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CUYAHOGA COUNTY AIR TOXICS EMISSIONS INVENTORY

FINAL REPORT

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EXECUTIVE SUMMARY

An air toxics emission inventory was prepared for Cuyahoga County (representing the greater Cleveland, Ohio area) as a project under the Cleveland Clean Air Century Campaign. This Campaign and the associated inventory project is an outgrowth of the U.S. Environmental Protection Agency's (EPA's) Integrated Air Toxics Strategy program. The Strategy presented a framework for addressing air toxics in urban areas, including plans to conduct initiatives at both the national and local level to address specific pollutants and to identify and address specific community risks.

The Cleveland pilot study is one of the first demonstrations of a community-based approach to air toxics emissions reduction that may serve as a national model. In 2001, the U.S. EPA's Office of Air and Radiation began the Cleveland Air Toxics Pilot Program to test whether an inclusive, local-scale decision-making process can result in voluntary reductions in air toxics exposure with wide-based acceptance and support in the community. The approach is intended to supplement, not replace, regulatory programs. The pilot is designed to address air toxics in an integrated manner, with projects directed at outdoor (stationary and mobile) and indoor sources. Its primary three goals are to reduce air toxics in Cleveland, ensure the overall project is sustainable within the community, and ensure the approach can be replicated in other counties across the United States.

A Working Group was formed to act as the project's decision-making body. It consists of Cleveland residents, environmental groups, local area businesses and business organizations, governmental and non-governmental agencies, the Ohio EPA, U.S. EPA Region V, and EPA headquarters. Local citizen involvement is particularly strong from the Cleveland neighborhoods of Slavic Village and St. Clair-Superior. Work Group subcommittees were charged with developing project proposals that included a discussion of the air toxic pollutants that are potentially reduced, expected emissions reductions, length and difficulty of implementation, and other issues. In July 2002, the Working Group decided to fund the development of an air toxics emission inventory for Cuyahoga County, Ohio.

The study area for the air toxics inventory is the entire geographic boundary of Cuyahoga County, Ohio. This includes the Cleveland metropolitan area and all smaller cities surrounding it that lie in Cuyahoga County. The inventory addressed air toxics emissions from stationary point sources, stationary nonpoint sources, and mobile sources (onroad and nonroad). The 33 pollutants identified by the U.S. EPA in its Integrated Air Toxics Strategy program were the pollutants quantified in the Cuyahoga County inventory effort. The goal of this inventory development process was to provide emissions data with a 2002 base year. However, given that the inventory was primarily compiled during the second quarter of 2003, much of the 2002 annual activity data for sources and categories were not yet fully available. Where reliable growth factor data were identified, non-2002 year estimates were projected to a 2002 base year.

The point source component of the inventory compiled facility-specific data such as activity data (e.g., amount of fuel or raw material used), emission estimates, locational data, and other information necessary for use in risk assessment (e.g., controls information, stack height, stack diameter, emission temperature, and flow rates). Emission estimates for point sources were derived from facility air pollution permits, Ohio EPA emission information, and the U.S. EPA's National Emission Inventory (NEI) and the Toxic Release Inventory (TRI).

Nonpoint sources are stationary sources for which facility-specific data were not available and tend to be smaller sources that collectively can have a significant impact on local air quality. Emissions were estimated for 54 different nonpoint source categories using EPA-approved methodologies in conjunction with local activity data (where available). When local data were not readily available, state or national data were adjusted using appropriate surrogates to represent activity in Cuyahoga County. Nonpoint emission estimates were also adjusted to account for application of control devices in compliance with existing regulatory programs and seasonal activity limitations (e.g., no cutback asphalt use during summer ozone season).

Mobile sources include onroad vehicles such as cars, trucks, and buses, and nonroad sources including aircraft, commercial marine vessels (CMVs), locomotives, and other nonroad engines and equipment (e.g., agricultural, construction, and lawn and garden equipment). The

onroad estimates were developed by applying local vehicle miles traveled (VMT) and meteorological data to emission factors generated by the U.S. EPA MOBILE6.2 model. Emissions from aircraft, CMVs (in port), and yard locomotives were estimated by using local activity data in conjunction with the latest U.S. EPA emission factors and hazardous air pollutants (HAP) speciation profiles. Emissions from CMVs underway and other nonroad engines and equipment were derived by adjusting estimates in the latest version of the 1999 NEI for Cuyahoga County to represent 2002 conditions.

Table ES-1 contains a summary of the estimated emissions from point, nonpoint, and mobile sources for each of the 33 urban HAPs. Mobile sources account for approximately 64% of total HAP emissions, nonpoint sources account for 23%, and point sources account for 14%. In this inventory, eight pollutants account for almost 96% of the total Cuyahoga County urban HAP emissions. For some of the more significant HAPs, mobile sources are the most important contributor. For example, the largest HAP emissions are associated with benzene (830 tpy), with mobile sources accounting for 91% of Cuyahoga County's total benzene emissions. Similarly, formaldehyde emissions for Cuyahoga County are estimated to be 354 tpy, with mobile sources accounting for approximately 90% of these emissions. Also, over 99% of total acetaldehyde emissions (160 tpy) and 1,3-butadiene (93 tpy) emissions are attributed to mobile sources.

Other significant HAPs tend to be split between point and nonpoint emission sources. Methylene chloride total emissions are estimated to be 235 tpy, with the emissions split between nonpoint sources (74%) and point sources (26%). For trichloroethylene, the situation is reversed with point sources accounting for 99+% of total emissions (74 tpy), compared with <0.01% for nonpoint sources (0.06 tpy). Nonpoint and point sources split the county's total perchloroethylene emissions of 163 tpy, with 46% attributed to nonpoint sources and 54% of emissions attributed to point sources. Lastly, nonpoint sources account for over 99% of the County's total 1,3-dichloropropene emissions (112 tpy).

Table ES-1. Summary of 33 Urban HAP Emissions in Cuyahoga County by Source Type

HAP Category Name	Point Source Emissions (Tpy)	Nonpoint Source Emissions (Tpy)	Mobile Source Emissions (Tpy)	Total (Tpy)
Benzene	6.63	64.52	830.11	830.11
Formaldehyde	24.16	10.16	319.61	353.93
Methylene Chloride (Dichloromethane)	61.40	173.71	0	235.11
Tetrachloroethylene (Perchloroethylene)	87.49	75.75	0	163.24
Acetaldehyde	0.49	0.06	159.58	160.13
1,3-Dichloropropene	6.02E-04	112.42	0	112.42
1,3-Butadiene	6.16E-03	0.01	93.01	93.03
Trichloroethylene	74.27	0.06	0	74.33
Nickel Compounds	5.94	22.60	0.05	28.59
Acrolein	0.20	7.00	16.25	23.45
Lead Compounds	12.30	0.37	0.01	12.68
Manganese Compounds	11.95	0.11	0.02	12.09
Chloroform	0.01	7.28	0	7.29
Chromium Compounds	1.40	0.03	0.06	1.49
Vinyl Chloride	1.49	4.51E-06	0	1.49
Ethylene Oxide	0	1.40	0	1.40
Polycyclic Organic Matter as 7-PAH	1.31E-03	0.86	0.33	1.19
Acrylonitrile	1.09	2.59E-04	0	1.09
1,1,2,2-Tetrachloroethane	0.61	1.18E-06	0	0.61
Ethylene Dichloride (1,2-Dichloroethane)	0.15	4.10E-03	0	0.15
Arsenic Compounds	0.13	0.01	0	0.14
Mercury Compounds	0.11	0.02	0	0.14
Cadmium Compounds	0.12	6.11E-03	1.30E-03	0.13
Propylene Dichloride (1,2-Dichloropropane)	0.07	7.74E-06	0	0.07
Carbon Tetrachloride	2.84E-03	0.01	0	0.02
Beryllium Compounds	6.67E-03	4.24E-03	1.27E-03	0.01
Ethylene Dibromide (Dibromoethane)	1.63E-03	0	0	1.63E-03
Polychlorinated Biphenyls (Aroclors)	0	9.98E-04	0	9.98E-04
Dioxins/Furans (total, non TEQ)	4.34E-05	2.14E-06	0	4.55E-05
Dioxins/Furans as 2,3,7,8-TCDD TEQs	4.20E-06	1.35E-05	8.11E-07	1.85E-05
Hexachlorobenzene	0	7.94E-06	0	7.94E-06
Total HAP Emissions	290.03	476.41	1347.88	2114.33
Percent of Total HAP Emissions	13.7%	22.5%	63.7%	100%

ACRONYMS/ABBREVIATIONS

ACE	Army Corps of Engineers
ASPEN	Assessment System for Population Exposure Nationwide
<i>AP-42</i>	Compilation of Air Pollutant Emission Factors
CAA	Clean Air Act
CBP	County Business Patterns
CLAA	Cleveland Local Air Agency
CMV	Commercial Marine Vessel
DOE	Department of Energy
DOT	Department of Transportation
EDMS	Emissions Dispersion and Modeling System
EFIG	Emission Factor and Inventories Group
EIA	Energy Information Administration
EIIP	Emission Inventory Improvement Program
EIS	Emissions Inventory System
EPA	Environmental Protection Agency
ERG	Eastern Research Group
ETBE	Ethyl Tert-butyl Ether
FAA	Federal Aviation Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FIRE	Factor Information and Retrieval
GA	General Aviation
GIS	Geographic Information Systems
HAP	Hazardous Air Pollutant
IPP	Inventory Preparation Plan
LTO	Landing and Take-off
MMBtu	Million British Thermal Units
MTBE	Methyl-t-butyl-ether
MACT	Maximum Achievable Control Technology
MSDS	Material Safety Data Sheet
NAICS	North American Industrial Classification System
NATA	National Air Toxics Assessment
NEI	National Emissions Inventory
NOACA	Northeast Ohio Areawide Coordinating Agency
NTI	National Toxics Inventory
OAQPS	Office of Air Quality Planning and Standards
OTAQ	Office of Transportation and Air Quality
PAH	Polycyclic Aromatic Hydrocarbons
PM	Particulate Matter
PM ₁₀	Particulate Matter less than or equal to 10 microns in diameter
PM _{2.5}	Particulate Matter less than or equal to 2.5 microns in diameter
PMSA	Primary Metropolitan Statistical Area

ACRONYMS/ABBREVIATIONS (CONTINUED)

QA	Quality Assurance
QC	Quality Control
SCC	Source Classification Code
SIC	Standard Industrial Classification
SIP	State Implementation Plan
TAF	Terminal Area Forecast
TEQ	Toxic Equivalency
TOG	Total Organic Gases
TPY	Ton Per Year
TRI	Toxics Release Inventory
UST	Underground Storage Tanks
VMT	Vehicle Miles Travelled
VOC	Volatile Organic Compounds
VRU	Vapor Recovery Units

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1.0 INTRODUCTION

This document contains a description of the process and results of a project conducted to develop an emission inventory for selected air toxics pollutant species in Cuyahoga County, Ohio (greater Cleveland metropolitan area). The background and purposes leading up to the inventory, the nature and orientation of the inventory, the data and methods used to identify sources and compile the emission estimates, and the summary emission estimates results are described in this document.

1.1 Inventory Background

An air toxics emission inventory was prepared for Cuyahoga County (representing the greater Cleveland, Ohio area) as a project under the Cleveland Clean Air Century Campaign. This Campaign and the associated inventory project is an outgrowth of the U.S. Environmental Protection Agency's (EPA's) Integrated Air Toxics Strategy program. As part of its overall efforts to reduce air toxics, on July 19, 1999, the EPA released the Integrated Air Toxics Strategy (64 FR 38705). The Strategy presented a framework for addressing air toxics in urban areas, including plans to conduct initiatives at both the national and local level to address specific pollutants and to identify and address specific community risks.

The Cleveland pilot study is one of the first demonstrations of a community-based approach to air toxics emissions reduction that may serve as a national model. In 2001, the U.S. EPA's Office of Air and Radiation began a pilot effort (i.e., the Cleveland Air Toxics Pilot Program) to test whether an inclusive, local-scale decision-making process can result in voluntary reductions in air toxics exposure with wide-based acceptance and support in the community. The approach is intended to supplement, not replace, regulatory programs. The pilot is designed to address air toxics in an integrated manner, with projects directed at outdoor (stationary and mobile) and indoor sources. Its primary three goals are to reduce air toxics in Cleveland, ensure the overall project is sustainable within the community, and ensure the

approach can be replicated in other counties across the United States (see <http://ohiolung.org/ccacc.htm>).

The U.S. EPA made funds available to conduct risk reduction activities, facilitate and evaluate the stakeholder process, and perform limited assessment activities. After an extensive selection process, EPA proposed to conduct a pilot program in Cleveland, Ohio. Prior to the launch of the pilot program in March 2001, EPA hired an independent facilitation firm to convene a Working Group that would be the project's decision-making body. The Working Group was formed in June 2001. It consists of Cleveland residents, environmental groups, local area businesses and business organizations, governmental and non-governmental agencies, the Ohio EPA, U.S. EPA Region V, and U.S. EPA headquarters. Local citizen involvement is particularly strong from the Cleveland neighborhoods of Slavic Village and St. Clair-Superior. Work Group subcommittees were charged with developing project proposals that included a discussion of the air toxic pollutants that are potentially reduced, expected emissions reductions, length and difficulty of implementation, and other issues. In July 2002, the Working Group decided which project proposals to fund. One of the approved projects was the development of an air toxics emission inventory for Cuyahoga County, Ohio.

Since the early 1990's, the Ohio EPA has been conducting ambient monitoring measurements for various particulate (e.g., trace metals), gaseous organic (e.g., benzene, xylene), and polycyclic aromatic hydrocarbons (PAHs, which can be in either a particulate or gaseous form) in the Cleveland area. Air toxic pollutants such as arsenic, cadmium, chromium, nickel, benzene, methylene chloride, and PAHs have been consistently found in measurable quantities in Cuyahoga County (Rosenbaum and Carr, 2001a). In 2001, the U.S. EPA conducted a national scale assessment of potential inhalation exposures and health risks associated with 33 air toxic pollutants, including diesel particulate matter (PM). This assessment was conducted as a component of EPA's National Air Toxics Assessment (NATA) Program (see <http://www.epa.gov/ttn/uatw/nata>) for more detailed information. The assessment was performed using emission estimates contained in the 1996 National Toxics Inventory (NTI) and

the predictive pollutant concentration modeling system known as the Assessment System for Population Exposure Nationwide (ASPEN) model.

Overall, the NATA analysis indicated that average modeled toxics concentrations for Cuyahoga County were similar to other comparable urban counties, for most compounds, within a factor of 2 (Rosenbaum and Carr, 2001b). The pollutants from the NATA assessment that were the primary drivers of projected health risks in Cuyahoga County were:

- Benzene,
- Formaldehyde,
- Acrolein,
- Acetaldehyde,
- 1,3 butadiene,
- Perchloroethylene,
- Diesel PM exhaust,
- Chromium,
- Arsenic, and
- Cadmium.

EPA's characterization of the NATA results noted that such national scale programs have low resolution at the local level. It is recommended that the results of the NATA work be used to craft more locally-specific assessment efforts. Specifically, a much more refined air toxics emissions inventory at the local county level is needed to reflect local conditions and identify potential "hot spots" that often do not show up in a national scale analysis. This need fueled the drive to construct a current, local-scale air toxics inventory for Cuyahoga County as a part of Cleveland's broader air toxics reduction pilot program.

1.2 Inventory Design

To initiate the air toxics emissions inventory process for Cuyahoga County, a detailed outline for an Inventory Preparation Plan (IPP) was first prepared (ERG, 2002). The IPP outline was provided to the Work Group Emission Inventory subcommittee for review. Meetings were held with the inventory subcommittee and the Work Group as a whole to present and discuss the IPP in greater detail. The outline was revised to incorporate comments received. Based on the final outline, a full comprehensive IPP for the Cuyahoga County air toxics inventory was developed prior to beginning the inventory process (ERG, 2003). The IPP was reviewed by the U.S. EPA Office of Air Quality Planning and Standards (OAQPS). The most significant change to the IPP from the EPA review was to expand the subject pollutant list for the inventory from the 10 compounds identified from the NATA analysis (see above) to the full 33 pollutant species contained in EPA's Integrated Air Toxics Strategy (see Table 1-1). The IPP was then finalized and work begun on the Cuyahoga County toxics inventory.

As described previously, the primary goal of this study was to develop an air toxics emissions inventory for Cuyahoga County that was as locally specific as possible. This means as much local source information as possible would be used to identify sources and calculate emissions as opposed to relying on national level statistics that were allocated down to the Cuyahoga County level or other default data that were not specific to Cuyahoga County. A summary overview of the basic design and configuration of the inventory is presented as follows.

What Geographic Area is Inventoried?

The study area for the air toxics inventory is the entire geographic boundary of Cuyahoga County, Ohio. This includes the Cleveland metropolitan area and all smaller cities surrounding it that lie in Cuyahoga County. Particular emphasis was placed on trying to get as complete and thorough an inventory as possible for the St. Clair-Superior and Slavic Village communities. Zip codes including 44103, 44108, 44114, 44105, and 44127 were targeted to conduct searches to identify point source facilities in these two communities.

What Emission Sources are Included in the Inventory?

The inventory addressed air toxics emissions from stationary point sources (e.g., large factories, steel mills, power plants), stationary nonpoint sources (e.g., home heating sources, small printing shops), onroad mobile sources (e.g., cars, trucks, buses), and nonroad mobile sources (e.g., airplanes, ships, bulldozers). The specific source categories addressed are defined in detail in the appropriate sections of Chapter 3. Since this is geared to be a county level inventory, the goal was to get as much Cuyahoga-specific source information reflected as possible. The study tried to identify and inventory individual facilities as point sources to the extent possible and did not necessarily follow the Clean Air Act (CAA) definition of “major” and “area” sources for hazardous air pollutants (HAPs). Under the CAA, any individual emission of a HAP ≥ 10 tons/yr or multiple HAPs emitted in aggregate of ≥ 25 tons/yr are considered major, everything else is an area source. For example, in many local scale inventories, categories like autobody repair/paint shops, drycleaners, and gasoline service stations are treated as nonpoint sources and inventoried as a group (no individual facility estimates). For Cuyahoga, attempts were made to inventory as many of these types of categories as possible as individual point sources based on the existence of data at Cuyahoga agencies. In some cases not all individual facilities in a category could be treated as point sources. Where there were known data gaps, a category estimate would be compiled on a nonpoint source group basis and then the contributions of identified point sources were subtracted to avoid double counting.

What Pollutants are Included in the Inventory?

The 33 pollutants identified by the U.S. EPA in its Integrated Air Toxics Strategy program were the focus of the Cuyahoga County inventory effort. These 33 are shown in Table 1-1 below.

Table 1-1. 33 Pollutants in EPA’s Integrated Air Toxics Strategy

Acetaldehyde*	Ethylene Oxide
Acrolein*	Formaldehyde*
Acrylonitrile	Hexachlorobenzene
Arsenic Compounds*	Hydrazine
Benzene*	Lead Compounds
Beryllium Compounds	Manganese Compounds
1,3- Butadiene*	Mercury Compounds
Cadmium Compounds*	Methylene Chloride
Carbon Tetrachloride	Nickel Compounds
Chloroform	Polychlorinated Biphenyls (PCBs)
Chromium Compounds*	Perchloroethylene*
Coke Oven Emissions	Polycyclic Organic Matter
1,2-Dibromoethane	Quinoline
1,2-Dichloropropane	1,1,2,2-Tetrachloroethane
1,3-Dichloropropene	Trichloroethylene
Dioxins and Furans	Vinyl Chloride
Ethylene Dichloride	

* On initial priority toxics list for Cuyahoga County.

As noted in the table, the list of 33 contains nine air toxics pollutants that have previously been identified as being priority species to be inventoried in the Cleveland area.

What is the Base Year of the Air Toxics Inventory?

The goal of this inventory development process was to provide emissions data with a 2002 base year. However, given that the inventory was primarily compiled during the second quarter of 2003, much of the 2002 annual activity data for sources and categories were not available (e.g., Census Bureau data, Energy Information Administration data). Some data for 2002 simply were not available in the time frame of this project (e.g., 2002 Toxics Release Inventory (TRI) information will not be made publicly available until 2004 according to EPA news releases). For this reason, some estimates in the inventory are for a 2001 base year because that is the latest year for which reliable data are available. Where reliable growth factor data were available, non-2002 year estimates were projected to a 2002 base year. Cases in which projections were performed are explained in the emission estimate documentation.

For several of the source categories, the 1999 National Emissions Inventory (NEI) for air toxics provided a starting point for information gathering. NEI estimates for the 2002 base year are in the process of being compiled by EPA/EFIG, but the precise timing of their release is uncertain and generally did not coincide with the schedule of this project. For some categories, it was possible to project the 1999 data to at least 2001 where activity statistics are readily available (or possibly 2002 if data were available). The inventory documentation clearly identifies the base year of all estimates and discusses how projections were made for any non-2002 year.

What is the Spatial and Temporal Basis for the Emission Estimates?

As noted previously, the primary spatial resolution basis for this air toxics inventory is county level. In particular, special attention was directed to address local sources of concern in the St. Clair-Superior and Slavic Village communities, since these areas have been a focus within the overall Cleveland pilot study. Depending on the source type, a more refined spatial basis was applied as a function of readily available data. For example, latitude/longitude coordinates were developed for all facilities treated as point sources in the inventory. For

nonpoint sources, all emissions estimates were spatially allocated to the county level. No sub-county level allocations were compiled for nonpoint emissions due to resource limitations.

For mobile sources, most of the emissions were spatially allocated to the county level. There are, however, some exceptions. Emissions are assigned to specific latitude/longitude coordinates for aircraft (airports) and CMVs (individual docks). Onroad mobile, locomotives and other nonroad engines emissions allocations were done at the county level due to resource limitations.

The temporal basis for the inventory is annual emission estimates. No sources of data could be determined to provide locally-specific temporal allocation factors. Even the permits for point sources did not have the necessary operational information to construct estimates on a more refined basis than annual. The same is true for nonpoint and mobile sources. It is possible that default temporal allocation factors from EPA's emissions modeling web page (<http://www.epa.gov/ttn/chief/emch/temporal/>) can be applied to obtain more refined estimates (i.e., hourly numbers). Also, default allocation procedures in the EMS-HAP preprocessing model can be used to determine emissions on a more refined basis than annual for several source categories. Resources were not sufficient in this project to attempt these temporal allocation options.

What Are the Intended Uses of the Inventory?

The primary use of the inventory will be to serve as a baseline from which future trends in emissions can be tracked and compared. This will aid in determining how air quality in Cuyahoga County is improving in the future. A complete inventory of all toxics sources also helps focus risk reduction efforts, such that emphasis can be placed on the sources/categories that are the biggest contributors to air quality problems.

One other important application of the inventory is its use in air quality modeling and health risk assessments. The inventory emission estimates can be used to help estimate the

amount of urban air toxics in the air that people breathe, and determine how great the risks are to the public. Using more intensive air modeling and source-receptor analyses, the inventory can then be used to identify specific facilities and source categories that are causing emissions that are contributing to high health risks in the Cleveland area.

What Are the Sources of Data for the Inventory?

Several primary sources of data were used to complete the Cuyahoga County air toxics inventory. Since this inventory was designed to be as locally specific as possible, a significant amount of information was obtained from the staff and files of agencies such as the Cleveland Health Department - Air Quality Division, other local Cleveland/Cuyahoga government agencies (e.g., County Auditor's Office), the Northeast Ohio EPA district office, other Ohio state agencies (e.g., Department of Transportation, Fire Marshall, Division of Surface Water), the Northeast Ohio Areawide Coordinating Agency (NOACA), local officials responsible for marine vessels and harbors, airports, and railroads, state trade associations, and from specific companies and firms operating in the County. Relevant information from the activities of specialized projects operating within the Cleveland Clean Air Century Campaign Work Group, including projects such as the autobody refinishing and chrome electroplaters pollution prevention efforts, was also sought out.

In addition to these sources, published sources of inventory and inventory-related data such as EPA's NEI (1999 and preliminary draft 2002 data) and TRI, Census Bureau publications and statistics, and Department of Energy fuel use statistics were consulted as appropriate.

What Quality Assurance/Quality Control (QA/QC) Procedures Were Applied to the Inventory?

After all county level HAP emission estimates were developed, each calculation was independently reviewed by senior inventory specialists to insure that the emissions have been

estimated correctly. Critical QA/QC procedures implemented during the inventory development process included the following.

- Tracking of original data obtained;
- Reviewing proposed emission estimation method (including review of activity and emission factor data) and preprocessing of data sets;
- Reviewing calculated or compiled emission estimates; and
- Reviewing files prior to transfer to EPA and the Work Group.

All pertinent data obtained over the course of inventory development have been archived in the project files, along with the day-to-day working files. Copies of all correspondence, data submittals, etc., have been stored in the files for reference and replication purposes. The transparency of all QA/QC activities is enhanced by routinely saving QA/QC forms and instructions in the project file. In this way, corrections and changes that have been made to the inventory can be reviewed.

1.3 Report Organization

The remainder of this report is organized as follows. Chapter 2 provides a summary of the air toxics emission estimates compiled for Cuyahoga County. It contains tabular and graphical presentations of the emissions inventory data. Emission estimates are presented by source type (i.e., point, nonpoint, mobile) and pollutant contribution. Where feasible and informative, source type data are subdivided into component source categories (e.g., nonroad - aircraft tables, locomotive tables, vessel tables, etc.).

Chapter 3 contains discussions documenting how air toxics emission sources in Cuyahoga County were identified and appropriate emissions estimated. This chapter will define each source type inventoried, the methods used to calculate emission estimates, the procedures used to identify and collect necessary input data, assumptions applied to calculate or allocate

emissions, and QA/QC procedures applied in the course of estimating emissions. Data limitations and their associated impacts on the Cuyahoga County emission estimates are identified. Recommendations for addressing these limitations to improve the inventory in the future are presented.

