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EXECUTIVE SUMMARY

In the 1990 Clean Air Act Amendments (CAAA), Congress established a list of 188 toxic chemicals and designated them as Hazardous Air Pollutants (HAPs). As a part of the implementation of the CAAA, one of four key activities within the Air Toxics Program (ATP) of the EPA's Office of Air Quality Planning and Standards (OAQPS) is the National Air Toxics Assessment (NATA). Expanded air toxics monitoring is one of NATA's major activities, and will take the form of a National Air Toxics Monitoring Network. This report describes the results of initial data analyses aimed at examining an existing comprehensive archive of ambient measurements of air toxics. In total, analyses were conducted on millions of individual ambient measurements collected for more than a decade and across all 10 EPA regions. These preliminary results, along with modeling efforts and forthcoming analyses of data from the 10 city pilot study, are intended to provide important information for guiding the design of a National Air Toxics Monitoring Network.

> *Note: In view of the limitations of the existing data, this analysis cannot provide any definitive recommendations about network design. At best, the results: (1) provide examples of spatial and temporal variability based on several case studies, (2) describe the limitations in the current data base, (3) evaluate various statistical and graphical methods for analysis of air toxics data, and (4) provide some initial suggestions about network design. More specific recommendations must await completion of the analyses of the forthcoming pilot city data.*

A large number of preliminary network design recommendations based on numerous diverse data analyses are provided in Section 2 of this report. The beginning of each subsection within Section 2 has a clearly marked "box" containing specific network design recommendations, implications, and caveats. Please refer to Section 2 for these individual recommendations. Section 3 of this report provides an evaluation of the results of Section 2, leading to a broader set of overall preliminary recommendations for a National Air Toxics Monitoring Network. In general, two important themes were identified that appeared repeatedly: (1) appropriate network design depends on monitoring objectives and (2) consistency is critical to reducing uncertainties. The broad recommendations that follow incorporate these two themes, and are intended to address different monitoring needs across the range of scales that may be of concern to a National Air Toxics Monitoring Network.

As stated in the Air Toxics Monitoring Concept Paper, the three primary uses of (i.e., objectives for) ambient air toxics monitoring data are to:

- Characterize ambient concentrations in representative monitoring areas,
- Provide data to support and evaluate dispersion models, and

- Establish trends and evaluate the effectiveness of HAP reduction strategies.

Initial data analyses have revealed that these different objectives can lead to apparently conflicting monitoring needs. For example, consider bullet (3) by itself. Establishing accurate long-term, nationally-representative trends via monitoring requires a core network collecting highly consistent data over time. Collectively, the sites must be geographically distributed in a manner that appropriately represents the larger national scale. In particular, source-oriented locations are inappropriate for a national trends objective because they are too dependent on micro scale changes (e.g., control strategies at a particular facility, plant closings due to business cycle fluctuations, etc.). In contrast, source-oriented sites are quite appropriate for evaluating the effectiveness of local HAP reduction strategies (e.g., quantifying changes in ambient conditions in the vicinity of localized hot spots). Therefore, it is recommended that a nested approach be applied to designing the national air toxics monitoring network, in order to meet all of its objectives across the wide range of scales it is expected to address.

Specifically, start by dividing the problem into a larger national/regional scale component and a smaller urban/local scale component. Note, however, it is not clear at this time the degree to which the "national" network might commit resources to addressing issues at smaller more local scales. A very high level of consistency should be required for all facets of the national/regional component. While some core consistency throughout the urban/local component should be maintained, allow room for design flexibility as needed. To aid the design process, specify in advance the temporal endpoint(s) of primary concern at the different scales of concern. The annual average (and possibly quarterly averages) seems appropriate at the national/regional scale, and a range of shorter-term averages may be appropriate at the urban/local scale.

Some preliminary spatial recommendations: The data analyses show that monitoring needs at the local scale may, in some cases, conflict with national needs. An overall design similar to the $PM_{2.5}$ speciation network is recommended. Specifically:

- Establish a "core" set of air toxics monitoring stations that provide uniform data appropriate for addressing objectives on a national or regional scale. Attributes should include geographic representativeness, population-oriented and background sites (not source-oriented), a common suite of important (or most, or all) air toxics, use of common monitoring technologies (including consideration of a national laboratory depending on 10 city pilot study results), common reporting, and stability in the entire process over time (to the degree possible).

