# SMOKE MONITORING GUIDE

# DEVELOPED BY THE NEW MEXICO SMOKE MANAGEMENT MOU MONITORING WORKGROUP

**February 2003**

# EXECUTIVE SUMMARY

Increased public and regulatory scrutiny as well as additional regulations pertaining to particulate matter contained in prescribed and wildland fire smoke have led to an increasing need for smoke monitoring in New Mexico. In an effort to provide consistent data and shared resources for smoke monitoring, a workgroup formed at the January 2002 New Mexico Smoke Management MOU meeting have endorsed the following guidelines:

- Focus on $PM_{2.5}$ (particulate matter less than 2.5 microns in diameter). It is a new federal air quality standard and may be harder to meet in wildland prescribed fire smoke.
- Conduct and document visual monitoring on every fire.
- Conduct and document real-time monitoring on fires that may impact sensitive areas.
- Collocate Federal Reference Method (FRM) samplers with real-time samplers when there are major air quality issues.
- Conduct real time visibility monitoring, measuring light scatter, adjacent to Class I areas when prescribed fire has the potential to impair visibility.

Data produced by this monitoring will be used to provide information to fire managers, guiding their efforts to manage smoke. It will also be used to provide feedback to regulators and the public, informing and educating them on the impacts to human health, welfare, and visibility from prescribed and wildland fire smoke. Smoke monitoring data may also be used to validate models and assumptions made in planning.

Training in smoke monitor operation, procedures, guidelines, and documentation skills will be coordinated by this workgroup. Eventually, it is hoped that each agency will provide a program lead or smoke monitoring Technical Specialist(s) to develop monitoring strategies and coordinate training. Besides developing in-house expertise in smoke monitoring, the use of contractors is another option for agencies to consider.

The workgroup emphasizes that this document is dynamic and is subject to revision based on increased experience with smoke monitoring, new and developing regulations, and changing permit requirements. An interagency workgroup will remain in place to periodically review and update these guidelines.

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# INTRODUCTION

Fire is a powerful and enduring force in land management, both as a tool to manage and maintain landscapes, manage fuels, and as a natural process to maintain ecosystem diversity. Smoke resulting from fire is unavoidable, so understanding the movement and effects of smoke is critical to the successful and acceptable uses of prescribed and wildland fire. Managers need to understand smoke effects to help them make the best science-based decisions in applying fire. The information established within these guidelines will enable managers to evaluate prescribed and wildland fire management strategies, which will be key to successful adaptive management practices throughout state and federal agencies. Even if agencies opt to contract this work out, these guidelines will assist interagency partners in determining if they are meeting management objectives, and should help insure that smoke emissions are minimally affecting identified sensitive receptor areas. Appropriate actions or changes can be made to increase precision and judgment regarding fire and smoke management.

## Purpose and Need

Smoke monitoring data can be used to help managers gain an understanding of particulate matter less than 2.5 microns in size ($PM_{2.5}$) in smoke generated from prescribed fire and how these concentrations relate to federal standards. Ambient air monitoring is important to evaluate potential health, visibility, safety, and nuisance problems while helping managers meet land and resource management objectives.

Increased and formalized smoke monitoring is necessary for several reasons:

- ⇒ Regulatory and public scrutiny of smoke emissions from fire is increasing and air quality regulations are becoming more pertinent to smoke from prescribed fire.
- ⇒ There is a new federal standard for particulate matter: the standard for particulate matter less than 2.5 microns in size ($PM_{2.5}$). This is in addition to the federal $PM_{10}$ standard for particulate matter less than 10 microns in size. Because there is a greater percentage of $PM_{2.5}$ in combustion emissions, the $PM_{2.5}$ standard may be harder for land managers to meet when burning wildland fuels. $PM_{2.5}$ is a target pollutant of the new Regional Haze Rule, which aims to reduce visibility impairment over Class I areas (see the Appendix for a map of Class I areas).
- ⇒ Some of the catastrophic fires of the last decade (Dome Fire, Hondo Fire, Cerro Grande, Scott Able) have increased air quality concerns due to smoke. There have been increasing public health concerns and requests from the New Mexico Department of Health for monitoring particulate matter during wildfires.
- ⇒ Due in large part to increased public and regulatory concerns, land managers need to be able to describe smoke impacts in quantitative terms. Smoke data can be used for public awareness, education, concerns, and complaints.
- ⇒ Real-time smoke monitoring can be used as part of adaptive management strategies to help agencies manage smoke impacts.
- ⇒ Open burning permits obtained from the New Mexico Environment Department Air Quality Bureau may specify certain types of smoke monitoring. The permit

may require that a smoke monitor be placed in a certain community or other sensitive area.

⇒ A Burn Plan itself may specify certain types of smoke monitoring to be used on a project.

⇒ Public involvement during the NEPA process may indicate a need for monitoring above and beyond what would normally be implemented.

⇒ Data from ambient air sampling during smoke events may be used to validate models and assumptions made in planning.

⇒ Data can be used as a planning tool to help estimate impacts from projects. Data from wildfires can be compared with data from prescribed fire to illustrate differences in magnitude of smoke production.

## Interagency Workgroup

A smoke monitoring workgroup was formed at the January 11, 2002, New Mexico Smoke Management Memorandum of Understanding (MOU) meeting in Santa Fe, New Mexico. The workgroup's mission was to develop interagency guidelines for smoke monitoring in the state of New Mexico. This Monitoring Workgroup is the author of this document. Workgroup members include:

- Gretchen Barkmann, USDA Forest Service,
- Tim Booker, New Mexico Environment Department (NMED) Air Quality Bureau,
- Lawrence Garcia, Gila National Forest,
- Tommy Gonzales, Pecos/Las Vegas Ranger District, Santa Fe National Forest,
- John Kwait, Bureau of Land Management,
- Bob Lineback, National Park Service,
- Hal Luedtgke, Bureau of Indian Affairs,
- Mike Main, US Fish and Wildlife Service, Region 2, and
- David Martinez, USDA Forest Service, Region 3 Fire & Aviation.

Other interested persons who asked to be put on the mailing list to receive meeting notes include:

- Chuck Campbell, El Rito Ranger District, Carson National Forest,
- Debby Potter, USDA Forest Service, Region 3 Air Program, and
- Fred Rossbach, New Mexico State Forestry.

This workgroup is providing the following guidelines to land management agencies and the New Mexico Smoke Management MOU signatories. Signatories to the New Mexico Smoke Management MOU are the New Mexico Environment Department, the USDA Forest Service, the National Park Service, the Bureau of Land Management, the US Fish and Wildlife Service, and the New Mexico Department of Energy, Minerals and Natural Resources.

# GUIDELINES

The smoke monitoring workgroup identified the need for consistency in monitoring, sampling, and analyzing of particulate matter concentrations in ambient air by prescribed fire managers.

Establishing standard smoke monitoring protocols for state and federal prescribed fire mangers ensures consistent collection and documentation of smoke data. A database is expected to be developed to store and retrieve smoke monitoring data. Such a database would provide land and resource managers an accurate source of information to assist with NEPA planning and implementation of fire management programs.

## Visual Monitoring

Visual monitoring consists of two basic types of monitoring:

- Visual estimates - the most common method of documenting smoke activities. Most agencies currently use a test fire coupled with visual observations to ensure that the smoke plume does not heavily impact smoke-sensitive areas.
- Photo documentation (digital cameras and videos) - photo points are established adjacent to the project location. A permanent record of plume height, color, and direction is obtained.

Visual monitoring will be conducted on every prescribed burn and wildfire fire use project. Objectives of visual monitoring are to describe overall plume behavior and ambient air conditions at sensitive receptors. Photographs from different perspectives and distances will describe plume behavior. Photographs taken at sensitive receptors, when necessary, including class I areas, will describe conditions, including any visibility impairment. The use of digital cameras is recommended so that photographs can be integrated into reports and sent electronically to interested parties if necessary. Standardized forms have been developed on which to document visual monitoring. These forms can be found in Appendix E.

Visual monitoring will augment data collected by ambient air samplers. Visual monitoring might assist fire managers to gain an understanding of any relationship between concentrations of particulate matter and visual conditions by comparing photographs to instrument data.

## $PM_{2.5}$

Ambient air monitoring will be focused on $PM_{2.5}$: particulate matter with a diameter of 2.5 microns or less. The federal standard for $PM_{2.5}$ will be in effect in New Mexico by 2004. The current standard is for $PM_{10}$ (particulate matter with a diameter of 10 microns or less). Rather than duplicate sampling for $PM_{10}$ and $PM_{2.5}$, monitoring will focus on

$PM_{2.5}$ unless there is a particular need to monitor $PM_{10}$ such as near a $PM_{10}$ non-attainment area.. Studies have indicated that $PM_{10}$ makes up approximately 90% of wood smoke, and of that $PM_{10}$ approximately 90% is $PM_{2.5}$ (Ward and Hardy 1991). Smoke particles smaller than 2.5 microns pose potential health risks, visibility, safety, and nuisance problems at elevated levels. Generally, the smaller the particle size, the greater the health risk to individuals, especially those with respiratory ailments. Because fine particles contribute significantly to visibility impairment, $PM_{2.5}$ is a target pollutant in the Clean Air Act's Regional Haze Rule.

## Meteorology

Meteorology is an important piece of data to be collected during ambient air sampling. Most ambient air instruments record ambient temperature and pressure, and relative humidity. Wind direction and speed are two additional pieces of information that assist with data interpretation. Information on 10-20 foot winds may assist in determining where the recorded particulate matter came from: if it came from the fire, or a wind shift carried dust, residential wood smoke or other particulate matter from other sources.

The collocation of portable weather stations such as the Remote Automatic Weather Stations (RAWS) or the addition of a wind vane can provide wind information. RAWS stations can be connected to certain real-time instruments enabling the remote download of all data simultaneously. Most FRMs have connection ports for wind vanes, enabling wind data to be logged along with temperature, pressure and relative humidity.

### Ambient Air Sampling

Two types of ambient air monitoring are endorsed: real-time monitoring and Federal Reference Method (FRM) filter sampling. Real-time monitoring provides light scatter information or concentrations of particulate matter in the ambient air at any given instant. FRM filter monitoring requires laboratory analysis of particulate matter collected on filter media. It can take several weeks before FRM filter data is received from the laboratory.

FRM data, as long as it is collected according to the prescribed methods, is considered "EPA approved", and as such will stand up to regulatory and legal scrutiny. Real-time particulate data generally is not considered "EPA approved". Real-time data generated from DataRAMs typically overestimates the concentration of particulate matter. While FRM data can be compared directly to federal air quality standards, data obtained from DataRAMs cannot be used in any regulatory manner.

Light scatter measured by real-time instruments gives an indication of visibility conditions critical in assessing potential visibility impairment over class I areas.

The value of real-time data is that it is available during the time in which smoke is being generated, and can be used to compare relative magnitudes and observe trends over time. This enables fire managers to adjust burn timing and patterns as necessary to help manage smoke by reducing, displacing, or dispersing emissions.