In the course of developing the inventory, several information management databases and tools were created to organize and expedite the process. This includes calculation spreadsheets, relational databases, and input/output files for emission models. Chapter 4 identifies and describes all of these tools, and indicates how they can be effectively used in future updates to the inventory. Data sets of the final emission estimates are also discussed in Chapter 4.

Appendices to this report contain detailed background information and calculations on the derivation of the air toxics emission estimates for Cuyahoga County. Appendix A contains detailed information on all point sources contained in the inventory. Appendix B contains detailed documentation for all nonpoint source estimates. The basis for the derivation of emission estimates for nonroad commercial marine vessels is detailed in Appendix C.

2.0 EMISSIONS SUMMARY

This chapter presents a summary of the 2002 air toxics emissions estimates developed for Cuyahoga County. Summary data are provided here for the major source types (point, nonpoint, mobile) and by pollutants (i.e., 33 urban HAPs). The objective in presenting these summaries is to indicate the source types that are contributing the greatest amount of toxics to Cuyahoga County air quality and what pollutants (in terms of potential health risk) are being emitted in the greatest quantities. Greater details regarding emissions from specific point source facilities, source categories, and vehicle classes are provided in the pertinent section of Chapter 3 and in the appendices.

Table 2-1 contains a summary of estimated air toxics emissions from stationary point source facilities. The most prevalent toxics from point sources are perchloroethylene (87.5 tpy), trichloroethylene (74.3 tpy), methylene chloride (61.4 tpy), formaldehyde (24.2 tpy), lead compounds (12.3 tpy), and manganese compounds (12 tpy), as depicted in Figure 2-1. Of the total amount of 33 urban HAPs emitted from point sources in Cuyahoga County, these six pollutants account for 94%.

Similar data are provided in Table 2-2 for nonpoint sources in Cuyahoga County. Total emission of the 33 urban HAPs are estimated to be approximately 476.4 tpy. The primary pollutant constituents are methylene chloride (173.7 tpy), 1,3-dichloropropene (112.4 tpy), perchloroethylene (75.8 tpy), benzene (64.5 tpy), nickel compounds (22.6 tpy), formaldehyde (10.2 tpy), chloroform (7.3 tpy), and acrolein (7 tpy), as shown in Figure 2-2. Together these eight HAPs account for roughly 99% of the nonpoint source HAPs in Cuyahoga County.

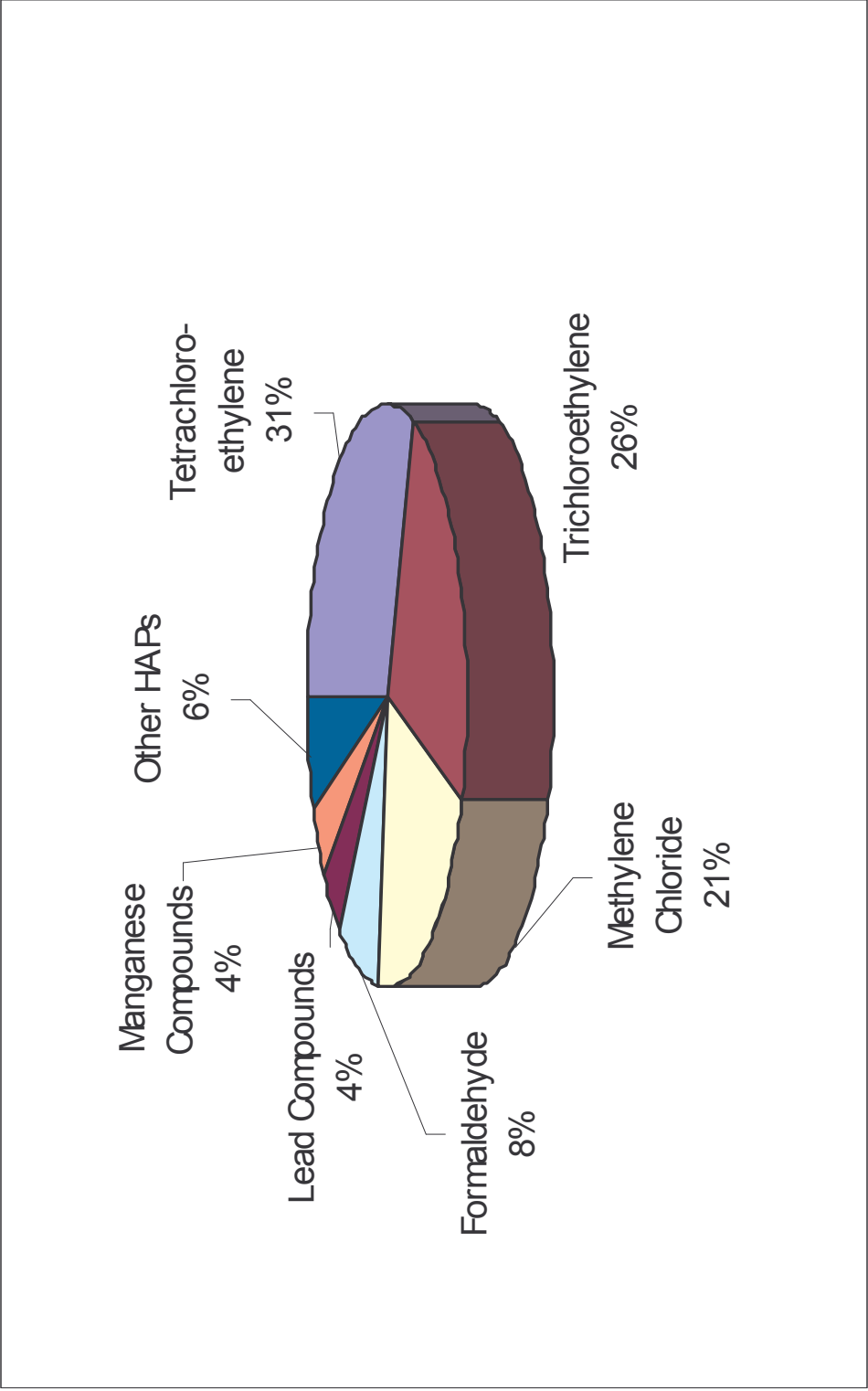


Figure 2-1. HAP Distribution for Point Sources

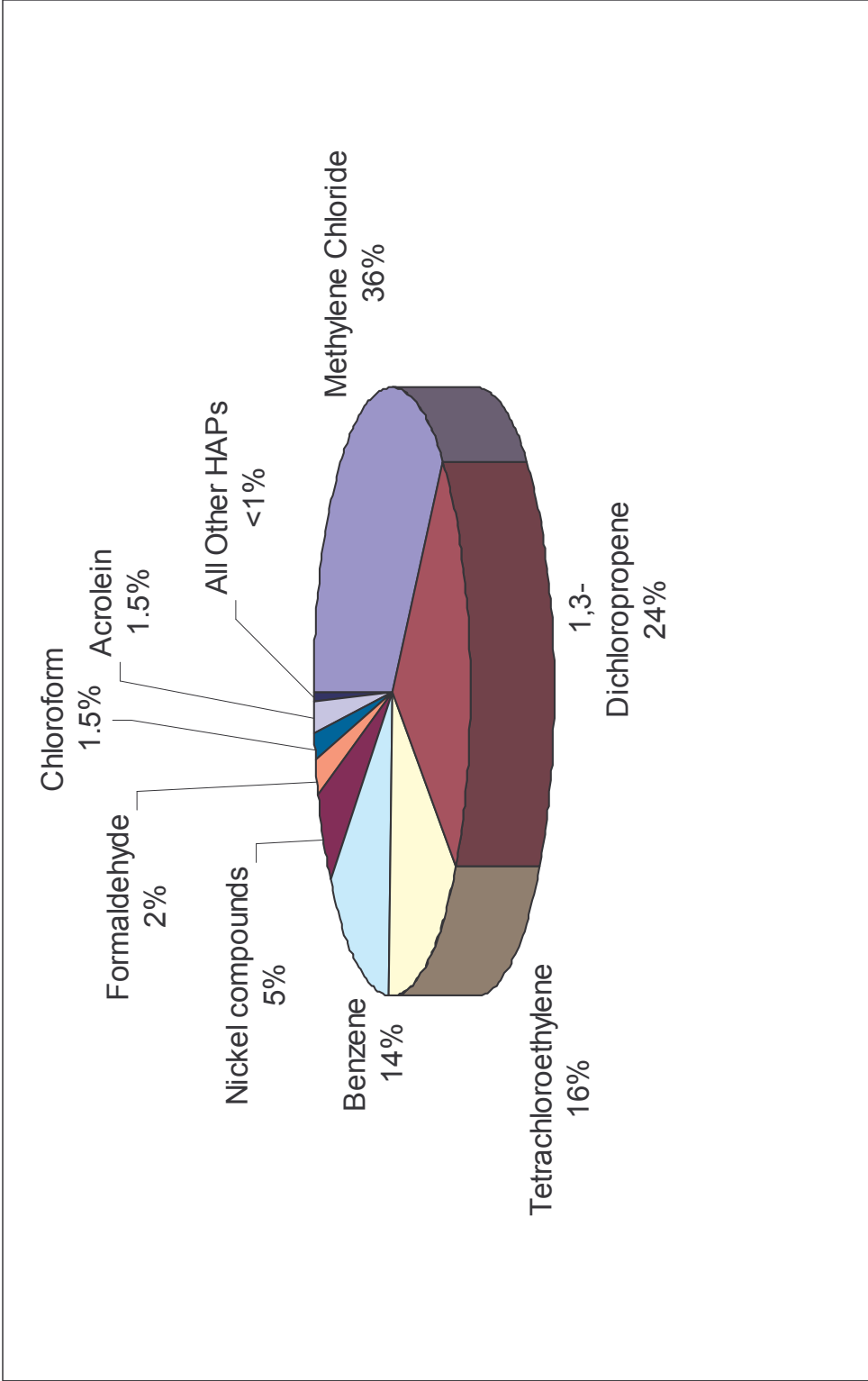


Figure 2-2. HAP Distribution for Nonpoint Sources

Table 2-1. Summary of 33 Urban HAP Emissions from Point Sources in Cuyahoga County

HAP Category Name	Emissions (Tpy)
Tetrachloroethylene (Perchloroethylene)	87.49
Trichloroethylene	74.27
Methylene Chloride (Dichloromethane)	61.40
Formaldehyde	24.16
Lead Compounds	12.30
Manganese Compounds	11.95
Benzene	6.63
Nickel Compounds	5.94
Vinyl Chloride	1.49
Chromium Compounds	1.40
Acrylonitrile	1.09
1,1,2,2-Tetrachloroethane	0.61
Acetaldehyde	0.49
Acrolein	0.20
Ethylene Dichloride (1,2-Dichloroethane)	0.15
Arsenic Compounds	0.13
Cadmium Compounds	0.12
Mercury Compounds	0.11
Propylene Dichloride (1,2-Dichloropropane)	0.07
Chloroform	0.01
Beryllium Compounds	6.67E-03
1,3-Butadiene	6.16E-03
Carbon Tetrachloride	2.84E-03
Ethylene Dibromide (Dibromoethane)	1.63E-03
Polycyclic Organic Matter as 7-PAH	1.31E-03
1,3-Dichloropropene	6.02E-04
Dioxins/Furans (total, non TEQ)	4.34E-05
Dioxins/Furans as 2,3,7,8-TCDD TEQs	4.20E-06
Total HAP Emissions	290.03

**Table 2-2. Summary of 33 Urban HAP Emissions from
Nonpoint Sources in Cuyahoga County**

HAP Category Name	Emissions (Tpy)
Methylene Chloride (Dichloromethane)	173.71
1,3-Dichloropropene	112.42
Tetrachloroethylene (Perchloroethylene)	75.75
Benzene	64.52
Nickel Compounds	22.60
Formaldehyde	10.16
Chloroform	7.28
Acrolein	7.00
Ethylene Oxide	1.40
Polycyclic Organic Matter as 7-PAH	0.86
Lead Compounds	0.37
Manganese Compounds	0.11
Acetaldehyde	0.06
Trichloroethylene	0.06
Chromium Compounds	0.03
Mercury Compounds	0.02
Arsenic Compounds	0.01
Carbon Tetrachloride	0.01
1,3-Butadiene	0.01
Cadmium Compounds	6.11E-03
Beryllium Compounds	4.24E-03
Ethylene Dichloride (1,2-Dichloroethane)	4.10E-03
Polychlorinated Biphenyls	9.98E-04
Acrylonitrile	2.59E-04
Dioxins/Furans as 2,3,7,8-TCDD TEQs	1.35E-05
Hexachlorobenzene	7.94E-06
Propylene Dichloride (1,2-Dichloropropane)	7.74E-06
Vinyl Chloride	4.51E-06
Dioxins/Furans (total, non TEQ)	2.14E-06
1,1,2,2-Tetrachloroethane	1.18E-06
Total HAP Emissions	476.41

Mobile source emissions summaries are presented in Table 2-3. The table addresses both onroad and nonroad mobile sources. Total county mobile source emissions of the 33 urban HAPs are estimated at 1,347.8 tpy. Onroad mobile sources constitute 53% of total mobile emissions, while nonroad mobile sources make up the remaining 47%. The largest contributor to the nonroad mobile figure of 47% is the category of other nonroad engines, which encompass sources such as lawn and garden equipment (16% of total mobile emissions), pleasure boats (9% of mobile emissions), construction equipment (8% of mobile emissions), commercial equipment (7% of mobile emissions), and industrial equipment (3% of mobile emissions). Aircraft emissions constitute about 3% of the total for mobile sources, while locomotives and CMVs each account for less than 1% of the mobile emissions total. Figure 2-3 illustrates the contribution by source category.

Table 2-3. Summary of 33 Urban HAP Emissions from Mobile Sources in Cuyahoga County

Pollutant	Onroad (Tpy)	Nonroad (Tpy)				Total (Tpy)
		Aircraft	CMV	Locomotive	Other Engines ^a	
Benzene	463.29	5.11	0.31	0.24	290.00	758.96
Formaldehyde	130.98	25.31	2.27	2.66	158.40	319.61
Acetaldehyde	72.32	7.72	1.13	1.06	77.35	159.58
1,3-Butadiene	45.50	3.35	0	0.25	43.90	93.01
Acrolein	6.53	3.64	0.05	0.15	5.88	16.25
Polycyclic Organic Matter as 7-PAH	0.20	0.02	2.42e-03	2.50e-03	0.07	0.29
Nickel Compounds	0.04	0	8.07e-03	3.64e-04	4.23e-03	0.05
Chromium Compounds	0.05	0	1.82e-04	4.28e-04	3.44e-03	0.05
Manganese Compounds	0.02	0	3.38e-04	1.13e-04	2.31e-03	0.02
Lead Compounds	0	0	4.58e-04	3.87e-03	6.87e-03	0.01
Cadmium Compounds	0	0	3.67e-05	1.26e-03	0	1.30e-03
Beryllium Compounds	0	0	0	1.26e-03	0	1.27e-03
Dioxins/Furans as 2,3,7,8-TCDD TEQs	1.02e-08	0	0	0	8.01e-07	8.11e-07
Total HAP Emissions	718.93	45.15	3.77	4.37	575.61	1347.83

^a Includes sources such as agricultural, construction, lawn and garden, and recreational equipment.

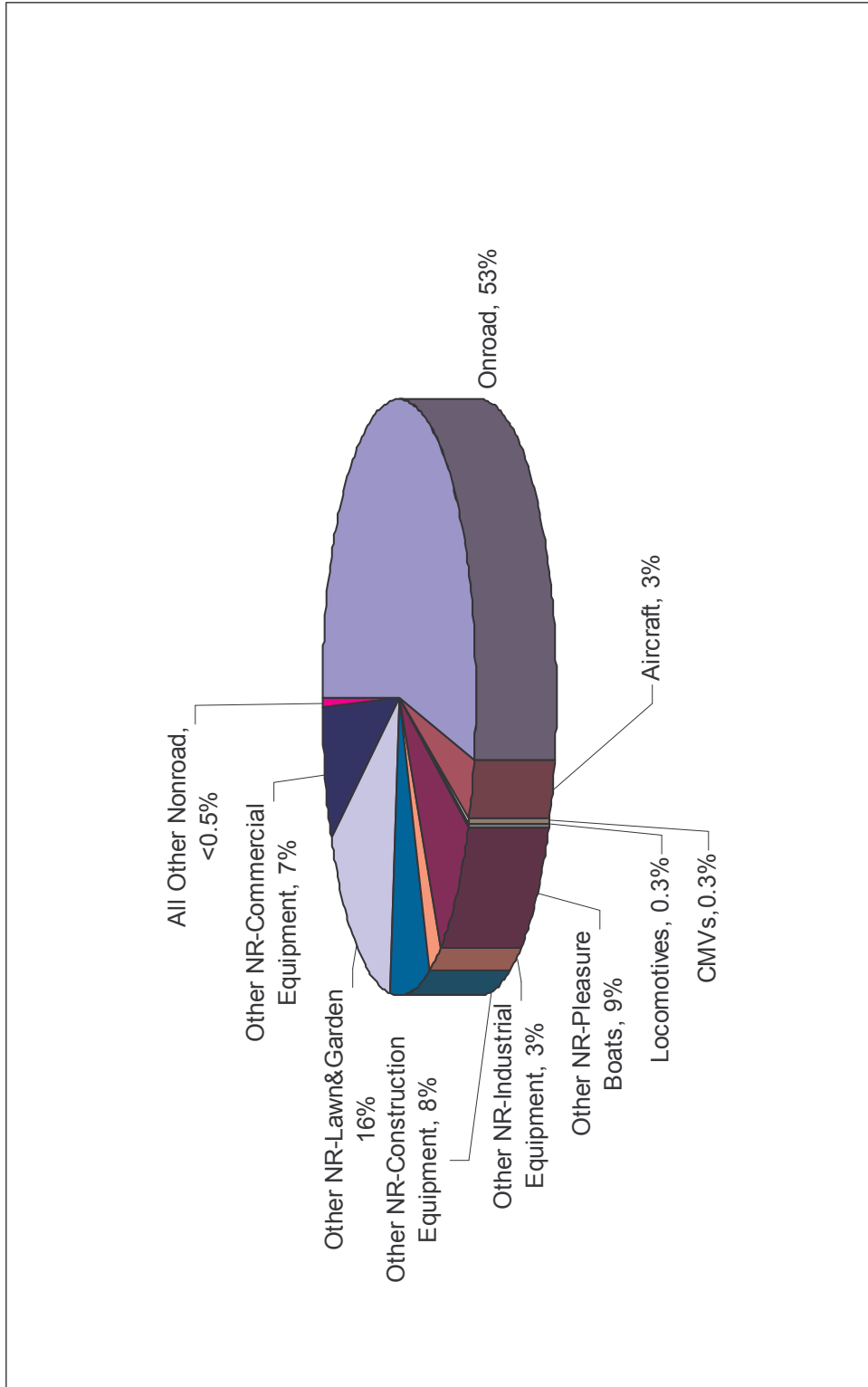


Figure 2-3. Total HAP Distribution for Each Mobile Source Category

In terms of total mobile source emissions, five pollutants make up over 99+% of the emissions (see Figure 2-4). These HAPs include benzene (759 tpy), formaldehyde (319.6 tpy), acetaldehyde (159.6 tpy), 1,3-butadiene (93 tpy), and acrolein (16.3 tpy).

Table 2-4 presents a comparison of air toxics emissions for all point, nonpoint, and mobile sources. The table is sorted according to total HAP emissions across all source types. As the table indicates, almost 64% (or 1,348 tpy) of Cuyahoga County air toxics are attributable to mobile source emissions. Nonpoint and point sources constitute about 23% (476 tpy) and 14% (290 tpy), respectively. Figure 2-5 illustrates this relationship graphically. On a countywide basis, across all source types, the primary air toxics pollutants emitted in Cuyahoga County include: benzene (830 tpy), formaldehyde (354 tpy), methylene chloride (235 tpy), perchloroethylene (163 tpy), acetaldehyde (160 tpy), 1,3-dichloropropene (112 tpy), 1,3-butadiene (93 tpy), trichloroethylene (74 tpy), nickel compounds (28.6 tpy), acrolein (23.5 tpy), lead compounds (12.7 tpy), and manganese compounds (12.1 tpy). These 12 pollutants make up 99% of total county urban HAP emissions. Figure 2-6 illustrates the primary pollutant contributors to total county emissions.

Table 2-5 reinforces the differences in emissions between stationary point sources and mobile sources in the County. Mobile sources are responsible for 64% of total air toxics emissions and stationary sources 36%.

