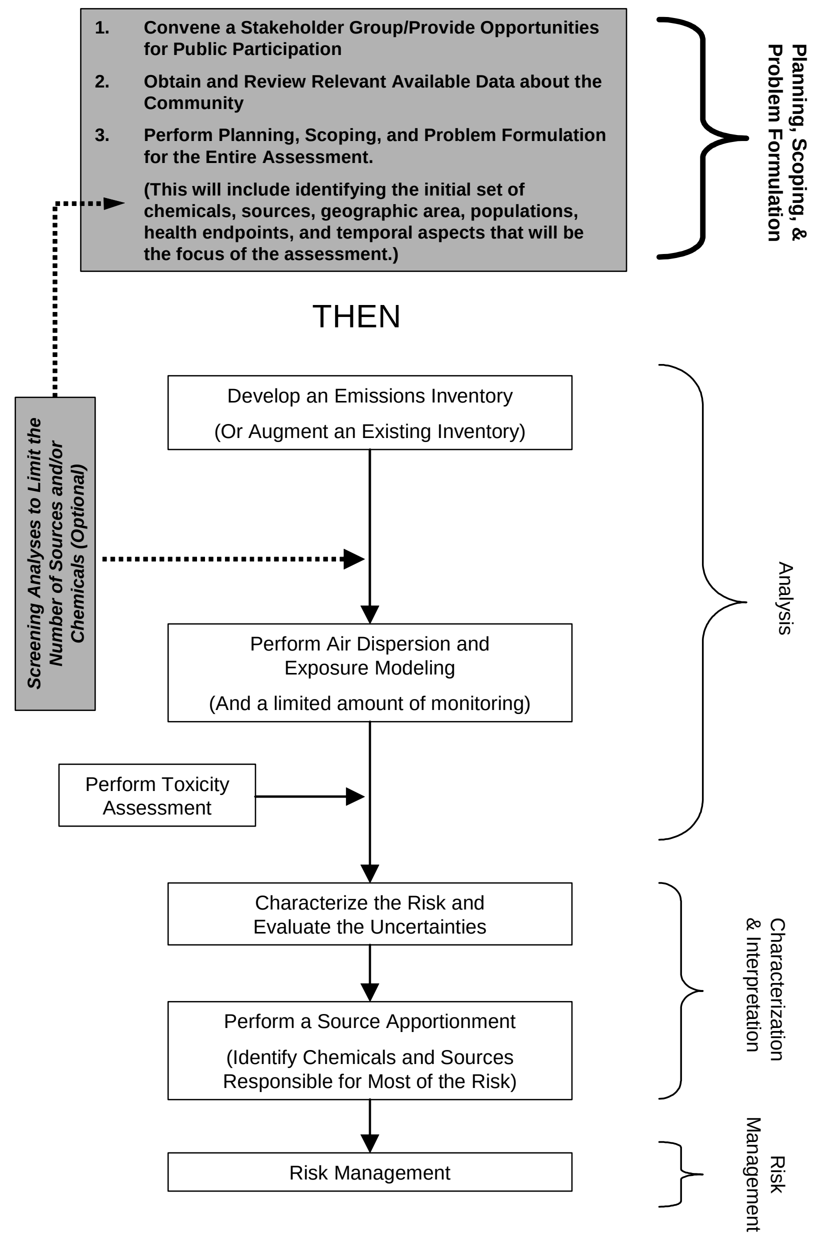
Chapter 4 Planning, Scoping, and Problem Formulation for a Multisource Cumulative Assessment

Table of Contents

4.0 Introduction

As introduced in Chapter 3, the three main phases of risk assessment are: (1) planning, scoping, and problem formulation; (2) analysis; and (3) risk characterization and interpretation. This chapter focuses on the first phase of the process – Planning, Scoping, and Problem Formulation (see highlighted portion of Exhibit 4-1).

Exhibit 4-1. The General Multisource Cumulative Air Toxics Risk Assessment Process for a Community Assessment - Focus on Planning, Scoping, and Problem Formulation



For a multisource community-scale air toxics assessment the process of planning, scoping, and problem formulation can move forward once the key stakeholders are engaged and the risk assessment technical team established. The discussion below is a summary of more detailed discussions in ATRA Volume 1 on these topics (Chapters 3, 5, and 6) as well as the *Community How To Manual* (Chapters 1 and 2),[1] and analysts are encouraged to review these chapters before proceeding. Additional discussions of planning, scoping, and problem formulation can be found in EPA's Risk Assessment Guidance for Superfund (RAGS): Volume I, Chapter 2.[2]

Good planning, scoping, and problem formulation at the beginning of the project is critical to the success of the overall effort because they clearly:

- Articulate the specific problem(s) that triggered the assessment and the questions it is intended to answer;
- Provide an evaluation of existing data to determine what is known about potentially important emission sources, chemicals, and exposures;
- State the quantity and quality of data needed to answer those questions to the satisfaction of the risk managers (the data quality objectives, or DQOs);
- Provide a detailed plan of how the assessment team will perform the analysis;

What You Should Know Before You Proceed

EPA's Science Policy Council has developed guidance that directs the Agency to take into account cumulative risk issues in scoping and planning major risk assessments and to consider a broader scope that integrates multiple sources, effects, pathways, stressors and populations for cumulative risk analyses in all cases for which relevant data are available.

Analysts performing a multisource cumulative assessment will find the following guidance documents helpful will performing planning, scoping, and problem formulation for a multisource inhalation air toxics risk assessment:

- *Framework for Cumulative Risk Assessment*
- *Guidance on Cumulative Risk Assessment. Part 1. Planning and Scoping*
- *Cumulative Risk Assessment Lessons Learned* Document

See: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=54944.

ATRA Volume 1, Chapters 5 and 6, also provide an overview of Planning, Scoping and Problem Formulation.

What Are Data Quality Objectives?

Qualitative and quantitative statements derived from the data quality objectives (DQO) process clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support the decisions. The DQO process is an example of "systematic planning" that assessors use to translate a decision maker's aversion to decision error into a quantitative statement of data quality needed to support that decision. This type of process is recommended when decision makers are using data to select between two opposing conditions such as determining compliance with a standard. To learn more about data quality in the air toxics risk assessment process, see ATRA Volume 1, Section 6.4. To learn more about EPA's quality program, including guidance documents on developing high quality data, see http://www.epa.gov/quality.

- Outline timing and resource considerations, as well as product and documentation requirements; and
- Identify who will participate in the overall process from start to finish and what their roles will be.

The planning, scoping, and problem formulation process also need to identify important gaps and uncertainties in existing data and the steps that will be needed to address these issues. Where the extent of data gaps and their potential impacts on the assessment are not fully understood, the planning, scoping, and problem formulation process may be iterative, with decision points specified during the analytical phase that are contingent on the results of data gathering efforts or sensitivity/uncertainty analyses.

The importance of good planning, scoping, and problem formulation cannot be overstated. Poor planning, scoping, and problem formulation will almost certainly lead to a multisource assessment that does not answer the correct questions, does not provide a supportable basis for decision making or development of supportable risk reduction strategies, and wastes significant amounts of time, resources, and good will.

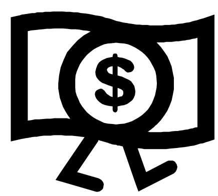
Planning, scoping, and problem formulation is composed of several functions, including:

- **Identifying "who needs to be involved" in the process.** Many different groups of people will probably be interested in the assessment, but not everyone will want to participate to the same degree. This step identifies the various interested stakeholders and ways to appropriately involve them in the process. The technical team that will actually perform the assessment is also identified as are the key customers of the assessment outputs (e.g., the key risk managers). A discussion of this topic is provided in Section 4.1. Additional information on community involvement can be found in Chapter 10.

- **Identifying the concern(s).** This step brings together all necessary stakeholders and tries to understand their concerns. At the end of this step, the partnership team should have identified the specific perceived problem (or set of problems) that they want to evaluate using the risk assessment process. Depending on the identified problems, a full multisource cumulative assessment process may not be necessary (e.g., the partnership team may opt for a screening-level assessment as described in EPA's *How To Manual* - see Section 3.5.1). In

Who's Going to Pay for All This Work?

All of the activities identified during the planning and scoping phase (and the concurrent activities to work with the community at large) will require resources. Money, in-kind services, and the partnership team's time will all be need to fuel the generation and analysis of data, work with community stakeholders (e.g., by holding meetings, hosting training opportunities, developing risk communication materials, etc.) and, in some cases, pay for implementing risk reduction activities. The amount of resources needed will, of course, vary from community to community and each stakeholder group will need to identify the best mix of public and private resources to fund their project. Section 10.2.2 of this resource document provides an overview of key resources the partnership team may which to consider to not only fund the analysis, but sustain the effort over time.



order to help identify and clarify the initial set of concerns, it will be important at this point to gather together and perform a preliminary evaluation of existing data about the community (such as existing demographic and emissions inventory data). A discussion of this topic is provided in Section 4.2.[a]

- **Establishing the scope of the assessment.** In a multisource inhalation community-scale assessment, all sources impacting the study area could theoretically be evaluated; however, time, money, access to expertise and information, technological limitations, and other factors may limit the ability of the technical team to perform a complete analysis. Thus, the partnership team will use this step to set limits on the risk assessment study. Specifically, they will obtain and evaluate existing data to help identify the sources and chemicals to be evaluated, the geographic limits of the study area, timing considerations, and the health endpoints to be considered in the risk characterization. A discussion of this topic is provided in Section 4.3.

- **Further clarifying the perceived problem and describing how it will be studied.** During the progression of the planning and scoping phase, the technical team, in conjunction with other appropriate stakeholders, creates both a pictorial representation and written description of exactly how the sources of interest may be contributing to exposures of potential public health concern in the community (the **conceptual model**) along with a detailed written plan of how they are going to study each piece of that model (the **analysis plan**). A summary statement of the perceived problem (the **problem statement**) clarifies for all the stakeholders what question(s) is being studied and how. Statements of what will not be studied may also be included to help avoid expectations not being met at the end of the project. A discussion of this topic is provided in Section 4.4.

4.1 Identify Who Needs to Be Involved in the Process

On occasion, a community scale multisource assessment will be performed by only a small group of researchers with little or no input from other stakeholders in the community. More commonly, the process of organizing, performing, and responding to the results of a multisource assessment will require the ongoing participation and input from a larger group of community stakeholders. In such cases, getting a community-scale assessment started will require upfront work to build a broad partnership team within the community, clarify the assessment goals, prepare a plan for conducting the assessment, and prepare a plan for communicating with and involving the community. This effort can be time consuming but is necessary to help ensure that the technical analysis of local air quality and risk reduction measures are successful in the long run.