A Matrix that can be used to assist managers decide when and where to use the different ambient air monitoring methods is presented in Table 1.

| Sampler Locations/ Situations | Visual | Real-Time | FRM |
|---|---|---|---|
| Sensitive communities/ individuals potentially subject to daytime smoke | Yes | Recommended | Consider |
| Communities in diurnal drainages | Yes | Recommended | Consider |
| High profile, potentially contentious projects where smoke is a critical concern | Yes | Yes | Yes |
| "Back 40" remote areas | Yes | Consider | Consider |
| Adjacent to or in Class I areas | Yes | Recommended (light scatter) | Consider |
| Condition of permit | Yes | Yes | Yes |
| Adjacent to areas of concentrated recreation or other use | Yes | Recommended | Consider |

**Table 1. Guidelines for deciding when and where to use different monitoring types.**

## Existing Ambient Air Monitoring Networks

There are several ambient air monitoring networks already in place in the state of New Mexico. The NM Environment Department Air Quality Bureau maintains a network of monitors, including those for particulate matter, in various locations around the state. Most of these monitors are in urban areas, and run on an intermittent basis. For these reasons, these monitors can not be relied upon to catch smoke data from all fires or burns.

The Los Alamos National Laboratory also has a network of ambient air monitors around Los Alamos County. Data from these monitors may be useful for burns and fires in the Jemez Mountains.

Federal Land Managers operate IMPROVE (Interagency Monitoring of Protected Visual Environments) stations adjacent to many Class I areas in New Mexico (Wheeler Peak Wilderness, Bandelier National Monument, San Pedro Parks Wilderness, White Mountain Wilderness, Gila Wilderness, Bosque del Apache Wildlife Reserve, Salt Creek Wilderness, and the San Andres Wilderness.) These samplers collect data on light scatter and visibility impairing compounds including particulate matter. Although semi-real time information is possible from certain IMPROVE instruments, there is a significant lag time before data from particulate samplers is available. IMPROVE data could be used to compare to other smoke monitoring data collected near those locations.

See Appendix G for a list of pertinent websites.

## Real-time Ambient Air Sampling

Real-time monitoring of ambient air should be conducted near sensitive communities at risk or other sensitive areas. Refer to Table 1 on page 5 for guidelines for when and where to use real-time monitors. Sites at the edge of town or near sensitive receptor(s) likely to be impacted by smoke, either daytime or diurnal should be considered for these samplers. Town outskirts generally provide better sites than in town since the objective is usually to monitor smoke effects as early as possible. Real time samplers located immediately adjacent to Class I areas downwind of a prescribed fire can be used to measure light scatter in an attempt to document visibility impairment.

Site locations will vary with size of town, topography of local airshed etc. Local direct influences such as dirt roads, chimneys, stovepipes, or other combustion sources (generators), should be avoided. Sampler inlets should be at least 2 meters (approximately 6 feet) away from other sampler inlets and any objects that may interfere with airflow (Environmental Protection Agency 1998).

If possible, background data should be collected prior to burning. Representative data sets should be collected to adequately characterize background conditions at the site. This might be 2-7 days prior to and 2-7 days after the burn, or it could be a separate run as long as two weeks during conditions similar to those under which burning is expected to occur. Background data enables fire managers to characterize $PM_{2.5}$ concentrations in ambient air prior to any burning, providing an understanding of fire's contribution to local ambient particulate matter concentrations. Generally, the larger the data set, the more information is gained.

For wildland fire use, if there is concern over a particular sensitive area, as soon as the decision is made to allow the fire to be managed as fire use, a site, or sites, should be established and sampling methods documented. Background data should be collected for at least 48 hours after the burn has been completed and there is no more residual smoke observed or indicated by the smoke data.

Agencies and incident management personnel should seek opportunities to monitor smoke emissions from wildfire. When wildfire smoke is likely to impact sensitive receptors, including Class I areas, samplers should be located adjacent to those areas once there has been a start.

The workgroup recommends that fire managers in the state of New Mexico acquire the Thermo Andersen/MIE "DataRAM 4"s (DataRAMs) as standard real-time samplers. This does not imply that other instruments already in use be discarded, but that first consideration for any further acquisitions is for Thermo Andersen/MIE DataRAM 4 samplers.

The reasons for this recommendation include:

- The Forest Service Technology and Development Program in Missoula, Montana (MTDC) evaluated many different types and makes of real-time monitors. These

studies indicate that overall, DataRAMs are one of the most cost effective, easy to use, reliable, and portable instruments suitable for monitoring smoke in ambient air. Results of these evaluations are published in two documents: "Evaluation of Optical Instruments for Real-Time Continuous Monitoring of Smoke Particulates, December 2000 (0025-2860-MTDC), and Real-Time Smoke Particulate Sampling, Fire Storm 2000, October 2001 (0125-2832-MTDC).

- The Forest Service provides a central cache of 11 DataRAMs in Fort Collins, CO. On a national basis, BLM is purchasing 23 DataRAMs, and the US FWS Southwest Region has purchased 6 DataRAMs. Many of these instruments are available nation-wide for monitoring smoke and may be available to other agencies.
- Satellite transmitters that connect to DataRAMs providing remote access to the real-time data via the Internet are available. DataRAMs can be connected to the mobile RAWS weather stations, allowing remote transmittal of both weather and smoke particulate or scatter data.
- Using the same instruments allows better comparison of data than using different types of instruments.
- It will be easier to get instruments set up at a prescribed or wildland fire if all agencies are trained in the use of the same kind of instrument.

There is a sample Purchase Order on the Smoke Management website (see Appendix G) which gives contact names, numbers, and pricing for ordering DataRAMs and accessories. Sample Purchase Orders are attached in Appendix B.

There are certain limitations to the use of DataRAMs. These instruments contain nephelometers, which measure the amount of light scattered over a known path length and then use mathematical equations to estimate the mass concentration. While nephelometers provide a direct measurement of light scatter useful in the analysis of visibility conditions, they do not provide a direct measurement of particulate concentration. The MTDC studies have shown that the DataRAMs overestimate particulate matter concentration anywhere from 20-90% (Trent et.al. 2000). This range appears to depend on individual instrument variations and mass concentration, and may also be related to local factors such as fuel types and loading, etc. For this reason, and because this is not a direct measurement of mass concentration, data from DataRAMs cannot be directly compared to federal standards. However, this data can provide an estimate of the direction of change in the concentration and the magnitude of the overall ambient particulate concentration. The value of real-time monitoring is that the data can guide fire managers while burning to use smoke management methods to keep particulate matter below regulatory levels.

## Filter FRM Ambient Air Sampling

Federal Reference Method (FRM) samplers generally require filters and gravimetric analysis. Tapered Element Oscillating Microbalance (TEOM) samplers have USEPA

equivalency designation for $PM_{10}$ but they do not employ gravimetric analysis on filters. Collocated FRMs can be used to verify DataRAM data when there are critical smoke related issues, such as near extremely sensitive areas or when there is concern over meeting the National Ambient Air Quality Standards (NAAQS). FRM filter samplers provide a direct measurement of mass concentration per volume of air, and as such relate directly to the federal standard. FRM data can be used to verify Real-time data by refining the range of overestimation based on local factors and individual DataRAM characteristics. Data comparisons after smoke incidents can help refine DataRAM smoke measurements and build confidence in future correlations.

Filter Federal Reference Method (FRM) samplers should be collocated with real-time samplers in areas where smoke is a critical issue (non-attainment areas, areas with extremely sensitive individuals, areas where there is likely to be significant public or regulatory scrutiny, etc.). FRM data may be used to verify numbers that DataRAMs produce, and will compare directly to federal standards.

Considerations for siting FRM samplers include available resources, project sensitivity, and/or impacts associated with an area, and documentation that may be necessary to successfully evaluate smoke emissions. Refer to Table 1 on page 5 for guidelines on when and where to use FRM samplers.

The workgroup recommends that Rupprecht & Patashnick (R&P) Partisol 2025 samplers be acquired as standard filter FRM samplers in the state of New Mexico. This does not imply that other FRM instruments already in use be discarded, but that first consideration for any further acquisition is for R&P Partisol 2025 samplers.

The reasons for this recommendation include:

- NMED Air Quality Bureau has investigated and evaluated several different types of filter FRM samplers. The NMED chose the R&P Partisol 2025 due to its ease of use, reliability, and its ability to move filters automatically into the sampling chamber, reducing the risk of accidental contamination of filters and minimizing trips to the sampling site.
- Using the same make and model of filter FRM sampler enables agencies' ability to use samplers without the need for additional training or the need to learn how other makes and models operate.

There is a sample Purchase Order on the smoke Management website (see Appendix G) that gives contact names, numbers, and pricing for ordering the R&P Partisol 2025 and accessories. Sample Purchase Orders are attached in Appendix B.

## Standardized Forms and Operating Procedures

In order for data collection and storage to be consistent across the state, standardized forms, operating procedures, and guidelines have been developed. Protocols and Standard Operating Procedures (SOPs) for instrument operations are attached in

Appendix D. Standardized forms can be found in the Appendix E. Forms and SOPs are available on the Smoke Management website (see Appendix G).

The protocols and SOPs provide guidelines to ensure that data collected meets certain Quality Assurance and Quality Control (QA/QC) requirements. These requirements are most rigorous for the FRM samplers. The standardized forms assist in ensuring that QA/QC requirements are followed.

## Monitoring Plans

Monitoring plans should be developed for all smoke monitoring projects. The detail and complexity of monitoring plans will vary depending on the complexity and sensitivity of each project. For example, a monitoring plan for a prescribed fire in a remote area that does not have much potential to impact sensitive areas may be simple and brief, consisting only of visual monitoring. A prescribed fire near a sensitive community or Class I area might have a more detailed monitoring plan describing visual, real-time, and FRM sampling efforts. Objectives for monitoring and questions that the monitoring is designed to answer should be outlined in these plans. Going through the process of developing monitoring plans will assure that the monitoring is adequate to cover the needs for that particular project. A sample monitoring plan, or template, can be found in Appendix C and on the Smoke Management website (see Appendix G).

## Data Interpretation, Stewardship, and Dissemination

Once data is collected by the instruments, cameras or visual methods, the data needs to be collated and interpreted. It can then be used for any number of reasons dictated by the objectives determined in the monitoring and/or Burn Plan. Agencies need to decide how and where to house the data so it can be of greatest use. At this time, it is up to each agency to decide how to house and disseminate data collected from smoke monitoring. It is the vision of the Interagency Smoke Monitoring Workgroup that eventually data collected from smoke monitoring will be housed in one place and accessible to all agencies for use as a valuable information and planning tool.

## Smoke Data as an Education Tool

Data from real-time samplers (DataRAMs) and Federal Reference Method (FRM) samplers can provide information helpful in educating the public on smoke effects. Smoke monitoring data can also educate fire managers on relative magnitudes of particulate matter concentration produced by different fuels and fire types.

Visual documentation (photographs, videos) can be used directly or in combination with other kinds of data such as graphs and spreadsheet presentations of data. For example, in a video or slide presentation, photographs (or video clips) of a smoke plume, or smoke

impacts to a sensitive receptor can be presented along with graphs of particulate matter concentration. This would provide the viewer with both a visual depiction of smoke concentration as well as a graphic interpretation. The graphical presentation can include a relation to federal air quality standards, if FRM data and a correlation factor are available.

The working group suggests that a professional video be made on wildland fire smoke effects for public education. Data from real-time and FRM samplers, photographs, and picture/video clips from different types of prescribed burns and wildfires would be used in this production. The video could demonstrate different magnitudes of $PM_{2.5}$ concentrations. This video would be made available to all agencies to use in public outreach and education meetings, state fair booths etc.