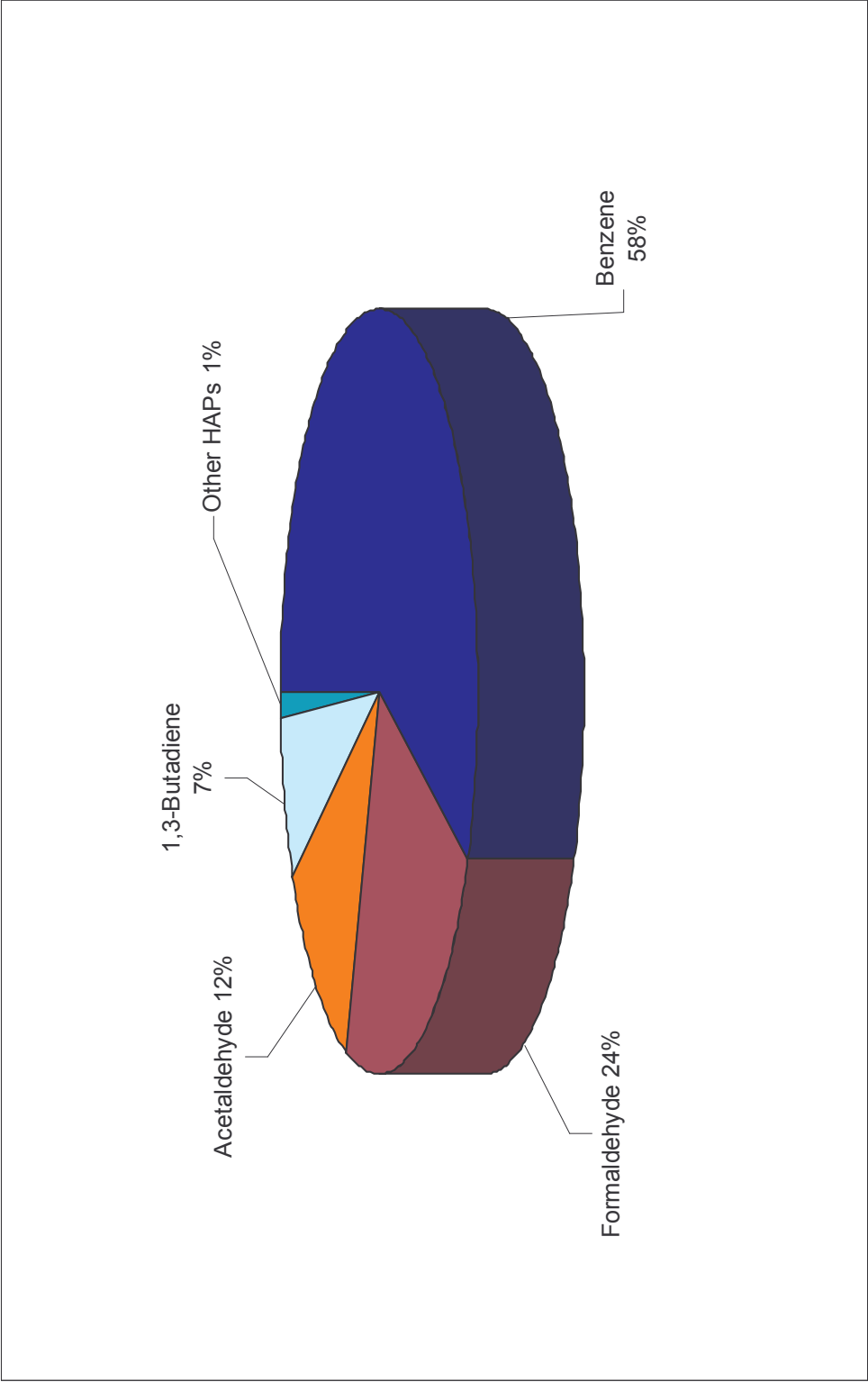


Figure 2-4. HAP Distribution for Mobile Sources

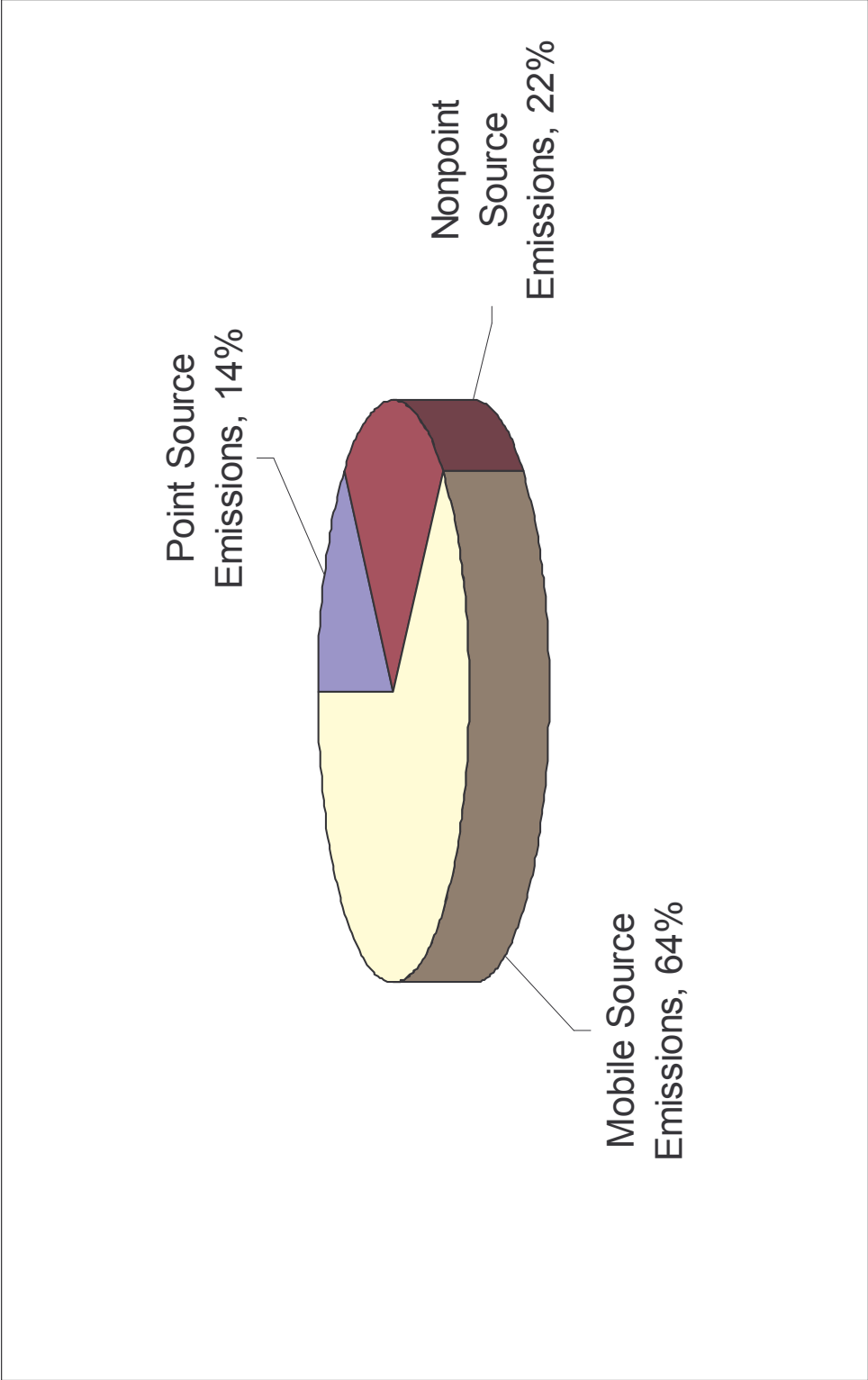


Figure 2-5. Distribution of Air Toxics Emissions in Cuyahoga County

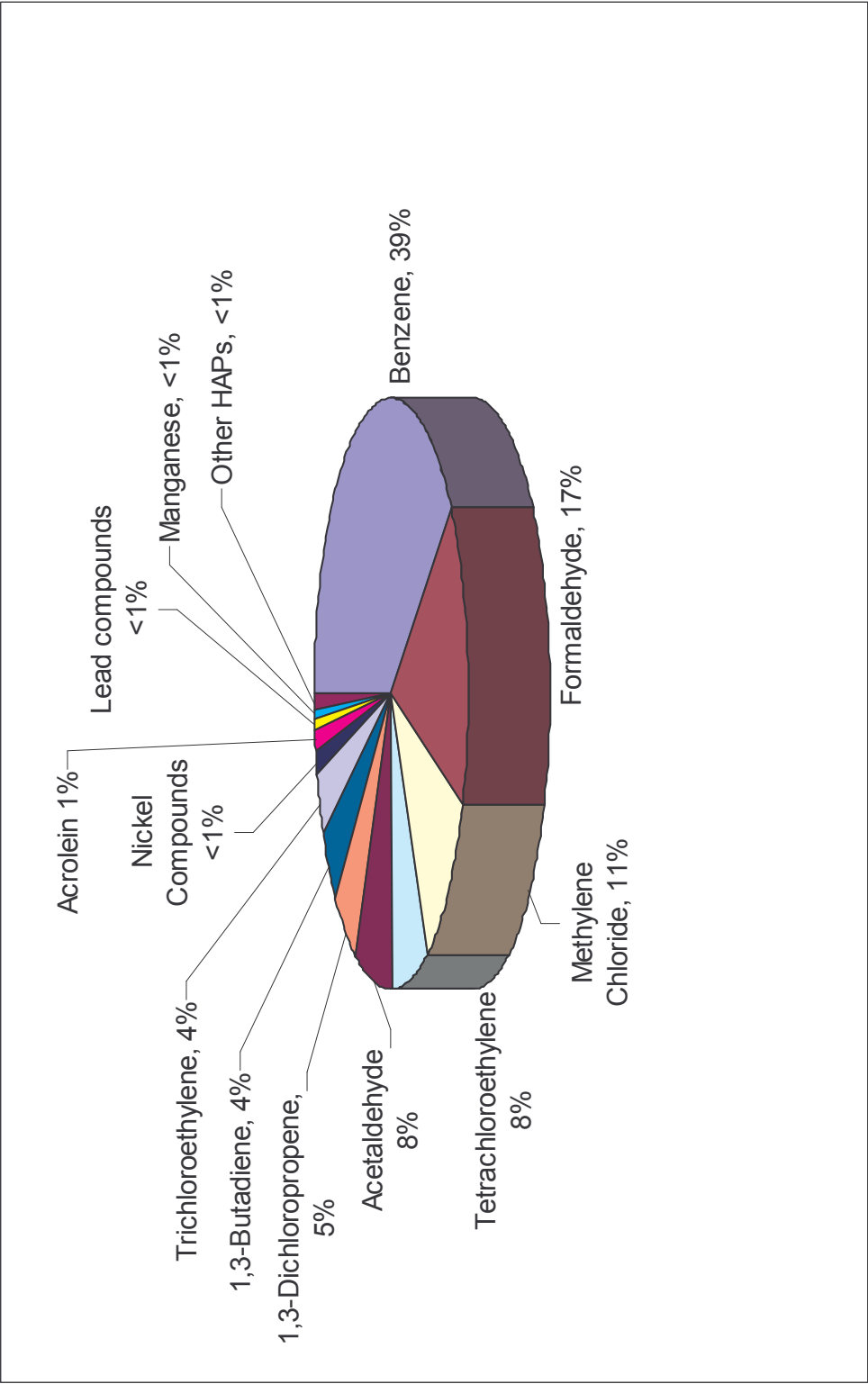


Figure 2-6. Pollutant Contributions in the Cuyahoga County Air Toxics Inventory

Table 2-4. Summary of 33 Urban HAP Emissions in Cuyahoga County by Source Type

HAP Category Name	Point Source Emissions (Tpy)	Nonpoint Source Emissions (Tpy)	Mobile Source Emissions (Tpy)	Total (Tpy)
Benzene	6.63	64.52	830.11	830.11
Formaldehyde	24.16	10.16	319.61	353.93
Methylene Chloride (Dichloromethane)	61.40	173.71	0	235.11
Tetrachloroethylene (Perchloroethylene)	87.49	75.75	0	163.24
Acetaldehyde	0.49	0.06	159.58	160.13
1,3-Dichloropropene	6.02E-04	112.42	0	112.42
1,3-Butadiene	6.16E-03	0.01	93.01	93.03
Trichloroethylene	74.27	0.06	0	74.33
Nickel Compounds	5.94	22.60	0.05	28.59
Acrolein	0.20	7.00	16.25	23.45
Lead Compounds	12.30	0.37	0.01	12.68
Manganese Compounds	11.95	0.11	0.02	12.09
Chloroform	0.01	7.28	0	7.29
Chromium Compounds	1.40	0.03	0.06	1.49
Vinyl Chloride	1.49	4.51E-06	0	1.49
Ethylene Oxide	0	1.40	0	1.40
Polycyclic Organic Matter as 7-PAH	1.31E-03	0.86	0.33	1.19
Acrylonitrile	1.09	2.59E-04	0	1.09
1,1,2-Tetrachloroethane	0.61	1.18E-06	0	0.61
Ethylene Dichloride (1,2-Dichloroethane)	0.15	4.10E-03	0	0.15
Arsenic Compounds	0.13	0.01	0	0.14
Mercury Compounds	0.11	0.02	0	0.14
Cadmium Compounds	0.12	6.11E-03	1.30E-03	0.13
Propylene Dichloride (1,2-Dichloropropane)	0.07	7.74E-06	0	0.07
Carbon Tetrachloride	2.84E-03	0.01	0	0.02
Beryllium Compounds	6.67E-03	4.24E-03	1.27E-03	0.01
Ethylene Dibromide (Dibromoethane)	1.63E-03	0	0	1.63E-03
Polychlorinated Biphenyls (Aroclors)	0	9.98E-04	0	9.98E-04
Dioxins/Furans (total, non TEQ)	4.34E-05	2.14E-06	0	4.55E-05
Dioxins/Furans as 2,3,7,8-TCDD TEQs	4.20E-06	1.35E-05	8.11E-07	1.85E-05
Hexachlorobenzene	0	7.94E-06	0	7.94E-06
Total HAP Emissions	290.03	476.41	1347.88	2114.33
Percent of Total HAP Emissions	13.7%	22.5%	63.7%	100%

Table 2-5. Summary of 33 Urban HAP Emissions from Stationary and Mobile Sources in Cuyahoga County

HAP Category Name	Stationary Source Emissions (Tpy)	Mobile Source Emissions (Tpy)	Total Emissions (Tpy)
Benzene	71.15	758.96	830.11
Formaldehyde	34.32	319.61	353.93
Methylene Chloride (Dichloromethane)	235.11	0	235.11
Tetrachloroethylene (Perchloroethylene)	163.24	0	163.24
Acetaldehyde	0.55	159.58	160.13
1,3-Dichloropropene	112.42	0	112.42
1,3-Butadiene	0.02	93.01	93.03
Trichloroethylene	74.33	0	74.33
Nickel Compounds	28.54	0.05	28.59
Acrolein	7.20	16.25	23.45
Lead Compounds	12.68	0.01	12.69
Manganese Compounds	12.07	0.02	12.09
Chloroform	7.29	0	7.29
Chromium Compounds	1.72	0.06	1.78
Vinyl Chloride	1.49	0	1.49
Ethylene Oxide	1.40	0	1.40
Polycyclic Organic Matter as 7-PAH	0.86	0.33	1.19
Acrylonitrile	1.09	0	1.09
1,1,2,2-Tetrachloroethane	0.61	0	0.61
Ethylene Dichloride (1,2-Dichloroethane)	0.15	0	0.15
Arsenic Compounds	0.14	0	0.14
Mercury Compounds	0.14	0	0.14
Cadmium Compounds	0.13	1.30E-03	0.13
Propylene Dichloride (1,2-Dichloropropane)	0.07	0	0.07
Carbon Tetrachloride	0.02	0	0.02
Beryllium Compounds	0.01	1.27E-03	0.01
Ethylene Dibromide (Dibromoethane)	1.63E-03	0	1.63E-03
Polychlorinated Biphenyls (Aroclors)	9.98E-04	0	9.98E-04
Dioxins/Furans (total, non TEQ)	4.55E-05	0	4.56E-05
Dioxins/Furans as 2,3,7,8-TCDD TEQs	1.77E-05	8.11E-07	1.85E-05
Hexachlorobenzene	7.94E-06	0	7.94E-06
Total HAP Emissions	766.45	1347.88	2114.33
Percent of Total HAP Emissions	36.3%	63.7%	100.0%

3.0 EMISSION INVENTORY DEVELOPMENT DOCUMENTATION

3.1 Stationary Point Sources

For stationary emission sources, air toxics emitters are defined as being either “point” or “nonpoint” sources. Point sources can be specifically identified and have their emissions characterized on an individual facility or business basis. A specific geographic location such as the facility’s physical address can be determined, and details are known on the characteristics of the emission release points. If the inventory will be used in an air quality modeling effort, the release height, stack diameter, exit gas temperature, exit gas velocity, and exit gas flow rate of the released emissions must be known.

Point sources are usually categorized under one of the following broad source categories:

- Chemical manufacturing and use industries
- Food and agriculture industries
- Industrial fuel combustion boilers, turbines, engines, and process heaters
- Metallurgical industries
- Mineral products industries
- Petroleum-related industries
- Utilities
- Waste disposal facilities
- Wood products industries

Emissions from point sources are characterized as being emitted from stacks, or as fugitive emissions. Fugitive emissions are defined as emissions from sources that are technically infeasible to collect and control (such as equipment leaks). Emissions from ground-level sources can also be considered fugitive sources if there is no true stack that would require consideration of the release point height, exit gas velocity, or stack diameter in an air quality modeling study.

Point source facilities and emission processes need to be specified by the type of activity occurring. Facility operations are delineated by their Standard Industrial Classification (SIC) code. SIC codes are used to identify the types of products manufactured or the types of operations performed (such as metal stamping, automotive repair). If possible, it is preferable to delineate the specific type of emission unit in a point source inventory, rather than grouping all of the facility operations under a single SIC code. Source Classification Codes (SCCs) are used to define emission processes such as the types of fuel burned in a boiler, types of surface coating operations, etc. It is also important to identify point source facilities and processes that have or will have applicable federal HAP standards, called Maximum Achievable Control Technology (MACT) standards. In a point source inventory, MACT codes should be used to represent these sources.

If a federal (or state/local) standard applies to a facility or process, it is likely that air pollution control devices are required. The presence of an air pollution control device should be noted in a point source inventory.

Point source emissions can be reported in a number of ways. In the Cuyahoga County inventory, the goal was to report *actual* emissions. In some cases, actual emissions were not available, or could not be calculated. In these cases, to make the inventory as complete as possible, emissions were reported as either potential or maximum emissions. Emissions labeled as potential or maximum represent permitted levels that cannot be exceeded; actual emissions are most likely lower.

The goal of the Cuyahoga County inventory effort was to obtain or calculate emissions information for as many point sources as possible. In particular, all major sources in the county, and smaller facilities identified in the St. Clair-Superior and Slavic Village neighborhoods, were targeted. However, obtaining the detail needed to calculate emissions for every single factory or manufacturing facility in the county was not feasible. For some source categories, there are point source facilities as well as nonpoint source emission estimates. Combined, these estimates represent emissions from the entire source category.

What Data Sources Were Used to Compile the Point Sources Inventory?

Four key data sources were used to develop the Cuyahoga County point sources inventory:

- The U.S. EPA's TRI;
- The U.S. EPA's NEI for HAPs;
- The Cleveland Local Air Agency (CLAA), Division of Air Quality Inspection Reports database and permit files; and
- The Ohio EPA Division of Air Pollution Control's criteria pollutant emission inventory databases for Title V and other permitted sources.

The facilities included in these data sources were used to compile a master facility list of all potential point sources to be included in the inventory (Figure 3-1). Each of these data sources will be discussed briefly below.

Toxics Release Inventory

Begun in 1988, the TRI program collects and disseminates information on releases of

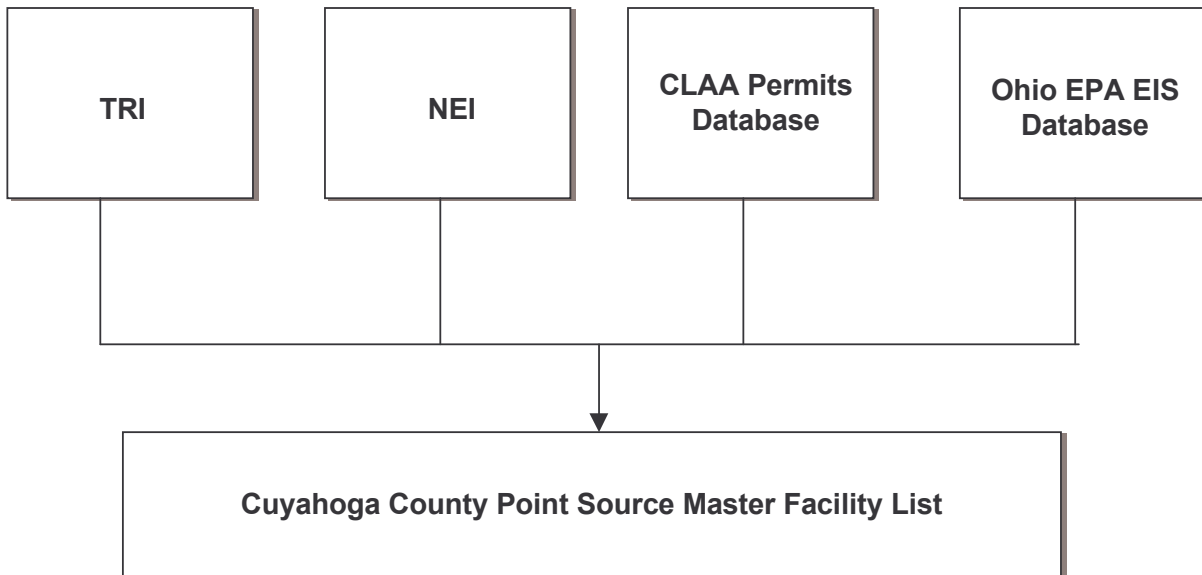


Figure 3-1. Development of Master Point Source Facility List

nearly 650 chemicals and chemical categories from industries including manufacturing, metal and coal mining, electric utilities, and commercial hazardous waste treatment, among others. A federal law called the Emergency Planning and Community Right to Know Act (EPCRA) requires facilities in certain industries, that meet certain requirements for number of employees and chemical usage, to report annually on their releases of these chemicals. The reports contain information about the types and amounts of toxic chemicals that are released each year to the air, water, and land as well as information on the quantities of toxic chemicals sent to other facilities for further waste management.

TRI is considered a reliable source of information on air toxics releases, in large part because the data are provided directly by the emitting facilities. The most recent TRI data available for this study are the 2001 data (U.S. EPA, 2003a); 2002 data will be released in the summer of 2004. Data obtained from TRI for this study consists of:

- Facility name;
- Address;
- Annual reported HAP air releases for the facility;
- Standard Industrial Classification (SIC) code for the facility; and
- Latitude and longitude location coordinates of the facility.

National Emissions Inventory

The NEI for HAPs is released triennially. The point source NEI is broader in facility coverage than the TRI, because it is EPA's goal to include as many point sources as possible in the inventory. TRI is one component of the NEI; additional data include emissions data for MACT sources that have or will have federal air toxics emissions regulations. The NEI includes the same information that TRI includes, as well as additional information needed by air quality modelers such as stack height and diameter. The NEI data may also be reported at the process

level (e.g., for a given unit or boiler) rather than for the entire facility. The most recent NEI for HAPs currently available is for 1999 (U.S. EPA, 2003b); preparation of the 2002 inventory will in large part begin in 2004.

The Cleveland Local Air Agency Inspection Reports Database and Permit Files

The CLAA Division of Air Quality has the mandate to ensure that regulated air pollutants from industrial sources throughout Cuyahoga County are in compliance with federal, state, and local regulations. The CLAA is the Ohio EPA's delegated agent to enforce state air pollution control regulations for the county. Air pollution sources within the county are required to obtain a permit to operate from the CLAA.

The CLAA provided a database of permitted facilities in the county with facility name, address, and premise (permit) number that indicated the type of facility, and if the facility was in operation when last inspected. Point sources in Cuyahoga County that have permits on file with the CLAA are routinely inspected. The CLAA also provided an electronic, master database of all Inspection Reports from 2000-2002 (CLAA, 2003). The information in the Inspection Reports varies, but typically includes the reason why the inspection was conducted (response to a complaint, routine inspection), applicable regulations (such as federal MACT standards), changes in ownership, and changes in the permit and operating status, such as removal of perchloroethylene dry cleaning machines or a switch to powder coating lines that eliminate the use of solvents. The Inspection Reports sometimes included HAP emissions estimates, or the activity data (such as raw material usage) needed to calculate HAP estimates.

Other information available from the CLAA consists of hard-copy permit files with inspection reports and permit details.

Ohio EPA Emission Inventory System Databases for Title V and Other Permitted Sources

The 1990 federal CAA Amendments established new permitting and reporting requirements for sources of air pollution. Under Title V of the CAA, facilities that have the potential to emit certain amounts of air pollution are required to apply for and obtain a state-federal operating permit and pay emission fees. The Title V permit program is administered by the Ohio EPA, which uses the fees for air pollution monitoring, inspections, and to provide technical assistance.

Title V applies only to major point sources, which are defined as facilities that emit:

- 100 tons per year or more of any one regulated criteria pollutant (particulate matter, nitrogen oxides, sulfur dioxide, carbon monoxide, volatile organic compounds, and lead);
- 10 tons per year or more of any one HAP; or
- 25 tons per year or more of any two or more HAPs.

Title V facilities submit emission inventory data annually to the Ohio EPA Division of Air Pollution. Title V fees are based on the facility's actual emissions of particulate matter, sulfur dioxide, organic compounds, nitrogen oxides and lead for the previous calendar year. In addition to the emissions data, data are also required on operating hours, material usage, control devices in place, and stack parameters.

Under the non-Title V emission fee program, all facilities permitted that are not subject to Title V, or that do not meet certain exemptions, are also required to pay a fee based on actual criteria pollutant emissions, as well as facilities that are considered synthetic minor Title V sources (i.e., these facilities limit their operations and/or have installed control devices that limit emissions to below major source levels).

Annual Title V and other criteria pollutant Emission Inventory System (EIS) data are available for download through the Ohio EPA's website (Ohio EPA, 2001). The 2001 activity data for all permitted boilers in the EIS database were used to calculate emissions associated

with natural gas, distillate oil, and residual oil fuel combustion sources. The activity data for other facilities and emission units that are not included in other data sources such as TRI and NEI were also used, to the extent possible, to calculate emissions based on the SCC and reported throughput.

The Ohio EPA's website also includes a 2001 coal burning operations database (Ohio EPA, 2001). The activity data for all coal-burning units were used to calculate emissions for these units.

Were Data Gathering–Site Visits Conducted?

Two data gathering trips were made to Cleveland to develop the point source inventory. The first trip included tours of the St. Clair-Superior and Slavic Village neighborhoods to identify facilities of concern, and a visit with CLAA personnel to discuss information needs and priorities. It was during the first visit that the database of permitted facilities in the county with facility name, address, and premise (permit) number was obtained.

Prior to the second visit, priority lists were prepared for reviewing the hard copy permits at the CLAA. The lists, in order of importance, contained facilities that were not found in the 2001 TRI or the 1999 NEI, thus no HAP estimates were available at the time of the visit:

- Facilities that are labeled as Title V by the CLAA (meaning they are major sources under some definition in the Clean Air Act);
- Facilities that were identified in the CLAA database as synthetic minor facilities (these facilities have installed control devices that limit emissions to below major source levels), with recent permit-to-install (PTI) or permit-to-operate (PTO) permits;
- Facilities that were identified as facilities of concern by the Neighborhood Associations and through the neighborhood tours; and
- Facilities not on any of the above lists that are in the CLAA database with SIC codes of concern such as manufacturing facilities. The SIC codes for these

facilities were obtained from a Name and Business Index for Cuyahoga County (PhoneDisc, 1997).

It was during the second site visit that an electronic Inspection Reports database (CLAA, 2003) was provided by the CLAA that included 40% of these priority facilities.

While not all of the inspection reports include HAP estimates, the reports often have useful information on criteria pollutant emissions and calculations, Material Safety Data Sheet (MSDS) information on the HAP content of coatings used, information on raw material usage, and control status.

Over 100 additional hard-copy facility permits were reviewed for facilities that were not included in the Inspection Reports database or any other data source, but were on the priority list for inclusion in the inventory. The review noted if the facilities had been shutdown or air pollution-emitting equipment withdrawn prior to 2002. As with the inspection reports, additional information targeted included: HAP/criteria pollutant estimates; MSDS information; information on raw material usage; and control status. Where useful information was identified, it was entered into an electronic Access[®] database for use in calculating emission estimates.

How was the Point Source Inventory Compiled?

After all data sources were identified and researched, the next step in preparing the Cuyahoga County point source HAP inventory was to compile all of the available data, and determine if emissions were available or could be estimated for all facilities on the master facility list.

The first step was to compile most recent TRI and NEI data sets. This data compilation focused on the 33 urban HAPs targeted for this study. Thus, some facilities may have been excluded from the inventory if they did not emit any of the targeted HAPs.

The TRI and NEI data sets were combined and consolidated into a single database by removing duplicate facilities. With one exception, the TRI data were given preference over the NEI data because the TRI data are more recent. The one exception to this rule was that NEI data for mercury emitted from the coal-fired power plant (Cleveland Electric Illuminating (CEI) Company) were given priority because the data were developed by EPA and are more specific than the mercury data reported in TRI. EPA's mercury data for CEI are speciated as elemental gaseous mercury, gaseous divalent mercury, and particulate divalent mercury. If this inventory is used in an air quality modeling study/risk assessment, these individual species may be handled differently.

As noted above, emissions for fuel combustion sources--boilers, turbines, and coal-burning operations--were calculated using the EIS database activity data (Ohio EPA, 2001). Emission factors were obtained from the EPA report "Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition" (U.S. EPA, 2003c) and from EPA's Emission Standards Division's Combustion Group, who develop MACT standards for boilers, turbines, and electric utilities (Porter, 1998).

The EIS database information was also used to calculate emissions for facilities and emission units other than fuel combustion sources. EIS activity data for facilities on the master facility list that were missing from other sources were evaluated to determine if emissions could be estimated with the EIS activity data. EIS data are reported at the process level by SCC. The EPA's FIRE database was searched by SCC for applicable HAP emission factors (U.S. EPA, 2000). If a match was found, estimates were developed for these processes and facilities.

Emission estimates were obtained from the Inspection Reports when available, or alternatively emissions were calculated using information from the Inspection Reports if the reports included the necessary data. The inspection reports review focused particularly on facilities in the electroplating, polishing, anodizing, and coloring (SIC code 3471) sectors, and on dry cleaners. Electroplating facilities were targeted based on anecdotal information that activity is high in Cleveland. This is supported by information in the *Name and Business Type*

Index—the prevalence of electroplating facilities in Cuyahoga County is higher than in any other county in Ohio, and Ohio ranks third in the nation for facilities in SIC code 3471(PhoneDisc, 1997). Emission factors used to calculate emissions from hard chromium electroplating and decorative chromium electroplating were obtained from the EPA's *AP-42* (U.S. EPA, 2003c).

