Section 4 - NCore Network

4.1 Introduction and Objectives

The NCore network is both a repackaging and enhancement of existing networks. The emphasis on the term "Core" reflects a multi-faceted role of national networks that can be complemented by more specific applications, such as intensive field campaigns to understand atmospheric process dynamics, or personal and indoor measurements to assess human exposure. The NCore term basically replaces the more common NAMS/SLAMS terminology and attempts to more effectively leverage all of the major existing networks to produce a more integrated multiple pollutant approach to air monitoring. Additional new measurements are proposed that foster a multiple pollutant measurement approach intended to address current and future data needs. Such measurements would replace existing ones that either do not have the measurement sensitivity attendant with current atmospheric concentrations, or have reached a point of strongly diminished value.

The overall structure of NCore is described in some detail below and is based on a tiered system of measurements referred to as Levels 1, 2, and 3, ranging from most complex near research grade sites (Level 1) to sites more typical of the existing NAMS/SLAMS network with as few as one measurement parameter. The NCore Level 2 sites represent a new network element which specifically requires the co-location of multiple air pollution measurements at 75 or more sites nationwide.

NCore provides an opportunity to address new directions in monitoring and begin to fill measurement and technological gaps that have accumulated in the networks. The Strategy recognizes that there are both nationally and locally oriented objectives in monitoring that require different design approaches despite our best attempts at leveraging resources and maximizing versatility of monitoring stations. NCore takes a more proactive approach at addressing national level needs that often had to make the most of available data sources, regardless of their design basis. NCore addresses the following objectives:

- **Timely reporting of data to public** by supporting AIRNow, air quality forecasting and other public reporting mechanisms

- **Support for development of emission strategies** through air quality model evaluation and other observational methods

- **Accountability of emission strategy progress** through tracking long term trends of criteria and non-criteria pollutants and their precursors

- **Support for long-term health assessments** that contribute to ongoing reviews of the NAAQS

- **Compliance** through establishing nonattainment/attainment areas through comparison with the NAAQS

- **Support to scientific studies** ranging across technological, health, and atmospheric process disciplines

- **Support to ecosystem assessments** recognizing that national air quality networks benefit ecosystem assessments and, in turn, benefit from data specifically designed to address ecosystem analyses.

All of these objectives are equally valued, a departure from a historical emphasis on compliance where the NAMS/SLAMS networks was viewed principally as a "NAAQS comparison" network. That is not to imply that NCore is a research grade network, as the measurements generally are produced through routine operations conducted by most monitoring organizations. The underlying philosophy adopted in NCore is that regulatory assessments are strengthened through a more comprehensive measurement approach that is well integrated with scientific applications and, in turn, science and research efforts become more focused and effective from taking on a program relevancy perspective.

NCore should be viewed as a core structure or network backbone that provides a basic group of data that are needed to support a broad spectrum of objectives and analyses (Table 4-1). It is important to point out that, by itself, NCore cannot meet all of the data requirements for most assessments. There always will be necessary additions to flesh out the specific spatial, temporal and compositional parameters suited for a particular analysis. Accordingly, it is appropriate to view NCore as a main trunk of information, upon which the necessary branching of specific monitoring needs can be added. The NCore design assumes that pollutant measurements inherently serve multiple data needs and, therefore, network efficiencies are enhanced through collocating measurements. Relatedly, a tension exists between designing for a specific data objective versus taking a more holistic design approach that risks a dilution of attention toward a specific need. Such caution must be acknowledged in communicating the limitations of a nationally designed network, and recognizing the equal importance of local and other program specific monitoring efforts that build off of a core design.

Table 4-1. Relationships Across NCore Measurement Levels and Data Objectives.		
Objective	**NCcore Level (Primary/Secondary purpose)**	**Example Analyses/Rationale**
Public Reporting	3/2 (continuous PM and ozone)	direct reporting through AIRnow
Emission strategy development	2/2 (trace gases, $PM_{2.5}$ spec., VOCs)	model evaluation, source apportionment and other observational models
Assessing effectiveness of emission reductions and AQ trends	2/3 (trace gases, $PM_{2.5}$ speciation, VOCs)	time series comparisons to emssions projections
Support health assessments and NAAQS reviews	2/3,1 (trace gases, O_3, PM (mass and species)	ambient input to exposure models; direct association analyses
Compliance (NAAQS comparisons)	3/2 $PM_{2.5}$, $PM_{(10-2.5)}$, ozone	point and spatial field comparions to NAAQS
Science support	1/2 (all)	methods evaluation, size distribution analyses, diagnostic analysis (model processes, particle formation)
Ecosystem assessment	2 (NOy, HNO_3, NH_3, O_3)	mass balance analysis, deposition calculations

4.2 NCore Design Attributes.

Much of this discussion addresses NCore Level 2 multiple pollutant sites that are a new addition to the nation's networks. The NCore Level 2 data objectives lead to a handful of very basic design attributes:

