LESSON 7
Evaluating, Documenting, and Reporting

Goal

To familiarize you with the requirements and guidance for evaluating, documenting, and reporting network design and site selection.

Objectives

After completion of this lesson you should be able to:

1. Describe elements needed to document networks and prepare annual reports.
2. Design and analyze data from saturation studies to determine the zone of representation of sampling sites.
3. Identify measurement redundancy and re-located sites to enhance community exposure estimates.
4. Identify factors that must be evaluated to ensure selected sites remain eligible for spatial averaging.

Reading Assignment Topics

- Evaluating Zones of Representation
- Evaluating Site Redundancy
- Evaluating Network Adequacy for Spatial Averaging
- State PM Monitoring Network Description
- Annual Measurement Report
- Annual Network Evaluation

Procedure

1. Read sections 5.3 through 5.5 (pg. 5-3 through 5.7) and sections 6.0 through 6.3 (pages 6-1 through 6-5) of *Guidance for the Network Design and Optimum Site Exposure for $PM_{2.5}$ and PM_{10}.*
2. Complete the self-test questions and exercises.

3. Check your answers against the answer key in Appendix A.
4. Review the pages from any material you missed.
5. Take the final examination under the supervision of your test supervisor, according to test directions.

Review Exercise

1. Which section should be included in the State PM Monitoring Network Description?

   a. Community Monitoring Approach

   b. Transport and Background Areas

   c. Schedule and Responsibilities for Network Change

   d. All of the above

2. True or false? The CMZ maps in the MPA appendices should be more detailed than those in the main network description document.

   a. True

   b. False

3. Concentration uniformity measures should be discussed in which document?

   a. Annual Network Evaluation

   b. Annual Measurement Reports

   c. State PM Monitoring Network Descriptions

   d. None of the above

4. A site originally selected to represent community exposure may have its zone of representation change due to

   a. redefinition of CMZ boundaries or MPA description.

   b. long-term changes in land use or short term events.

   c. both a and b.

   d. neither a nor b.

5. True or false? Siting redundancy can be examined using spatial uniformity measures.

   a. True

   b. False

6. When the information content among sites within a CMZ is redundant, _____

   a. the CMZ is correctly spatially averaged.
   b. recommendations can be justified for the transfer of sites within a CMZ.
   c. the CMZ has been incorrectly designated and must be reconsidered, taking the siting evidence into account.
   d. the CMZ is correctly measuring population oriented exposure.

7. True or false? To be eligible for spatial averaging, $PM_{2.5}$ monitoring sites must each represent a neighborhood or larger spatial measurement scale.

   a. True
   b. False

8. To satisfy homogeneous air quality requirements, the sites' annual averages must be within _____ of the CMZ-wide average on an annual basis, be influenced by _____ sources, and be reasonably correlated on a _____ basis.

   a. 30%, similar, yearly
   b. ± 30%, similar, yearly
   c. ± 20%, different, daily
   d. ± 20%, similar, daily

9. True or false? The aerosol for all eligible sites in the CMZ should have similar chemical composition on an annual basis.

   a. True
   b. False

10. Why should annual site surveys be carried out?

   a. Because of potential change in land use and sources around the site
   b. Because a more appropriate site might be found nearby
   c. Because a specific event may have caused elevated PM measurements
   d. All of the above