Dry cleaners were targeted for inclusion in the point source inventory because the MACT standard for facilities using perchloroethylene requires annual reporting of perchloroethylene usage (Federal Register, 1993). To calculate emissions based on perchloroethylene usage, an assumed emission rate of 0.56 lb/lb perchloroethylene was used. This is based on the projected 44% emission reduction due to MACT controls (Federal Register, 1993).

Emissions for other facilities on the master database were calculated using information obtained from the hard-copy permit if possible. Again, if the information needed to calculate emissions was found in the permit file, emission factors were obtained from FIRE or *AP-42* (U.S. EPA, 2000, 2003c).

The Cuyahoga County point source emissions inventory was compiled such that the source of the emission estimates is known. The following codes indicate the source of each emissions estimate (Table 3-1).

Table 3-1. Data Source Codes

Data Source Code	Data Source Description
1999 NEI	Data pulled from the 1999 National Emissions Inventory for HAPs.
CLAA	Emissions data pulled directly from CLAA inspection report, or calculated using information in the inspection report or permit file.
EIS	Emissions calculated using activity data from the Ohio EPA EIS database.
TRI-2001	Data pulled from the 2001 TRI.

What Gap Filling Was Done for Future Air Quality Modeling Efforts?

The goal of this project was to create a point source inventory that not only includes HAP emission estimates, but also facility-specific data such as stack information, and specific facility location coordinates.

Stack Parameters

The stack information needed includes stack diameter and height, gas temperature, velocity, and flow rate. To this end, information was needed to supplement the inventory where stack information was not available. The process used to review and supplement the stack parameters is explained briefly here, and in more detail in Pope (2003), “NEI Quality Assurance and Data Augmentation Steps for Point Sources.”

Default stack parameters have been published by the EPA for over 3,000 SCCs. An SCC is used to represent the actual emitting source at an industrial facility, such as a boiler, degreasing operation, or coating line. These default stack parameters were compiled from a national emissions inventory, thus they represent an average for the industrial operation.

EPA also published default stack parameters for over 900 SIC codes compiled from a national emissions inventory. An SIC code is used to represent operations at an entire facility, not each individual process. While these codes are less-specific than SCCs, these defaults are needed for TRI-reported emissions, which are reported at the SIC code level. The assumptions that were made in populating the Cuyahoga County inventory with default stack parameters are discussed below.

- Available stack and fugitive parameters from NEI and EIS were reviewed to determine if they are physically plausible. Values outside of the ranges shown below were either recalculated or replaced with a default value.
 - Stack Height (ft): 0.1 to 1,000
 - Fugitive or release vent height (ft): 0.1 to 100
 - Stack Diameter (ft): 0.1 to 50
 - Stack Temperature (°F): 50 to 1,800
 - Stack Velocity (ft/sec): 0.1 to 560
 - Stack Flow (cu ft/sec): 0.001 to 1,100,000

- For each emission release point, default or calculated stack parameters were added if any of the five fields were blank or out of range, if height was less than diameter, or if the calculated flowrate and the reported flowrate were not within 10% of one another;

- For facilities where no information was available on the type of emission release (i.e., stack vs. fugitive), it was assumed that the emission release point is a stack, and, where available, default stack parameters were added. Only emission release points reported as fugitives were treated as fugitives.

- The following national default fugitive emission release point values were applied if the existing height was outside the acceptable range for fugitive emission release points:
 - Height: 10 ft
 - Diameter: 0.003 ft
 - Temperature: 72°F
 - Velocity: 0.0003 ft/sec
 - Flow: 0 cu ft/sec

If the height was within range, the height was retained and all other stack parameters were replaced with the national defaults.

The source of each stack parameter is identified by a flag in the inventory (Table 3-2). The flags indicate whether the stack data were obtained from the EIS database (Ohio EPA, 2001), SIC code-based, SCC-based, or based on national default stack values.

Table 3-2. Stack Parameter Defaults

Stack Default Code	Stack Default Description
EIS	Stack parameters obtained from the Emissions Inventory System database
National Default	National defaults for fugitive emissions (it was not necessary to apply any stack national defaults).
SCC-Default	Defaulted based on the SCC for stacks.
SIC-Default	Defaulted based on the SIC Code for stacks.

Specific Facility Location

Because the Cuyahoga County inventory may be used in an air quality modeling effort in the future, the association of a specific latitude/longitude coordinate to each emission release point is required. Some data sources such as TRI, NEI, and EIS include latitude/longitude coordinates. In the absence of actual coordinate data, the facility address was used to determine the associated latitude and longitude. The Tele Atlas North America “EZ-Locate” geocoding software was used. (Tele Atlas, 2003). A file of facility addresses was uploaded into the software, and the associated coordinates were matched as accurately as possible. To assign the coordinates, a matching hierarchy is used by the software, as shown in the default code flags assigned in the inventory. The default codes are presented from most-to-least accurate (Table 3-3).

Table 3-3. Facility Location Defaults

Default Location Code	Description
Exact	Matched to within a unique intersection or within a single side of a single street block
Near	Matched to a single street block, but the correct placement within block is unknown
Zipcode+2	Matched to the 5-digit zip code, plus the first two digits of the 4-digit extension
Zipcode5	Matched to the 5-digit zip code
Zipcode3	Matched to multiple 3-digit zip codes
Ambig	Matched to multiple street segments
Cntycent	Not matched using geocoder, coordinates represent the county centroid

What are the Emission Estimates for Point Sources?

Table 3-4 provides a summary of the point source 33 urban HAP emission estimates developed for Cuyahoga County. The top-emitted HAPs are tetrachloroethylene (perchloroethylene; 87.49 tons), trichloroethylene (74.27 tons), methylene chloride (61.4 tons), and formaldehyde (24.16 tons). Combined, these HAPs account for 85% of the total 33 urban HAPs emitted by point sources in the county. For the most part, these emissions are associated with the use of solvents. Table 3-5 provides a summary of the total point source 33 urban HAP emission estimates. For tetrachloroethylene, numerous facilities contribute to the total, with the primary contributor being Auto-Tap, Incorporated. For trichloroethylene, the primary contributor is Linderme Tube Company. For methylene chloride, numerous facilities also contribute to the total, with the primary contributor being Cleveland Laminating Corporation. Formaldehyde is emitted from solvent use as well as from fuel combustion. The formaldehyde sources consist of numerous individual emission units and boilers. The primary contributor to total point source formaldehyde emissions is Ford Motor Company's Cleveland Casting Plant.

Table 3-4. Total Point Source HAP Emissions by Pollutant

HAP Category Name	Emissions(TPY)
Tetrachloroethylene (Perchloroethylene)	87.49
Trichloroethylene	74.27
Methylene Chloride (Dichloromethane)	61.40
Formaldehyde	24.16
Lead Compounds	12.30
Manganese Compounds	11.95
Benzene	6.63
Nickel Compounds	5.94
Vinyl Chloride	1.49
Chromium Compounds	1.40
Acrylonitrile	1.09
1,1,2,2-Tetrachloroethane	0.61
Acetaldehyde	0.49
Acrolein	0.20
Ethylene Dichloride (1,2-Dichloroethane)	0.15
Arsenic Compounds	0.13
Cadmium Compounds	0.12
Mercury Compounds	0.11
Propylene Dichloride (1,2-Dichloropropane)	0.07
Chloroform	0.01
Beryllium Compounds	6.67E-03
1,3-Butadiene	6.16E-03
Carbon Tetrachloride	2.84E-03
Ethylene Dibromide (Dibromoethane)	1.63E-03
Polycyclic Organic Matter as 7-PAH	1.31E-03
1,3-Dichloropropene	6.02E-04
Dioxins/Furans (total, non TEQ)	4.34E-05
Dioxins/Furans as 2,3,7,8-TCDD TEQs	4.20E-06
Total	290.03

Table 3-5. Point Source Emissions Summary by Facility

Facility Identifier	Facility Name	Total Annual HAP Emissions(tpy)^a
1318000242	Cleveland Laminating Corporation	49.67
1318008053	Auto-Tap, Incorporated	45.50
1318008048	Linderme Tube Company (the)	34.30
1318120180	Ford Motor Company - Cleveland Casting Plant	28.14
1318001613	ISG Cleveland, Incorporated -- Cleveland Works	13.53
1318007817	Hi Tech Metal, Incorporated BMT	8.43
1318000838	Manufacturers Plating Company, Incorporated	8.09
1318005949	BF Goodrich Landing Gear Division - Plating Operations	6.67
1318277862	Getters Corporation of America -- Independence	6.57
1318007731	Hi Tecmetal, Incorporated	6.38
1318001253	Nettleton Steel Treating Company	6.38
1318538191	Cuyahoga C and DD Landfill	5.48
1318040267	Sherwin-Williams Company Consumer Group (Sprayon Product, Incorporated)	5.14
1318005887	Cleveland Manufacturing Division	4.77
3903500005 ^b	City of Westlake Landfill	4.32
1318105884	Areway, Incorporated Plant 2	4.00
1318003059	Medical Center Company (the)	3.01
1318617648	DryClean USA #401 - Westlake Store	2.65
1318001982	Meyer Products	2.35
1318006474	Smith Bros Cleaners	2.25
1318031627	Morgan Electro Ceramics, Incorporated (Morgan Matroc Electro Ceramics Division)	2.10
1318316477	DryClean USA #501 (formerly Mr. Todd Cleaners)	2.04
1318007651	Chemical Solvents, Incorporated (the)	1.93
1318536280	Tool-Die Engineering Company (TDE Group, Incorporated)	1.87
1318546476	Barri-Lee Cleaners, Incorporated	1.76
3903500010 ^b	Norton Environmental Landfill	1.70
1318004933	East Ohio Gas Company - # 2 Works Station	1.53
1318207468	Argo-Tech Corporation	1.51
1318402645	I. Schumann & Company, Incorporated	1.30
1318247914	Industrial Metal Finishing, Incorporated	1.26
1318006552	Day-Glo Color Corporation	1.23
1318041114	American Spring Wire Corporation	1.18
1318086492	Village Dry Cleaners (withdrawn - new # 1318088089)	0.96

Table 3-5. Point Source Emissions Summary by Facility (Continued)

Facility Identifier	Facility Name	Total Annual HAP Emissions(tpy)^a
1318000245	Cleveland Electric Illuminating Company - Lake Shore Plant	0.90
1318018134	DiMauro's Dry Cleaners, Incorporated	0.83
3903500008 ^b	Joy Mining Machinery Bedford Gear	0.64
1318000246	Dominion Cleveland Thermal, Incorporated -- Hamilton Avenue Plant (formerly Cleveland Energy Resources) (combined with emissions from 131800244)	0.61
3903500003 ^b	City of Brooklyn Landfill	0.61
1318170235	Ferro Corporation - Cleveland Frit Plant	0.55
1318006501	Satellite Cleaners	0.55
3903500009 ^b	Nicky Boulevard Landfill	0.54
1318000103	River Recycling Industries, Incorporated	0.53
1318568242	Fairmont Cleaners	0.53
1318397855	Sam's Cleaners	0.53
1318247721	BFI - Glenwillow Landfill	0.52
1318170314	ALCOA-Cleveland Works	0.51
1318001529	Victory White Metal Company	0.50
1318121632	Wellman Friction Products Brook Park	0.50
1318000117	Whitmore Manufacturing Company	0.50
1318228068	One Hour Turney Cleaners (see 1318226484)	0.49
1318596446	Rako Cleaners and Tailors, Incorporated	0.45
1318546504	Hillcrest Cleaners	0.45
1318457571	Eagle Cleaners (One Hour Cleaners)	0.45
1318288133	Kergaard Cleaners -- Dario, Incorporated	0.45
1318007293	Top Cleaners	0.45
1318006436	Mel's Cleaners	0.45
1318006490	Sunshine Cleaners, Incorporated	0.44
1318082830	Marathon Ashland Petroleum, LLC - BRK2830	0.41
1318005897	Center Terminal Company - Cleveland (formerly Fleet Supplies, Incorporated)	0.39
1318001092	TRW, Incorporated - Valve Division	0.38
1318596538	Perfection Valet	0.38
1318348105	Islander Cleaners	0.38
1318168088	Quality Assured Dry Cleaner	0.36
1318518177	Dutch Cleaners	0.34
1318005609	Chemical Solvents, Incorporated	0.33
1318002698	Sun Refining and Marketing Company, Incorporated - Cleveland Terminal	0.31
1318000156	G E Lighting - Ivanhoe Road	0.31

Table 3-5. Point Source Emissions Summary by Facility (Continued)

Facility Identifier	Facility Name	Total Annual HAP Emissions(tpy)^a
1318288102	New Westlake Cleaners	0.30
1318216460	Jiffy Cleaners	0.28
1318536516	Obbok, Incorporated (also Solon Cleaners)	0.26
1318007755	Alcon Industries, Incorporated	0.25
1318556463	Strongsville Cleaners	0.23
1318346465	Karr's Custom Cleaners	0.23
1318576031	Boyas Excavating, Incorporated -- Valley View	0.22
1318120179	Ford Motor Company - Cleveland Engine Plant 1	0.22
1318030172	Hukill Chemical Corporation	0.21
1318166449	Heights Laundry and Dry Cleaning	0.21
1318002740	Equilon Enterprises, LLC -- Cleveland Terminal	0.21
1318008076	Tomaric Cleaners	0.21
1318376451	Alva's Cleaners	0.19
1318007129	Collar-N-Cuff, DBA Northern Ohio Cleaners	0.19
3903500001 ^b	American Tank & Fabricating Co.	0.18
1318008111	Keco Plating Company	0.16
1318202137	Lincoln Electric Company (the)	0.16
1318548104	La Roy Cleaners & Tailors	0.15
1318577915	Weyerhaeuser Company (formerly MacMillan Bloedel Containers)	0.13
1318400068	Federal Metal Company (the)	0.12
1318456544	Class Cleaners and Tailors - West	0.11
1318002907	Sun Oil Company, Incorporated	0.09
1318172479	Southerly Wastewater Treatment Center, Northeast Ohio Regional Sewer District	0.09
1318397488	Windy Hill Dry Cleaners	0.08
1318001618	SIFCO Forge Group, Incorporated	0.07
1318537766	Snow Metal Products Company	0.06
1318000101	PPG Industries, Incorporated	0.05
1318170183	US Logistics (formerly BP Oil Company-Cleveland Terminal)	0.05
1318006406	Sherwood Division of Harsco Corporation	0.05
1318030264	Ferro Corporation - Bedford Chemical Division	0.05
1318000504	T & B Foundry Company	0.05
1318394002	Southwest General Hospital (Southwest General Health Center)	0.05
1318007477	Quality Plating Company, Incorporated	0.05

Table 3-5. Point Source Emissions Summary by Facility (Continued)

Facility Identifier	Facility Name	Total Annual HAP Emissions(tpy)^a
1318000303	Ashland, Incorporated -- Cleveland West Plant (Ashland Chemical Company; Ashland Specialty Chemical Company)	0.05
1318581043	Ford Motor Company - Cleveland Stamping Plant	0.04
1318002480	Westerly Wastewater Treatment Plant	0.04
1318451029	GMC Metal Fabricating Division -- Parma Plant	0.04
1318003300	Center Terminal Company -- Cleveland South (formerly Fleet Supplies Terminal - South)	0.04
1318005977	General Environmental Management, LLC	0.03
1318000248	American Bronze Corporation	0.03
1318000133	Cleveland Public Power - Service Center	0.03
1318000204	GE Lighting Euclid LP Plant	0.03
1318001169	NASA John H. Glenn Research Center at Lewis Field	0.02
1318040081	Metaldyne - Bedford Heights Plant (formerly ITT Lester Industries, Incorporated)	0.01
1318126134	Foseco Metallurgical, Incorporated (formerly Foseco, Incorporated)	0.01
1318000120	Accurate Plating Company	0.01
1318000132	Cleveland Public Power - Collinwood Substation	0.01
1318226096	Tomlinson Industries	0.01
3903500023 ^b	Go/Dan Industries	0.01
1318043843	Weyerhaeuser Company (Weyerhaeuser Packaging, Incorporated; Traub Container Corporation)	0.01
1318008143	Diamond Hard Chrome, Incorporated	0.01
3903500004 ^b	City of Euclid Sludge Handling Facility	0.01
1318531037	Solon Specialty Wire Company (North American Wire Products Corporation)	0.01
1318001287	Wabash Alloys, LLC	0.01
1318207955	Marine Mechanical Corporation	0.01
1318002278	Harnischfeger Industries (Horsburgh and Scott)	0.01
1318001788	Chromium Corporation (Chromium Corporation of America)	0.01
1318001881	Woodhill Plating Work Company	5.00E-04
1318002481	Easterly Wastewater Treatment Plant	4.13E-03
1318000732	Art Galvanizing Works, Incorporated (the)	4.00E-03
1318182623	G E Lighting - Nela Park	2.50E-03
3903500002 ^b	Atlas Plating Inc.	2.50E-03
1318220069	Garfield Alloys, Incorporated	2.50E-03
1318001732	Rosborough Supply Company	2.50E-03

Table 3-5. Point Source Emissions Summary by Facility (Continued)

Facility Identifier	Facility Name	Total Annual HAP Emissions(tpy)^a
1318000138	Cleveland Range Company	2.50E-03
1318005230	Oatey Company	2.00E-03
1318004020	Redmond Waltz Electric Company	1.58E-03
1318557304	Modine Great Lakes	1.50E-03
1318001085	Ferro Corporation - Polymer Additives Division - Plant 1	1.50E-03
1318006616	L. Gray Barrel & Drum Company	1.30E-03
1318532662	Saint-Gobain Cuystals and Detectors, a division of Saint-Gobain Ceramics and Plastics (formerly Saint Gobain Industrial Ceramics, Incorporated -- Bicon Division)	1.18E-03
1318007924	Greenfield Crematory (Foresight Family Service)	1.05E-03
1318001715	Master Chrome Service	1.01E-03
1318007491	Techmetal, Inc., Modern Steel Treating	8.06E-04
1318617346	American Metals Corporation - Westlake	6.00E-04
1318000005	Prince Platers, Incorporated (Plastic Platers, Incorporated -- Plant #2; PP Acquisition Company)	5.04E-04
1318007422	Unviversal Oil, Incorporated	5.01E-04
3903500029 ^b	Stanley Works	5.00E-04
1318171623	Charter Steel -- Cleveland (formerly American Steel and Wire Corporation)	5.00E-04
1318007657	Cooper - Standard Automotive (formerly Standard Products Company, Reid Division)	5.00E-04
3903500018 ^b	Cast Specialties Inc.	4.80E-04
1318007658	Charter Steel -- Cleveland -- TOW Division (formerly American Steel and Wire Corporation - TOW Division)	4.79E-04
1318537971	Venture Lighting International, Incorporated -- Solon	3.00E-04
1318000039	Chrome Industries Company	2.37E-04
1318001670	American Brass Manufacturing Company	1.89E-04
3903500017 ^b	Brothers Printing Co.	1.25E-04
1318007385	Metal Fabricating Corporation	1.25E-04
1318001513	Sales Promotion Printing Incorporated	1.17E-04
1318008109	Forestek Plating & Manufacturing Company	8.70E-05
1318008119	South Shore Finishers, Incorporated	8.02E-05
1318001642	Durable Plating Company	6.41E-05
1318007874	Buschman Corporation	4.48E-05
1318005194	Basic Aluminum Castings Company	5.00E-06
1318127839	Adelphia, Incorporated -- Cleveland Plant	2.06E-07

Facility Identifier	Facility Name	Total Annual HAP Emissions(tpy) ^a
Total		290.03

^a Equals the sum of all of the 33 urban HAPs emitted by the facility.

^b Premise numbers created by ERG—not found in CLAA permitting database.

As shown in Table 3-5, estimates are included in the inventory for 161 facilities. Not all of these facilities are large, major sources. The inventory includes estimates for many facilities that are often handled as nonpoint sources rather than as individual point sources. These smaller sources include 33 dry cleaners, 8 gasoline distribution bulk plants, 12 landfills, and 18 metal plating and polishing facilities.

The top-emitting facilities are also the sources discussed above—Cleveland Laminating Corporation, Auto-Tap, Inc., Linderme Tube Company, and Ford Motor Company’s Casting Plant. A review of the criteria pollutant information available for these sources in EIS indicates that the HAP emission estimates are consistent with the reported estimates for volatile organic compound (VOC) and other organic compounds (non-volatile pollutants).

More details on the HAP emission estimates by facility can be found in Appendix A. Table A-1 presents the individual 33 urban HAP estimates for each facility. Table A-2 presents each facility by name, address, and SIC code.

What Point Source QA/QC Activities Were Performed?

QA/QC efforts associated with development of the Cuyahoga County point source inventory consisted primarily of:

- Independent checking of calculations;
- Independent checking for data entry errors;
- Completeness checks against the master facility list;

- In-depth assessment of permits and inspection reports to identify closed facilities;
- Verification by CLAA of questionable emissions;
- Verification of stack parameter relationships to one another;
- Verification of latitude/longitude coordinates to confirm they are in Cuyahoga County; and
- Comparison of inventory results to those of other major industrial cities in the U.S.

The Cuyahoga County point source emissions estimates for the total urban 33 HAPs were compared to the NEI 1999 point source inventory (for the 33 urban HAPs) for Detroit (6 counties), Chicago (6 counties), and Pittsburgh (6 counties).

The results below indicate that the Cuyahoga County estimates are consistent with the estimates for these other cities.

Metropolitan Area	Number of Facilities	Total Urban HAP Emissions (tpy)	Urban HAP Emissions (tons) per Facility
Cuyahoga County (draft)	161	290	1.80
Detroit	442	1030	2.33
Chicago	2632	4000	0.85
Pittsburgh	321	376	1.17

What are the Limitations of the Point Source Inventory?

The primary limitation associated with the Cuyahoga County point source inventory is that facilities may be missing from the inventory that could be important contributors of HAP emissions. This is the first targeted effort to develop a point source HAP inventory for Cuyahoga County. While every effort was made to include all of the large point sources in the county, as well as small facilities in the St. Clair-Superior and Slavic Village neighborhoods, gaps remain. Not all of the missing facilities may emit HAPs; or any of the 33 urban HAPs in particular. In-depth review of the available information for each facility is needed, but time and resource limitations did not permit such a review. In addition, for some facilities of concern in the St. Clair-Superior neighborhood no information is available—the facilities are not permitted by the CLAA. Conversely, while every effort was made to exclude facilities that closed prior to 2002, some may be included if they were operating in 2000 or 2001 when last inspected by CLAA.

Other limitations of the point source inventory are common to all HAP inventories—the availability and quality of HAP emission factors used to estimate emissions is limited.

What are the Recommendations for Future Improvements to the Point Source Inventory?

Further review of the point source inventory for completeness is the key recommendation for future improvements. This will require on-site review of CLAA hard-copy files, primarily for Title V or major source facilities that report to EIS but Material Safety Data Sheets are needed to speciate the VOC other organic compounds (non-volatile pollutants) estimates in EIS.

3.2 Stationary Nonpoint Sources

What Are Stationary Nonpoint Sources?

Stationary nonpoint sources are defined in two ways: 1) small stationary point sources that can be grouped by a source category and whose emissions are usually not calculated for individual facilities because the category contains too many and/or too widely dispersed sources to make this reasonable; and 2) sources that do not really have a true “point” of emission (U.S. EPA, 2003a).

Stationary sources can be reported as an individual facility, which is referred to as “point” or at the county level, which is referred to as “nonpoint”. Examples of stationary point sources that are commonly reported as nonpoint sources include dry cleaners, graphic arts, and autobody refinishing activities; these facilities are often reported by source category at the county level. Examples of sources that do not have a “point” of emission include forest fires, commercial pesticide usage, and traffic marking activities; these source categories can only be delineated to the county level.

Several steps were needed to develop a Cuyahoga County air toxics nonpoint source inventory. The general steps needed are:

- Identifying nonpoint source categories;
- Gathering activity and HAP emission factors;
- Evaluating state, local, and federal regulations;
- Developing nonpoint source category estimates; and
- Resolving QA/QC checks specific to nonpoint source inventories.

What Were the Specific Data Sources Used to Compile the Inventory?

The first step to developing a countywide nonpoint source inventory was to develop a comprehensive list of emission source categories. Table 3-6 summarizes the nonpoint source categories that were initially considered, and the ones finally developed. Nonpoint source categories and their associated emissions identified in the 1999 NEI for Cuyahoga County were the starting point for the 2002 inventory development. Initially, 73 source categories were identified as potential candidates for emission estimations development after: 1) reviewing the 1999 category list for Cuyahoga County; 2) evaluating specific information for Cuyahoga County; and 3) reviewing other state/local inventories that provided estimates to the 1999 NEI.

After researching and contacting Ohio and Cuyahoga County programs and agencies, and reviewing data available to the point sources inventory, this list was finalized to 54 source categories that emitted at least one of the 33 urban HAPs. Table 3-7 lists these source categories and the primary data source used to gather activity data. Table 3-8 provides a summary of the 19 source categories not in this inventory.

What Procedures Were Used to Estimate Emissions?

County level estimates for the nonpoint categories were developed using EPA-approved methodologies or through other peer-reviewed methodologies and models, such as those in Emission Inventory Improvement Program (EIIP), *Compilation of Air Pollutant Factors (AP-42)*, NEI and/or developed by other state and local agencies.

