Introduction to Air Monitoring and Remote Professional Assistance

November 19, 2020

Webinar Logistics

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- Please complete the webinar feedback survey – Link for the feedback survey will be in post-webinar email

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Thank you for joining the webinar!

Thursday, November 12, 2020; 10:00am-11:30am Pacific Time

Submit questions in the "Questions" pane

Raise your hand if you would like to be unmuted

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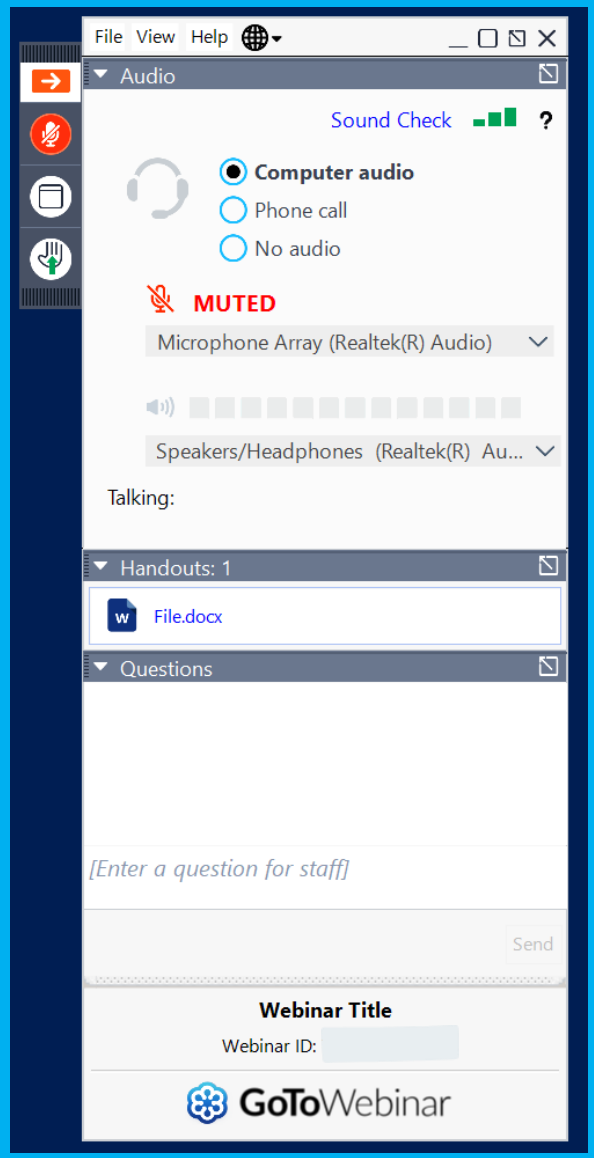


Presented by the Institute for Tribal Environmental Professionals
American Indian Air Quality Training Program
Questions? Contact Darlene.Santos@nau.edu

Polling Questions

Poll Question 1

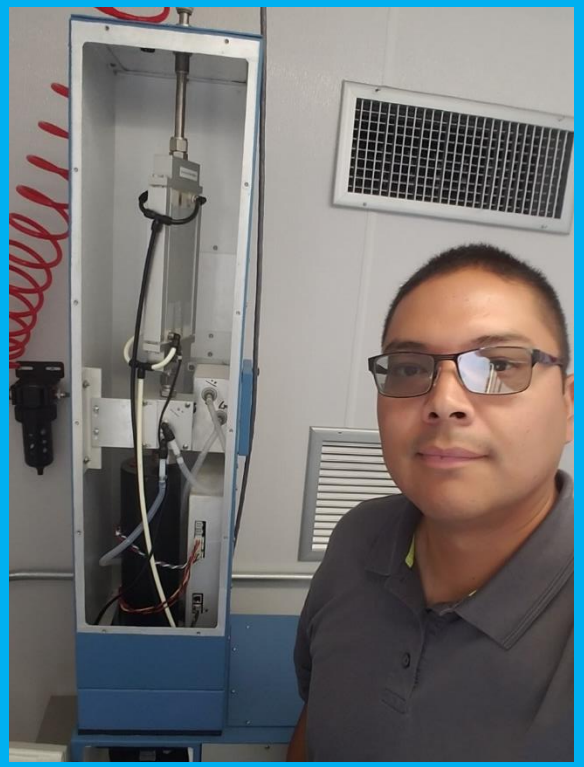
- Which of the following best describes your role?
  - Environmental Staff
  - Community or Tribal Leader
  - Federal or State Partner
  - Other

Poll Question 2

- How many years have you worked in Air Quality?
  - Less than a year
  - 1-3 years
  - 3-5 years
  - 5-10 years
  - Over 10 years

Presenters

Michael King
ITEP- TAMS Center



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Institute for Tribal Environmental Professionals
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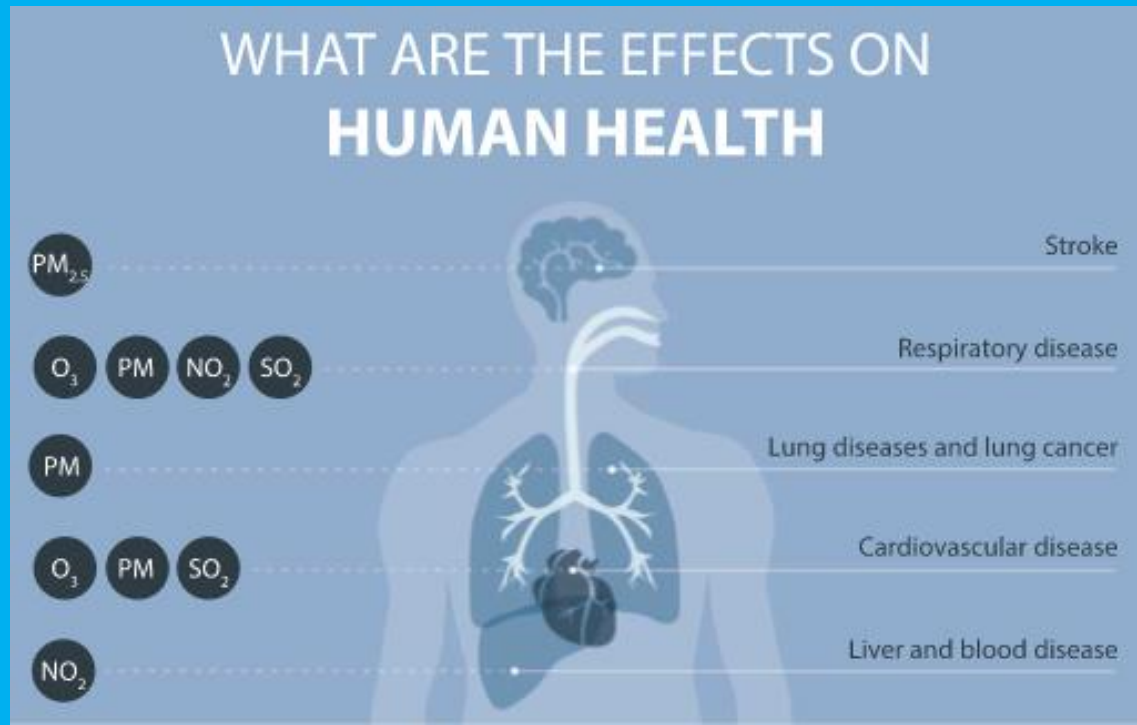
Michael King

Webinar Agenda

- Introduction to criteria pollutants and the NAAQS
- Overview of FEM & FRM air monitors
  - Basic theory of operation of air monitors
- Remote Professional Assistance (PA)
- Tribal Presenter – Overview of the MBCI Air Quality Monitoring Program
- Demonstration of remote PA
- Q & A session with presenters

Introduction to Criteria Air Pollutants and the National Ambient Air Quality Standards

- Clean Air Act requires U.S. EPA to set National Ambient Air Quality Standards NAAQS) to protect public health and the environment (40 CFR Part 50)
  - Primary standards are set to protect human health
  - Secondary standards are set to protect public welfare
- There are six principal pollutants, which are called "criteria" air pollutants each with both primary and secondary standards
  - Nitrogen Dioxide (NO_2)
  - Sulfur Dioxide (SO_2)
  - Ozone (O_3)
  - Lead (Pb)
  - Particulate Matter-10 microns and smaller
  - Particulate Matter-2.5 microns and smaller



National Ambient Air Quality Standards

The current NAAQS standards are listed below. Units of measure for the standards are:

- Parts per million (ppm) by volume of air
- Parts per billion (ppb) by volume of air
- Micrograms per cubic meter of air ($\mu g/m^3$)

Many tribes monitor for NAAQS designation purposes

Pollutant [links to historical tables of NAAQS reviews]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide (CO)		primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead (Pb)		primary and secondary	Rolling 3 month average	0.15 $\mu g/m^3$ (1)	Not to be exceeded
Nitrogen Dioxide (NO_2)		primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary and secondary	1 year	53 ppb (2)	Annual Mean
Ozone (O_3)		primary and secondary	8 hours	0.070 ppm (3)	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (PM)	$PM_{2.5}$	primary	1 year	12.0 $\mu g/m^3$	annual mean, averaged over 3 years
		secondary	1 year	15.0 $\mu g/m^3$	annual mean, averaged over 3 years
		primary and secondary	24 hours	35 $\mu g/m^3$	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24 hours	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)		primary	1 hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

FEM and FRM Air Monitors

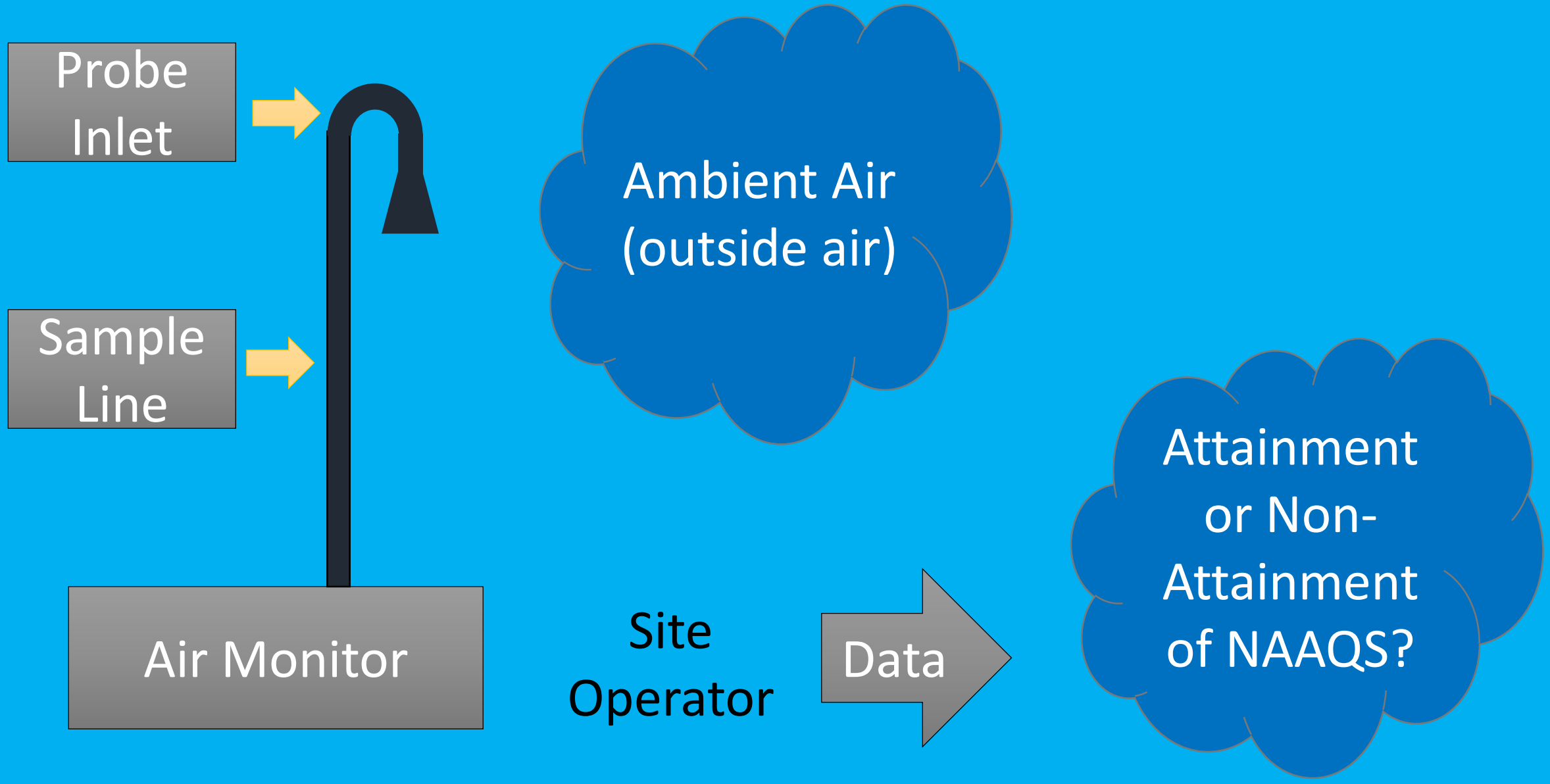
What are FRM and FEM Air Monitors? Why are They Important?

