VOLUME I

INTRODUCTION TO THE EMISSION INVENTORY IMPROVEMENT PROGRAM

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DISCLAIMER

As the Environmental Protection Agency has indicated in Emission Inventory Improvement Program (EIIP) documents, the choice of methods to be used to estimate emissions depends on how the estimates will be used and the degree of accuracy required. Methods using site-specific data are preferred over other methods. These documents are non-binding guidance and not rules. EPA, the States, and others retain the discretion to employ or to require other approaches that meet the requirements of the applicable statutory or regulatory requirements in individual circumstances.

ACKNOWLEDGEMENT

This document was prepared by Joe Mangino of Eastern Research Group, Inc., for the Steering Committee, Emission Inventory Improvement Program, and for Steve Bromberg of the Emission Factor and Inventory Group, U.S. Environmental Protection Agency.

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INTRODUCTION TO THE EMISSION INVENTORY IMPROVEMENT PROGRAM

The Emission Inventory Improvement Program (EIIP) was established in 1993 to promote the development and use of standard procedures for collecting, calculating, storing, reporting, and sharing air emissions data. The EIIP is designed to promote the development of emission inventories that have targeted quality objectives, are cost-effective, and contain reliable and accessible data for end users. To this end, the EIIP is developing inventory guidance and materials which will be available to states and local agencies, the regulated community, the public, and the EPA. The materials prepared under EIIP will:

- Establish standardized procedures for the preparation of emission inventories by presenting preferred and alternative methods for emissions estimation;

- Promote consistency within inventories among reporting agencies/groups;

- Document consistent quality assurance (QA)/quality control (QC) methods applicable to all inventory programs;

- Provide guidance to improve the current system of data collection and reporting; and

- Specify a standard data model and data transfer format to facilitate sharing of data among agencies.

These guidance materials are being developed for point, area, mobile, and biogenic sources typically included in air emissions inventories.

The EIIP is a joint program of the State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials (STAPPA/ALAPCO) and the U.S. Environmental Protection Agency (EPA). Both of these organizations are represented in the Standing Air Emissions Work Group (SAEWG), which endorsed the original EIIP plan. Figure 1.1-1 shows the steps in the implementation of the EIIP. While the EPA coordinates the EIIP efforts, all of the tasks are performed by working committees made up of state and local

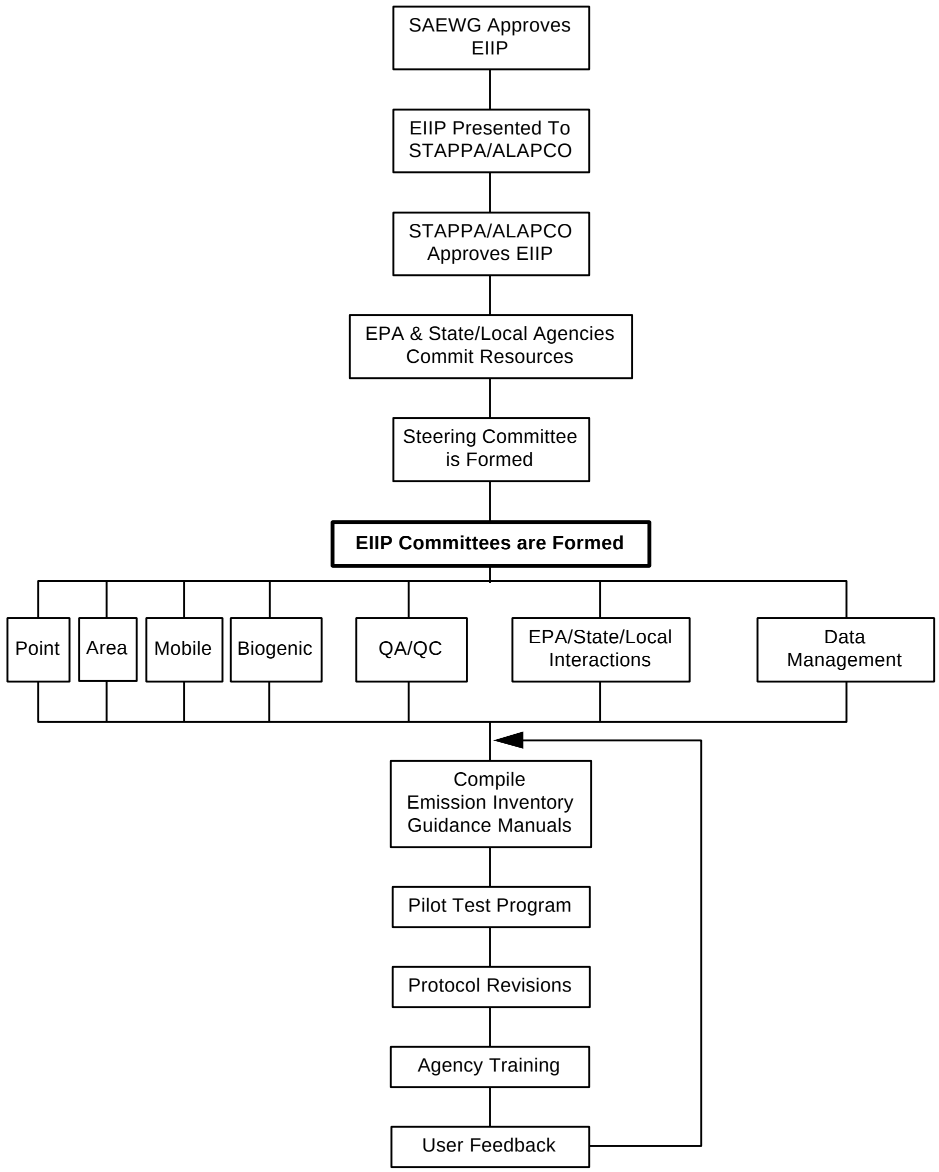

FIGURE 1.1-1. STEPS FOR IMPLEMENTING THE EIIP

agency personnel, EPA and industry. The following working committees have been formed:

- Steering Committee;
- Point Sources Committee;
- Area Sources Committee:
- Mobile Sources Committee;
- Biogenics Sources Committee;
- Quality Assurance Committee;
- Data Management Committee; and
- Governmental Interactions Committee.

The committees oversee and direct the development of procedural manuals, pilot studies, and all other activities associated with their particular facet of the inventory. The specific roles and activities of each of the committees are described in detail in Section 1.2 of this volume.

A significant portion of the guidance material produced thus far appears in a series of EIIP documents that are specific to each of the working committees. Figure 1.1-2 shows the volume titles in the initial series of EIIP documents. The methods used in developing the guidance, the approach taken, and the work products (in addition to the core guidance) have evolved with slight variations as each committee addresses the issues unique to their particular segment of the inventory. The scope and content of the EIIP guidance documents are summarized in Section 2.2 of this volume.

1.1 IMPORTANCE OF EMISSION INVENTORIES

An air emissions inventory can range from a simple summary of estimated emissions compiled from previously-published emissions data to a comprehensive inventory of a facility using specific source test data that will be used to support compliance activities. Just as there are different types of emissions inventories, their usage is varied and continually expanding. Because of this wide use of inventory data, the EIIP will benefit not only state and local air pollution agencies, but industry and EPA as well.

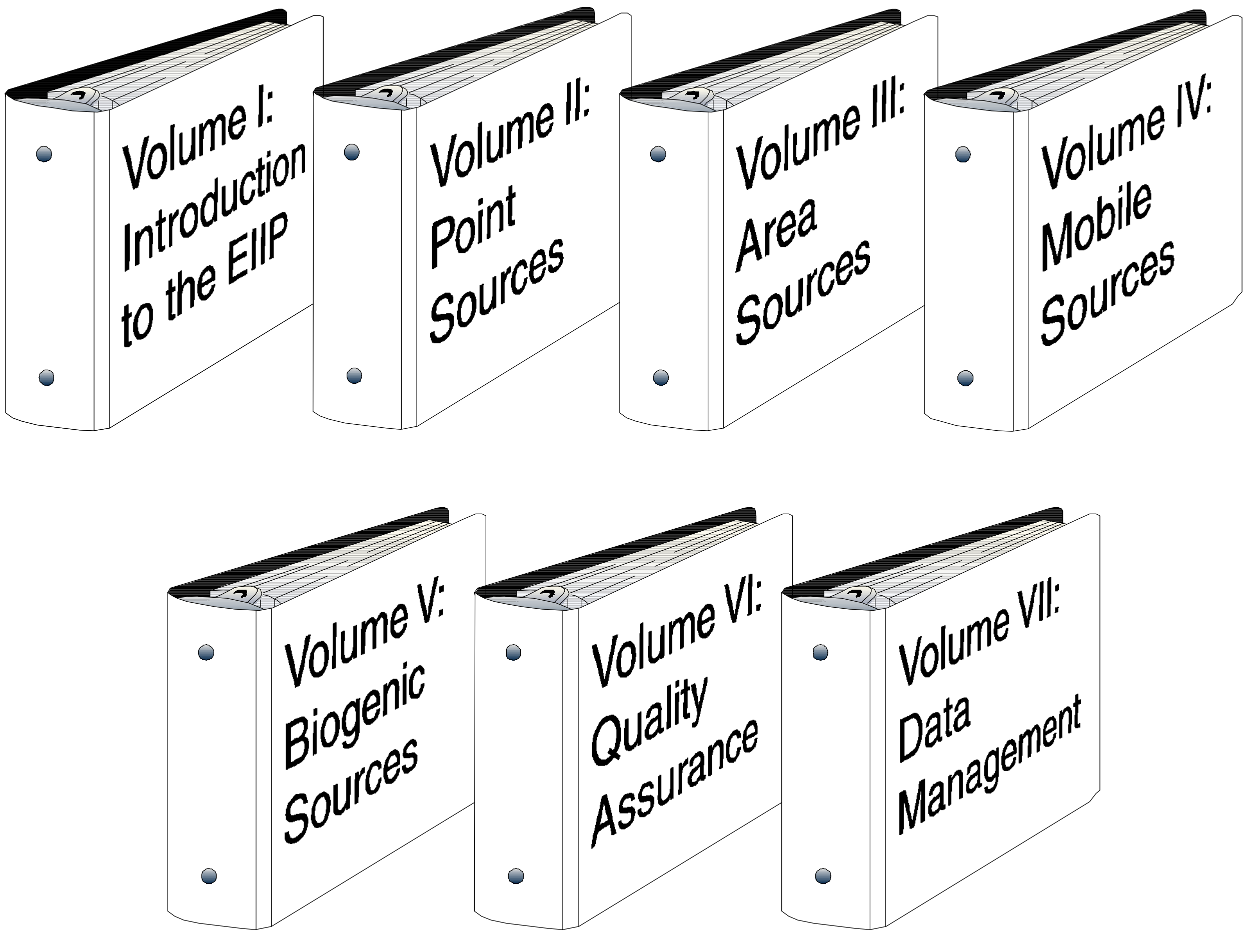

FIGURE 1.1-2. EIIP DOCUMENTS

The applications for emissions inventory data include use of the data in annual trends reports, State Implementation Plans (SIPs), compliance demonstrations, emissions trading, emissions fees programs, and in modeling activities designed to evaluate ambient air concentrations encountered by the general public. For the SIP program, the air emission inventory is a fundamental building block in developing an air quality control and maintenance strategy. Section 172, Part C, of the Clean Air Act (CAA) as amended in 1990, which addresses SIP requirements, states that ". . . plan provisions shall include a comprehensive, accurate, current inventory of actual emissions from all sources or the relevant pollutants or pollutants in such area . . ." Regulatory agencies and industrial facilities rely on emission inventories on an ongoing basis as indicators of air quality changes and for setting permit requirements.

Air emission inventories may also be developed for research purposes. For example, concern over the prospect of global warming has prompted the development of regional, national, and global inventories of greenhouse gases. At a smaller scale, pilot studies or field tests of new control techniques or devices may require preparation of emission estimates from a single source to measure effectiveness of the technique.

The importance placed on emission inventories requires that they be of the highest quality obtainable considering their end use. Since they are the foundation of many air quality decisions, inventory quality is critical to defining realistic regulations and attainment strategies. Deficiencies and inconsistencies in existing compilation processes accentuate the need for developing and implementing more uniform and systematic approaches to collecting and reporting data. One of the primary goals of the EIIP is to improve the quality of inventory data so that it is a reliable source of information for sound decision making.

1.2 EIIP COMMITTEES

Following is a brief description of each of the EIIP committees' goals, and current and planned activities. While sharing the same overall goals of the EIIP to improve the quality of emission inventories, each committee is unique in the issues affecting its particular sources and the approaches used to address those issues. Each committee is chaired by one state/local agency representative and an EPA representative and is composed of state/local agency, industry, and EPA representatives.

1.2.1 POINT SOURCES COMMITTEE

The Point Sources Committee (PSC) was formed to develop a series of guidance documents intended to familiarize the private and government sectors with the basic concepts and procedures involved in estimating air pollutant emissions from industrial processes as well as to provide instructional guidance on preferred methods for developing emission inventories. Cumulatively, the series of documents will provide a comprehensive set of manuals which will serve the user in generating a point source emissions inventory.

The PSC seeks participation from several different arenas. The committee works closely with the EIIP Area Sources Committee to develop guidance manuals on processes common to both types of inventories, such as surface coating operations. Through information gathering efforts, state agency workers have been introduced to the EIIP and have joined the working committee, serving in various roles (some as technical reviewers, some as authors, some as technical advisors). The PSC has also worked closely with industry and trade associations on document development efforts. Specifically, the National Asphalt Pavement Association and the National Paint and Coatings Association (NPCA) have actively participated in document development. PSC members have toured facility sites with members of these industry groups to better understand their overall activities.

PSC members have attended meetings of the NPCA and the American Electronics Association to request their assistance through "partnering" in developing guidance documents for the industries. During national meetings of the Air and Waste Management Association (A&WMA), the PSC has surveyed attendees for suggestions and rationale for selecting source categories for guidance document development. A database with results of these two surveys is maintained by the committee.

PSC members also spoke with personnel at state air pollution control agencies across the United States and acquired emissions estimation guidance information pertinent to the industries within their states. The information was reviewed and, where applicable, emission estimation approaches were standardized for presentation in the guidance documents. The committee is also actively involved in the development of the EIIP data transfer model (see Section 1.2.6 for more information), which will be used as a mechanism for transferring inventory data to other user formats.

1.2.2 AREA SOURCES COMMITTEE

The primary goal of the Area Sources Committee (ASC) has been to develop improved methods guidance for area source inventories. Other objectives include:

- Achieve consistency among inventories;
- Provide flexibility in inventory development at the preparing agency level;
- Identify new and innovative methods;
- Support planning and QA/QC in inventory development.

To achieve this goal, the committee surveyed the inventory community to find out which source categories were seen as high priority for methods improvement chapters in the ASC EIIP guidance document. Each chapter in Volume III is written to discuss the unique aspects of the source category. One of the main issues encountered by the ASC in developing their document was the selection of preferred methods versus alternative methods for presentation in each of the chapters (see Section 2.3.1 for further discussion on the selection of "preferred" vs. "alternative" methods).

1.2.3 MOBILE SOURCES COMMITTEE

The main focus of the Mobile Sources Committee (MSC) is to provide specific guidance on how state and local agencies could better take advantage of potential locality-specific data sources and, at the same time, retain a known level of quality and completeness in their inventory. Currently, the committee has concentrated its efforts on onroad mobile sources, specifically on providing locality-specific inputs for the EPA's MOBILE and California's EMFAC emission factor models. Also included in the mobile sources document is the development of locality-specific inputs from transportation demand models and the use of local data for making vehicle miles traveled (VMT) projections. The specific guidance developed by the MSC is to be used in conjunction with EPA's existing guidance on procedures for estimating emissions from mobile sources (EPA, 1992a) . Future efforts of the MSC include a top-down evaluation of the MOBILE model and attention to nonroad mobile source issues.

1.2.4 BIOGENIC SOURCES COMMITTEE

The Biogenic Sources Committee (BSC) is composed of members from the EPA, states/local agencies, and academic institutions. The specific objective of the work of the BSC has been to develop consistent emission inventory preparation guidance for emissions of volatile organic compounds (VOC) and nitrogen oxides (NO_x) from biogenic sources such as forests, agricultural crops and soils, lightning, and natural gas and oil seeps.

The BSC's primary work product is a final document of preferred and alternative methods, much like the point and area source volumes. However, the bulk of Volume V focuses on the use of Biogenic Emission Inventory System (BEIS)-2 (and similar computer models) for estimating emissions from vegetation, and addresses the needs of inventory preparers and modelers who want to develop biogenic emission estimates using these models.

1.2.5 QUALITY ASSURANCE COMMITTEE

The Quality Assurance Committee (QAC) was formed to develop: (1) a plan for the EIIP's QA program; (2) a comprehensive QA source document of methodologies and tools to use in developing emission inventories; and (3) an emission inventory quality rating system. The QAC's objectives have been achieved though a variety of activities including the development of the EIIP's *Quality Assurance Procedures* document (Volume VI), the adaptation of the Data Attribute Rating System (DARS) for state inventories, and by providing review and assistance on QA/QC to the other committees.

The QAC reviewed existing EPA guidance (EPA, 1986; EPA, 1988; EPA, 1989; EPA, 1992b; EPA, 1994a), and felt that while it adequately addressed fundamental QA principles, inventory preparers needed more concrete guidance that included tools and methods that could be used to implement QA programs. Furthermore, the issue of uncertainty has become an increasingly important topic for inventory developers and users; therefore, the QAC expanded the purpose of emission inventory QA to include measures to document (qualitatively and quantitatively) uncertainty. The QA volume relies heavily on examples from actual inventories to demonstrate the use of alternative QA methods.

In addition to the QA volume, the EIIP QAC sponsored training in the use of DARS to evaluate emission inventories. Workshops were held in which states and local agency personal participated. The results were used to standardize the DARS, and to develop guidance materials to assist state and local agencies in evaluating their inventories. The training materials developed for those workshops are included in the QA volume. The QAC is currently sponsoring the development of the DARS software system.

1.2.6 DATA MANAGEMENT COMMITTEE

The primary goal of the Data Management Committee (DMC) is to develop and facilitate a data exchange mechanism for the emission inventory community. The DMC is not producing a database system but, rather, a standard data transfer format and transfer procedure that is independent of the databases from which the inventory data originates. Because of the many different emission inventory data management systems that are used by preparing agencies, standardization of the inventory data elements, their meaning, and their relationships is necessary to prepare the transfer/exchange protocol.

The DMC has developed a EIIP Phase I data model (hereafter referred to as the "Data Model") with its initial effort focussed on the electronic exchange of data for baseline SIP inventories, attainment demonstration modeling, and air quality strategy development.

Figure 1.1-3 shows the flow of data using the Data Model. The data transfer format used in the Data Model is based on the Electronic Data Interchange (EDI) X-12 Standard, which is an existing and fully functional standard that is accepted by the EPA, other government sectors, and industry. The DMC envisions future development of the Data Model so that it can be used for other purposes such as permitting, emission reduction credits, and emission cap and trading programs.

1.2.7 GOVERNMENTAL INTERACTIONS COMMITTEE

The Governmental Interactions Committee (GIC) examines the relationship between various agencies and government bodies involved in the emission inventory process. The GIC prepared a report entitled *Roles and Responsibilities of Government Agencies in the Development of Emission Inventories* (EPA, 1995). This report contains guidelines and flow charts which explain the inventory process and generally define the roles and responsibilities of each participating group. The discussion focuses primarily on the development of city/county scale inventories that require some level of EPA review, such as ozone or carbon monoxide nonattainment area SIP inventories.