- Reserve sufficient resources (not yet determined) for additional air toxics monitoring stations that provide localized data appropriate for addressing different objectives on an urban or local scale. Outside of some basic consistency requirements with respect to monitoring and analysis methods, sampling attributes may vary depending on local

needs (e.g., greater frequency, better time resolution). To address the potential for data differences due to less consistency at the local level, incorporate sufficient Quality Assurance/Quality Control (QA/QC) elements to recognize and account for such differences.

- In areas where HAP concentration levels are **not** dominated by local emissions, very few monitoring sites (possibly only one) may be required to accurately characterize any given chemical compound's ambient concentration level at an urban area or similar spatial scale for an annual or longer time duration. To address more local assessment needs, in areas of concern that are dominated by particular local point sources, more monitoring sites are needed to capture the concentration gradients. Also, these sites may need monitoring with higher time resolution.

- Finally, it should be noted that the MATES-II study found that the use of mobile monitoring stations allowed them to target localized areas. These could be areas of public concern or areas of high concentration identified by modeling. The mobile monitoring also increased the geographic representativeness of the study. [See (South Coast Air Quality Management District 2000) in Appendix C.]

Some preliminary temporal recommendations: To aid in the network design process, the primary time average needs to be more clearly defined up front and should be associated with different scales of concern. Specifically:

- At the national/regional scale, specify the annual average endpoint (and/or possibly quarterly averages) to be of primary concern. (This recommendation is for design purposes only, it does NOT mean to imply that seasonal or quarterly averages are not of interest.) With the annual endpoint as the focus, the temporal resolution provided by 24-hour integrated samples, or even longer averages, is sufficient (provided the HAP is reasonably stable).

- At the urban/local scale, plan for a range of averaging endpoints to be of primary concern depending on urban or local scale needs, including 1-hour, 3-hour, 24-hour, or longer averages. To the degree that local characterization analyses require more resolved data, 24-hour integrated samples or longer averages are not sufficient.

- In most cases, a site-specific annual average concentration (for VOCs, carbonyls, and metals) can be estimated with 10-15 percent relative error or less using every third to every sixth day sampling. More frequent sampling (i.e., every third day) is recommended for higher concentration, source-oriented sites.

- While many HAPs do exhibit varying degrees of seasonality, sampling schedules that vary depending on season are not generally recommended for the national/regional scale component. The simpler approach of a uniform sampling schedule (i.e., 1:3 or 1:6 day sampling throughout the year) is recommended for estimating an annual average.

Some preliminary technology recommendations: Commonly used state-of-the-art monitoring technologies, such as the methods used in the 10 city pilot study or the Photochemical Assessment Monitoring Stations (PAMS) program, are expected to be sufficient to meet most national/regional scale and urban/local scale needs. This recommendation may not apply to all air toxics or all monitoring objectives. Specifically:

- At the national/regional scale, common methods are sufficient for precisely characterizing annual average concentrations, even at lower ambient levels and with a large percentage of non-detect data (e.g., up to 50 percent).

- At the urban/local scale, common methods of monitoring for carbonyls and VOCs are sufficient for precisely characterizing (<20% CV) 24-hour average concentrations when ambient levels are high enough (approximately >0.15 ppbv).

- The more common methods may not be adequate for all local needs. At lower ambient levels the analytical methods assessed do not always characterize ambient air toxics in a precise fashion. Alternative monitoring approaches may be necessary to sufficiently address certain objectives with low or trace-level concentrations. For example, laboratory methods that increase sample concentration might be considered for improving VOC analytical relative errors at lower ambient levels. Likewise, at the expense of temporal resolution, longer sample durations (> 24 hours) might be considered for improving carbonyl and metal relative errors at lower ambient levels.

- Additionally, at the local/urban scale, if a high time resolution is needed to establish or control potential acute concentration spikes, continuous or near continuous methods would be beneficial. Continuous methods can also serve to meet other primary and secondary monitoring objectives at both the national/regional and urban/local scales. However, since these methods are still being developed, there is not yet a historical record established on which to base more detailed recommendations.