- FRM refers to Federal Reference Method monitors
- FEM refers to Federal Equivalent Method monitors
- EPA approved and designated monitoring methods to measure ambient air pollutants used to make NAAQS designations (40 CFR Part 53)
- Subject to Quality Assurance procedures and Quality Control Checks
- List of EPA designated monitors and recent designated monitors
- https://www.epa.gov/sites/production/files/2019-08/documents/designated_reference_and-equivalent_methods.pdf

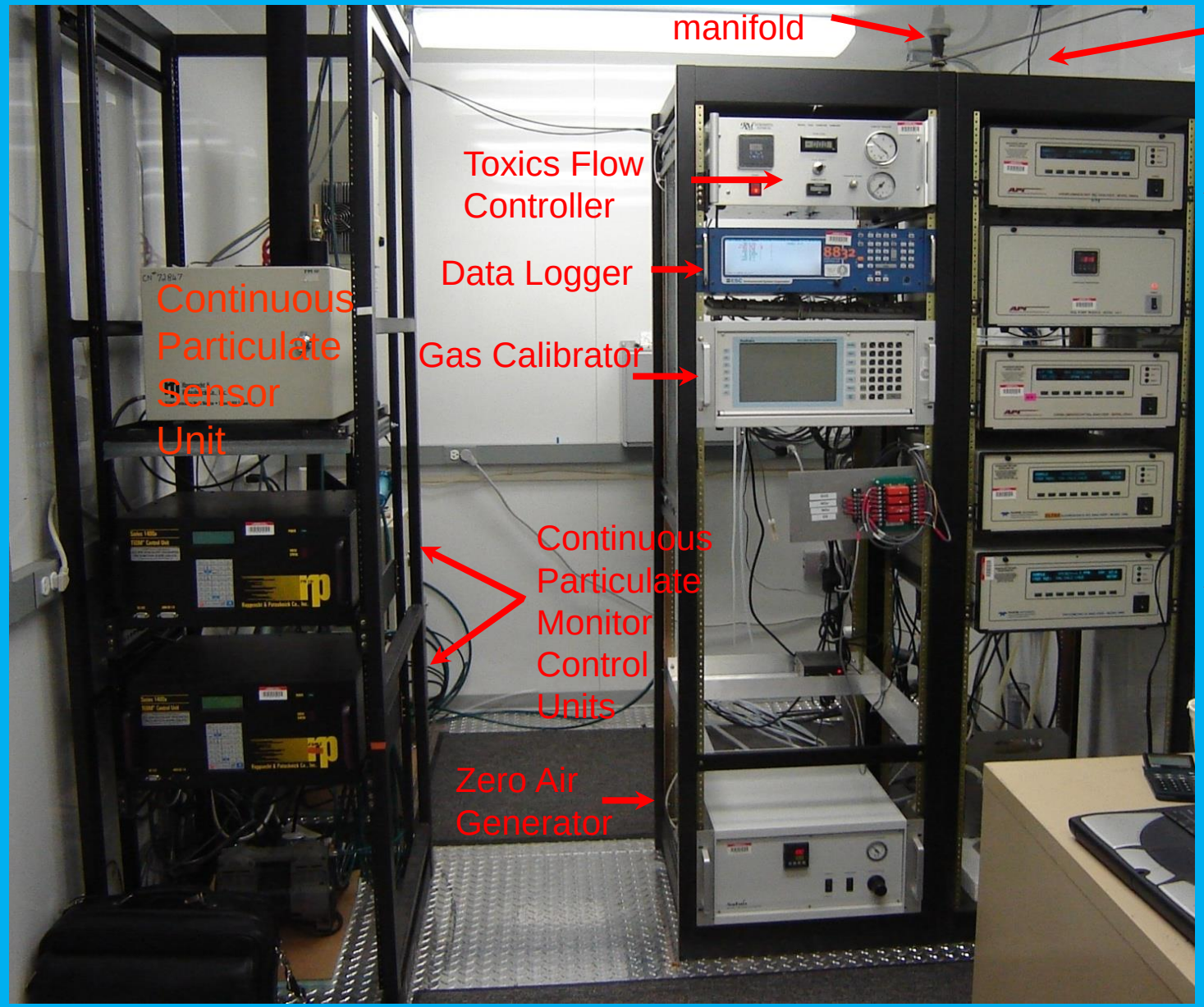
Reference or Equivalent Method label or sticker can be found on the monitor

Basic Theory of Operation of Air Monitors

Understanding an Air Monitoring Sample Collection System


Probe Inlet
Sample Line
Air Monitor
Ambient Air (outside air)
Site Operator
Data
Attainment or Non-Attainment of NAAQS?

Inside a State and Local Air Monitoring Station/Tribal Air Monitoring Station (Air Quality Surveillance System)



Gas Analyzer Rack

NO_y

NO_x

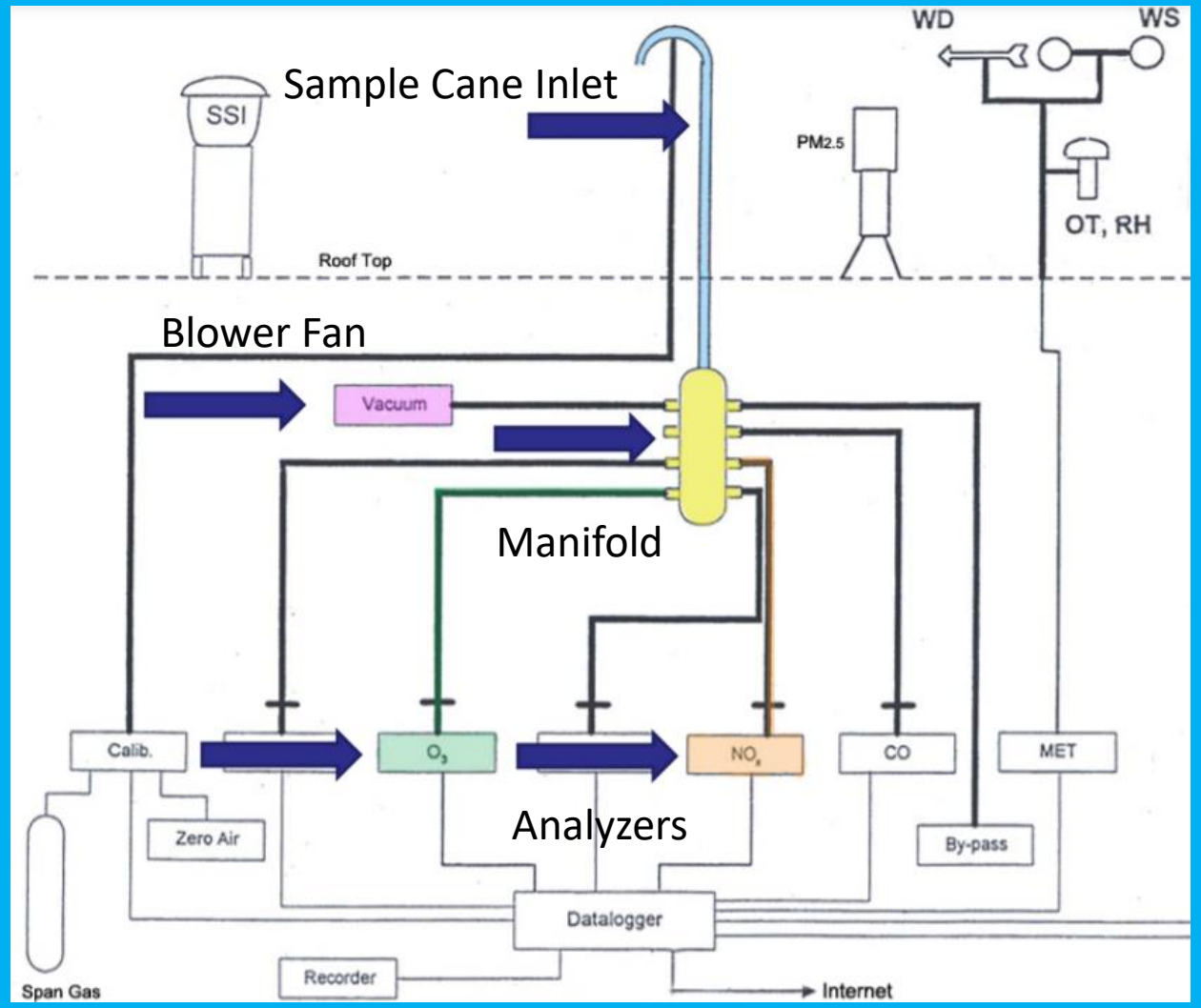
SO_2

Ozone

Stainless Steel 1/8 inch tubing connects regulator to calibrator

EPA Protocol Calibration Gas: 24.2 ppm NO, 24.1 ppm NOx, 24.8 ppm SO2

Diagram of a SLAMS/Tribal Air Monitoring Station Sampling System

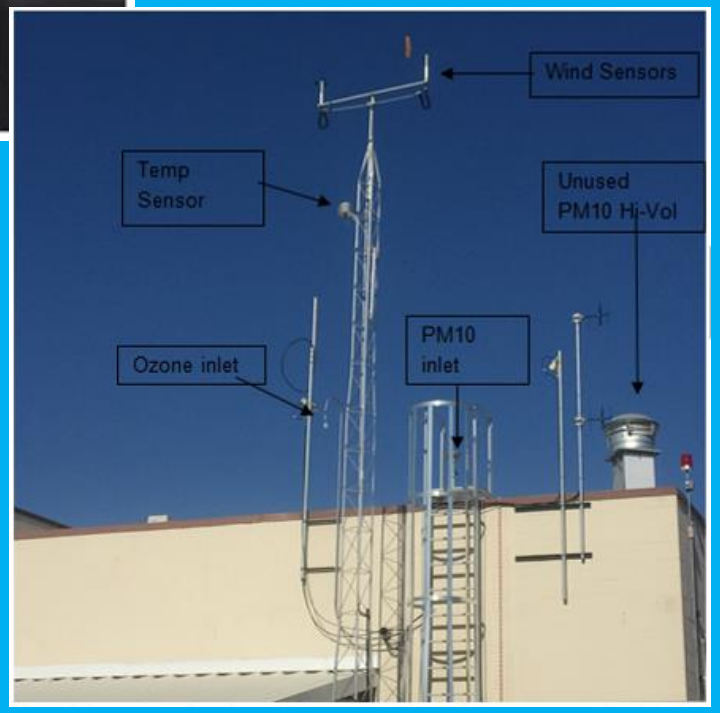


- Roof Top
  - Meteorological monitors (WS, WD, RH, Temp)
  - Particulate samplers on rooftop (Size selective inlet & separator to collect for PM2.5 & PM10)
  - Sample Cane Inlet
- Inside Air Station
  - Gaseous Analyzers (NOx, CO, O3, etc.)
  - Manifold, blower fan, sample lines, calibrator, zero air, cal gas cylinder
  - Data logger
    - PC (recorder)
    - Internet to send data to office

SLAMS/Tribal Air Monitoring Station

Inside Air Station

- Gaseous Analyzers
- Inlet, sample lines, calibrator, zero air, cal gas cylinder
- Data logger
  - PC (recorder)
  - Internet to send data to office



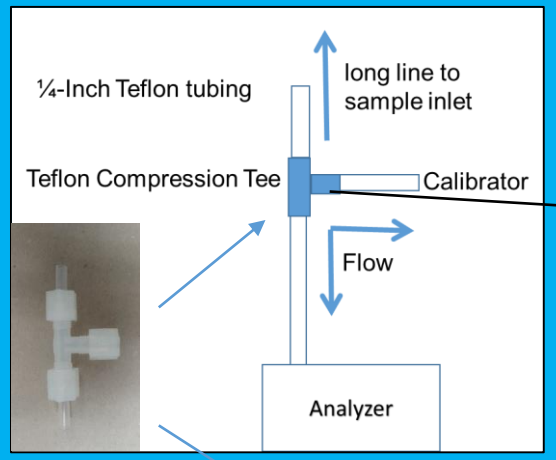
Roof Top

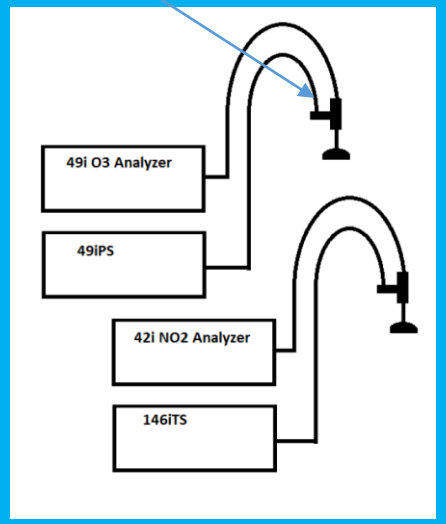
- Meteorological monitors (WS, WD, RH, Temp)
- Particulate samplers on rooftop
- Sample Inlet