Required Readings

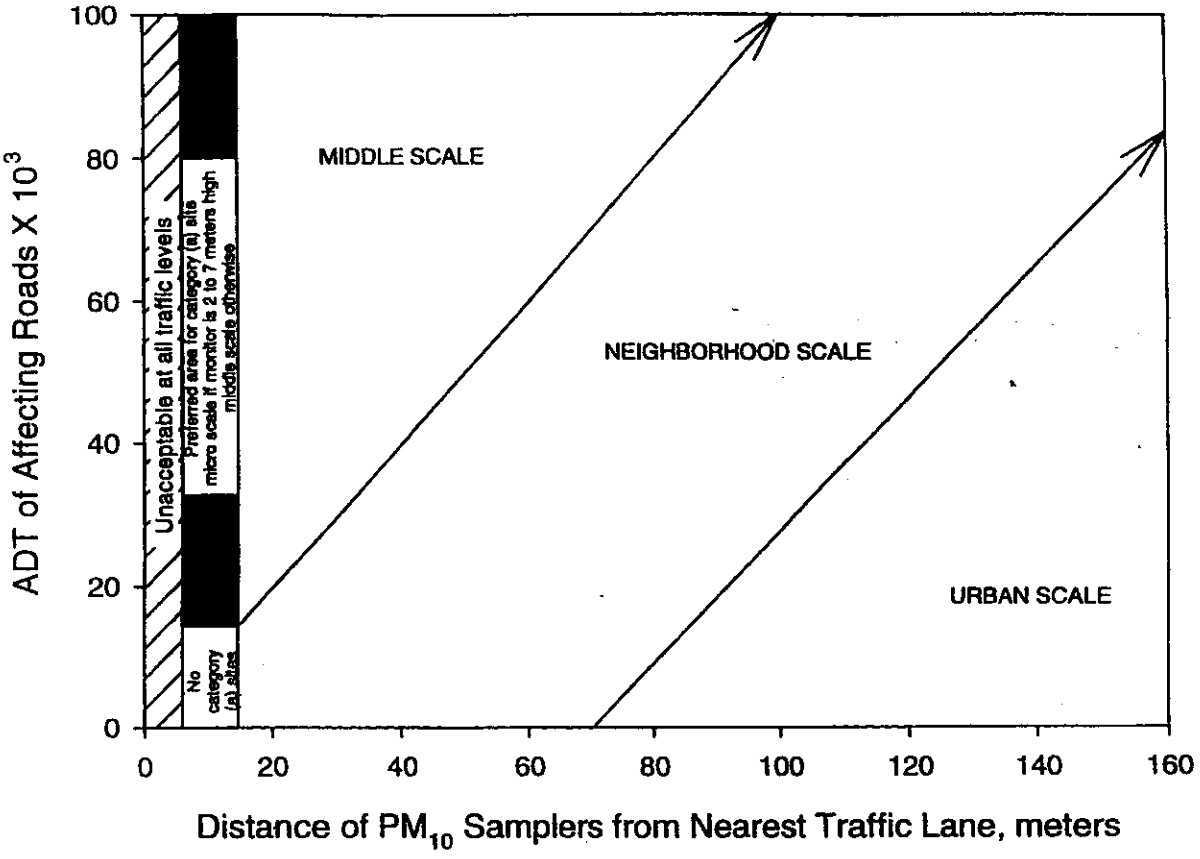

Figure 5.2.1. Recommended distances and elevations of PM sampler inlets from heavily traveled roadways.

explain high PM readings as caused by wind blown dust. These gusts are often localized, and would not be detected on a more distant monitor. Similarly, a strong correspondence between hourly CO and PM readings would indicate that locally emitted vehicle exhaust is a large contributor at that site. This conclusion would be more tenuous if the CO measurements were not collocated. In particular, collocating PM_{10} and $PM_{2.5}$ monitors will provide information on the size distribution of suspended particles.

5.3 Evaluating Zones of Representation

A site originally selected to represent community exposure (generally on a neighborhood or urban scale) may have its zone of representation change owing to long-term changes in land use or short term events that affect that particular site.

- **Annual Site Surveys:** The land use and sources around a monitoring site may change from year to year, especially in high growth areas. Maps should be updated as part of the annual measurement network summary, and the setbacks

from emissions sources and obstructions should be re-evaluated to ascertain that they are still met.

- **Records of Intermittent Events:** High $PM_{2.5}$ or PM_{10} concentrations may have corresponded to a specific event, such as construction or a fire, occurring near the measurement location. Visual events should be recorded as part of the measurement network maintenance, and these should be summarized at the end of each year for inclusion in the annual network evaluation report.

- **Saturation Monitoring Studies:** To evaluate the zone of representation of sites, many monitors may be located at different distances around and between monitors in a CMZ. Spatial uniformity measures can be determined for these temporary locations and compared to those from the sites within the CMZ to evaluate how well the long-term sites represent population exposures to PM.

5.4 Evaluating Siting Redundancy

The spatial uniformity measures specified in Section 4 to can be applied to $PM_{2.5}$ concentrations at the sites within a CMZ to determine the extent to which each one supplies additional information concerning exposure. When information content is redundant, recommendations can be justified for the transfer of sites within a CMZ to other parts of the CMZ or to other CMZs.

5.5 Evaluating Network Adequacy for Spatial Averaging

Appendix D of 40 CFR 58 lays out several specific requirements for $PM_{2.5}$ monitoring sites to be eligible for spatial averaging: (1) they each represent a neighborhood or larger spatial measurement scale and (2) their community monitoring zone represents homogeneous air quality. To satisfy the latter, the sites' annual averages must be within ±20% of the CMZ-wide average on an annual basis, be influenced by similar sources and be reasonably correlated on a daily basis ($r > 0.6$). This assessment can be made in a preliminary manner with one year of data, but will require three years of $PM_{2.5}$ air quality data before final evaluation of site eligibility and comparisons to the NAAQS can be made.

EPA recommends that the State follow additional design criteria to ensure that the air quality in a community monitoring zone is spatially homogeneous. This should include an evaluation of several factors including the year-to-year variability of each individual site, the effect of changing emissions over time, the relative distribution of concentrations among the sites, the spatial patterns within the CMZ, similarities and differences in speciated $PM_{2.5}$, and the relationship between population density and air quality patterns.

5.5.1 Temporal Behavior

The evaluation of ±20% year-to-year variability should support spatially homogeneous air quality during 3-year period.

One location should not be consistently and substantially higher (e.g., 30% higher) than all the other sites. The variation among annual means should reflect sampling and meteorological variation and should not characterize consistent differences in air quality within the community monitoring zone. The left hand graph in Figure 5.5.1 supports homogeneity while the right hand diagram does not. Accordingly, it may not be sufficient that individual means be ±20%.