- **Collocated multiple pollutant measurements**. Air pollution phenomena across ozone, particulate matter, other criteria pollutants and air toxics are more integrated than the existing single pollutant program infrastructure suggests. From an emissions source perspective, multiple pollutants or their precursors are released simultaneously (e.g., combustion plume with nitrogen, carbon, hydrocarbon, mercury, sulfur gases, and particulate matter). Meteorological processes that shape pollutant movement, atmospheric transformations and removal act on all pollutants. Numerous chemical/physical interactions exist underlying the dynamics of particle and ozone formation and the adherence of air toxics on surfaces of particles. The overwhelming programmatic and scientific interactions across pollutants demand a movement toward integrated air quality management. Collocated air monitoring will benefit health assessments, emission strategy development, and monitoring. Health studies with access to multiple pollutant data will be better positioned to tease out confounding effects of different pollutants, particularly when a variety of concentration, composition and population types are included. The tools for strategy development (e.g., air quality models and source attribution methods) benefit by performing more robust evaluations (i.e., by checking performance on several variables to ensure the model produces results for correct reasons and not through compensating errors). Just as emission sources are characterized by a multiplicity of pollutant releases, related source apportionment models yield more conclusive results from use of multiple measurements. Multiple measurements streamline monitoring operations and offer increased diagnostic capabilities to improve instrument performance. In addition, as we move aggressively to integrate continuous PM (e.g., both mass and speciation) monitors in the network, it is important to retain a number of collocated filter and continuous instruments as the relationships between these methods now are subject to future changes brought on by modifications of aerosol composition (e.g., as nitrate replaces sulfate, assuming proportionally greater sulfur reductions, as the major inorganic component, aerosol sampling losses due to volatility may increase at different rates dependent on instrument type). Given that we cannot measure everything everywhere within a constrained resource environment, a natural conflict arises between the relative value of spatial richness versus multiple parameters at fewer locations. This Strategy assumes that there is a geometric increase in value attained from combining measurements at a single location, as opposed to spreading out single measurements in a very rich spatial context.

- **Emphasis on continuously operating instruments**. Continuous systems allow for immediate data delivery through state-of-the art telemetry transfer and support reporting mechanisms such as AIRNow, and critical support for a variety of public health and monitoring agencies charged with informing public on air quality. Continuous data add considerable insight to health assessments that address a variety of averaging times, source apportionment studies that relate impacts to direct emission sources, and air quality models that need to perform adequately over a variety of time scales to increase confidence in projected emissions control scenarios.

- **Diversity of "representative" locations,** across urban (large and medium size cities) and rural (characterize background and transport corridors) areas. National level health assessments and air quality model evaluations require data representative of broad urban (e.g., 5 to 40 km) and regional/rural (> 50 km) spatial scales. Long term epidemiological studies that support review of national ambient air quality standards benefit from a variety of airshed characteristics across different population regimes. The NCore sites should be perceived as developing a representative report card on air quality across the nation, capable of delineating differences among geographic and climatological regions. While "high" concentration levels will characterize many urban areas in NCore, it is important to include cities that also experience less elevated pollution levels or differing mixtures of pollutants for more statistically robust assessments. It also is important to characterize rural/regional environments to understand background conditions, transport corridors, regional-urban dynamics, and influences of global transport. Air quality modeling domains continue to increase. Throughout the 1970's and 80's localized source oriented dispersion modeling evolved into broader urban scale modeling (e.g., Urban Airshed Modeling for ozone) to regional approaches in the 1980's and 1990's (e.g., Regional Oxidant (ROM) and Acid Deposition (RADM) Models to current national scale approaches (Models 3- CMAQ) and eventually to routine applications of continental/global scale models. The movement toward broader spatial scale models coincides with increased importance of the regional/rural/transport environment on urban conditions. As peak urban air pollution levels decline, slowly increasing background levels impart greater relative influence on air quality. Models need to capture these rural attributes to be successful in providing accurate urban concentrations.

These design attributes differ from historical approaches that emphasized maximum concentration locations, often dependent on a particular pollutant. Those perspectives remain valid from a local perspective and need to be addressed through elements of NCore Level 3 measurements as well as through the more discretionary monitoring conducted outside the scope of NCore.

4.3 NCore Measurement Levels.

NCore would be structured as a three tiered site classification (Levels 1-3, Figure 4-1) based on measurement complexity, ranging from most (Level 1) to least (Level 3) complex site classification. A range of 3 - 6 Level 1 "master" sites would serve a strong science and technology transfer role for the network. Approximately 75 Level 2 sites would add a new multiple pollutant component to the networks with a minimum set of continuously operating instruments that in many areas would benefit from placement at existing PM speciation, PAMS and air toxics trends sites. Level 3 sites are largely single pollutant sites, emphasizing the need for spatially rich network in the most ubiquitous criteria pollutants (i.e., $PM_{2.5}$ and ozone) and addressing an assortment of compliance related needs. Note that the pyramid depiction reflects a continuum of gradient site complexities. The levels only establish minimum monitoring expectations. Realistically, there will exist a diversity of site complexities that do not fit conveniently into a 3-level scheme. Across the board, agencies are encouraged to enhance the number of measurement parameters at all stations, including Level 3, which has a minimum requirement of a single pollutant measurement.