1.3 EIIP COMMITTEE PRODUCTS

The initial work products of the EIIP committees include this set of manuals (Volumes I through VII), a version of the EIIP Data Model, and pilot studies and training using the EIIP version of the DARS. Hard copies of the manuals are available from the National Technical Information Service.[a] Electronic copies of the EIIP documents can also be retrieved from the CHIEF Internet World Wide Web site (www.epa.gov/ttn/chief/).

[a] NTIS, U.S. Department of Commerce, Springfield, VA 22161, telephone (800) 553-6847.

[b] For information on the different options available to retrieve documents from the TTN BBS, contact the TTN 2000 helpline at (919) 541-5384.

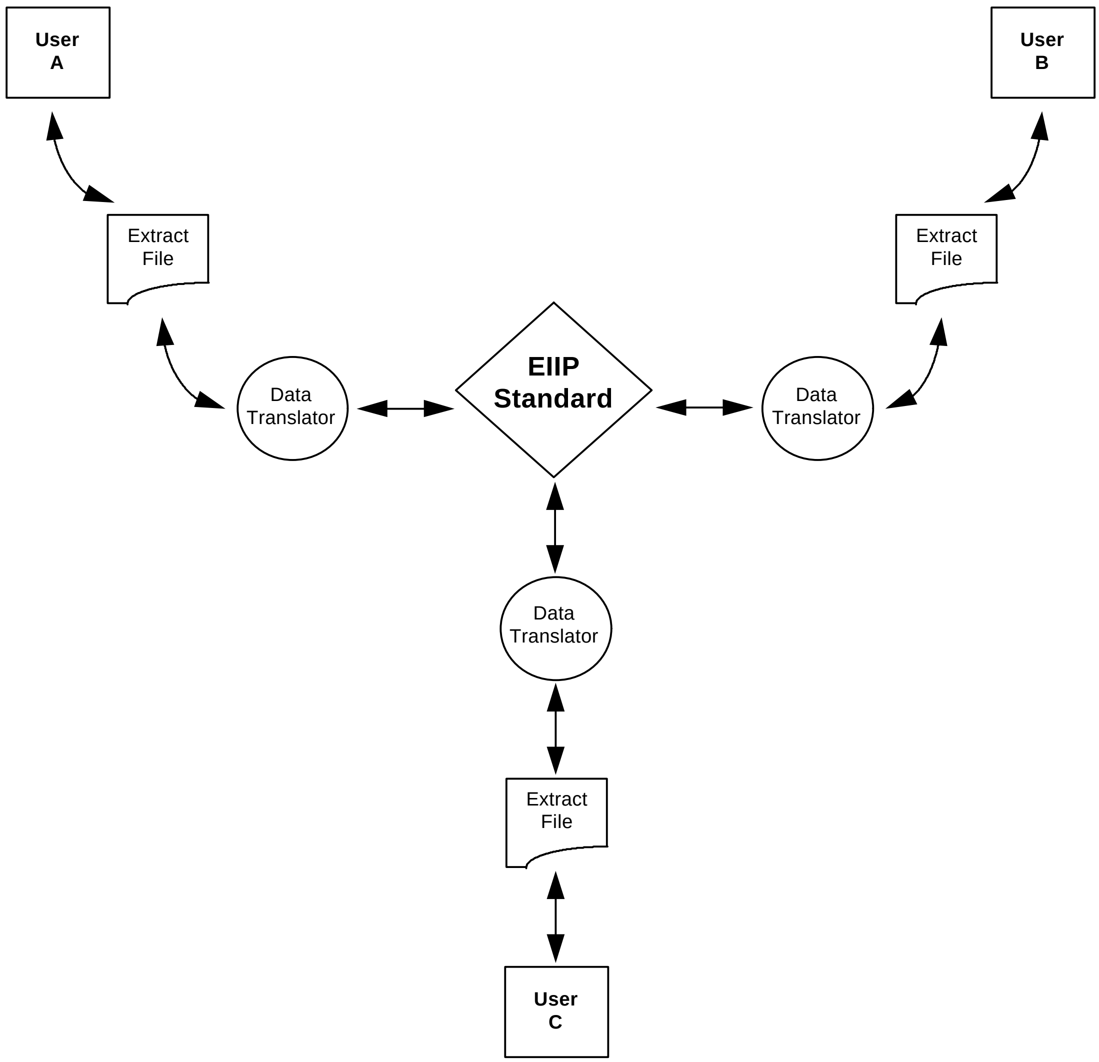

FIGURE 1.1-3. DATA TRANSFER USING THE EIIP DATA MODEL

1.4 ORGANIZATION OF VOLUME I

Section 2 of this document provides details on how to use the EIIP documents, particularly the usage of “preferred” and “alternative” emission estimation methods.

Section 3 of this volume discusses training considerations for staff who will be preparing emissions inventories, conducting QA checks, or working with the Data Model. Training is a key inventory preparation exercise which directly affects the quality of the resulting emissions inventory.

Inventory planning procedures are covered in Section 4. Planning is another critical step in the emissions inventory process which cannot be overlooked or trivialized. Careful planning is needed to assure that inventory end-uses are identified and met, and that time schedules and resources (personnel and budget allocations) are established that will not compromise the quality or comprehensiveness of the inventory.

Section 5 discusses inventory development steps in general terms so that inexperienced inventory preparers can visualize the numerous steps that must be taken in preparing an emissions inventory.

Reporting and documentation is discussed in Section 6 of this volume. Elements of a written document, examples of standardized reporting formats, and the increasingly important need for the electronic transfer of inventory data are covered in this section.

References cited in this volume are presented in Section 7. A glossary of terms commonly used throughout all the volumes in the EIIP series is presented in Section 8, with the terms grouped by the subject of each volume (e.g., point sources, area sources). The exception is data management; because of the technical nature of the terms and symbols used in the data management volume, the reader is referred to Chapter 1, Appendix B, Data Element Dictionary, of Volume VII.

Appendix A contains a list of EIIP committee members with addresses and phone numbers for those needing further information on a particular committee.

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2

IMPLEMENTATION OF EIIP GUIDANCE

2.1 PURPOSE OF EIIP GUIDANCE

The goal of the EIIP is to provide guidance on the development of cost-effective, reliable inventories by improving the quality of emissions data collected and providing for uniform documentation and reporting of this information. The EIIP has adopted a philosophy that the use of standardized emission estimation procedures will produce data of increased precision, accuracy, and consistency. Using standardized approaches enables industry, federal, state, and local agencies to generate data of known quality at acceptable costs.

In order to achieve its goal, the EIIP has implemented a system for presenting preferred and alternative methods for estimating air emissions so that agencies will use this guidance in the development of their inventories. Emission estimation methods have been delineated for many point, area, mobile, and biogenic source categories. For example, EPA's widely used *AP-42* document (EPA, 1995-1996) contains many emission factors and source category data that can be used to estimate emissions. The EIIP guidance does not replace the *AP-42* document, but instead supplements and complements it.

The EIIP's system of preferred and alternative methods selection for estimating emissions allows users to match the end-uses of their inventory to the inventory development efforts. Inventory preparers, for example, can select a preferred or alternative estimation method for an individual source category based on the significance they assign to that source category . By referring back to the EIIP guidance, subsequent data users can decide whether the quality is adequate to meet their needs; if it is not, the inventory preparer then has the option of collecting higher quality data if improved methodologies are available or using an alternative method, if for example, available resources will not allow the use of a preferred method.

The EIIP's emissions inventory preparation guidance has been developed to ensure that consistent and unambiguous procedures are used to do the following:

- **Identify all emission sources in a defined area**. The EIIP provides guidance on how to identify sources that should be included in an emissions inventory.

- **Select methods to estimate emissions from each source.** Guidance is provided to estimate emissions and choose between preferred and alternative emission estimation methods based on accuracy.

- **Identify and select data sources for activity levels and other parameters required by an emission estimation method.** The EIIP documents specify the minimum data elements required to estimate emissions for each method and provides guidelines for obtaining data efficiently.

- **Perform QA/QC checks on the inventory**. The EIIP QA volume presents techniques, tools, and methods used for assuring the quality of inventory data.

- **Document emission estimation methods, data sources and QA/QC procedures.** Proper documentation is stressed throughout all volumes of the EIIP documents to ensure reliability and accuracy of results, reproducibility of emissions estimates, and instill confidence in the inventory.

- **Collect and transfer data.** Guidance on data collection, storage, and handling is provided in the guidance documents. The EIIP's Data Model was designed to standardize data transfer efforts by state and local agencies, industry, and federal agencies.

Figure 1.2-1 depicts the major processes involved in preparing an emission inventory. The diagram highlights significant decision points and steps in the implementation of EIIP guidance.

The EIIP guidance allows industry, state, and local agencies to choose the inventory development method that matches their needs, priorities, and budgets. However, the burden of properly using inventory data falls on the end-users of the inventory. In the past, many data requestors did not know the quality of information required to meet their needs, but wanted the "best" data they could get. The EIIP approach places the responsibility on users to realize that the data may be inadequate even though it may be the best available. The inventory preparer is strongly encouraged to document the data quality, evaluate the impact on emissions estimates, and to prioritize inventory-development efforts to focus resources where they have the most impact. This will allow end-users to make an informed decision on the use of the data. A discussion of sources of uncertainty is provided for each source type in Volumes II through V of the EIIP document series, and methods for assessing uncertainty (quantitatively and qualitatively) are discussed in Volume VI.

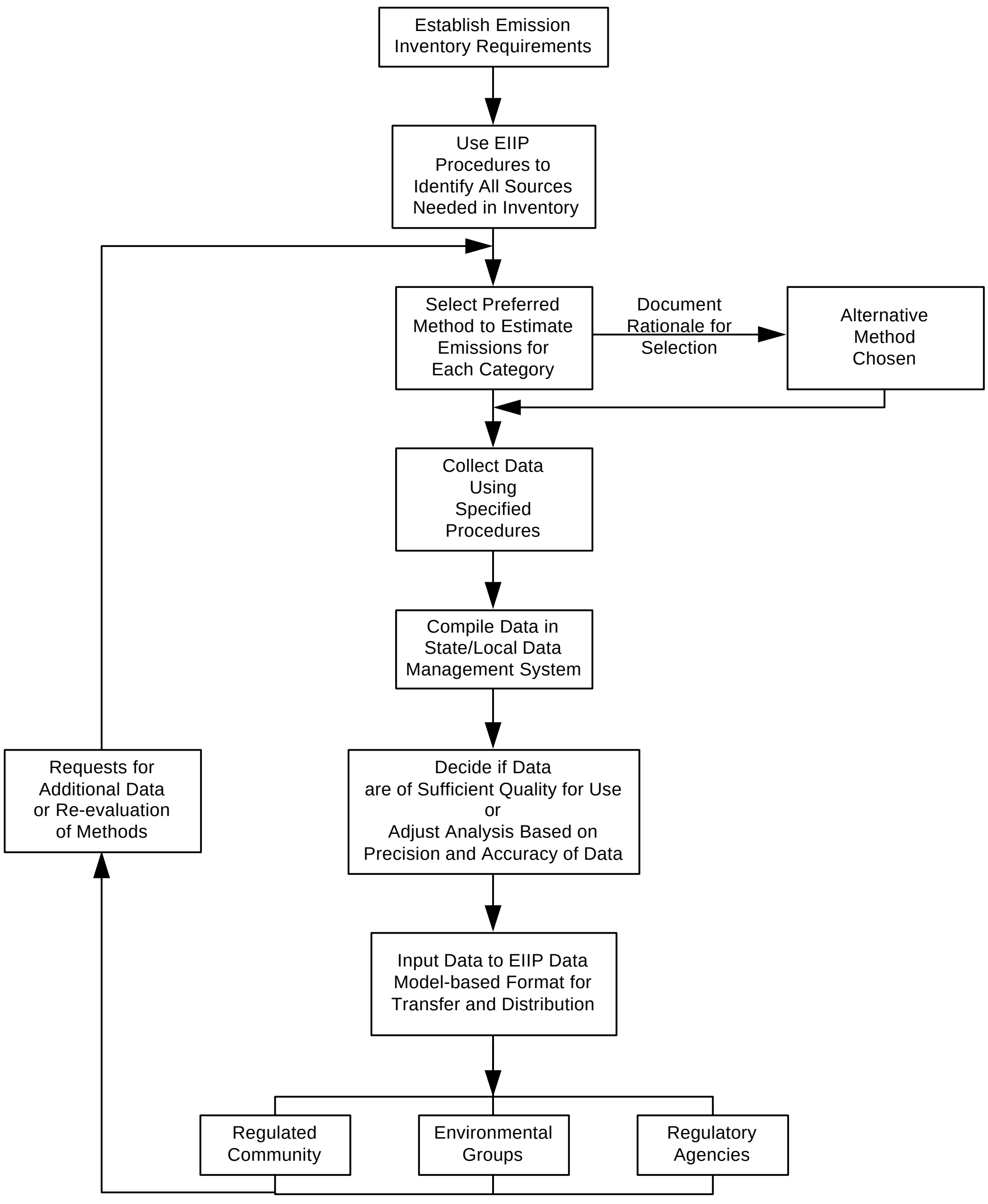

FIGURE 1.2-1. EMISSION INVENTORY PROCESS

2.2 SCOPE AND GENERAL CONTENT OF DOCUMENTS

The following is a summary of the information contained in each of the seven EIIP volumes.

Volume I: Introduction to the EIIP. This introductory volume describes the concept, implementation, and goals of the EIIP. The EIIP's focus on standardized inventory development approaches through the selection of preferred or alternative emission estimation methods is discussed. Also, general emission inventory concepts are explained.

Volume II: Point Sources. The overall goal of Volume II is to familiarize the private sector with the basic concepts and procedures involved in estimating air pollutant emissions from industrial processes, and provide instructional guidance to state and local agency personnel on preferred methods for developing emission inventories. The emission inventory procedures presented in Volume II are specific to point sources. Practical, detailed calculations and procedures applicable to specific categories are provided within each chapter. These chapters present several different estimation scenarios and provide example calculations to aid in actual emission estimation. A brief discussion is presented on the source category, available control techniques, and QA/QC. The source classification codes (SCCs) needed for entry of the data into a database management system are presented. Data collection forms are included as well.

Volume III: Area Sources. Volume III addresses the process of planning and developing an area source inventory. Fundamental emission estimation approaches are presented, and inventory management, QA/QC, and documentation procedures are discussed. Each chapter contains a general description of the source category, an overview of available control technologies, and the EIIP's preferred and alternative emission estimation methods, including new and innovative estimation methods where available. A "how-to" approach is provided for each estimation method. The various methods' uncertainty and data coding procedures are also discussed.

Volume IV: Mobile Sources. Volume IV presents guidance for state and local agencies to use in developing motor vehicle emission inventories using Highway Performance Monitoring System (HPMS) and Travel Demand Model (TDM) data. Specifically, Volume IV guides the users in: (1) the conversion of HPMS vehicle miles traveled (VMT) data to EPA's MOBILE emission factor model vehicle classes; (2) the use of TDM data for modeling; and (3) the development of VMT projection data. Preferred methods are presented for each of these three items.

Volume V: Biogenic Sources. Volume V of the EIIP manual series presents preferred and alternative methods for developing VOC and NO_x emission estimates from biogenic sources (e.g., forests, crops, and soils), NO_x emissions from lightning, and VOC emissions from oil and natural gas seeps. The assumptions and uncertainty inherent to each of these methods are described, in addition to the data that must be supplied by the user to estimate emissions. Guidance is provided for the three computer models that can be used to estimate biogenic emissions, as well as another alternative method that involves collecting local information to substitute for defaults in the three models. Biogenic emission estimation models typically provide emission information in a format specific to an air quality model. The input needs of the air quality model therefore typically determine the choice of the biogenic emission estimation model.

Volume VI: Quality Assurance. The purpose of Volume VI is to identify, improve, consolidate, and document QA/QC practices and procedures in all steps of the inventory development and review process. The goal of an emission inventory QA/QC program is to develop and implement techniques for improving inventory consistency and to reduce and document data uncertainty. Within the context of the EIIP, the emission estimation procedures and the inventory QA/QC program are complementary. Volume VI presents tools, procedures, and methods useful for inventory QA/QC. A series of standardized procedures and auditing steps to be used in implementing the QA/QC program have been developed. The standardized QA/QC procedures provide guidance for each step of the emission inventory preparation and reporting process. Also provided are procedures for those using an alternative rather than a preferred method. The QAC worked with the Point, Area, and Mobile Source Committees to ensure that inherent uncertainties in emission estimation methods are discussed as fully as possible.

Volume VII: Data Management. The primary focus of this volume is to provide a unified standard for defining and sharing emissions inventory data, specifically through defining the use and implementation of the EIIP Data Model and the EIIP data transfer standard. The EIIP DMC developed the Data Model to facilitate an improved data exchange mechanism for state and local agencies, EPA, and industry. The EIIP Point, Area, Mobile, and Biogenic Sources Committees identified the data elements needed in the Data Model, and were asked to demonstrate how the data elements related to one another. The resulting organization of the Data Model is similar to that found in many point source inventory systems. However, in order to accommodate area, mobile, and biogenic source types for this application, a greater level of abstraction was needed in terminology as well as in organization. This volume should be used to guide the development of database translation software programs to convert from an agency's current database to standard EIIP format (and vice versa). It also provides a common format for industry to use to submit their data to state/local or federal agencies.

2.3 APPROACH FOR SELECTING METHODS

2.3.1 RATIONALE FOR EIIP'S SELECTION OF METHODS

The EIIP consists of several committees whose mandate is to develop concise, accurate, and innovative inventory development guidance. Emission estimation methods were identified by reviewing procedures used or recommended in the past by EPA, state and local agencies, trade organizations, and research groups. New and innovative emission estimation procedures were particularly of interest to the EIIP committees. Research and development or source test activities for developing new emission factors or activity data, for example, are not within the scope of the EIIP's functions. To select the methods included in the EIIP documents, input was solicited from committee members and a consensus was reached on identifying which methods to include in the documents.

An important aspect of the EIIP's selection of methods was the identification of “preferred” and “alternative” approaches. Selection of a method as preferred or alternative considered several issues. First, the availability of data needed to use a particular method was considered. Both preferred and alternative methods had to be practical for each specific source category; the data had to be available and obtainable with a reasonable amount of effort. Second, the data had to be of suitable quality for developing an emissions estimate. In general, the preferred method is the most accurate and precise of the available estimation methodologies. Alternative methods were identified, however, in the event it was not feasible for the preparing agency to use the preferred approach. In a few cases, a method was found that was very accurate, but required data that would either be very difficult or very costly to obtain (or both). A method of this type would not be selected as the preferred method, but may be included as an alternative.

It is important to emphasize that preferred methods were identified on a source category-specific basis; this means that a method type identified as preferred for one source category (e.g., AP-42 emission factors) may not be the preferred approach for another source category. This is consistent with the EIIP's goal of improving the quality of emission estimates for all point, area, mobile, and biogenic source categories.

2.3.2 RATIONALE FOR USER'S SELECTION OF METHODS

The user of EIIP documents will need to select methodologies that reflect the planned end uses of the inventory and the priority and importance that the user assigns to a certain source category. In practice, different procedures will require different commitments of time and resources. The user should develop realistic selection criteria for inventory methodologies based on staffing, resource availability, and the time allowed for inventory development.