## Sharing Monitoring Resources

It is the intent of this workgroup that monitoring resources be shared among agencies. This should reduce the overall cost of monitoring, as well as provide easier access to smoke monitoring data. Using the same equipment and standard forms and operating procedures facilitates this sharing. Personnel as well as equipment should be considered as shared resources. Eventually, individuals within each agency will gain enough experience to become smoke monitoring Technical Specialists. A list of equipment by agency and agency contacts for the current fiscal year is included in Appendix F.

## Training

This monitoring workgroup will coordinate training in smoke monitoring, including the use of samplers, and protocols for collecting, interpreting, and storing the data. A training will be provided in the winter of 2003. It is the intent of this workgroup to develop a cadre of persons from the various agencies that can provide this training, as well as "train-the-trainers."

# REFERENCES

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# GLOSSARY

**Adaptive Management**: Strategy in which monitoring and evaluating the results of specific activities will determine if desired results are being achieved, and if not, what needs to be changed.

**Air Quality**: The characteristics of the ambient air (all locations accessible to the general public) as indicated by concentrations of the six air pollutants for which national standards have been established [ i.e., particulate matter (PM), sulfur dioxide (SO2), nitrogen dioxide (NO2), Ozone (O3) carbon monoxide (CO) and Lead (PB)], and by visibility in mandatory Federal Class I areas.

**Ambient Air**: Any unconfined portion of the atmosphere: open air, surrounding air.

**Attainment Area**: An area considered having air quality as good as or better than the National Ambient Air Quality Standards (NAAQS) as defined in the Clean Air Act. Note that an area may be in attainment for one or more pollutants but be a non-attainment area for one or more other pollutants.

**Avoidance**: A smoke emission control strategy that considers meteorological conditions when scheduling prescribed fires in order to avoid incursions into smoke sensitive areas.

**Carbon Dioxide ($CO_2$)**: a colorless, odorless, nonpoisonous gas, which results from fuel combustion and is normally a part of the ambient air.

**Carbon Monoxide (CO)**: A colorless, odorless, poisonous gas produced by incomplete fuel combustion. Carbon monoxide is measured in parts per million.

**Class I Area**: An area set aside under the Clean Air Act (CAA) to receive the most stringent protection from air quality degradation. Mandatory Class I Federal areas are (1) international parks, (2) national wilderness areas which exceed 5,000 acres in size, (3) national memorial parks which exceed 5,000 acres in size, and (4) national parks which exceed 6,000 acres and were in existence prior to the 1977 CAA Amendments. The extent of a mandatory Class I Federal area includes subsequent changes in boundaries, such as park expansions.

**Criteria Pollutants**: The 1970 amendments to the CAA required EPA to set National Ambient Air Quality Standards (NAAQS) for certain pollutants known to be hazardous to human health. EPA has identified and set standards to protect human health and welfare for pollutants: Ozone, carbon monoxide, particulate matter ($PM_{10}$ and $PM_{2.5}$), sulfur dioxide, lead, and nitrogen oxide.

**DataRAM**: Compact, self-contained instrument that internally estimates mass concentration from the measured scattering of light. The instrument can provide a direct measurement of light scatter and an indirect measurement of particulate concentrations from 0.1 to 400,000 $\mu g/m^3$. The DataRAM can be configured to measure $PM_{2.5}$ or $PM_{10}$ concentration by installing a different impactor head.

**Emission**: Pollution discharged into the atmosphere. Examples of emission sources are wildland and prescribed fires, smokestacks, other vents, and surface areas of commercial or industrial facilities; from residential chimneys; and from motor vehicle, locomotive, aircraft, or other non-road engines.

**Emission Inventory**: A listing, by source, of the amount of air pollutants discharged into the atmosphere.

**Federal Reference Method (FRM) $PM_{2.5}$ Air Samplers**: Microprocessor-controlled, volumetric flow rate air-sampling instruments that obtain a valid $PM_{2.5}$ air sample. When Federal Reference Methods are followed, the sampling procedure is equivalent to EPA methodology.

**Interagency Monitoring Of Protected Visual Environments (IMPROVE)**: A cooperative visibility monitoring effort, using a common set of standards across the United States, between the Environmental Protection Agency, federal land management agencies, and state air agencies.

**Lead (Pb)**: a criteria pollutant, elemental lead emitted by stationary and mobile sources can cause several types of developmental effects in children including anemia and neurobehavioral and metabolic disorders. Non-ferrous smelters and battery plants are the most significant contributors to atmospheric lead emissions.

**Monitoring**: The orderly collection, analysis, and interpretation of resource data to evaluate progress toward meeting management objectives.

**National Ambient Air Quality Standards (NAAQS)**: Standards for maximum acceptable concentrations of pollutants in the ambient air to protect public health with an adequate margin of safety, and to protect public welfare from any known or anticipated adverse effects of such pollutants (e.g., visibility impairment, soiling, materials damage, etc.) in the ambient air. Standards are set for ozone ($0_3$), carbon monoxide (CO), sulfur dioxide ($SO_2$), nitrogen dioxide ($NO_2$), lead (Pb), and particulate matter (PM) (solid aerosols).

**National Environmental Policy Act (NEPA)**: Establishes procedures that Federal agencies must follow in making decisions on Federal actions that may impact the environment. Procedures include evaluation of environmental effects of proposed actions, and alternatives to proposed actions; involvement of the public and cooperation agencies.

**Natural Background Condition**: An estimate of the visibility conditions at each Federal Class I area (or ambient air quality at any sensitive receptor) that would exist in the absence of human-caused impairment.

**Nitrogen Dioxide ($NO_2$)**: The result of nitric oxide combining with oxygen in the atmosphere. A major component of photochemical smog.

**Nitrogen Oxide[s] ($NO_x$)**: A class of compounds that are respiratory irritants and that react with volatile organic compounds (VOCs) to form ozone ($0_3$). The primary combustion product of nitrogen is nitrogen dioxide ($NO_2$). However, several other nitrogen compounds are usually emitted at the same time and these may or may not be distinguishable in available test data.

**Non-attainment Area**: An area identified by an air quality regulatory agency through ambient air monitoring (and designated by the Environmental Protection Agency) that presently exceeds federal ambient air standards.

**Nuisance smoke**: The amount of smoke in the ambient air that interferes with a right or privilege common to members of the public, including the use or enjoyment of public or private resources.

**Objective**: Specific results to be achieved within a stated time period. Objectives are subordinate to goals, are narrower in scope and shorter in range, and have an increased possibility of attainment. An objective specifies the time periods for completion and measurable, quantifiable outputs and achievements.

**Optical Real-Time Monitors**: Two types of optical real time continuous monitors; 1) Light-scattering (nephelometers) instruments and 2) Light-absorbing (aethalometers) instruments. The nephelometers measure the amount of light scattered over a known path length and use a mathematical relationship to estimate the aerosol mass concentration. The aetholometers quantify the light-absorbing aerosol (black carbon, for example) by depositing the aerosol on a quartz-fiber filter and measuring the light transmission or reflectivity.

**Ozone ($O_3$)**: Ozone is a colorless gas and is a major component of smog. Ozone is not emitted directly into the air but is formed through complex chemical reactions between precursor emissions of volatile organic compounds (VOCs) and $NO_x$ in the presence of sunlight.

**Particulate Matter (PM)**: Any liquid or solid particle (e.g., dust, smoke, mist, fumes, or smog). "Total suspended particulates" as used in air quality are those particles suspended in or falling through the atmosphere. They generally range in size from 0.1 to 100 microns. The two size classes of particulate matter for which there are federal standards are $PM_{10}$ and $PM_{2.5}$.

**PM2.5**: Particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers.

**PM10**: Particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers (including PM2.5).

**Prescribed Fire**: Any fire ignited by management actions to meet specific objectives (i.e., managed to achieve resource benefits). A written, approved prescribed fire plan must exist, and NEPA requirements must be met prior to ignition.

**Regional Haze**: Generally, concentrations of fine particles in the atmosphere extending up to hundreds of miles across a region and promoting noticeably hazy conditions; wide-spread visibility impairment, especially in mandatory Class I Federal areas where visibility is an important value.

**Regional Haze Regulations**: The regional haze regulations apply to all states, including those states that do not have any Class I areas. The Regional Haze Regulations require states to demonstrate reasonable progress for improving visibility in each Class 1 area over a 60-year period during which visibility should be returned to natural conditions. These regional haze regulations were intended to improve visibility, or visual air quality and were established on July 1, 1999 (64 CFR 35714).

**Remote Automatic Weather Station (RAWS)**: An apparatus that automatically acquires, processes, and stores local weather data for later transmission to the GOES Satellite, from which the data is re-transmitted to an earth-receiving station for use in the National Fire Danger Rating System.

**Residual Smoke**: Smoke produced by smoldering material. The flux of smoke originating well after the active flaming combustion period with little or no vertical buoyancy, and therefore, most susceptible to subsidence inversions and down-valley flows.

**Scattering (light)**: An interaction of a light wave with an object that causes the light to be redirected in its path.

**Sensitive Receptors**: Areas that could be impacted by the proposed burning activity and are considered sensitive due to legislation, air quality concerns, or public concerns. Examples of sensitive receptors are Class 1 areas, non-attainment areas, or population centers such as towns and villages, campgrounds and trails, hospitals, nursing homes, schools, roads, and airports.

**Sulfur Dioxide ($SO_2$)**: A gas consisting of one sulfur and two oxygen atoms. Of interest because sulfur dioxide converts to an aerosol that is a very efficient at scattering light and therefore impairing visibility. Also, it can convert into acid droplets consisting primarily of sulfuric acid.

**Sulfur Oxides ($SO_x$)**: A class of colorless, pungent gases that are respiratory irritants and precursors to acid rain. Sulfur oxides are emitted from various combustion or incineration sources, particularly from coal combustion.

**State Implementation Plan (SIP)**: Plans devised by states to carry out their responsibilities under the Clean Air Act. SIPs must be approved by the U.S. Environmental Protection Agency and must include public review.

**Strategies**: A general approach or specific action to achieve objectives.

**Visual Range**: Maximum distance at which a given object can just be seen by an observer with normal vision.

**Wildfire**: Any fire occurring on wildlands that is not meeting management objectives and thus requires a suppression response.