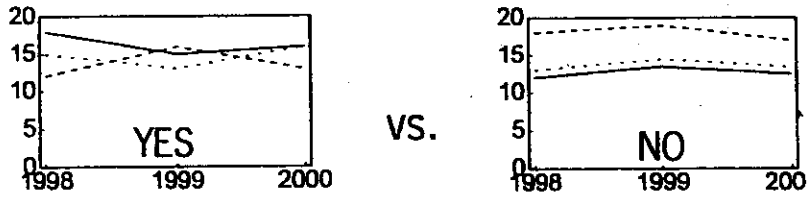

Figure 5.5.1. Example of spatial homogeneity over a three-year period.

5.5.2 Consistent trends

The variation among the eligible core monitors should be stable over time. Changes in emissions can differently affect individual monitoring locations. This can cause site eligibility to change over time. Although the sites can be within ±20 % during the first year, they can be ±30% or more after changes in emissions have occurred. This is depicted in Figure 5.5.2. Therefore the initial set of annual means should be well within ±20 % (e.g. 10-15%) to allow for potential changes over time.

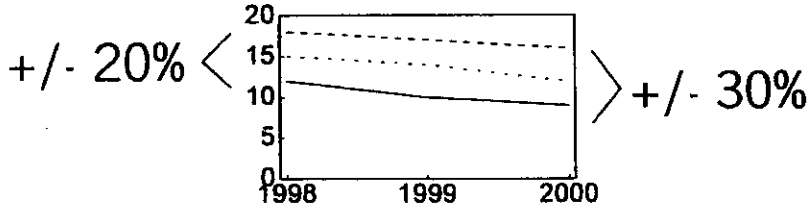

Figure 5.5.2. Example of temporal trends.

5.5.3 Spatial Placement of Monitors

The core monitoring sites should adequately reflect area-wide average air quality. With the help from modeling or spatial interpolation, the site average can be compared to other estimates of the area-wide average. An example of this is shown in Figure 5.5.3. If there are significant discrepancies between the different area-wide estimates, the placement of the monitors within the zone can be questioned.

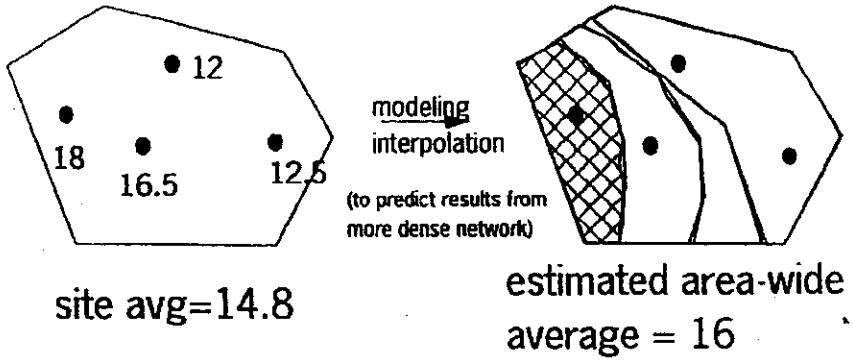

Figure 5.5.3. Example of spatial averaging.

5.5.4 Chemical Composition of $PM_{2.5}$

To satisfy the requirement that the sites are influenced by similar sources, the aerosol for all eligible sites in the CMZ should have similar chemical composition on an annual basis. Moreover, for more sensitive evaluation, this should also be true on seasonal basis. Although chemical analysis to determine eligibility for spatial averaging is not required, the use of chemical speciation data, when available, can provide important insights into the relative differences among monitoring sites. Appropriate chemical species can be used (e.g., carbon, metals) for making this assessment.

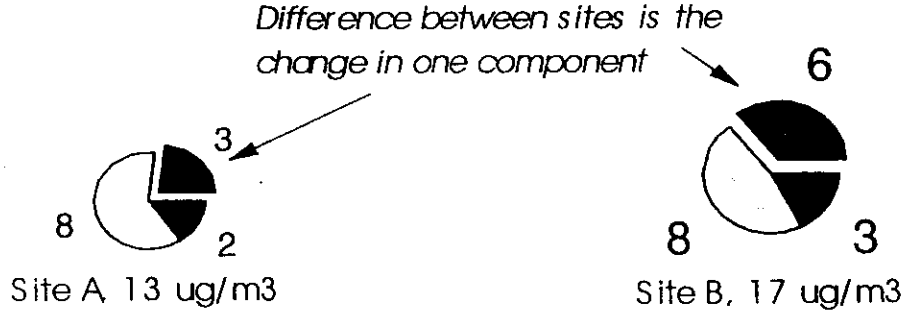

Figure 5.5.4. Example of differences in chemical composition between two sites.

5.5.5 Population Density and Air Quality Patterns (additional supporting evidence)

To further justify the placement of monitoring sites within the community monitoring zones, the estimated air quality pattern and population density should support the placement of core monitors. This is illustrated in the following figure which presents a case where average air quality is or is not representative of potential population exposure.