EPA's *How To Manual*[1] stresses the importance of building and maintaining a partnership within the community in order to successfully complete a community-scale assessment. This section draws on the information provided in the *How To Manual* to briefly describe the importance of such a partnership, the process for building the partnership, potential roles and

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[a] This activity illustrates that the risk assessment process is not completely linear. For example, the analysis of available data will commonly have already been done (to some degree) prior to convening a stakeholder workgroup (since it was probably existing data that led to the multisource assessment effort in the first place). However, at the point of formal planning, scoping, and problem formulation, the stakeholder group will want to revisit these data sources to more carefully evaluate what they indicate about important emission sources, chemicals, and exposures in the study area.

responsibilities of the partnership members, needed skills, and suggested teams for conducting the assessment. ATRA Volume 1, Chapter 28, provides further background on community involvement.

The effort needed to understand and improve local air quality is complex and will require a wide range of skills and resources (Exhibit 4-2). No single sector of the community or government will commonly have the ability or resources to do this work alone. A stakeholder partnership, on the other hand, will have the ability to bring together the required resources, information, and skills that will be needed to reach an agreement on the questions to be studied, the goals of the assessment, the approach to be taken, and an effective plan for action once the assessment is complete. The partnership will also provide the means for different parts of the community to share ideas and develop the trust that will be necessary for joint action.

Some of the important skills that will be needed over the course of the project include:

- **Leadership**. Successful completion of the assessment depends on leaders with a clear understanding of the partnership's goals and direction and the skills to lead the community toward those goals.

- **Dialogue**. The willingness and ability to exchange information and to learn from others is essential to maintaining a functioning partnership.

Exhibit 4-2. Potential Recruitment Pools for Membership in a Local Partnership
• Community residents • Community civic, environmental, and economic development organizations and associations • Local business representatives, including those representing potential air toxics sources • Housing associations • Religious organizations • School staff • Community students and student organizations or environmental clubs • Youth organizations • Local library staff • Local and national business associations • Unions representing local employees • Colleges and universities, including college students and student organizations • Local government, including elected officials and agency representatives from health, environmental, planning, permitting, development, public works, parks, police and fire departments • State and tribal government agency representatives from transportation, environment, health and natural resources departments • Federal government agency representatives from environment, housing, energy, and transportation • National and state environmental organizations • Environmental justice organizations • Public health organizations • Local foundations concerned with the environment or public health

- **Technical knowledge and skills**. Members with the technical skills needed to conduct the analysis are critical. Fundamental skills generally include:

  - Data collection;
  - Air dispersion modeling;
  - Engineering;
  - Database management;
  - Toxicology; and
  - Risk assessment.

  The partnership may have access to this expertise directly (e.g., from government agencies, universities, local organizations, or community members) or may need the aid of consultants to perform the technical analysis. Once the risks have been evaluated, identifying and implementing meaningful risk reductions measures may require specialized expertise such as transportation planning, environmental engineering, and pollution prevention.

- **Communication**. Because the work of the partnership depends on community support and participation, the ability to explain the work of the partnership to the community is essential. This will require both communication skills and knowledge of the community. The ability to communicate the science used in the assessment to non-scientists is especially important. Stakeholders should begin the communication process as early as possible and continue throughout the process. The partnership may want to make the development of a communication strategy and plan one of its first priorities. ATRA Volume 1, Chapter 29, discusses the fundamentals of risk communication. Chapter 7 of this volume provides additional examples of communicating assessment results.

- **Organizational skills**. Logistics such as chairing meetings, keeping records, organizing community events and actions, developing budgets, handling and raising funds, and other related administrative skills will be needed over the course of the assessment.

- **Facilitation skills**. The ability to foster a process that will build trust, improve communication, clarify goals, and develop participation in the partnership is essential.

- **Ability and willingness to develop and implement risk reduction strategies** (including a willingness to compromise, when necessary and appropriate). Developing and implementing risk reduction strategies will require the active participation of the business community, technical experts, and community leaders. Active participation of individual community members will often be critical to successfully implement risk reduction strategies.

The strategy for getting a partnership started will be different for each community and will depend on factors such as the types of established organizations, the availability of technical resources, and local interest in air quality issues. The partnership may be formed as a part of, or separate from, existing community organizations.

A successful partnership for a multisource analysis will usually require an organization to take the lead and act as a consistent champion of working together to improve air quality. A small steering committee (commonly, around 20 members) will commonly lead, organize, and oversee the work described in this resource document (referred to here as the "partnership team").

The partnership team should include a balanced representation from as many different sectors of stakeholders in the community as possible. A broad representation will help ensure that all views are considered and that the partnership has access to the information and support needed for a successful outcome. A larger group of community members, or the entire community, would be expected to participate in activities organized by the steering committee by attending public meetings, providing input, and taking part in community activities to improve air quality.

Because the scope of partnership activities will depend on the specific assessment goals that are chosen, the tasks and membership in the steering committee may evolve as goals are clarified. At a minimum, the steering committee will need to do the following:

- Represent the views of the community residents, businesses, and other relevant organizations in partnership decisions;
- Exchange information so that all partnership members have the understanding necessary to participate fully in the work;
- Consider the views of all members of the partnership and work to develop a collaborative decision-making process;
- Participate, as appropriate, in the technical analysis of air quality;
- Help to communicate the work and results to the larger community;
- Help to develop and lead the implementation of an action plan to make improvements in air quality;
- Identify and obtain the resources to fuel the effort; and
- Help with group logistics such as organizing, chairing, and keeping meeting records.

The partnership team, augmented with other stakeholders, as appropriate, also acts as the Planning and Scoping Team. The Planning and Scoping Team should be comprised of all the people necessary to establish the assessment questions and goals, identify the data quality objectives for the project, and agree to the technical approach to be taken. At a minimum, this team must include both the risk assessors who will perform the work as well as the people who will be using the output of the risk assessment in the decision making process (the risk managers). Under this umbrella group, a number of topic-specific workgroups may be formed, including:

- **Risk Assessment Team** to direct the overall framework of the analysis and estimate exposures and risk;
- **Emission Inventory Team** to collect and organize emissions inventory data;
- **Modeling Team** to conduct air dispersion and/or exposure modeling;
- **Monitoring Team** to collect and analyze monitoring data;

- **Quality Assurance/Quality Control Team** to help establish data quality requirements, and audit technical analyses;

- **Recommendations Team** to decide whether the risks are acceptable or not and to develop risk reduction options (i.e., the risk managers);

- **Implementation Team** to implement selected risk reduction strategies and measure results; and

- **Communications Team** to be the primary interface with the community.

(Depending on the skills mix, these workgroups may combine functions, with the exact set of workgroups formed varying from study to study.)

What Level of Review Will the Risk Assessment Need?

In order to enhance the quality and credibility of risk management decisions, analysts should ensure that the scientific and technical work products underlying these decisions (the risk assessment, analysis plans, etc.) receive an appropriate level of technical review. Depending on the circumstances, an adequate review may be accomplished by people within the organization performing the analysis. In other instances, a formal peer review by independent scientific and technical experts might be necessary. The circumstances of each community-scale assessment will dictate the number, type, and timing of reviews a technical work product should receive. EPA's Peer Review Handbook provides policy and direction for risk assessments performed by the Agency and is a good source of basic information on when and how technical assessments should be performed (see http://www.epa.gov/OSA/spc/2peerrev.htm).

What is Peer Review? *Peer review is a documented critical review of a specific technical work product. The peer review is conducted by qualified individuals (or organizations) who are independent of those who performed the work, but who are collectively equivalent in technical expertise (i.e., peers) to those who performed the original work. The peer review is conducted to ensure that activities are technically adequate, competently performed, properly documented, and satisfy established quality requirements. The peer review is an in-depth assessment of the assumptions, calculations, extrapolations, alternate interpretations, methodology, acceptance criteria, and conclusions pertaining to the specific major scientific and/or technical work product and of the documentation that supports them. Peer review may provide an evaluation of a subject where quantitative methods of analysis or measures of success are unavailable or undefined; such as research and development. Peer review is usually characterized by a one-time interaction or a limited number of interactions by independent peer reviewers. Peer review can occur during the early stages of the project or methods selection, or as typically used, as part of the culmination of the work product, ensuring that the final product is technically sound.*

4.1.1 The Separation of Risk Assessment and Risk Management

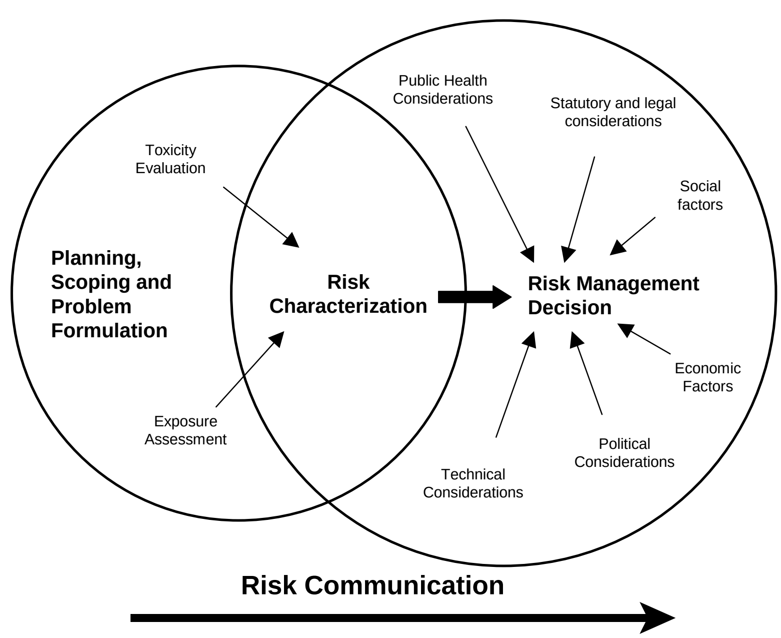
It is important to keep in mind that at the outset of the analysis, all key stakeholders must convene to establish the overall direction of the assessment. However, once the actual technical work begins, the activities of the technical workgroups should generally be separated from risk managers and other stakeholders with an interest in the assessment outcomes. It follows that the people performing the risk assessment and those who will be managing the risk results should not be the same people, if possible.

There has been a great deal of discussion and debate about how best to achieve an appropriate balance between those "doing the science" and those "managing the answers." For example, the National Research Council (NRC) of the National Academy of Sciences (NAS), in their 1983 study entitled *Risk Assessment in the Federal Government: Managing the Process* (the "Red Book"),[3] advocated a clear conceptual distinction between risk assessment and risk management, noting, for example, that maintaining the distinction between the two would help to prevent the tailoring of risk assessments to the political feasibility of regulating a chemical substance. However, the NRC also recognized that the choice of risk assessment techniques could not be isolated from society's risk management goals. (An example of the interplay between risk assessment and risk management is provided in Exhibit 4-3.) Ultimately, effective, yet appropriate, communication will be needed throughout the process between the risk assessors and risk managers and with external stakeholders (see Chapter 7).