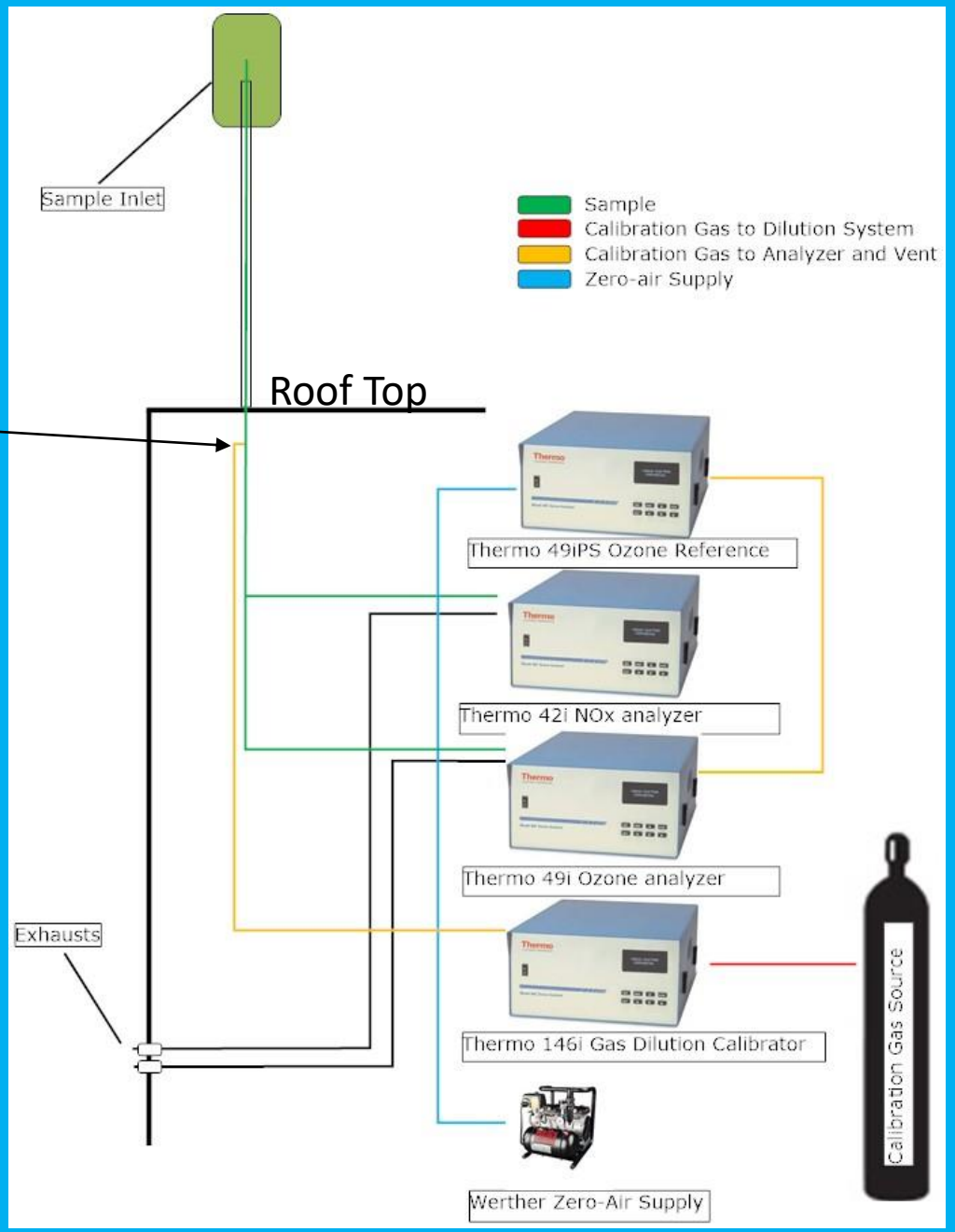
Example of a Sample Collection System for Gaseous Monitoring

- **Sample lines are used both as Inlet Probe and Manifold**
- **Calibration gas is introduced at the inlet**
  - *Why is that?*

- Below is a link to gaseous air monitoring plumbing demo video

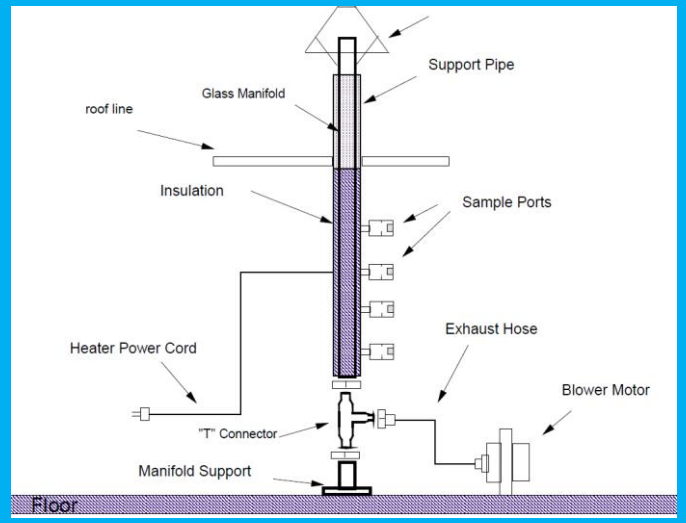




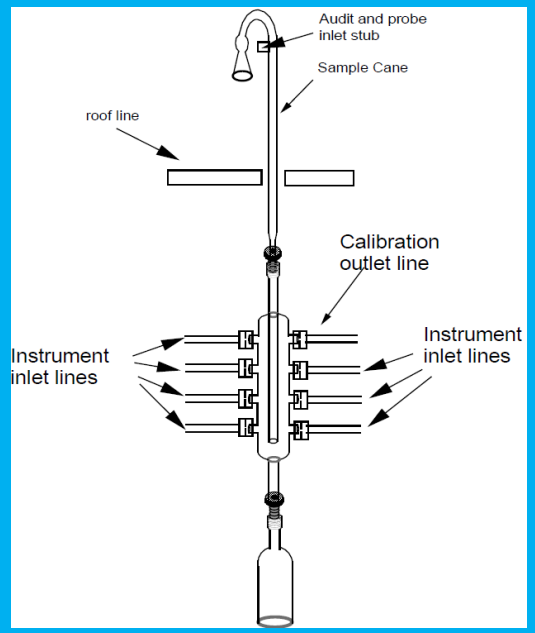


https://www.youtube.com/watch?v=voRGlsXJ66U&list=PLdtViTRnkGurbO-bzak9xQcJ-hQA6Fbgj&index=1

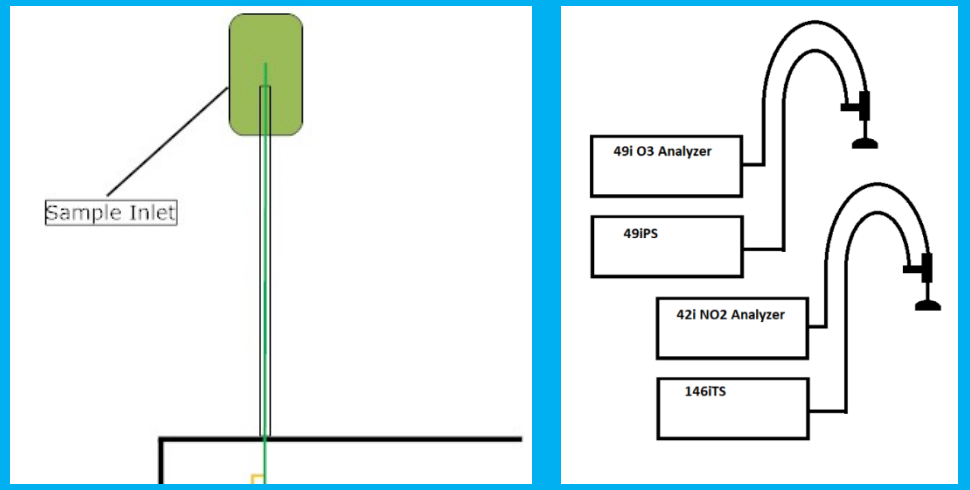
Examples of Sample Inlets and Manifolds



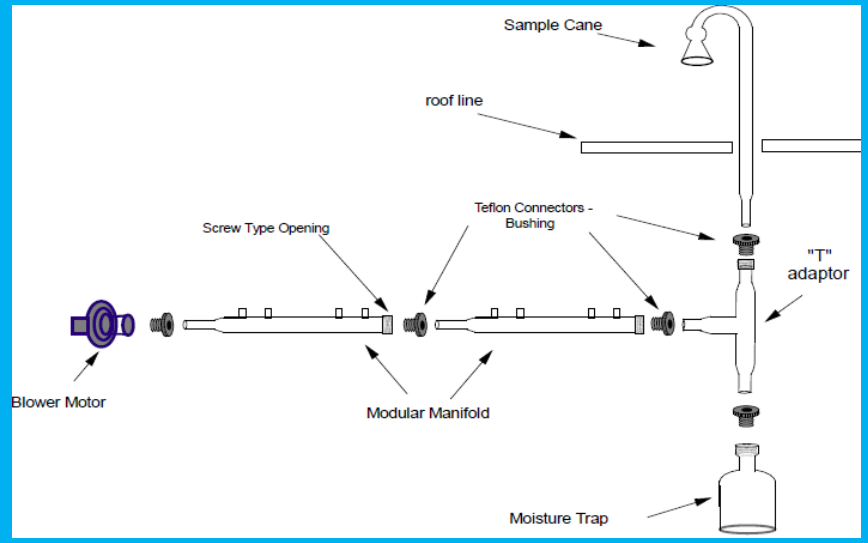
Vertical manifold



Octopus manifold



Sample lines manifold



Conventional T-type manifold

Outside of a SLAMS/Tribal Air Monitoring Station

- Electrical power
- HVAC unit
- PM samplers
- Sample probe inlets
- Ladder to access roof
- Security fence line
- Siting Criteria (Probe Siting & Placement)
  - 40 CFR Appendix E to Part 58
- Meteorological monitors

Stand Alone FRM/FEM Air Monitors

- Typically these are designed to monitor particulate matter
  - Inlet
  - Sample Collection System
  - Internal Data logger
- Equipped with enclosure and HVAC if needed
- Temp, Pressure, RH may include WS, WD
- May need a platform base and security fencing
- Electrical outlet for power
- Siting Criteria


Cabinet Interior with Rack

Example of Siting Criteria Requirements FRM/FEM Particulate Monitors

Parameter	Category	Siting Requirement
Inlet height	General	2-15 m above ground
	On rooftop	2 m above roof
	Collocated samplers	Within 1 vertical m of each other
Inlet radius clearance	General	≥ 1 m radius clearance
	Near small obstructions (fences, walls, etc.)	≥ 2 m with a minimum of 180 degrees of open sample pathway
	Near large obstructions (buildings, sound walls, billboards, etc.)	Distance ≥ 2x height of obstruction
	Near overhanging trees	≥ 10 m from tree drip line
	Arc of air flow	Unrestricted 270° arc that includes prevailing direction of high concentrations
Nearby Air sources	General	As far away as possible from vents
	Near any residential/commercial wood burning device	≥100 m away
Distance from roadways	< 1,000 vehicles per day*	≥ 10 m from nearest traffic lane
	Elevated roadway (> 25 m high)	≥ 25 m away
	Unpaved roads	As far away as possible

Neighborhood scale siting criteria (40CFRPart 58, Appendix E)

Polling Questions

Poll Question 3

- Do you currently monitor for a criteria air pollutant or pollutants? (Yes/No)?