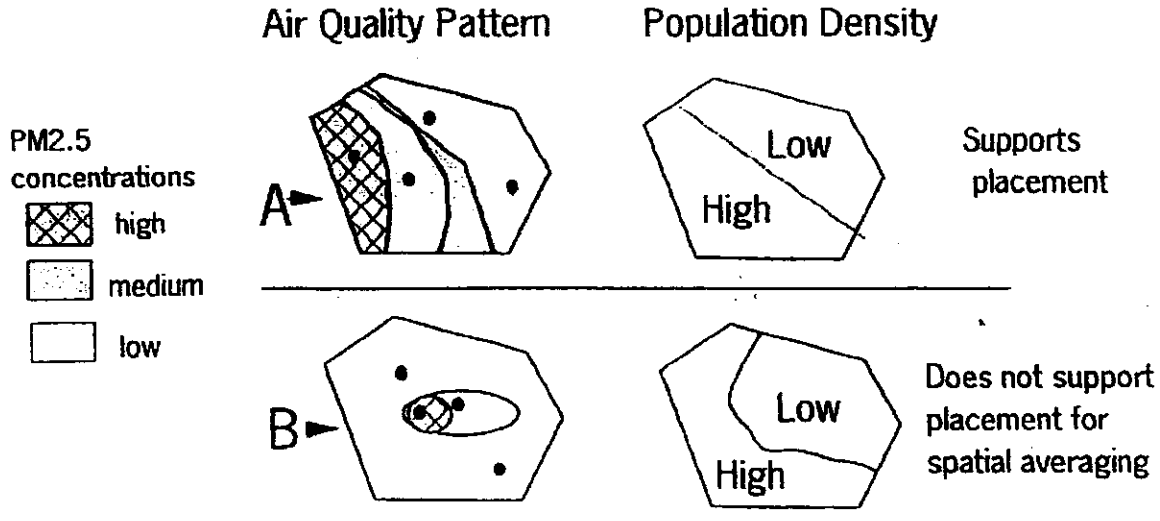

Figure 5.5.5. Example of using population density for monitor placement.

6.0 STATE PM MONITORING NETWORK DESCRIPTIONS, ANNUAL REPORTS, AND NETWORK EVALUATIONS

As implied by this guidance, monitoring network configurations are likely to change from year to year. NAMS sites will remain fixed to the extent allowed by such considerations as leasing arrangements, urban renewal projects, and loss of monitoring locations due to other construction, fires, or natural disasters. NAMS will include some of the current NAMS network for PM_{10} and the current PAMS network for ozone to maintain continuity with long-term data sets acquired at these sites. PAMS with $PM_{2.5}$ monitors will be a subset of the core SLAMS as well as selected regional transport sites.

Non-NAMS SLAMS sites may change their locations from year to year, however, if they are shown to provide the same information for determining attainment as NAMS sites. SPMs will surely change location from year to year, and may even be discontinued without major review once they have provided the data for their intended purposes. This section outlines the elements of state network descriptions, annual reports, and network evaluations that will document and justify changes in the monitoring network.

6.1 State PM Monitoring Network Descriptions

The State PM Monitoring Network Description should describe the PM monitoring strategy based on the use of SLAMS (including NAMS and PAMS) and SPMs for PM_{10} and $PM_{2.5}$. The phase-in of $PM_{2.5}$ monitors and changes in the existing PM_{10} and TSP network should be specified and justified. These descriptions should document the application of this guidance to the selection of MPAs within each state, the definition of MPA and CMZ boundaries, and transport and background sites within each state. Specific definitions for CMZs are only needed for spatial averaging, otherwise more general descriptions of community monitoring areas are appropriate. The description should be a single summary report that documents monitoring for the entire state, with a separate appendix for each of the designated MPAs. The network description should consist of the following sections.

1. **Introduction**: Describe the state's physical setting, major metropolitan areas, economic activity and industry. Show those MSAs within the state having populations levels requiring MPAs. Identify other areas with lower populations that the state chooses to define as MPAs and specify the reasons for these additional MPAs.

2. **Monitoring Planning Areas**: Show the MPAs that have been defined for the state and summarize the justification for these MPAs, based on the steps in Section 3. USGS (1:125000) maps and census data are available in electronic formats (see Appendix A).

3. **Community Monitoring Approach**: Indicate the extent to which spatial averaging is intended and provide maps showing boundaries for the CMZs. These maps need not be as detailed as those shown in the appendices to justify the CMZs.

4. **Transport and Background Areas**: Show the areas where transport between or upwind of MPAs is expected to occur and explain why that transport is expected. Locate monitors distant from source areas and explain why these should represent background levels within the state or selected portions of the state.

5. **Schedule and Responsibilities for Network Change:** Show the planned start-up date for each new $PM_{2.5}$ monitoring site, with its MPA and CMZ (where appropriate) designation, its type (community-exposure, daily compliance, SPM, transport, or background), its anticipated monitoring methods (e.g., FRM, Class I, II, and/or III equivalent or other non-reference/equivalent methods), and its measurement frequency. Show which PM_{10} monitoring sites will be modified by discontinuation or reduction in measurement frequency. Network changes are to be phased in between 1998 and 1999 for $PM_{2.5}$ and between 1998 and 2000 for PM_{10}.

A separate appendix for each MPA should present the following detailed information:

1. **Introduction**: Describe the physical setting of the MPA, population characteristics, climate and weather, dominant economic activities, and emissions sources. Much of this information can be concisely and efficiently summarized on maps such as USGS (1:50000 or 1:2400), aerial photographic, or commercial maps available on CD-ROM (Appendix A identifies several options).