The end use of the inventory is an extremely important consideration in the selection of methods. Data of high quality is the goal in all inventories; however, for certain inventory uses, such as emission limitations and standards, it is imperative that high-quality emission estimates are pursued. Emission limitations and standards must be legally defensible, and therefore the user may have to demonstrate that the best available approach was used to prepare the emission estimates on which they are based.

The inventory preparer must remember that, in some cases, the quality of emission assessments is directly affected by the quality of the variables used in the estimation process. Just because a preferred approach is selected does not mean that a high quality estimate is guaranteed. The preferred approach, in this example, may require previously collected data to calculate emissions; the precision and accuracy of these emissions will be based, in part, on the quality of the original data.

It is important for the user to select their methods and approaches prior to the inventory preparation. This selection should be done for each source category. It is also important for users to be flexible about the method selected if the original method selected can not be performed. For example, a preferred approach may have been selected for an area source category because it would lead to a higher quality emission estimate. However, upon initiation of work, the user realizes that appropriate activity level data can not be readily obtained within the time frame and resources that are allocated. The user may decide that, since this source category is of relatively low priority, an alternative approach is more suitable to complete the inventory. The effects of these decisions on the original quality objectives for the inventory, however, must be considered before proceeding.

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3

TRAINING OF INVENTORY STAFF

Training of staff members can be a key component of the inventory development process. Depending on the experience level of the personnel preparing the inventory and the intended end use of the inventory, training may be a necessary part of the planning process. Appropriate level of staff training is needed to convey information on basic inventory concepts, types of inventories, pollutant sources, and inventory development methods. Training is even more important when an emission inventory is viewed as the fundamental building block in developing an air quality control and maintenance strategy, or when it will be used to demonstrate compliance with existing regulations.

3.1 TOPICS FOR TRAINING

The EIIP series of documents identifies some possible topics for training. The discussions on planning, emission estimation methods, QA/QC, documentation, and database management highlight key points that should be covered in formal or informal training sessions. The decision on what type of training is necessary should be based on an evaluation of the experience of the staff, the technical skills that will be required to prepare the inventory, and the end-use of the inventory.

Training is an on-going process; training requirements for staff preparing the inventory should be regularly reviewed so that the latest skills and guidance are made available to them. The type of training that should be provided depends on the staff's current and future roles and responsibilities in the inventory program. Some staff require training only on point sources, others only on area sources or database management. Training of entry-level staff is particularly important if their long-term goals remain linked to emission inventories and their uses. Since many of the basic concepts of inventory preparation are repeated in different inventory types, particularly those that build on previous efforts such as projection and modeling inventories, consistency among staff is an important issue.

Training should be accounted for in the inventory planning process so that a proper time frame and mechanism can be established for accomplishing it. This includes budgetary commitments and the identification of any specialized training resource needs (e.g., computer software and hardware). There will be some methodologies and tools that are completely new to all staff, and it will be necessary to identify the appropriate personnel for training.

3.2 TRAINING RESOURCES

The EIIP document series can serve as a training tool for inventory development personnel, but the documents are most effective if the user has some basic knowledge of inventories and can understand the concepts discussed. Depending on the level of experience, there are a variety of sources for basic and specialized training in inventory development.

Training of inventory development personnel can be conducted on-site with staff members or off-site through courses offered by agencies such as the EPA. In-house training may consist of reviewing previously-developed inventories, formal or informal discussions with co-workers and supervisors on the importance of planning, documentation, and QA/QC. Regular staff meetings are also necessary to discuss proposed methods, review progress, inform staff of new methodologies or developments, and allow for in-depth question and answer sessions.

In-house training of inventory staff may not be feasible if experienced personnel do not have time to provide guidance on a day-to-day basis. Courses offered by the EPA, private consultants, or trade associations may be a more realistic way for inexperienced staff members to learn the basics of inventory development, and may be held on- or off-site.

The EPA sponsors numerous training courses through their Air Pollution Training Institute (APTI).[a] Table 1.3-1 lists some of the classes routinely offered by APTI. Courses are available on inventory planning, inventory management, point source emissions, emissions calculations, projection techniques, and data reporting. The A&WMA, in conjunction with EPA, sponsors an annual conference specifically devoted to emissions inventories. The A&WMA also offers numerous continuing education courses and workshops throughout the year on air pollution and solid waste permitting, estimation, control technology evaluation, and waste management issues. Examples of some of the A&WMA training courses that are offered are shown in Table 1.3-2.

The TTN 2000 Internet web site (www.epa.gov/ttn/chief/) is an excellent on-line resource for information on training guidance, including documents, memoranda, regulatory news, contact lists of EPA personnel, and databases. Staff members should regularly review the EIIP and the Clearinghouse for Inventories/Emission Factors (CHIEF) sections of this web site in order to keep abreast of the latest information from EPA sources.

[a] For more information, contact the Training Coordinator at (919) 541-3724.

TABLE 1.3-1

EXAMPLES OF AIR POLLUTION TRAINING INSTITUTE COURSES

Air Pollution Dispersion Models-Application	Control of Gaseous Emissions
Analytical Methods for Air Quality Standards	Introduction to Hazardous Air Pollutants
Atmospheric Sampling	Overview of the Clean Air Act Amendments of 1990
Combustion Evaluation	Principles and Practices of Air Pollution Control
Continuous Emission Monitoring	Source Sampling for Pollutants
Control of Particulate Emissions	Sources and Control of Volatile Organic Air Pollutants

TABLE 1.3-2

EXAMPLES OF A&WMA TRAINING COURSES

Fundamentals of New Source Review and Prevention of Significant Deterioration	Title III Air Toxics Workshop
Management of Process Fugitive VOC Emissions	Air Dispersion Modeling and Emission Factors
Title V - Operating Permits Workshop	International Organization for Standardization/Draft International Standards (ISO/DIS) 14000 - Environmental Management Systems
Recent Advances in Continuous Emission Monitoring	Estimating Fugitive Particulates from Various Sources

As discussed throughout the EIIP manuals, the EPA maintains and makes available emissions inventory development tools for those preparing emissions inventories. The CHIEF portion of the TTN 2000 contains the entire *AP-42* document, each document in the *Locating and Estimating Air Emissions* series, the VOC/Particulate Matter (PM) Speciation Database Management System (SPECIATE), a number of air quality dispersion models, the Factor Information Retrieval (FIRE) Data System, and emissions models such as TANKS and the Landfill Air Emissions Estimation Model (LAEEM). The EPA's RACT/BACT/LAER Clearinghouse is also available on the TTN 2000 and contains control technology and permit information for criteria pollutants.

4

INVENTORY PLANNING

The reasons for developing an air emissions inventory are often--but not necessarily--regulatory. Emission regulations or statutes specifically require air emission inventories to determine the amount of pollutants released to the atmosphere. For example, the Clean Air Act as amended in 1990 sets forth requirements for specific inventories such as SIP base year inventories; in addition, the development of regulations often necessitates a nationwide inventory of emissions from a particular industry or type of emission source. On a smaller scale, inventories from a facility are used as the basis for construction and operating permits, determining compliance with existing permit conditions or emission regulations, conducting environmental impact assessments for proposed new sources, and for input to human health risk assessment studies under a variety of air quality management programs.

Each of these different types of inventories requires advanced planning. Figure 1.4-1 provides an overview of inventory planning and preparation steps. In general, the data quality needs of the program will dictate the level of effort required for planning, executing, and quality assuring the results. The EIIP guidance is focused on the emission inventory development process for a state/local agency and an individual facility. However, the guidance should also be useful for planning any level or type of inventory.

This section provides guidance on planning a typical regional inventory of point, area, mobile, and biogenic sources. Information of general interest or that pertains to all sources is covered. Other volumes provide details in planning that pertain to specific types of sources. The subject of planning is divided into four general topics: identification of inventory uses, preliminary planning activities, inventory work plan, and QA plan.

4.1 IDENTIFICATION OF INVENTORY USES

The end uses of the inventory will dictate the level of effort required for an inventory, the structure of the inventory, the data quality objectives (DQOs), the required staffing and resource allocation, and the type of source categories that need to be included. The first step in inventory planning should be to clearly define the end use, and identify who will be the potential users of the final product.

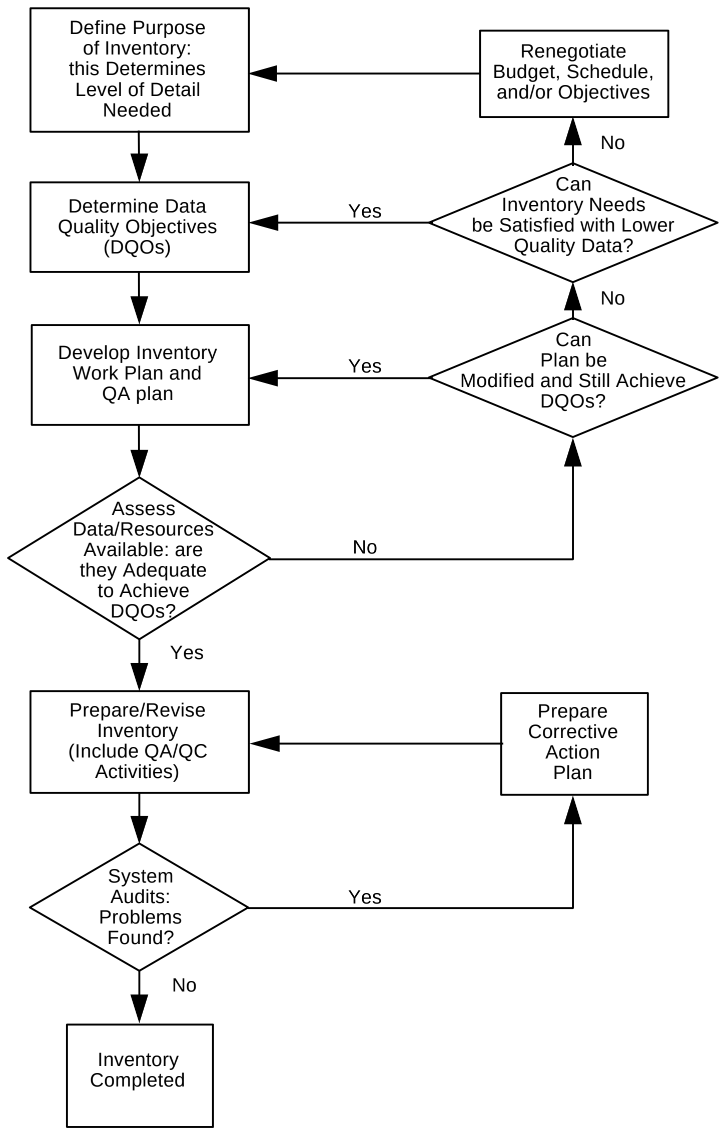

FIGURE 1.4-1. OVERVIEW OF INVENTORY PLANNING AND PREPARATION

The most common end uses of air emissions inventories include air quality studies, control strategy development, progress tracking, dispersion modeling, and permitting of facilities. Based on their different uses, emissions inventories can be categorized into the four general levels as shown in Table 1.4-1. By assigning an inventory to a category level, the inventory preparer can follow general staffing, method selection, QA/QC, and documentation requirements as described throughout the EIIP manuals. A Level I inventory requires the highest degree of defensibility, and is based on site-specific data. Level I inventories must be sufficient in scope so that their results can be used directly in compliance or litigation support.

Level II inventories are used to directly support decisionmaking or standard setting, as in the case of a SIP inventory or a national inventory developed to support a National Emissions Standards for Hazardous Air Pollutants (NESHAP), New Source Performance Standards (NSPS), or Maximum Achievable Control Technology (MACT) standard. Site- or region-specific information are generally required.

In developing a Level III inventory, site-specific data may be gathered, however these inventories do not directly support rulemaking activities. The results of a Level III inventory may guide future research efforts. Examples include Superfund Amendments and Reauthorization Act (SARA) 313 inventories.

Overall inventory preparation and documentation requirements are the least stringent for Level IV inventories. Level IV inventories are usually compiled from previously- published emissions data, and are not intended to directly support rulemaking or compliance activities. Level IV inventories include pure research and development projects, greenhouse gas inventories, and voluntary internal compliance audits.

There are other inventory uses as well, including:

- Input data for regional air quality modeling;
- Emission trading proposals; and
- Impacts assessments.

These specialized inventory uses will require up-front planning to ensure that all required data elements are produced and that DQOs are met. Communication with intended users early in the development process will help to clarify expectations and to begin the planning process.

TABLE 1.4-1

EXAMPLES OF INVENTORY LEVELS

Inventory Category	Description of Example Inventory	Reason(s) for Classification
Level I	Point source data collected by CEM for compliance purposes.	Data directly tied to permit fee program, serves as the basis for emissions limitations and standards, must be legally defensible. Statutory requirements for CEMs include detailed performance audits and QA plan.
	Operating permits data required under Title V of the CAA.	Data directly tied to permit fee program, used to demonstrate compliance.
	Title IV allowance trading program emissions data.	High-quality estimates needed to demonstrate overall reduction in acid rain emissions, economic incentives.
	Assessment of emissions required under the Comprehensive Environmental Recovery and Comprehensive Liability Act (CERCLA).	Used to access the potential toxics exposure at National Priority List sites, could be related to liability issues.
Level II	CAA-mandated SIP inventories.	Site-specific information gathered for point sources, stringent QA/QC requirements, results may be used to support strategic decision making or standard setting or to evaluate effectiveness of regulations.
	National inventories developed in support of NESHAP, NSPS, and MACT standards.	Data used to develop and evaluate emission reduction/control strategies. Site-specific data generally required, but not necessarily direct source sampling.

TABLE 1.4-1

(CONTINUED)

Inventory Category	Description of Example Inventory	Reason(s) for Classification
Level III	Inventories required under the Superfund Amendments and Reauthorization Act of 1986 (SARA 313).	May be based on facility-specific information, but resulting emissions estimates do not directly drive regulatory development efforts or permit fee programs. Only penalties are for nonreporting, no QA requirements specified.
	Recordkeeping as part of an integrated plant maintenance and management program.	Documentation of maintenance inspections, equipment cleaning, and damage/repair procedures used to promote emissions reductions. Need for program is not directly driven by regulatory program.
Level IV	Inventories of greenhouse gas emissions.	EPA is required to prepare for Congress a series of reports on methane emissions form anthropogenic and natural sources; compiled from previously published data.
	Internal environmental audits.	Operations and practices are reviewed to determine if the facility is meeting its environmental requirements, and to plan for environmental activities in the future, need for program not directly driven by regulatory or permit fee program.

4.2 PRELIMINARY PLANNING ACTIVITIES

4.2.1 SCOPE OF INVENTORY

The first step of the planning process is to define the scope of the proposed inventory. The pollutants, emission sources, source categories, and geographical boundaries of the inventory all need to be identified before data collection begins. All of these factors will help to determine the scope of the inventory in terms of resources and data needs.

For most inventories, the geographic area covered is typically defined by political boundaries (county lines, township boundaries, and state boundaries). Inventory areas are collections of jurisdictions representing air basins or experiencing common air pollution problems. The inventory purpose determines the exact geographic area covered. For examples, inventories prepared as part of SIP requirements cover classified ozone or carbon monoxide (CO) nonattainment areas. A legal listing of these areas and their boundaries is contained in Title 40, Code of Federal Regulations, Part 81 (40 CFR Part 81). The nonattainment area is designated by the EPA in conjunction with the states and may change depending on the area's progress in reaching attainment goals.

Inventories developed for modeling purposes are based on a "modeling region." The modeling region is defined in terms of the grid boundary that outlines the region and accounts for the size of the individual grid cells which will be used to subdivide the region. An ozone modeling region will be larger than an ozone nonattainment area in order to include all major emission sources that may affect ozone formation in the nonattainment area and to encompass ozone and precursor pollutant monitoring stations and any additional areas that may have an effect on the modeling meteorology.

The next step is to specify the pollutants to be inventoried. This must be done before the relevant source categories can be identified and prioritized. The pollutants of interest for ozone precursor inventories are VOC, NO_x, and CO. Pollutants such as sulfur oxides (SO_x), particulate matter (PM) and CO may be inventoried separately, while a hazardous air pollutant (HAP) inventory should consider the emission sources of all of the 188 listed HAPs per Section 112(b) of the 1990 CAA or subsequent revisions. Some HAPs may be determined to be insignificant in a particular inventory area. A greenhouse gas inventory should include emissions of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and also chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs) and perfluorinated compounds (PFCs), and ozone precursors if they could be significant contributors in the study area.

After the relevant pollutants are delineated, general types or categories of sources to be included are identified. A SIP inventory has extensive and specific reporting requirements. Point, area, mobile, and biogenic sources are typically required and a very thorough accounting of sources within each of these groups is expected. The extent of the sources to be included is generally specified where regulations drive the need for the inventory. When this is not the case, it is important that the inventory planners specify clearly which sources are to be included.

Finally, the inventory scope must specify the spatial and temporal scales at which results will be presented. More than one scale may be required. A SIP ozone precursor inventory will require that emissions be calculated on an annual and an ozone season day basis. A point source inventory may include emissions from individual stacks, plants, or counties, depending on the spatial disaggregation required by the end user.

4.2.2 STAFF AND RESOURCE CONSIDERATIONS

There must an appropriate commitment of staff and resources to match the level of inventory that is being prepared. Staff considerations should account for the time needed to complete defined tasks in the inventory, and the level of experience needed to accomplish those tasks. If there are a high number of inexperienced staff members, then training will need to be included in the inventory planning phase. Many of the inventories mandated by regulations will require a significant time allocation for staff to prepare the initial inventory, make modifications if necessary based on review of the inventory, and to use the inventory data for specific applications (e.g., modeling purposes or projection inventories). Planning must account for the time frame over which staff will be needed to complete all phases of the inventory.

Resource requirements (e.g., funding, equipment, and training tools) must be established early in the planning phase. In some cases, not all resource requirements will be met to match the level of inventory that is desired. In these cases, it will be necessary to prioritize tasks based on available resources. Estimated budget allocations must be known early in order to plan resource and staff needs. For example, if a new data management system relies on computer software upgrades that can not be purchased in the time frame of the inventory preparation, then alternative approaches much be planned. A useful tool is to develop an integrated time-line that shows budget/resource allocations next to inventory milestones. This way the preparer can anticipate shortfalls and possibly reprioritize tasks.