Poll Question 4

- If so, how many air pollutants do you monitor?
  - None
  - 1
  - 2
  - 3 or more

Poll Question 5

- Which FEM or FRM monitors would you like to know more about?
  - Particulate Monitors
  - Gaseous Monitors
  - Both
  - I am uncertain right now

Particulate Matter and Gases in the Atmosphere

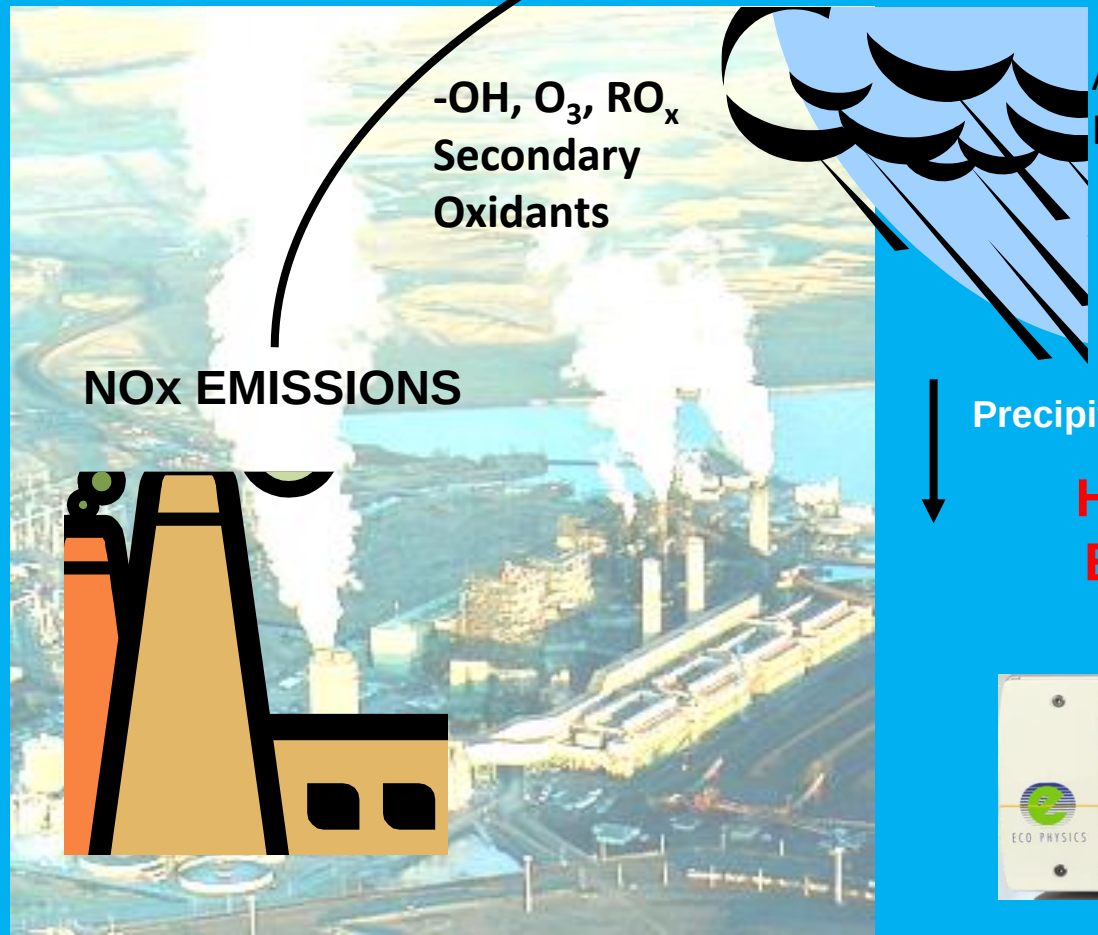
Atmospheric Deposition

ATMOSPHERIC TRANSPORT & TRANSFORMATION REACTIONS

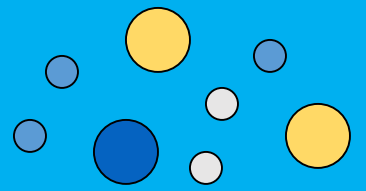
REMOVAL

AQUEOUS PHASE PRECIPITATION

GAS/PARTICULATE PHASE AEROSOL PARTICLES & GASES



Atmospheric Nitrate:
$HNO_{3(g)}$, $NO_3^-{}_{(s),\,(aq)}$



Precipitation

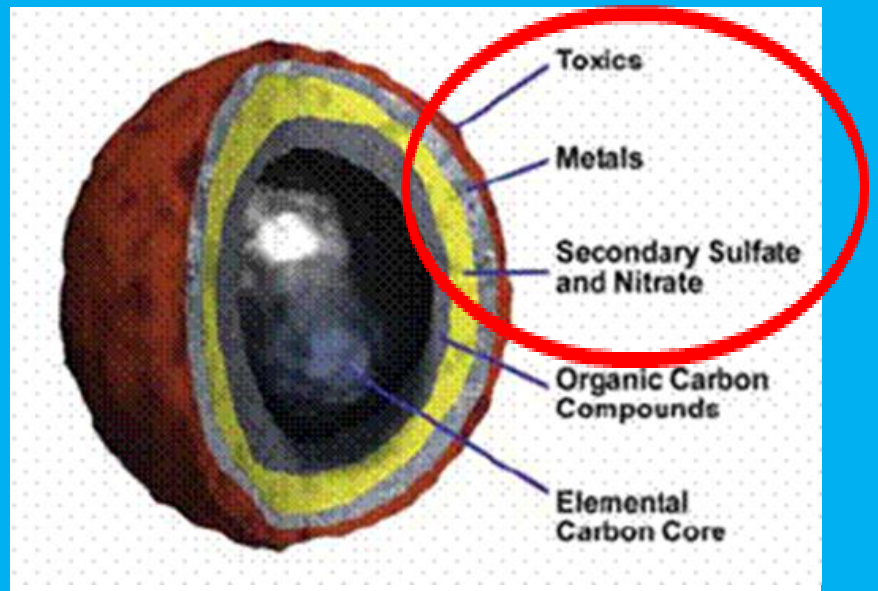
Deposition

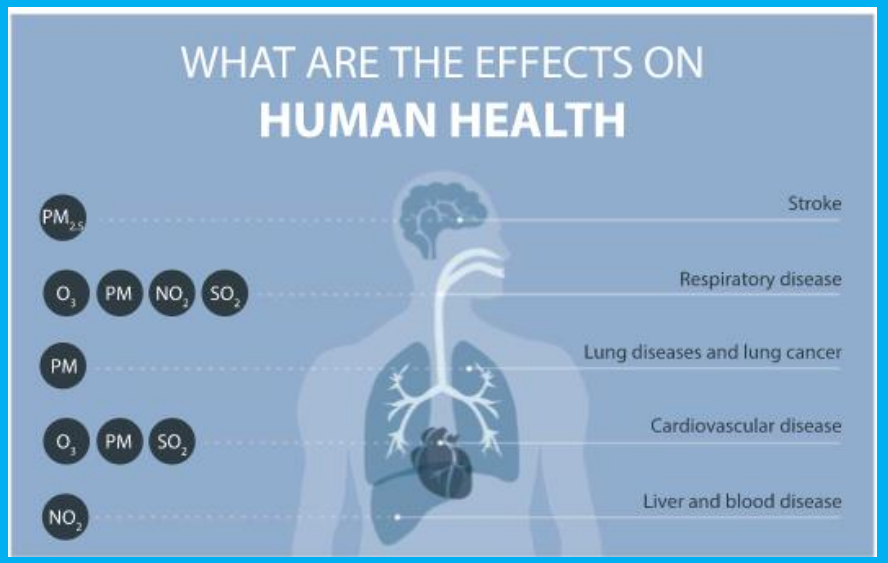
HUMAN HEALTH & ENVIRONMENTAL IMPACTS

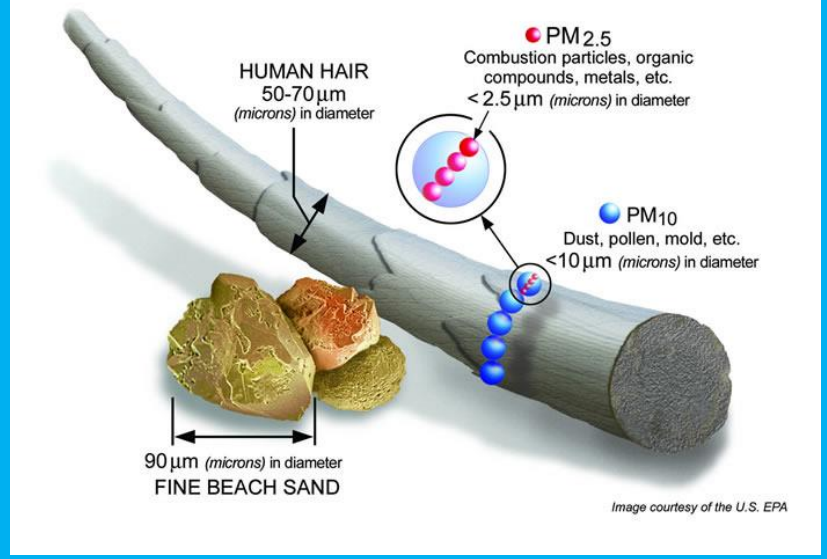
RECEPTORS

Basic Theory of Operation of PM Monitors

Health and Environmental Impacts







Deposition: Deforestation and Eutrophication

Reduce Visibility in Grand Canyon

Particulate Matter (aerosols) can be liquid (semi-volatiles) or solid

Semi-volatiles form through atmospheric chemistry

- SO2, NOx and other gasses can contribute
- Can volatilize back to gaseous form
- Can be lost from a filter based sample

Particulate Monitors

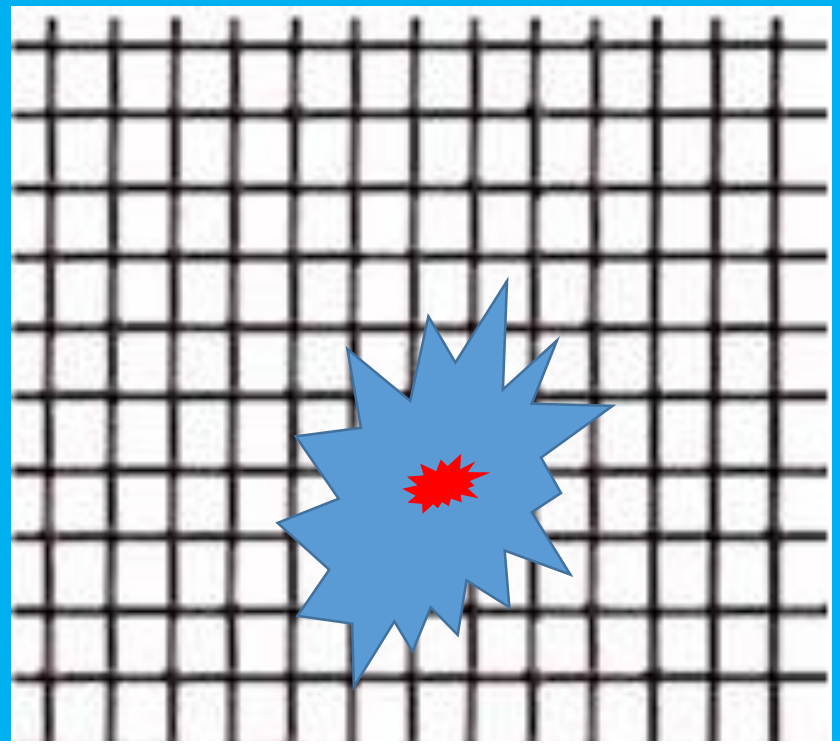
- PM monitoring methods
  - Light Scattering
  - Beta Attenuation
  - Gravimetric (filter-based)

Filter- Based

Beta Attenuation

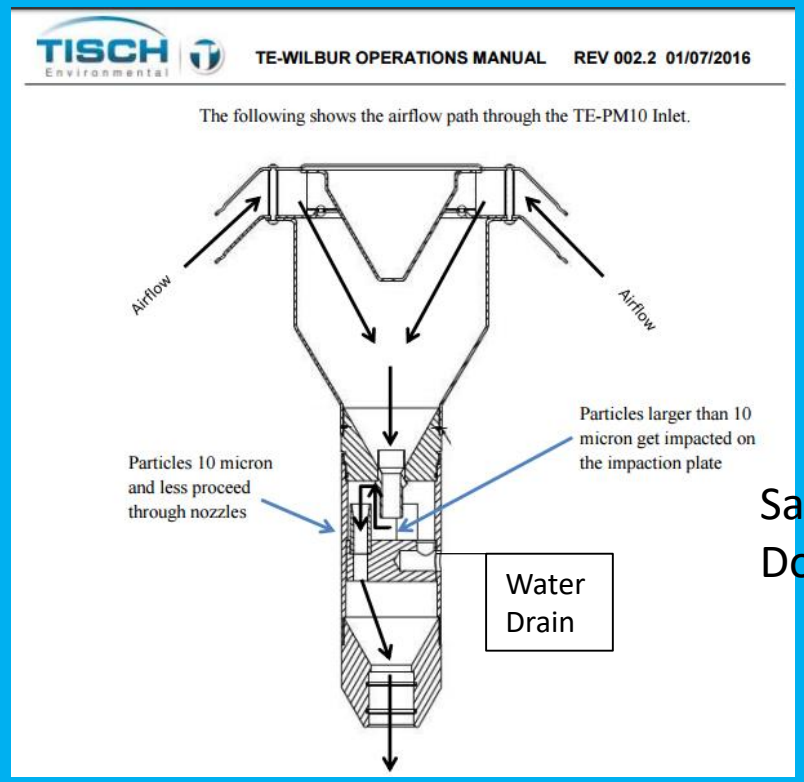
Light Scattering

We can't use successive screens to isolate our desired particle size for measurement



What we want to measure would get stuck on the screen or on something else that is stuck to the screen