Ultimately, the risk assessors should be aware of risk management goals; however, the fundamental science performed in the risk assessment should be impartial and based on the factual base of information, to the extent possible. The risk managers and the technical team should touch base at appropriate defined points along the way, particularly when some element of the project scope or analytical approach changes significantly. However, all parties must be careful not to let this interaction influence (or give the impression of influencing) the scientific process in such a way as to achieve a predetermined outcome.

In order to limit overt or unintentional skewing of the results of the analysis, it is prudent to establish an upfront scheme that will be followed in assessing the meaning of the risk results as well as the level of risk that the partnership team considers acceptable. With these decisions made prior to developing the actual risk estimates, the partnership and other relevant community

Exhibit 4-3. Illustration of the Integration Between Risk Assessment and Risk Management



stakeholders will have agreed on the "ground rules" early in the process, at a time when data and analytical results are not yet known. One way to do this is to develop a *risk management plan* that identifies both the agreed-upon risk management framework and a menu of generic risk management actions that might be pursued if risks are found to be unacceptably high.

More general information on the use of risk in decision making about air toxics and the interplay of risk assessment and risk management, see ATRA Volume 1, Chapter 27. Focused information on risk management for air toxics in a multisource context , including the development of a risk management plan, is provided in Chapter 8.

4.2 Identify the Multisource Concerns to Be Evaluated

The planning and scoping process is the appropriate step in the overall process for the needs and goals of the partnership team to be identified and then ***distilled down to a realistic set of assessment questions and goals*** that will be carried forward. Several important activities that need to happen during this process include:

- Identifying and evaluating existing data on potential air toxics emission sources, the chemicals they release, and the potential exposures to populations in the study area;
- Identify team members' concerns and interests;
- Preparing for different outcomes of the analysis;
- Setting realistic expectations;
- Identify and implement short- and long-term goals; and
- Integrate air quality goals with other community priorities.

Each of these topics is discussed in more detail below.

4.2.1 Identifying and Evaluating Existing Data on Sources, Chemicals, and Exposures

The partnership team will want to review existing information to help them understand what is already known about the potential impacts of air toxics on the local population. This will help them refine their concerns about the area, establish the questions they want the assessment to answer, and set the scope (the limits) of the study (discussed in Section 4.3 below). Information sources that are commonly considered include the NATA risk characterization, TRI data, census data, land use maps, local air monitoring and modeling data, citizen concerns and complaints, and health studies that have been performed in the area (e.g., studies of cancer rates). A discussion of how to obtain and use each of these data types is provided in the sections that follow.[b]

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[b] Depending on the situation, there may be little or no data to perform an initial characterization of the air toxics concerns in the study area and the stakeholder group may need to develop new information to support the multisource air toxics effort. New research or data collection (e.g, sample collection by air monitoring) should be carefully planned and executed to ensure that the resulting information is credible, accurate, and relevant to the concerns of the community. The process of developing an emissions inventory for multisource assessment is described in ATRA Volume 1, Chapter 7 and Chapter 5 of this Volume. Information on developing air toxics monitoring data is provided in ATRA Volume 1, Chapter 10.

EPA Internet Gateways to Community-level Information

EPA maintains a vast array of data and tools that can be used in planning and scoping a community-based multisource air toxics assessment. In an effort to help partnership teams access and use this information effectively and efficiently, the Agency has developed several internet-based gateways and other tools to help in the navigation of EPA resources. Several important internet-based tools include:

EnivroFacts (http://www.epa.gov/enviro/). This website provides access to several EPA databases that provide information about environmental activities that may affect air, water, and land anywhere in the United States. The partnership team can also use EnviroFacts to generate maps of environmental information.

EnviroMapper (http://www.epa.gov/enviro/html/em/). EnviroMapper is a powerful tool used to map various types of environmental information, including air releases, drinking water, hazardous wastes, water discharge permits, and Superfund sites. Users can select a geographic area within EnviroMapper and view the different facilities that are present within that area. EnviroMapper can be used to create maps at the national, state, and county levels, and link them to environmental text reports. Users can even insert dynamically created maps in their own webpages.

Window to My Environment (http://www.epa.gov/enviro/wme/). Window To My Environment (WME) is a powerful web-based tool that provides a wide range of federal, state, and local information about environmental conditions and features in a specific area. This internet tool is provided by EPA in partnership with federal, state and local government and other organizations.

The CARE Resource Guide (http://cfpub.epa.gov/care/index.cfm?fuseaction=Guide.showIntro). As noted in Chapter 2, the CARE program has developed this resource guide to help anyone interested in working with communities to evaluate and reduce environmental risk. The Resource Guide enables stakeholder groups to find on-line resources that can help their community through every step of the risk evaluation and risk reduction process.

Environmental Justice (EJ) Graphic Assessment Tool (http://www.epa.gov/enviro/ej/). EPA's EJ Graphic Assessment Tool can be used to map EPA environmental data in relation to available demographic data (e.g., population density, percent minority population).

4.2.1.1 National Air Toxics Assessment National-Scale Risk Characterization

As introduced in Chapter 2, EPA has developed a national-scale risk characterization for 177 toxic air pollutants and diesel particulate matter (Exhibit 4-4), based on 1999 emissions data. EPA used computer modeling of the 1999 NEI air toxics data as the basis for developing health risk estimates for each of these chemicals at the census tract level across the United States. The goal of the national-scale risk characterization is to identify those air toxics which may be of potential concern in terms of contribution to population risk. The results are being used to, among other things, set priorities for the collection of additional air toxics data (e.g., emissions data and ambient monitoring data). EPA plans to update the national scale assessment every three years.[c]

[c] EPA plans eventually to include all 187 HAPs in the NATA national-scale assessment.

Exhibit 4-4. Chemicals Evaluated in the 1999 NATA Risk Characterization

Acetaldehyde
Acetamide
Acetonitrile
Acetophenone
2-Acetylaminofluorene
Acrolein
Acrylamide
Acrylic acid
Acrylonitrile
Allyl chloride
4-Aminobiphenyl
Aniline
o-Anisidine
Antimony compounds
Arsenic compounds (inorganic, may include arsine)
Arsine
Asbestos
Benzene
Benzidine
Benzotrichloride
Benzyl chloride
Beryllium compounds
Biphenyl
Bis(2-ethylhexyl)phthalate
Bis(chloromethyl)ether
Bromoform
1,3-Butadiene
Cadmium compounds
Calcium cyanamide
Captan
Carbaryl
Carbon disulfide
Carbon tetrachloride
Carbonyl sulfide
Catechol
Chlordane
Chlorine
Chloroacetic acid
2-Chloroacetophenone
Chlorobenzene
Chlorobenzilate
Chloroform
Chloromethyl methyl ether
Chloroprene
Chromium III
Chromium VI
Cobalt compounds
Coke Oven Emissions
Cresols - Cresylic acid (isomers and mixture)
Cumene
Cyanide compounds
Diazomethane
Dibenzofurans
1,2-Dibromo-3-chloropropane
Dibutylphthalate
p-Dichlorobenzene
3,3-Dichlorobenzidene
Dichloroethyl ether
1,3-Dichloropropene
Dichlorvos
Diesel particulate matter
Diethanolamine
Diethyl sulfate
3,3-Dimethoxybenzidine
p-Dimethylaminoazobenzene
Dimethyl carbamoyl chloride
Dimethyl formamide
1,1-Dimethyl hydrazine
Dimethyl phthalate
Dimethyl sulfate
3,3-Dimethyl benzidine
4,6-Dinitro-o-cresol, and salts
2,4-Dinitrophenol
2,4-Dinitrotoluene
1,4-Dioxane
1,2-Diphenylhydrazine
Epichlorohydrin
1,2-Epoxybutane
Ethyl acrylate
Ethyl benzene
Ethyl carbamate
Ethyl chloride
Ethylene dibromide
Ethylene dichloride
Ethylene glycol
Ethylene imine (Aziridine)
Ethylene oxide
Ethylene thiourea
Ethylidene dichloride
Fine mineral fibers
Formaldehyde
Glycol ethers
Heptachlor
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Hexamethylene-1,6-diisocyanate
Hexamethylphosphoramide
Hexane
Hydrazine
Hydrochloric acid
Hydrofluoric acid
Hydroquinone
Isophorone
Lead compounds
Lindane (all isomers)
Maleic anhydride
Manganese compounds
Mercury compounds
Methanol
Methoxychlor
Methyl bromide
Methyl chloride
Methyl chloroform
Methyl ethyl ketone
Methyl hydrazine
Methyl iodide
Methyl isobutyl ketone
Methyl isocyanateMethyl methacrylate
Methyl tert butyl ether
Methylene chloride
4,4'-Methylene bis(2-chloroaniline)
4,4'-Methylenedianiline
Methylene diphenyl diisocyanate
N,N-Diethyl aniline
Naphthalene
Nickel compounds
Nitrobenzene
4-Nitrobiphenyl
4-Nitrophenol
2-Nitropropane
Nitrosodimethylamine
N-Nitrosomorpholine
N-Nitroso-N-methylurea
Parathion
Pentachloronitrobenzene
Pentachlorophenol
Perchloroethylene
Phenol
p-Phenylenediamine
Phosgene
Phosphine
Phthalic anhydride
Polychlorinated biphenyls (PCBs)
Polycyclic Organic Matter (POM)
1,3-Propane sultone
beta-Propiolactone
Propionaldehyde
Propoxur
Propylene dichloride
Propylene oxide
1,2-Propylenimine
Quinoline
Quinone
2,4-D, salts and esters
Selenium Compounds
Styrene
Styrene oxide
1,1,2,2-Tetrachloroethane
Titanium tetrachloride
Toluene
2,4-Toluene diamine
2,4-Toluene diisocyanate
o-Toluidine
Toxaphene
1,2,4-Trichlorobenzene
1,1,2-Trichloroethane
Trichloroethylene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
Triethylamine
Trifluralin
2,2,4-Trimethylpentane
Vinyl acetate
Vinyl bromide
Vinyl chloride
Vinylidene chloride
Xylenes (isomers and mixture)

The importance of NATA for local scale assessment is that it can provide important clues to the chemicals and sources that ***may be causing*** exposures of potential public health concern within a study area. For example, the NATA risk characterization results for an area can be used to identify the chemicals and sources (of those evaluated) that pose potentially significant exposures in a given place. At a minimum, these chemicals and sources would commonly be included the multisource analysis.

That having been said, analysts should use caution when interpreting NATA risk characterization results at the local level as the NATA was designed to help identify general patterns in air toxics exposure and risk across the country, not as a tool to characterize or compare risk at local levels (e.g., to compare risks from one part of a city to another). For more information about NATA activities, results, and caveats, see http://www.epa.gov/ttn/atw/natamain/. NATA is also discussed in ATRA Volume 1, Chapter 3.