4.2.3 INTERAGENCY COMMUNICATION

In the course of developing an inventory, communications and interactions take place among the inventory team members, and between the inventory team and other agencies or departments. Figure 1.4-2 illustrates some of the potential interactions required to develop a SIP (or other required) inventory within the framework of the EIIP guidance structure. Specific entities that would be contacted are identified in each of the pertinent EIIP guidance volumes. All types of

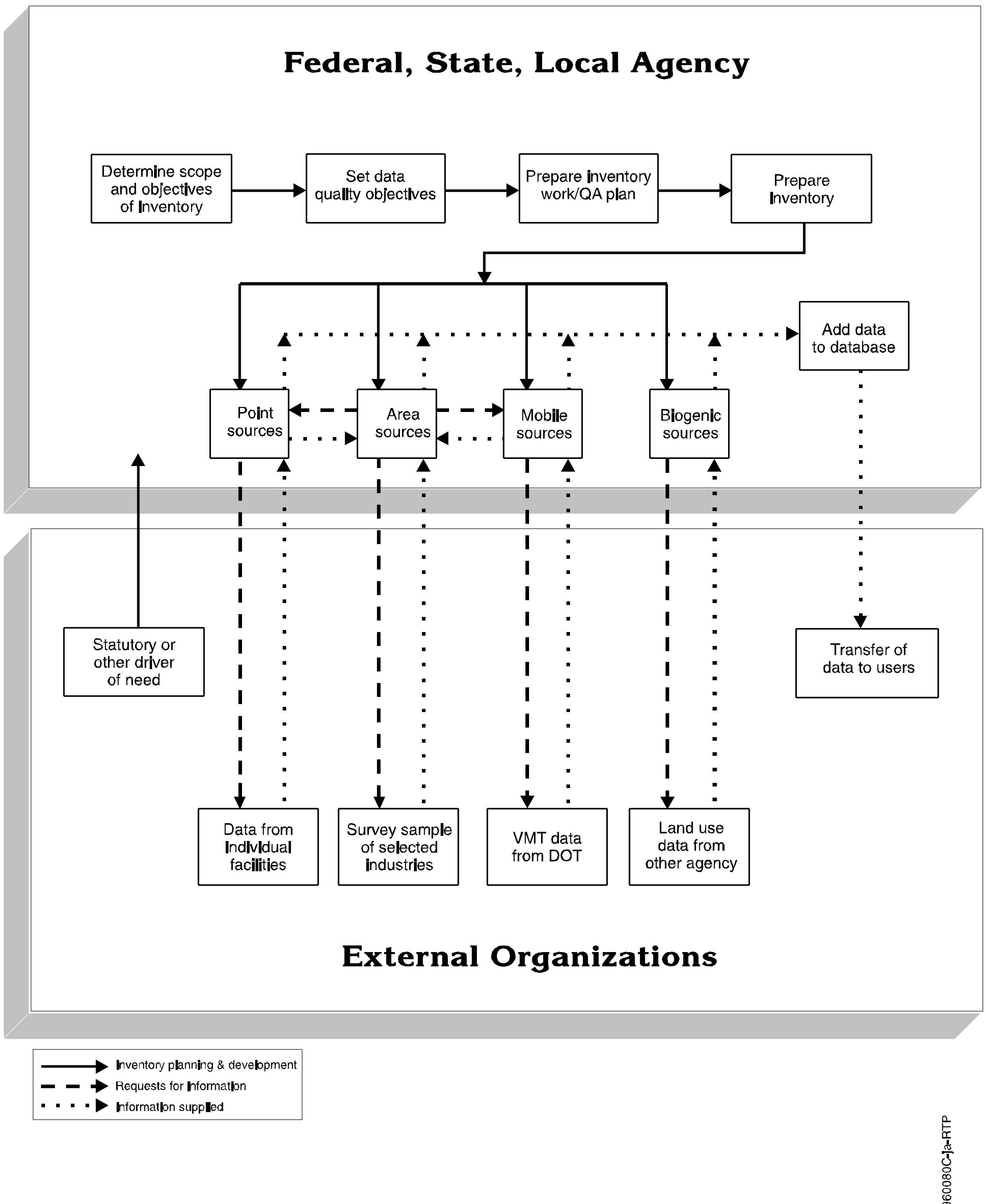

FIGURE 1.4-2. INTERACTIONS IN INVENTORY DEVELOPMENT

interaction should be considered in inventory planning and should be planned as part of the definition of responsibilities in the inventory work plan. Key points are:

- Start early, defining necessary interactions and responsibilities while the inventory work plan is being written;
- Set up schedules and goals;
- Identify contact people for the important inventory tasks and give them plenty of advance notice of what will be needed from them;
- Schedule routine meetings; and
- Advise management of the schedule and resource needs of the effort, securing their commitment to the process.

To facilitate communication and information sharing, standardized procedures for collecting and recording information from telephone contacts and written correspondence are often necessary. Many examples are provided throughout the EIIP guidance volumes that can be used as a starting point for developing templates, forms, and other standardized procedures. In particular, see Volume VI, *Quality Assurance Procedures*.

4.3 INVENTORY WORK PLAN

The inventory work plan is a concise, prescriptive document that declares how an agency intends to develop and present its inventory. It should include inventory objectives and general procedures. The inventory work plan should clearly describe how an inventory preparer plans to present and document the inventory for submission to the EPA or to other users. The inventory work plan establishes a line of communication between the preparing agency and the other departments and agencies that are involved to ensure that the inventory is conducted effectively; within the preparing agency, it ensures good communication and direction amongst the staff for the development of the inventory. The EIIP encourages the incorporation of the QA plan as part of the inventory work plan. The QA plan is discussed separately in Section 4.4 to highlight its importance in the EIIP planning guidance.

The inventory work plan should clearly describe how an agency plans to present and document the inventory for submission to the EPA or to other users. The documentation procedures described in the inventory work plan can facilitate the inventory review process. The inventory work plan should specify the written and computerized methods that will be used to compile and report data.

The inventory work plan will generally:

- Define the geographic area for the inventory;
- Define pollutants to be inventoried;
- Define source categories;
- Define the time interval of the inventory (e.g., annual, seasonal, hourly);
- Provide the background/basis for the inventory (i.e., previous efforts that are viable and related);
- Identify control strategy programs that will affect the baseline inventory;
- Specify who is responsible for the inventory, with a detailed organization chart of key personnel/consultants;
- Establish resource requirements, budget allocations, and schedule;
- Specify the QA coordinator (who should be different than the inventory management or technical staff);
- Set data quality objectives DQOs;
- Define QA/QC procedures for the entire inventory process (i.e., QA plan);
- Define all procedures to be used to determine emissions, including data collection steps; and
- Specify how the data will be stored, managed, and documented.

In developing the schedule, it is critical to set the major project milestones during planning to avoid setbacks in achieving the goals identified for the inventory uses. The inventory work plan should include a timeline that shows when key tasks are expected to be completed so that the progress of the overall inventory effort can be tracked. This procedure will allow the preparing agency to more efficiently accommodate changes in labor commitments when priorities change or problems are encountered.

Following is a description of some of the key issues in developing the inventory work plan, including source category coverage, selection of emission estimation methods, and data management and reporting.

4.3.1 SOURCE CATEGORY COVERAGE

The source categories that are to be addressed in an inventory should be explicitly listed in the inventory work plan. Typically, source categories fall into one of the following five major source types: (1) point sources; (2) stationary area sources; (3) onroad mobile sources; (4) nonroad mobile sources; and (5) biogenic sources. Under ideal conditions all stationary sources would be considered point sources with emissions determined using detailed site-specific data such as process throughputs, process parameters, and operating schedules. In practical applications, however, an emission reporting threshold is usually established to separate point and stationary area sources.

The EPA has identified numerous source categories for point, area, mobile, and biogenic sources through its SIP inventory guidance and the series of *Locating and Estimating Air Emissions* documents. These references are good starting points for developing a list of source categories in an inventory area; however, the preparing agency must realize that not all the sources listed in these documents may be operating in the particular inventory area, and that there also may be unique sources that are not listed. Since the source category coverage is driven by the pollutants of interest, it is useful to research possible sources for the particular pollutants and determine if any are operating in the inventory area. This research should include a review of all of the documents and tools made available by EPA, the historical and current knowledge of the area, and current research publications.

All possible source categories for the given pollutant and inventory type should be investigated; however, due to certain constraints (time, budget, etc.) it may be necessary to prioritize source categories for inclusion in the inventory. This prioritization should be clearly documented in the work plan, with the rationale for how the ranking was established. The prioritization may also help define the level of effort that will be dedicated for each source category that is included. When source categories are excluded from an inventory, the source categories and the reasons for their exclusion should be provided in the inventory work plan. Additional emphasis should be given to categories in which an agency plans to use an approach not specified by previous guidance. Any major assumptions for emissions estimates development for a category should be clearly stated.

The preparing agency may find that subcategorizing a source category will allow for more detailed and higher quality emission estimates. For example the area source category of "dry cleaners" can be broken down into coin-operated, self-service machines and commercially operated businesses. These can be further broken down into units that use perchloroethylene and those that use petroleum solvents. These different combinations of processes and solvent use result in different levels of emissions. By breaking down a general source category into specific types of processes and procedures it may be possible to calculate emissions at a more detailed level, which will improve the quality of the emission estimate for the overall source category.

4.3.2 SELECTION OF EMISSION ESTIMATION METHODS

Emission estimation methodologies should be determined for each source category during the planning phase. The choice of methodologies will be based on a number of factors, including agency resources, source category priority, DQOs, the inventory level (I through IV as described in Section 4.1 of this document), and the intended uses of the inventory. Figure 1.4-3 shows the process for selecting emission estimation methods.

The EIIP guidance documents refer to "preferred" and "alternative" methods for each source category. Selection of a preferred or alternative emission estimation procedure by the user takes place in the planning stage of the inventory development process, and should be documented in the work plan. Preferred methods will yield a higher quality estimate of emissions, yet not exceed a typical state or local agency's capability in terms of resources and staff expertise. These methods should be used when anticipating a control regulation for the source category, when a category is ranked as a high priority category, or when a specific local characteristic would skew the results obtained from an alternative method. In contrast, alternative methods will yield lower quality estimates of emissions, but are well within any state's capability to perform. These methods are best used for source categories that are not highly prioritized and for which controls are not anticipated.

Decisions on the methods to use for individual source categories are affected by the available resources, source priorities, availability of data, and time schedules. If the available methods vary in the amount of resources that they require, rank them according to their resource needs and see how that ranking compares to the prioritized source category list. An increase in resource allocation may be justified by an increase of accuracy or detail level in the emission estimate. For example, if the risks of adverse environmental or regulatory effects are high, more sophisticated and costly emission determination methods may be necessary, such as using continuous emissions monitors (CEMs) or conducting source tests (for point sources). Conversely, if the risks are low, less expensive estimation methods may be acceptable.

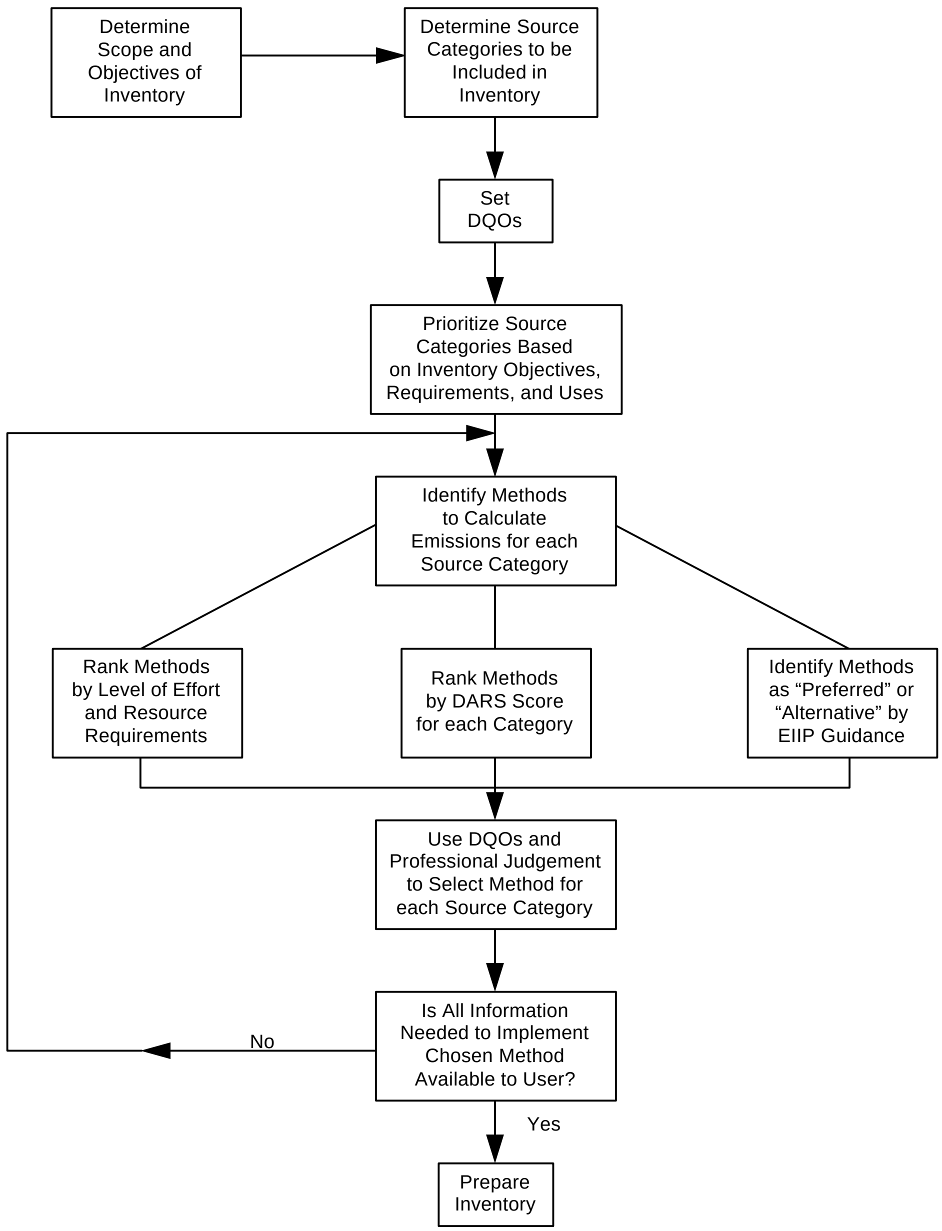

FIGURE 1.4-3. PROCESS FOR SELECTING EMISSION ESTIMATION METHODS

The DARS is another tool that can be used to help select emission estimation methods. The DARS rating scores are based on the perceived quality of the emission factor and activity data. Scores are assigned to four data attributes: measurement/method; source specificity; spatial congruity; and temporal congruity. Using the DARS scores, an inventory preparer can rate the emission factor and activity data for the methods that are under consideration. Methods could then be ranked according to their DARS scores and the rankings could be added to a matrix containing the prioritization and resource allocation rankings.

Another consideration in selecting methods is to compare the needs of the inventory with the information that the available methods produce. For example, does the method calculate the pollutant at the required level of detail in terms of speciation, and temporal or spatial allocation? Does the method reflect economical or regional differences that would affect emissions? These considerations represent unique conditions in an inventory area and should be considered in selecting methods.

In some cases the selection of methods is limited. For example, for an onroad mobile source inventory being prepared to meet SIP requirements, preparing agencies are directed to use the EPA's MOBILE emission factor model (or EMFAC model in California). Because of the importance and complexity of these inventories, these emission factor models provide a known level of quality in terms of the data source and final products that can be used by EPA, states, and local authorities in setting attainment strategies.

4.3.3 DATA MANAGEMENT AND REPORTING

The inventory work plan should specify the written and computerized methods that will be used to compile and report data. Planning for the required level of documentation will: (1) ensure that important supporting information is properly developed and maintained; (2) allow extraneous information to be identified and discarded, thereby reducing the paperwork burden; (3) help determine data storage requirements; and (4) aid in identifying aspects of the inventory on which to concentrate the QA efforts.

One of the biggest challenges in the inventory planning phase, especially for large scale inventory efforts, is deciding on an efficient strategy to manage and report all of the data that is produced. The inventory preparer should anticipate the volume and types of data-handling needed in the inventory effort. If the inventory preparer must deal with large amounts of data, maximizing the use of computerized inventory data-handling systems will allow them to spend more time gathering, analyzing, and verifying the inventory data, as opposed to manipulating the data. Computerized data management also has the advantage of forcing organization, consistency, and accuracy.

The selection of the database should be matched to the planned uses of the inventory data. The format for reporting data can range from a fully documented written report to computer-generated files for input to other estimation models. Selection of the data management system should facilitate the reporting format and will depend on several factors:

- Type of computer system;
- Size of the inventory database;
- Complexity of the emissions calculations;
- Number of calculations to be made;
- Variety of tabular summaries to be generated;
- Graphic presentation of data;
- Availability and expertise of clerical and data-handling personnel; and
- Time constraints.

Considerations must also be given to the end-use of the inventory and the required formats for transferring, sharing and storing data. For example, the EIIP Data Model development program will require the preparing agency to map certain data elements from its own computerized data format to the EIIP Data Model transfer protocol. Another example is the transfer of data to photochemical modelers, who will require certain data elements in order to prepare their models. In both these examples, the preparing agency must identify the requirements of the receiving agency in the planning process to ensure that all required data elements and formats are available for use in the eventual transfer of the inventory data. Upfront planning is critical in developing most of the computer-based data management programs due to the size of the operations, set-up time required, training of staff, and the cost involved.

4.4 QUALITY ASSURANCE PLAN

The involvement of QA personnel during the planning stage of the work promotes good communication between the QA coordinator and inventory development personnel, and enhances the effectiveness of both the QA and QC programs. It also inherently decreases the number of quality concerns found during the audits because the expectations are clearly outlined in the QA Plan and discussed with the inventory development personnel prior to starting the work.

Listed below are the elements that should be covered in the planning process to ensure preparation of a quality inventory:

- Identify a QA coordinator;
- Identify DQOs;
- Determine manpower and budget allocations, organizational structure, and distribution of authority and responsibilities; and
- Develop an inventory work plan that specifically incorporates the QA program elements (i.e., the QA plan).

The QA plan describes the specific QA/QC procedures and responsibilities of the agency for the preparation of the emissions inventory. Using a QA plan encourages the development of a complete, consistent, accurate, and reasonable inventory by implementing specific procedures for collecting, reporting, and documenting emissions data. Volume VI of the EIIP guidance document series provides a detailed breakdown of what the QA plan should include and examples of its applications. A model QA plan is also presented.

QC procedures defined in the plan encompass a system of activities that are designed to ensure the quality of the inventory in terms of the data collected, emission calculations, and the transfer and storage of data. QC is typically carried out by members of the project team as the inventory is being prepared. It is crucial that QC activities are part of an ongoing process in inventory preparation so as to detect errors prior to the release of a final product. This eliminates the high cost and time that would be necessary to correct a final product that has a high level of data uncertainty.

QA is a planned system of activities designed to insure that the QC program is effective and it is preferable that it involves oversight by individuals who are external and independent of the team. Systems audits are QA activities that need to be scheduled in the QA plan. Systems audits evaluate the documentation and procedures associated with the inventory development activities. Through the use of QA/QC procedures, the inventory and accompanying data will meet a specified level of quality that minimizes data uncertainty.

The purpose and intended use of the inventory determine the DQOs for the inventory, and drive the selection of methods. A DQO statement is included in the QA plan to delineate the level of uncertainty that a decision maker or other user of the inventory is willing to accept. DQO statements ensure that the final data will be sufficient for its intended use. DQOs are method specific, are based on the quality of the available data for a given methodology, and are often based on a review of past inventory efforts and problems.

The process of developing an acceptable plan is an iterative one. The QA coordinator and inventory manager(s) must work together to balance the quality objectives with the resources available. It is important to acknowledge the constraints that limit the ultimate quality of the inventory, especially if the achievable DQOs fall far short of the desired DQOs.

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5

INVENTORY DEVELOPMENT

The data needed to develop emission estimates is drawn from a wide range of sources. The agency may collect some of the data specifically for the inventory effort. Information to support inventory activities also may be drawn from other agency operations such as permitting, compliance, and source inspections. For effective use of resources, an agency or facility should plan to fulfill specific emissions inventory requirements by building upon and improving the quality of regularly collected data. The following sections describe some of the key steps in inventory development, including data collection, data handling, and emission calculations. It is important that QA/QC activities be implemented in all stages of the inventory development process. Figure 1.5-1 shows an example of the key steps in the development of an inventory and where QA/QC activities would be necessary.