Table 3-6. Initial Nonpoint Source Category List

Animal Cremation
Asphalt Paving - Cutback
Autobody Refinishing
Aviation Gasoline Distribution: Stage I
Aviation Gasoline Distribution: Stage II
Chromium Plating: Chromic Anodizing
Chromium Plating: Decorative Chromium Plating
Chromium Plating: Hard Chromium Plating
Commercial Agricultural Pesticide Application
Concrete, Gypsum, and Plaster Products Manufacturing
Consumer Products Usage - Adhesives & Sealants
Consumer Products Usage - Automotive Aftermarket
Consumer Products Usage - Coating & Related Products
Consumer Products Usage - FIFRA-regulated
Consumer Products Usage - Household Products
Consumer Products Usage - Miscellaneous
Consumer Products Usage - Personal Care Products
Dental Use and Preparation
Fireplaces: General
Fireplaces: Insert; EPA certified; catalytic
Fireplaces: Insert; EPA certified; non-catalytic
Fireplaces: Insert; non-EPA certified
Flexible Polyurethane Foam Fabrication
Flexible Polyurethane Foam Production
Fluorescent Lamp Recycling
Gasoline Distribution - Stage I: Bulk terminals, Bulk plants, and Pipeline Facilities
Gasoline Distribution - Stage I: Service Stations
Gasoline Distribution - Stage II
General Lab Activities
Grain Elevators
Graphic Arts
Halogenated Solvent Cleaning
Hospital Sterilizers
Human Cremation
Industrial Boilers: Anthracite Coal
Industrial Boilers: Bituminous Coal
Industrial Boilers: Distillate Oil
Industrial Boilers: Natural Gas
Industrial Boilers: Residual Oil
Industrial Boilers: Waste Oil
Institutional/Commercial Heating - Anthracite Coal
Institutional/Commercial Heating - Bituminous Coal
Institutional/Commercial Heating - Distillate Oil

Institutional/Commercial Heating - Natural Gas
Institutional/Commercial Heating - POTW Digester Gas
Institutional/Commercial Heating - Residual Oil
Lamp Breakage
Leaking Underground Storage Tanks
Miscellaneous Organic Chemical Processes
Motor Vehicle Fires - Components
Motor Vehicle Fires - Tires
Natural Gas Transmissions and Storage
Oil and Natural Gas Production
Open Burning - Forest and Wildfires
Open Burning - Prescribed Burning
Open Burning - Residential Trash
Open Burning of Scrap Tires
Outdoor Swimming Pools
Paint Stripping Operations
Perchloroethylene Dry Cleaning
Publicly Owned Treatment Works (POTWs)
Residential Heating: Anthracite Coal
Residential Heating: Bituminous & Lignite Coal
Residential Heating: Distillate Oil
Residential Heating: Liquefied Petroleum Gas
Residential Heating: Natural Gas
Structure Fires
Surface Coating: Architectural - water based
Surface Coating: Industrial Maintenance
Surface Coating: Traffic Markings
Woodstoves: catalytic, general
Woodstoves: conventional
Woodstoves: non-catalytic, general

Table 3-7. Activity Data Sources for Nonpoint Source Categories

Source Category	Primary Activity Data Source
Animal Cremation	CLAA Permit data/Personal Communication
Autobody Refinishing	EPA's Lead Locating & Estimating Document
Aviation Gasoline Distribution: Stage I	Airport-Specific Fixed Base Operations
Aviation Gasoline Distribution: Stage II	Airport-Specific Fixed Base Operations
Chromium Plating - Chromic Anodizing	EPA's MACT data
Chromium Plating - Decorative Electroplating	EPA's MACT data
Chromium Plating - Hard Chromium	EPA's MACT data
Commercial Agricultural Pesticide Application	U.S. Dept of Agriculture
Consumer Products Usage - Adhesives & Sealants	Cuyahoga County population
Consumer Products Usage - Automotive Aftermarket	Cuyahoga County population/Marketing data
Consumer Products Usage - Coating & Related Products	Cuyahoga County population
Consumer Products Usage - FIFRA-regulated	Cuyahoga County population/Marketing data
Consumer Products Usage - Household Products	Cuyahoga County population
Consumer Products Usage - Miscellaneous	Cuyahoga County population
Consumer Products Usage - Personal Care Products	Cuyahoga County population
Dental Use and Preparation	EPA's Mercury Report to Congress
Fireplaces: General	Cuyahoga County Auditor's Office
Fireplaces: Insert; EPA certified; catalytic	Cuyahoga County Auditor's Office
Fireplaces: Insert; EPA certified; non-catalytic	Cuyahoga County Auditor's Office
Fireplaces: Insert; non-EPA certified	Cuyahoga County Auditor's Office
Gasoline Distribution - Stage I - Service Station Filling	Ohio Department of Transportation
Gasoline Distribution - Stage II	Ohio Department of Transportation
General Lab Activities	EPA's Mercury Report to Congress
Hospital Sterilizers	Ethylene Oxide Industry Council
Human Cremation	Cremation Association of North America
Industrial Boilers: Anthracite Coal	DOE's Energy Information Administration
Industrial Boilers: Bituminous Coal	DOE's Energy Information Administration
Industrial Boilers: Distillate Oil	DOE's Energy Information Administration

Table 3-7. Activity Data Sources for Nonpoint Source Categories (Continued)

Source Category	Primary Activity Data Source
Industrial Boilers: Natural Gas	DOE's Energy Information Administration
Industrial Boilers: Residual Oil	DOE's Energy Information Administration
Institutional/Commercial Heating - Anthracite Coal	DOE's Energy Information Administration
Institutional/Commercial Heating - Bituminous Coal	DOE's Energy Information Administration
Institutional/Commercial Heating - Distillate Oil	DOE's Energy Information Administration
Institutional/Commercial Heating - Natural Gas	DOE's Energy Information Administration
Institutional/Commercial Heating - Residual Oil	DOE's Energy Information Administration
Lamp Breakage	National Electrical Manufacturer's Association
Leaking Underground Storage Tanks	Ohio Bureau of Underground Storage Tanks
Motor Vehicle Fires - Components	Ohio Fire Prevention Bureau
Motor Vehicle Fires - Tires	Ohio Fire Prevention Bureau
Outdoor Swimming Pools	Cuyahoga County Health Department; Pool List USA
Paint Stripping Operations	Halogenated Solvent Industrial Alliance
Perchloroethylene Dry Cleaning	Halogenated Solvent Industrial Alliance
Publicly Owned Treatment Works (POTWs)	Ohio Division of Surface Water
Residential Heating: Anthracite Coal	DOE's Energy Information Administration
Residential Heating: Bituminous & Lignite Coal	DOE's Energy Information Administration
Residential Heating: Distillate Oil	DOE's Energy Information Administration
Residential Heating: Liquefied Petroleum Gas	DOE's Energy Information Administration
Residential Heating: Natural Gas	DOE's Energy Information Administration
Structure Fires	Ohio Fire Prevention Bureau
Surface Coating: Architectural - water based	Census Bureau Current Industrial Reports
Surface Coating: Traffic Markings	Census Bureau Current Industrial Reports
Woodstoves, Catalytic	DOE's Energy Information Administration
Woodstoves: Conventional	DOE's Energy Information Administration
Woodstoves: Non-catalytic	DOE's Energy Information Administration

Table 3-8. Categories Not Included in the Nonpoint Sources Inventory

Source Category	Reason Not Included
Asphalt Paving - Cutback	Banned in Cuyahoga County
Concrete, Gypsum, and Plaster Products Manufacturing	Assumed to be covered in TRI data
Flexible Polyurethane Foam Fabrication	Assumed to be covered in TRI data
Flexible Polyurethane Foam Production	Assumed to be covered in TRI data
Fluorescent Lamp Recycling	Not practiced in Cuyahoga County
Gasoline Distribution - Stage I: Bulk Terminals, Pipelines, and Bulk Plants	Source category completely in point sources database
Grain Elevators	No Urban-33 HAP
Graphic Arts	No Urban-33 HAP
Halogenated Solvent Cleaning	Source Category completely in point sources database
Industrial Boilers: Waste Oil	No activity data available
Institutional/Commercial Heating: POTW Digester Gas	No activity data available
Miscellaneous Organic Chemical Processes	Assumed to be covered in TRI data
Natural Gas Transmissions and Storage	Assumed to be covered in TRI data
Oil and Natural Gas Production	Assumed to be covered in TRI data
Open Burning - Forest and Wildfires	No activity in 2002
Open Burning - Prescribed Burning	Banned in Cuyahoga County
Open Burning - Residential Trash	Banned in Cuyahoga County
Open Burning of Scrap Tires	No activity in 2002
Surface Coating - Industrial Maintenance	No Urban-33 HAP

In cases where multiple methodologies were available, the cost effectiveness of using an approach in terms of any locally-specific data requirements that existed were evaluated. For example, surveys can be a useful tool for gathering county-specific activity data, especially for consumer products usage. However, due to limited time and resources needed to execute an effective survey, an alternate approach, purchasing marketing data for the Cleveland primary metropolitan statistical area (PMSA), was used instead for selected source categories. This proved to be a more cost-effective alternative to the survey approach for both time and resources, and still yielded acceptable emissions estimates.

Where county level data are not readily available, state or national data were collected and allocated to the county level using an appropriate surrogate, such as county business employment, population, or land use type. Locally-specific data enhanced the emissions inventory as compared to allocating national-level activity data via a Cuyahoga County surrogate. For example, using the NEI allocation approach for apportioning nationwide tetrachloroethylene (also called perchloroethylene) emissions from dry cleaning, which is based on the number of employees working at dry cleaning facilities, would have estimated Cuyahoga County emissions as 109.1 tons per year (tpy). The NEI allocation methodology was amended for this inventory to first allocate emissions by amount of money spent on dry cleaning in the Cleveland PMSA (made up of six counties, including Cuyahoga County) in comparison to the amount spent in the entire county. This approach was used because it was believed that consumer spending is more closely related to perchloroethylene consumption than number of employees. From the PMSA-level, emissions were then allocated to Cuyahoga County based on 2001 County Business Patterns (CBP) employment for dry cleaners (U.S. Census Bureau, 2003). This amended method provided an estimate of 92.21 tpy. The result is that county-wide emissions would have been overestimated by nearly 17 tons if using the NEI allocation method. A description of the full methodology for this category is located in Appendix B-28.

Expertise from the Cleveland Public Health Department staff was used to help acquire activity data or provide contacts among other state/local agencies and programs. For example, the Department of Transportation (DOT) is typically responsible for the annual repainting of traffic lines for a state (source category: traffic markings). Cuyahoga County lane miles were provided by the Cuyahoga County DOT, and, using national lane miles, a county-specific proportion was applied to the national-level estimates for traffic markings.

Other contacts included:

- The state Fire Marshall to retrieve the number of structure and motor vehicle fires in 2002;

- The Ohio Division of Surface Water for an estimate of the gallons of wastewater treated;
- The County auditor's office for number of homes with fireplaces and square footage of commercial/institutional buildings; and,
- The County Public Health Offices to retrieve information on outdoor swimming pools.

Source categories that are affected by MACT or VOC rules that took effect prior to 2002 were also evaluated for mandatory emission source reduction. For example:

- The National Volatile Organic Compound Emission Standards for Consumer Products calls for a reduction of VOC content of 20% in many consumer products, such as hair sprays, insecticides, and household cleaning agents (U. S. EPA, 1998). A number of the 33 urban HAPs can be speciated from the total VOCs being released from these emission sources;
- Although Cuyahoga County is no longer designated as an ozone nonattainment area, certain emission sources in Ohio are required to install control equipment to reduce VOC emissions. For example, gasoline service stations in Cuyahoga County (among several counties) that distribute more than 10,000 gallons per month are required to install VOC vapor recovery units (VRUs) on their fuel nozzles (U.S. EPA, 1991). The minimum control efficiency required for these VRUs is 95% VOC reduction, which is higher than the minimum 86% required by the federal government; and,
- Additionally, the Cuyahoga County DOT confirmed the year-round ban on the use of cutback asphalt for their paving operations (Ciupa, 2003). Thus, there are no HAP emissions from this source category.

For most of the source categories, no seasonal adjustments are needed to generate the annual emissions estimate. However, some assumptions were made for certain categories which are dependent upon season. Although "seasonal" activity information was available, emissions were calculated and reported on an annual basis. For example:

- Outdoor swimming pools are active during warmer times of the year. Information provided by the Cuyahoga County Health Department indicated that public

outdoor pools are used during the four month period from May to September. During the other eight months, it is assumed that the public outdoor pools are drained and/or covered. It was assumed that residential outdoor pools were active from May to October. Similar to public outdoor pools, the residential outdoor pools are assumed to be drained and/or covered during the other seven months. Thus, chloroform emissions from public outdoor pools presented in this inventory were indicative for the four-month active season, while residential outdoor pools were indicative of the five-month active season;

- Soil excavation for remediation of underground storage tanks (USTs) was assumed to occur during the summer season (June through August), when the soil is warm. Thus benzene emissions from leaking USTs were indicative of the three-month summer season; and,
- Residential/commercial/institutional/industrial fuel combustion for heating was assumed to be most active (if not all) during the colder, winter season.

What are the Calculated Emission Estimates for Nonpoint Sources in Cuyahoga County?

Annual emission estimates, in tons per year, for the 33 urban HAPs were developed, and are listed in Table 3-9 by source category. Over 476 tpy were emitted from 54 nonpoint source categories. All methodologies containing references and assumptions for developing these estimates are listed Appendix B. In most methodologies, an activity factor is multiplied by an emission factor to generate an emission estimate. For example, amount of natural gas consumed for institutional/commercial buildings in million British Thermal Units (MMBtu) was multiplied by a natural gas emission factor in the format of pound pollutant emitted per MMBtu consumed, resulting in pounds of pollutant emitted. The calculated emission estimate was then converted to tons by dividing by 2000 pounds per ton.

Table 3-9. Nonpoint Source Category Emissions of the 33 Urban HAPs

Nonpoint Source Category	Total Annual HAP Emissions (tpy)^a
Consumer Products Usage - FIFRA-regulated	113.30
Paint Stripping Operations	85.84
Perchloroethylene Dry Cleaning	72.57
Surface Coating: Architectural - water based	53.89
Fireplaces: Insert; non-EPA certified	38.68
Residential Heating: Liquefied Petroleum Gas	22.49
Consumer Products Usage - Automotive Aftermarket	19.08
Woodstoves: Conventional	17.42
Consumer Products Usage - Coating & Related Products	14.94
Structure Fires	8.62
Outdoor Swimming Pools	6.59
Consumer Products Usage - Adhesives & Sealants	6.02
Consumer Products Usage - Household Products	3.32
Residential Heating: Natural Gas	2.12
Leaking Underground Storage Tanks	1.90
Gasoline Distribution - Stage II	1.47
Hospital Sterilizers	1.40
Industrial Boilers: Natural Gas	1.28
Aviation Gasoline Distribution: Stage I	0.80
Institutional/Commercial Heating: Natural Gas	0.76
Fireplaces: Insert; EPA certified; catalytic	0.73
Consumer Products Usage - Miscellaneous	0.54
Gasoline Distribution - Stage I: Service Stations	0.50
Motor Vehicle Fires - Components	0.44
Autobody Refinishing	0.35
Woodstoves: Catalytic	0.33
Industrial Boilers: Residual Oil	0.28
Industrial Boilers: Distillate Oil	0.20
Institutional/Commercial Heating: Distillate Oil	0.18
Motor Vehicle Fires - Tires	0.15
Institutional/Commercial Heating: Bituminous Coal	0.05
Residential Heating: Distillate Oil	0.03
Aviation Gasoline Distribution: Stage II	0.02
Fireplaces: Insert; EPA certified; non-catalytic	0.02
Chromium Plating: Chromic Anodizing	0.02
Publicly Owned Treatment Works (POTWs)	0.02
Surface Coating: Traffic Markings	0.01
Woodstoves: Non-catalytic	9.89E-03
Institutional/Commercial Heating: Anthracite Coal	6.86E-03

Table 3-9. Nonpoint Source Category Emissions of the 33 Urban HAPs (Continued)

Nonpoint Source Category	Total Annual HAP Emissions (tpy)^a
Dental Use and Preparation	6.82E-03
General Lab Activities	6.19E-03
Lamp Breakage	3.57E-03
Consumer Products Usage - Personal Care Products	2.80E-03
Chromium Plating: Hard Chromium Plating	1.53E-03
Residential Heating: Bituminous & Lignite Coal	1.38E-03
Human Cremation	1.12E-03
Industrial Boilers: Bituminous Coal	6.29E-04
Chromium Plating: Decorative Chromium Plating	5.21E-04
Residential Heating: Anthracite Coal	2.15E-06
Institutional/Commercial Heating: Residual Oil	2.26E-04
Industrial Boilers: Anthracite Coal	2.15E-06
Commercial Agricultural Pesticide Application	2.65E-07
Fireplaces: General	3.38E-08
Animal Cremation	1.29E-08

^a Equals the sum of all of the 33 urban HAPs emitted by the category.

Where applicable, emissions may have been adjusted to account for control devices in place. For example, the VOC rule requirements for using VRUs are applied at gasoline dispensing facilities as mandated for Cuyahoga County to reduce emissions by 95%. Thus, the calculated emissions were multiplied by an adjustment factor of 0.05 to account for the control technology required.

The top 90% of the nonpoint emissions in this inventory comprise nine source categories. The top three categories are: consumer products usage using Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)-regulated chemicals, paint stripping operations, and perchloroethylene dry cleaners, representing over 57% of the nonpoint emissions. According to the 1999 NEI (U.S. EPA, 2003b), nationwide the top three emitting categories for the 33 urban HAPs are forest/wildfires (37.96%), prescribed burnings (10.03%), and perchloroethylene dry cleaners (5.26%). Consumer products usage using FIFRA-regulated chemicals (4.91%) and paint stripping operations (4.73%) are the next highest categories. Since Cuyahoga County did not

have any forest/wildfires in 2002 and prescribed burnings are not allowed, the county profile matches well with the nationwide profile.

Table 3-10 is a summary of the 33 urban HAP emissions from nonpoint sources by pollutant. Methylene chloride, 1,3-dichloropropene, and tetrachloroethylene sources comprise nearly 76% of the total emissions. According to the 1999 NEI, the top three urban HAPs by emissions are formaldehyde (27.89%), benzene (22.67%), and methylene chloride (11.24%). Benzene and formaldehyde emissions are ranked 4th and 6th, respectively, in the Cuyahoga County nonpoint inventory. The difference in this profile is that in the NEI, those pollutants are being driven by emission sources that didn't occur in 2002 in the county (forest/wildfires) or are not permitted in the county (prescribed burnings, residential burning of trash, etc.).

What QA/QC Procedures Were Applied in the Derivation of Emission Estimates?

Rigorous QA/QC approaches were applied to all emission estimates. The use of Excel spreadsheets for calculations provided a favorable approach to check for computational and systematic errors. Specific QA/QC checklist was implemented for all estimates and all estimates were peer reviewed by a senior staff member. Tables 3-11 compares the 2002 estimates against the 1999 NEI emissions. For many source categories, there are significant differences. This reflects the use of more accurate local activity data, for the most part.

Many source categories also have a point source component, such as perchloroethylene dry cleaners. Wherever possible, small stationary point estimates which overlapped with the nonpoint source categories were retained at the facility level and submitted with the point sources inventory; the nonpoint source category was then adjusted to account for the point source contribution.

Table 3-10. Cuyahoga County Nonpoint Source HAP Emissions by Pollutant

33 Urban HAPs	Emissions (tpy)
Methylene Chloride (Dichloromethane)	173.11
1,3-Dichloropropene	112.42
Tetrachloroethylene (Perchloroethylene)	75.75
Benzene	64.52
Nickel Compounds	22.60
Formaldehyde	10.16
Chloroform	7.28
Acrolein	7.00
Ethylene Oxide	1.40
Polycyclic Organic Matter as 7-PAH	0.86
Lead Compounds	0.37
Manganese Compounds	0.11
Acetaldehyde	0.06
Trichloroethylene	0.06
Chromium Compounds	0.03
Mercury Compounds	0.02
Carbon Tetrachloride	0.01
Arsenic Compounds	0.01
1,3-Butadiene	0.01
Cadmium Compounds	6.11E-03
Beryllium Compounds	4.24E-03
Ethylene Dichloride (1,2-Dichloroethane)	4.10E-03
Polychlorinated Biphenyls	9.98E-04
Acrylonitrile	2.59E-04
Dioxins/Furans as 2,3,7,8-TCDD TEQs	1.35E-05
Hexachlorobenzene	7.94E-06
Propylene Dichloride (1,2-Dichloropropane)	7.74E-06
Vinyl Chloride	4.51E-06
Dioxins/Furans (total, non TEQ)	2.14E-06
1,1,2,2-Tetrachloroethane	1.18E-06

Table 3-11. Comparison of 1999 NEI and 2002 Nonpoint Source HAP Emissions

Nonpoint Source Category	1999 NEI Emissions for Cuyahoga County (tpy)	2002 Cuyahoga County Emissions (tpy)	% Change
CPU - FIFRA-regulated Products ^a	110.60	113.30	2.45%
Perchloroethylene Dry Cleaners ^b	108.58	72.57	-33.17%
Paint Stripping Operations	97.40	85.84	-11.87%
Architectural Surface Coating	57.23	53.89	-5.84%
Outdoor Swimming Pools	25.66	6.59	-74.31%
Fireplaces: Inserts - non-EPA certified	23.87	38.68	62.04%
Residential Heating - Conventional Woodstoves	20.37	17.42	-14.49%
CPU - Automotive Aftermarket Products	17.89	19.08	6.64%
CPU - Coating and Related Products	14.97	14.94	-0.18%
Publicly Owned Treatment Works	10.67	0.02	-99.82%
Structure Fires	8.10	8.62	6.42%
Stage II Aviation Gasoline Distribution	0.01	0.02	263.84%
CPU - Adhesives and Sealants	6.00	6.02	0.35%
CPU - Household Products	3.30	3.32	0.52%
Hospital Sterilizers	1.76	1.40	-20.37%
Stage I Gasoline Distribution	1.62	0.50	-68.98%
Residential Heating - Natural Gas	1.55	2.12	36.91%
Stage I Aviation Gasoline Distribution	0.96	0.80	-16.82%
Institutional/Commercial Heating: Natural Gas	0.86	0.76	-11.87%
Industrial Boilers: Residual Oil	0.84	0.28	-67.17%
Industrial Boilers: Natural Gas	0.74	1.28	73.19%
Stage II Gasoline Distribution	0.67	1.47	121.23%
CPU - Miscellaneous	0.53	0.54	0.30%
Institutional/Commercial Heating: Distillate Oil ^b	0.46	0.18	-59.97%
Fireplaces: Inserts - EPA certified	0.45	0.73	62.16%
Residential Heating - Catalytic Woodstoves	0.39	0.33	-14.39%
Residential Heating - Distillate Oil	0.35	0.03	-92.44%
Autobody Refinishing and Paint Application	0.27	0.35	30.52%
Traffic Markings	0.19	0.01	-94.40%
Institutional/Commercial Heating: Residual Oil	0.12	2.26E-04	-99.81%
Industrial Boilers: Distillate Oil	0.05	0.20	285.85%
Hard Chromium Electroplating ^b	0.03	1.53E-03	-95.05%
Residential Heating - Bituminous and Lignite Coal	0.02	1.38E-03	-91.38%
Fireplaces: Inserts - Non-catalytic, EPA-certified	0.01	0.02	56.43%
Institutional/Commercial Heating: Bituminous and Lignite	0.01	0.05	255.19%
Residential Heating - Non-catalytic Woodstoves	0.01	9.89E-03	-29.36%
Residential Heating - Anthracite Coal	7.00E-03	4.97E-04	-92.90%
Lamp Breakage	6.00E-03	3.57E-03	-40.48%

Nonpoint Source Category	1999 NEI Emissions for Cuyahoga County (tpy)	2002 Cuyahoga County Emissions (tpy)	% Change
Dental Preparation and Use	4.68E-03	6.82E-03	45.72%
General Laboratory Activities	4.52E-03	6.19E-03	36.97%
CPU - Personal Care Products	3.00E-03	2.80E-03	-6.67%
Decorative Chromium Electroplating ^b	2.00E-03	5.21E-04	-73.97%
Institutional/Commercial Heating: Anthracite Coal	1.98E-03	6.86E-03	246.44%
Human Cremation ^b	1.60E-03	1.12E-03	-29.71%
Chromic Acid Anodizing ^b	7.66E-04	0.02	2680.83%
Animal Cremation	9.78E-06	1.29E-08	-99.87%
Commercial Agricultural Pesticide Application	3.79E-07	2.65E-07	-30.09%
Fireplaces	1.21E-08	3.38E-08	179.27%

^a CPU - consumer product usage.

^b Estimate does not reflect point source contribution.

For example, calculated countywide perchloroethylene dry cleaning emissions were calculated to be 92.21 tpy. However, nearly one-third of the estimated facilities using perchloroethylene are populated in the point source inventory, totaling 19.642 tpy. Thus, the nonpoint estimates were reduced by the point source contribution to calculate a revised nonpoint estimate of 72.568 tpy. Other source categories where point source adjustments were made are noted in Table 3-12.

Table 3-12. Nonpoint Source Categories that Overlapped with the Point Source Inventory

Source Category
Chromium Plating - Decorative Electroplating
Chromium Plating - Hard Chromium
Halogenated Solvent Cleaning
Human Cremation
Institutional/Commercial Heating - Distillate Oil
Perchloroethylene Dry Cleaning

What are the Limitations of the Nonpoint Source Inventory?

Readers reviewing the nonpoint emissions inventory need to understand the data limitations in this inventory. Four limitations are identified for those using this inventory for other purposes, such as for local-scale modeling, submittal to EPA's NEI, and/or emissions trend analysis.

First, this inventory only covers the pollutants which are considered 33 urban HAPs, and not the full 188 HAPs classified by EPA from the CAA. Consequently, this inventory will significantly underestimate overall county level nonpoint emissions of air toxics. Some source categories in this inventory emit much higher emissions on a total HAP basis, such as autobody refinishing. This category is ranked 10th for total HAPs in the 1999 NEI, yet ranked 25th in this inventory. The highest emitting HAPs from autobody refinishing are xylene, toluene, methyl ethyl ketone, methyl isobutyl ketone, and glycol ethers. None of these HAPs are 33 urban HAPs.