2. **Community Monitoring Areas or Zones:** Show maps of the selected community monitoring areas or community monitoring zones, if appropriate, and justify them based on the procedures in Section 4. Document modeling and data analysis activities that were conducted to determine these zones. These maps should include, where available and appropriate: 1) populated entity boundaries (e.g. census tracts or blocks), 2) relevant jurisdictional boundaries; 3) commercial, residential, agricultural, and industrial land uses; 4) suspected area source emissions hot spots (e.g. wood burning communities, diesel emissions hot spots identified from bus transfer locations, railyards, marine terminals, waste recycling, land preparation, unpaved roads, etc.). Include tables of spatial uniformity measures (spatial averages, spatial coefficients of variation, 98^{th} percentile concentrations, and spatial correlations) using existing data to determine the zone of representation of existing monitors. Use wind roses and trajectories to identify potential transport pathways and terrain maps to identify potential barriers to transport.

3. **Sampling Site Descriptions**: Provide site descriptions, including maps showing surrounding sources as well as verbal descriptions of activities surrounding the site. Define the variables measured at each site in terms of observables measured (e.g., PM_{10} mass, $PM_{2.5}$ mass, chemical composition), sample duration, frequency, and measurement method.

4. **Sites Intended for Comparison with NAAQS**: Specify those sites that acquire measurements to be compared with the NAAQS, with their designation as community-oriented, daily compliance, or other sites. Identify sampling methods that acquire compliance data at these sites.

5. **Special Purpose Monitoring Projects**: Where there is doubt concerning the validity of the CMZs, the zone of representation of a sampling site, or the influence on PM from different sources, define special purpose monitoring projects to resolve these concerns.

6. **Phase-In and Responsibilities:** Estimate costs of hardware, operation, and maintenance for the number of stations and measurement frequencies required, and reconcile these costs with current resources. Justify trade-offs between additions of $PM_{2.5}$ monitors at the expense of PM_{10} monitors. Specify responsibilities of local and state monitoring authorities, and determine a schedule for changes.

6.2 Annual Measurement Reports

The annual measurement report should include the following information for each MPA:

1. **Annual Site Data Summaries**: Include tables of PM_{10} and $PM_{2.5}$ annual averages, maximum concentrations, and 98th and 99th percentile concentrations for each monitoring site for each year. For most situations these data can be obtained from EPA's AIRS database. This will include data from non-compliance monitors, including SPMs, as well as for compliance monitors.

2. **Spatial Averages:** When spatial averaging is utilized, include tables of spatially averaged annual-average $PM_{2.5}$ concentrations for each CMZ for each year. Identify sites with annual averages differing by more than ±20% from the spatial average, and remove them from the average.

3. **Compliance Statistics:** Include three-year-average annual averages for each core site (and when appropriate for each CMZ) and three-year-average 98th and 99th percentile averages for each eligible site.

4. **Compliance Determination**: Compare the compliance statistics with standards, and discuss the compliance or non-compliance of each site and/or CMZ in the MPA. Compare measurements at background and transport sites with those at core sites to estimate the extent to which urban-scale (within the MPA) or regional-scale (within and outside of the MPA) sources contribute to the excess concentrations. Discuss the comparison of concentrations at background and transport sites with the core sites.

6.3 Annual Network Evaluation

The annual network evaluation should include the following information for each MPA:

1. **Changes in Site Characteristics:** Document changes in site exposure owing to construction or demolition of nearby buildings or the growth of foliage, the presence of temporary (e.g., building construction, road repair) or permanent (e.g., an industrial facility or a new highway) emitters within 1 km of the site, or special events (e.g., accidental fires, major wind storms). Record the magnitude, location, and duration of these changes. Examine PM measurements in conjunction with these changes to evaluate the continued population-orientation of the site.

2. **Concentration Uniformity Measures:** Evaluate spatial time-series plots, spatial correlation coefficients, differences between site-specific averages and 98^{th} percentile values, and spatial coefficients of variation within and between CMZs within an MPA. These measures are especially important for evaluating the spatial average used to determine compliance with the annual $PM_{2.5}$ standard. The annual average at each site within a CMZ should not differ by more than ±20% from the CMZ average. If one or more of these site-specific averages exceeds this tolerance, it may be necessary to re-define the CMZs to better represent community exposure, or to re-evaluate the site exposure. On the other hand, high correlations among measurements, low spatial coefficients of variation, and annual averages and 98^{th} and 99^{th} percentiles that do not differ by more than ±5% within a CMZ indicate that some stations are redundant. Justification can be made for moving one or more of the non-NAMS trend stations to another location where it might better represent population exposure. Similar results for measurements in different CMZs within the MPA indicate that the adjacent CMZs with similar concentrations might be combined into a larger CMZ, with a consequent reduction in the number of monitors needed to represent the spatial average.