**Wildland Fire**: All fires that burn in wildlands.

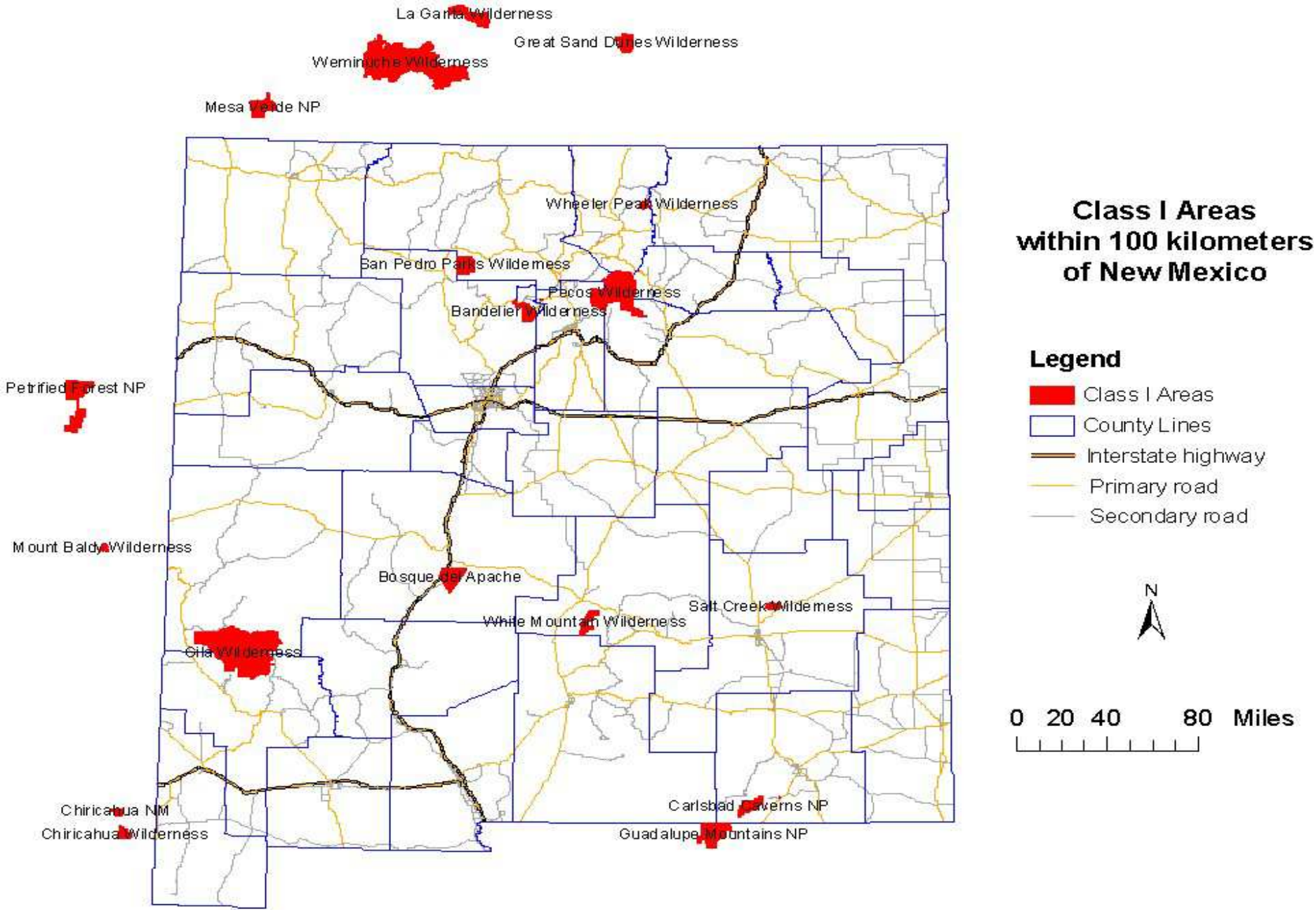
**Wildland Fire Use**: The management of naturally ignited wildland fires to accomplish specific pre-stated resource management objectives in predefined geographic areas outlined in Fire Management Plans.

# APPENDIX A – Maps

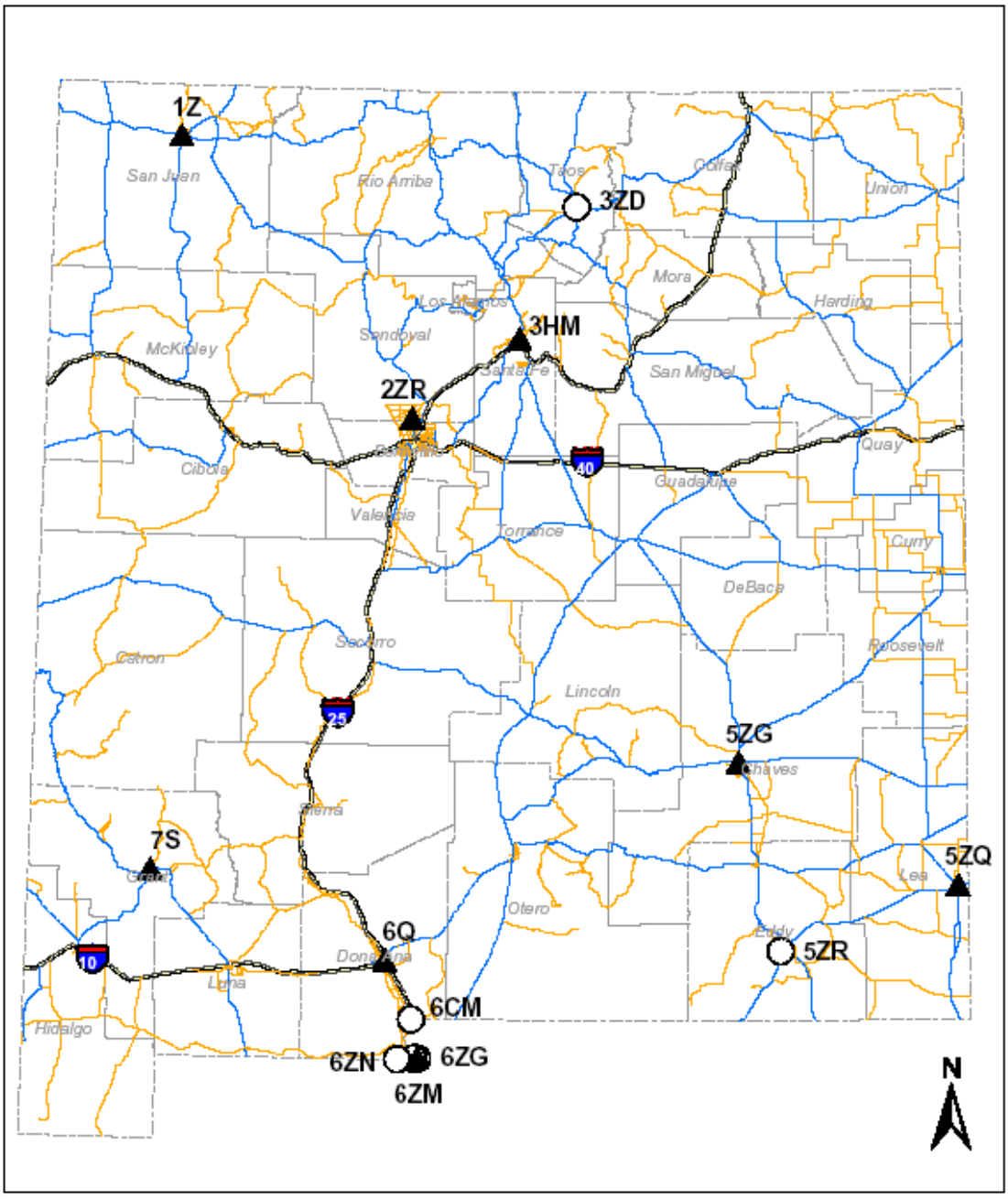
## New Mexico Class I Areas

## NMED Air Quality Bureau's $PM_{2.5}$ Monitoring Network

## Los Alamos National Lab's Network


La Garita Wilderness
Great Sand Dunes Wilderness
Weminuche Wilderness
Mesa Verde NP
Wheeler Peak Wilderness
San Pedro Parks Wilderness
Pecos Wilderness
Bandelier Wilderness
Petrified Forest NP
Mount Baldy Wilderness
Bosque del Apache
Salt Creek Wilderness
White Mountain Wilderness
Gila Wilderness
Chiricahua NM
Chiricahua Wilderness
Carlsbad Caverns NP
Guadalupe Mountains NP
Class I Areas within 100 kilometers of New Mexico
Legend
Class I Areas
County Lines
Interstate highway
Primary road
Secondary road
N
0 20 40 80 Miles

PM2.5 Monitoring Sites

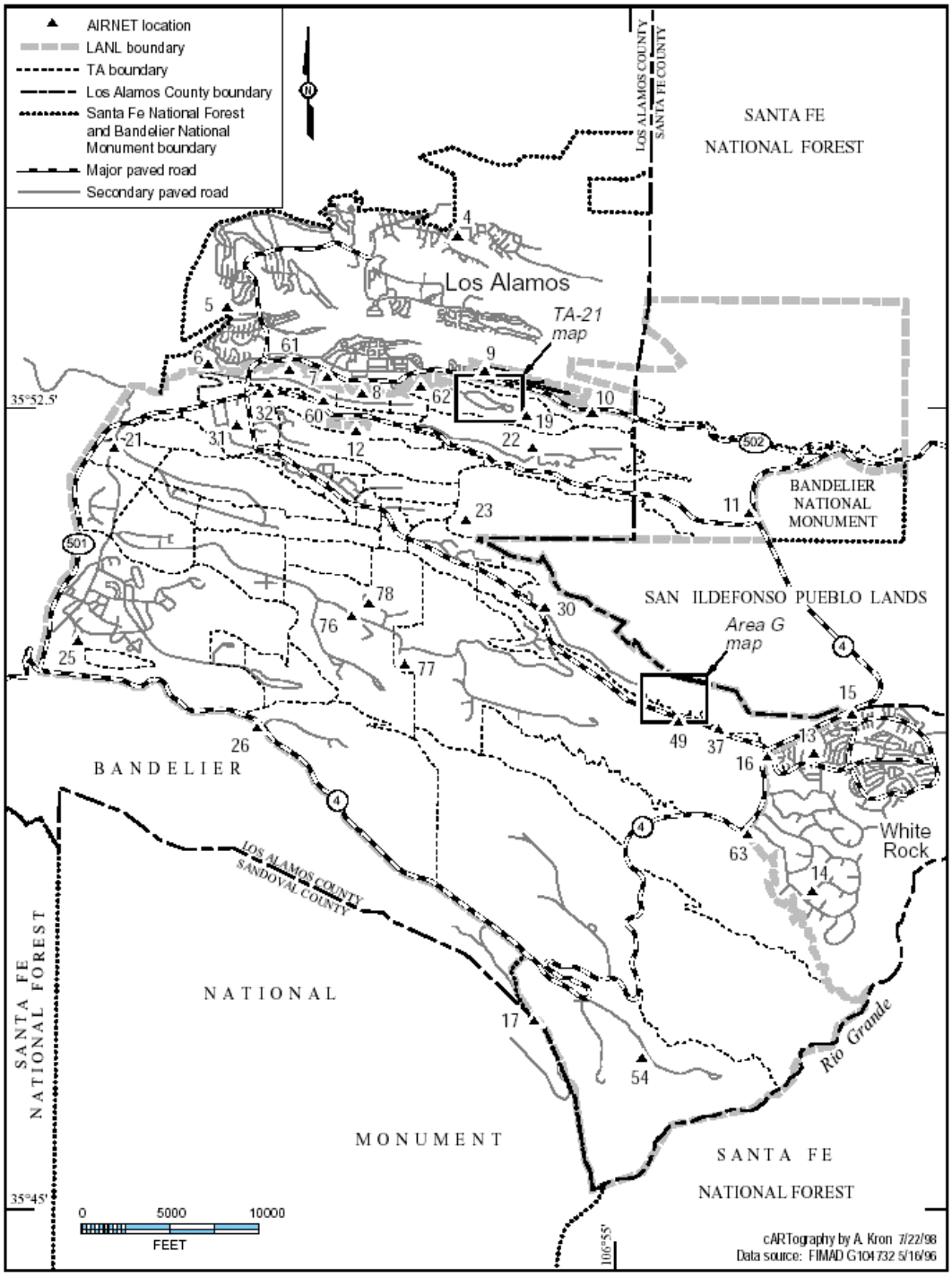



0 50 100 200 Miles

▲ PM2.5 (Noncontinuous)