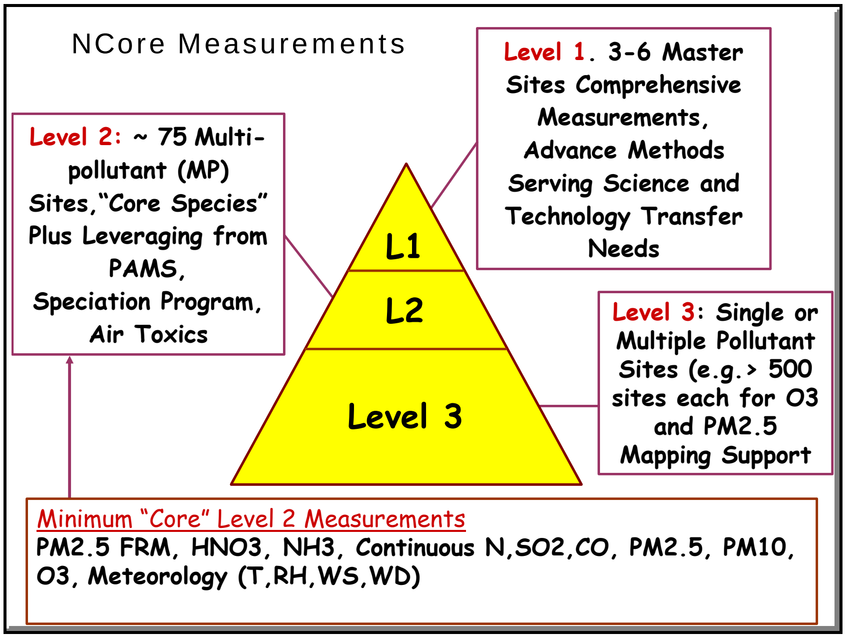

Figure 4-1. Components of NCore

4.3.1 Level 1. A small number (3-6) of Level 1 (master) sites would include the most comprehensive list of routine measurements (i.e., the most complete Level 2 site with PAMS, PM speciation and air toxics trends), research level measurements with potential for routine application (e.g., PM size distribution, continuous nitric acid and ammonia, true NO_2), and additional measurements dependent on area specific priorities, available expertise, and resources. These sites would serve three needs: (1) a comprehensive suite of measurements providing the most insightful of all routine air monitoring networks; (2) a technology transfer mechanism to test emerging methods at a few locations with disparate conditions that eventually would find more mainstream application;[1] and (3) addressing a specific monitoring objective, such as providing a continental U.S. background site, international trans-boundary transport site, or support ambient methods testing. Consideration should be given to establishing three sites initially that focus on methods/technology transfer in different regions of the nation and in locations that serve a critical spatial need such as characterizing inflow or outflow of transcontinental transport, a true background location within the continental United States or a major intra-continental transport location (note that the NCore Level 2 sites may be more appropriate in addressing transport).

The Level 1 sites need not be considered as only fixed sites operating indefinitely like the NCore Level 2 sites which have a trends and program accountability objective. As a program, Level 1 should be instituted as a base component with stable funding for an indefinite period

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[1]True nitrogen dioxide measurements should be part of routine operations; however, field testing and demonstration efforts must precede application in routine networks. Consideration for routine applications should be given to other measurements such as continuous ammonia, nitric acid, and particle size distributions.

recognizing the importance of the dynamic interaction between research grade and routine monitoring networks. However, it may be more prudent to view Level 1 sites as having a short term or even a mobile role where, for example, dedicated, intensive measurements are conducted for a 1-3 year period in a particular location and perhaps rotated to another location with a built-in period assessment prior to each new deployment. Such an approach would be compatible with the joint NOAA-EPA proposed urban collaboration studies that seeks to conduct intensive studies linking sources to human welfare effects.

These Level 1 sites are an exception to the earlier analogy where NCore replaces the NAMS/SLAMS nomenclature. A more appropriate association places Level 1 sites as a replacement for the current $PM_{2.5}$ Supersites program. Administratively, resources for Level 1 sites would not be derived from existing STAG program that supports most routine monitoring. Separate, and as yet unidentified, dedicated internal EPA funding needs to support the Level 1 sites, as in the Supersites program.

There is a clear need for a dedicated testing program. Over the last ten years, EPA's ORD has decreased its level of methods development and testing to a point where it no longer is considered a leader in this field. Methods testing now is conducted through a rather loose collection of State sponsored trials (especially California's Air Resources Board), vendor sponsored initiatives, miscellaneous research grants and agreements to universities (e.g., PM Supersites and health centers) combined with a skeleton level effort of internal EPA testing. The Supersites program does fulfill some of the needed technology transfer needs, but is of short duration and mostly focused on broad array of particle characterization issues in addition to technology testing. Level 1 sites would be one component addressing this national level weakness that needs attention. State agencies cannot continue to be burdened with being "trial" testers of new methods. More importantly, we can not afford to lose the opportunities in greatly enhanced data value that emerging technologies present. Where it is appropriate to do so, Level 1 sites may be situated at a cooperative Level 2 site. In such situations, the Level 2 site responsibilities would be operated by a host agency, and the augmented monitoring to comprise a Level 1 stature would be operated by the entity (e.g., EPA contractor) responsible for that specific monitoring. Clearly, for such an arrangement to occur, there would need to be ample space, power, and security to accommodate both monitoring functions.