Second, only sources that emit an 33 urban HAP are presented in this inventory. Additional source categories, such as graphic arts and industrial surface coatings, typically emit no 33 urban HAPs, according to speciation profiles used in the NEI. It is possible that some 33 urban HAPs are emitted from special solvents and coatings typically used in Cuyahoga County that are not identified in the current NEI methodologies.

Third, certain source categories have higher quality activity data than others. Generally, locally-specific activity data have highest quality, while allocation of a national emission estimate via a surrogate has the lowest quality. Estimation methodologies that have the highest quality include fireplaces (with and without inserts), and publicly owned treatment works. Estimation methodologies that have the lowest quality include paint stripping operations, autobody refinishing, chrome electroplating (all types), and some of the mercury-emitting source categories (lamp breakage, dental preparation and use, and general laboratory activities).

Finally, source categories and pollutants may not be easily comparable to estimates currently retained in the 1993, 1996, and 1999 NEIs compiled by EPA. NEI emission

methodologies for several source categories, such as perchloroethylene dry cleaners, stage I and II gasoline distribution, stage I and II aviation gasoline distribution, and institutional/commercial heating have different methodologies and/or allocation surrogates than what were developed in this inventory. For example, outdoor swimming pool estimates in the NEI calculate a nationwide estimate of surface area of swimming pools using nationwide number of outdoor public and residential pools. An emission factor flux is applied, assuming all pools are uncovered year-round. The nationwide estimates were then allocated to the county level using the county level proportion of nationwide employment at recreation clubs and swimming pool maintenance and repair businesses. For this inventory, actual number of public outdoor pools and a county level estimate of the number of residential outdoor swimming pools were used to calculate surface area. Additionally, outdoor swimming pool activities were assumed during certain times of the year to reflect the seasonal variations in Cuyahoga County. Consequently, the use of more accurate local data has yielded chloroform emissions estimates for this source category that are nearly five times lower than the chloroform estimates in 1999 NEI.

What are the Recommendations for Future Improvements to the Nonpoint Source Inventory?

To address the limitations identified above, three recommendations are made for future activities concerning this inventory. They are:

- *Expand the inventory to include all 188 HAPs.* If the inventory is expanded to all 188 HAPs, then a more complete data set could be used for modeling. Other emitted pollutants, such as the surface coating HAPs (toluene, xylenes, glycol ethers, etc.) would be included, and would be useful in developing overall air toxic strategies. Additionally, source category coverage would include categories which are highly visible to the public, such as graphic arts, but not accounted for in this inventory. Finally, a more complete inventory will be useful for submittal to EPA's 2002 NEI.
- *Develop locally-specific activity factors to improve data quality.* Limited time and resources prevented a completely locally-specific inventory. For the lowest quality source categories identified above, Cuyahoga County officials may want to consider a survey to improve the activity data. For other source categories

which have higher quality, a review of permit data (such as industrial combustion, all fuel types) or a carefully-designed survey (such as consumer products usage, all product types) would improve the data quality even more.

3.3 Mobile Source Categories

The mobile source categories include all emission sources that are not stationary. This would include onroad vehicles, aircraft, commercial marine vessels (CMVs), locomotives, and other nonroad engines and equipment. The other nonroad engines and equipment source category includes a wide variety of equipment from lawn mowers, tillers, recreational vehicles and vessels to larger portable industrial, commercial, construction, and agricultural combustion engines.

Section 3.3.1 addresses the derivation of inventory estimates for onroad mobile sources. The first category of nonroad mobile emissions, aircraft, are documented in Section 3.3.2. Section 3.3.3 documents the derivation of nonroad mobile inventory estimates for CMVs. The source of locomotive emission estimates is explained in Section 3.3.4. Other nonroad engine (e.g., agricultural and construction equipment, lawn and garden equipment, etc.) emission estimates are documented in Section 3.3.5.

The onroad and other nonroad mobile engines emission source categories dominate Cuyahoga's mobile source inventory (see Table 3-13). Aircraft, CMV, and locomotive source categories account for a relatively small fraction of the mobile source emissions.

Table 3-13. Cuyahoga County Mobile Source Emission Totals

Pollutant	Onroad (tpy)	Aircraft (tpy)	CMV (tpy)	Locomotive (tpy)	Other Nonroad Engines (tpy)	Total (tpy)
1,3-Butadiene	45.50	3.35		0.25	43.90	93.01
Dioxins/Furans 2,3,7,8-TCDD TEQ	1.023e-08				8.010e-07	8.112e-07
Polycyclic Organic Matter as 7-PAH			2.301e-06			2.301e-06
Acetaldehyde	72.32	7.72	1.13	1.06	77.35	159.58
Acrolein	6.53	3.64	0.05	0.15	5.88	16.25
Benzene	463.29	5.11	0.31	0.24	290.00	758.96
Benzo(a)Anthracene	0.15	2.436e-03	1.161e-03	8.898e-04	0.02	0.18
Benzo(a)Pyrene	0.01	2.432e-03	3.717e-04	1.508e-04	0.01	0.03
Benzo(b)Fluoranthene	0.01	2.912e-03	3.241e-04	3.555e-04	9.671e-03	0.03
Benzo(k)Fluoranthene	0.01	2.912e-03	3.210e-04	2.887e-04	8.827e-03	0.03
Beryllium Compounds			2.621e-06	1.264e-03		1.267e-03
Cadmium Compounds			3.670e-05	1.264e-03		1.301e-03
Chromium (VI)	0.02		1.185e-04	1.196e-04	1.170e-03	0.02
Chromium (III)	0.03		6.867e-05	2.321e-04	2.272e-03	0.04
Chrysene	0.01	2.435e-03	2.238e-04	6.611e-04	0.01	0.03
Dibenzo(a,b)Anthracene					3.800e-04	3.800e-04
Formaldehyde	130.98	25.31	2.27	2.66	158.40	319.61
Indeno(1,2,3-c,d)Pyrene	7.810e-03	1.941e-03	1.480e-05	1.495E-04	0.02	0.03
Lead Compounds			4.577e-04	3.872e-03	6.874e-03	0.01
Manganese Compounds	0.02		3.377e-04	1.134e-04	2.314e-03	0.02
Nickel Compounds	0.04		8.065e-03	3.641e-04	4.227e-03	0.05

It should be noted that there are a number of HAPs that are typically emitted by mobile sources, but because these pollutants are not on EPA's list of 33 urban HAPs, they were not included in this inventory effort. The excluded HAPs include nine additional PAHs (including naphthalene), 2,2,4-trimethylpentane, ethyl benzene, N-hexane, propionaldehyde, selenium, styrene, toluene, methyl tertiary butyl ether (MTBE), and xylenes.

3.3.1 Onroad Source Categories

What are Onroad Mobile Sources?

Annual HAP emissions estimates for all onroad mobile source categories operating in Cuyahoga County were developed for base year 2002. These onroad source categories can be aggregated up to the following vehicle types:

- Light-duty gasoline vehicles,
- Light-duty gasoline trucks,
- Heavy-duty gasoline vehicles,
- Light-duty diesel vehicles,
- Light-duty diesel trucks,
- Heavy-duty diesel trucks, and
- Motorcycles.

Equipment which is not licensed for highway use such as agricultural tractors and combines, vehicles used in logging operations, construction equipment, recreational vehicles, and aircraft service vehicles are not included in the onroad category, but are included in the “Other” nonroad engines source category.

The U.S. EPA encourages states and local environmental agencies to use the current MOBILE model to estimate emissions from onroad sources. The MOBILE6.2 model used in this inventory effort further subdivides the above vehicle types into a total of 28 different vehicle categories. In addition to the different vehicle types, emissions vary according to different types of driving, which are classified by road type driving cycles. MOBILE6.2 uses the following different driving cycles;

- Freeway Driving Cycles;
- Arterial/collector Driving Cycles;
- Local Roadway Driving Cycle; and
- Freeway Ramp Driving Cycle.

In addition to vehicle and roadway types, onroad emissions can vary significantly depending upon the fuel being used. Currently there are a number of onroad fuels that are used in highway vehicle, including the following:

- Baseline gasoline, conventional lead-free fuel;
- Reformulated fuels with MTBE or tertiary amyl methyl ether (TAME);
- Reformulated fuels with ethanol;
- Winter oxygenated gasoline with MTBE or TAME;
- Winter oxygenated gasoline with ethanol; and
- Diesel.

Many of these fuels are not used throughout the year, but may be used during specific months to address different air pollution concerns. For example, winter oxygenated fuels tend to be used in winter time to address concerns of carbon monoxide (CO) nonattainment, while the other reformulated gasolines may be used during the summer months to address concerns over ozone nonattainment.

How Were the Onroad Emission Estimates Calculated?

Onroad emission estimates for Cuyhoga County were developed by using local vehicle miles travelled (VMT) data in conjunction with emission factors generated from the EPA's MOBILE6 model (EPA, 2002b). The MOBILE6 model is an emission factor model for

predicting gram per mile emissions of hydrocarbons (HC), CO, nitrogen oxide (NO_x), carbon dioxide (CO₂), particulate matter (PM), and toxics from cars, trucks, and motorcycles under various conditions. For this project, MOBILE6.2 was run generating typical monthly criteria and HAP emission factors based on types of fuel used during each month. These monthly emission factors were applied to local VMT data to estimate emissions, the emissions were adjusted to reflect fuel sales for each month as noted in Figure 3-2. This procedure is discussed in greater detail below.

Northeast Ohio Areawide Coordinating Agency (NOACA) provided ERG with a base

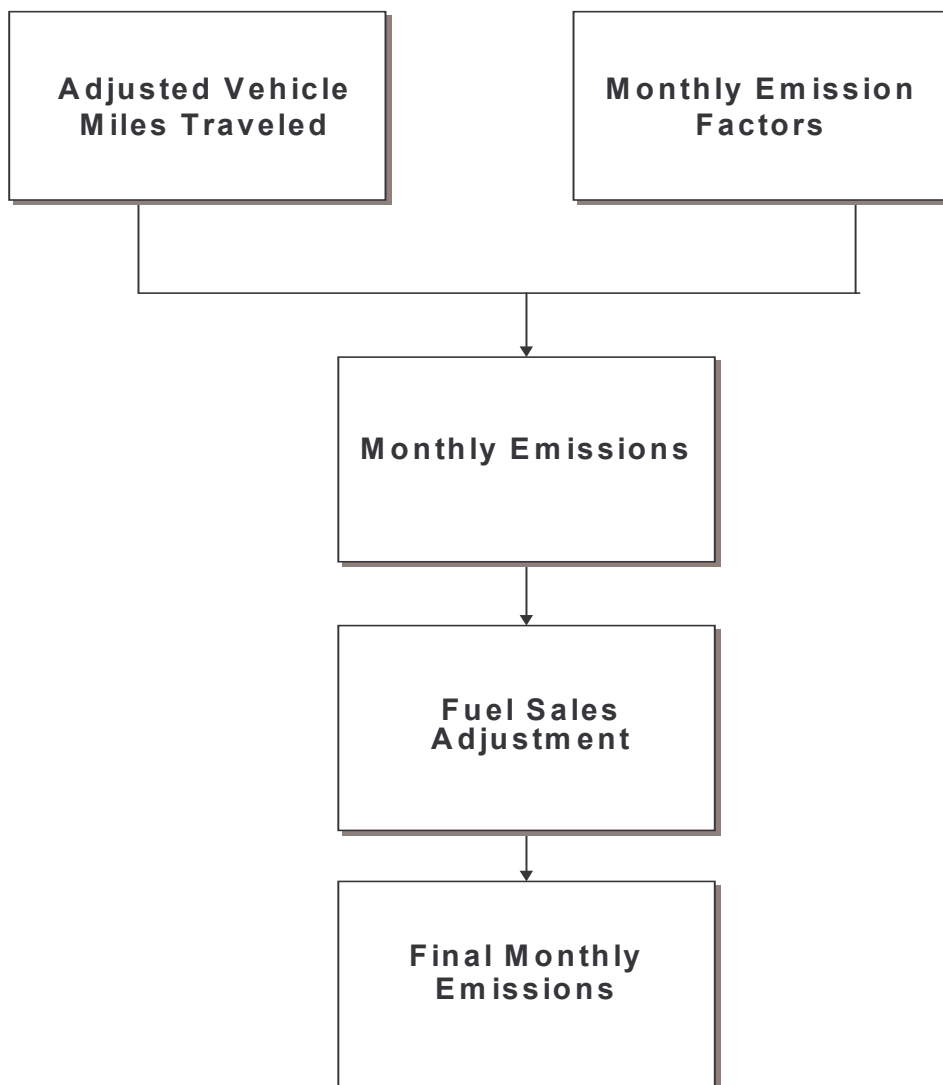


Figure 3-2. Onroad Emissions Estimation Approach

case MOBILE6 input file and VMT estimates from the most recent Cuyahoga County 2002 Carbon Monoxide Conformity Demonstration (Davis, 2003). Several steps were taken to adjust the NOACA files to extrapolate to annual average emissions. The base case NOACA MOBILE6 input file was adjusted to reflect typical conditions in each month of the year. Average minimum and maximum temperatures were calculated from the meteorological data from the National Weather Data Center's Cleveland-Hopkins International Airport Weather Site for each month of 2002 (see Table 3-14 below).

Table 3-14. Average Minimum and Maximum Temperatures by Month – 2002

Month	Average Minimum (F)	Average Maximum (F)
January	28.5	40.7
February	26.2	41.6
March	29.1	45.7
April	42.3	58.7
May	45.9	64.9
June	60.9	79.9
July	65.7	84.3
August	64.8	82.3
September	58.7	78.4
October	44.7	59.0
November	36.1	46.1
December	25.8	36.0

Source: NCDC, 2003.

The MOBILE6 EVALUATION MONTH flag was set to 1 for January through June, and 7 for July through December to reflect the effects of fleet turnover. MOBILE6 HAP fuel parameter inputs files were developed to approximate fuels used in Cuyahoga County. Summer fuel parameter specifications were assumed for May through September, and winter fuel parameters were used for the remainder of the months. Baseline gasoline was assumed for summer months, and oxygenated gasoline with ethanol or ethyl tert-butyl ether (ETBE) was assumed for the winter months. The 1999 NEI wintertime fuel data were adjusted to reflect the local oxygenate content and market share indicated in the NOACA MOBILE6 input files (10.15% vol. ethanol at 41.9% market share). The national default diesel sulfur value of 500

ppm was assumed for all months. The final HAP fuel parameters used for the MOBILE6 modeling are provided below in Table 3-15.

Table 3-15. Summer and Winter Gasoline Fuel Parameters Used in MOBILE6 HAP Modeling

Parameter	Summer (May – Sept)	Winter (Oct – April)
RVP	9.4	14.0
Sulfur (ppm)	287	338
Olefins (% vol)	7.9	8.1
Aromatics (% vol)	29.5	23.8
Benzene (% vol)	1.4	1.1
E200 (C)	51	56
E300 (C)	83	83
Ethanol (% vol)	5.5	10.2
Ethanol market share (%)	100	41.9

Source: U.S. EPA, 2002b.

The ADDITIONAL HAPS external file, which contains the HAP speciation profiles that integrate into the MOBILE6.2 model, were obtained from the 1999 NEI inputs for Cuyahoga County (<ftp://ftp.epa.gov/EmisInventory/draftnei99ver3/haps/datafiles>).

Once all of the input data were compiled, MOBILE6.2 was run 12 times using data corresponding to the representative conditions in each month of the year. The MOBILE6.2 scenarios and VMT estimates obtained from NOACA were broken out across the following Highway Performance Monitoring System (HPMS) roadway classifications for all MOBILE6 speed bins (0 to 65 mph, in 5 mph increments):

- Freeway
- Major Arterial
- Special Arterial Roads
- Toll Way

- Minor Arterial
- Local Link
- Intrazonal

Freeway and Toll Way VMT were assigned to the MOBILE6.2 Freeway cycle, while all other VMT was assigned to the MOBILE6.2 Arterial cycle based on discussions with NOACA staff. Using this convention, MOBILE6.2 HAP emission factors (in mg/mi) were combined with their corresponding VMT estimates to calculate tons of pollutant per typical weekday for each month, for each of the 28 MOBILE6.2 vehicle classes. The VMT estimates obtained from NOACA for the 2002 CO Conformity Demonstration are provided in Table 3-16, for each roadway classification and MOBILE6 speed bin.

Table 3-16. NOACA VMT Data for 2002 CO Conformity Demonstration

Speed Range (miles/hour)	Freeway VMT (miles)	Major Arterial VMT (miles)	Special VMT (miles)	Toll VMT (miles)	Minor Arterial VMT (miles)	Local Link VMT (miles)	Intrazonal VMT (miles)	Total VMT (miles)
0.00-5.00	23,374	1,586	5,177	0	12,161	0	0	42,298
5.01-10.00	2,627	25,110	0	168	22,779	0	870	51,555
10.01-15.00	52,637	74,683	2,078	0	54,241	1,918,874	0	2,102,513
15.01-20.00	33,115	136,963	177	783	144,431	0	5,964	321,432
20.01-25.00	59,532	279,043	2,052	671	649,228	0	40,726	1,031,252
25.01-30.00	157,584	3,424,791	8,297	516	306,258	0	25,542	3,922,987
30.01-35.00	642,808	2,524,638	20,498	1,355	1,883,579	0	115	5,072,991
35.01-40.00	734,824	3,883,765	29,512	585	308,294	0	0	4,956,980
40.01-45.00	739,257	0	0	0	0	0	0	739,257
45.01-50.00	1,140,442	0	0	0	0	0	0	1,140,442
50.01-55.00	2,700,137	0	0	0	0	0	0	2,700,137
55.01-60.00	6,198,047	0	0	0	0	0	0	6,198,047
60.01-65.00	0	0	0	0	0	0	0	0
Total	12,484,384	10,350,579	67,791	4,078	3,380,971	1,918,874	73,217	28,279,892

Source: Davis, 2003.

Weekday VMT and emissions were then adjusted to account for monthly differences in fuel consumption, using DOE/EIA's Transportation Fuel Sales data for Ohio in 2002

(http://www.eia.doe.gov/emeu/states/oilsales_trans/footer). Separate monthly adjustment factors were developed for gasoline and diesel vehicles, as shown in Table 3-17 below.

Table 3-17. 2002 Monthly Fuel Sales Adjustment Factors for Ohio (December Baseline)

Month	Gas Adjustment Factor	Diesel Adjustment Factor
January	1.008	0.828
February	1.046	0.862
March	1.054	0.998
April	1.007	0.934
May	1.092	0.967
June	1.077	0.916
July	1.084	1.032
August	1.071	0.951
September	1.066	0.962
October	0.965	0.905
November	1.017	0.952
December	1.000	1.000

Source: DOE, 2003.

These typical weekday emissions estimates were extrapolated to monthly totals based on the number of days in each month. This approach will tend to overestimate monthly VMT and emissions estimates to the extent that weekday VMT tends to be greater than weekend VMT. However, no time-of-week adjustment factors were available from NOACA or other sources consulted for the Cleveland area. It is anticipated that the degree of over estimation will be relatively small.

Finally, emissions totals were summed across MOBILE6.2 emission categories (e.g., exhaust, running losses, diurnal emissions, etc.), the 28 vehicle types, and the 12 months to obtain annual totals for each HAP species in tons per year.

The MOBILE6.2 model does not estimate HAP emissions for dioxin and furan congeners. For Cuyahoga County, emission factors were obtained from the 1999 NEI

documentation. These emission factors are not speciated into individual congeners, instead the individual data were weighted relative to the Toxic Equivalent (TEQs) of 2,3,7,8 TCDD and are provided in Table 3-18.

Table 3-18. Dioxin/Furans as 2,3,7,8-TCDD TEQ Emissions Factors

Fuel Type	Factor	Units
Gasoline-Powered Vehicles	6.39E-19	tons TEQ/mile
Diesel Vehicles	8.87E-16	tons TEQ/mile

Source: U.S. EPA, 2001.

These TEQ emission factors were applied to annual VMT data provided by NOACA disaggregated into gasoline and diesel vehicle types. The dioxin/furan emission estimates, reported as 2,3,7,8-TCDD TEQ, are included Table 3-19, along with the other onroad emission estimates disaggregated into gasoline and diesel-powered vehicles.

Table 3-19. Cuyahoga County 2002 Onroad Mobile Source Emission Estimates

Pollutant	Gasoline Vehicles (tpy)	Diesel Vehicles (tpy)	Total Onroad Emissions (tpy)
1,3 Butadiene	44.33	1.18	45.50
Acetaldehyde	67.01	5.30	72.32
Acrolein	5.87	0.66	6.53
Benzene	461.22	2.07	463.29
Benzo(a)Anthracene	0.01	5.290e-03	0.02
Benzo(a)Pyrene	0.01	1.810e-03	0.01
Benzo(b)Fluoranthene	0.01	1.650e-03	0.01
Benzo(k)Fluoranthene	0.01	1.650e-03	0.01
Chromim (III)	0.03	2.600e-04	0.03
Chromim (VI)	0.02	1.700e-04	0.02
Chrysene	0.01	1.070e-03	0.01
2,3,7,8-TCDD TEQ	5.617e-11	1.017e-08	1.023e-08
Formaldehyde	116.45	14.52	130.98
Indeno(1,2,3-c,d)Pyrene	7.620e-03	1.900e-04	7.810e-03
Manganese Compounds	0.02	2.700e-04	0.02
Mercury Compounds	0.01	0.03	0.04
Nickel Compounds	0.04	8.500e-04	0.04

What Quality Checks Were Performed on the Onroad Data and Emission Estimates?

The NOACA input data that were provided were compared with national data and were found to correspond to typical wintertime weekday conditions across the country. The VMT scenario tables that were developed were independently reviewed to insure that the estimates were correctly compiled. The Access[®] queries developed to link the VMT data, scenarios, fuel usage, and MOBILE6.2 emission factors were checked to insure that the data were correctly linked.

The emission estimates were also compared with the 1999 NEI data; the new 2002 estimates are consistent across most HAP species except for the metal species that are estimated based on speciation of PM emission estimates rather than VOC emission estimates, as was done for the organic HAPs. The new Cuyahoga County estimates are approximately 50% lower than the previous 1999 NEI values. It is expected that this variance is due to differences in the VMT data used in the two inventories.

What Limitations Should be Considered When Using These Estimates and What Improvements can be Made to this Component of the Inventory in the Future?

As with any onroad mobile emission inventory, the quality of the emission estimates is dependant upon the quality of the VMT data, the fuel usage data, and the emission factors and speciation profiles. The onroad HAP estimates are based on currently available VOC and PM speciation profiles. As new HAP speciation profiles become available in the future, the ADDITIONAL HAP file should be modified and the MOBILE model re-run. In the future, onroad emission estimates can be developed for individual road links if the VMT data and resources are available.

3.3.2 Aircraft Emissions

What are Aircraft Emission Sources?

The aircraft source category includes all aircraft types used for public, private, and military purposes. This includes four types of aircraft:

- Commercial;
- Air Taxis;
- General Aviation; and
- Military.

It should be noted that ground support vehicles such as baggage handling carts, fueling tankers, and auxillary generators are not included in this source category, but are considered in the “other” nonroad source category.

Commercial aircraft include those used for transporting passengers, freight, or both. Commercial aircraft tend to be larger aircraft powered with jet engines. Air taxis carry passengers, freight, or both, but usually are smaller aircraft and operate on a more limited basis than the commercial carriers. The air taxi fleet includes both jet and propeller-driven aircraft. General aviation includes most other aircraft used for recreational flying and personal transportation. Aircraft that support business travel, usually on an unscheduled basis, are included in the category of general aviation. Most of the general aviation fleet is made up of propeller-driven aircraft, though smaller business jets can also be found in this category. Military aircraft cover a wide range of aircraft types such as training aircraft, fighter jets, helicopters, and jet- and propeller-driven cargo planes of varying sizes.

What Local Airports Were Considered in This Inventory Effort?

Cuyahoga County has three airports, the Cleveland-Hopkins International Airport, the Burke Lakefront Airport, and the Cuyahoga County Airport. The Cleveland-Hopkins International Airport primarily provides services to commercial air carriers and air taxis, while Burke Lakefront and the Cuyahoga County also provide services to air taxis, but most of their traffic is associated with general aviation (GA). All three airports support a relatively small amount of military air traffic.

How Were the Aircraft Emissions Estimates Calculated?

For each aircraft type criteria pollutant emission factors were speciated into HAP emission factors using speciation profiles from the SPECIATE database (U.S. EPA, 1995) and other publically available references to estimate aircraft emissions. These emission factors were applied to airport-specific landing and take-off (LTO) data, as noted in Figure 3-3. It should be noted that because of the great diversity of aircraft used in military activities, there are no representative HAP speciation profiles for this source category. Given the lack of appropriate HAP profiles and the fact that military aircraft represent less than 1 percent of the airport activity in Cuyahoga county, it was considered appropriate not to include military operations in this inventory effort.