○ PM2.5 (Continuous)

Air Quality Bureau
NMED




**Los Alamos National Laboratory Air Monitoring Network**

**Sites 15, 61, and 81 are continuous PM $_{2.5}$ and PM $_{10}$**

# APPENDIX B – Sample Purchase Orders

**DataRAM4**

**R&P Partisol Plus Model 2025**

# Sample Purchase Order for DataRAMs

Crown Systems Quotation #02-0401CRN-1 *(date of quote: March 28, 2002)*
3844 N 24th St. *(contact: Marc Shoub)*
Phoenix, AZ 85016
PH: (602) 381-8855, FX: (602) 381-8866
E-Mail: **CrownPhx@aol.com**

| ITEM | QTY | P/N | DESCRIPTION | UNIT $ |
|---|---|---|---|---|
| 1 | 1 | DR-4000 | MIE DataRAM 4<br>**Includes:**<br>Soft Shell Carrying Case<br>Digital Output Cable<br>Standard Filter Cartridge<br>Analytical Filter Holder<br>Universal Charger/Power Supply | 10,550 |
| 2 | 1 | DR-AMB | Ambient Sampling Set<br>**Includes:**<br>Omnidirectional Sampling Inlet<br>Temperature Conditioning Heater<br>In-Line Impactor (PM 10 & 2.5) | 1,255 |
| 3 | 1 | DR-DCS | External Power Cable DC<br>(for connecting to Marine Gel Deep Cell Battery)<br>**Total** | 65<br><br>**$11,870** |
| 4 | 1 | DR-SOL | **OPTION:**<br>Solar Power Supply<br>(Delivery 4-6 weeks Solar Only)<br>**Includes:**<br>Solar Panel in Weatherproof Enclosure<br>Charge Controller<br>Marine Gel Deep Cell Battery<br><br>**NOTES:**<br>1. Prices good for 60 days<br>2. Terms: Net 30<br>3. Delivery: 2-3 weeks except Solar<br>4. FOB shipping point (around $50 to Albuquerque for Items 1,2,3. Item 4 more due to weight of battery)<br>5. Prices do not include any tax if applicable<br>**6. Please issue P.O. to:**<br>**Thermo Anderson, Inc.**<br>**c/o Crown Systems, Inc.**<br>**3844 N 24th St**<br>**Phoenix, AZ 85016** | Add $2,500 |

# DataRAM Accessories and Consumables

**Accessories not provided by manufacturer:**

Marine type cell battery (for operation without line power or solar cell)
Surge protector with at least >1 outlets (heater requires outlet, satellite modem will need power source after ~4 days)
Power cord(s)
Laptop/PC to download data
"Raincoat" (weather proof cover): manufactured by MTDC. MTDC will provide free of charge (per Andy Trent 3/27/02). Coordinate acquisition through Gretchen Barkmann
Satellite transmitter/modem: ADSI Applied Digital Security Inc. 619-585-0435
Base component/modem = $2,040
Air time: $40 activation fee then varies depending on expected usage, Monthly vs. annual etc. Current Forest Service package is $50/month paid annually.

**Consumables:**

HEPA filters (in DataRAM, install at bottom of sampler). From manufacturer, MIE part #MSA-95302

Glass filters for PM10/2.5 In-Line Impactor: (recommend that these be checked and replaced before each run if any visible soiling)
Glass filters, Type A/E, 25 mm
One source = Pall Life Sciences, Ann Arbor, MI 1-800-521-1520
Product # 61630, approximately $85 + shipping for a box of 500

**Other:**

Table, old file cabinet or some other kind of stand. The inlet of the DataRAM has to be at least 1 meter (39.4") above the ground: 2 meters (78.8) is optimal. The height of the DataRAM plus heater plus the PM10/2.5 impactor plus the inlet = 33". In addition, the satellite antenna should be as high off the ground as possible.

Crown Systems Quotation #02-0522CRN-7
3844 N 24th St
Phoenix, AZ 85016
PH: (602) 381-8855, FX: (602) 381-8866
E-Mail: Crownphx@aol.com

| ITEM | QTY | P/N | DESCRIPTION | UNIT$ | EXTEND$ |
|---|---|---|---|---|---|
| 1 | 1 | 99-004660-0120 | **Rupprecht & Patashnick's Partisol-Plus Model 2025 Sequential USEPA PM2.5 Reference Sampler (RFPS-0498-118)**<br>**Includes:**<br>USEPA – designed PM-2.5 Inlet System Stand<br>Pneumatically activated filter exchanger in ventilated filter compartment<br>Active volumetric flow control system<br>Flow audit adapter kit<br>Brushless pump<br>Microprocessor with menu-driven software<br>Display and keypad<br>10 filter cassettes for 47 mm filters<br>3 filter cassette magazines with end caps<br>1 Magazine transport container<br>Sensors for ambient temperature, pressure, relative humidity and filter temperature<br>Box of 25 glass fiber filters (37 mm)<br>Bottle of WINS Impactor Oil (30 ml)<br>2 Operating Manuals<br>1 Quick start guide | $11,890.00 | **$11,890.00** |
| 2 | 1 | SH2025 | 9-to-9 pin computer cable<br>AK Comm RS232 software | 275.00 | **275.00** |
| 3 | 1 | 59-004953 | Shipping and Handling Charge for Item #1 | 1,620.00 | **1,620.00** |
| 4 | 1 | 59-004733 | Wind Vane/Anemometer & 15m Cable | 190.00 | **190.00** |
| 5 | 1 | 38-004892 | Filter Cassette Removal Kit | 45.00 | **45.00** |
| 6 | 3 | 36-004768 | Filter Cassette Separator Tool | 14.00 | **42.00** |
| 7 | 1 | 55-005569 | Solid Filter leak Check/Separator Disk | 159.00 | **159.00** |

| | | | | | |
|---|---|---|---|---|---|
| 8 | 1 | 20-004997 | Filter Cassette Magazine (**Spare Unit**) | 35.00 | **35.00** |
| 9 | 1 | 55-005052 | Magazine Transport Container (**Spare Unit)** | 170.00 | **170.00** |
| 10 | 1 | 57-004506-001 | P-Plus Pass Adapter Tube (for PM 10 setup) | 1,120.00 | **1,120.00** |
| 11 | 1 Pkg | 59-004648-0010 | 1 Flow Streamline FTS w/10" H20 Manometer | 210.00 | **210.00** |
| 12 | 1 | 59-004292-0100 | Package of 10 Partisol-FRM/Plus Filter Cassettes | 80.00 | **80.00** |
| 13 | 1 | 57-004006 | Bottle of WINS Impactor Oil, 100 ml | 375.00 | **375.00** |
| 14 | 1 | 56-005554 | WINS PM-2.5 Impactor (Spare Unit) | 350.00 | **350.00** |
| 15 | 1 | 56-005555 | Temperature Cal Device – NIST Traceable<br><br>Pressure Calibration Device | 600.00 | **600.00** |

**NOTES:**

1. Prices good for 60 days
2. Terms: Net 30
3. Delivery 2-4 weeks ARO
4. FOB shipping point
5. Prices do not include any tax if applicable
6. Please issue P.O. to:
   Rupprecht & Patashnick Co., Inc.
   c/o Crown Systems, Inc.
   3844 N 24th St
   Phoenix, AZ 85016

Recommended starter package:

| | |
|---|---|
| • Items 1 & 2, Sampler with shipping | $12,165.00 |
| • Item 3, Wind vane/anemometer | 1,620.00 |
| • Item 6, solid filters (3) | 42.00 |
| | $13,827.00 |

Recommended extras:

| | |
|---|---|
| • Item 11, 10 cassettes | $210.00 |
| • Item 12, Impactor Oil | 80.00 |
| | $290.00 |

Consider:

| | |
|---|---|
| • Item 13, spare WINS impactor (facilitates WINS maintenance during sampling runs) | $375.00 |
| • Item 9, Adapter Tube for PM-10 | 170.00 |

Also needed: NIST-traceable calibration instruments

| | |
|---|---|
| • Item 10, flow manometer | $1,120.00 |
| • Item 14, temperature device | 350.00 |
| • Item 15, pressure device | 600.00 |
| | $2,070.00 |

## Other sources for calibration instruments (2001 prices):

Flow meter (easier to use than manometer)

BIOS International Corp. 973-494-8400
Flow meter DCL-MH
DyrCal DC-Lite Medium/High Kit $1,099.00
(GSA rate of $989.10)

Temperature calibration device:

Cole-Parmer Instrument Co. 800-323-4340

| | |
|---|---|
| U-08402-00 Single Input Thermistor Thermometer | $140.00 |
| U-08438-00 YSI NIST Thermistor Probe | 110.00 |
| | $250.00 |

Pressure calibration device:

Ben Meadows. 800-241-6401
#102110 Thommen TX Barometer $279.00

# APPENDIX C – Template for a Smoke Monitoring Plan

# Template for a Smoke Monitoring Plan

*This template is just a guide to be used in developing project specific Ambient Air Monitoring Plans. Some examples are given, but they are just a sample of the possible choices..*

## I INTRODUCTION

Project description << lift out of NEPA document>>

### A. Objectives and Questions

The objectives of this monitoring plan are to ensure that air quality is not significantly impaired in the project area. Specific objectives include: *Some examples:*

- Document adverse impacts or minimized to the extent predicted in the EA/EIS
- Ensure that the project is implemented in compliance with applicable laws, regulations, and Forest Plan standards (in particular that the NAAQS are not violated).
- Capture any unexpected results.
- Add information to knowledge and inventory database.
- Describe and perhaps quantify, how smoke management techniques can reduce particulate emissions.
- Quantify how prescribed fire emissions contribute to cumulative effects within the immediate airshed.
- Ensure that visibility over sensitive receptors, including Class I areas, is not significantly impaired.
- Provide data to assist with future prescribed fire planning.
- Provide information to aid in responding to public concerns.
- Validate modeling results.
- *Others……..*

Questions that this monitoring is designed to answer are: *Questions should relate to issues raised in the NEPA process. Some examples:*

- Will particulate matter emitted from this project reach state or federal standards for $PM_{10}$? *<<insert sensitive receptor where monitor will be placed>>.*
- Will smoke emissions from this project reach the federal standard for $PM_{2.5}$ ? *<<insert sensitive receptor where monitor will be placed>>.*
- How much does prescribed fire in the *<<insert project area>>* increase smoke related emissions over *<<insert sensitive area where monitor will be placed>>.*
- How do data from prescribed fire in this area compare to data collected from wildfire?
- *Others……..*

### B. Sensitive Receptors

*<<describe sensitive receptors that were identified in the NEPA process and Burn Plan. Explain why specific sensitive receptors have been selected as monitoring locations (most representative of sensitive population, most likely to be impacted, available power, secure location, etc).>>*

## II SAMPLING RATIONALE *this is just an example*

The sampling and monitoring outlined in this plan was designed to meet the objectives outlined above, and to answer the above questions. Two separate types of monitoring are contained in this plan. *This*

*may not be true for every project. Not all projects may need instrument monitoring. It depends on how the questions are answered in the above section.*

Because people's reactions to smoke in the atmosphere can be very subjective, Visual Monitoring is used as a means to document different atmospheric conditions related to the project. *And depending on objectives and questions, relate the visual data to instrument data.*

Instrument data will provide Real-Time information and defensible data quantifying the amount of particulate matter in the ambient air. *depending on what instruments will be used.*

### A. Visual Monitoring

Visual monitoring will consist of recording observations and taking photographs from predetermined photo points, as well as from any other locations where significant smoke is observed. These photo points will be views that are likely to document smoke emissions from distant perspectives, form selected sensitive areas, and from locations near the project.