5.1 DATA COLLECTION

An important step in the planning process is to assess data needs and data collection plans for point, area, mobile, and biogenic inventories, and to look for possible overlaps. While development of each type of inventory may be carried out by different staff, data collection and management should be under central control or oversight. A master file for all records, memoranda, documents, reports and other references used in the inventory should be established and maintained.

A major inventory planning consideration is whether, and to what extent, information contained in existing emissions inventories can be used. Existing inventories should be examined to determine whether the appropriate sources have been included and that the emissions data represent current conditions. Existing inventories can serve as a starting point for developing extensive data and support information, such as documentation of procedures, but often it will be necessary to collect new data and information to calculate emissions and represent current conditions.

For point source inventories, information may be obtained from contacts with individual facilities. The two most common types of plant contacts are the mail survey and direct plant inspections. A type of indirect plant contact also commonly employed is the use of permit applications or compliance files. Point source emissions must be calculated and reported at the process level (within a point source) and related to a specific source classification code (SCC). That is, emissions are to be reported for each SCC rather than at the "point" level within a plant.

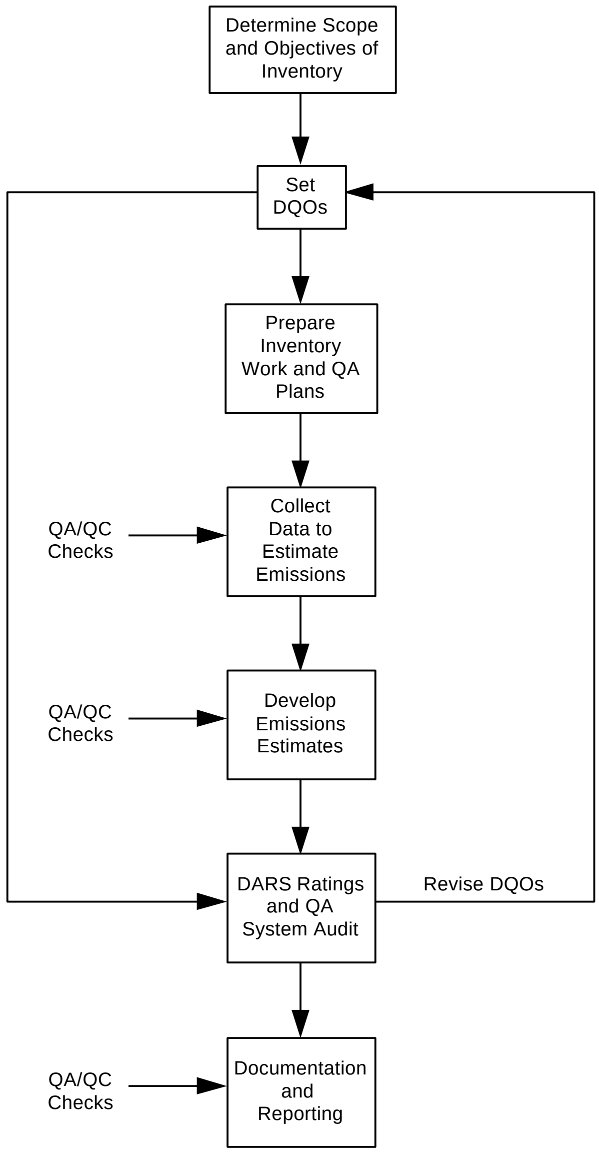

FIGURE 1.5-1. EXAMPLE OF INVENTORY DEVELOPMENT

Often, time or resources for advanced planning will not be available for a pre-inventory contact of facilities or a sample of facilities. In such cases, general estimates of process schedules, materials usage, and other information may be used from the recollections of plant operators and the available plant records (bills of lading, receipts of raw materials, etc.).

Combinations of these approaches may also be undertaken. For example, a sample of facilities (either randomly selected or those deemed representative) are contacted before the study period of the inventory. Information collected for each process should include schedule for the period, type of materials used, quantity of materials used, and the amount of end product produced. Emission factors based on the amount of product for each surveyed process could then be used to estimate emissions from the facilities outside the pre-inventory sample. For example, the amount of each product shipped from a facility could be collected through facility records and then be used with an emission factor to determine an emission rate. It should be noted that these approaches are general in nature. Gaining an accurate picture of the emissions from batch or intermittent processes may be time consuming and costly.

Surveys used for area and mobile sources will, for practical means, not achieve the same level of coverage as those used for the larger point sources. This reflects the fact that the area and mobile sources are individually small, but much more numerous than point sources. Emissions are estimated for area and mobile sources by selecting representative subsets of individual sources from which emission calculation parameters can be derived and then scaled up to reflect the entire population of these sources. When planning to collect survey data for area and mobile sources it is critical that the subset of individual sources be carefully selected so that they are representative of the population as a whole. For example, the emission factors presented for consumer/commercial solvent use and architectural coatings in Volume III of the EIIP series were developed from surveys of manufacturers. Those surveys attempted to cover as many sources as possible, and where manufacturers could not be included, the uncovered contribution was quantified to make the emission factors more representative of the industry as a whole.

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5.2 DATA HANDLING

Data handling will rely to some extent on the selection and use of a computer database system. Because many inventories produce a large quantity of data, it is essential to choose a computerized data management system that meets all the required function and storage requirements of the inventory effort. After a system is selected, a plan for data flow should be implemented to ensure that the data are handled properly in the different stages of inventory development, and that QC checks are in place.

Some activities that can be performed efficiently and rapidly by computers:

- Printing mailing lists and labels;
- Maintaining status reports and logs;
- Calculating and summarizing emissions;
- Performing error checks and other audit functions;
- Storing source, emissions, and other data;
- Sorting and selectively accessing data; and
- Generating output reports and graphical presentations.

Where data are not stored on electronic files, the inventory preparer must document all manually calculated emissions on worksheets. These worksheets should become part of the final documentation of the inventory when completed. In all cases, whether emissions are calculated by hand or with computer spreadsheets, all assumptions should be clearly stated and all data used in the emissions calculation should be referenced.

An important QA/QC aspect to data handling is the transcription of data during the inventory preparation. There must be checks built into the process for handling data that comes from the raw calculations sheets and is reported, summarized, or otherwise manipulated in some other form. It may be possible to build these checks into the computer database that is handling the data. For example, for electronic data entries it may be possible to reject an entry if it exceeds a reasonable or expected value. Otherwise, sample QC checks tracking the data manually from its generation to its final use may suffice.

5.3 EMISSION CALCULATIONS

The steps involved in calculating emissions will depend on the particular estimation technique that is selected in the planning phase for each source category. Most emission calculations are based on one of the following types of data or procedures: (1) source test data; (2) material balance; and (3) emission factors. The following sections briefly describe the basic concepts of each; for detailed procedural guidance, the reader is directed to Volumes II through V.

5.3.1 SOURCE TEST DATA

The best method of estimating a source's emissions can be the use of test data obtained by the preparing agency or supplied by the plant itself. The use of source test data reduces the number of assumptions regarding the applicability of emissions data to a source (a common consideration when emission factors are used), as well as the control device efficiency, equipment variations, and fuel characteristics. Of course, the testing must be properly conducted over a sufficiently long period of time to produce results representative of conditions that would prevail during the time period inventoried. The most complete type of source testing is continuous emissions monitoring (CEM). CEM measures and records actual emissions during the time period the monitor is operating and the data produced can be used to estimate emissions for different operating periods.

Two items should be noted when using source test data to calculate emissions. First, because most source tests are generally only conducted over several hours or days at most, adjustments may need to be made when using these data to estimate emissions over longer time intervals or for conditions different from those under which the tests were performed. Second, a source test supplied by a plant may not adequately describe a given facility's annual or seasonal operating pattern. The amount of time that a control device actually operates at peak efficiency will also greatly impact the accuracy of the emissions estimate. In those cases where such data are not included in the test reports, the range of operation on an annual basis should be researched so that reliable annual or seasonal emissions estimates can be made. The information can be obtained by contacting the plant. Although the information could be obtained from questionnaire data, it may not be as accurate as that obtained from a direct query.

5.3.2 MATERIAL BALANCE

An agency can in some cases use material balance considerations to estimate emission factors or, better yet, total emissions for an inventory period. For some sources, a material balance can be a practical method of estimating certain emissions, such as VOC, and can be the most accurate, especially when the balance covers the entire inventory period and the nonair losses are small or easily measured. Emissions from solvent evaporation sources are most commonly determined by the use of material balances.

Use of material balances involves the examination of a process to determine whether emissions can be estimated solely on knowledge of operating parameters, material compositions, and total material usage. The simplest material balance assumes that all solvent used in a process will evaporate to become air emissions somewhere at the facility. For instance, for many surface coating operations, it can be assumed that all of the solvent in the coating evaporates to the atmosphere during the application and drying processes. In such cases, emissions equal the amount of solvent contained in the surface coating plus any added thinners.

Material balances are greatly simplified and very accurate in cases where all of the consumed solvent is emitted to the atmosphere. But many situations exist where a portion of the evaporated solvent is captured and routed to a control device such as an afterburner (incinerator) or condenser. In these cases, the captured portion must be measured or estimated by other means and the disposition of any recovered material must be accounted for. As a second example, in degreasing operations, emissions will not equal solvent consumption if waste solvent is removed from the unit for recycling or incineration. A third example is where some fraction of the diluent (which is used to liquify cutback asphalt, for example) is believed to be retained in the substrate (pavement) rather than evaporated after application. In these examples, a method of accounting for the non-emitted solvent is required to avoid an overestimation of emissions.

Material balances cannot be accurately employed at a reasonable cost for some evaporation processes because the amount of material lost is too small to be determined accurately. As an example, applying material balances to petroleum product storage tanks is not generally feasible because the losses are too small relative to the uncertainty of any metering devices. In these cases, *AP-42* emission factors or equations can be used.

5.3.3 EMISSION FACTORS

One of the most useful tools available for estimating emissions from point, area, and mobile sources is the emission factor. An emission factor is an estimate of the quantity of pollutant released to the atmosphere as a result of some activity such as combustion or industrial production, divided by the level of that activity. In most cases, emission factors are expressed simply as a single number, with the underlying assumption that a linear relationship exists between emissions and the specified activity level over the probable range of application.

Because such factors are typically averages obtained from data with a wide range of representation and varying degrees of accuracy, emissions calculated this way for a given facility are likely to differ from that facility's actual emissions. Because they are averages, factors will indicate higher-than-actual emissions for some sources and lower-than-actual emissions for others. Only specific source measurement can determine the actual pollutant contribution from a source, under conditions existing at the time of the test. For the most accurate emissions estimate, it is recommended that source-specific data be obtained whenever possible.

Emission factors are more appropriately used to estimate the collective emissions of a number of sources, such as is typically done in emissions inventory efforts for area sources in a particular geographic boundary. If factors are used to predict emissions from new or proposed sources, an agency should review the latest literature and technology to determine whether such sources would likely exhibit emissions characteristics different from those of typical existing sources.

5.4 EMISSIONS CALCULATION TOOLS

This section gives a brief overview of emission factor databases, models, and other available information that may be useful for inventory preparation. Specific emissions measurement are generally the best and most accurate method to quantify emissions; however, source data are not always available. As an alternative, documents and databases containing emission factors and models can be used as tools to estimate air pollutant emissions for inventory purposes. The calculation of area source emissions relies to a great extent on the use of emission factors since it is usually the most efficient approach to estimating emissions from these sources. Models often use computers, so that a large number of equations and interactions can be easily manipulated and the effect of many different parameters can be accounted for. EIIP guidance can be incorporated into the use of many of these tools, and some (e.g., the EIIP mobile source guidance) rely specifically on the use of these tools (e.g., the MOBILE emission factor model for estimating mobile source emissions).

5.4.1 FACTOR INFORMATION RETRIEVAL SYSTEM

The EPA's Factor Information Retrieval System (FIRE) is a consolidation of emission factors for criteria pollutants and HAPs that includes emission factors from EPA documents such as *AP-42* and the *Locating and Estimating Air Emissions* series, factors derived from state- reported test data, and factors taken from literature searches . These references are the basic sources of emission factors that have been used in the preparation of inventories, as well as economic analyses, permit preparation for prevention of significant deterioration and New Source Review applications, and other federal, state, and local agency assessments of air pollution sources.

Each emission factor in FIRE also includes information about the pollutant (Chemical Abstract Service [CAS] numbers and chemical synonyms) and about the source (Standard Industrial Classification [SIC] codes and descriptions, and SCCs and descriptions). Each emission factor entry includes comments about its development, in terms of the calculation methods and/or source conditions, as well as the references where the data were obtained. The emission factor entry also includes a data quality rating.

The FIRE database has been designed to be very "user friendly." Data can be searched in many different ways and can be downloaded to data files, or can be printed in a report format that is designed by the user. The FIRE database can be accessed from the EPA's CHIEF Internet web site on the TTN 2000. FIRE is also available on the Air CHIEF CD-ROM as a compact disc read-only memory (CD-ROM) form and can be obtained by calling the Info CHIEF Help Desk at (919) 541-1000.

5.4.2 CHEMDAT8

CHEMDAT8 is a Lotus®1-2-3 spreadsheet prepared by the EPA's Emissions Standard Division that includes analytical models for estimating VOCs from treatment, storage and disposal facility (TSDF) processes. The original models include disposal impoundments, closed landfills, land treatment facilities, and aeration and nonaeration impoundment processes. Predicted emissions can be viewed on the screen or printed. A graphical presentation of the relationships between emission prediction and vapor pressure and between emission prediction and the partition coefficient is also available. The resulting scatter diagrams can be printed via PrintGraph®, another Lotus® program.

The models in CHEMDAT8 can be applied to other types of TSDF processes besides those contained in the original design. The nonaerated impoundment model in CHEMDAT8 can estimate emissions from storage surface impoundments and open-top wastewater treatment tanks. The CHEMDAT8 model for predicting emissions from surface treatment impoundments and aerated wastewater treatment tanks is the aerated impoundment model. The land treatment model in CHEMDAT8 can estimate emissions from land treatment soil, open landfills, and waste piles. Emissions from an oil film surface in a land treatment facility or an oil film on surface impoundments can be predicted via the oil film model in CHEMDAT8. When a CHEMDAT8 model is not available to predict emissions, the equations shown in the reports that provide the background to the model can be used to perform hand calculations of emissions.

Default input parameters in the CHEMDAT8 diskette demonstrate example calculations. However, the input parameters can be changed to reflect different TSDF characteristics and then recalculate emissions under these modified conditions. The list of 60 compounds currently in CHEMDAT8 can be augmented by an additional 700 chemicals. Procedures for introducing data for additional compounds into CHEMDAT8 are described in the supporting documentation report.

For more information about CHEMDAT8, contact the EPA's Emissions Standards Division at (919) 541-5499. Executable code and documentation for CHEMDAT8 can be downloaded from the TTN 2000 Internet web site.

5.4.3 WATER8

WATER8 is a menu-driven computer program that is intended for estimating emissions from wastewater treatment systems only. WATER8 uses some of the same models found in CHEMDAT8, but has data for over 950 compounds. Recent updates to this model have added routines to estimate emissions from collection system elements such as trenches, conduits, junction boxes and manholes. For more information about WATER8, contact the EPA's Emission Standards Division at (919) 541-5499. The executable code and documentation for WATER8 can also be downloaded from the TTN 2000 Internet web site .

5.4.4 LANDFILL AIR EMISSIONS ESTIMATION MODEL

The Landfill Air Emissions Estimation Model (LAEEM) is a computer program specifically designed for use by state and local regulatory agencies to monitor the air emissions from landfills. The system allows the user to enter specific information regarding the characteristics and capacity of an individual landfill and to project the emissions of methane, CO, nonmethane organic compounds, and individual HAPs over time using the Scholl Canyon decay model for landfill gas production estimation. The Scholl Canyon Model is a first-order decay equation that uses site-specific characteristics for estimating the gas generation rate. In the absence of site-specific data, the program provides default values for regulatory uses of the model, and default values drawn from *AP-42* for inventory uses. The user also may tailor decay rate characteristics on an individual basis. An integrated decay rate constant calculator is provided for landfills that may be operating a gas recovery system to allow more accurate assessments of decay attributes. Outputs may be reviewed in either tabular or graphical forms. A help system is also provided with information on the model operation as well as details on assumptions and defaults used by the system.

The LAEEM is available on the Control Technology Center (CTC) portion of the TTN 2000 Internet web site. The model is IBM PC-compatible, requires at least 512 kilobytes of memory, and can be used with a monochrome or color graphics adaptor. For additional information contact the EPA's Air Pollution Prevention and Control Division, Office of Research and Development, Research Triangle Park, North Carolina, at (919) 541-2709.

5.4.5 TANKS

The TANKS program is designed to estimate emissions of organic chemicals from storage tanks. The calculations are performed according to *AP-42* equations. The user provides specific information concerning the storage tank and its contents; the TANKS program then estimates the annual or seasonal emissions and produces a report. The emissions can be separated into breathing and working losses.

The TANKS program has a chemical database of over 100 organic liquids and meteorology data from over 250 cities in the United States. The user may add new chemicals and cities to their version of the database. The tank styles addressed in the program include vertical and horizontal fixed roof tanks, and internal and external floating roof tanks. The tank contents can consist of single or multiple liquid components.

TANKS version 3.0 is currently available. The emission estimating equations that form the basis of the TANKS 3.0 software program were developed by the American Petroleum Institute (API). The API retains the copyright to these equations but has granted permission for the nonexclusive, noncommercial distribution of this material to governmental and regulatory agencies. The API, however, reserves the rights regarding all commercial duplication and distribution of its material. Therefore, the TANKS program is available for public use, but the program cannot be sold without written permission from the API, the U. S. EPA, Midwest Research Institute, and Perrin Quarles Associates, Inc. The TANKS 3.0 program is written in FoxPro2.5,™ and is distributed by the EPA through the TTN 2000 Internet web site or through the mail on diskette.

5.4.6 MOBILE5a

At the time of this writing, MOBILE5a is the EPA’s current version of the emission factor model for use in preparing onroad mobile source emission inventories (there is a MOBILE5b version that can be used for certain modeling scenarios only). Since this model is regularly updated and revised, the user is directed to the EPA’s Office of Mobile Sources (OMS) Internet web site located on the TTN 2000 to obtain the latest information on this model.

The major function of MOBILE5a is to calculate emission factors for gasoline- and diesel-fueled light-duty vehicles, light-duty trucks, heavy-duty vehicles, and motorcycles. These motor vehicle types are also grouped by low- and high-altitude areas of the United States. Specifications on the required use of variables, such as temperature, speed, and other factors, are also provided. MOBILE5a is capable of calculating emission factors for any calendar year between 1960 and 2020 and it includes provisions for modeling the effects of oxygenated fuels on exhaust CO emissions.

6

DOCUMENTATION AND REPORTING

The goal of inventory documentation is to ensure that the final written report or compilation of data accurately reflects the inventory effort. At a minimum, documentation should be sufficient to determine quality of emissions estimates, identify the data references, and allow reproducibility of emissions estimates. A successful inventory report also addresses the original goals for preparing the inventory and provides summary data and documentation that allow the quality of the inventory effort to be effectively judged. It also facilitates quality review of the inventory, executive decision-making based on the data, and updates and modifications to the inventory.