4.2.1.2 Emissions Inventories

As discussed in ATRA Volume 1, Chapter 4, information on releases of air toxics is primarily compiled and maintained in **emissions inventories**. The primary emissions inventory for HAPs is EPA's NEI. EPA's TRI is a second inventory that has some utility for planning and scoping an air toxics risk assessment, but is of limited use for the actual modeling assessment because of the nature of the way the data are reported. In addition to the NEI and the TRI, SLT air agency permit files as well as localized inventories that have been developed, but not submitted to the NEI, can also provide information on the location and source characteristics of air toxics releases. An overview of emissions inventories is described in ATRA Volume 1, Chapter 4. An overview of the process for developing an emissions inventory is described in ATRA Volume 1, Chapter 7. Readers are encouraged to review these chapters for a more comprehensive on the structure and contents of readily available EPA emissions inventories as well as to provide insight into the kind of activities that may be required to augment an existing inventory or develop an inventory. A brief description of the two most common inventories used for community-scale multisource analysis is provided below. In addition, some of the key differences between these two inventories are highlighted in the text box that follows the descriptions.

Note that the success of a modeling effort will be strongly dependent on the quality of the emissions inventory available for the study area. It is for this reason that a significant emphasis will be needed to identify the quantity and quality of emissions inventory data needed for the effort, to review the existing emissions inventory data to see if it meets the identified data quality objectives, and to augment the existing inventory, if necessary. In addition to the information provided in ATRA Volume 1, Chapters 1, 4, and 7, information specific to augmenting an existing inventory for a multisource assessment is provided in Chapter 5 of this volume.

- **National Emissions Inventory (NEI).** EPA's Office of Air and Radiation compiles and maintains the NEI that includes quantitative data on emissions of HAPs as well as characteristics of the sources of these air toxics (e.g., stack heights, emission rates, etc.). It includes point, non-point, and mobile sources for all 50 states, Washington, D.C., and U.S. territories. HAP emissions data are available for 1993, 1996, 1999, and 2002. The NEI is available at http://www.epa.gov/ttn/chief/eiinformation.html. EPA plans to update the NEI every three years.

The NEI is developed by EPA's Emission Factors and Inventories Group with input from SLT agencies, industry, and a number of EPA offices. In some cases, if a SLT agency does not submit data, EPA may use data available from other sources (e.g., HAP collected by EPA as part of the development of emission standards, or data submitted by sources under the TRI program). Separate inventory documentation files have been prepared for each part of NEI (i.e., for point, nonpoint, and mobile sources).

An important fact to keep in mind about the NEI is that it includes data on HAPs from both small and large stationary sources and both on- and off-road mobile sources. Equally important, it is much more likely to include the data necessary for modeling (although many of the data fields needed for modeling are not "mandatory," and thus states and tribes are not required to provide this information to the NEI).[d] Information such as stack height, emission rate, and temperature are critical information for dispersion modeling and, thus, to developing reasonably accurate estimates of human exposure in the areas surrounding a source. It is for this reason that the NEI can be of more use than other emissions databases for developing exposure and risk estimates in a study area.

- **Toxics Release Inventory (TRI).** TRI is a publicly available EPA database that contains information about environmental releases and other waste management activities reported annually by certain covered industry groups as well as federal facilities for over 650 toxic chemicals (see http://www.epa.gov/tri/. This inventory was established under the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) and expanded by the Pollution Prevention Act of 1990. TRI reporting is required only for facilities that meet all of the following three criteria:

  - They have ten or more full-time employees or the equivalent (i.e., a total of 20,000 hours or greater; see 40 CFR 372.3);
  - They are included in specified industrial sectors; and
  - They exceed any one reporting threshold for manufacturing, processing, or otherwise using a TRI chemical.

  If a facility meets these criteria, then it must report releases to environmental media as well as waste management data. In 2003 (the latest year for which data are publicly available), on-site air emissions of toxic chemicals totaled 1.59 billion pounds (36% of all TRI chemicals disposed or otherwise released to the environment).[4]

  While the TRI data have utility for the scoping phase of an air toxics risk assessment project (they include release information on many more types of chemicals than the NEI); they have several significant limitations that assessors must understand. One important drawback is that the TRI only provides total facility annual air releases (segregated by stack releases and fugitive releases). While annual emissions are useful in evaluating chronic exposures, they may be of little use in assessing acute noncancer hazard associated with short term, peak

[d] Stack parameters and certain other release characteristics are provided in NEI for all releases. Where values for these fields were missing in the data submitted to EPA (e.g., state databases), EPA has included default values based on MACT category code, source classification code (SCC), or other data for the emission source. More information regarding EPA's inventory QA efforts and parameter default strategy for the most recent version of NEI can be found at http://www.epa.gov/ttn/chief/net/2002inventory.html.

emission levels.[e] Another drawback is that emission characteristics information is not reported to the TRI (e.g., exact location of release on the facility property, release rates, stack height, stack diameter, release temperature), making TRI of limited use as an input to dispersion modeling. Finally, it should be reiterated that TRI only covers an important, but limited, universe of emissions sources.

Summary of Key Differences Between NEI and TRI

	National Emissions Inventory	**Toxics Release Inventory**
EPA's purpose for creating database	Compile a national emissions data for use in air dispersion modeling, regional strategy development, regulation setting, air toxics risk assessment, and tracking trends in emissions over time	Inform citizens of chemical releases in their area from industrial sources
Chemicals included	HAPs and criteria pollutants, plus precursors (about 525 substances in all)	~650 TRI chemicals
Types of emissions	Point and nonpoint stationary and mobile source air emissions	Industrial facility emissions to air, water, and land (waste management information is also included)
Frequency	Updated every three years	Annually
Source of data	Submitted by state, local, and tribal agencies, industry, and EPA offices	Self-reported by industry
Quality Differences	Formal QA/QC methodology implemented by EPA: data from multiple sources blended/merged; defaults substituted for missing elements; data base reviewed internally and externally	Inventory data quality dependent on individual facility QA/QC procedures; facility reporting requirements enforced by EPA

Once appropriate emissions inventory data have been identified, they can be used during the scoping phase of the assessment to help hone in on the important sources and chemicals that will become the focus of the multisource air dispersion modeling exercise. For example, emissions can be "toxicity weighted" to provide a screening level assessment of hazard. Those chemicals that collectively pose most of the hazard (e.g., 99 percent) could be used to identify the specific emissions for the modeling exercise. Emissions can also be used as inputs to air dispersion models run in a "screening mode," the outputs of which could then be compared to screening-level "risk-based concentrations" or simply used to calculate screening-level estimates of risk and hazard. Appendix B provides an overview of some techniques to screen emissions inventory data. The *How To Manual* (see Section 3.5.1) also provides techniques for using emissions inventory data to perform a screening level assessment. (Note that caution should be used when using historic emission inventories as the emission profile for a study area may have changed significantly since the time the emissions data were collected.)

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[e] Note that the NEI data for a community may also be limited regarding the variability of emissions from a given facility over the course of time. Analysts should carefully evaluate the level of detail provided in the NEI to determine whether the existing data will allow them to meet their modeling DQOs (see Chapter 5).

The Risk Screening Environmental Indicators (RSEI) Software

RSEI is a fast and effective screening tool that uses risk concepts to quickly and easily screen large amounts of TRI data, saving time and resources. RSEI users can perform, in a matter of minutes or hours, a variety of screening-level analyses to perform the complex and sophisticated analyses that are necessary to provide a risk-related perspective of TRI data. RSEI is particularly useful for examining trends to measure change, ranking and prioritizing chemicals and industry sectors for strategic planning, conducting risk-related targeting, supporting community-based projects, and investigating environmental justice issues.

How Does RSEI Work?

The model uses the reported quantities of TRI releases and transfers of chemicals to estimate the impacts associated with each type of air and water release or transfer from every TRI facility. For each exposure pathway from each chemical release, the model generates an *Indicator Element*. For instance, a release of the chemical benzene to air via a stack from the "ABC Facility" in 1999 is an indicator element. Each Indicator Element is associated with a set of results, including risk-related results, hazard-based results, and pounds-based results.

- Risk-related results — Surrogate Dose × Toxicity Weight × Population
- Hazard-based results — Pounds × Toxicity Weight
- Pounds-based results — TRI Pounds Released

Once results are calculated for each Indicator Element, they can be combined in many different ways. All of the results are additive, so a result for a specific set of variables is calculated by summing all the relevant individual Indicator Element results. This method is very flexible, allowing for countless variation in the creation of results. For example, results can be calculated for various subsets of variables (e.g., chemical, facility, exposure pathway) and compared to each other to assess the relative contribution of each subset to the total potential impact. Or, results for the same subset of variables for different years can be calculated, to assess the general trend in pounds-based, hazard-based, or risk-related impacts over time. For more information on RSEI, including limitations of the RSEI results, see: http://www.epa.gov/opptintr/rsei/.

4.2.1.3 Existing Monitoring or Modeling Data

In some communities, a certain amount of air dispersion modeling or air monitoring data may already be available. At a minimum, analysts should check with the relevant state, tribal, and local air agencies, local universities, and the following EPA websites:

- EPA AirData Website (http://www.epa.gov/air/data/); and
- Air Toxics Community Assessment and Risk Reduction Projects Database (http://yosemite.epa.gov/oar/CommunityAssessment.nsf/Welcome?OpenForm).

Usually, such data are limited (e.g., one monitor in one neighborhood collecting one class of chemical compound; one modeling study of one or a few chemicals from one facility). Such data, while useful in that they can provide a better understanding of potential exposures, will commonly be limited in their ability to fully represent exposures to the wider variety of chemicals and sources across the study area. Depending on the data, they may also be limited in their representation of spatial or temporal variation. It is for these reasons that analysts should use caution in interpreting existing monitoring and modeling data as a means of narrowing the scope of the larger assessment. Analysts should also evaluate whether conditions in the area have changed since the time the monitoring or modeling data were developed.

Procedures similar to those for screening emissions inventory data are applicable to evaluating existing monitoring or modeling data and are discussed in Appendix B.

4.2.1.4 Existing Health Studies and Health Outcome Data

In some communities, a public health agency or other researchers (e.g., university faculty) may have performed health evaluations that shed light on potential chemicals and sources of concern in the local area. For example, the Agency for Toxics Substances and Disease Registry (ATSDR) or their state health department partners routinely perform various types of ***public health assessments*** (PHAs) to evaluate relevant environmental data, health outcome data (e.g., cancer or asthma statistics), and community concerns associated with a study area where hazardous substances have been released. These studies typically attempt to identify populations living or working on or near areas for which more extensive public health actions or studies are indicated. These investigations can be conducted to confirm case reports, determine an unusual disease occurrence (e.g., a disease cluster), and explore potential risk factors such as exposures to air toxics. This type of data can be highly informative and useful to partnership teams working to identify chemicals and sources to include in the multisource assessment. Information about ATSDR's PHA process and the investigations that have been performed to date can be obtained on the ATSDR website (www.atsdr.cdc.gov). Analysts should also check with state, tribal, and local health departments, local health care providers (e.g., hospitals), and university researchers.