To estimate emissions from commercial aircraft, air taxis and GA, airport specific LTO data are required. The LTO cycle begins when the aircraft approaches the airport on its descent from cruising altitude, lands, taxis to the gate, and idles during passenger deplaning. It continues as the aircraft idles during passenger boarding, taxis back out onto the runway for subsequent takeoff, and ascent (climbout) to cruising altitude. Thus, the five specific operating modes in an LTO are:

- Approach;

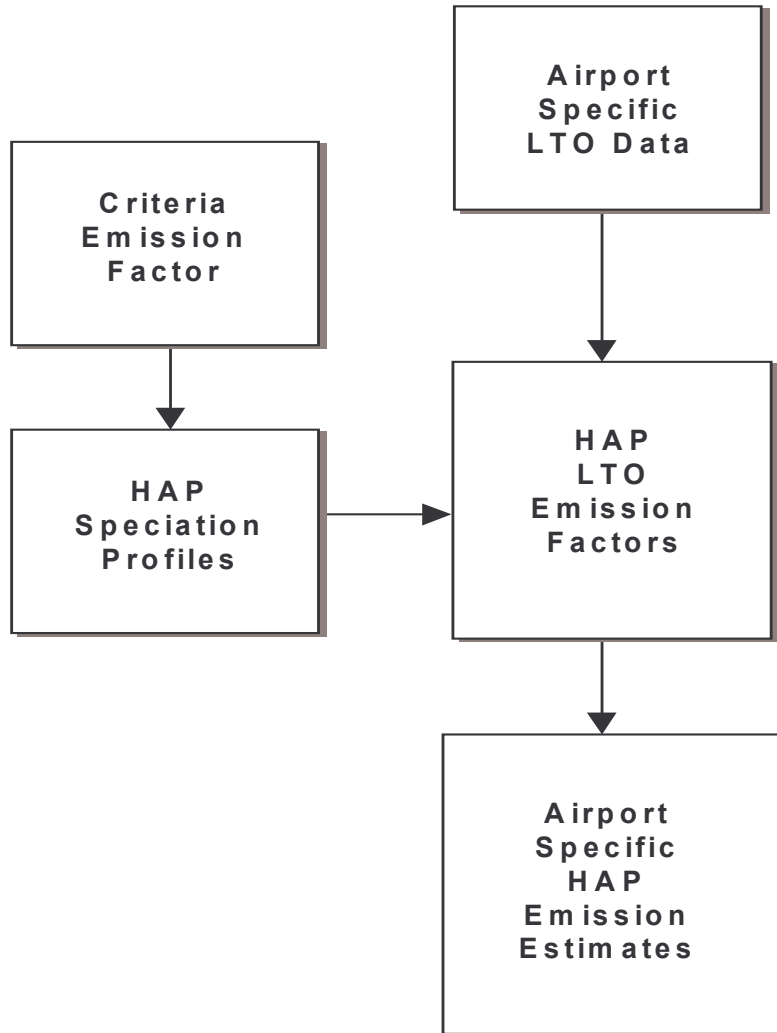


Figure 3-3. Aircraft Emission Estimation Approach

- Taxi/idle-in;
- Taxi/idle-out;
- Takeoff; and
- Climbout.

For commercial aircraft, the preferred approach to estimate criteria emission estimates uses the Federal Aviation Administration’s (FAA’s) Emissions and Dispersion Modeling System (EDMS). This software requires aircraft model-specific (e.g., Boeing 747 model 200)

LTO data. Unfortunately, sources at Cleveland-Hopkins could only provide 2002 LTO activity by air carrier, not aircraft model. In this inventory effort, the Cleveland-Hopkins air carrier data were aggregated into the general aircraft types (i.e., commercial aircraft, air taxis, and GA) and emissions were estimated using generic emission factors and speciation profiles as discussed below.

For GA and air taxis, aircraft model-specific data are often not readily available. In such cases, generic emissions factors are used to estimate criteria pollutant emissions. These emission factors were obtained from the EPA's State Implementation Plan (SIP) Guidance (U.S. EPA, 1992). To use these criteria emission factors, LTO data for each airport are required. As noted above, general aircraft activity for Cleveland-Hopkins was provided by the airport. For Burke Lakefront, the local airport provided their airport traffic record data as it appeared in FAA form 7230-1. These forms provided daily aircraft operations for the period from January 1, 2002 to December 31, 2002. For Cuyahoga County, no data could be obtained from the airport operators; therefore, LTO data were obtained from the FAA's Terminal Area Forecast (TAF) System. The FAA TAF database estimates annual activity at individual airports, disaggregated into air carrier, air taxi, and GA operations. As Cuyahoga County does not have any air carrier traffic, the FAA only estimated emissions for the later two aircraft categories.

Some of the air traffic data are reported as individual operations. For example, an aircraft landing would be counted as one operation and the same aircraft taking off would count as another operation. The emission factors developed for this inventory are in terms of LTOs such that one LTO would include a landing and a take-off. Where aircraft operations data are reported, these data have been converted to LTO data by dividing the total operations by 2. The aircraft LTO data for each airport included in this inventory are summarized in Table 3-20.

Table 3-20. 2002 Airport Activity Data (LTO/yr)

Aircraft Type	Cleveland-Hopkins International¹	Burke Lakefront²	Cuyahoga County³
Commercial Air Carriers	44,621	35	0
Air Taxis	61,425	5,921	6,726
General Aviation	3,978	40,729	26,790

¹ Yesenko, 2003.

² Schoger, 2003.

³ U.S. DOT, 2003.

For each aircraft type criteria pollutant emission factors were identified and speciated into HAP emission factors using speciation profiles from the SPECIATE database and other published sources. Some of the speciation data were developed to speciate VOC, TOG, or PM emission estimates. Tables 3-21, 3-22, and 3-23 compile the criteria and HAP emission factors used in this inventory for each aircraft type. The commercial air carrier criteria emission factors, noted in Table 3-21, were developed from national air carrier emissions and LTO data reported in the 1999 NEI. Note, at this time there are no emission factors available for PM emissions for commercial air carriers.

Table 3-21. Commercial Air Carrier Speciation Profiles and Emission Factors

Pollutant	VOC Speciation Profiles	TOG Speciation Profiles	Emission factors (tons/LTO)
VOC			2.934e-03
TOG			3.276e-03
1,3-Butadiene		0.02	5.897e-05
Acetaldehyde	0.05		1.523e-04
Acrolein	0.03		7.423e-05
Benzene		0.02	6.356e-05
Benzo(a)Anthracene	6.390e-08		1.875e-10
Benzo(a)Pyrene	3.530e-08		1.036e-10
Chrysene	5.720e-08		1.678e-10
Formaldehyde		0.15	4.918e-04

Source: U.S. EPA, 2002.

Criteria pollutant emission factors for air taxis, and general aviation are noted in Tables 3-22 and 3-23, respectively. The PM_{2.5} emission factors were derived from data in the EPA's *National Air Pollution Emission Trends, Procedures Document for 1900-1996*. This reference suggested that 69% of aircraft PM₁₀ is PM_{2.5}. For air taxis, the emission factors are adjusted assuming that 73 percent of the air taxi fleet are powered by piston engines and 27 percent are powered by jet turbines.

Table 3-22. Air Taxi Speciation Profiles and Emission Factors

Pollutant	VOC Speciation Profiles	TOG Speciation Profiles	PM Speciation Profiles	Emission Factors (Tons/LTO)
1,3-Butadiene		0.01		7.598e-06
Acetaldehyde		0.02		1.080e-05
Acrolein		0.01		4.001e-06
Benzene		0.03		2.294e-05
Benzo(a)Anthracene	1.647e-08		7.300e-05	2.203e-08
Benzo(a)Pyrene	9.018e-09		7.300e-05	2.203e-08
Benzo(b)Fluoranthene			8.760e-05	2.643e-08
Benzo(k)fluoranthene			8.760e-05	2.643e-08
Chrysene	1.534e-08		7.300e-05	2.203e-08
Formaldehyde		0.06		3.856e-05
Indeno(1,2,3-cd)pyrene			5.840e-05	1.762e-08

Source: U.S. EPA, 2002.

The emission factors developed for the general aviation aircraft group, and presented in Table 3-23, assume that 94 percent of the fleet is powered by piston engines and 6 percent are powered by jet turbines.

Table 3-23. General Aviation Speciation Profiles and Emission Factors

Pollutant	VOC Speciation Profiles	TOG Speciation Profiles	PM Speciation Profiles	Emission Factors (Tons/LTO)
1,3-Butadiene		0.01		2.092e-06
Acetaldehyde		8.420e-03		1.735e-06
Acrolein		1.800e-03		3.709e-07
Benzene		0.04		8.066e-06
Benzo(a)Anthracene	3.660e-09		9.400e-05	1.113e-08
Benzo(a)Pyrene	2.004e-09		9.400e-05	1.113e-08
Benzo(b)Fluoranthene			1.128e-04	1.335e-08
Benzo(k)fluoranthene			1.128e-04	1.335e-08
Chrysene	3.408e-09		9.400e-05	1.113e-08
Formaldehyde		0.03		6.959e-06
Indeno(1,2,3-cd)pyrene			7.520e-05	8.900e-09

Source: U.S. EPA, 2002.

Though alkylated lead is a component of aviation gasoline, no lead emission factors have been developed in terms of LTOs. The only lead emission factors currently available are fuel-based emission factors, and given that only a relatively small amount of aviation gasoline is combusted at the airport, it is anticipated that actual LTO lead emissions associated with air taxis and GA are relatively small and were not included in this inventory.

The compiled activity data in Table 3-20 were applied to the emission factors developed in Tables 3-21, 3-22, and 3-23 to estimate criteria pollutant and HAP emissions using the following equations (See Figure 3-3 for an overview of this approach).

$$E = A \cdot EF$$

Where:

- E = emission estimate (tpy)
- A = Activity data (LTOs/yr)
- EF = emission factor (tons/LTO)

The calculated emissions are summarized in Table 3-24 below.

Table 3-24. 2002 Cuyahoga County Aircraft Emissions (tpy)

Pollutant	Cleveland - Hopkins	Burke Lakefront	Cuyahoga County	Total
1,3-Butadiene	3.11	0.13	0.11	3.35
Acetaldehyde	7.46	0.14	0.12	7.72
Acrolein	3.56	0.04	0.04	3.64
Benzene	4.28	0.47	0.37	5.11
Benzo(a)Anthracene	1.406e-03	5.840e-04	4.462e-04	2.436e-03
Benzo(a)Pyrene	1.402e-03	5.840e-04	4.462e-04	2.432e-03
Benzo(b)Fluoranthene	1.676e-03	7.000e-04	5.354e-04	2.912e-03
Benzo(k)fluoranthene	1.676e-03	7.000e-04	5.354e-04	2.912e-03
Chrysene	1.405e-03	5.840e-04	4.462e-04	2.435e-03
Formaldehyde	24.34	0.53	0.45	25.31
Indeno(1,2,3-cd)pyrene	1.118e-03	4.670e-04	3.569e-04	1.941e-03

How Were the Emissions Spatially Allocated in Cuyahoga County?

The dataset associated with this report includes latitude and longitude coordinates for the spatial center of each airport for which emissions have been estimated. These coordinates will allow the aircraft data to be handled as point sources for modeling purposes.

What QA/QC Activities Were Performed on the Aircraft Emission Estimates?

Quality checks have been performed on the procedures used to estimate aircraft emissions. These checks included independent review of the emission factors and speciation profiles to insure the data were accurately transferred and the derived LTO-emission factors were calculated correctly. The airport-specific activity data were checked to insure that they were correctly transferred from the hard copy faxes to an electronic format. The links between the emission factors and activity data were also checked to insure that the spreadsheet calculations were correct. The emission estimates that were noted in the spreadsheets were compared with the emission totals reported in this report's summary tables. Any identified errors were corrected and new summary tables were developed.

What Are the Limitations of the Aircraft Estimates?

It should be noted that more accurate emission estimates can be developed using aircraft-specific activity data in conjunction with the FAA's EDMS software. Given the available resources for this project and the fact that aircraft emissions represent only 3% of mobile source emissions, the use of more generic emission factors and speciation profiles were considered to be appropriate. It should also be noted that aircraft emissions tend to occur throughout an airport's flight path, such that spatially allocating the emissions to discrete point sources will lead to an overestimation of actual airport emissions.

3.3.3 Commercial Marine Vessels Emission Estimates

What are CMV Emission Sources?

The CMV source category includes all boats and ships used either directly or indirectly in the conduct of commerce or military activity. These vessels range from 20-foot charter boats to large tankers and military vessels which can exceed 1,000 feet in length. In spite of the broad range of vessels represented by this category, a number of common characteristics allow for the use of simple emission estimation methods.

The majority of vessels in this category are powered either by diesel engines or steam turbines. The predominant fuel used is oil, both distillate (diesel) and residual grades. In general, it can be assumed that CMVs powered by diesel engines predominantly use distillate fuel oil or higher grade residual oils, and those powered by steam turbines use residual fuel oil.

The CMV source category does not include recreational marine vessels, which are vessels less than 100 feet in length, most being less than 30 feet, and powered by either inboard or outboard engines. Emissions from recreational marine vessels are included in the "other" nonroad engines source category.

The CMV emission estimates for Cuyahoga County were developed by considering the port and underway emissions separately. Port emissions include emissions associated with transit from the shipping lane to the port, maneuvering within the port area, dockside emissions, maneuvering to leave the port area, and transit from the port to the shipping lane. Underway emissions are those emissions that occur while a vessel is operating in the coastal shipping lanes.

CMVs are comprised of two engine types, diesel marine engines and engines that operate only on residual fuel oil, typically in a boiler configuration where the steam is used in a turbine to propel the vessel. Marine diesel engines are able to use distillate, residual or a mixture of distillate and residual fuels. In developing the Cuyahoga County CMV emission estimates, port emissions included only diesel-powered vessels using diesel fuel as the Cleveland-Cuyahoga Port Authority reported only diesel fuel usage. Residual fuels are not dispensed to CMVs in the port.

Because underway activities include vessels fueled in other ports, underway emission estimates are provided for both diesel and residual engine types. The underway emissions estimates used in this Cuyahoga inventory were obtained from the EPA's NEI.

How Were the Emission Estimates for the Port of Cleveland Developed?

To estimate port emissions, terminal-specific activity data were developed and applied to criteria pollutant emission factors. These criteria pollutant emission estimates were speciated into HAP components are noted in Figure 3-4.

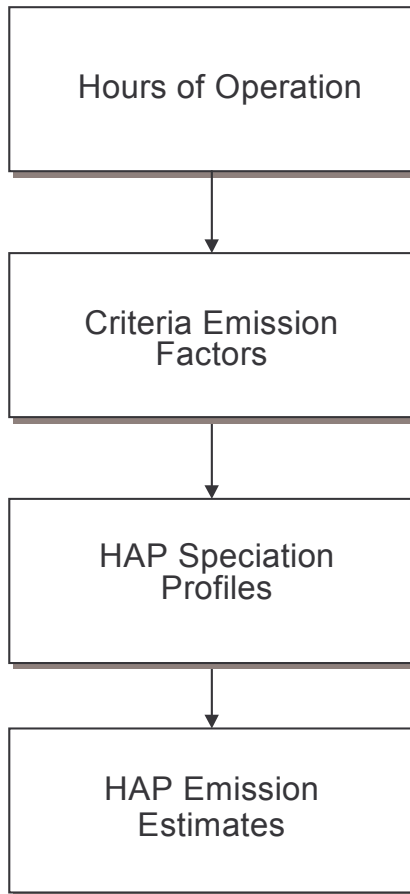


Figure 3-4. Port Emission Estimation Approach

Activity data were provided by the Port Authority for the Interlake, Ceres, and Federal Marine terminals. It was assumed that it takes one hour to leave the shipping lane and maneuver up to the dock and another hour is required to return to the shipping lane from the dock. For Interlake, monthly data were provided for the number of vessels visiting the terminal and tons of cargo discharged. Vessels do not take on cargo, but leave the port empty. Interlake has cargo handling equipment which operates at 5,000 tons per hour, such that a typical vessel can unload its cargo in approximately three hours. For the Ceres and the Federal Marine terminals, logs were provided that documented the vessels that docked and the number of days that they remained at the dock. The number of days were converted to hours based information provided by the Port Authority as summarized in Table 3-25.

Table 3-25. Day to Hour Conversion

Days	Period (hrs)	Hourly Value Used in Emissions Calculations (hrs)
1	12 - 24	18
2	>24 and <48	36
3	>48 and <72	60
4	>72 and <96	84
5	>96 and <120	108
6	>120 and <144	132

Source: Cuyahoga County Port Authority, 2003.

Average diesel engine rating was provided by the Port Authority to be 7,000 horsepower (hp). The engine rating information and the hours of operation were used to estimate horsepower hours in transit and dockside. These horsepower hours were applied to select criteria pollutant emission factors noted in Table 3-26. These emission factors were obtained from EPA background documents in support of recent marine diesel engine rule making (U.S. EPA, 2002a, 2002b). PM_{2.5} emission factors were derived based on the NEI methodology, which assumes that 92 percent of PM₁₀ emissions are PM_{2.5}.

Table 3-26. Criteria Pollutant Emission Factors

Transit Emission Factors		
Pollutant	g/hp-hr	tons/hp-hr
PM ₁₀	1.31	1.44 E-06
PM _{2.5}	1.205	1.33 E-06
VOC	0.395	4.35 E-07
Dockside Emission Factors		
PM ₁₀	0.239	2.63 E-07
PM _{2.5}	0.21988	2.42 E-07
VOC	0.1	1.1E-07

Source: U.S. EPA, 2002a, 2002b.

Criteria pollutant emission estimates are provided for individual terminals in Attachment A. Table 3-27 summarizes the total port criteria pollutant emission estimates for all three terminals.

Table 3-27. Port Summary of Criteria Pollutant Emissions

Pollutant	Terminals (tpy)			Total (tpy)
	Interlake	Ceres	Federal Marine	
PM ₁₀	16.56	3.55	2.73	22.84
PM _{2.5}	15.24	3.27	2.51	21.02
VOC	5.40	1.39	1.07	7.86

The criteria pollutant emission estimates were speciated into HAP components using the speciation profiles noted in Table 3-28 and the equation provided below.

$$\text{VOC/PM}_{10/2.5} * \text{speciation profile}_i = \text{emission estimate}$$

Where:

$$\begin{aligned} \text{VOC/PM}_{10/2.5} &= \text{VOC or PM emission estimate} \\ \text{speciation profile}_i &= \text{VOC or PM speciation fraction for pollutant } i \end{aligned}$$

These marine diesel speciation profiles were originally developed for heavy-duty diesel vehicles (HDDV) and were obtained from *Evaluation of Factors That Affect Diesel Exhaust Toxicity* (Truex and Norbeck, 1998). Note, chromium emissions were split into hexavalent and trivalent chromium based on an assumption that 34% of total chromium was hexavalent and the remaining 66% was trivalent. Table 3-28 also provides the HAP emission estimates for the Cuyahoga County port area.

Table 3-28. Speciation Profiles and Port HAP Emission Estimates

Pollutant	Speciation Profiles			Total Port HAP Emission Estimates (tpy)
	VOC	PM ₁₀	PM _{2.5}	
Acetaldehyde	0.07			0.58
Acrolein	3.50e-03			0.03
Benzene	0.02			0.16
Benzo(a)Anthracene			4.00e-05	8.41e-04
Benzo(a)Pyrene			1.30e-05	2.73e-04
Benzo(b)Flouranthene			1.10e-05	2.31e-04
Benzo(k)Flouranthene			1.10e-05	2.31e-04
Chromium (VI)		1.09e-06		2.49e-05
Chromium (III)		2.18e-06		4.98e-05
Chrysene			7.00e-06	1.47e-04
Formaldehyde	0.15			1.18
Indeno(1,2,3-c,d)Pyrene			1.00e-06	2.10e-05
Manganese Compounds		2.04e-06		4.66e-05
Nickel Compounds		6.55e-06		1.50e-04

Source: U.S. EPA, 2002 and Truex, 1998.

How Were Underway Emission Estimates for Cuyahoga County Developed?

Underway emissions for shipping lanes located offshore of Cuyahoga County were obtained from the EPA’s NEI. These emission estimates were calculated by using a Geographic Information System (GIS) dataset from the DOT and the Army Corps of Engineers (ACE), which identified shipping lanes and estimated shipping activity in terms of ton miles. The shipping lane lengths and activity were estimated from the GIS data set by overlaying county borders onto the DOT data. The county level tonnage miles were divided by the total shipping lanes in the United States, and then multiplied by the national emission estimates for each pollutant to get a county level distribution.

Cuyahoga County underway emission estimates are summarized in Table 3-29, along with the other commercial marine vessel emission estimates.

Table 3-29. In Port and Underway Emission Estimates

Pollutant Name	Diesel: In port (tpy)	Diesel: Underway (tpy)	Residual: Underway (tpy)	Total (tpy)
Polycyclic Organic Matter as 7-PAH			2.301e-06	2.301e-06
Acetaldehyde	0.58	0.43	0.11	1.13
Acrolein	0.03	0.02	5.374e-03	0.05
Benzene	0.16	0.12	0.03	0.31
Benzo(a)Anthracene	8.406e-04	2.859e-04	3.428e-05	1.161e-03
Benzo(a)Pyrene	2.732e-04	9.291e-05	5.576e-06	3.717e-04
Benzo(b)Fluoranthene	2.312e-04	7.862e-05	1.425e-05	3.241e-04
Benzo(k)Fluoranthene	2.312e-04	7.862e-05	1.115e-05	3.210e-04
Beryllium Compounds			2.621e-06	2.621e-06
Cadmium Compounds			3.670e-05	3.670e-05
Chromium (VI)	2.490e-05	8.637e-06	2.674e-05	6.027e-05
Chromium (III)	4.980e-05	1.677e-05	5.190e-05	1.185e-04
Chrysene	1.471e-04	5.003e-05	2.664e-05	2.238e-04
Formaldehyde	1.18	0.86	0.23	2.27
Indeno[1,2,3-c,d]Pyrene	2.100e-05	7.147e-06	5.576e-06	3.372e-05
Lead Compounds		3.135e-04	1.442e-04	4.577e-04
Manganese Compounds	4.660e-05	1.585e-05	2.752e-04	3.377e-04
Nickel Compounds	1.496e-04	5.088e-05	7.864e-03	8.065e-03

What QA/QC Activities Were Performed on the CMV Emission Estimates?

Quality checks have been performed on the procedures used estimate CMV emissions. These checks included independent review of the emission factors and speciation profiles to insure the data were transferred correctly. The terminal-specific activity data were checked to insure that they were correctly transferred from the hard copy faxes to electronic format. The links between the emission factors and activity data were also checked to insure that the spreadsheet calculations were correct. The CMV emission estimates in the spreadsheets were compared with the emission totals reported in the above summary tables. The underway emission estimates that were downloaded from the EPA's website were independently

reviewed to insure that the correct data had been downloaded. Any identified errors were corrected and new summary tables were developed.

What are the Limitations of the CMV Inventory?

It should be noted that the CMV emission estimates developed for this study are for a vessel's main propulsion units. Ancillary engines which may be used to help transfer cargo, or run portable generators and winches, were not considered in this inventory. It should also be noted that Cuyahoga County has a number of private terminals that service specific facilities. These private terminals may be visited by vessels a couple times a month or even a couple times a year. This inventory only addressed the public terminals where the majority of CMV traffic occurs. More accurate port estimates can be developed in the future if activity at the private terminals is quantified.

Many of the HAP emission factors used to characterize CMV emissions are derived from stationary sources such as boilers that burn residual fuel or heavy-duty diesel engines used in locomotives or highway vehicles. It is recommended that the CMV inventory be updated in the future when more specific emission factors and speciation profiles become available.

3.3.4 Railroad Emission Estimates

What are Locomotive Emission Sources?

The locomotive source category includes railroad locomotives powered by diesel-electric engines. A diesel-electric locomotive uses 2-stroke or 4-stroke diesel engines in conjunction with an alternator or generator to produce the electricity required to power its traction motors. The locomotive source category does not include locomotives powered directly by electricity or steam. Emissions associated with the operation of electric locomotives used in light rail and subway operations would be included in the point source

utility emission estimate. Locomotives involved with railroad maintenance activities are not included in this source category, but are considered in the “Other” nonroad source category.

The locomotive source category is further divided up into five categories: line haul class I, class I yard, line haul class II/III, passenger, and commuter. Class I railway operations in Cuyahoga County include the larger interstate companies, such as Norfolk Southern and CSX. Class II/III lines include smaller railways that operate within a limited region or state. Commuter railways provide transportation to passengers within a defined metropolitan area, often operating in conjunction with urban mass transit systems. Passenger railways such as Amtrak carry passengers and light cargo across the country.

What are the Locomotive Sources in Cuyahoga County?

Cuyahoga County has several Class I, II/III, passenger, and yard railroad operations. For this inventory effort NEI data were used for Class I and passenger line haul operations. Though we identified five Class II/III rail operations, the rail companies did not respond to our request for data, and therefore, their emissions could not be included in this inventory. Three railroads, CSX, Norfolk Southern, and Cuyahoga Valley operate yard locomotives in Cuyahoga County. These companies provided data on the number, horsepower rating, and schedule of the switch engines that they use. This information was applied to available emission factors and speciation profiles to estimate local HAP emissions. These yard locomotive HAP emissions were combined with the Class I and passenger long haul emission estimates to quantify Cuyahoga’s locomotive emissions.

How Were Emissions Estimates for Yard Locomotives Developed?

To estimate HAP emissions, fuel consumption was estimated and applied to available HAP and criteria pollutant emission factors. For some HAPs, criteria pollutant estimates were speciated to estimate HAP emissions. The general approach used for this inventory is summarized in Figure 3-5.

For this inventory effort, criteria pollutant emission factors were obtained from EPA background documents in support of recent rule making to control emissions from long haul and yard locomotives (U.S. EPA, 1998). The criteria pollutant emission factors were in terms of fuel usage. Some HAP emission factors are also available in terms of fuel usage. To use these fuel-based emission factors, it was necessary to disaggregate the yard locomotives into 2- stroke and 4-stroke engine configurations. For the purpose of this inventory, it was assumed that all yard locomotives in the Cuyahoga area are configured as 4-stroke engines. For many other HAPs, speciation profiles are available as fractions of PM. Note, that chromium emission estimates were speciated into chromium (III) and chromium (VI) using the ratios 0.66 and 0.34, respectively (Scarboro, 2001). Table 3-30 lists all of the emission factors and speciation profiles used in this inventory. These HAP emission factors and speciation profiles were obtained from the most recent version of the NEI nonroad documentation (U.S. EPA, 2002).