4.3.2 Level 2. Level 2 measurements represent the mainstream multiple pollutant sites in the network and best reflect the design attributes discussed above. The approximate total number of sites (75) as well as proposed measurements are modest recommendations that attempt to balance total network growth while introducing a manageable realignment in the networks. Site locations will be based on design criteria that also balance technical needs with practical considerations, such as leveraging established sites, maintaining geographic equity.

The minimum recommended measurements (Table 4-1), mostly through near continuous monitors reporting at 1-hr intervals or less, include gaseous sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen oxide and total reactive nitrogen (NO and NOy)[2], ozone (O_3); and particles with size cuts less than 2.5, between 2.5 and 10 µ, ($PM_{2.5}$) and ($PM_{10-2.5}$), respectively. Additional parameters include filter based $PM_{2.5}$ (with FRMs) and basic meteorological parameters, including temperature, relative humidity, wind speed and direction. In addition, integrated nitric acid and ammonia samples will be collected through denuders for subsequent laboratory analysis. While these parameters include most criteria pollutants except nitrogen dioxide [NO_2], and lead [Pb], they are not chosen for compliance purposes. They represent a robust set of indicators that support multiple objectives, including accountability, health assessments, and emissions strategy development (e.g., air quality model evaluation, source apportionment and numerous observational model applications). In most cases, these minimum measurements will be accompanied with existing measurements. For example, aerosol sulfate from the speciation program combined with gaseous SO_2 provides valuable insight into air mass aging and transformation dynamics.

The continuous PM measurements are not expected to use FRM monitors, recognizing that currently, no $PM_{2.5}$ continuous monitor has equivalency status. The reason for specifying continuous methods for PM has been addressed at length. $PM_{10-2.5}$ measurements have been included in anticipation that EPA will promulgate a new PM NAAQS that include requirements for measuring $PM_{10-2.5}$. In addition, the inclusion of $PM_{10-2.5}$ as part of a suite multiple pollutant measurements supports health studies and emission strategy development. As a peripheral benefit, the presence of co-located integrated and in-situ continuous aerosol methods will provide a continuing reference check for the performance of continuous instruments and address some of the network collocation requirements to meet Regional Equivalency (Section 6). Collocation with FRMs is an important component of the $PM_{2.5}$ continuous implementation strategy as the relationship between FRMs and continuous monitors drives the integration of these systems. These relationships will vary in place and time as a function of aerosol composition (e.g., gradual evolution of a more volatile aerosol in the East as carbon and nitrate fractions increase relative to more stable sulfate fraction). Continuous PM measurements have the potential to produce measurements more representative of true environmental conditions, relative to filter based FRM. As the aggressive deployment of continuous PM monitors advances, the “reference” network that underlies future health effects studies will reflect the shift to continuous monitors.

4.3.3 NCore Level 2 Measurement Issues. The philosophy for the Level 2 measurements is to use commercially available, reasonably priced continuous instruments that are not considered research grade or laboratory bench operations. Admittedly, the list of new measurements include trace gases which pose challenges which may not be viewed as classic

[2] NO and NOy are chosen as they provide indicators for relatively fresh (NO) and aged (NOy) emissions. They serve as a critical tool in accounting for progress in large scale nitrogen emission reduction programs (e.g., Nox SIP calls and Clear Sky Initiative, CSI), provide input for a variety of observational based and source apportionment models, and assist evaluation of air quality models. True nitrogen dioxide, NO_2, should be added as a core measurement. However, the lack of affordable and routinely operational instrumentation prevents such a recommendation at this time.

research level operations yet, nevertheless, require a level of attention not typically associated with routine monitoring. With respect to the trace gas measurements, they are of such national importance that they simply need to be adequately characterized in the ambient atmosphere. The expectation that the efficiencies gained from locating multiple instruments and enhancing the Information Transfer Technology capabilities, such as frequent zero baseline adjustments, at monitoring platforms will somewhat offset the operational burden. The introduction of ammonia and nitric acid through denuder extractions is not expected to significantly increase operator burden or capital expenses. The approach will be to start the NCore Level 2 sites with fairly simple denuder systems that include acid and base denuders operating under low flow for a monthly averaging period. Consequently, the total cost per site amounts to 12 laboratory extractions and associated analysis costs which will be roughly an order of magnitude less cost relative to other pollutant measurements, with minimal operator burden relegated to monthly cartridge replacement and associated mailing to a central laboratory. The NCore Level 2 network is to be phased over 3 years with 2005 considered as a pilot to work out many unanticpated problems and take appropriate corrective actions. Additional discussion on methods issues is covered in Section 6, quality assurance and training in Section 7, and related implementation and funding issues in Section 11.