> **Biological Monitoring and Biomarkers**
>
> Public health studies can involve the use of *biological monitoring* in which samples (e.g., hair, tissue, blood) from individuals are analyzed for signs of toxic substances. The results of such tests are sometimes referred to as *biomarkers*. A biomarker is a biological index that is associated with or indicative of an endpoint of interest, such as an exposure level or effect. For example, mercury levels in blood or hair samples can be used as indicators of past exposure to mercury. Biological monitoring and biomarkers can be useful in some cases to help determine the extent and types of exposures and effects that may occur in a population.

[Note that readily available health outcome data may provide initial clues regarding an exposure of potential public health concern, but may ultimately prove to be of limited value unless a more in-depth follow-up epidemiological evaluation can be performed. For example, if an evaluation of summary-level state cancer registry statistics for a study area indicates an elevated rate of disease, a next step could be to evaluate the exposure histories of the patients involved (e.g., to see if they have lived in the exposure area for a period of time sufficient to reasonably suspect a potential causal relationship). Issues such as confidentiality concerns, access to medical records, and access to epidemiological and medical expertise could play a role in whether and how a stakeholder group would be able to perform such a follow-up evaluation. That having been said, analysts are encouraged carefully consider the type of conclusions that can legitimately be drawn from available health statistics. It is advisable, when evaluating such data, to engage appropriate experts who have a working knowledge of both the data and how to evaluate them (e.g., epidemiologists, public health scientists, and those in the medical profession).]

4.2.1.5 Information Provided by the Community

The people who live in the community are often one of the best sources of information about potential air toxics issues in the area and stakeholder groups may wish hold informational meetings or use other techniques to solicit concerns and information from citizens and other local stakeholders. For example, the planning and scoping team may wish to perform a survey of local citizens' concerns (see Section 12.3.1.3).

4.2.1.6 Demographic and Land Use Data

The U.S. Census Bureau (http://www.census.gov) is the main source of information on demographics in the United States. The Bureau also provides a range of economic information. For example, the Census Bureau can provide information on the numbers of people living within specified geographic areas (e.g., a census tract, a census block) along with information about their age, race, sex, and income levels (important information when evaluating exposure and impact at the local level).

In addition to demographics, the type of land use across the study area is another important consideration. For example, partnership teams may only be interested in exposures that occur within residential areas or they may be interested in exposures occurring over other types of land use as well. Land use cover data is available from a variety of sources including the U.S. Geological Service National Land Cover Database (http://landcover.usgs.gov/natllandcover.asp).

Other points of interest in the local study area can include locations where the young, the elderly, and people with special health concerns spend a large part of their day, such as schools, rest homes, and hospitals. Local government agencies are a good source of this information. EPA's Environmental Justice (EJ) Graphic Assessment Tool (http://www.epa.gov/enviro/ej/) can also be used to map EPA environmental data in relation to available demographic data (e.g., population density, percent minority population).

4.2.1.7 Compliance and Enforcement Data

Compliance and enforcement is an integral part of environmental protection. For example, EPA achieves cleaner air, purer water and better-protected land by working with companies to ensure compliance with environmental laws. Enforcement is also a vital part of encouraging governments, companies and others who are regulated to meet their environmental obligations.

EPA's Compliance and Enforcement Gateway

EPA's Office of Compliance and Enforcement Multimedia Data Systems and Tools website (http://www.epa.gov/compliance/data/systems/index.html) can be used as a gateway to access a wide array of national data systems related to compliance and enforcement, including systems related to air quality, hazardous waste, pesticides and toxics, and water quality.

As part of the stakeholder group's activities to gather and evaluate existing information about the community, members will commonly obtain and review information on the compliance status of local industry which have Clean Air Act (and other relevant statutory) requirements related to air toxics. One way to do this is by coordinating with the air permitting authority for the local area (usually a state, tribal, or local air agency). They are a good place to start for relevant information on allowable air releases as well as compliance and enforcement records. (For further information regarding the air permitting program, visit EPA's air permits page at http://www.epa.gov/oar/oaqps/permits/).

Another way to obtain compliance and enforcement information is through EPA's Air Facility System (AFS; http://www.epa.gov/oeca/data/systems/air/afssystem.html), which contains compliance and permit data for regulated stationary sources. States use AFS information to track the compliance status of point sources with various regulatory programs under the Clean Air Act. [AFS was once a part of Aerometric Information Retrieval System (AIRS), hence the historical utilization of that term may be incorporated within referenced documentation.]

AFS data is also visible in EPA's Enforcement and Compliance History Online (ECHO) Web site (http://www.epa.gov/echo/index.html). This tool provides the public with compliance, permit and demographic data from approximately 800,000 facilities regulated under the Clean Air Act stationary source program and other statutes. ECHO's integrated reports present inspections, violations, enforcement actions, penalties and locate facilities on demographic maps. EPA's Envirofacts Data Warehouse (http://www.epa.gov/enviro/) also contains the AFS data.

4.2.2 Identify Team Members' Concerns and Interests

Members of the stakeholder group will all share the goal of understanding and improving local air quality. Nevertheless, members will initially have different perceptions of this goal and how to achieve it. In addition, members may have personal objectives not directly related to air quality that they are hoping or assuming will be included in the scope of the assessment. Adequate time must be spent at the beginning of the process to discuss and understand the expectations of all the participants in order to discover and clarify the goals that can be accepted by all. Clarifying goals will help enable the partnership to develop an analysis plan that ensures that the results of the assessment will meet the established goals. Clarifying goals also will help set realistic expectations for the results of the assessment. For example, air quality is likely to be only one of the factors affecting community health and efforts to improve air quality, by themselves, may not meet a community member's goal of achieving measurable improvements in overall community health. (A fuller discussion of addressing non-air community environmental issues is provided in Part IV of this resource document.) Exhibit 4-5 identifies several potential goals of a community-scale air quality assessment.

Exhibit 4-5. Example Goals for A Community-scale Assessment
• **Estimate emissions (e.g., through development of an inventory)** of all significant sources of pollutants in community air with information about type and quantity of chemicals emitted to the air in the study area. • **Estimate concentrations** of chemicals in community air that result from all the sources in and around the community. • **Develop estimates of aggregate exposures** from all sources in the community. • **Calculate estimates of cumulative risk** by combining estimates of exposures with toxicological dose-response data that represents the carcinogenic and noncarcinogenic toxicological properties of the chemicals in question. • **Compare estimates of risk** to preestablished risk management goals. • **Establish clear priorities** for focusing community efforts on the chemicals and sources that present the greatest risk to the community. • **Develop a baseline** and the ability to measure progress in improving air quality. • **Increase community capacity** to understand and address air issues in the long-term that results from the knowledge, understanding, and trust gained in completing the process. • **Promote agreement** within the community on air issues based on the improved understanding provided by the assessment. • **Compare community air quality** to air quality in other reference communities where air concentrations have been measured or estimated (i.e., communities that are similar with regard to meteorology, land use, topography, and source mix).

4.2.3 Preparing for Different Outcomes of the Analysis

It will be important for the members of the stakeholder group to discuss all the possible outcomes of the assessment and what each outcome would mean to each of the members. What if small businesses, large businesses, households, or mobile sources were identified as the priority concerns? What would it mean if *my* business, *my* home, or *my* car were identified as a risk reduction priority? Some members of the partnership may also enter the process with a conviction about which sources will need to be targeted to improve air quality while other members may have different sources in mind. It is unlikely that the initial expectations of all the members can be met by any analysis. A discussion of all the different possible outcomes will allow participants to consider carefully what the project results might mean for them. In the end, discussions of this sort will help facilitate development of a consensus on at least some common goals and also introduce the concept that an unbiased assessment may reveal unexpected concerns.

4.2.4 Setting Realistic Expectations

It is important to discuss what the partnership will be able to do to improve air quality both during the analysis and when it is completed and priorities have been identified. Critical questions include:

- What resources will be available to make changes?
- What issues can be addressed by the community, and which are likely to require broader action (e.g., such as regulations that go beyond those currently required)?
- What issues are already being addressed by existing (or upcoming) regulations?

- What could be done early on if exploratory data analysis identifies an unambiguous concern from a specific large business, small business, mobile source, etc.?
- In what circumstances would enforcement authorities be used to improve air quality? What kind of information will be required to support this approach?
- In what circumstances would voluntary actions be used to improve air quality? What resources does the partnership have to implement these actions? What information will be required to support this approach?

This is also a good time to begin discussing any short-term actions that will be accomplished while the assessment is taking place. If there are obvious actions that do not depend on the outcome of the assessment, a discussion of those actions is also appropriate at this point (see next section).

4.2.5 Identify and Implement Short- and Long-Term Goals

Some members of the community will be more interested in action than in studying local air quality, and some problems may be so obvious that action can reasonably be taken without extensive study. The partnership should consider identifying areas where there is already sufficient agreement to begin immediate work to improve air quality. This will benefit everyone since the community will see real change in their environmental quality over the short-term while the long-term study proceeds. Examples of projects that might be started early on include working with the community to address indoor air problems by addressing known risk factors (e.g., second hand smoke); developing community plans for transportation sources (e.g., car-pooling bulletin boards, broader dissemination of mass transit information, diesel retrofits for school and/or city buses, anti-idling options); or working to provide pollution prevention assistance to local businesses. Specific examples and helpful web sites that provide information on a wide variety of indoor and outdoor air emissions and risk reduction actions are provided in Chapter 8 of this resource document.

The partnership may also wish to begin developing the long-term goals and capacity of the community to address air quality issues beyond the end of the assessment. Specific issues that might be addressed include:

- Mechanisms for retaining the knowledge and skills learned during the assessment;
- Mechanisms for responding to known risk factors currently in the community, but which will take a long-term effort to address (including funding for risk mitigation efforts);
- Mechanisms for responding to future new impacts on air quality;
- Maintaining long-term interest and momentum at the community level; and
- Mechanisms for working with other communities to build a larger resource pool for addressing air quality and community health concerns.

A discussion of sustaining efforts over time is provided in Section 12.5.

4.2.6 Integrate Air Quality Goals to Other Community Priorities

As noted previously, an understanding and improving air quality will not be the only community priority. Most communities will also be concerned about additional issues, such as education, jobs, crime, and access to quality healthcare. It will be important to identify these other community priorities to ensure that the air quality efforts can both support and complement these issues. For example, the assessment team could strive to organize work to avoid unnecessary conflicts, duplication of effort, and opposition by community members with other priorities. The ability to integrate work on air quality into the other community priorities may be essential to finding the resources that will be needed to address air quality issues. Part IV of this resource document provides information on other environmental factors that may be of concern to communities, along with basic information on how to assess and mitigate those risks.