3. **Monitoring Site Additions and Deletions**: When sites are determined to no longer represent population exposure, or when spatial uniformity measures show that they provide consistently redundant information, recommendations and justifications for deletion may be submitted to the EPA regional office for approval. When spatial uniformity measures show high variability within a CMZ, when a populated area expands beyond its original boundaries, or when special monitoring sites are deemed necessary, measurement locations may need to be added. These, too, should be justified. The intent of this annual evaluation is to continually re-define the network, within available monitoring resource constraints, to best represent population exposures. This section of the evaluation allows substantial flexibility for networks to evolve to attain this end.

4. **Changes to CMZ and MPA Boundaries and Site Designations**: SLAMS with $PM_{2.5}$ standard exceedances should be considered for re-designation as core sites.

SPM sites showing NAAQS violations should be considered for designation as SLAMS sites. Changes in population or emissions may require changes in MPA or CMZ boundaries, including the creation of additional MPAs or CMZs. The evaluation of spatial uniformity measures may also justify recommendations for changes in MPA or CMZ boundaries. In particular, the 2000 census will provide more current information on population distributions, and when these data become available in 2001 or 2002, the MPA and CMZ boundaries will need to be re-assessed. Locally generated land-use patterns in rapidly growing areas can also be used to determine the extent to which the boundaries of planning areas and averaging zones should be expanded.

APPENDIX A

Answers to Review Exercises

Lesson 2

1. a
2. b
3. d
4. c
5. c
6. d
7. a
8. b
9.
    - define concepts and terms of network design.
    - summarize the availability and usage of existing resources for network design.
    - demonstrate the methodology in practical applications.
    - present a methodology for defining planning areas and selecting and evaluating monitoring sites in a network.
10.
    - Twenty-four hour average $PM_{2.5}$ not to exceed 65 $\mu g/m^3$ for a three-year average of annual 98^{th} percentiles at any population-oriented monitoring site in a monitoring area.
    - Three-year annual average $PM_{2.5}$ not to exceed 15 $\mu g/m^3$ concentrations from a single community-oriented monitoring site or the spatial average of eligible community-oriented monitoring sites in a monitoring area.
    - Twenty-four hour average PM_{10} not to exceed 150 $\mu g/m^3$ for a three-year average of annual with percentiles at any monitoring site in a monitoring area.
    - Three-year average PM_{10} not to exceed 50 $\mu g/m^3$ for three annual average concentrations at any monitoring site in a monitoring area.

Lesson 3

1. less than 0.08 μm
2. from 0.08 μm to 2.5 μm
3. greater than 2.5 μm

4. d
5. c
6. d
7. b
8. a
9.

- To determine representative concentrations in areas of high population density.
- To determine the impact on ambient pollution levels of significant sources or source categories.
- To determine general background concentration levels.
- To determine the extent of regional pollutant transport among populated areas; and in support of secondary standards.
- To determine the highest concentrations expected to occur in the area covered by the network.
- To determine the welfare-related impacts in more rural and remote areas such as visibility impairment and effects on vegetation.

10. c
11. b
12. a
13. f
14. e
15. b
16. a
17. d
18. a

Lesson 4

1. b
2. c
3. a
4. c
5. c
6. c
7. a
8. a
9. c
10. b
11. a

Lesson 5

1.
   - Identify political boundaries of populated areas.
   - Identify natural air basins.
   - Locate existing air quality monitoring sites.
   - Reconcile boundaries with existing planning areas.
2. a
3. a
4.
   - Locate emissions sources and population
   - Identify meteorological patterns
   - Compare pm concentrations.
   - Adjust cmzs to jurisdictional boundaries
   - Locate sites
5. b
6. d
7. b
8. a
9. b

Lesson 6

1. d
2. a
3. b
4. c

Lesson 7

1. d
2. a
3. a
4. b
5. a
6. b
7. a
8. d
9. a
10. d

Network Design and Site Selection for Monitoring $PM_{2.5}$ and PM_{10} in Ambient Air

Final Exam

Directions: Take this final exam to determine whether you have mastered the objectives of this course.

Do not use your notes or books. Take no more than 1 hour to complete the exam. Forward the answer sheet by mail or fax to the appropriate Registrar listed on pages 2 and 3 of the student handbook.

Air Pollution Training Institute

1. The NAAQS primary standard for $PM_{2.5}$ is

   a. $15\mu g/m^3$ as an annual arithmetic mean from a single community-oriented monitoring site and 50 $\mu g/m^3$ for a 24 hour average of a 3 year average of annual 99^{th} percentiles.

   b. $15\mu g/m^3$ as an annual geometric mean from a population-oriented monitoring site and 50 $\mu g/m^3$ for a 24 hour average of a 3 year average of annual 98^{th} percentiles.

   c. $15\mu g/m^3$ as an annual arithmetic mean from a single or multiple community-oriented monitoring site(s) and 65 $\mu g/m^3$ for a 24 hour average of a 3 year average of annual 98^{th} percentiles.

   d. $15\mu g/m^3$ as an annual geometric mean from a population-oriented monitoring site and 65 $\mu g/m^3$ for a 24 hour average of a 3 year average of annual 99^{th} percentiles.