A log will accompany photographs, documenting location, time and date, direction, weather conditions and any other information pertinent to the project or smoke behavior.

### B. Instrument Monitoring

Instrument(s) will be used to collect particulate matter data from a location(s) carefully chosen to represent an area likely to be impacted by smoke from prescribed fire in the <<*project area*>>. Federal air quality standards were developed primarily to protect human health; therefore the instrument(s) should be located at an area representative of populated areas likely to be impacted by smoke. Because of the topography of the <<*insert project area*>> and the <<*sensitive receptor*>>, the most sensitive area is likely to be <<*insert location where instrument(s) will be placed*>>.

Two methods of collecting data on particulate emissions will be used: Real-Time and Federal Reference (FRM) filter analysis. Instruments employing these two methods will be collocated so that data can be compared.

The focus of instrument monitoring will be on $PM_{2.5}$. The new federal standard for $PM_{2.5}$ may be harder to meet with wildland fire smoke. For this reason, instruments will collect PM 2.5 data. *this is a recommendation, there may be a reason to collect $PM_{10}$ rather than PM 2.5.*

## III MONITORING LOCATIONS

### A. Visual Monitoring

Photo points will be established at various locations to provide documentation for the smoke plume size, direction of travel, and general behavior. These photo points will include: *examples:*

- *Fire lookout tower or other highpoint*
- *At burn location*
- *Overlooking sensitive receptor(s) including Class I areas*
- *Near sensitive receptors such as at city limits, wilderness boundary etc*
- *Any other locations where photographs might provide useful information on smoke behavior*
- *Other ……..*

### B. Instrument(s)

The Real Time/FRM instruments will be located at <<*insert location*>>. This location was selected because it

- Is secure, surrounded by fence with locked gate,
- Has line power,
- Has open terrain in which to situate the instruments for unobstructed air intake,
- Is representative of the populated area most likely to be significantly impacted by smoke from <<*insert project*>>
- *Other……..*

## IV RECORD KEEPING AND REPORTING

### A. Quality Assurance/Quality Control

Appropriate Standard Operating Procedures and Guidance Documents will be followed. *(list those that are appropriate, ie Forest Service DataRAM4 User's Guide, Manufacturer's Operating Manuals. If FRMS are to be used, be sure and reference the EPA Quality Assurance Guidance Document 2.12 for instrument operation and lab procedures)*

Standard forms will be used for documentation and record keeping. *(list the appropriate forms, ie photograph log, DataRAM log sheets, FRM filter log, Lab chain of custody sheets, etc)*

### B. Reporting

*<<describe what sort of report will be prepared at the end of the monitoring, for example: photo log, data sheets and other field documentation, graphical interpretation of the data, lab reports, summary and conclusion. Use the summary and conclusion to answer the questions and describe if objectives were met.>>*

# APPENDIX D - Protocols and Standard Operating Procedures (SOPs)

**FRM Quick Reference**

**FRM Standard Operating Procedures**

# FRM QUICK REFERENCE

Date: year/month/day
Time: hr:min:sec

Set time/date: Main screen
F5 Set up -> sample definition setup screen (EDIT IN **STOP** MODE)
F5 system -> system stet up screen

Start sample/stop sample time
F5 setup -> sample definition set up screen

Master Menu also provides access to system set up by selecting MENU

-List and +List decrease/increase value of the parameter currently being edited

ENTER retains changes and returns monitor to Browse mode
ESC changes are not retained and " " " "

To advance filters, from main menu: F3 Audit the F2: FiltAdv

F5 setup to enter sample setup screen
Set sample start and atop time
For continuous 24 hour (consecutive) default sample repeat time and default sample duration both set to 024:00

Sample definition method selected in sample set up screen
If Basic the when in Main screen
F3 filtset gives Basic filter set up screen

Filter list setup screen
F4: filtlist
Enter sn of filters and cassettes

Filter times screen
Accessible from Basic filter set up screen if Basic selected previously
F1times from the filter set up screen to enter filter times screen

**2025 Audit:**

audit magmazine: EMPTY (top)
FILTER
SOLID

From main screen select Audit then press enter, press Filt Adv to move empty cassette into chamber Remove inlet, open top cover and remove WINS impactor, insert external thermometer in sampling chamber measure and compare filter temp.

Clean WINS if necessary, replace and close cover

Measure and compare ambient temp
Measure and compare ambient pressure

ELC: external leak check
Advance filter into chamber
Put flow adapter on tube, close valve
Press F5Leak Check, F2 start and follow instructions

Flow check
F1pumb then F2 valve.
Let flow rate stabilize, compare to flow meter
F2 valve, F1 turn off pump

ILC: internal leak check
Advance solid filter onto chamber
F2 start

Move solid filter to supply
Replace inlet and press ESC until return to main screen

## To program sampling run

F3 filtset to display filter setup screen
F4 filt list, EDIT, enter ID and numbers
When done pres enter

In stop mode from Main screen
F5 twice to get system setup screen
EDIT to correct data
ENTER when done
ESC to main screen, verify all is correct

RUN/STOP to WIT mode
A cassette will advance automatically at programmed start time

**To download data**
F5,F5 to system setup screen
F2 I/O the F3 RS232
Verify: 9600 AK
8 52
None 75048
1 13010
None 0
Connect PC to sampler
F5 to download
Use F4 last to select last data record
F1 first to access the first
Use F2 –Ptr or F3 +Ptr to select the first data record to download
F5 start

## 2000 Audit

stop mode to enter Audit screen
F5 audit
Compare and record ambient temperature, filter temp, ambient pressure

ELC:
Filter in cassette
Remove inlet, install adapter
Turn on flow valve F2 valve from Audit screen
Turn on pump F3pump from audit screen
Shut off valve on adapter
Shut off manual flow valve, left side compartment
Record reading on gauge once stable
    Should be at least 15" (382) Hg
Shut off flow to pump by closing other manual valves (bottom compartment)
    Should not drop > 8.5 " Hg
Open flow controller and pump manual vales
Slowly open valve on flow adapter

ILC
Solid disk in cassette
Turn no flow valve F2: valve from audit screen
Turn on pump F3: pump
Shut off control valve left side compartment
Record reading on gauge
Shut off pump valve at bottom of compartment
Turn off pump F3pump
Let 30 sec pass
Record reading on vacuum gauge
    Should not drop >8.5:
F2 valve to open valve, open the two manual valves
Remove leak check disk

Flow, F5 audit
Filter in cassette
Attach flow adapter with open valve
Turn on pump F5:pump
Turn on sample flow Valve F2: valve
Read flow on meter
Turn off pump F#
open valve F2
Reinstall inlet
Remove filter cassette

# R & P PARTISOL FRM SAMPLER (Model 2025 and Model 2000) STANDARD OPERATING PROCEDURES

*Follow directions for all audits, calibrations, and leak checks in the R&P Operating Manual. Reference: EPA QA Guidance Document 2.12*

Every time the instrument is set up (or once a year if no use):

- Clean inlet and tubes
- After at least 15 minutes allowing sensors to equilibrate, perform a Temperature and Pressure Audit. (Section 10 in Operating Manual). Use the "Instrument Data Sheet" to record all information. This form, when used on the laptop or PC, performs all needed calculations to verify that readings are within specified ranges.
- If values are outside specified rages ($\pm$ 2° C, $\pm$ 10 mm Hg), Calibrate. (Section 11 in Operating Manual).
- Perform a Five-Point Flow Calibration to ensure the average flow is within $\pm$ 4% of 16.7 L/min *(after* calibrating temperature and pressure) (Section 11).
- Perform External and Internal Leak Checks (ELC, ILC) (Section 6)
- Use the "Calibration and Data Verification Data Sheet" to record all information. This form, when used on the laptop or PC, performs all needed calculations to verify that readings are within specified ranges.
- Make sure a copy of each Data Sheet is placed in the instrument's log book.

Every time a seal is broken (cleaning inlet, performing flow check etc)

- Perform External and Internal Leak Checks (ELC and ILC).

Every 15 or days of operation or 49 filters

- Download data

If continuous operation in one place

- Perform temperature, pressure and flow audits and calibrations once a month
- Clean inlet and tubes every two weeks
- Perform ILC (Internal Leak check) once every month
- Perform ELC (External Leak check) every 5 days
- Inspect water bottle and remove accumulated water once every 5 days

When running for PM 2.5: clean WINS Impactor every 5 days of operation

Once a year:

- Replace batteries in electronic cabinet
- Inspect O-rings and cassette seals for cracking and drying
- Replace large in-line filter
- Clean air screens
- Perform a 3-point temperature calibration on each sensor

General:

- field blanks should be run at a frequency of 10%
- to prevent cross-contamination between filters when using the sequential magazine, it is a good idea to put solid filter cassettes between each filter
- the flow meter, thermometer and barometers used in calibration must be NIST traceable

# PARTISOL PLUS 2025 LEAK CHECKS

## Load leak check (or audit) cartridge tube in sampler.

*Audit cartridge: filter cassette on bottom, solid disk cassette in middle, and empty cassette on top. The empty cassette for the external leak check to run first, the solid for the internal leak check to run second, and the filter for the flow audit)*

## EXTERNAL LEAK CHECK

Press **RUN/STOP**

Press **MENU**

Use arrow key to scroll to **Service Mode** and Press **ENTER**

Screen will prompt "**Are you sure**" press **YES**

In the Audit screen, press **<F2:Leakchk>** to enter the leak check screen

Press **<F4:Filtadv>** to move the empty disk into the sampling position. Wait for filter change to complete.

Press **<F4:Filtadv>** again to move the filter leak check disk into the sampling position. Wait for filter change to complete.

Press **<F2:Start>**

Remove the sample inlet from the external sample tube

Install the flow audit adapter on the end of the tube.

Close the valve on the flow audit adapter.

Read instructions displayed on screen, then press **<F1:Externl>**

Read instructions displayed on screen again, then press **<F1:Yes>**

Read instructions displayed on screen again, then press **<F1:On/Off>**

Sampler will automatically start to pull vacuum and check for flow

A pass or a fail message will display at the end of the leak check cycle. A pressure drop of 140mm Hg or less is the sampler's leak check pass criteria.

Screen will now prompt you to "Press any key to continue", Press **<F1:On/Off>** and screen will display the leak rate value

If a failure message is displayed. Clean the cassette and leak check disk carefully. Inspect the cassette and disk for any external nicks or scratches. Discard any damaged cassettes or disks and perform leak check test again with a clean undamaged cassette and leak check disk.

If a leak check fails after 2 attempts, refer to leak check flow chart in section 2

After a successful leak check, **SLOWLY** open the valve on the flow audit adapter.

Leave the flow adapter in the open position in order to perform and Internal leak check.
See instructions for internal leak check below.

## INTERNAL LEAK CHECK

Press **<F4Filtadv>** to move the solid leak check disk into the sampling position. Wait for filter change to complete.

Press, **<F2:Start>** After prompt , press **<F2:Internl>** to perform an internal leak check

Follow instructions displayed on screen, then press **<F1:Yes>**

Follow instructions displayed on screen again, then press **<F1:On/Off>**

Sampler will automatically start to pull vacuum and check for flow

A pass or a fail message will display at the end of the leak check cycle. A pressure drop of 60mm Hg or less is the sampler's leak check pass criteria.