So, we **"cut"** the particle size we want to measure **aerodynamically**



PM-10 Inlet

Removes particles bigger than PM-10

Airflow is critical to get the right size particle cut

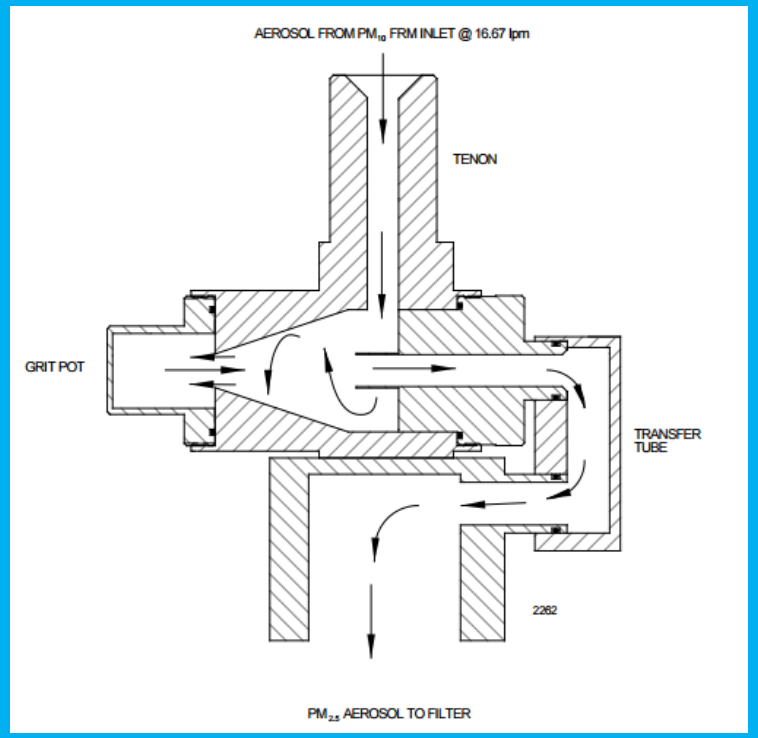
If flow is too far off we won't know what particle size we are actually measuring (PM-9? PM-11? …)

Sample Down Tube

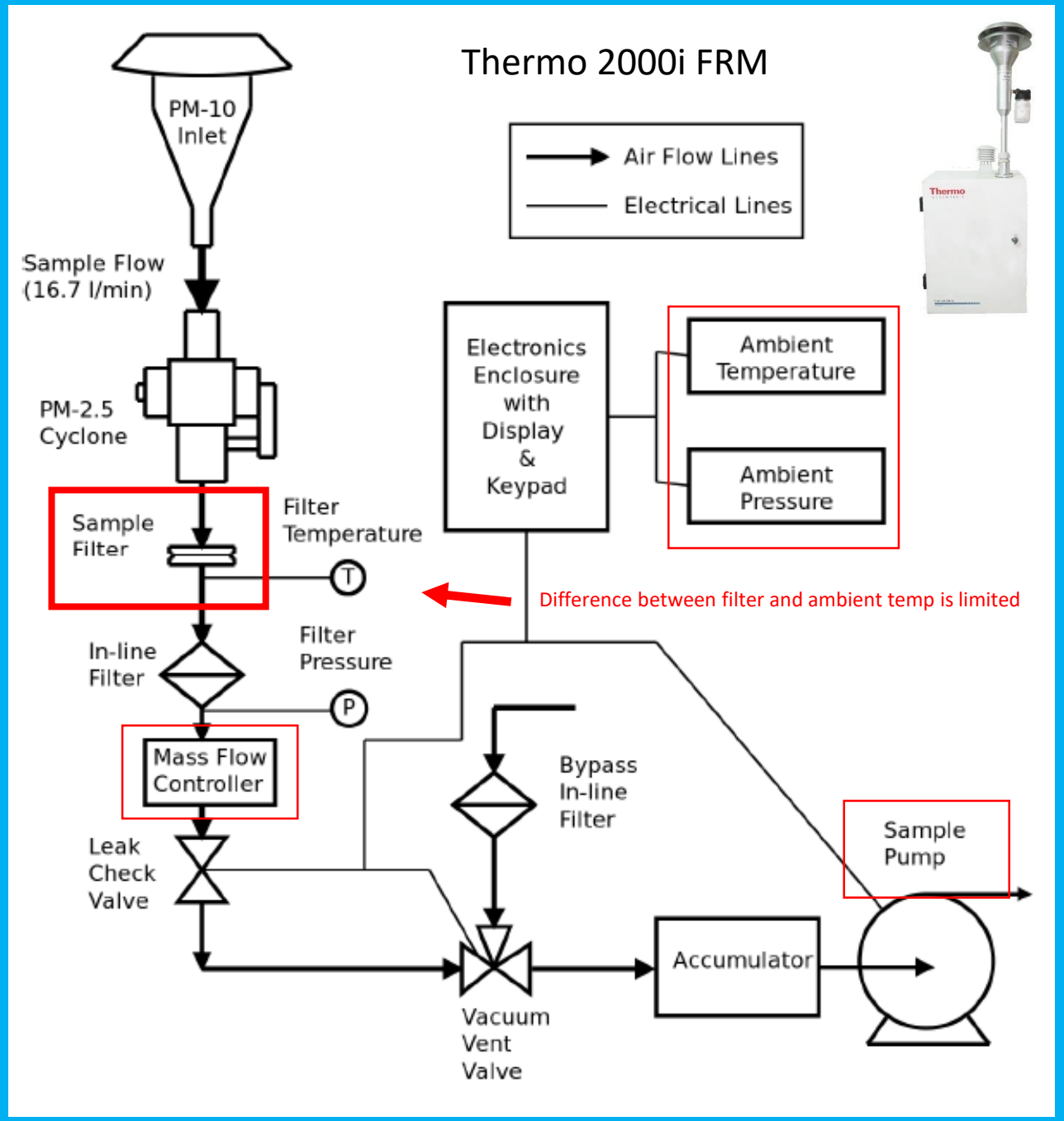
Very Sharp Cut Cyclone (VSCC)

Removes particles bigger than PM-2.5

Airflow is critical to get the right size particle cut



Filter-Based Sampler



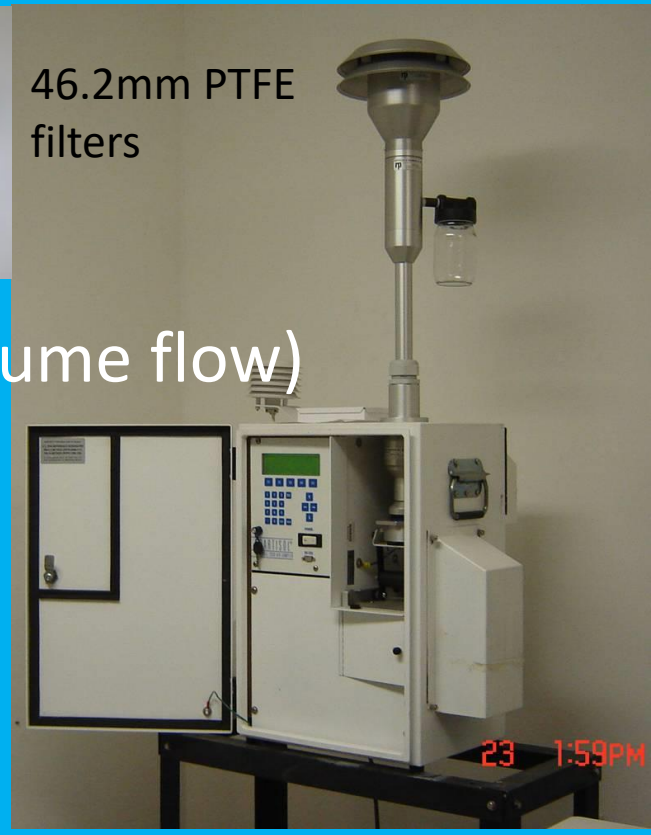
- Pre-weighed filter
- Filter is exposed and PM deposits onto filter
- Filter post-weighed for mass gain
- Determine Total sample volume (m^3)
- Mass gain/total sample volume gives you a concentration µg/m3
- 24-hour sample event
  - 00:00 to 00:00 (midnight to midnight)

8x10 in borosilicate filters

HiVol (high volume flow)
36 - 60 ft^3/min
~1019 – 1699 Liters/min

46.2mm PTFE filters

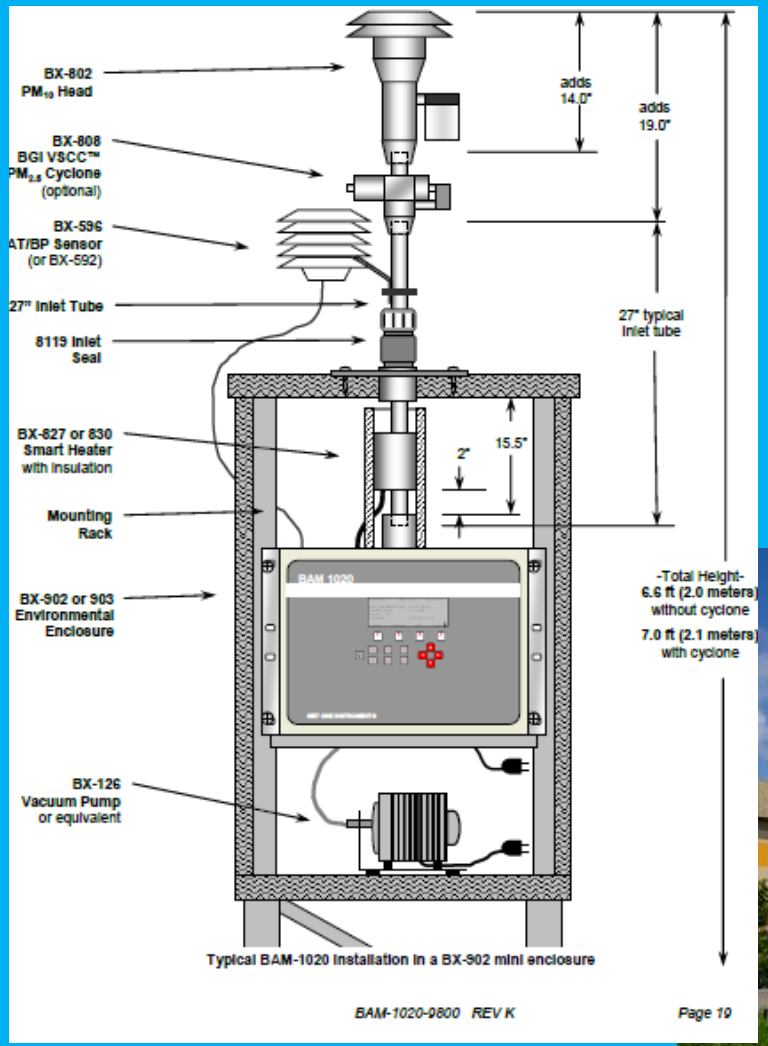
LowVol (low volume flow)
1-25 Liters/min

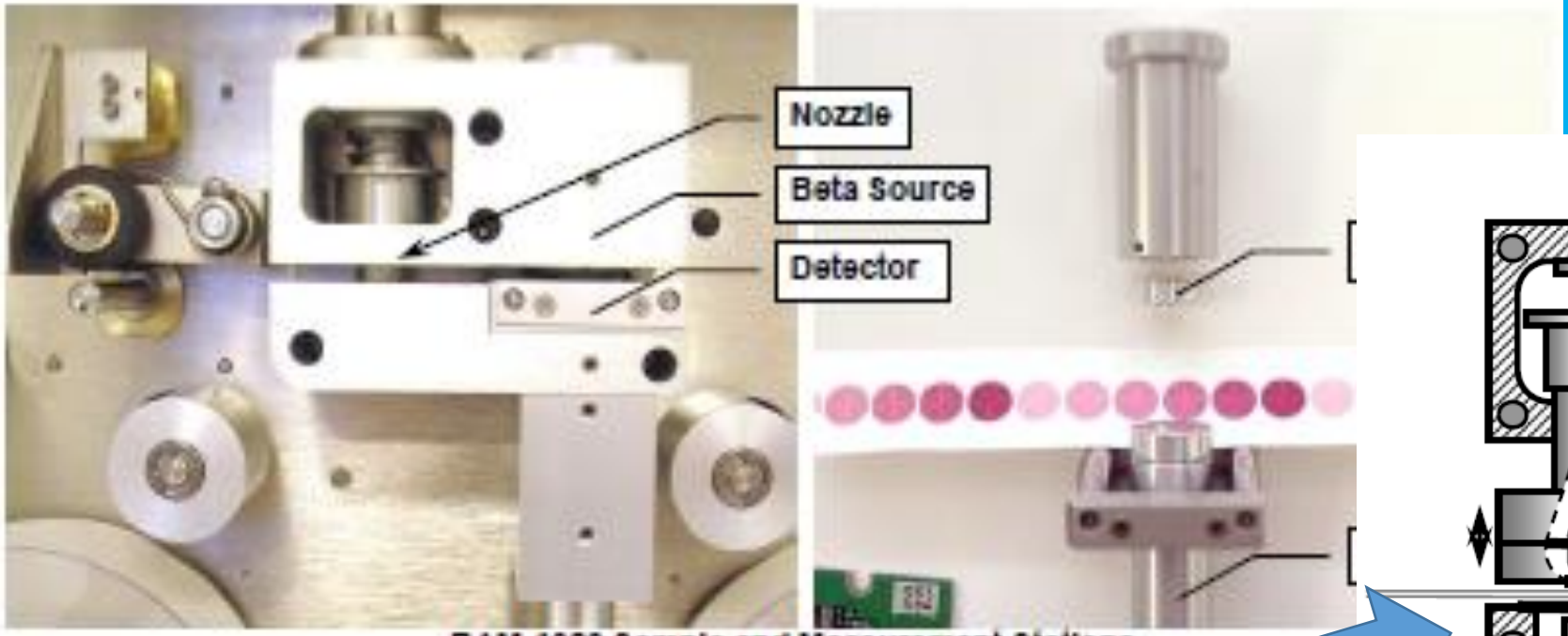


MiniVol (mini volume flow)
Not FRM or FEM
~5 Liters/min

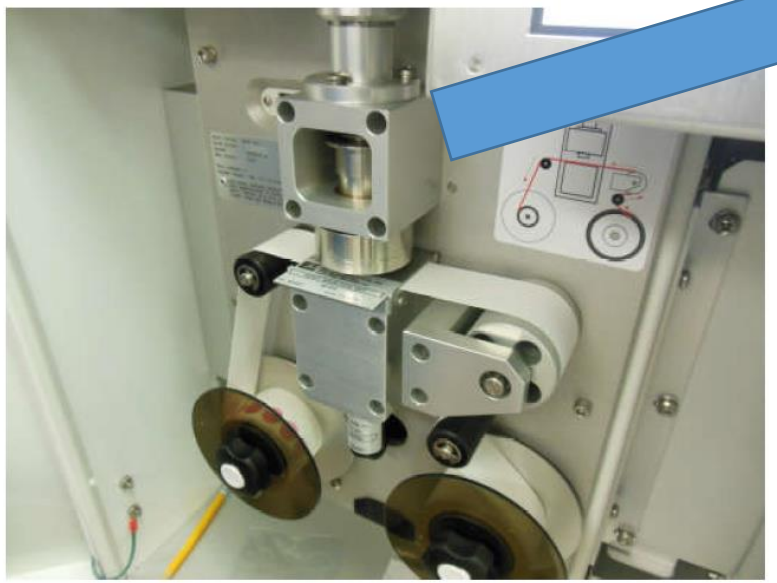
Beta Attenuation Monitor (BAM)