2. Which of the following is **NOT** an objective of the EPA document ***Guidance for the Network Design and Optimum Site Exposure for $PM_{2.5}$ and PM_{10}:***

   a. Define concepts and terms of network design.

   b. Summarize the availability and usage of existing resources for network design.

   c. Demonstrate the technologies and methodology for monitoring $PM_{2.5}$ and PM_{10}.

   d. Present a methodology for defining planning areas and selecting and evaluating monitoring sites in a network.

3. The EPA requires States to archive collected $PM_{2.5}$ filters because the EPA will need the filters to

   a. help identify PM emission sources.

   b. develop effective control programs.

   c. both a and b

   d. neither a nor b

4. Which of the following EPA documents provides information and guidance about the validity of data and the accuracy of measurement systems?

   a. *Guidance for the Network Design and Optimum Site Exposure for $PM_{2.5}$ and PM_{10}.*

   b. *Guidance for the Sampling and Analysis for $PM_{2.5}$ and PM_{10}.*

   c. *Guidance for the Continuous Monitoring for $PM_{2.5}$ and PM_{10}.*

   d. *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements.*

5. Which of the following EPA documents provides guidance to evaluate the feasibility and practicality of different sampling and analysis combinations for a variety of monitoring situations and data uses?

   a. *Guidance for the Network Design and Optimum Site Exposure for $PM_{2.5}$ and PM_{10}.*

   b. *Guidance for the Sampling and Analysis for $PM_{2.5}$ and PM_{10}.*

   c. *Guidance for the Continuous Monitoring for $PM_{2.5}$ and PM_{10}.*

   d. *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements.*

6. The accumulation range consists of particles with a diameter

   a. less than 0.08 μm.

   b. from 0.08 μm to 2 μm.

   c. from 2 μm to 10 μm.

   d. greater the 10 μm.

7. Aerodynamic diameters for PM_{10} size fraction range from

   a. 0 to 2.5 μm.

   b. 0 to 10 μm.

   c. 2.5 to 10 μm.

   d. 10 to 40 μm.

8. Aerodynamic diameters for $PM_{2.5}$ size fraction range from

   a. 0 to 2.5 μm.

   b. 0.5 to 2.5 μm.

   c. 2.5 to 10 μm.

   d. 2.5 μm and greater.

9. True or False? Particles in the fine particle size fraction have substantially longer resident times than coarse particles. Therefore, fine particles act more like gases than like coarse particles.

   a. True

   b. False

10. Which of the following is **NOT** a characteristic property of primary particles?

   a. Atmospheric concentrations of primary particles are, on average, proportional to the quantities emitted.

   b. Primary particles are directly emitted by sources.

   c. Primary particles undergo few changes between source and receptor.

   d. Primary particles transfer mass between the gas and particle phase to maintain chemical equilibrium.

11. A NAMS is **NOT** used for which of the following purposes:

   a. Acquire data for determining compliance with $PM_{2.5}$ standards.

   b. Determine general background concentration levels.

   c. Focus on community exposure surveillance.

   d. Determine impact of significant sources on ambient pollution levels.

12. Which of the following is **NOT** a general characteristic of a transport site?

    a. Typically located between MPAs
    b. Usually associated with meteorological measurements
    c. Used to assess compliance with NAAQS
    d. Assesses effects of emissions from one MPA on other MPAs

13. ____ monitors are usually placed in pristine areas and are used to represent PM emissions on a regional scale.

    a. Special purpose
    b. Background
    c. Transport
    d. NAMS

14. For the first two years of operation, non-attainment designations will not be made based upon _____

    a. Transport monitors
    b. Special purpose monitors
    c. PM_{10} measurements
    d. None of the above

15. Which of the following is NOT a component of a $PM_{2.5}$ sampler?

    a. Impactor
    b. Inlet
    c. Downtube
    d. Downdraft

16. Test procedures and performance requirements for _____ will be determined on a case-by-case basis.

    a. Class III candidate method instruments
    b. Class II candidate method instruments
    c. Class I candidate method instruments
    d. All non-FRM candidate method instruments

17. _____ uses knowledge of source emissions and sensitive receptor locations, couple with mechanisms for pollutant transport, to locate measurement sites.

    a. Random sampling
    b. Systematic sampling
    c. Judgmental sampling
    d. Spatial uniformity

18. _____ relies on a numerical or analytic model to estimate particulate concentrations in space and time.

    a. Geographic variation
    b. Linear programming
    c. Modeling
    d. Principal component analysis

19. The upper limit of the mass concentration range is determined by _____

    a. Filter size.
    b. Filter mass loading.
    c. Impactor velocity.
    d. Temperature and humidity conditions.

20. Which series of steps for MPA definition is correct?

    a. Identify Political Boundaries of Populated Areas; Identify Natural Air Basins; Locate Existing Air Quality Monitoring Sites; Revise Existing Planning Areas to Match MPA Boundaries

    b. Identify Political Boundaries of Populated Areas; Identify Natural Air Basins; Reconcile Boundaries with Existing Planning Areas; Examine Data from Existing Sites for Confirmation of MPA Designation

    c. Identify Political Boundaries of Populated Areas; Identify Natural Air Basins; Locate Existing Air Quality Monitoring Sites; Reconcile Boundaries with Existing Planning Areas

    d. Identify Political Boundaries of Populated Areas; Identify Meterological Patterns; Locate Existing Air Quality Monitoring Sites; Reconcile Boundaries with Existing Planning Areas

21. MPAs are required to correspond to all metropolitan statistical areas with populations ____.

    a. less than 100,000.

    b. greater than 100,000.

    c. less than 200,000.

    d. greater than 200,000.