The following sections discuss typical documentation requirements for preparing an inventory report and options for the electronic reporting of data. Refer to each of the pertinent volumes on point, area, mobile, and biogenic sources for detailed reporting procedures for those source types.

6.1 DOCUMENTATION

The specific documentation required for an inventory will vary based on the end use of the inventory. The definitions of the Level I through IV inventories, provided previously in Section 4.1, give an indication as to the amount of documentation that may be required. In some cases, documentation and reporting requirements are specified by the requestor or statutory requirement for the inventory. Most inventories will require some form of an inventory report to document and convey the results of the inventory effort.

An emissions inventory report should include an introduction explaining the background and purpose for the inventory development, and usually some form of an executive summary to show summary data and conclusions up-front. The summary of the emissions data should be by some matrix of pollutant, source type (point, area, mobile, biogenics), and geographic area. Graphics are useful to illustrate different contributions of source categories to the inventory, and can be used to clarify various interpretations of the data. Separate discussions to describe the inventory development procedures and results for all sources should follow.

The following information is typically documented in most inventories:

- Base year (or other applicable time frame) of the inventory;

- The geographic area covered by the inventory;

- Pollutants and source categories addressed in the inventory;
- Record of all methods used in the inventory preparation;
- Record of all data used in emissions calculations;
- Explanation of all assumptions used;
- Example calculations for each type of methodology used;
- Any demographic data (e.g., population, employment, economic) that was used to calculate or spatially allocate emissions;
- A listing of all data references;
- Copies of questionnaires or surveys;
- Results of surveys or questionnaires;
- QA/QC checklists;
- QA audit reports; and
- Any other letters, memorandum, or supporting documentation used in the inventory preparation.

An emissions inventory that is documented according to standardized guidelines enables the receiving agency to review the inventory in a consistent manner, although it is recognized that some variability is needed to meet the specific needs of each inventory region. Therefore, standardization is required for the types of data reported (e.g., many of the items listed above), but not necessarily for the format in which they are reported. For example, states were given considerable latitude in the formats for their SIP inventory reports, but minimum information requirements were identified (EPA, 1991a; EPA, 1991b).

For more information on documenting point and area sources, refer to the EIIP Volumes II and III respectively. These volumes contain discussions on inventory reporting and documentation recommendations from the SIP inventory perspective. In addition, Chapter 2 of Volume VI discusses the need for comprehensive documentation and reporting from a QA program standpoint and provides example documentation.

6.2 EXAMPLES OF STANDARDIZED REPORTING FORMAT

One example of standardized reporting procedures are those recommended by the Intergovernmental Panel on Climate Change (IPCC). The IPCC provides detailed reporting instructions which consist of step-by-step directions for assembling, documenting, and transmitting national greenhouse gas inventory data, regardless of the method used to produce the estimates. The reporting instructions were developed to ensure consistency and comparability between reports.

Part of the IPCC reporting system is a standard table format (IPCC, 1994) that shows the source categories included in the inventory and an overview of quality of the estimates (Tables 1.6-1 and 1.6-2), respectively. Emission inventory results and all main assumptions (in summary form) are transmitted to IPCC. The standard data tables also allow the user to report the inventory at the level of detail that the data permit. As shown in Table 1.6-2, the IPCC also asks those preparing greenhouse gas emissions estimates to indicate the completeness, quality, and inclusion of background information for each emissions estimate.

Another example of standardized reporting format is contained in the EPA's annual report on emission trends in the United States. Since 1973, EPA has prepared estimates of annual national emissions in order to assess historic trends in criteria pollutant emissions. These trends are reported annually in a report entitled *National Air Pollutant Emission Trends 1900-(current year)*. The standardized emissions reporting structure in the Trends report consists of a "tier" categorization of source categories. Table 1.6-3 shows the Tier 1 and Tier 2 category levels used in the report. These tiers represent the highest level of reporting; there are more detailed levels (Tier 3 and Tier 4) which provide a further breakdown of sources that are more specific to each pollutant type and emission process.

The examples provided for the IPCC reporting system and for the EPA's Trends report are for summary and overview purposes and are relatively simple in their presentation. Other inventories require more abundant and complex reporting formats. The EPA document *Example Documentation Report for 1990 Base Year Ozone and Carbon Monoxide SIP Emissions Inventories* (EPA, 1992c) provides numerous example summary tables and formats for reporting inventory data collected as part of SIP requirements. The goal of the EPA in providing this example documentation was to have preparing agencies submit inventory reports that could be efficiently reviewed that would also facilitate comparison of inventory data. Similar types of written reporting procedures can be adapted to most other inventory efforts.

TABLE 1.6-1

IPCC SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES[a]

Summary Report for National Greenhouse Gas Inventories (Log)									
Greenhouse Gas Source and Sink Categories	CO_2 Emissions	CO_2 Removals	CH_4	N_2O	NO_x	CO	NMVOC	HFCs	PFCs
Total National Emissions and Removals									
1. All Energy (Fuel Combustion + Fugitive)									
A. Fuel Combustion									
1. Energy & Transformation Industries									
2. Industry (ISIC)									
3. Transport									
4. Small Combustion									
5. Other									
6. Traditional Biomass Burned for Energy									
B. Fugitive Emissions from Fuels									
1. Solid Fuels									
2. Oil and Natural Gas									
2. Industrial Processes									
3. Solvent and Other Products Use									

[a] Adapted from IPCC (1994).

TABLE 1.6-2

IPCC OVERVIEW TABLE FOR NATIONAL GREENHOUSE GAS INVENTORIES[a]

Overview Table

Greenhouse Gas Source and Sink Categories	CO_2		CH_4		N_2O		NO_x		CO		NMVOC		Documentation	Footnotes
	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality		
Total National Emissions and Removals														
1. All Energy (Fuel Combustion + Fugitive)														
A. Fuel Combustion														
1. Energy & Transformation Industries														
2. Industry (ISIC)														
3. Transport														
B. Fugitive Emissions from Fuels														
1. Solid Fuels														
2. Oil and Natural Gas														
2. Industrial Processes														
3. Solvent and Other Products Use														

Notation Key for Overview Table

Estimates		**Quality**		**Documentation**	
code	Partly estimated	code	Meaning	code	Meaning
PART	Partly estimated	H	High Confidence in Estimation	H	High (all background information included)
ALL	Full estimate of all possible sources	M	Medium Confidence in Estimation	M	Medium (some background information included)
NE	Not estimated	L	Low Confidence in Estimation	L	Low (only emission estimates included)
IE	Estimated but included elsewhere				
NO	Not occurring				
NA	Not applicable				

[a]Adapted from IPCC (1994).

TABLE 1.6-3

TIER 1 AND TIER 2 SOURCE CATEGORIES[a]

Tier 1	Tier 2
FUEL COMBUSTION-ELECTRIC UTILITIES	Coal Oil Gas Other Internal Combustion
FUEL COMBUSTION-INDUSTRIAL	Coal Oil Gas Other Internal Combustion
FUEL COMBUSTION-OTHER	Commercial/Industrial Coal Commercial/Industrial Oil Commercial/Industrial Gas Misc. Fuel Combustion (except residential) Residential Wood Residential Other
CHEMICAL & ALLIED PRODUCT MFG.	Organic Chemical Mfg. Inorganic Chemical Mfg. Polymer & Resin Mfg. Agricultural Chemical Mfg. Paint, Varnish, Lacquer, Enamel Mfg. Pharmaceutical Mfg. Other Chemical Mfg.
METALS PROCESSING	Nonferrous Ferrous Not elsewhere classified (NEC)
PETROLEUM & RELATED INDUSTRIES	Oil & Gas Production Petroleum Refineries & Related Industries Asphalt Manufacturing
OTHER INDUSTRIAL PROCESSES	Agriculture, Food, & Kindred Products Textiles, Leather, & Apparel Products Wood, Pulp & Paper, & Publishing Products Rubber & Miscellaneous Plastic Products Mineral Products Machinery Products Electronic Equipment Transportation Equipment Construction Miscellaneous Industrial Processes

TABLE 1.6.3
(CONTINUED)

Tier 1	Tier 2
SOLVENT UTILIZATION	Degreasing Graphic Arts Dry Cleaning Surface Coating Other Industrial Nonindustrial Solvent Utilization (NEC)
STORAGE & TRANSPORT	Bulk Terminals & Plants Petroleum & Petroleum Product Storage Petroleum & Petroleum Product Transport Service Stations: Stage I Service Stations: Stage II Service Stations: Breathing & Emptying Organic Chemical Storage Organic Chemical Transport Inorganic Chemical Storage Inorganic Chemical Transport Bulk Materials Storage Bulk Materials Transport
WASTE DISPOSAL & RECYCLING	Incineration Open Burning Publicly Owned Treatment Works Industrial Waste Water Treatment Storage and Disposal Facility Landfills Other
HIGHWAY VEHICLES	Light-Duty Gas Vehicles & Motorcycles Light-Duty Gas Trucks Heavy-Duty Gas Vehicles Diesels
OFF-HIGHWAY	Off-highway Gasoline Off-highway Diesel Aircraft Marine Vessels Railroads
NATURAL SOURCES	Biogenic Geogenic Miscellaneous (lightning, freshwater, saltwater)
MISCELLANEOUS	Agriculture & Forestry Other Combustion (Forest Fires) Catastrophic/accidental Releases Repair Shops Health Services Cooling Towers Fugitive Dust

[a]Adapted from EPA (1994b).

6.3 ELECTRONIC REPORTING OF DATA

Sharing of emissions data is essential for urban and regional air quality modeling exercises that cross state boundaries, for regional and national regulatory impact and other policy analyses, for scientific research efforts, and for informing the public. In order to facilitate this process, the EIIP DMC is currently working on the completion of the Data Model to allow transfer of electronic data from the inventory preparer to multiple end users.

The EIIP Data Model is currently focused on the emission inventory data needed to support air quality modeling. While the initial scope covers the inventory data compiled for the SIP attainment demonstrations (as well as base year inventories, annual point source reporting, and trends analysis), the Data Model does not yet address some of the more detailed facility-level information needed, for example, for permit processing. Additional phases of development will need to be conducted by the EIIP to address these related data areas.

Examples of the application of electronic reporting techniques is evident in the different options available to states to report emissions data as part of their annual and periodic reporting requirements as prescribed under Sections 110(a)(2)(F) and 182(a)(3)(A) of the CAA as amended in 1990, respectively. Annual reporting requirements under Section 110(a)(2)(F) require reporting of criteria air pollutants for all areas under the general SIP requirements of Section 110. Section 182(a)(3)(A) requires that States with ozone nonattainment areas submit periodic inventories of VOC, NO_x, and CO emissions for point sources, area sources, mobile sources, and biogenic sources. Electronic reporting facilitates access by the inventory community to the wealth of emissions data created by these efforts.

Four basic options currently exist for electronic data reporting for the examples listed above.

- EIIP Data Model transfer format;
- EPA National Emissions Trends (NET) Database format;
- Aerometric Information Retrieval System (AIRS) AFS (Facility Subsystem) format; and
- State-specific format.

Two of the data reporting options discussed here, the EIIP/EDI format and the NET Database format, use the data element relationships defined in the EIIP Data Model. The EIIP has developed a data transfer format using existing EDI standards. The EDI data exchange standard is a nonproprietary standard created and maintained by the American National Standards Institute

(ANSI). The EIIP/EDI format can provide a common data exchange format for federal, state and local government agencies, and eventually industry, to exchange emissions inventory information electronically using a single data transfer format.

Another data transfer option for the annual reporting requirements is to use the EPA NET Database Format. The NET database will be compatible with the EIIP Data Model, and include the data elements and data relationships as they are defined in the EIIP Data Model. The new NET database will also be used in the EIIP EDI data transfer demonstration described above.

The AIRS format has been used for electronic reporting for previous state-submitted inventories and is still the primary inventory data storage vehicle for several states. Although using the AIRS format is a feasible and valid way to make an electronic inventory submittal, this method of reporting has some limitations. The chief constraint is that only point source information can be submitted in the AIRS format. Information about AIRS can be found on the OAQPS CHIEF BBS, or through the TTN 2000 Internet web site, described earlier in this chapter.

Other reporting formats for inventory data include electronic files in a state-specified format and may consist of database, spreadsheet, or flat ASCII files. If a state intends to submit inventory data in this form as part of their reporting requirements for annual or periodic inventories, the EPA's EFIG should be contacted ahead of time to confirm these procedures.

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8

GLOSSARY

8.1 POINT SOURCES

Actual Emissions are the actual rate of emissions of a pollutant from an emissions unit calculated using the unit's actual operating hours, production rates, and types of materials processed, stored, or combusted during the selected time period.

Allowable Emissions are the emissions rate that represents a limit on the emissions that can occur from an emissions unit. This limit may be based on a federal, state, or local regulatory emission limit determined from state or local regulations and/or 40 Code of Federal Regulations (CFR) Parts 60, 61, and 63.

Ambient Standards limit the concentration of a given pollutant in the ambient air. Ambient standards are not emissions limitations on sources, but usually result in such limits being placed on source operation as part of a control strategy to achieve or maintain an ambient standard.

Area Sources are smaller sources that do not qualify as point sources under the relevant emissions cutoffs. Area sources encompass more widespread sources that may be abundant, but that, individually, release small amounts of a given pollutant. These are sources for which emissions are estimated as a group rather than individually. Examples typically include dry cleaners, residential wood heating, auto body painting, and consumer solvent use. Area sources generally are not required to submit individual emissions estimates.

Carbon Monoxide (CO) is a colorless, odorless gas that depletes the oxygen-carrying capacity of blood. Major sources of CO emissions include industrial boilers, incinerators, and motor vehicles.

Class I Substances as defined in Title VI of the Clean Air Act Amendments (CAAA) include chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and methyl chloroform. According to the CAAA, all of these compounds must be phased out of production by the year 2000 with the exception of methyl chloroform, which must be phased out of production by the year 2002. Provisions are also made that allow for acceleration of this phaseout.

Class II Substances as defined in Title VI of the Clean Air Act Amendments (CAAA) include hydrochlorofluorocarbons (HCFCs). These substances must be phased out of production by the year 2015.

Continuous Emissions Monitoring (CEM) is any monitoring effort that "continuously" measures (i.e., measures with very short averaging times) and records emissions. In addition to measuring and recording actual emissions during the time of monitor operation, CEM data can be used to estimate emissions for different operating periods and longer averaging times.

Criteria Pollutant refers to a pollutant for which a National Ambient Air Quality Standard (NAAQS) has been set. Criteria pollutants are carbon monoxide (CO), lead (Pb), nitrogen oxides (NO_x), Ozone (measured as volatile organic compounds [VOCs]), particulate matter of aerodynamic diameter less than or equal to 10 micrometers (PM_{10}), and sulfur dioxide (SO_2).

Design Standards impose certain hardware requirements. For example, a design standard might require that leaks from compressors be collected and diverted to a control device. Design standards are typically used when an emissions limit is not feasible.

Emission Concentration Standards limit the mass emissions of a pollutant per volume of air. Emission concentration standards are expressed in terms such as grams per dry standard cubic meter (g/dscm) or other similar units.

Emission Factors are ratios that relate emissions of a pollutant to an activity level at a plant that can be easily measured, such as an amount of material processed, or an amount of fuel used. Given an emission factor and a known activity level, a simple multiplication yields an estimate of the emissions. Emission factors are developed from separate facilities within an industry category, so they represent typical values for an industry, but do not necessarily represent a specific source. Published emission factors are available in numerous sources.

Emissions Reduction Standards limit the amount of current emissions relative to the amount of emissions before application of a pollution control measure. For example, an emission reduction standard may require a source to reduce, within a specified time, its emissions to 50 percent of the present value.

Emission Standards are a general type of standard that limit the mass of a pollutant that may be emitted by a source. The most straightforward emissions standard is a simple limitation on mass of pollutant per unit time (e.g., pounds of pollutant per hour).

Engineering Estimate is a term commonly applied to the best approximation that can be made when the specific emission estimation techniques such as stack testing, material balance, or emission factor age are not possible. This estimation is usually made by an engineer familiar with the specific process, and is based on whatever knowledge may be available.

Equipment Standards require a specific type of equipment to be used in certain processes. Equipment standards are typically used when an emissions limit is not feasible.

Fugitive Emissions are emissions from other sources that are technically infeasible to collect and control (e.g., storage piles, wastewater retention ponds, etc.).

Hazardous Air Pollutants (HAPs) are listed in Section 112(b) of the 1990 Clean Air Act Amendments (CAAA). These pollutants are emitted in smaller quantities than criteria pollutants but may be reasonably anticipated to cause cancer, developmental effects, reproductive dysfunctions, neurological disorders, inheritable gene mutations, or other chronically or acutely toxic effects in humans. The CAAA specifies an initial list of 189 HAPs to be subject to further regulation. The list of HAPs includes relatively common pollutants such as formaldehyde, chlorine, methanol, and asbestos, as well as numerous less-common substances. Pollutants may, under certain circumstances, be added to or deleted from the list.

Lead (Pb) is an element that causes several types of developmental effects in children including anemia, neurobehavioral alterations, and metabolic alterations. Lead is emitted from industries such as battery manufacturing, lead smelters, and incineration. Although regulated in highway fuels, lead may also be emitted from unregulated off-highway mobile sources.

Material Balance or ***Mass Balance*** is a method for estimating emissions that attempts to account for all the inputs and outputs of a given pollutant. If inputs of a material to a given process are known and all outputs except for air emissions can be reasonably well quantified, then the remainder can be assumed to be an estimate of the amount lost to the atmosphere for the process.

Maximum Achievable Control Technology (MACT) Standards in addition to National Emissions Standards for Hazardous Air Pollutants (NESHAP), are promulgated under Section 112 of the Clean Air Act Amendments (CAAA). Technically NESHAP and MACT standards are separate programs. MACT standards differ from older NESHAPs because MACT standards are mandated by law to require the maximum achievable control technology, while NESHAPs were based on risks to public health. MACT standards are source category-specific, and each standard covers all the pollutants listed in Section 112 of the CAAA that are emitted by that source category. The first MACT standard promulgated (for the Synthetic Organic Chemical Manufacturing Industries) was originally developed as a NESHAP and is still referred to as the Hazardous Organic NESHAP (HON).

Means of Release to the Atmosphere is the mechanism by which emissions enter the atmosphere. Environmental agencies usually classify release mechanisms into three categories: process emissions, fugitive emissions, and process fugitive emissions. This characteristic of an emission source is important because emission factors and other estimation methods are specific to the type of release.

Mobile Sources include all nonstationary sources, such as automobiles, trucks, buses, motorcycles, aircraft, trains, construction and farm equipment, and other nonroad engines and vehicles.

National Ambient Air Quality Standards (NAAQS) are the main ambient standards for the following six criteria pollutants: carbon monoxide (CO), lead (Pb), nitrogen oxides (NO_x), sulfur oxides (SO_x), volatile organic compounds (VOCs), and particulate matter of aerodynamic diameter less than or equal to 10 micrometers (PM_{10}).

National Emissions Standards for Hazardous Air Pollutants (NESHAP) are a class of standards limiting emissions of HAPs and are based on risk to public health. The common usage of NESHAP actually refers to two different sets of standards, which are pollutant or source category-specific. The NESHAP, are published in 40 Code of Federal Regulations (CFR) Part 61.