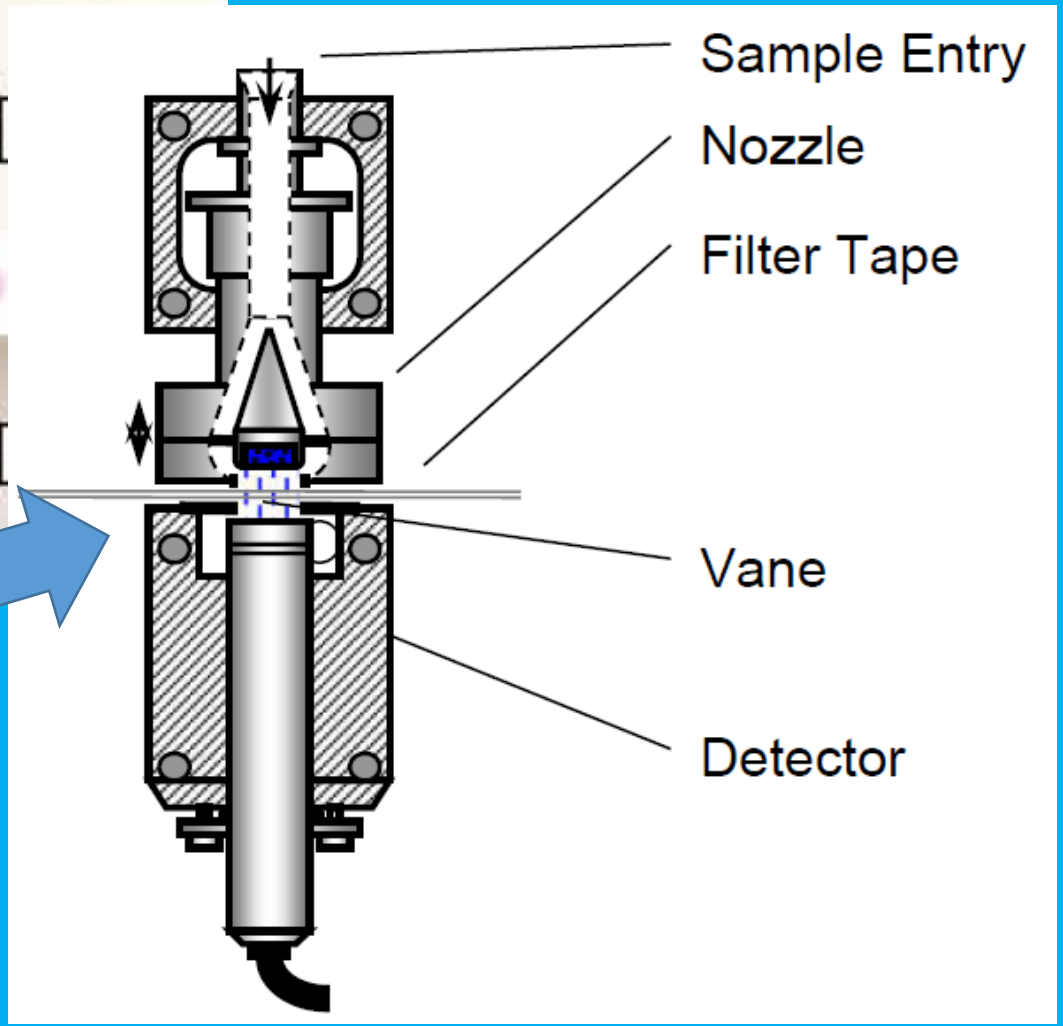
- Based on the Principle of Beta Ray Attenuation
- Contains a radioactive C-14 element (called the source)
- Equipped with vaccum pump, flow sensor, temperature, pressure, and RH sensors





BAM-1020 Sample and Measurement Stations





Polling Question

Poll Question 6

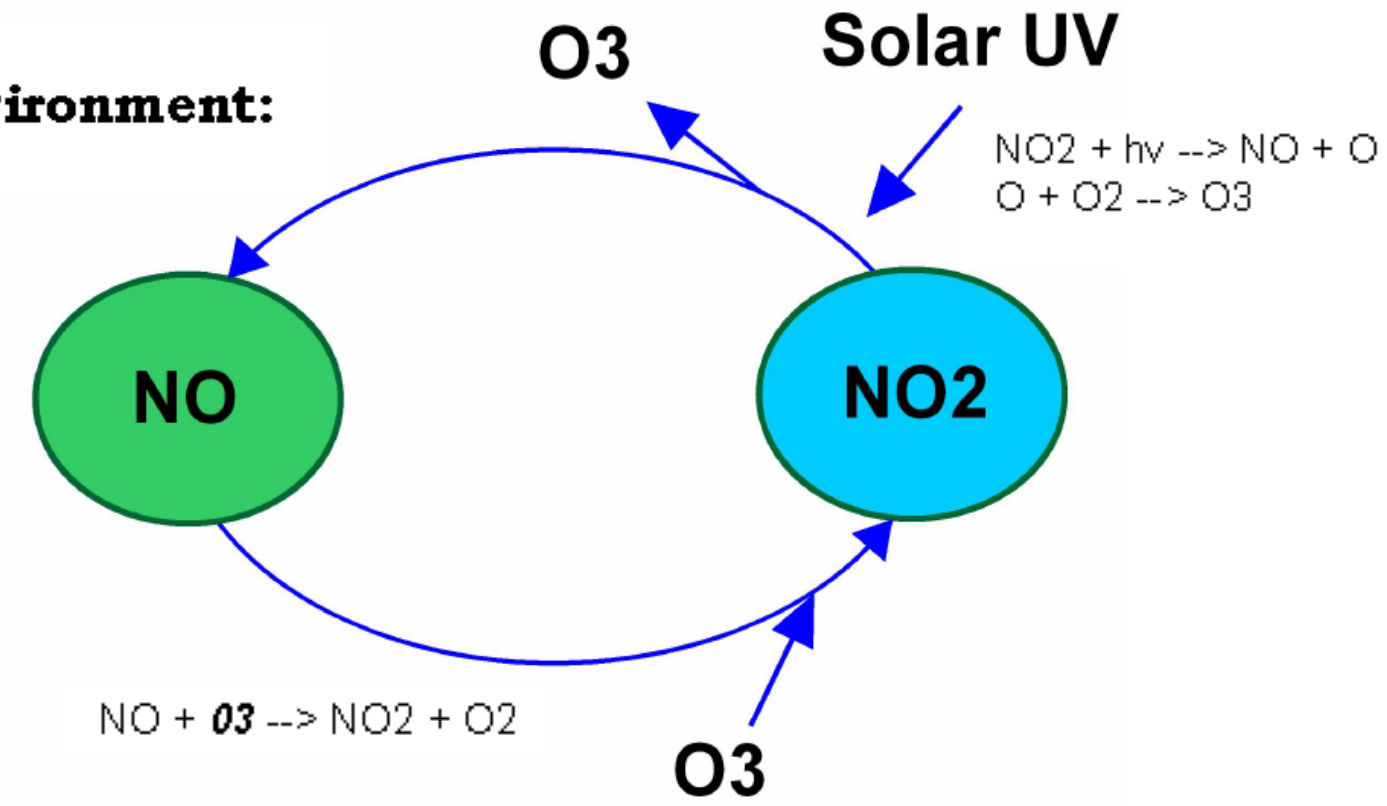
- Which FEM or FRM particulate monitor would you like to know more about?
  - Filter-Based Monitors
  - Continuous Monitors
  - Both
  - None

Basic Theory of Operation of the Ozone (O_3) Analyzer

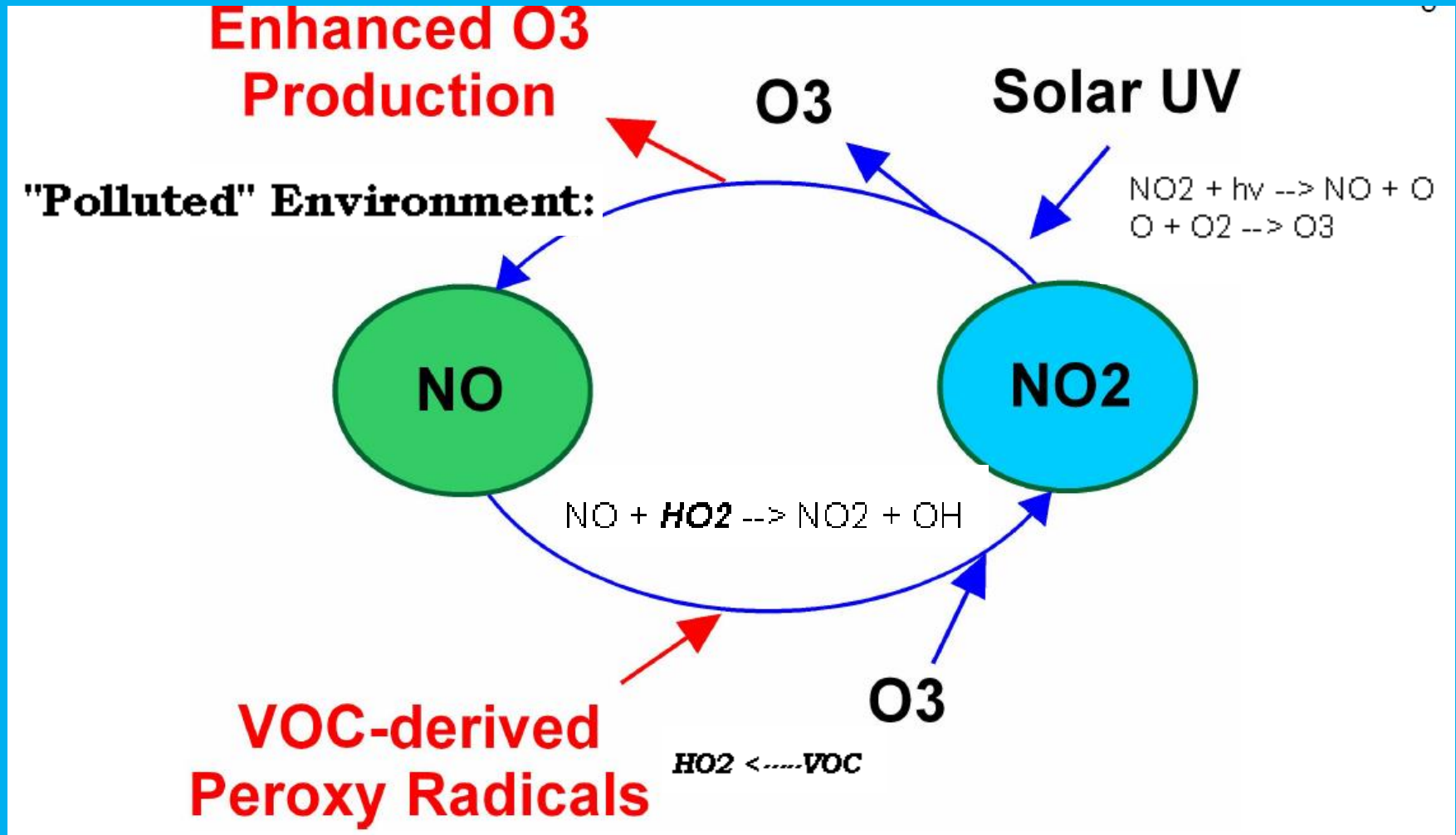
The ozone layer in the stratosphere absorbs the vast majority of ultraviolet light entering Earth's atmosphere.