22. True or false? Initial CMZ boundaries should be modified to better represent exposure to nearby source emissions from commercial, residential, industrial, and other emissions.

    a. True

    b. False

23. If measurements of $PM_{2.5}$ are not available to examine PM concentrations, what measurements should be used (ideally) instead?

    a. PM_{10}

    b. Visibility

    c. Sulfur Dioxide

    d. Ozone

24. Which series of steps for CMZ designation is correct?

    a. Locate Emssions Sources and Population; Identify Meteorological Patterns; Compare PM Concentrations; Adjust CMZs to Jurisdictional Boundaries; Modify MPA to Coordinate with CMZs

    b. Identify Meteorological Patterns; Compare PM Concentrations; Adjust CMZs to Jurisdictional Boundaries; Locate Sites; Modify MPA to Coordinate with CMZs

    c. Locate Emissions Sources and Population; Identify Meteorological Patterns; Compare PM Concentrations; Locate Sites; Adjust CMZs to Jurisdictional Boundaries

    d. Locate Emissions Sources and Population; Identify Meteorological Patterns; Compare PM Concentrations; Adjust CMZs to Jurisdictional Boundaries; Locate Sites

25. When determining compliance for NAAQS, it is critical to determine spatial homogeneity in

    a. designating MPAs.

    b. designating CMZs.

    c. Both

    d. Neither

26. Which of the following historical PM measurements is NOT valid as a basis for selecting CMZs?

    a. Spatial plots of maximum, annual, and seasonal average PM

    b. Pollution roses for hourly PM concentrations

    c. Annual maximum PM concentrations

    d. Time series plots of PM mass and selected chemical concentrations

27. True or false? A building which houses a coal furnace would be a good site for a NAMS monitor.

    a. True

    b. False

28. If an existing site within a CMZ does not meet the criteria for neighborhood or urban zones of representation, _____

    a. the monitor cannot be used to determine compliance and must be removed.

    b. the monitor can still be used for compliance with the 24-hour standard, but not for compliance with the annual standard or for spatial averaging.

    c. the monitor can still function as a background site.

    d. the monitor cannot be used to determine daily compliance, but can be used as a special purpose monitor site.

29. Which of the following is NOT a potential source of bias for particulate measurements?

    a. Unpaved roads

    b. Residential wood-burning appliances

    c. Freshly mowed lawns

    d. Large buildings

30. Monitors should be placed more than 20 m from nearby ___, and twice the difference in elevation from nearby ___.

    a. buildings, trees

    b. roads, buildings

    c. roads, trees

    d. trees, buildings

31. Core $PM_{2.5}$ sites should include which of the following:

    a. a population-oriented site with the highest expected community-oriented concentrations

    b. a population-oriented site with the lowest anticipated community-oriented concentrations

    c. a site with high population density with high air quality (low population exposure)

    d. all of the above

32. Which of the following site characteristics can serve as indices of stable monitoring conditions?

    a. Distance from nearby emitters
    b. Proximity to other measurements
    c. Both a and b
    d. Neither a nor b

33. Which section should be included in the State PM Monitoring Network Description?

    a. Community Monitoring Approach
    b. Transport and Background Areas
    c. Schedule and Responsibilities for Network Change
    d. All of the above

34. The State PM Monitoring Network Description document should contain an appendix for each MPA. Which of the following sections should NOT be included?

    a. Sampling Site Descriptions
    b. Special Purpose Monitoring Projects
    c. MPA Designation Justification
    d. Both b and c

35. A site originally selected to represent community exposure may have its zone of representation change due to

    a. redefinition of CMZ boundaries or MPA description.
    b. long-term changes in land use or short term events.
    c. both a and b.
    d. neither a nor b.

36. Which of the following is **NOT** related to the evaluation of zones of representation?

    a. Annual Site Surveys
    b. Records of Intermittent Events
    c. Saturation Monitoring Studies
    d. Temporal Behavior

37. Why should visual events be recorded as part of the measurement network maintenance?

    a. To ascertain if high PM_{10} or $PM_{2.5}$ concentrations may have corresponded to a specific event
    b. To aid in categorization of sources
    c. To help identify potential new emissions sources
    d. To track risk of monitor damage

38. To satisfy homogeneous air quality requirements, the sites' annual averages must be within _____ of the CMZ-wide average on an annual basis, be influenced by _____ sources, and be reasonably correlated on a _____ basis.

    a. 30%, similar, yearly
    b. ± 30%, similar, yearly
    c. ± 20%, different, daily
    d. ± 20%, similar, daily

39. True or false? The aerosol for all eligible sites in the CMZ should have similar chemical composition on an annual basis.

    a. True
    b. False

40. The estimated air quality pattern and _____ should support the placement of core monitors within a CMZ.

    a. Population density

    b. Geographic features

    c. PM_{10} levels

    d. None of the above