Some preliminary leveraging recommendations: The general recommendation is that existing air toxics monitoring programs can and should be leveraged to build a national air toxics monitoring network in a cost effective manner. However, this approach must be pursued with caution, ensuring that appropriate QA/QC infrastructure is in place for assessing the usefulness and limitations of various data sources. Specifically:

- At the national/regional scale, combining data across many different programs is not recommended in light of the strong need for consistency at this scale. However, this does not mean that current resources could not be leveraged in this case. For example, the trends component of the $PM_{2.5}$ speciation network includes a core set of sites (~50) collecting speciated $PM_{2.5}$ HAP metals data. The overall geographic representativeness and individual micro scale siting requirements of these monitors may present an appropriate foundation of monitoring locations, and possibly data, for estimating trends in metals and other air toxics.

- At the urban/local scale, combining data across many different programs is not as much of an issue because there is somewhat less of a need for overall consistency from the local perspective. This viewpoint may allow for the incorporation of the data from many of the state and local air toxics programs currently in existence. It is likely that most of the data being generated by these individual programs is already appropriate for meeting local objectives. The challenge will be to assess the data's appropriateness for a national program. For example, part of the Quality Assurance Project Plan (QAPP) for a local program could include a demonstration of appropriateness. Some basic consistency, such as consistency in reporting, is essential.

Some preliminary siting recommendations: Two of the most important siting recommendations for monitors, as discussed in Section 2 of this report, are the need to use local emissions sources and local wind patterns in designing the air toxics network. Emissions and wind data are possibly the two most critical inputs to most air dispersion models. Thus, taking the Section 2 recommendations one step further, it is recommended that model predictions be used in the design of the national air toxics monitoring network. However, this recommendation must be coupled with the recognition that modeling exercises can be expensive and time consuming. If resources do not permit, a less intensive approach that is recommended is to use a GIS application to overlay/combine information on emissions sources and wind patterns, and possibly other factors (e.g., population, terrain, land use, etc.), to help site monitors. Specifically:

- At the national/regional scale, ASPEN model predictions may provide useful guidance for selecting broad areas to site monitors. Knowledge of where ASPEN predictions are highly uncertain might suggest areas in need of monitoring support. Knowledge of where ASPEN predictions are generally high or low might provide a means to ensure that a representative range of ambient conditions is characterized. However, the ASPEN model is too reliant on local scale spatial interpolations and approximations for it to accurately suggest exact coordinates in space for siting monitors.

- At the urban/local scale, use of dispersion models such as industrial source complex (ISC) models may be useful for selecting specific locations to site monitors. To obtain a coordinated set of receptor results for simultaneously considering alternative

urban/local network designs, a model should be applied across an air shed, urban, or similar spatial region. This could be a large undertaking. The use of existing model runs might be a useful option. Otherwise, the availability (or lack thereof) of resources for such an effort may be the determining factor as to whether such an approach can be taken.

- The full range of implications and detailed suggestions for particular modeling applications are not within the scope of this report. Rather, the analyses in this report point out the need for examining emissions inventories and local meteorology, and then considering them in the network design. Detailed suggestions for the applications and additional study are currently being drafted by EPA and ICF. (See Rao 2001 and Cohen and Rosenbaum 2001.)

***Some caveats*:** Note that a great deal of effort was made to maximize the validity of every data analysis summarized in this report. In particular, (1) archive data were often restricted or thrown out due to a lack of quality or completeness; (2) a literature search was conducted in an attempt to identify corroborating evidence; (3) an assessment of the certainty in the conclusions was typically made; (4) results were qualified with respect to the overall representativeness of the conclusions; and (5) caveats are included along with the recommendations provided throughout the report.

Nonetheless, the results must be viewed with an appropriate level of caution. Results are based mostly on the air toxics data archive, which is derived from a host of programs with different objectives, monitoring methods, reporting units, reporting requirements, and quality. Some of these uncertainties are uncovered when matching the different archive sub-data sets. Others are revealed during quality/completeness assessments or actual data analyses. Yet, there are undoubtedly other sources of error that do not get noticed. Further, there is often uncertainty in the results due simply to the fact that the existing database is not representative of a complete range of environmental or other conditions. This is not to say that the archive data are suspect, but rather that users need to be cautious in its use and interpretation.

Ideally, air toxics data analyses and associated conclusions should be based on a database derived from a well-designed network or study with clear objectives and consistent components; hence, the need for a National Air Toxics Monitoring Network. It is expected that the 10 city pilot study data will be of this nature. Therefore, the data analysis results to date, summarized in this report, are considered preliminary until more definitive evidence for network design recommendations is uncovered via data analyses of the pilot data. Specifically, the pilot data will be analyzed to refute or support and otherwise further the results and network design recommendations presented in this report.