We definitely need ozone in the stratosphere.

"Clean" Environment:

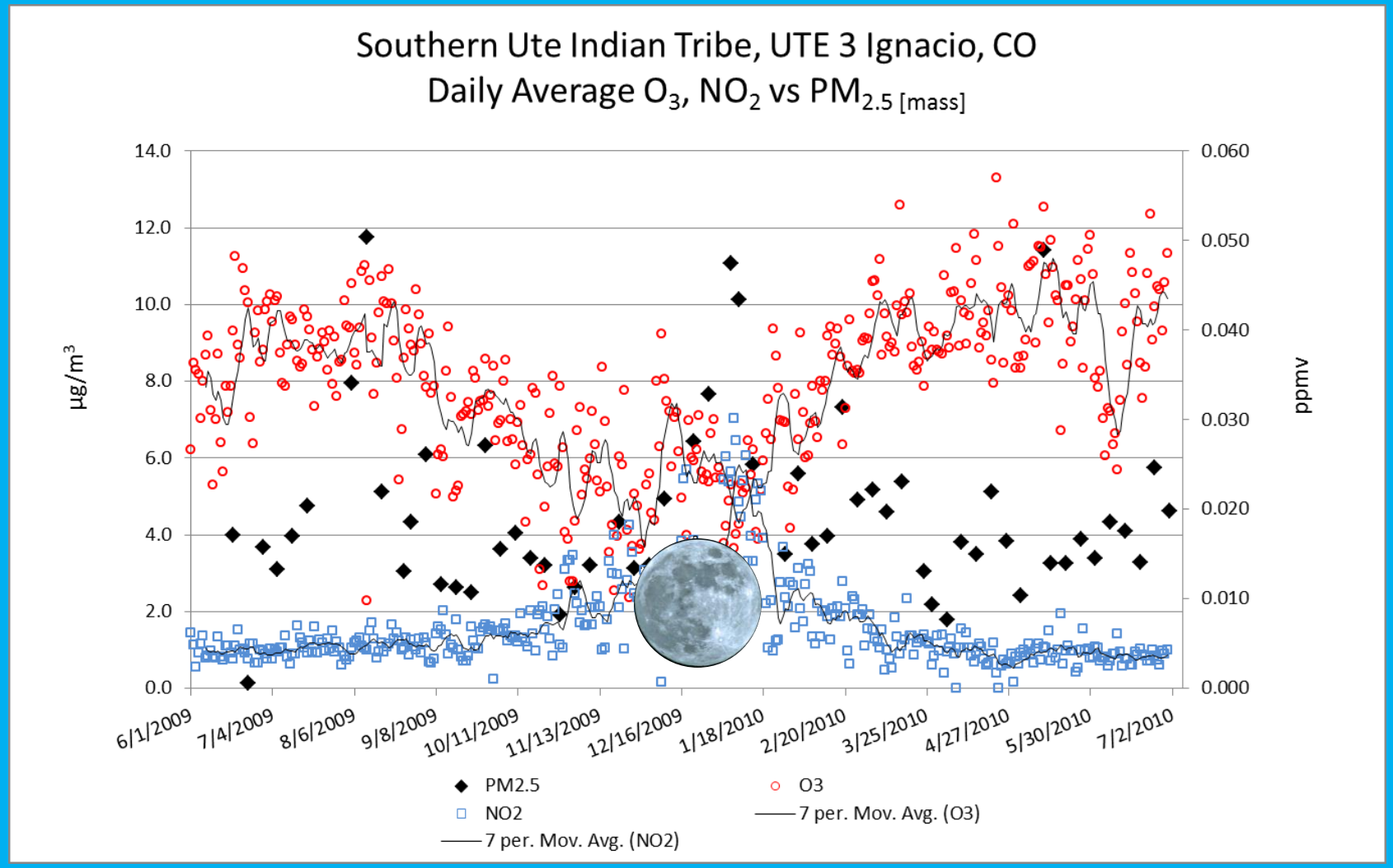


In the absence of VOCs, solar ultraviolet radiation interacts with Nitrogen Dioxide (NO2) to form Nitric Oxide (NO) and Ozone (O3). O3 and NO, in turn, react to reform NO2. This cycle is fast and generates little or no net Ozone.



With VOCs present, VOC-derived Peroxy Radicals combine with NO to reform NO2. More NO2 is available for O3 production and the balance of this cycle shifts towards net O3 production. NO2 reformation is a key step for enhanced production of O3.

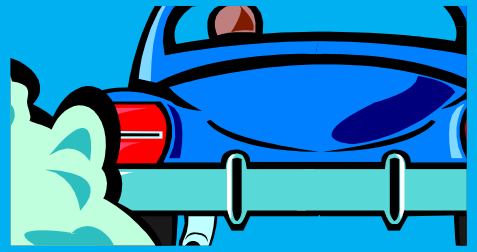
Southern Ute Indian Tribe: Ozone & NO_x Photochemistry

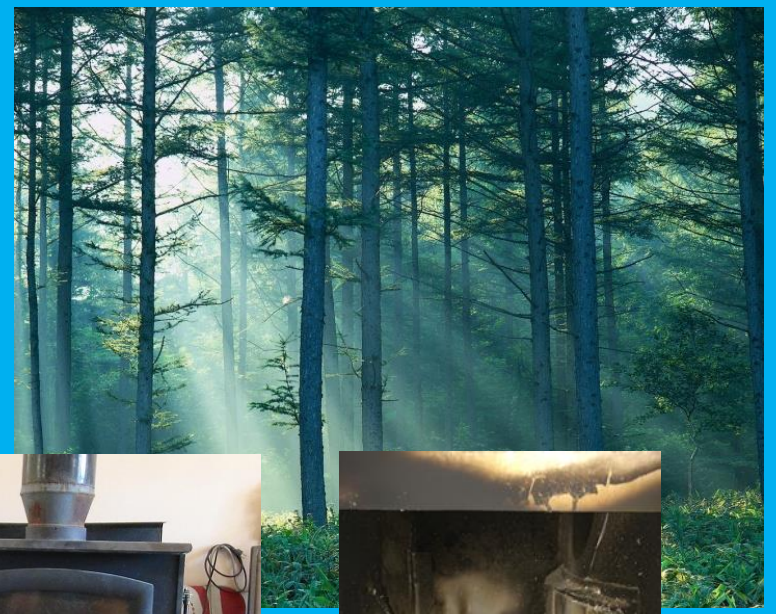


$NOx = NO + NO_2$

Ground level ozone, however, is known to have significant adverse impacts on the health of humans and ecosystems. Ground level ozone is what we monitor.

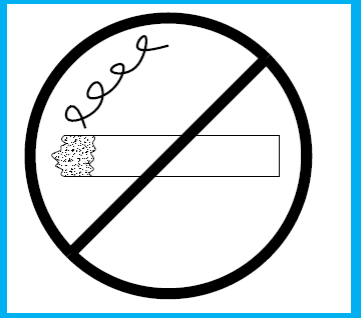
Ozone formed by atmospheric chemical reactions in the presence of sunlight. Major precursors are reactive oxides of nitrogen and volatile organic compounds.





Ozone analyzers are photometers. They use the fact that ozone absorbs UV light to measure ozone.

By the way, don’t smoke around any gas analyzer



Ozone is most efficient absorbing UV light near the 254 nm wavelength. Sample gas fills the absorption tube (measurement cell) and ultraviolet light at near 254 nm is sent through the sample gas. At the UV detector intensity is measured.

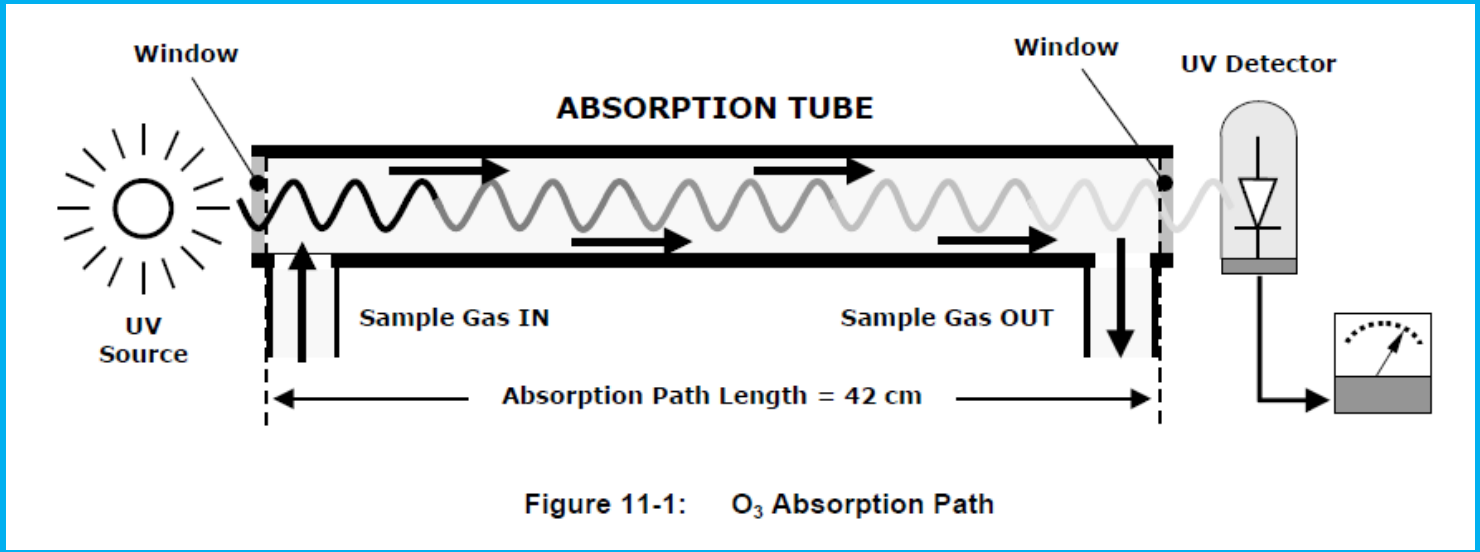


Figure 11-1: O_3 Absorption Path

Illustration is from Teledyne API 400E Operator's manual

Other gases absorb at 254 nm so the analyzer has a reference cycle that scrubs out ozone to measure just those interferants and subtracts that intensity that from the sample measurement

Wind Direction

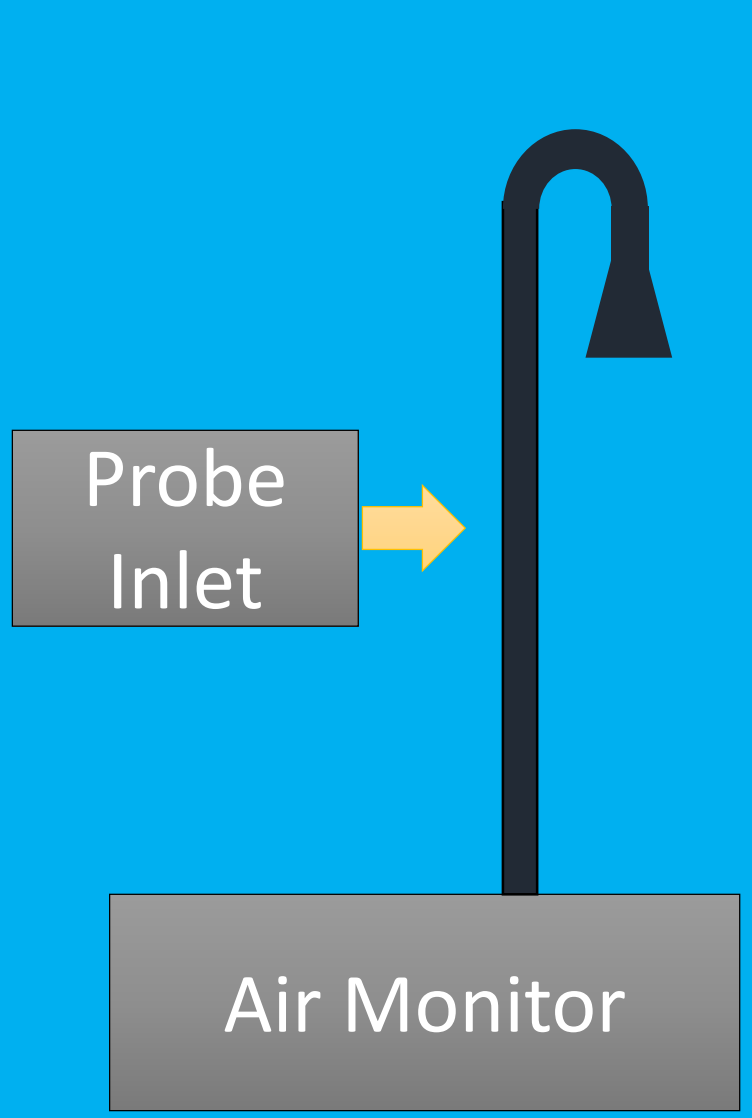
Ozone titration downwind of NOx source

Ozone Concentrations

NO2 + VOC
ozone produced

$$NO + O_3 \rightarrow NO_2^* + O_2$$

Power Plant



Depending on your monitoring objective it important to get ambient air to the monitor without changing its characteristics so siting and placement is important