4.3 What Will Be the Scope of the Multisource Assessment?

Once existing data for the study area have been gathered and evaluated and the concerns and needs of the partnership team considered, the team can set the initial scope of the assessment. The scope of the overall multisource assessment will follow directly from the concerns and goals identified by the partnership team and the resources available for the study. It may be narrow or broad, depending on the depth and breadth of specific goals. For example, an overall goal such as "reducing air toxics emissions from all the sources in the community" may require an extensive information gathering effort that examines many types of sources (e.g., stationary, mobile) and dozens or even hundreds of air toxics and following emissions changes over time. On the other hand, a goal such as "reducing the estimated cumulative cancer risk and hazard in the community" might entail development of an emissions inventory followed by air dispersion and exposure modeling to estimate exposure concentrations, identifying toxicity values, development of quantitative risk estimates, apportionment of risk to specific chemicals and emission sources, development and implementation of one or more risk reduction strategies, and periodic analysis to ascertain whether risks posed by these chemicals have actually been reduced over time.

The scoping process also helps to align the assessment design with the most important concerns and goals of the partnership team. For example, overly broad goals may require an assessment with a scope which is either difficult or impossible to achieve with available resources. Several iterations of goal setting may be required before the scope is fully aligned with the goals and the available resources; further iteration may be necessary once work begins and circumstances and information change.

As discussed in ATRA Volume 1, Chapter 5, critical aspects of establishing the assessment scope include:

- **Specific sources to be included**. A community-scale, multisource assessment may need to consider hundreds or even thousands of individual sources. The sources to be evaluated will usually include all of the major, area, and mobile source emissions in the study area. An evaluation of the existing inventory for the study area (i.e., the NEI or a more refined local inventory) is a critical first step in identifying the sources that will be carried forward to the air dispersion modeling step. If the existing inventory is found to be lacking, further steps in developing the community's emissions inventory will be needed (see Chapter 5). [Note that some level of additional screening may have been performed to reduce the number of sources carried forward in the assessment (see the *How To Manual*, Chapter 5 of this Volume, and Appendix B).]

How Do I Evaluate Indoor Versus Outdoor Air Toxics Concentrations?

In a multisource cumulative assessment of the type described in this resource document, the focus of the evaluation is usually on the risk posed by exposures to chemicals *released to or created in outdoor air*. However, most people spend the majority of their time "indoors" (e.g., in office buildings, at home, in cars, in planes, etc.) where the concentrations of the chemicals in question may be different (either higher or lower). How do (or don't) some common exposure assessment approaches deal with this issue?

The Continuous Lifetime Exposure Approach to Outdoor Air Concentrations

In this approach, the analyst will make the (usually) conservative assumption that an exposed group of people spend all of their time (24 hours a day, seven days a week for a lifetime) standing in one outdoor location and breathing only outside air (i.e., they never go into an indoor environment of any type). This approach (which is referred to by some as the "porch potato" scenario) will usually (but not always) lead to estimates of exposure and risk to outdoor air pollution that are biased high. This approach is performed by simply using the results of the air dispersion modeling at given spatial locations (or, in some cases, ambient monitoring results) as a surrogate for chronic exposure (i.e., no exposure modeling has been performed – see below). The benefit of this approach is that it is relatively straightforward to perform and does not require the application of an exposure model. If the maximum concentration in an exposure area (the highest modeled or measured value) is used as a surrogate for exposure, the result could potentially be considered a high end (or bounding) estimate of risk for the entire exposed population. Because of its generally conservative nature, the continuous lifetime exposure approach is considered a "screening level" approach to exposure assessment.

> **Note:** A limited number of chemicals released to outdoor air may be more concentrated in an indoor space than is reflected by available outdoor air dispersion model or monitoring results. For example, benzene concentrations in the passenger compartments of vehicles traveling on highways will commonly exhibit higher concentrations than a nearby local air monitor might suggest (due to many cars emitting benzene in close proximity to one another).

The Microenvironment Approach

People do not really stand in one place for their entire lives breathing the same thing. Instead, most people move around quite a bit during the course of the day and spend a significant amount of time in different types of "microenvironments." For example, they will spend part of the day at home, part of the day at work or school, part of the day engaged in recreational activities or going shopping, etc. In addition, the concentration of a toxic air pollutant in outdoor air will usually decrease with distance from its emission source and may also be reduced as it moves into an indoor environment (an example of this is the physical filtering out of air toxics-bound particulate matter at the outdoor air intake on a building). The difference between outdoor air and indoor air concentrations of a toxic air pollutant (in the absence of indoor sources) is reflected by a penetration factor. [A penetration factor of one (1) indicates that concentrations inside and outside are equal; a value less than one (1) indicates lower concentrations in indoor spaces relative to outdoor air.]

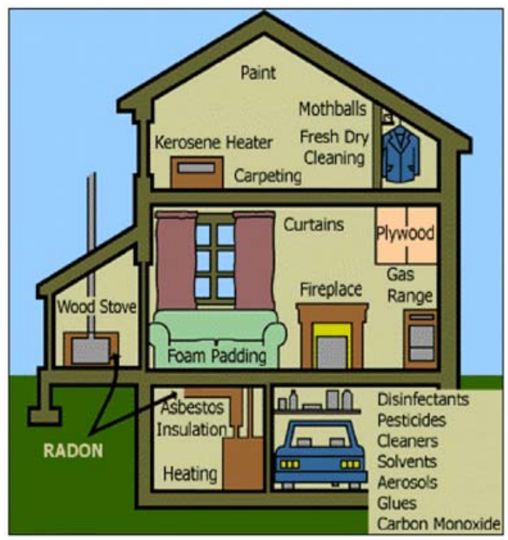
(Text box is continued on following page)

How do I Evaluate Indoor versus Outdoor Air Toxics Concentrations? (Continued)

Exposure models try to take these issues into account by both capturing the way in which different kinds of people move around within a geographic area, including how they move into and out of different microenvironments over the course of time, and by predicting (e.g., through the application of penetration factors) the concentrations of outdoor air pollutants within each of those microenvironments. This type of approach is used when a more complete estimate of potential exposures and risk is needed (e.g., when a screening level analysis points to need for a more robust assessment of risk). The microenvironment approach is also useful for deriving estimates of the distribution of risks across a population, based upon statistical distributions of activity patterns across a population and microenvironment partitioning factors across multiple microenvironmental types. The microenvironment approach to exposure assessment, along with a description of commonly used exposure models is discussed in ATRA Volume 1, Chapter 11.

What About Indoor Sources?

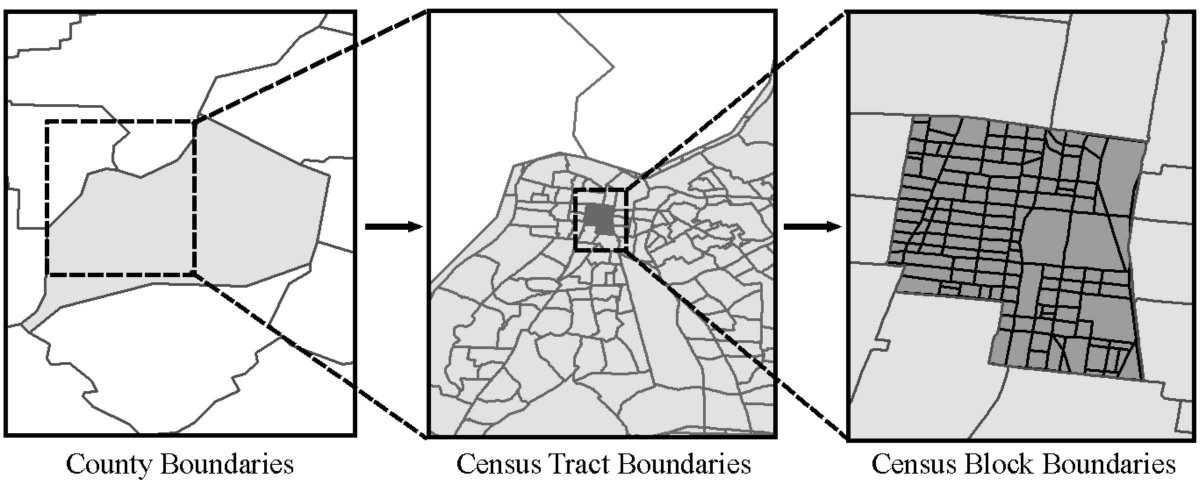
In addition to outdoor air moving into indoor spaces, there are many types of indoor sources of air toxics that can greatly contribute to the overall concentration of chemicals in indoor microenvironments. Unfortunately, there is currently no established methodology for routinely including these additional source contributions within the framework of a standard community-level multisource assessment. However, the most commonly used exposure models (e.g., HAPEM, TRIM.Expo/APEX) have the capability for simulating indoor sources of exposure, and analysts are encouraged to consider developing and evaluating inputs for inclusion of indoor sources, when appropriate to the assessment. If indoor source inputs are not included in the simulation, the potential impact of having omitted indoor sources should be included as a discussion in the uncertainty section of the risk characterization.



- **Specific air toxics to be included**. Once the sources of air releases have been identified, the specific chemicals they release are then determined. Of all the chemicals released by the study area sources, the only ones that are generally carried forward are those that (1) have sufficient emission characterization data to perform the air dispersion modeling, and (2) have toxicity data to perform the risk characterization. For some chemicals, all of these elements may not be available. If appropriate surrogate data for the missing elements are not available, these chemicals may be dropped from the quantitative portion of the analysis. The impact of not quantifying these chemicals would have to be discussed in the uncertainty write up for the evaluation. In some cases, a decision may be made to carry forward chemicals for which quantitative information is not readily available. For example, a planning team may be interested in evaluating a chemical for which a dispersion modeling analysis can be performed, but for which toxicity values are not available (for information on dealing with chemicals with no toxicity data, see ATRA Volume 1, Chapter 12). [Note that some level of additional screening may have been performed to reduce the number of chemicals carried forward in the assessment (see the *How To Manual*, and Chapter 5 and Appendix B of this Volume).]

- **Physical boundaries of the study area**. The physical boundary of the study area is commonly the land area that is made up of the human populations of interest and the sources potentially impacting them. For example, the partnership team may choose to set the physical boundaries at city limits or at a county boundary. In contrast, the partnership team may also choose to focus on just a specific neighborhood. Both the needs and desires of the partnership team as well as data and analytical limitations (e.g., available emissions data, limitations of analytical tools, data storage and file size challenges) will influence the decision. Exhibit 4-6 shows examples of several geographic boundary cutoffs for study areas at progressively higher levels of resolution.