Press <**F5:Audit**>, then press **<F2:Valve1>** to release vacuum.

Press <**F4:Filtadv**> to move the leak check disk into the storage cassette. Wait for filter to change to complete.

If a failure message is displayed, clean the cassette and leak check disk carefully. Inspect the cassette and disk for any external nicks or scratches. Discard any damaged cassettes or disks and perform leak check test again with a clean undamaged cassette and leak check disk.

If leak check fails refer to leak check flow chart in Section 2.

When leak checks are complete press **ESC** key twice.

Press **MENU** key

Use the arrow key to scroll down to "**Exit service mode**"

Press **ENTER**, sampler is now ready to load with filters, or perform flow audit.

# APPENDIX E – Forms

**Data Log Sheets**

**Filter Log Sheets**

**Audit Sheets**

**Module Handbook**

**Index to DataRAM and Federal Reference Method Forms**

| Form Title | Instrument Type | Intended Use | Form Number |
|---|---|---|---|
| Additional Data Form | DataRAM or FRM | Provide data needed in interpreting instrument data: weather observations, other conditions creating air pollution, type and duration of burn/fire etc | SM-DR4.0 |
| DataRAM Start Up and Shut Down Log Sheet | DataRAM | Checklist and documentation of instrument start and stop times | SM-DR1.0 |
| Smoke Monitor Data Log Sheet | DataRAM | Log data points when visiting DataRAM. Use in case data logger enabled or problems downloading data: ensures some data acquired | SM-DR2.0 |
| DataRAM Smoke Monitoring Stored Data Points Log Sheet | DataRAM | Use when no satellite modem is available and need to portray data before downloading entire dataset | SM-DR3.0 |
| FRM Calibrate Blank | FRM | Spreadsheet to use when calibrating FRMs | SM-FRM2.0 |
| FRM-Audit Blank | FRM | Spreadsheet to use when performing audits on FRMs | SM-FRM1.0 |
| FRM Filter Log | FRM | Log filters as loaded into FRMS. Use in absence of form provided by lab | SM-FRM3.0 |
| FRM Maintenance Log | FRM | Keep track of required maintenance for an individual FRM instrument | SM-FRM4.0 |

# Smoke Monitoring – Information to Accompany DataRAM Downloads

This information will help others to understand your data, and will allow comparison of different burn data. It will also allow the use of this data in planning of similar projects. If it is easier, attach a copy of the burn plan sheet from the NM Smoke Database, and fill in only additional information (marked by asterisks).

**Project/Fire Name**_____

**Rx burn***_____ **Background data collection***_____ **Wildfire***_____

**Forest/District**_____

**Contact Name**_____**Contact Phone**_____

**Lat**_____ **Long**_____

**Predominant Fuel type**_____

**Fire Type**_____ **Burn Purpose**_____

**Actual Days and Times of Ignition***_____

**Rx RH**_____ **Rx Temp**_____**Rx wind speed**_____**Rx wind direction**_____

**Fuel Moisture**_____ **Elevation**_____

**Actual Acres/day*** _____

**Actual Piles/day***_____

**Weather synopsis during the burn*:**

| | Sky conditions (clear, overcast, etc) | Temperature hi and low | Average wind speed and direction | other |
|---|---|---|---|---|
| Day 1 | | | | |
| Day 2 | | | | |
| Day 3 | | | | |
| Day 4 | | | | |
| Day 5 | | | | |
| Day 6 | | | | |
| Day 7 | | | | |
| Day 8 | | | | |
| Day 9 | | | | |
| Day 10 | | | | |
| Day 11 | | | | |
| Day 12 | | | | |
| Day 13 | | | | |
| Day 14 | | | | |

# SMOKE MONITORING DATA LOG SHEET
## For DataRAM

Fire Name:_____ Specific Location of Monitor:_____

Instrument ID:_____ Operator(s):_____

*Use to record real-time data from DataRAM prior to downloading*

| Date[a] | Tag# | Time[b] | Conc.[b] | TWA[b] | ET[b] | Comments* | initials |
|---|---|---|---|---|---|---|---|
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[a] Today's' Date [b] from instrument screen * use back of page for additional comments
Conc. = concentration in µg/$m^3$ TWA=Time Weighted Average in µg/$m^3$ ET = elapsed time in minutes Comments: weather observations, other PM in air, etc Tag# found on DataRAM screen

# DataRAM Start-Up and Shut-Down Log Sheet

**Instrument ID:_____ Operator(s):_____FireName:_____**

| | |
|---|---|
| Tag # | Monitor Location: |
| Date ON: | Set for<br>PM 10 or 2.5? |
| Time ON: | Inlet Ht. (inches off ground): |
| Initials: | Data Logger Enabled? |
| Date OFF: | Log interval = |
| Time OFF: | Auto zero set for 12 hour intervals?<br>Zero/Initialize? |
| Initials: | Both sources normal? |
| | Cal Factor = 0.48? |
| | Heater or RH correction enabled?<br>Raincoat on? |
| | Comments: |

* * * * * * * * * * * * * * * * * * * * * * *

**Instrument ID:_____ Operator(s):_____Fire Name:_____**

| | |
|---|---|
| Tag # | Monitor Location: |
| Date ON: | Set for<br>PM 10 or 2.5? |
| Time ON: | Inlet Ht. (inches off ground): |
| Initials: | Data Logger Enabled? |
| Date OFF: | Log interval = |
| Time OFF: | Auto zero set for 12 hour intervals?<br>Zero/Initialize? |
| Initials: | Both sources normal? |
| | Cal Factor = 0.48? |
| | Heater or RH correction enabled?<br>Raincoat on? |
| | Comments: |

# DataRAM Smoke Monitoring Stored Data Points Log Sheet

Fire Name:_____ Specific Location of Monitor:_____

Instrument ID:_____ Operator(s):_____

*Use to record **stored data points** from DataRAM prior to downloading* PM: 2.5_____ or 10_____ ?

| Date | Tag# | Time | Conc. | Date | Tag# | Time | Conc. | Date | Tag# | Time | Conc. |
|---|---|---|---|---|---|---|---|---|---|---|---|
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Date, Time and Concentration from stored data points * use back of page for comments
Conc. = concentration in $\mu g/m^3$

# FRM Filter Log

Operator:_____Site:_____

| Filter ID 1* | Filter ID 2** | Instrument | Location | Date In | Time In | Date Out | Time Out | PM 10 0r 2.5 | Operator Initials | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
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* = lab ID **= R&P cassette screen ID

# FRM MAINTENANCE LOG

| **Days of Oper-ation** | **Total Days** | **Date** | **Audit** *(each time setup)* | **ELC** *(after 4weeks of use)* | **ILC** *(after 4 months operate)* | **Calib-Rate** *(1x year)* | **Clean/ change WINS (after 5 days operate, or after each run)** | **Clean/ inspect cassette Seals** *(when change filters)* | **2025 Check "V" seals** *(monthly)* | **Replace Seals** *(as nec-essary)* | **Clean Inlet, tubes** *(after every 14 days oper-ation)* | **Replace in-line filter** *(after 6 months oper-ation)* | **Clean Air Screens** *(after every 6 months oper-ation)* | **Check Battery voltage** *(every 6 months)* | **Pump** *(replace or rebuild every 12-18 months)* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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Date

# PM10/2.5 Instrument Audit Data Sheet
# Flow Rate, Temperature, and Pressure

| | | | | |
|---|---|---|---|---|
| Site Name | | | | |
| Auditor | | | | |
| Instrument Number | | | | |
| Flow Standard Number | | | | |
| Pressure Standard Number | | | | |
| Temperature Standard Number | | | | |
| Field Pressure Standard Number | | | | |
| Ambient Temperature | | deg. C | | |
| Ambient Pressure | | inches Hg | ###### | mm Hg |

## Temperature Audit

(± 2 deg C)

| | Standard Temperature Degrees C | | Monitor Indicated Temperature Degrees C | | Delta Degrees C | Delta % |
|---|---|---|---|---|---|---|
| Ambient | | | | | #VALUE! | #VALUE! |
| Filter | | | | | #VALUE! | #VALUE! |

## Pressure Audit

(± 10 mmHg)

| | Standard Pressure Inches Hg | | Standard Pressure mm Hg | Monitor Indicated Pressure mm Hg | | Delta mm Hg | Delta % |
|---|---|---|---|---|---|---|---|
| | | | #VALUE! | | | #VALUE! | #VALUE! |

## Flow Audit

(± 5%)

| | Average Standard Flow Rate Liters/min | | Monitor Indicated Flow Rate Liter/min | | | | Delta % |
|---|---|---|---|---|---|---|---|
| | | l/min | | | l/min | | #VALUE! |

## External Leak Check

(≤8.5")

| try | initial (") | after 30 sec | loss (") | loss (mmHg) | | pass | fail | comments |
|---|---|---|---|---|---|---|---|---|
| 1 | | | ###### | #VALUE! | | | | |
| 2 | | | ###### | #VALUE! | | | | |
| 3 | | | 0.0 | 0.0 | | | | |
| 4 | | | 0.0 | 0.0 | | | | |

## Internal Leak Check

(≤8.5")

| try | initial | after 30 sec | loss (") | loss (mmHg) | | pass | fail | comments |
|---|---|---|---|---|---|---|---|---|
| 1 | | | ###### | #VALUE! | | | | |
| 2 | | | 0.0 | 0.0 | | | | |
| 3 | | | ###### | #VALUE! | | | | |
| 4 | | | 0.0 | 0.0 | | | | |

Date

# PM10/2.5 FRM Instrument Calibration and Verification Data Sheet

| | |
|---|---|
| Site Name | |
| Calibrator | |
| Instrument Number | |
| Flow Standard Number | |
| Pressure Standard Number | |
| Temperature Standard Number | |
| Field Pressure Standard Number | |
| Ambient Temperature | deg. C |
| Ambient Pressure | inches Hg ####### mm Hg |

## Ambient Temperature Probe Verification (± 2 deg C)

| Sampler Reading | Temperature Standard Reading | Delta Temperature |
|---|---|---|
| deg. C | deg. C | #VALUE! deg. C |

## Filter Temperature Probe Verification

| Sampler Reading | Temperature Standard Reading | Delta Temperature |
|---|---|---|
| deg. C | deg. C | #VALUE! deg. C |

## Filter Compartment Temperature Probe Verification

| Sampler Reading | Temperature Standard Reading | Delta Temperature |
|---|---|---|
| deg. C | deg. C | #VALUE! deg. C |

## Pressure Sensor Verification (± 10 mm Hg)

| Sampler Reading | Pressure Standard Reading | | Delta Pressure |
|---|---|---|---|
| mm Hg | inches Hg | #VALUE! mm Hg | #VALUE! mm Hg |

## External Leak Check

| Try | Pass | Fail | Pressure Drop | Comments |
|---|---|---|---|---|
| 1 | | | mm Hg/min | |
| 2 | | | mm Hg/min | |
| 3 | | | mm Hg/min | |

# Flow Calibration

| Point | Current Flow | Qa | Delta % |
|---|---|---|---|
| 1 | liter/min. | liter/min. | #VALUE! |
| 2 | liter/min. | liter/min. | #VALUE! |
| 3 | liter/min. | liter/min. | #VALUE! |
| 4 | liter/min. | liter/min. | #VALUE! |
| 5 | liter/min. | liter/min. | #VALUE! |

m = #DIV/0! b = #DIV/0! liter/min. r = #DIV/0!