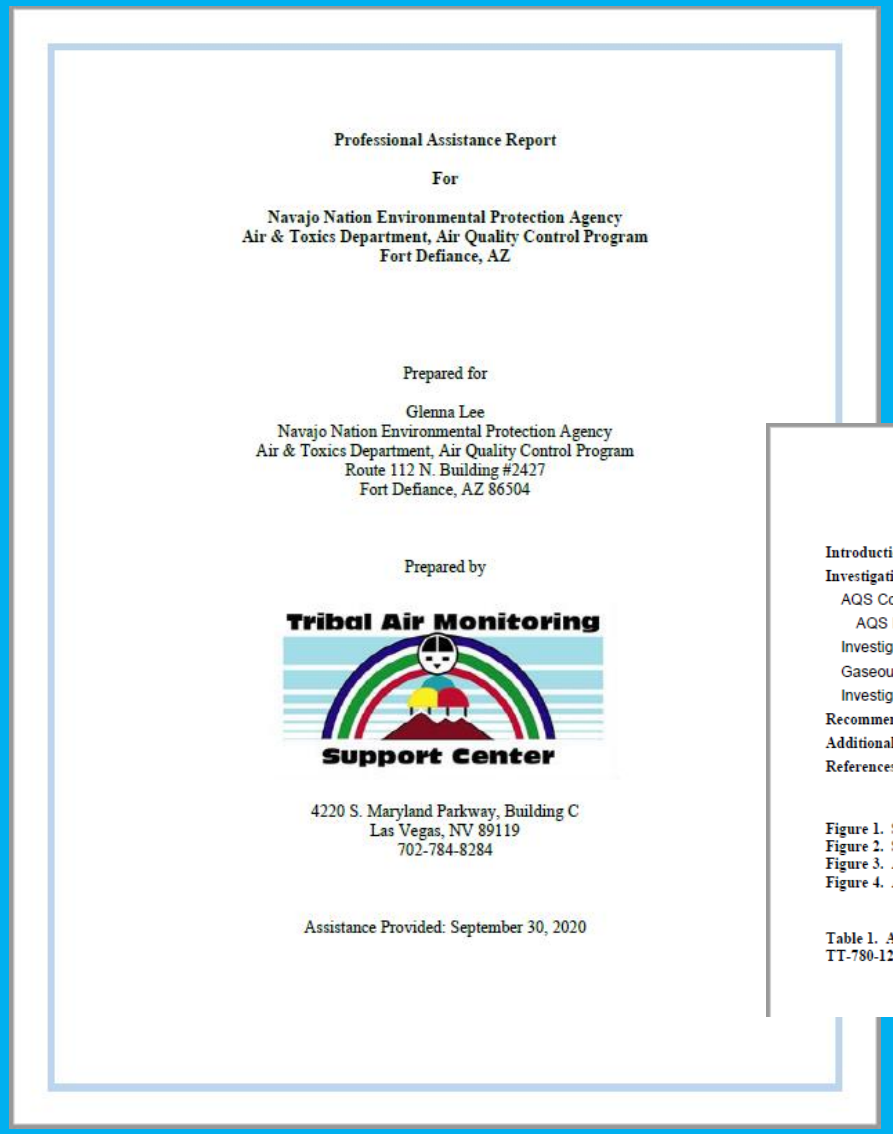
Overview of TAMS Professional Assistance Process

- Apply for assistance by completing PA application form located on the ITEP TAMS website https://www7.nau.edu/itep/main/air/air_pa
- TAMS Center Co-Directors and TAMS staff will coordinate an initial conference call to discuss the PA request and plan support roles.
- Due to COVID-19 all onsite PA support has been provided remotely using online web-based tools and platforms such as Zoom and GoToMeeting.
  - Cell phone camera or laptop camera is used to view monitors and/or equipment (onsite or office setting)
- After the completion of the PA assistance, a Technical PA Report will be provided to the tribal air program

Overview of the PA Technical Report

A resource to be used as a guidance document

- Includes
  - Introduction of the Problem
  - Investigation and Findings
  - Recommendations
  - Additional Follow-up
  - References/Resources



Professional Assistance Report

For

Navajo Nation Environmental Protection Agency
Air & Toxics Department, Air Quality Control Program
Fort Defiance, AZ

Prepared for

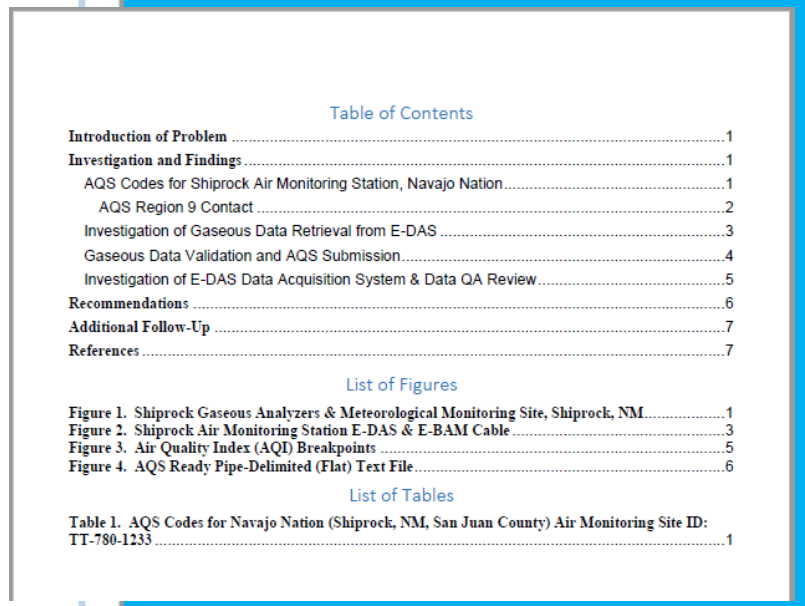
Glenna Lee
Navajo Nation Environmental Protection Agency
Air & Toxics Department, Air Quality Control Program
Route 112 N. Building #2427
Fort Defiance, AZ 86504

Prepared by

Tribal Air Monitoring Support Center

4220 S. Maryland Parkway, Building C
Las Vegas, NV 89119
702-784-8284

Assistance Provided: September 30, 2020



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Polling Questions

Poll Question 7

- Do you currently monitor for ozone or other gaseous pollutants?
  - Yes
  - No
  - Maybe in the future

Poll Question 8

- Do you currently have a need for technical assistance with a monitor or monitoring equipment?
  - Yes
  - No
  - Not right now but maybe in the future

Tribal Presenter – Overview of the MBCI Air Quality Monitoring Program & Remote PA

OFFICE OF ENVIRONMENTAL PROTECTION

MISSISSIPPI BAND OF CHOCTAW INDIANS

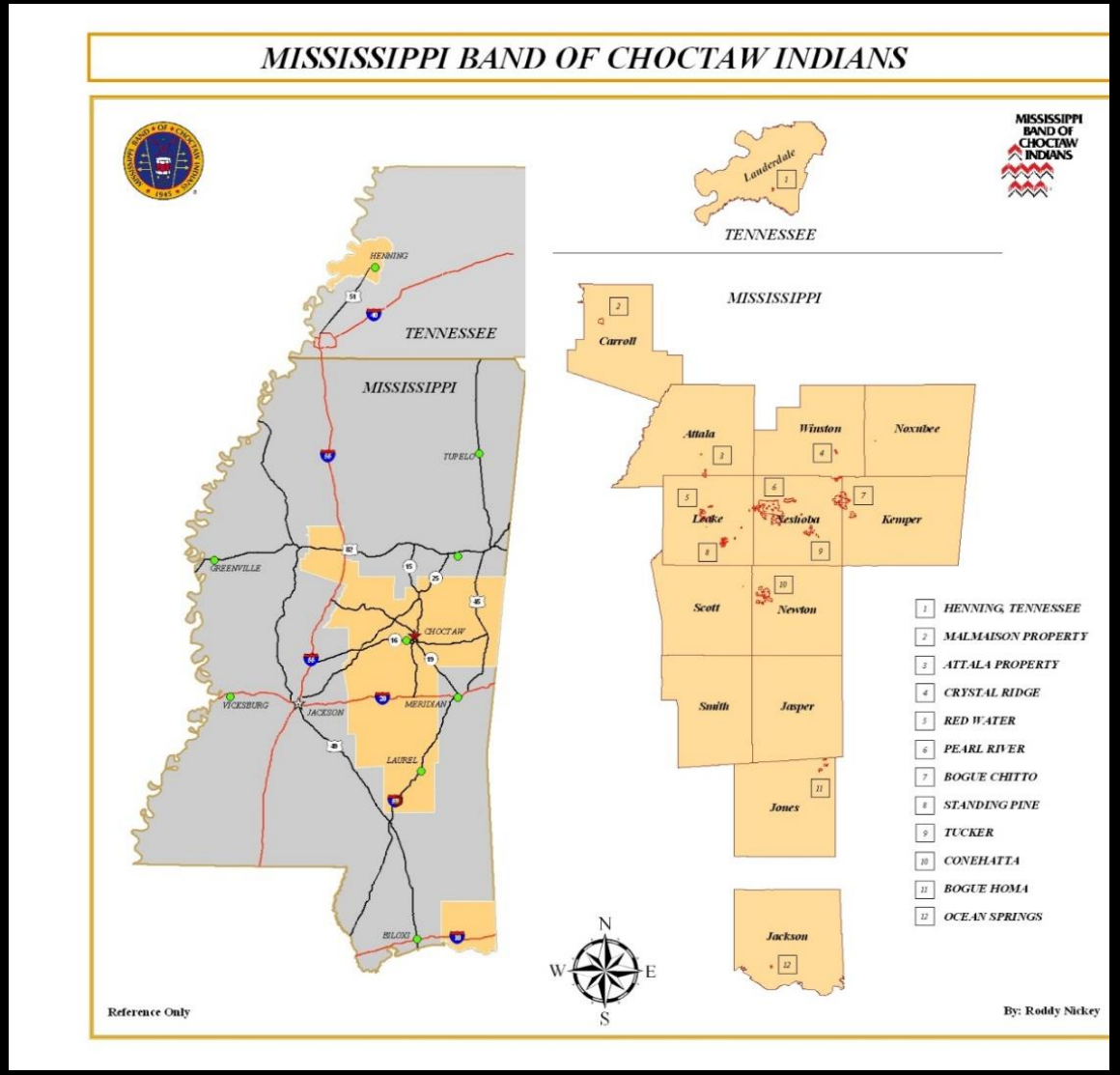
Presented by
Nicklaus Shumake

Overview

- About MBCI
- MBCI Air Quality Program History
- Collaboration with TAMS for Ambient Air Monitoring Equipment
- Plans for air monitoring
- Video

Tribal Lands

- 11,000 + tribal members
- 9 tribal communities
- 35,000 acres
- 12 Counties
- Tribal HQ in Pearl River



Air Quality Program History

- 90s-03
  - LBP and water testing
  - Radon testing
  - Other?
- 2015-present
  - EPA CAA 103
  - Capacity Building
    - Employees
    - Training
    - IAQ assessments
    - Emissions Inventory
    - Draft TAS Application

Air Program Objective

- Establishing Baseline and Background
- Prevention of Significant Deterioration (PSD)
- Examine the effects of nearby sources on reservation air quality
- Guidance for decision making
- Protect Tribe by maintaining excellent Air Quality

The Loan Process

1. Contacted Christopher Lee
   - Discussed Program goals and needs
2. E-mailed request for equipment to Farshid Farsi
   - Completed equipment loan application
3. COVID Intermission
4. Michael King
   - Provided remote professional assistance for the BAM 1022

Remote Professional Assistance for BAM 1022

- Zoom calls
- Site Selection
- Setup of equipment
- Field Calibration (Flow rate, ambient temperature, and barometric pressure)
- Management of data collected
- Maintenance of equipment

Monitoring Site Selection

- Choctaw Central Middle School Roof
- Met siting requirements per 40 CFR 58
  - Height
  - Distance from obstructions, Sources, Roadways, etc
- Availability of power
- Proximity to schools and tribal HQ

Future Air Quality Plans for MBCI

1

GET

MORE FUNDS

2

GET

MORE TRAINING

3

GET

TELEDYNE T640X

4

GET

DATA TO EPA.

MBCI Air Monitoring Site Short Video

Questions?

Nicklaus.Shumake@Choctaw.org
Office: (601)663-7021

Demonstration of Remote PA Short Video

Resources

Tribal Air Monitoring Support Center Resources:

- TAMS Guidance on Developing Tribal Air Quality Programs
- Professional Assistance Application
  - http://www7.nau.edu/itep/main/air/air_pa
- TAMS air monitoring equipment training videos and links

Courses:

- US EPA Air Pollution Training Institute
  - https://www.apti-learn.net/LMS/EPAHomePage.aspx
- TAMS Webinar Trainings https
  - https://www7.nau.edu/itep/main/training/training_air

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Tribal Air Monitoring Support Center

Thank you for joining todays webinar!