Exhibit 4-6. Example Options for Establishing Physical Boundaries for the Assessment



Also related to establishing the physical boundaries of the study area is the consideration of how sources outside the boundary should be treated. For example, should the assessment include distant large point sources that are releasing chemicals subject to long-range transport? (In general, sources outside the study area that will likely impact the study area significantly should be included in the analysis.)

Finally, the partnership team must decide whether they will subdivide a large study area into subareas to facilitate the presentation and communication of results (e.g, will a county level assessment be presented at the neighborhood level, at the census tract level, etc.). When choosing subdivisions, the partnership team will need to consider the locations of exposed populations, the presence of special receptors such as high proportions of children or the elderly, and other groups of interest such as EJ areas. (Subdivisions of the study area are usually set at the census tract or census block level to allow the assessment to match available demographic data from the Census Bureau.) Examples of ways to represent exposures and risk are discussed in the following chapters and analysts should understand these different approaches in order to provide the most useful information to the risk assessment customers. Additional background information on displaying risk is provided in ATRA Volume 1, Chapter 13.

- **Temporal Issues**. Temporal considerations fall into several general categories, including the amount of time available to perform the assessment, the specific exposure timeframes to be evaluated (e.g., chronic and/or acute exposures), and timing considerations inherent in the emissions inventories.

  – ***Time to Perform the Assessment.*** Time and money are always limited; therefore, the planning and scoping process will almost certainly involve trade-offs between the amount and quality of information the partnership team desires and the time and resources available to obtain and analyze the information. The time to plan and perform a full multisource assessment can range from as little as a few months (when the assessment is performed by a small group of seasonal technical experts that have easy access to complete, high quality data) to as long as several years. The amount of time to perform the work will depend on the scope of the analysis, the available data, the expertise of the analysts, the access to resources, and the need to involve stakeholders. In particular, the need to refine (or develop) an emissions inventory of sufficient quality and/or perform ancillary monitoring efforts can substantially increase the amount of time needed to perform an assessment.

    Clear objectives, resource commitments, and estimated schedules from project management will drive the approach and level of detail that can be considered. Once timing and resource considerations have been identified, assessment teams should establish critical milestones and institute a clear, yet reasonably flexible, schedule to keep the assessment on track. (Resources may also determine whether the work is to be performed in-house by the assessment team or by a contractor or other external source, such as a local university).

    It should be noted that the need to coordinate with the schedules of other organizations may become an important factor in defining the scope of the project. Assessments that require short-term, low-budget efforts may not have the time or resources for extensive stakeholder involvement. When there is extensive stakeholder involvement, on the other hand, it is especially important that a budget and time schedule be developed and understood by all participants.

  – ***Exposure Timeframes.*** At a minimum, most assessments will evaluate chronic exposures. Since most emissions inventories provide (or allow the calculation of) annual emissions, analysts can usually perform this part of the analysis in a straightforward fashion. However, many assessments will also need to include an evaluation of acute exposures. Depending on the DQOs of the assessment, analysts may need to augment the existing emission inventory to provide additional details of the day to day variability in source emissions to allow a high quality acute assessment to be performed. In other words, if the emissions inventory only provides a single yearly amount of chemical released, an evaluation of shorter period high concentration spikes in releases is not possible. The team will have to either refine the emissions inventory to develop information on release variability or make simplifying assumptions using the existing data. (The NEI provides some emission data for non-annual time frames; in addition, the next version of NEI will have a new field indicating whether emissions are upset in nature.)

– ***Emission Inventory Timing.*** Most emissions inventories are historical in nature. While the multisource assessment will commonly rely on the most recent emission inventory year available, it important to keep in mind that the inventory may not be completely reflective of current conditions. For example, in 2005, the most recent available NEI is for the year 2002. Thus, if contemporaneous emissions estimates are required for the assessment, data augmentation of the existing inventory will be needed. In some cases, state, tribal, and local agencies compile emission inventories on a more recent basis (e.g., annually), so a team may want to contact these agencies for data not reflected in the current version of NEI. At a minimum, the analysts should perform some level of exploratory analysis to determine if current emissions are expected to vary significantly from those represented in the available emissions inventory.

- **Potential exposure pathways**. The human health multisource assessments discussed in this chapter include only the inhalation exposure pathway. Furthermore, such assessments are usually limited to exposures to outdoor air sources (i.e., exposure to chemicals that have been emitted directly to outdoor air); however, if there is information on indoor sources, this can be factored in as well. In some cases it may be necessary to consider exposures via additional pathways (e.g., deposition of air emissions of dioxin which ultimately results in ingestion of dioxin-contaminated food). A detailed discussion of how to develop *multipathway analyses* for multiple sources at the community level is discussed in Part III of this Volume and in ATRA Volume 1, Part III. (Part III also discusses approaches to evaluating multisource assessments for ecological receptors.)

- **Potentially exposed populations**. The potentially exposed populations that will be the focus of the study are likely to parallel the way in which the physical boundaries of the study area are subdivided for analysis (e.g., at the census tract or census block level). If there are certain populations (e.g., children, elderly) of a particular concern, the analysis may also need to identify specific locations (e.g., schools, playgrounds, nursing homes) where these people spend large amounts of time.

- **Types of health risks to be evaluated**. The risk characterization for the assessment may include predictive estimates of cancer risk as well as chronic hazard and acute noncancer hazard for the study population(s). In the case of cancer risk, the estimates are most often provided in terms of an incremental excess probability of an individual developing cancer over a lifetime. The chronic and acute hazard estimates compare exposures to reference levels believed to have no adverse health effects over a chronic or acute exposure period, respectively. Acute hazard estimates are developed for effects other than cancer; this is usually also the case for chronic hazard estimates, but there may be instances in which a chronic hazard estimate includes cancer as a potential hazard.

Once all these issues have been evaluated, the scoping process will have produced a clear understanding of what the multisource assessment will include, what it will not include, and why. This process may require several iterations and some initial screening-level analyses to identify the final scope for the community-scale assessment. Once the analysis begins, more screening may be performed or new information brought to light that will result in a modification of the initial scope (see the *How To Manual*, and Chapter 5 and Appendix B of this volume for examples of screening level approaches).

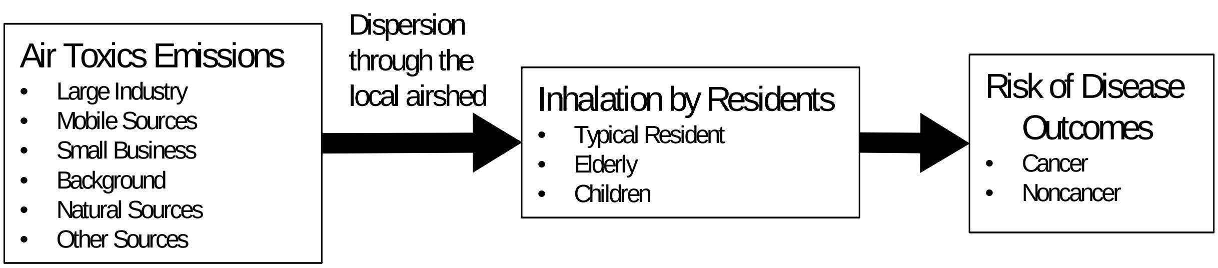
4.3.1 Problem Statement

A problem statement summarizes the end result of the planning and scoping process by describing the specific concerns that the risk assessment will address. The problem statement should be as specific as possible and may include explicit statements of how the analysis will be performed and what will not be assessed in the risk assessment. In short, this is a clear and unambiguous statement designed to communicate to all stakeholders what the perceived problem is that will be evaluated, how it will be evaluated, and what issues will not be evaluated. An example problem statement is provided below.

Example Problem Statement and Overall Study Plan

Problem Statement

The exposure to HAP air emissions from major sources, area sources, and mobile sources (both on- and off-road) in a county may be causing unacceptable long-term inhalation health risks to people in this county.



Study Plan - Key Components:

- A cumulative risk assessment based on air dispersion modeling, augmented with exposure modeling, will be performed to evaluate potential chronic and acute human health impacts of inhalation exposures to all HAPs emitted by all known sources in the county.
- Inhalation risks will be assessed for residential-type exposures and sensitive receptors (e.g., hospitals, schools, and nursing homes).
- Limited air dispersion monitoring will be performed to evaluate the modeling results, look for gaps in the emissions inventory, and help to evaluate potential hotspots.

What this Analysis Will Not Evaluate:

- Non-inhalation pathways will not be assessed.
- Risks to ecological receptors will not be assessed.
- Long-range transport from outside the county will not be considered.

4.4 Problem Formulation

During the planning and scoping steps described above, the partnership team will have provided answers to several key questions such as:

- What are the goals of the assessment?
- What are the specific questions the assessment will try to answer?
- What is the scope of the analysis?

They will have also written a summary statement of what they think the problem is and how (generally) they are going to study it. As they are performing these tasks, they will also need to further formulate the problem by building a formal **conceptual model** that explicitly identifies and describes all the sources, chemicals, receptors, exposure pathways, and potential health impacts that will be the focus of the assessment. (In the example problem statement provided in the previous text box, a simplified conceptual model was drawn to illustrate the general concept of the potential air toxics problem. The formal conceptual model expands on this generalized version by providing the details of each element contained within the model - see Section 4.4.1).

The last step in the process (after development of the formal conceptual model) is the development of an **analysis plan** that outlines the specific analytical approaches that will be used to actually perform the assessment. Another important part of problem formulation is developing study-specific DQOs to guide data collection and analysis. Each of these is discussed in a separate subsection below.