## Flow Verification (± 5%)

| Flow Setting | Current Flow | Qa | Delta % |
|---|---|---|---|
| 16.70 liter/min | liter/min. | liter/min. | #VALUE! |

## Internal Leak Check

| Try | Pass | Fail | Pressure Drop | Comments |
|---|---|---|---|---|
| 1 | | | mm Hg/min | |
| 2 | | | mm Hg/min | |
| 3 | | | mm Hg/min | |

# FIRE BEHAVIOR OBSERVATIONS

**INTERAGENCY FIRE USE MODULE HANDBOOK**

| FIRE NAME: | DATE: | OBSERVERS: |
|---|---|---|

| TIME | LOCATION | ELEVATION | ASPECT | SLOPE | FIRE TYPE (B/F/H) | FLAME LENGTH | FLAME ZONE DEPTH | ROS | PRIMARY CARRIER | FUEL MODEL | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|
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|  | **FIRE BEHAVIOR OBSERVATIONS SUMMARY SHEET** | **INTERAGENCY FIRE USE MODULE HANDBOOK** |
|---|---|---|

Fire Name_____ _____Fire #__

Management Unit _____ Date_____ Time _____

Current Fire Size_____ Observation Location (map grid/elev.)_____

*Attach current map indicating active fire perimeter, spread direction and other significant information*

Fuel Model/Vegetation Type (of active area) _____

Fire Activity: Creeping, Running, Torching, and Crowning?

- Rate of Spread_____ch/h Head Flanking Backing Average (select any that apply)
- Perimeter growth _____ acres, direction _____ Growth Rate? (area/time) _____
- Percent of perimeter actively burning? _____
- Max temp/Min RH _____/_____ Min. FDFM_____Max. PI _____ **(give times of these obs.)**
- Wind: Max sustained & dir. _____ Max Gust _____
- Smoke (describe column: color, shape, etc) _____
- Distance to MMA, Trigger Points, other values at risk (note on attached map also)_____

Other notes (i.e. influencing factors – topography, shading, etc., potential fuel model changes, resistance to control efforts (if applicable), more on observations above) _____

**Attach any Weather Observations, Fire Behavior Observations and Smoke Observations**

Prepared by: _____ Date _____

Name, Title, and Qualification

Reviewed by: _____ Date _____

Name, Title, and Qualification

|  | **FUEL MOISTURE SAMPLING SHEET** | **INTERAGENCY FIRE USE MODULE HANDBOOK** |
|---|---|---|

***FIRE NAME***_____

*COLLECTED BY:*_____ *WEIGHED BY:*_____ *DATE OUT OF OVEN:*_____

*DATE COLLECTED:*_____ *DATE INOVEN:*_____*TIME OUT OF OVEN:*_____

*TIME COLLECTED:*_____ *TIME IN OVEN:*_____ *WEIGHED BY:*_____

| SPECIES / MATERIAL | CAN # | TARE | WET WT (g) | DRY WT (g) | % MOIST. * | COMMENTS |
|---|---|---|---|---|---|---|
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WEATHER OBS: DRY BULB: _____ WET BULB: _____

DEW POINT: _____ HUMIDITY: _____ % CLOUD COVER: _____

CLOUD TYPE: _____ 10 HOUR FMTL STICKS: _____ TIME: _____

WIND DIRECTION/MPH: _____/_____ GUST DIRECTION/MPH: _____/_____

*FUEL MOISTURE CALCULATION FORMULA:

$$\left( \frac{(WET - DRY)}{} \right) \text{ X } 100$$

# SMOKE OBSERVATION SHEET

**INTERAGENCY FIRE USE MODULE HANDBOOK**

| FIRE NAME: | OBSERVERS: |
|---|---|

| DATE | TIME | OBSERVER LOCATION AND ELEVATION | WIND SPEED & DIRECTION | ELEVATION OF SMOKE COLUMN ABOVE GROUND | SMOKE COLUMN DIRECTION | APPROX. ELEVATION OF SMOKE INVERSION LAYER ABOVE GROUND | OTHER OBSERVATIONS* |
|---|---|---|---|---|---|---|---|
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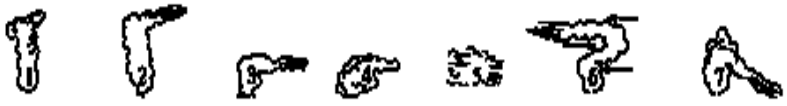

*VISIBILITY, VOLUME, COLOR, PLUME TYPE, INVERSION STATUS, VISIBILITY TO SIGHTED DISTANCE, SMOKE SENSITIVE RESOURCES

SMOKE SENSITIVE AREAS: _____

_____

FORECASTED TRANSPORT WINDS: _____

HAINES INDEX: _____

WS FORM D-1
(12-86)
Pres. By WSOM D-41

**FIRE WEATHER SPECIAL FORECAST REQUEST**

U.S. DEPARTMENT OF COMMERCE
NOAA
NATIONAL WEATHER SERVICE

**I – REQUESTING AGENCY WILL FURNISH:**

| 1. NAME OF FIRE OR OTHER PROJECT | 2. CONTROL AGENCY | 3. REQUEST MADE | |
|---|---|---|---|
| | | TIME | DATE |

| 4. LOCATION (*By ¼ Sec-Sec-Twp-Range)* | 5. DRAINAGE NAME | 6. EXPOSURE (*NE, E, SE, etc.)* |
|---|---|---|
| | | |

| 7. SIZE OF PROJECT (*Acres*) | 8. ELEVATION* | | 9. FUEL TYPE | 10. PROJECT ON: |
|---|---|---|---|---|
| | TOP | BOTTOM | | GROUND<br>CROWNING |

**11. WEATHER CONDITIONS AT PROJECT OR FROM NEARBY STATIONS**

| PLACE | ELE-VATION | OB TIME | WIND DIR.VEL. | | TEMP. | | | | REMARKS *(Indicate rain, thunderstorms, etc. Also wind conditions and 10ths of cloud cover)* |
|---|---|---|---|---|---|---|---|---|---|
| | | | 20 FT | EYE LEVEL | DRY | WET | RH | DP | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

| **12. SEND FORECAST TO:** | PLACE | VIA | ATTN: |
|---|---|---|---|
| | | | |

**II-FIRE WEATHER FORECASTER WILL FURNISH:**

13. FORECAST AND OUTLOOK:
(*SPECIFY Wind – 20 foot or Eye Level)* TIME AND DATE:_____
Synopsis:

| Burn Period | Sky Cover | Temperature | Humidity | Wind | | Indices |
|---|---|---|---|---|---|---|
| | | | | Eye-Level | 20-Foot | |
| ❑ Today (sunrise to dusk)<br>❑ This Afternoon (noon until dusk)<br>❑ This evening (1600 until dusk)<br>❑ Tonight (sunset until sunrise) | ❑ Moslty Sunny/Clear<br>❑ Fair<br>❑ Partly Cloudy<br>❑ Mostly Cloudy<br>❑ Cloudy<br>❑ Variable Clouds | _____ °F<br>❑ High<br>❑ Low<br>❑ Range | _____%<br>❑ Maximum<br>❑ Minimum<br>❑ Range | ❑ Upslope<br>❑ Downslope<br>Direction:_____<br>Velocity_____<br>Gusts_____ | ❑ Upslope<br>❑ Downslope<br>Direction:_____<br>Velocity_____<br>Gusts_____ | Haines:<br>LAL:<br>BI:<br>CI: |
| ❑ Today (sunrise to dusk)<br>❑ This Afternoon (noon until dusk)<br>❑ This evening (1600 until dusk)<br>❑ Tonight (sunset until sunrise) | ❑ Moslty Sunny/Clear<br>❑ Fair<br>❑ Partly Cloudy<br>❑ Mostly Cloudy<br>❑ Cloudy<br>❑ Variable Clouds | _____ °F<br>❑ High<br>❑ Low<br>❑ Range | _____%<br>❑ Maximum<br>❑ Minimum<br>Range | ❑ Upslope<br>❑ Downslope<br>Direction:_____<br>Velocity_____<br>Gusts_____ | ❑ Upslope<br>❑ Downslope<br>Direction:_____<br>Velocity_____<br>Gusts_____ | Haines:<br>LAL:<br>BI:<br>CI: |
| Outlook For (Date):<br>_____ | ❑ Moslty Sunny/Clear<br>❑ Fair<br>❑ Partly Cloudy<br>❑ Mostly Cloudy<br>❑ Cloudy<br>❑ Variable Clouds | _____ °F<br>❑ High<br>❑ Low<br>❑ Range | _____%<br>❑ Maximum<br>❑ Minimum<br>Range | ❑ Upslope<br>❑ Downslope<br>Direction:_____<br>Velocity_____<br>Gusts_____ | ❑ Upslope<br>❑ Downslope<br>Direction:_____<br>Velocity_____<br>Gusts_____ | Haines:<br>LAL:<br>BI:<br>CI: |

| NAME OF FIRE WEATHER FORECASTER | FIRE WEATHER OFFICE |
|---|---|
| | |

III – REQUESTING AGENCY WILL COMPLETE UPON RECEIPT OF FORECAST

| **FORECAST RECEIVED:** | TIME | DATE | NAME |
|---|---|---|---|
| | | | |

# FIRE WEATHER OBSERVATIONS

**INTERAGENCY FIRE USE MODULE HANDBOOK**

| FIRE NAME: | DATE: | OBSERVERS: |
|---|---|---|

| TIME | LOCATION | ELEVATION | ASPECT | SLOPE | DRY BULB | WET BULB | RELATIVE HUMIDITY | DEW POINT | WIND SPEED (GUSTS) | WIND DIRECTION | % CLOUD COVER | % SHADING | FINE DEAD FUEL MOISTURE | PROB. OF IGNITION | COMMENTS (PRECIP, FIRE BEHAVIOR, SMOKE, ETC) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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MAX TEMP: _____

TIME OF MAX TEMP: _____
MIN TEMP: _____

TIME OF MIN TEMP: _____

MAX RH: _____

TIME OF MAX RH: _____

MIN RH: _____

TIME OF MIN RH: _____

## APPENDIX F - List of available equipment (location and contact) FY 2002-2003:

**Forest Service**: 4 DataRAMs. Albuquerque (David Martinez, 505-842-3353) Santa Fe (Gretchen Barkmann, 505-476-3799);

**Forest Service:** 2 FRM - one R&P Partisol Plus 2025 and one R&P Partisol 2000, both in Santa Fe (Gretchen Barkmann, 505-476-3799).

**BLM**: 2 DataRAMs in Santa Fe. (Lisa Bye, 955-8061)

**US FWS:** Southwest Region (NM, TX, AZ, OK) 6 DataRAMs, 3 FRMs. (Mike Main, Albuquerque. 505-248-6820)

**NPS:** none in NM

**BIA:** none

**NMED/AQB:** 1 FRM in Santa Fe (Tim Booker, 955-8067)

## APPENDIX G – Pertinent Websites

Smoke Management
http://www.fs.fed.us/r3/fsem/swa-smoke/

Cooperative Institute for Research in the Atmosphere
http://www.cira.colostate.edu/

NMED Air Quality Bureau
http://www.nmenv.state.nm.us/aqb/index.html

Southwest Area wildland Fire Operations
http://gacc.nifc.gov/swcc/