Table 4-1. NCore Level 2 Core Parameter List.

Measurements	**Comments**
$PM_{2.5}$ speciation	OC/EC fractions, major ions and trace metals (24 hour average; every 3rd day)
$PM_{2.5}$ FRM mass	typically 24 hr. average every 3rd day
continuous PM2.5 mass	1 hour reporting interval for all cont. species
continuous $PM_{(10-2.5)}$ mass	in anticipation of $PM_{(10-2.5)}$ standard
ozone (O_3)	all gases through cont. monitors (except HNO_3 and NH_3)
carbon monoxide (CO)	capable of trace levels (low ppb and below) where needed
sulfur dioxide (SO_2)	capable of trace levels (low ppb and below) where needed
nitrogen oxide (NO)	capable of trace levels (low ppb and below) where needed
total reactive nitrogen (NOy)	capable of trace levels (low ppb and below) where needed
ammonia (NH_3)	through denuders; 12 samples per year @monthly average
nitric acid (HNO_3)	through denuders; 12 samples per year @monthly average
surface meteorology	wind speed and direction, temperature, pressure, RH

4.3.4 Future NCore Level 2 Measurements. The minimum recommended NCore Level 2 measurements reflect a balance across a constrained resource pool, available monitoring technologies, and desired measurements. Consideration should be given to introducing additional Level 2 measurements at selected sites in the future. Examples of nationally important measurements that support multiple objectives include true nitrogen dioxide, continuous nitric acid and ammonia gases and particle size distributions. Consideration also should be given to routine particle size distribution measurements at selected locations. As multiple pollutant stations, NCore sites should over-design for space and power consumption with the expectation of additional future measurements. Such over-design will encourage collaboration between research scientists and government agencies as NCore Level 2 sites should accommodate periodic visits from health and atmospheric scientists that may conduct specialized intensive sampling.

4.3.5 Level 3. The Level-3 sites are the most numerous of the three tiers, but are focused generally on the more important criteria pollutants. These augment the Level-2 site network, and are sometimes referred to as "adjunct sites." Primarily dedicated to defining needed information for nonattainment areas, many of the Level-3 sites will still be single-pollutant, and mainly targeted to PM and ozone. Such sites will help define the nonattainment areas and boundaries, monitor in areas with the highest concentrations, the greatest population exposure, provide information in new growth areas, meet SIP needs, and evaluate local background conditions. It is expected that over 1,000 such monitoring sites will be part of the Level-3 network, many of them already functioning as part of the current air monitoring program. Although Level 3 sites may be required to include a minimum of one pollutant measurement, co-location of measurements is strongly encouraged at these sites.

4.3.6 Local, Flexible Component. In addition to the three NCore Levels, there is also a local, flexible component to the Strategy. This part recognizes that there are specific local needs which need to be addressed with air monitoring. Local considerations include such things as addressing environmental justice concerns, air toxics "hot spots," community concerns, local source impacts, political considerations, and a host of other elements which can be important on a local level. By incorporating this flexible part of the overall monitoring structure, both national and local needs can be addressed. In many situations, monitoring conducted for local needs can also be of value from a national perspective. Thus, SLT's are encouraged to utilize available monitoring funding, after Level 2 and 3 requirements have been met, toward local needs.

4.4 NCore Siting

The siting goal for Level 2 NCore sites is to produce a sample of representative measurement stations to service multiple objectives. Siting criteria include:

- **Collectively**
  - approximately 75 locations predominantly urban with 10-20 rural/regional sites
  - *urban:* a cross section of urban cities, emphasizing major areas with a population greater than 1 million; but also including mix of large (0.5 to 1.0 million) and medium (0.25 to 0.5 million) cities with geographically and pollutant diverse locations suitable as reference sites for long term epidemiological studies

- *rural:* capturing important transport corridors, including national, continental, and intercontinental scales, and regionally representative background conditions. In addition, some sites should allow for characterizing urban-regional coupling (e.g., how much additional aerosol does the urban environment add to a larger regional mix).

- **Individual site basis**

  - “representative” locations not impacted by local sources (urban sites, 5-40 km; rural sites, greater than 50 km)

  - leverage with existing sites where practical, such as the speciation, air toxics, PAMS, and CASTNET trends sites.

  - consistency with collective criteria..(i.e., does the selected site add holistic network value)

  - other factors (e.g., resource allocation, Tribal representation).

4.4.1. Guidance for Site Selection and Site Allocation Proposal.

a. Broad-based technical guidance. Level 2 network design is initiated by considering a cross-section of urban locations to support long term epidemiological studies, with subsequent addition of rural/regional locations to support national air quality modeling evaluation and emissions strategy accountability assessments, followed by a practical mapping of these general locations with existing sites, and an equitable/objective allocation scheme. This sequential approach is captured in Figure 4-2. Nearly 80 “representative” air quality regions that group populations based on statistical and geographic factors form a cross-section of desired areas for long term epidemiological studies. An additional 24 rural locations are identified to support evaluation of the national Community Modeling Air Quality System (CMAQ). These locations can be compared with available site candidates from existing networks (e.g., PM speciation, PAMS type 2 and CASTNET) that were designed with “representative” siting conditions commensurate with NCore Level 2 criteria. This procedure provides a modest objective based reference to judge the adequacy of the site allocation process (see below).