New Source Performance Standards (NSPS) are promulgated for criteria, hazardous, and other pollutant emissions from new, modified, or reconstructed sources that the U.S. Environmental Protection Agency (EPA) determines contribute significantly to air pollution. These are typically emission standards, but may be expressed in other forms such as concentration and opacity. The NSPS are published in 40 Code of Federal Regulations (CFR) Part 60.

Nitrogen Oxides (NO_x) are a class of compounds that are respiratory irritants and that react with volatile organic compounds (VOCs) to form Ozone (O_3). The primary combustion product of nitrogen is nitrogen dioxide (NO_2). However, several other nitrogen compounds are usually emitted at the same time (nitric oxide [NO], nitrous oxide [N_2O], etc.), and these may or may not be distinguishable in available test data. They are usually in a rapid state of flux, with NO_2 being, in the short term, the ultimate product emitted or formed shortly downstream of the stack. The convention followed in emission factor documents is to report the distinctions wherever possible, but to report total NO_x on the basis of the molecular weight of NO_2. NO_x compounds are also precursors to acid rain. Motor vehicles, power plants, and other stationary combustion facilities emit large quantities of NO_x.

Opacity Standards limit the opacity (in units of percent opacity) of the pollutant discharge rather than the mass of pollutant.

Operational Standards impose some requirements on the routine operation of the unit. Such standards include maintenance requirements or operator training certification requirements. Operational standards are typically used when an emission limit is not feasible.

Ozone (O_3) is a colorless gas that damages lungs and can damage materials and vegetation. It is the primary constituent of smog, and is formed primarily when nitrogen oxides (NO_x) and volatile organic compounds (VOCs) react in the presence of sunlight. It is also emitted in insignificant quantities from motor vehicles, industrial boilers, and other minor sources.

Particulate Matter of aerodynamic diameter less than or equal to 10 micrometers (PM_{10}) is a measure of small solid matter suspended in the atmosphere. Small particles can penetrate deeply into the lung where they can cause respiratory problems. Emissions of PM_{10} are significant from fugitive dust, power plants, commercial boilers, metallurgical industries, mineral industries, forest and residential fires, and motor vehicles.

Particulate Matter of aerodynamic diameter less than or equal to 2.5 micrometers ($PM_{2.5}$) is a measure of fine particles of particulate matter that come from fuel combustion, agricultural burning, woodstoves, etc. On November 27, 1996 the U.S. Environmental Protection Agency proposed to revise the current primary (health-based) PM standards by adding a new annual $PM_{2.5}$ standard.

Plant Level Emissions are consolidated for an entire plant or facility. A plant may contain one or many pollutant-emitting sources.

Plant Level Reporting is generally required if total emissions from a plant (which may be composed of numerous individual emission points) meet the point source cutoff. These data can be used by the state to conduct a detailed estimate of emissions from that plant. The plant level reporting used by most air pollution control agencies generally requires that the facility provide data that apply to the facility as a whole. Such data include number of employees and the Standard Industrial Classification (SIC) code designation for the plant. A plant usually has only one SIC code denoting the principal economic activity of the facility. For the purpose of clearly identifying and tracking emissions data, each plant is generally assigned a plant (alternatively, “facility”) name and number. The plant is also identified by geographic or jurisdictional descriptors such as air quality control region, county, address, and Universal Transverse Mercator (UTM) grid coordinates (or latitude/longitude) that identify a coterminous location. An owner or operator engaged in one or more related activities is also identified. In some cases, plantwide emissions may be reported at the plant level.

Point Level Emissions typically represent single stacks or vents individually large enough to be considered point sources.

Point Level Reporting includes specific data for individual emission points (typically stacks). These data are more detailed than that submitted in Plant Level Reporting and may include emission-related and modeling information such as stack height of the release point, diameter of the stack, emission rate, method of determination, fugitive emissions, gas exit velocity from a stack, gas temperature, and operating schedule. Source identification information, as previously described under Plant Level Reporting, is usually also required at the point level to ensure that emission data for a single plant remain clearly identified. Regulatory agencies generally maintain individual emission-related records at the point level.

Point Sources are large, stationary, identifiable sources of emissions that release pollutants into the atmosphere. Sources are often defined by state or local air regulatory agencies as point sources when they annually emit more than a specified amount of a given pollutant, and how state and local agencies define point sources can vary. Point sources are typically large manufacturing or production plants. They typically include both confined "stack" emission points as well as individual unconfined "fugitive" emission sources.

Within a given point source, there may be several **emission points** that make up the point source. Emissions point refers to a specific stack, vent, or other discrete point of pollution release. This term should not be confused with point source, which is a regulatory distinction from area and mobile sources. The characterization of point sources into multiple emissions points is useful for allowing more detailed reporting of emissions information.

For point sources, the emission estimate reporting system used by most state and local air regulatory agencies groups emission sources into one of three categories and maintains emission-related data in a different format for each. The three categories are plant level, point level, and process or segment level.

Potential Emissions are the potential rate of emissions of a pollutant from an emissions unit calculated using the unit's maximum design capacity. Potential emissions are a function of the unit's physical size and operational capabilities.

It is important to note that annual potential emissions from a unit are not necessarily the product of 8760 hours per year times the hourly potential emissions. For most processes, the operation of one piece of equipment is limited in some way by the operation of another piece of equipment upstream or downstream. For example, consider a batch process involving vessels X, Y, and Z in series (i.e., the output from Vessel X is the feed to Vessel Y, and the output from Vessel Y is the feed to Vessel Z) where the residence time for each vessel is different. In this process, Vessel Y may not operate 8760 hours per year because either the output from Vessel X is not feeding Vessel Y at all times or Vessel Z may not always be available to accept the output from Vessel Y.

It is also possible for the emission rate to vary over time. For instance, if a reaction requires 6 hours to reach completion, the emissions from the reaction vessel during the first hour will be different than those during the last hour. Thus, the highest hourly emission rate is not sustained during the entire cycle or for the entire year.

Process-based Emission Standards limit the mass emissions per unit of production. These standards may limit mass emissions per unit of material processed or mass emissions per unit of energy used. As process rate increases (e.g., an increase in tons of ore processed per hour), the allowable emissions increase (e.g., an increase in pounds of pollutant per hour).

Process Emissions are emissions from sources where an enclosure, collection system, ducting system, and/or stack (with or without an emission control device) is in place for a process. Process emissions represent emissions from process equipment (other than leaks) where the emissions can be captured and directed through a controlled or uncontrolled stack for release into the atmosphere.

Process Fugitive Emissions occur as leaks from process equipment including compressors, pump seals, valves, flanges, product sampling systems, pressure relief devices, and open-ended lines. Emissions from the process that are not caught by the capture system are also classified as process fugitive emissions.

Process or Segment Level Emissions usually represent a single process or unit of operation.

Process or Segment Level Reporting involves each process within a plant being identified by a U.S. Environmental Protection Agency (EPA) source classification code (SCC). For point sources, reporting guidelines may require that a plant identify, for each process or operation (designated by SCC), the periods of process operation (daily, weekly, monthly, annually); operating rate data including actual, maximum, and design operating rate or capacity; fuel use and fuel property data (ash, sulfur, trace elements, heat content, etc.); identification of all pollution control equipment and their associated control efficiencies (measured or design); and emissions rates. Source identification information, as previously described under Plant Level Reporting, is usually also required at the process level to ensure that emissions data for a single plant are clearly identified.

Process-specific Empirical Relationships are similar to emission factors in that they relate emissions to easily identifiable process parameters. However, these relationships are represented by more detailed equations that relate emissions to several variables at once, rather than a simple ratio. An example is the estimate for volatile organic compound (VOC) emissions from storage tanks that is based on tank size, air temperature, and vapor pressure.

Reported Emissions are those emission estimates that are submitted to a regulatory agency. Emissions inventories can be used for a variety of purposes such as State Implementation Plan (SIP) base year inventories, environmental compliance audits, air quality rule applicability, and reporting information in an air quality permit application. Emissions can be reported on an actual, potential, or maximum basis. Many state and local air pollution control agencies have rules and regulations that define an allowable emission value for a particular piece of equipment. Because of this, a facility should first define the purpose of the inventory and then choose the appropriate means of reporting emissions to the regulatory agency. For example, SIP base year inventories for point sources would contain actual emissions. However, regulatory applicability and air quality permit applications can require that actual, allowable, and potential emissions be reported.

Source Tests are short-term tests used to collect emissions data that can then be extrapolated to estimate long-term emissions from the same or similar sources. Uncertainties arise when source test results are used to estimate emissions under process conditions that differ from those under which the test was performed.

Stratospheric Ozone-depleting Compounds are chlorofluorocarbons (CFCs), halons, carbon tetrachloride, methyl chloroform, and hydrochlorofluorocarbons (HCFCs). These pollutants are regulated by Title VI of the Clean Air Act Amendments (CAAA) because they may destroy stratospheric Ozone. Title VI is primarily designed to limit the manufacture of these materials, not their use. The pollutants are divided into two classes (Class I and Class II) based on the dates by which their manufacture must be discontinued. Methods to estimate emissions of Ozone-depleting compounds are not discussed in Emission Inventory Improvement Program (EIIP) documents. Information on emissions of Ozone-depleting compounds can be obtained from the U.S. Environmental Protection Agency (EPA), Office of Atmospheric and Indoor Air Programs, Global Climate Change Division, located at EPA Headquarters in Washington, D.C.

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

Volatile Organic Compounds (VOCs) react with nitrogen oxides (NO_x) in the atmosphere to form Ozone (O_3). Although not criteria pollutants, VOC emissions are regulated under criteria pollutant programs because they are Ozone precursors. Large amounts of VOCs are emitted from fuel distribution, chemical manufacturing, motor vehicles, and a wide variety of industrial, commercial, and consumer solvent uses.

The use of certain photochemical models requires estimation of methane, ethane, and several other less photochemically reactive compounds and particulates. While not regulated as VOCs, these compounds may need to be estimated for certain modeling inventories or to meet certain state inventory requirements. For this reason, the term **total organic compounds** (TOCs) is used to refer to this broader class of chemicals.

Work Practice Standards require some action during the routine operation of the unit. For example, volatile organic compound (VOC) monitoring of a compressor might be required on a quarterly basis to ensure no leaks are occurring. Work practice standards are typically used when an emission limit is not feasible.

8.2 AREA SOURCES

Activity Level/Factor is a measurable factor that is directly or indirectly related to the emissions of a process. An emission estimate is calculated by multiplying an activity level by an emission factor. The activity level is either directly related to the amount of emissions (as in the case of the amount of fuel used in a combustion process), or is a more easily measured surrogate, such as population for consumer product usage.

Area Sources are smaller sources that do not qualify as point sources under the relevant emissions cutoffs. Area sources encompass more widespread sources that may be abundant, but that, individually, release small amounts of a given pollutant. These are sources for which emissions are estimated as a group rather than individually. Examples typically include dry cleaners, residential wood heating, auto body painting, and consumer solvent use. Area sources generally are not required to submit individual emissions estimates.

Biogenic Sources are biological sources of emissions such as trees, agricultural crops, or microbial activity in soils or water. This term is sometimes used to describe any natural emission source.

Carbon Monoxide (CO) is a colorless, odorless gas that depletes the oxygen-carrying capacity of blood. Major sources of CO emissions include industrial boilers, incinerators, and motor vehicles.

Control Efficiency (CE) is the emission reduction efficiency, and is a percentage value representing the amount of a source category's emissions that are controlled by a control device, process change, or reformulation.

Double Counting means estimation and counting of estimated emissions twice in an inventory. Area source inventories are at risk of double counting emissions from two sources because of point and area source overlap and overlap between two area sources.

Emission Factor is a ratio between the amount of pollution produced and an activity level. Given an emission factor and a known activity level, a simple multiplication yields an estimate of the emissions. See Activity Level/Factor, and the Point Source definition of Emission Factor.

Emission Inventory is a listing, by source, of the amount of air pollutants discharged into the atmosphere of a community; used to establish emission standards.

Growth Factors are surrogate indicators that predict the proportional change in the activity level or emissions for a particular emissions source.

Inventory Area is generally defined by political boundaries such as county and state boundaries, where the jurisdictions that are included in an inventory area make up an air basin or experience common air problems. The pollutant or the type of air pollution inventory will determine the exact geographic area that will be covered.

Material Balance or ***Mass Balance*** is a method for estimating emissions that attempts to account for all the inputs and outputs of a given pollutant. If inputs of a material to a given process are known and all outputs except for air emissions can be reasonably well quantified, then the remainder can be assumed to be an estimate of the amount lost to the atmosphere for the process.

Mathematical Emission Model is an emission estimation technique that uses a mathematical model to estimate emissions. A very simple mathematical model is an emission factor and an activity level. A more complex model may involve multiple parameters and iterations in the calculation process. A mathematical model may be used by inventory preparers as an equation or as a computer program.

Mobile Sources include all nonstationary sources, such as automobiles, trucks, buses, motorcycles, aircraft, trains, construction and farm equipment, and other nonroad engines and vehicles.

Nitrogen Oxides (NO_x) are a class of compounds that are respiratory irritants and that react with volatile organic compounds (VOCs) to form Ozone (O_3). The primary combustion product of nitrogen is nitrogen dioxide (NO_2). However, several other nitrogen compounds are usually emitted at the same time (nitric oxide [NO], nitrous oxide [N_2O], etc.), and these may or may not be distinguishable in available test data. They are usually in a rapid state of flux, with NO_2 being, in the short term, the ultimate product emitted or formed shortly downstream of the stack. The convention followed in emission factor documents is to report the distinctions wherever possible, but to report total NO_x on the basis of the molecular weight of NO_2. NO_x compounds are also precursors to acid rain. Motor vehicles, power plants, and other stationary combustion facilities emit large quantities of NO_x.

Nonmethane Hydrocarbons (NMHCs) are a class of compounds that includes a wide range of specific organic chemical substances including reactive volatile organic compounds (VOCs), which form Ozone, a greenhouse gas, in the troposphere. A major local and regional air pollutant, they cause significant health and environmental damage.

Ozone (O_3) is a colorless gas that damages lungs and can damage materials and vegetation. It is the primary constituent of smog, and is formed primarily when nitrogen oxides (NO_x) and volatile organic compounds (VOCs) react in the presence of sunlight. It is also emitted in insignificant quantities from motor vehicles, industrial boilers, and other minor sources.

Point Sources are emission units that are inventoried individually, and in much greater detail, in comparison to area sources. The distinction between point and area sources is usually defined by a cutoff level, typically based on emissions. See the following terms in the Point Sources Glossary: Plant Level Emissions, Plant Level Reporting, Point Level Emissions, and Point Level Reporting.

Projection Inventory is an inventory that is prepared to predict future emissions levels using base year emissions, growth factors, and current and future controls.

Quality Assurance (QA) is a process that involves both the inventory team and external reviewers to insure the overall quality of the inventory.

Quality Control (QC) comprises the activities undertaken by all members of the inventory team during the inventory preparation that will result in the correction of specific problems such as mistaken assumptions, lost or uncollected data, and calculation and data entry errors.

Rule Effectiveness (RE) is the measure of the ability of the regulatory program to achieve all emission reductions possible, which reflects the assumption that regulations are typically not 100 percent effective. RE is used as an adjustment to the control efficiency. See Control Efficiency and Rule Penetration.

Rule Penetration (RP) is the percentage of an area source category that is covered by an applicable regulation.

Standard Industrial Classification (SIC) Codes are codes defined by the U.S. Department of Commerce that classify businesses by products or services. SICs are the Federal standard for classifying establishment-based statistics..

Spatial Allocation entails assignment of activity levels or emission estimates to a smaller or larger geographic area than the area for which the activity level or emission estimate was prepared. Allocation usually requires the identification of a surrogate indicator that can be used for scaling.

State Implementation Plan (SIP) Inventories are inventories prepared to meet the requirements of a state plan approved by the U.S. Environmental Protection Agency for the establishment, regulation, and enforcement of air pollution standards.

Surveys are a method to collect inventory data using telephone or written questionnaires that are answered by manufacturers or suppliers of products, or by representatives at the facilities or sites where the emitting processes take place. An area source survey may also include review and data collection from existing air pollution permits within an agency. Surveys for area source inventories usually survey a subset of the population of sources.

Temporal Adjustments are adjustments to an emission estimate to reflect the time period desired for the inventory. Adjustments may need to be made to reflect differences in the usage level for a season, a certain day of the week, or time of day. Adjustments may also need to be made to reflect differences in temperature or other climatological variations that affect emissions.

Volatile Organic Compounds (VOCs) react with nitrogen oxides (NO_x) in the atmosphere to form Ozone (O_3). Although not criteria pollutants, VOC emissions are regulated under criteria pollutant programs because they are Ozone precursors. Large amounts of VOCs are emitted from fuel distribution, chemical manufacturing, motor vehicles, and a wide variety of industrial, commercial, and consumer solvent uses.

The use of certain photochemical models requires estimation of methane, ethane, and several other less photochemically reactive compounds and particulates. While not regulated as VOCs, these compounds may need to be estimated for certain modeling inventories or to meet certain state inventory requirements. For this reason, the term **total organic compounds** (TOCs) is used to refer to this broader class of chemicals.

8.3 MOBILE SOURCES

Highway Performance Monitoring System (HPMS) is a program developed by the U.S. Department of Transportation Federal Highway Administration in the mid-1970s to collect and report information on the nation's highways.

MOBILEX.X is the U.S. Environmental Protection Agency's emission factor model that helps analysts in estimating motor vehicle contributions to the local emissions inventory and is designed to account for the effect of numerous vehicle parameters on the volume of pollutants emitted. Latest versions are MOBILE5a and MOBILE5b.

Vehicle Miles Traveled (VMT) is an expression of vehicle activity that is used with emission factors, typically in units of grams per mile of travel. Because VMT does not directly correlate to emissions that occur while the vehicle is not moving, these nonmoving emissions are incorporated into the U.S. Environmental Protection Agency's MOBILE model emission factors.

Travel Demand Model (TDM) is a mathematical model used to assess the effects of growth on a highway network and allows transportation analysts to evaluate the improvements that are needed. From the perspective of air quality, important products of these models are estimates of vehicle miles traveled and speed on each of the roadway links coded in the highway network.

Federal Test Procedure (FTP) is a standardized procedure developed by the U.S. Environmental Protection Agency to measure emissions rates from motor vehicles. The FTP is a chassis dynamometer test conducted using a standardized driving cycle under standardized conditions.

Operating Modes include the three vehicle modes of operation represented by emission factors based on the federal test procedure driving cycle. The three modes of operation are: cold start, hot start, and hot stabilized.

> ***Cold Start*** is the operating mode that reflects conditions experienced at the beginning of a trip when the engine and the emission control system begin operation at ambient temperature and are not performing at optimum levels.
>
> ***Hot Start*** is the operating mode that reflects the condition of an engine that has been restarted after being turned off for 10 minutes and, therefore, has not cooled to ambient conditions.
>
> ***Hot Stabilized*** is the operating modes that reflects the condition of the engine when the vehicle has been in continuous operation long enough for all systems to have attained stable operating temperatures.

Vehicle Classes are designated categories of vehicles registered to use the public roadways, and include automobiles, trucks, buses, and motorcycles. The U.S. Environmental Protection Agency's MOBILE model contains eight vehicle classes for which emission factors can be produced.

8.4 BIOGENIC SOURCES

Anthropogenic Emission Sources are emission sources that depend on human behavior. Included in this group are emissions from agricultural operations, biomass burning, and emissions from microbial activity during waste treatment.