Fuel usage for yard locomotives was estimated based on assumptions that an individual yard locomotive will consume approximately 82,490 gallons of fuel in a year. This assumption was obtained from EPA SIP guidance documents (U.S. EPA 1992). The total fuel usage was derived by multiplying the total number of locomotives by 82,490 gallons. The total fuel usage for each railway company was applied to emission factors in Table 3-30 to estimate criteria pollutants and a limited number of HAPs. The VOC and PM criteria estimates were speciated into HAP components using the speciation profiles also noted in Table 3-30. These emission estimates are summarized in Table 3-31.

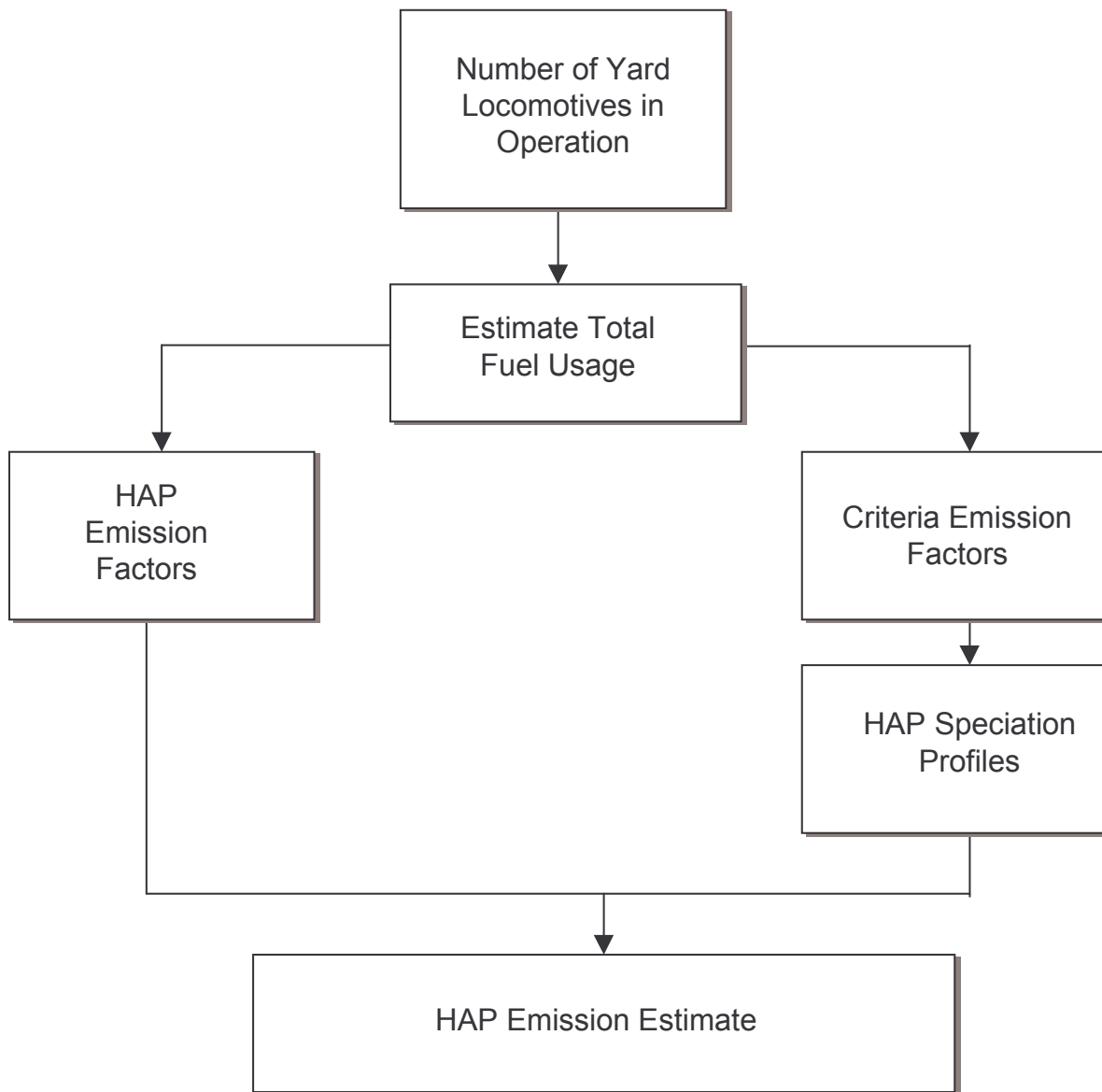


Figure 3-5. Yard Locomotive Emission Estimation Approach

Table 3-30. Yard Locomotive Emission Factors and Speciation Profiles

Pollutants	Tons /Gallon	PM Fraction
PM	1.014E-05	
1,3-Butadiene	4.55813E-08	
Acetaldehyde	1.61985E-07	
Acrolein	1.97009E-08	
Benzene	4.50931E-08	
Benzo(a)Anthracene		1.600E-05
Benzo(a)Pyrene		2.700E-06
Benzo(b)Flouranthene		6.400E-06
Benzo(k)Flouranthene		5.200E-06
Beryllium Compounds	2.100E-10	
Cadmium Compounds	2.100E-10	
Chromium (III)	4.26617E-11	
Chromium (VI)	2.19772E-11	
Chrysene		1.190E-05
Formaldehyde	4.24663E-07	
Indeno(1,2,3-c,d)Pyrene		2.700E-06
Lead Compounds	6.500E-10	
Manganese Compounds		2.040E-06
Nickel Compounds		6.550E-06

Source: U.S. EPA, 2002.

Fuel usage for yard locomotives was estimated based on assumptions that an individual yard locomotive will consume approximately 82,490 gallons of fuel in a year. This assumption was obtained from EPA SIP guidance documents (U.S. EPA 1992). The total fuel usage was derived by multiplying the total number of locomotives by 82,490 gallons. The total fuel usage for each railway company was applied to emission factors in Table 3-30 to estimate criteria pollutants and a limited number of HAPs. The VOC and PM criteria estimates were speciated into HAP components using the speciation profiles also noted in Table 3-30. These emission estimates are summarized in Table 3-31.

Table 3-31. Cuyahoga County Yard Locomotive Emissions (tpy)

Company	CSX	Norfolk Southern	Cuyahoga Valley	Total
Number of yard Locomotives	1	20	28	49
Total Annual Fuel Usage (gal)	82,490	1,649,800	2,309,720	4,042,010
Pollutant	Emissions			
	CSX	Southern	Valley	Total
PM	0.84	16.73	23.42	40.99
1,3-Butadiene	3.760E-03	0.08	0.11	0.18
Acetaldehyde	0.01	0.27	0.37	0.65
Acrolein	1.625E-03	0.03	0.05	0.08
Benzene	3.720E-03	0.07	0.10	0.18
Benzo(a)Anthracene	1.338E-05	2.677E-04	3.748E-04	6.558E-04
Benzo(a)Pyrene	2.259E-06	4.517E-05	6.324E-05	1.107E-04
Benzo(b)Flouranthene	5.354E-06	1.071E-04	1.499E-04	2.623E-04
Benzo(k)Flouranthene	4.350E-06	8.700E-05	1.218E-04	2.131E-04
Beryllium Compounds	1.732E-05	3.465E-04	4.850E-04	8.488E-04
Cadmium Compounds	1.732E-05	3.465E-04	4.850E-04	8.488E-04
Chromium (VI)	1.813E-06	3.626E-05	5.076E-05	8.883E-05
Chromium (III)	3.519E-06	7.038E-05	9.854E-05	1.724E-04
Chrysene	9.955E-06	1.991E-04	2.787E-04	4.878E-04
Formaldehyde	0.04	0.70	0.98	1.72
Indeno(1,2,3-cd)pyrene	2.259E-06	4.517E-05	6.324E-05	1.107E-04
Lead Compounds	5.362E-05	1.072E-03	1.501E-03	2.627E-03
Manganese Compounds	1.707E-06	3.413E-05	4.778E-05	8.362E-05
Nickel Compounds	5.479E-06	1.096E-04	1.534E-04	2.685E-04

How Were Emission Estimates for Long-haul Operations Developed?

The NEI data for Cuyahoga County were used in this inventory to quantify 2002 long haul emissions from Class I and passenger railroad operations (U.S. EPA, 2003). The NEI used national distillate fuel oil sales (in gallons) for railroads from the Department of Energy (EIA, 2000) to develop the criteria pollutant emission estimates. These fuel data were disaggregated into different railroad categories using railroad SCC ratios calculated from fuel data obtained by the U.S. EPA/OTAQ (Scarboro, 2002), as noted in the following equation.

$$\text{SCC Ratio} = \text{Railroad Category Fuel Use} / \text{Total National Fuel Use}$$

Emission estimates were spatially allocated to individual counties based on the railroad traffic activity data provided by the U.S. DOT as a GIS database (BTS, 2000). County level maps were applied to the DOT railroad traffic GIS data. The proportion of railroad activity for individual links were calculated based on the proportion of track length located in the specified county. All of the estimated track activity was totaled for each county by railroad type. The activity data for individual counties were divided by the total activity by railroad type to develop county-specific ratios, as noted in the following equation.

$$\text{County ratio by SCC} = \text{county SCC activity level} / \text{total SCC activity}$$

These county ratios, along with the SCC ratios, were applied to the national locomotive emission estimates for each railroad type to apportion the emissions to individual counties as noted in the equation below.

$$\text{County pollutant emission by SCC} = \text{National Estimates} * \text{SCC ratio} * \text{county ratio by SCC}$$

The long-haul emission estimates for Cuyahoga County are summarized in Table 3-32 for Class I and passenger railroad operations. These emission estimates were combined with the yard locomotive emission estimates discussed above to quantify the majority of Cuyahoga's railroad emissions.

Table 3-32. Long-haul HAP Emission Estimates

SCC Description	Pollutant Name	Emissions (tpy)
Mobile Sources; Railroad Diesel, Line Haul Locomotives: Class I Operations	1,3-Butadiene	0.07
	Acetaldehyde	0.38
	Acrolein	0.06
	Benzene	0.05
	Benzo(a)Anthracene	2.179e-04
	Benzo(a)Pyrene	3.733e-05
	Benzo(b)Fluoranthene	8.679e-05
	Benzo(k)Fluoranthene	7.038e-05
	Beryllium Compounds	3.863e-04
	Cadmium Compounds	3.863e-04
	Chromium (III)	5.557e-05
	Chromium (VI)	2.863e-05
	Chrysene	1.613e-04
	Formaldehyde	0.88
	Indeno(1,2,3-c,d)Pyrene	3.610e-05
	Lead Compounds	1.159e-03
Manganese Compounds	2.771e-05	
Nickel Compounds	8.898e-05	
Mobile Sources; Railroad Diesel, Line Haul Locomotives: Passenger Operations	1,3-Butadiene	4.874e-03
	Acetaldehyde	0.03
	Acrolein	4.691e-03
	Benzene	3.882e-03
	Benzo(a)Anthracene	1.614e-05
	Benzo(a)Pyrene	2.765e-06
	Benzo(b)Fluoranthene	6.428e-06
	Benzo(k)Fluoranthene	5.212e-06
	Beryllium	2.861e-05
	Cadmium Compounds	2.861e-05
	Chromium (VI)	2.120e-06

Table 3-32. Long-haul HAP Emission Estimates (Continued)

SCC Description	Pollutant Name	Emissions (tpy)
Mobile Sources; Railroad Diesel, Line Haul Locomotives: Passenger Operations	Chromium (III)	4.116e-06
	Chrysene	1.195e-05
	Formaldehyde	0.07
	Indeno(1,2,3-c,d)Pyrene	2.674e-06
	Lead Compounds	8.582e-05
	Manganese Compounds	2.052e-06
	Nickel Compounds	6.590e-06

Source: U.S. EPA, 2003.

What QA/QC Activities Were Performed on The Locomotive Emission Estimates?

Quality checks have been performed on the procedures used to estimate yard locomotive emissions. These checks included independent review of the emission factors and speciation profiles to insure the data were transferred correctly. The yard locomotive population data were checked to insure that they were correctly transferred from the hard copy files to electronic format. The links between the emission factors and activity data were also checked to insure that the spreadsheet calculations were correct. The railway emission estimates in the spreadsheets were compared with the emission totals reported in the above summary tables. The long-haul emission estimates that were downloaded from the EPA's website were independently reviewed to insure that the correct data had been downloaded. Any identified errors were corrected and new summary tables were developed.

What are the Limitations of the Locomotive Emission Estimates?

Given that not all railroad companies responded to our request for local data, the yard emission estimates provided in this report may be underestimating actual emissions. The overall quality of the yard locomotive estimates may be improved upon in the future by obtaining data from all of the yard operations. It should also be noted the NEI data set for

long-haul operations did not include estimates for class II/III railways. A number of these smaller railways were identified by the state, but not included in this effort because of a lack of response from the railroad companies. The inclusion of these class II/III railways in future versions of this inventory will allow for a more complete emission inventory of this source category.

Though the criteria pollutant emission factors have recently been developed specifically for this source category, many of the HAP emission factors and speciation profiles are derived from other similar source categories such as onroad highway vehicles. As new HAP emission factors and speciation profiles developed specifically for locomotives become available, these new factors should be included in future revisions to this inventory.

3.3.5 Other Nonroad Equipment and Engine Emission Estimates

What Are Other Nonroad Equipment and Engine Emission Sources?

The other nonroad equipment and engine source category includes 146 nonroad equipment types and engines, disaggregated into 2-stroke, 4-stroke, and diesel engine configurations. These engines are used in the following equipment categories:

- Agricultural equipment,
- Logging equipment,
- Construction equipment,
- Airport service equipment,
- Railroad maintenance,
- Recreational vehicles,
- Recreational vessels,
- Lawn and garden equipment,
- Light commercial equipment, and
- Industrial equipment.

How Were the Emission Estimates for the Other Nonroad Equipment and Engines Developed?

In the Cuyahoga County toxic air emission inventory, emissions estimates were developed for the Other Nonroad Engine source category by adjusting the 1999 NEI emission estimates to account for the 1.07 percent decline in population in Cuyahoga County that has occurred between 1999 and 2002 (U.S. Census Department, 2003).

In the NEI, VOC and PM emission estimates were obtained from the NONROAD model run (“Lockdown (May 2002)” version) and speciated into the HAP components. In speciating the NONROAD output, the use of different fuels in individual counties was taken into consideration. For example, different HAP speciation profiles for each of the different nonroad equipment were linked to individual counties based on fuel market surveys. Use of different fuels at the county level tends to affect organic HAPs more than inorganic HAPs. Estimating emissions of metal HAPs and dioxin/furan congeners are handled differently. Generally, metal and dioxin nonroad HAP emissions are derived by applying emission factors to activity or fuel usage data. Lead estimates were derived by applying the lead concentration of fuels to the total nonroad fuel usage. Metal and dioxin HAP emissions were spatially allocated to the county level based on the ratio of county PM_{10} emissions to the national PM_{10} emissions. For more details about how the NEI nonroad HAP emission estimates were developed see *Documentation for Aircraft, Commercial Marine Vessel, Locomotive and Other Nonroad Components of the National Emissions Inventory* (U.S. EPA 2002).

Nonroad emission estimates have been developed for 36 different HAPs, as noted in Table 3-33. The nonroad data set developed for this inventory contains over 5,000 records, such that Table 3-33 does not provide all of the detailed data incorporated in the the inventory,

Table 3-33. Other Nonroad Equipment and Engine Emission HAP Estimates for Cuyahoga County

Pollutant	1999 (tpy)	2002 (tpy)
1,3-Butadiene	44.38	43.90
Acetaldehyde	78.19	77.35
Acrolein	5.94	5.88
Benzene	293.17	290.03
Benzo(a)Anthracene	0.02	0.02
Benzo(a)Pyrene	0.01	0.01
Benzo(b)Fluoranthene	9.776e-03	9.671e-03
Benzo(k)Fluoranthene	8.922e-03	8.827e-03
Chromium (VI)	1.183e-03	1.170e-03
Chromium (III)	2.297e-03	2.272e-03
Chrysene	0.01	0.01
Dibenzo(a,h)Anthracene	3.840e-04	3.800e-04
Dioxin/Furans as 2,3,7,8-TCDD TEQs	8.090e-07	8.010e-07
Formaldehyde	160.11	158.40
Indeno(1,2,3-c,d)Pyrene	0.02	0.02
Lead Compounds	6.948e-03	6.874e-03
Manganese Compounds	2.339e-03	2.314e-03
Nickel Compounds	4.273e-03	4.227e-03

Source: U.S. EPA, 2002.

but instead summarizes the revised 1999 nonroad estimates downloaded from the NEI for Cuyahoga County and the adjusted 2002 emission estimates for this source category. For disaggregated estimates by pollutant and SCC code, consult the inventory data set provided in with this report.

What QA/QC Were Performed On The Other Nonroad Emission Estimates?

Quality checks were performed on the 1999 NEI emission estimates that were downloaded from the EPA's website, to insure that the correct data had been downloaded.

What are the Limitations of the Other Nonroad Emission Estimates?

To develop more accurate emission estimates, it is recommended that local activity data be collected for some of the more significant other nonroad engine source categories. These local data can be used in conjunction with the NONROAD model to improve the local estimates.

Many of the HAP emission factors and speciation profiles are derived from other similar source categories such as onroad vehicles. It is recommended that the other nonroad component of this inventory be updated in the future when more source-specific emission factors and speciation profiles become available.

4.0 INVENTORY DATABASE TOOLS

This chapter discusses the software tools used to calculate the HAP emission estimates for the Cuyahoga County inventory, and the resulting inventory data files. These electronic databases and spreadsheets can be used by the Work Group and the local Cleveland air agency in revising and updating future inventories.

All of the software tools developed for this project were created with the goal that they be easy to understand, interpret, and update in the future. Once established for the 2002 base year inventory, the tools will be able to be easily modified to either add/delete sources or change input estimation data (e.g., activity data) in the future.

4.1 Point Sources

The Cuyahoga County point source inventory was compiled in Microsoft Access[®]. The file structure is a simplified version of EPA's NEI Input Format (NIF) database structure. The point source inventory consists of three tables, each with different information on the facilities, emission units, and emissions estimates. The tables can be linked to form a large, single database with all of the detailed point source data for each facility, emission unit, and pollutant. Below is a list of the fields in each point source table.

Sites Table

- State code
- County code
- Facility identifier (premise or permit ID)
- Facility name
- Street address (physical, not mailing address)
- SIC code
- Facility category (area vs. major, as defined by CLAA and Ohio EPA)
- X coordinate
- Y coordinate
- Location default code

- Flag if in neighborhood of interest

Emission Units Table

- State code
- County code
- Facility identifier (premise or permit ID)
- Emission unit ID
- Emission unit description
- SCC
- MACT code
- MACT description
- Emission release point type (stack vs. fugitive)
- Stack height
- Stack diameter
- Exit gas temperature
- Exit gas velocity
- Exit gas flow rate
- Stack default flag
- Control device efficiency
- Control device capture efficiency
- Control device code
- Control device description

Emission Table

- State code
- County code
- Facility identifier (premise or permit ID)
- Emission unit ID
- Pollutant code
- Pollutant name
- HAP category name
- Year (base year of emission estimate)
- Emissions (in tons per year)
- Emission type (actual, potential, or maximum)
- Emission factor (populated for EIS estimates)
- Emission factor unit (populated for EIS estimates)
- Throughput (populated for EIS estimates)

- Throughput unit (populated for EIS estimates)
- Data source

Lookup tables for MACT code, SIC code, SCC, pollutant code

4.2 Nonpoint Sources

Included in this study are a database and spreadsheets developed to estimate HAP emissions for 54 nonpoint source categories. It should be noted that these tools are useful in developing future and prior year HAP emission inventories as it is relatively easy to update the activity data, emission factors and speciation profiles. These tools include only the 33 urban HAPs for which data are available to estimate emissions.

Nonpoint source HAP emission factors and speciation profiles are revised and updated frequently, therefore when using these databases and spreadsheet in the future, the factors and profiles should be compared with factors and profiles available from the EPA's EFIG, as well as published testing data, to insure that the latest factors and profiles are being used.

The databases and spreadsheets developed for the nonpoint source component of the Cuyahoga County inventory are briefly described below.

- Database:
 - (1) Emission Table (includes activity data and/or emission factor, if available)
 - (2) Source Category Table (includes NAICS, SIC, and MACT and descriptions, if available)
- Spreadsheets:
 - (1) Activity Data Source(s)
 - (2) Emission Factor Source(s)
 - (3) Adjustments/Control Assumptions
 - (4) Estimation Methodology
 - (5) Data Parameters Tables
 - (6) Embedded Equations

An Access[®] database was constructed to calculate, store, and manage the entire nonpoint source 33 urban HAP emissions inventory for Cuyahoga County. The nonpoint

emissions table also contains SCC, HAP code, emission factors (when available), and activity data (when available).

Additionally, an Excel[®] workbook containing the emission methodologies, assumptions, activity data parameters, and emission factors for the 54 nonpoint source categories included in the inventory were developed. This workbook contains active equations, thereby allowing the user to develop an estimate by updating the activity data. It is anticipated that development of future and prior year baseline inventories can be generated for nonpoint sources using this workbook.

It is important to note that the values generated by the workbook may not match the values in Appendix B due to rounding differences.

4.3 Mobile Sources

Included with this inventory are databases and spreadsheets developed to estimate HAP emissions, as well as data files that contain the final HAP emission estimates. These databases, spreadsheets, and data files were developed for a number of mobile source categories including:

- Onroad,
- Aircraft,
- CMV, and
- Railways.

It should be noted that these databases and spreadsheets are useful in developing future HAP emission inventories as it is relatively easy to update the activity data, emission factors and speciation profiles. These databases and spreadsheets include all of the HAPs for which data are available to estimate mobile sources emissions, not just the pollutants listed in

this study, making them particularly valuable in developing emission inventory submittals for the NEI.

Mobile source HAP emission factors and speciation profiles are revised and updated frequently, therefore when using these databases and spreadsheet in the future, the factors and profiles should be compared with factors and profiles available from the EPA's EFIG and OTAQ, as well as published testing data, to insure that the latest factors and profiles are being used.

The final mobile source emission estimates are compiled in a separate data file that contains the required fields for generating an EMS-HAP file, which can be applied to a variety of risk assessment models. This data file includes SCC, pollutant code, emission estimate and locational data, if relevant. The databases and spreadsheets developed for the mobile source component of the Cuyahoga Inventory are briefly described below.

4.3.1 Onroad Database

The onroad source category input files needed to run MOBILE6.2 are provided along with the databases that use the output from MOBILE6.2 to generate county-wide onroad emissions estimates.

The MOBILE6 input, external files, and VMT estimates obtained from NOACA are provided as data files. Additionally, two Microsoft Access[®] databases have been provided to aid with future revisions. Onroad_Estimates1.mdb contains the first half of the work, and Onroad_Estimates2.mdb continues the work and contains the final results. Both files have additional notes to help explain the tables found in that database. The databases were constructed so that the information can be altered and all of the queries reapplied to create new annual onroad emission estimates given revised data. For example, with new or revised VMT data, the VMT total mileage can be updated in the "ALLScenarios" table of Onroad_Estimates1.mdb, and new annual estimates can be obtained by running all of the

queries in the two databases. Adjustments based on monthly fuel sales can be made in the “AdjustEM” table in Onroad_Estimates2.mdb, and queries 14-18b can be applied to create new annual estimates.

The final mobile emission data set developed for this inventory provides county total onroad emission estimates disaggregated by SCC for each HAP included in the inventory.

4.3.2 Airport Spreadsheets

A set of spreadsheets are provided that use local LTO data to estimate HAP emissions. Results from these spreadsheets are compiled in the final mobile emissions data file.

The number of LTOs for each aircraft type are entered into each of the airport spreadsheets. Burke Lakefront provided monthly data so the spreadsheet developed for Burke Lakefront was developed to estimate monthly emissions. The LTO data were linked to aircraft criteria pollutant and HAP emission factors to estimate emissions for each aircraft type.

If in the future, aircraft-specific LTO data are used in conjunction with the FAA’s EDMS model, these spreadsheets would have to be modified to speciate the criteria pollutant estimates into HAP components.

The final emission data file associated with this inventory is provided with aircraft emission estimates disaggregated by SCC codes and individual pollutant for each airport included in the inventory. Airports are spatially defined by their latitude and longitude coordinates.

4.3.3 Port CMV Spreadsheets

The spreadsheets developed to estimate emissions at each of Cleveland's port terminals are similar to the summary tables in Appendix C. Monthly cargo tonnages and vessel visits are reported for the Interlake Terminal, while only vessel visits and length of stay are reported for the Ceres and Federal Marine Terminals. All spreadsheets convert the available activity data to horsepower hours, which are applied to criteria pollutant emission factors and speciation profiles to estimate HAP emissions.

The CMV emission estimates are compiled in the final mobile data file with estimates disaggregated by SCC code and individual pollutant for each terminal included in the inventory. Terminals are spatially defined by their latitude and longitude coordinates. Underway estimates are provided as county level totals for individual HAPs.

4.3.4 Yard Locomotives Spreadsheets

The spreadsheet used to estimate yard locomotive emissions is provided. Emission estimates obtained from the spreadsheet are compiled in the final mobile emissions data file.

In the yard locomotive spreadsheets, the number of yard locomotives used by a railway company is entered into the spreadsheet. Assumptions about the hours of operation and fuel consumption are built into the spreadsheet, but can be easily changed to more accurately reflect yard activities. The calculated fuel usage is applied to criteria pollutant and some HAP emission factors. The remaining HAP emissions are estimated by speciation of the criteria pollutant emission estimates.

The yard locomotive emissions are compiled in the final mobile emissions data file disaggregated by SCC codes for each HAP included in the inventory.

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