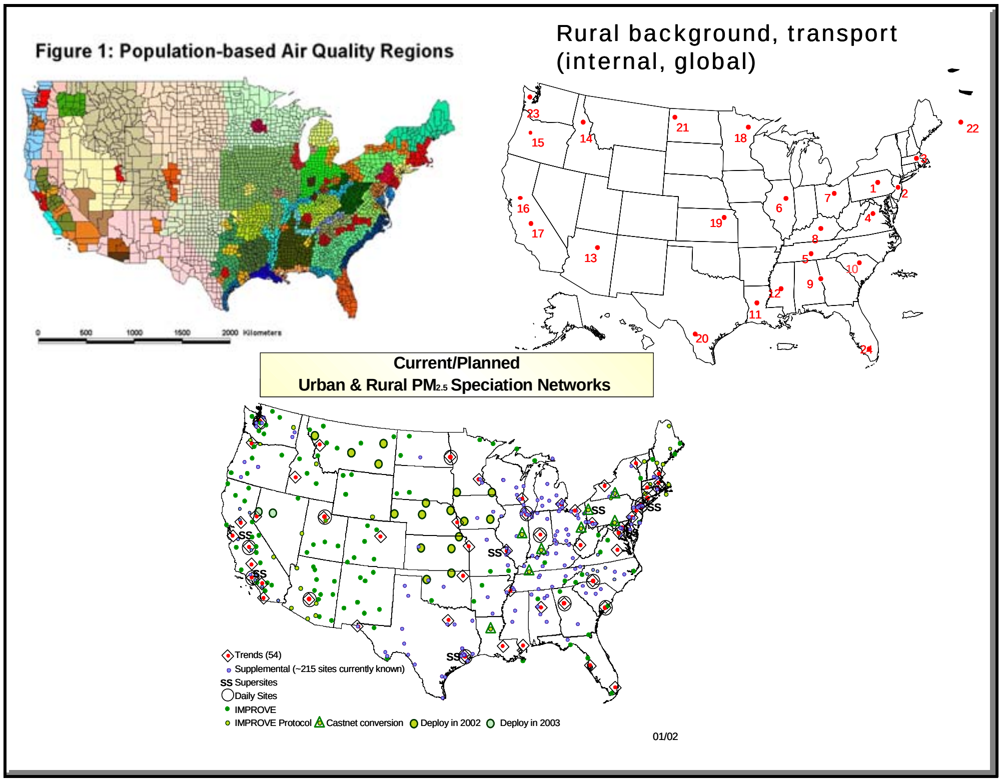

Figure 4-2. National maps providing initial broad scale siting guidance for NCore level 2 sites. The maps include recommendations based on supporting long term health assessments (top left) that emphasize an aggregate of representative cities and air quality mode evaluations that rely on rural background and transport locations (top right). Existing site locations in most cases will be used as NCore siting infrastructure (bottom).

b. Site allocation process. The allocation scheme (summarized in Table 4-2) is based largely on historical and political considerations (e.g.,one Level 2 site per state) that distributes monitoring resources based on a combination of population and geography, which in broad terms is consistent with several technical design aspects. Technical guidance sets a framework for assessing the development of NCore, while the allocation scheme provides a process for facilitating implementation. This allocation scheme provides a sweeping range of metropolitan areas. Clearly, the allocation must be flexible enough to ensure that sites add meaningful value and avoid redundancies. Suspected shortcomings in the proposed allocation scheme that need to be reconciled include, for example, a lack of rural locations in CA, lightly populated Western states that may not provide a meaningful rural location, multiple Florida locations with generally moderate air quality due to marine influences, and possible redundant locations along the East Coast and Midwest. Level 2 sites will require approval by the EPA Administrator (or delegate), a means to insure that the collective national siting criteria are adhered to. An NCore design committee will be constituted to site locations and facilitate site selection approval.

Table 4-2. Proposed NCore Level 2 Site Allocations.					
	Total	**Major Cities > 1.0 M**	**Large Cities 0.5 - 1.0 M**	**Medium Cities 0.25 - 0.5 M**	**Rural**
1 per State minimum	50	TBD	TBD	TBD	TBD
added 2 in most populated states (NY, CA, TX, Fl)	8	TBD	TBD	TBD	TBD
added 1 in each second tier populated States(OH, IL, PA, MI, NC)	5	TBD	TBD	TBD	TBD
additional rural sites	12	TBD	TBD	TBD	TBD
total	***75***	***32***	***13***	***10***	***20***
Note: allocation does not cover every major, large, medium sized city in United States; states lacking cities greater than 250,000 population can provide rural coverage					

