- Air quality studies and special monitoring programs.
- Other issues such as proposed regulations and funding.

The monitor review will be documented in a report within two months of completion. This report will be distributed to DNR staff and EPA.

16.3 Assessment Documentation

16.3.1 Number, Frequency, and Types of Assessments

The PM-2.5 and meteorological parameters are automatically measured and electronically logged and stored in the monitoring station's data logger. The site's data logger is polled by the LEADS system and records are stored on the IPS MeteoStar Server. The downloaded records are captured on the AQP's website.

The monitoring station is visited every 2 weeks during regular verifications of the air monitoring equipment and is examined quarterly to inspect the equipment and sensors, or more frequently as needed.

Semi-annual verifications are performed by the Air Quality Specialist at the station for all equipment and sensors. External audits are performed semi-annually by a selected contractor, for both the nephelometer and the MET sensors.

The Air Quality Specialist is responsible for inspecting, testing and accepting instruments and supplies, and for reporting to the Environmental Manager equipment and supply needs.

17.3.2 Assessment Personnel

The Air Quality Specialist is responsible for performing routine preventive and corrective maintenance. Calibration is performed by the Air Quality Specialist semi-annually or more frequently depending on audit findings. The Air Quality Specialist is responsible for working with the manufacturer on any other major maintenance and/or repair needs.

17. REPORTS TO MANAGEMENT

Monthly summaries are automatically generated by the IPS MeteoStar LEADS software and are available online at http://weather.meteostar.com/tribal_weather/

Semi-annual verification reports (conducted by the Air Quality Specialist) and semi-annual audit reports (conducted by the selected contractor) will be filed at the Air Quality Specialist's desk and are available for inspection as requested. Semi-annual audit reports are provided to the Project officer.

Quarterly progress reports are provided to the EPA Project Officer throughout the duration of EPA grant funding.

Special reports are developed to discuss data acquisition results and sources of error, assess seasonal trends, and recommend further investigation of site operations as necessary. These may include assessments of trends and comparison with historic data and they may include integrated analyses of meteorological and particulate pollution information. They may be used for program evaluation and to identify recommendations for future equipment modification and/or acquisition.

17.1 Response/Corrective Action Reports

The response/corrective action report procedure will be followed whenever a problem is found such as a safety defect, an operational problem, or a failure to comply with procedures. A separate report will be required for each problem identified. The response/corrective action report is one of the most important ongoing reports to management because it documents primary QA activities and provides valuable records of QA activities that can be used in preparing other summary reports. Copies of response/corrective action reports will be distributed twice: first when the problem has been identified and the action has been scheduled and second when the correction has been completed.

LIST OF APPENDICES