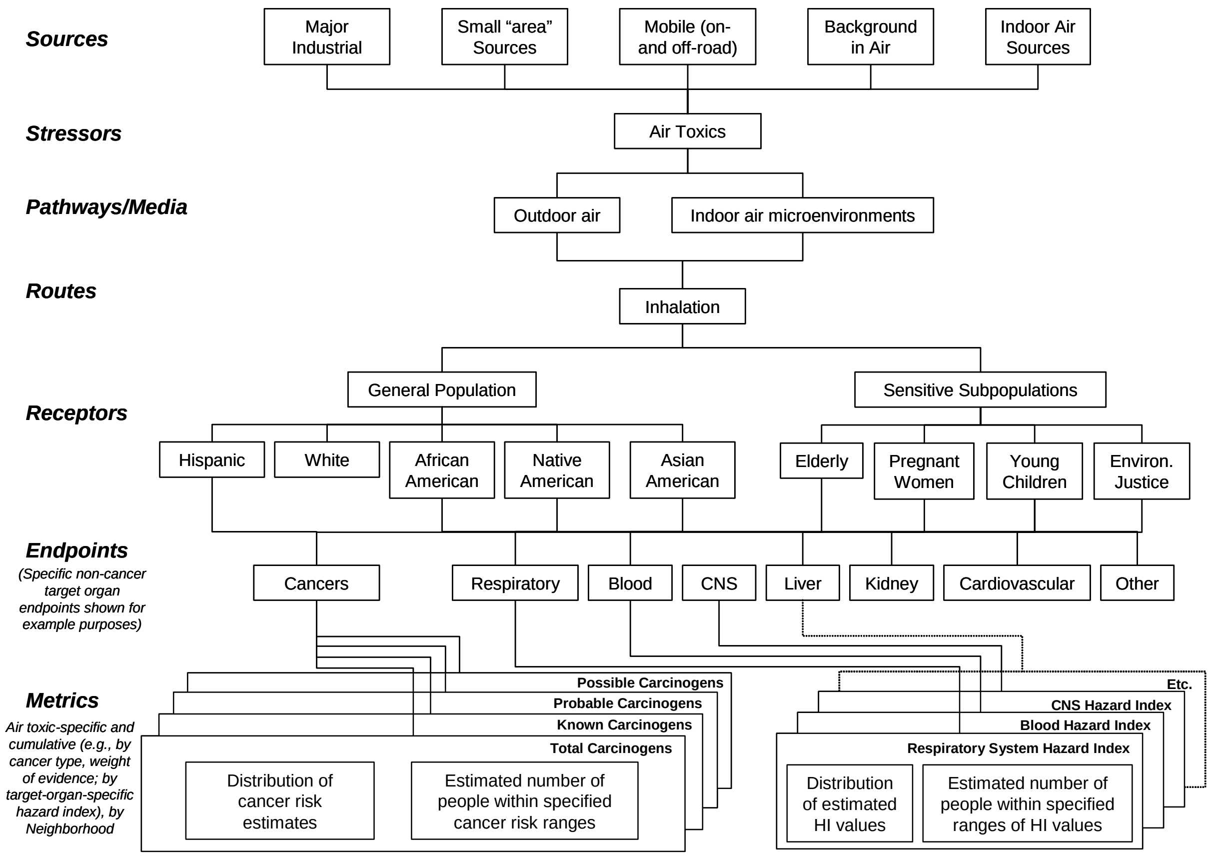
4.4.1 Developing a Multisource Conceptual Model

The study-specific conceptual model explicitly identifies the sources, chemicals, receptors, exposure pathways, and potential adverse human health effects of interest, their interrelationship, and specifies those aspects that the multisource community-scale assessment is going to evaluate. The conceptual model also describes the physical boundaries of the assessment area.

The conceptual model usually is illustrated using a picture (e.g., a flow diagram) of each model and is augmented with a written description of the actual names/locations of sources, the chemicals they release, the populations of concern and their location, the pathways by which the chemicals move from the point of release to the point of exposure (including the routes of exposures), and the specific potential health impacts of concern. The conceptual model is not static and the assessment team may revise or refine the conceptual model during the course of the risk assessment as they learn more about the study area. Exhibit 4-7 provides an example of a generalized conceptual model for multisource community-scale inhalation assessments.

The conceptual model may also include elements other than releases to air that may contribute to health impacts (e.g., waste sites, drinking water), even if these are not going to be quantitatively evaluated in the overall community-scale assessment. Including such other sources reminds all involved that air toxics likely represent only part of the overall health problem within the community (and may serve as a “placeholder” to guide future analyses).

Exhibit 4-7. Example Conceptual Model for a Multisource Community-based Inhalation Air Toxics Risk Assessment



This figure illustrates an example of a conceptual model for air toxics risk assessments. The conceptual model for a specific risk assessment will likely include only part of this model.

4.4.2 The Analysis Plan

After developing a formal conceptual model, the risk assessment team will then develop an analysis plan that details the link between each element of the conceptual model and the specific analytical approach that will be undertaken to evaluate the element (see ATRA Volume 1, Chapter 6). The analysis plan describes each of the analytical approaches (e.g., emissions characterization, risk calculations, etc.) in sufficient detail to assure that data of sufficient quantity and quality are developed to support the risk management decision. (The DQO process establishes what constitutes "data of sufficient quantity and quality." A general discussion of systematic planning, including the data quality objectives process, is discussed in ATRA Volume 1, Chapter 6, and in the chapters that follow).

The analysis plan is most helpful when it contains explicit statements of how the assessment team selected the various analytical approaches, what piece of the conceptual model they intended the approach to evaluate, how the approach integrates with other analytical elements, and specific milestones for completing the task. The analysis plan should include all methods, approaches, and assumptions that will be employed and, when possible, a discussion of known uncertainties associated with the analytical approach and methods for addressing these uncertainties.

The analysis plan may not result in just one document, but rather a combination of multiple work plans that, taken together, constitute "the analysis plan." For example, in a study where the assessment team will perform air dispersion modeling as part of the exposure assessment and air monitoring to assess the model results, the assessment team will develop separate work plans for the modeling and monitoring efforts. When multiple work plans are generated, it will be helpful to develop a master analysis plan that describes all the different analytical pieces and their relationship to one other. Exhibit 4-8 provides an example of the various pieces of a sample analysis plan for a community-level, multisource assessment.

Exhibit 4-8. Example Analysis Plan for a Multisource Community-scale Inhalation Air Toxics Assessment

A full scale multisource inhalation air toxics risk assessment will generally require a number of different analytical activities to happen (many of them simultaneously) by people with different expertise. Each of these major analytical steps will usually have its own workplan. However, a **master analysis plan** should be developed that describes the overall analytical framework and the relationship of all the analytical pieces to one another. This master plan should also show the linkages of the analysis plan to the conceptual model. Some of the most common workplans that will be developed as part of the overall analytical framework include the following:

- **Risk Assessment Workplan.** This workplan describes the overall process that will be used to perform the exposure assessment, toxicity assessment, and risk characterization. (If modeling and monitoring are performed as part of the exposure assessment, they will generally have their own workplans that interface with the risk assessment workplan – see below.) In particular, the risk assessment workplan will lay out any assumptions or surrogates that will be employed, the procedures that will be used to gather data about the study area population (e.g., demographic and location data), how any exposure modeling will be performed, how toxicity data will be identified, and the procedures that will be used (including equations) to calculate risk. The workplan will also discuss the DQO's for each step, the QA/QC procedures needed to ensure high quality work and products, how the efforts described by the workplan interface with other work efforts such as air dispersion modeling and monitoring studies, documentation requirements, schedules, and roles and responsibilities.

- **Air Dispersion Modeling Workplan.** This workplan describes the process by which the emissions inventory will be assessed and, if necessary, augmented for input into the air dispersion modeling. (A separate **Emissions Inventory Development Workplan** may also be developed and cited by the dispersion modeling workplan.) The model selection process will be described as well as the details of how the modeling will be performed. The workplan will also discuss the DQO's for the modeling effort, the QA/QC procedures needed to ensure high quality work and products, documentation requirements, schedules, roles and responsibilities, and how the efforts described by the workplan will interface with other work efforts such as monitoring studies.

- **Air Monitoring Workplan.** This workplan describes the process by which air monitoring data will be developed. The plan will usually discuss how the results will be used to assess the air dispersion modeling results, look for gaps in the emissions inventory, and evaluate hot spots. The workplan will also discuss the DQO's for the monitoring effort, the QA/QC procedures needed to ensure high quality work and products (including data validation), how the efforts described by the workplan will interface with other work efforts such as air dispersion modeling studies, and documentation requirements, schedules, and roles and responsibilities.

Additional References for Getting Started and Planning the Analysis

Community-Based Environmental Protection: A Resource Book for Protecting Ecosystems and Communities (http://www.epa.gov/ecocommunity/tools/resourcebook.htm)

Air Toxics Community Assessment and Risk Reduction Projects Database (http://yosemite.epa.gov/oar/CommunityAssessment.nsf/Welcome?OpenForm)

Risk Assessment Protocols for Hazardous Waste Combustion Facilities (http://www.epa.gov/epaoswer/hazwaste/combust.htm#risk)

Key Sources of Information on Pollution-related Risks Faced by Communities

General Information Gateways

- EPA's Envirofacts Information Gateway (http://www.epa.gov/enviro/)
- EPA's EnviroMapper Information Gateway (http://www.epa.gov/enviro/html/em/index.html)
- EPA's Toxic Release Inventory Information Gateway (http://www.epa.gov/tri/)

Outdoor Air Pollution

- EPA's Office of Air and Radiation Air Pollution Information Gateway (http://www.epa.gov/ebtpages/air.html)
- EPA's Criteria Pollutants Gateway (http://www.epa.gov/air/urbanair/6poll.html)
- EPA's Hazardous Air Pollutants Gateway (http://www.epa.gov/ebtpages/airairpohazardousairpollutantshaps.html)
- EPA's National Air Toxics Assessment (http://www.epa.gov/ttn/atw/natamain/)
- EPA's Trends in Air Pollution (http://www.epa.gov/airtrends/index.html)
- EPA's Technology Transfer Network Air Toxics Website (http://www.epa.gov/ttn/atw/)
- EPA's Pollutants and Sources (http://www.epa.gov/ttn/atw/pollsour.html)
- EPA's Notebook on Local Urban Air Toxics Assessment and Reduction Strategies (http://www.epa.gov/ttn/atw/wks/notebook.html)
- EPA's Clearing House for Inventories and Emission Factors (CHIEF) (http://www.epa.gov/ttn/chief/index.html)
- EPA's AirNow Website (http://cfpub.epa.gov/airnow/index.cfm?action=airnow.main)
- EPA's AirData Website (http://www.epa.gov/air/data/index.html)

Indoor Air Pollution

- EPA's Office of Air and Radiation Indoor Air Pollution Information Gateway (http://www.epa.gov/ebtpages/airindoorairpollution.html)

Mobile Source-related Air Pollution

- EPA's Mobile Source Pollutants Gateway (http://www.epa.gov/ebtpages/airmobilesources.html)

References

1. U.S. Environmental Protection Agency. 2004. *Community Air Screening How-To Manual, A Step-by-Step Guide to Using Risk-Based Screening to Identify Priorities for Improving Outdoor Air Quality*. EPA-744/B-04-001. Available at: http://www.epa.gov/ttn/fera/risk_atra_main.html

2. U.S. Environmental Protection Agency. 2001. *Risk Assessment Guidance for Superfund (RAGS): Volume I - Human Health Evaluation Manual (Part D, Standardized Planning, Reporting and Review of Superfund Risk Assessments) Final*. Office of Emergency and Remedial Response.
Available at: http://www.epa.gov/oswer/riskassessment/ragsd/index.htm.

3. National Research Council (NRC). 1983. *Risk Assessment in the Federal Government: Managing the Process* (The "Red Book"). National Academy Press, Washington, D.C.

4. U.S. Environmental Protection Agency. 2005. *Toxics Release Inventory (TRI) Program.* Figures generated using TRI Explorer on TRI website, available at http://www.epa.gov/tri/; figures represent values for 2003 (latest year publicly available).