c. Process for input into specific site locations. The number of sites and their distribution portrayed in Table 2 is only a first approximation that requires added input and consideration to reach decisions on actual site locations optimized to meet the NCore objectives. Site locations will be influenced by a combination of logistics associated with SLT capabilities and existing infrastructures, and input from SLTs and the health effects/exposure, atmospheric sciences and ecosystem assessment communities. OAQPS and the Regional Offices will serve largeley as facilitators for this siting effort. EPA Regional Offices will work with their States (including local agencies and Tribes) and RPOs to provide initial suggestions based on logistics and design considerations for which the States and Regional Offices are most familiar with. EPA OAQPS will solicit input from the research community through a combination of existing committee and organization structures and workshops and meetings as discussed in Section 11. There likely will be some iteration and negotiation involved in this outreach effort. The three year phased approach (Section 11) for implementation will allow for the necessary outreach and adjustments to start NCore Level 2 on the right track. Realistically, a set of NCore Level 2 site locations should be developed by April 2005.

d. Inter- and intra-continental transport sites. A subset of the rural NCore sites should be dedicated to characterizing inflow and outflow of a range of pollutants across United States borders. There is some difficulty in having SLTs assume operational responsibility for rural sites due to logistics associated with travel time and site access and the fact that rural sites tend to be more focused on serving a national or regional objective thus compromising some interest a local perspective. Some of these perspectives have been changed through RPO efforts. However, there likely will be a need to establish a dedicated pool of funding for international transport sites that may be operated by existing research or private institutions with the option for transfer to SLT organizations. Such sites should be viewed as a key component of the overall network changes and should not be compromised due incommensurabilities in existing funding arrangements.

e. Design concerns. Inevitably, there will be spatial coverage gaps given the limited number (75) of NCore Level 2 sites. This concern is balanced by the expectation that Level 2 sites are only minimum recommendations that serve as models for additional network modifications, not unlike the $PM_{2.5}$ speciation program where the majority of State SIP sites operate similarly to the National trend sites. While the proposed allocation scheme is based largely on population and existing EPA regions, the intention is to set the basic design goal and allow for regional flexibility to choose the most appropriate and practical locations. There are more overlaps in siting needs for the multiple objectives. For example, long term epidemiological studies are served by a cross-section of different cities with varying climates, source configurations, and air quality characteristics. Air quality model evaluations require similar locations, as well as proportionately more information on rural and background locations, along with vertical characterization of the atmosphere which is beyond the scope for NCore. Siting for accountability purposes benefits from “representative” locations but requires as much information in rural locations as urban locations, given the difficulty of separating source signals in urban environments (e.g., nitrogen in urban locations is dominated by mobile sources, whereas in selected rural locations, such as CASTNET sites, the emission signals from major utility sources are less effected by area wide sources).

f. Accurate site characterization data. There is an increased need to provide improved characterization of the spatial representativeness of monitoring sites. The importance of characterizing spatial representativeness is elevated as we try to promote spatial analysis techniques that attempt to resolve spatial gradients based on point measurements. The NCore Level 2 sites are being promoted as representing relatively broad spatial scales. Accordingly, these sites will require a dedicated effort to characterize their spatial representativeness. A key element of future network assessments should be a technically sound analysis through modeling or other means that establishes the average as well as some indication of variance as driven by topography and meteorology of spatial representation of a monitoring site.

4.4.2. Level 1 and 3 Siting

NCore Level 1 sites are an important bridge for technology transfer and corroboration between research and regulatory oriented organizations. Unfortunately, resource prospects for supporting these sites appear slim as they are not part of mainstream routine networks (like Levels 2 and 3) or research programs. These sites should include a range of representative locations across the nation. Candidate locations include existing supersites and other well developed platforms capable of accommodating large footprint for instruments with adequate power and security, such as co-location at an agency-operated Level 2 site. Consideration should be given to developing a rural-based master site, to ensure that technologies tested today can meet future conditions as concentration levels continue to decline.

Level 3 sites retain several NAMS/SLAMS attributes and require Regional Administrator approval. The subtle change incorporated in Level 3 is the recognition that mapping (e.g., AIRNow) and the production of pollutant concentration contours is a national level resource. Where possible, Level 3 sites should be optimized for multi-pollutant purposes, though not to the degree as required for a Level 2 site. For example, there may be opportunities to co-locate ozone and PM monitors without degrading the network information derived from having separate ozone and PM locations.

4.5 Relationship Between NCore and Existing Networks.

Excluding CASTNET and IMPROVE, the existing networks[3] largely consist of NAMS/SLAMS and special purpose/supplemental monitoring for criteria pollutants, PAMS, non FRM portions of $PM_{2.5}$ network (e.g., speciation, supersites and continuous mass) and air toxics. Most of these networks include a combination of prescriptive and less prescriptive monitoring based on relatively direct language in 40 CFR Part 58 of the monitoring regulations, or through specific guidance in the Federal 103/105 Grants. The more prescriptive aspects include NAMS (all criteria pollutants), $PM_{2.5}$ SLAMS, PAMS, speciation trends and the emerging air toxics national trends sites. Less prescriptive elements not included in the monitoring regulations (i.e., "local-flexible" component) include special purpose/supplemental monitoring, SLAMS (other than $PM_{2.5}$ mass), $PM_{2.5}$ speciation beyond trends, and a variety of air toxics sampling. Note that the estimated local fraction of resources for a particular program element is greatest for air toxics followed by $PM_{2.5}$ speciation (Table 4-3). While much of the SLAMS monitoring for criteria pollutants is not required in 40 CFR Part 58, over time the monitoring has taken on a "required" context associated with various Clean Air Act requirements (e.g., design value sites, maintenance plan provisions, new source review, miscellaneous arbitration).