Biogenic Sources are biological sources of emissions such as trees, agricultural crops, or microbial activity in soils or water. This term is sometimes used to describe any natural emission source.

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

Cloud Cover is the thickness, level, and percentage of load per level of clouds covering the sky. See Sky Cover.

Emission Factor is a ratio of the emissions per unit of activity per unit of time. When estimating biogenic volatile organic compound (VOC) emissions, the emission factor will be based on the amount of vegetation biomass. See Emission Rate.

Emission Flux is the emissions per unit of area per unit of time for a particular vegetation type (in the case of biogenic volatile organic compound [VOC] emissions) or land use type (in the case of biogenic nitric oxide [NO] emissions).

Emission Rate is the emissions per unit of time for a particular source type, such as a vegetation type, and for a particular chemical species. When calculating biogenic emissions, the emission rate is dependant on the vegetation type emission factor, the amount of biomass, and environmental factors accounting for solar radiation and leaf temperature.

Geogenic Emission Sources result from geological activity. Sources include volcanoes, fumaroles, and natural seeps of oil or natural gas.

Geographic Information System (GIS) is a computer-based information system that allows for storage and manipulation of spatially related data.

Greenhouse Gases that occur naturally include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and Ozone (O_3). Chlorofluorocarbons (CFCs) (a family of human-made compounds), its substitute hydrofluorocarbons (HFCs), and other compounds such as perfluorinated carbons (PFCs) are also greenhouse gases.

Land Use Data describe the predominant vegetative cover, type of water body, or anthropogenic use (buildings, parking lots, etc.) of land for areas of a defined scale.

Methane (CH_4) is a colorless, nonpoisonous flammable gas created by anaerobic decomposition of organic compounds; considered a greenhouse gas pollutant.

Natural Emission Sources are nonanthropogenic sources of emissions that include biogenic and geogenic emission sources.

Nitric Oxide (NO) is a colorless gas formed by combustion under high temperature and high pressure in an internal combustion engine. It changes into nitrogen dioxide (NO_2) in the ambient air and contributes to photochemical smog. It is the most thermally stable of the oxides of nitrogen.

Nitrogen Oxides (NO_x) are a class of compounds that are respiratory irritants and that react with volatile organic compounds (VOCs) to form Ozone (O_3). The primary combustion product of nitrogen is nitrogen dioxide (NO_2). However, several other nitrogen compounds are usually emitted at the same time (nitric oxide [NO], nitrous oxide [N_2O], etc.), and these may or may not be distinguishable in available test data. They are usually in a rapid state of flux, with NO_2 being, in the short term, the ultimate product emitted or formed shortly downstream of the stack. The convention followed in emission factor documents is to report the distinctions wherever possible, but to report total NO_x on the basis of the molecular weight of NO_2. NO_x compounds are also precursors to acid rain. Motor vehicles, power plants, and other stationary combustion facilities emit large quantities of NO_x.

Nitrous Oxide (N_2O) is a colorless gas with a mild, pleasing odor and sweet taste. Its behavior resembles that of oxygen as an oxidizing agent with combustible substances. It is considered a naturally occurring greenhouse gas.

Nonmethane Hydrocarbons (NMHCs) are a class of compounds that includes a wide range of specific organic chemical substances, including reactive volatile organic compounds (VOCs), which form Ozone, a greenhouse gas, in the troposphere. A major local and regional air pollutant, they cause significant health and environmental damage.

Ozone (O_3) is a colorless gas that damages lungs and can damage materials and vegetation. It is the primary constituent of smog, and is formed primarily when nitrogen oxides (NO_x) and volatile organic compounds (VOCs) react in the presence of sunlight. It is also emitted in insignificant quantities from motor vehicles, industrial boilers, and other minor sources.

Ozone Day is the time period (one day) that Ozone (O_3) emissions are estimated for a daily Ozone inventory. When modeling biogenic emissions, an Ozone day is selected from days with the highest actual recorded Ozone, and the meteorology from that day is used in the model.

Photosynthetically Active Radiation (PAR) is the photon flux density in the visible (or photosynthetic) portion of the spectrum (0.4 - 0.7 µm), expressed as the energy per square meter per second.

Sky Cover is the amount of sky completely hidden by clouds or other obscuring phenomenon. Sky cover is reported in tenths, so that 0.0 sky cover indicates a clear sky and 1.0 sky cover indicates a completely covered sky.

Volatile Organic Compounds (VOCs) react with nitrogen oxides (NO_x) in the atmosphere to form Ozone (O_3). Although not criteria pollutants, VOC emissions are regulated under criteria pollutant programs because they are Ozone precursors. Large amounts of VOCs are emitted from fuel distribution, chemical manufacturing, motor vehicles, and a wide variety of industrial, commercial, and consumer solvent uses.

The use of certain photochemical models requires estimation of methane, ethane, and several other less photochemically reactive compounds and particulates. While not regulated as VOCs, these compounds may need to be estimated for certain modeling inventories or to meet certain state inventory requirements. For this reason, the term **total organic compounds** (TOCs) is used to refer to this broader class of chemicals.

8.5 QUALITY ASSURANCE

100(1-α) Percent Confidence Interval of a Population Parameter means that if the process of drawing *n* samples from the population is repeated many times and the 100(1-α) percent confidence interval is computed each time, 100(1-α) percent of those intervals will include the population parameter value.

Accuracy is (1) the closeness of a measurement to its true value, or (2) the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator.

Area Sources are smaller sources that do not qualify as point sources under the relevant emissions cutoffs. Area sources encompass more widespread sources that may be abundant, but that, individually, release small amounts of a given pollutant. These are sources for which emissions are estimated as a group rather than individually. Examples typically include dry cleaners, residential wood heating, auto body painting, and consumer solvent use. Area sources generally are not required to submit individual emissions estimates.

Arithmetic Mean is the sum of all the values of a set of measurements divided by the number of values in the set, usually denoted by $\bar{x}$; also a measure of central tendency.

Attainment Area is an area considered to have air quality as good as or better than the National Ambient Air Quality Standards (NAAQS) as defined in the Clean Air Act. Note that an area may be in attainment for one or more pollutants but be a nonattainment area for one or more other pollutants.

Audit of Data Quality means a qualitative and quantitative audit in which data and data handling are reviewed and data quality is assessed.

Audits are systematic evaluations to determine the quality of a function or activity.

Average means the sum of all the items or observations in a sample divided by the number of items in the sample. Synonymous with “sample mean.”

Bias is the systematic or persistent distortion of a measurement process or estimation method.

Biogenic Sources are biological sources of emissions such as trees, agricultural crops, or microbial activity in soils or water. This term is sometimes used to describe any natural emission source.

Chain of Custody is a trail of accountability that documents the physical security of samples, data, and records.

Coefficient of Variation (CV) is the standard deviation expressed as a percentage of the mean. Also see ***Relative Standard Deviation***.

Comparability is the degree to which different methods, data sets, and/or decisions agree or can be represented as similar; a data quality indicator.

Completeness is the amount of valid data obtained compared to the planned amount, usually expressed as a percentage; a data quality indicator.

Confidence Interval is a range that has a designated probability (i.e., confidence level) of including a specific population parameter.

Correction is an action taken to determine causes of quality defects and to restore proper functioning of a system or procedure.

Criteria Pollutant refers to a pollutant for which a National Ambient Air Quality Standard (NAAQS) has been set. Criteria pollutants are carbon monoxide (CO), lead (Pb), nitrogen oxides (NO_x), Ozone (measured as volatile organic compounds [VOCs]), particulate matter of aerodynamic diameter less than or equal to 10 micrometers (PM_{10}), and sulfur dioxide (SO_2).

Data are facts or figures from which conclusions can be inferred; information.

Data Attribute Rating System (DARS) is a system developed by the U.S. Environmental Protection Agency (EPA) to evaluate emissions uncertainty by assigning numerical values to the perceived quality of the emission factors and activity data.

Data Management Plan is a written document prepared prior to inventory development that may be a part of the quality assurance (QA) plan. It describes the required inventory-development records, the steps required to produce them, how the records are to be stored, the retention period, the procedures for retrieving them, and the circumstances for their destruction.

Data Quality Indicators are qualitative and quantitative descriptors used to interpret the degree of acceptability or utility of data to the user. The principal data quality indicators are accuracy, comparability, completeness, and representativeness.

Data Quality Objectives are qualitative and quantitative statements of the level of uncertainty that a decision maker is willing to accept in the estimates and/or decisions made with emissions inventory data.

Data Reduction is the process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useful form.

Data Set refers to all observed values in a test or study; data collected under similar conditions that can be analyzed as a whole.

Defensible means the ability to withstand reasonable challenge related to the veracity or integrity of documents and derived data.

Emission means pollution discharged into the atmosphere from smokestacks, other vents, and surface areas of commercial or industrial facilities; from residential chimneys; and from motor vehicle, locomotive, aircraft or other nonroad engines.

Emission Factors are ratios that relate emissions of a pollutant to an activity level at a plant that can be easily measured, such as an amount of material processed, or an amount of fuel used. Given an emission factor and a known activity level, a simple multiplication yields an estimate of the emissions. Emission factors are developed from separate facilities within an industry category, so they represent typical values for an industry, but do not necessarily represent a specific source. Published emission factors are available in numerous sources.

Emission Inventory is a listing, by source, of the amount of air pollutants discharged into the atmosphere of a community; used to establish emission standards.

Emission Standards are a general type of standard that limit the mass of a pollutant that may be emitted by a source. The most straightforward emissions standard is a simple limitation on mass of pollutant per unit time (e.g., pounds of pollutant per hour).

Equivalent Method means any method of sampling and analyzing for air pollution that has been demonstrated to the U.S. Environmental Protection Agency (EPA) Administrator's satisfaction to be, under specific conditions, an acceptable alternative to normally used reference methods.

Fugitive Emissions are emissions not caught by a capture system.

Hazardous Air Pollutants (HAPs) are listed in Section 112(b) of the 1990 Clean Air Act Amendments (CAAA). These pollutants are emitted in smaller quantities than criteria pollutants but may be reasonably anticipated to cause cancer, developmental effects, reproductive dysfunctions, neurological disorders, inheritable gene mutations, or other chronically or acutely toxic effects in humans. The CAAA specifies an initial list of 189 HAPs to be subject to further regulation. The list of HAPs includes relatively common pollutants such as formaldehyde, chlorine, methanol, and asbestos, as well as numerous less-common substances. Pollutants may, under certain circumstances, be added to or deleted from the list.

Inventory Work Plan is a document that discusses staff assignments and responsibilities, establishes a commitment to the inventory development and quality assurance/quality control (QA/QC) processes, and establishes a commitment to personnel training and project documentation requirements. It may either be integrated with the quality assurance plan (QAP) or a separate document.

Level I, II, III, and IV Inventories refer to categories delineated by the Emission Inventory Improvement Program (EIIP) Quality Assurance (QA) Committee based on the intended use of the inventory. Level I inventories are used to support enforcement, compliance, or litigation activities. Level II inventories provide supportive data for strategic decision making or standard setting. Level III inventories are developed for general assessments or research that will not be used in direct support of decision making. Level IV inventories are compiled entirely from previously published data or other inventories, and no original data are gathered.

Mean is synonymous with “average.” Also called “arithmetic mean.”

Measurement/Method Attribute is one of the four Data Attribute Rating System (DARS) data attributes. It explicitly addresses the quality of the factor, not how it is applied.

Median is that value above which and below which half the sample population lies, in other words, the value of the variable in an ordered array that has an equal number of observations on each side of it.

Mobile Source means any nonstationary source of air pollution such as cars, trucks, motorcycles, buses, airplanes, ships and boats, locomotives, and equipment with internal combustion engines.

Mode is the value represented by the greatest number of observations in a sample population.

Nonparametric Technique is one that does not depend upon data being drawn from a specific distribution, such as the normal or log-normal, for its validity; a distribution-free technique.

Nonroad Emissions are pollutants emitted by internal combustion engines on farm and construction equipment, gasoline-powered lawn and garden equipment, and power boats and outboard motors. Also includes pollutants emitted by airplanes, ships, and locomotives.

Normal Distribution is a probability density function that approximates the distribution of many random variables associated with measurements of natural phenomena and takes the form of a symmetric "bell-shaped curve."

Observation refers to a fact or occurrence that is recognized and recorded.

Onroad Emissions are pollutants emitted by nonstationary sources of air pollution such as cars, trucks, motorcycles, and buses.

Outlier is an observation that does not conform to the pattern established by other observations in a data set.

Parameter is a variable, measurable property whose value is a determinant of the characteristics of a system (e.g., temperature, pressure, and density are parameters of the atmosphere).

Performance Audit is a quantitative appraisal of quality that includes the use of an objective standard or set of data to evaluate the effectiveness or accuracy of a system or procedure.

Point Sources are large, stationary, identifiable sources of emissions that release pollutants into the atmosphere. Sources are often defined by state or local air regulatory agencies as point sources when they annually emit more than a specified amount of a given pollutant, and how state and local agencies define point sources can vary. Point sources are typically large manufacturing or production plants. They typically include both confined "stack" emission points as well as individual unconfined "fugitive" emission sources.

Within a given point source, there may be several **emission points** that make up the point source. Emissions point refers to a specific stack, vent, or other discrete point of pollution release. This term should not be confused with point source, which is a regulatory distinction from area and mobile sources. The characterization of point sources into multiple emissions points is useful for allowing more detailed reporting of emissions information.

For point sources, the emission estimate reporting system used by most state and local air regulatory agencies groups emission sources into one of three categories and maintains emission-related data in a different format for each. The three categories are plant level, point level, and process or segment level.

Population means all possible items or units that possess a variable of interest and from which samples may be drawn.

Precision is (1) a measure of the closeness of agreement among individual measurements, and (2) the closeness of repeated measurements of the same quantity.

Prevention is an orderly program of planning and positive actions taken before or during the conduct of procedures to ensure that the procedures are effectively meeting the requirements for which they are intended.

Probability Sampling is the use of a specific method of random selection of population units for measurement.

Procedural Audit is an objective assessment of compliance to procedural requirements.

Quality is the sum of features and properties/characteristics of a product or service that bear on its ability to satisfy stated needs.

Quality Assurance (QA) is a planned system of activities designed to provide assurance that the quality control program is actually effective.

Quality Assurance Manual is a written document that identifies the policies, organization, objectives, functional activities, and specific quality assurance activities designed to achieve the quality goal desired.

Quality Assurance Objectives are project goals for accuracy, precision, completeness, representativeness, and comparability of data gathered during testing.

Quality Assurance Plan (QAP) is a formal document describing the management policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an agency or company for ensuring quality in its products and usefulness to its users.

Quality Control (QC) is a planned system of activities whose purpose is to provide quality services or products.

Quality Trilogy refers to planning, control, and improvement.

Random Measurement Uncertainty refers to unpredictable deviation from the true value of a parameter being measured.

Random Sampling Error is the variation in an estimated quantity due to the random selection of parameters for measurement.

Reference Method is a sampling and/or measurement method that has been officially specified by an organization as meeting its data quality requirements.

Relative Standard Deviation is the standard deviation expressed as a percentage of the mean recovery (i.e., the coefficient of variation multiplied by 100).

Representativeness means that an inventory is representative of the region and sources it is meant to cover; a data quality indicator.

Representative Sample refers to a sample that reflects the variable of interest in the population as accurately and precisely as possible. To ensure representativeness, the sample may be either completely random or stratified depending upon the conceptualized population and the sampling objective.

Representative Unit means one selected from the target population that in combination with other representative units will give an accurate picture of the phenomenon being studied.

Sample refers to a representative part of a large whole or a single item of a group; a finite part or subset of a statistical population. A sample serves to provide data or information from which are inferred the properties of the whole group or population.

Sample Mean. See ***Average***.

Sample Variance (Statistical) means a measure of the dispersion of a set of values. The sum of the squares of the difference between the individual values of a set and the arithmetic mean of the set divided by one less than the number of values in the set. (This is equal to the square of the sample standard deviation.)

Sampled Population is a set of population units available for measurement.

Sampling Error refers to that portion of the difference between a population value and an estimate thereof that is due to only a limited number of all possible values being observed. This is distinguished from errors due to imperfect selection, bias in response, or errors of observation, measurement, or recording, etc.

Source Specificity Attribute is one of the four Data Attribute Rating System (DARS) data attributes. It refers to how specific the original factor or activity surrogate is to the source being estimated.

Spatial Congruity Attribute is one of the four Data Attribute Rating System (DARS) data attributes. It addresses the spatial scaling of factors and activity data that is common to inventories.

Standard Deviation (s.d.) is the most common measure of the dispersion or imprecision of observed values expressed as the positive square root of the variance. See ***Sample Variance***.

Standard Error is the standard deviation of a statistic, usually used to designate the standard deviation of a sample mean.

Standard Method is an assemblage of techniques and procedures based on consensus or other criteria, often evaluated for its reliability by collaborative testing and receiving organizational approval.

Standard Operating Procedures (SOPs) refer to a written document that details the method of an operation, analysis, or action whose techniques and procedures are thoroughly prescribed and that is accepted as the method for performing certain routine or repetitive tasks.

State Implementation Plan (SIP) is a state plan approved by the U.S. Environmental Protection Agency for the establishment, regulation, and enforcement of air pollution standards.

Stationary Source is a fixed-site producer of pollution, including power plants and other major sources such as industrial manufacturing facilities as well as area sources.

Statistic is an estimate of a population characteristic calculated from a data set (observed or corrected values) (e.g., the mean or standard deviation).

Statistical Bias refers to a discrepancy between the expected value of an estimator and the population parameter being estimated.

Statistical Checks mean a miscellaneous set of tools/procedures that are part of quality assurance. Also referred to as “statistical quality control.”

Stratification means the division of a target population into subsets or strata that are more internally homogeneous with respect to the characteristic to be studied than with the population as a whole.

Stratified Sampling is the sampling of a population that has been stratified, with part of the sample coming from each stratum. See ***Stratification.***

Systems Audit is an on-site evaluation or assessment of the quality control program developed for a project or laboratory. The audit is conducted by a trained auditor who is not directly involved in the conduct of the work.

Systematic Error is a consistent deviation in the result from the expected or known value. Such error is caused by human and methodological bias.

Target Population refers to the set of *N* population units for which inferences will be made.

Technical Systems Audit is an on-site audit of a company's quality assurance system, physical facilities, and implementation of approved procedures.

Temporal Congruity Attribute is one of the four Data Attribute Rating System (DARS) data attributes. It describes the relationship between emission factor, activity, and temporal scale of the inventory.

Total Quality Management is a system of activities designed to provide continuous improvement at every level and in all areas of responsibility.

Trimmed Mean is the arithmetic mean of the data remaining after a specified percentage of the *n* data in both tails of the distribution curve are discarded.

Uncertainty comprises two types of errors in estimation: bias and imprecision.

Uncertainty Analysis is conducted to identify and quantify the various sources of variability and inaccuracies in data used to estimate emissions. It includes an assessment of bias and imprecision.

Validated Method is a method that has been determined to meet certain performance criteria for sampling and/or measurement operations.

Variable is an entity subject to variation or change.

Variance is a fundamental statistical measure of dispersion, calculated by summing the standard deviation of each sample from the mean and dividing that sum by the number of observations in the sample.

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APPENDIX A

EMISSION INVENTORY IMPROVEMENT PROGRAM COMMITTEE MEMBER LIST

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