A rough comparison of NCore with existing networks suggests:

Level 1- - PM supersites:

- Level 2 - - criteria pollutant NAMS, speciation trends, air toxics trends, PAMS site 2;
- Level 3 - - SLAMS criteria pollutants.

Several qualifying remarks are appropriate:

- The Supersites program is temporary and funding to transition into Level 1 master sites is not identified.
- Level 1 sites should be an integral long term network component, and operate with greater intersite consistency than the current Supersites.
- The minimum requirements determining criteria pollutant trends (analogous to NAMS) in most cases would be accomplished through Level 2 sites.
- It is expected that the majority of speciation trend sites will be selected as Level 2 sites.

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[3] not including CASTNET and IMPROVE; networks referred to are limited to those driven by Federal 103 and 105 Grants and operated by State/local agencies and Tribes that are more directly impacted by 40 CFR Part 58.

- The emerging national air toxics trend sites (NATTS) are being collocated at existing speciation sites (mostly trend sites) which in turn should emerge as formal NCore Level 2 sites.

- Note that major fractions of air toxics and PM speciation are not part of NCore and should be viewed as part of the "local" network.

- Approximately 50% of the remaining PAMS type 2 sites also serve as likely candidates for NCore Level 2, many of these already are collocated with speciation trend sites.

Table 4-3. Relationship Between Existing Networks and NCore

	NCore Level 1	NCore Level 2	NCore Level 3	Local	Other	Notes
PM Supersites	✓					lacking future funds
NAMS (CO, NO_2, O_3, SO_2, PM_{10}, $PM_{2.5}$)		✓				specified Level 2 $PM_{2.5}$, PM_{10}, NO/NOy do not use equivalent methods (assume each site has $PM_{2.5}$ FRM; cont. PM_{10} and $PM_{2.5}$ evolve into equivalent PMc)
SLAMS			✓			
PM speciation trends		✓			✓	assumes most (not all) trend sites are Level 2 locations
PM speciation (SIP)				✓		
Air toxic trends		✓				
Air toxics				✓		
PAMS type 2		✓		✓		unknown number of PAMS sites for Level 2
other PAMS				✓		

4.6 Utilizing NCore to Enhance Network Integration.

Initial reviews of the monitoring strategy suggest the need for greater integration into areas that extend beyond the traditional roles of routine networks operated by SLT's. More specifically, greater attention to ecosystem assessment support, coordination with intensive process oriented field campaigns, consideration of sites dedicated to inter-continental pollutant transport, and a linkage to a wealth of satellite data has been advocated by CASAC and the CENR. Initial steps taken to enhance such integration include adding ecosystem assessment support as a seventh NCore objective, and initiating a pilot study to to test new monitoring technologies in CASTNET with the goal of using CASTNET to fill certain rural NCore Level 2 spatial gaps and build on the established CASTNET connection to ecosystem oriented networks such as those under the umbrella of the National Atmospheric Deposition Program (NADP). Similarly, the recent addition of ammonia and nitric acid as NCore Level 2 measurements increases our ability to characterize nitrogen cycling which is relevant to watershed eutrophication and acidification assessments. The inclusion of Level 1 sites is an explicit attempt to foster partnerships with the research community. In addition to these small steps, more aggressive integration attempts should be pursued as NCore has the potential to provide a synergistic value much larger than the discrete measurements provided.

4.6.1 Sentinel Sites for International Transport. Strong consideration should be given to developing a close association with NOAA and other workgroups that address the technical issues with an international perspective to assist in the design and support of routinely operating "sentinel" stations. The primary objectives of these sites would be characterizing fluxes of key pollutants into and out of the United States. The NCore Level 2 parameter list would serve as a subset, or at least exhibit considerable overlap, of desired measurements from a transcontinental (and intra-continental) needs perspective.

4.6.2 Dedicated Emission Inventory Evaluations Sites. Over the last two decades there have been periodic efforts to evaluate components of emission inventories through well structured ambient data sets. Such efforts typically have included tunnel studies to evaluate the most recent Mobile source emission model or optical path approaches to capture the near tail pipe emissions from specific vehicles in real world conditions. Generally, there is no formal or routine program that allows for periodic evaluation of emissions through a linkage with ambient observations. While such a component may not fit neatly into the NCore model, it certainly merits consideration as part of an overall network re-engineering effort.

Mechanisms for addressing larger integration needs are discussed in the implementation plan (Section 11).