The Southwest Lake Michigan Pilot Study:

Developing an Inventory of Toxic Air Emissions from Area Sources in the Chicago, Milwaukee, and Gary Urban Areas, 1993

***** FINAL *****

December 1995

U.S. Environmental Protection Agency
Pilot Program for Emissions Inventory
Under the Clean Air Act
Sections 112(c), 112(k) and 112(m)

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Indiana Department of Environmental Management, Office of Air Management
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Table of Contents

Table of Contents
(continued)

List of Tables

List of Figures

(continued)

Acronyms and Abbreviations
(continued)

PAH	Polycyclic Aromatic Hydrocarbon
Pb	Lead
PC	Personal Computer
PCB	Polychlorinated Biphenyls
PCDD	Total Polychlorinated Dibenzodioxins
PCDF	Total Polychlorinated Dibenzofurans
PERC	Perchloroethylene
PM	Particulate Matter
POM	Polycyclic Organic Matter
POTW	Publicly Owned Treatment Works
QA/QC	Quality Assurance/Quality Control
RAPIDS	Regional Air Pollutant Inventory Development System
SCC	Source Classification Code
SIC	Standard Industrial Classification
SSD	Source Summary Database
STEPS	State Environmental Programs Systems
SWLM	Southwest Lake Michigan
TANKS	Storage Tank Emissions Software
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TCDF	2,3,7,8-tetrachlorodibenzo-furan
TCE	Trichloroethylene
TPY	Tons per year
TRI	Toxic Release Inventory
U.S. EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
VOM	Volatile Organic Material
WDNR	Wisconsin Department of Natural Resources

Preface

The Southwest Lake Michigan Pilot Study represents a unique milestone in the continuing effort to quantify and manage the toxic air emissions which impact the waters of the Great Lakes Basin. Three Great Lakes states, Illinois, Indiana, and Wisconsin, cooperated in compiling this emissions inventory as part of a program to quantify toxic air emissions from small sources in major urban areas. The pilot study provided the first practical test of processes, procedures, and systems which the states have been developing over the last several years to ensure that this, and subsequent, regionwide inventories, are accurate and consistent from one state to another.

The governors of the eight Great Lake states established the framework for reaching this milestone when they signed the Toxic Substances Control Agreement in 1986. This agreement recognized the need for coordinating regional action to quantify and control toxic pollutants entering the Great Lakes system. Since 1989, the Great Lakes states and the Province of Ontario, Canada have been working together through the Great Lakes Commission to develop a regional database of air toxic emissions data and estimates.

The U.S. EPA funded this pilot study to help meet the requirements of Sections 112(c)(6), 112(k), and 112(m) of the Clean Air Act, as amended in 1990. Section 112(k) requires U.S. EPA to identify "not less than 30 hazardous air pollutants which, as a result of emissions from area sources, present the greatest threat to public health in the largest number of urban areas." The categories of area sources that contribute 90 percent of the emissions of each of the 30 or more hazardous air pollutants must then be regulated by U.S. EPA by the year 2000. U.S. EPA must also establish a National Strategy which reduces the public health risks associated with such source categories by not less than 75 percent in the incidence of cancer attributable to emissions from such sources.

While we believe the air toxic emission estimates contained in the report for the Chicago, Gary, and Milwaukee urban areas represent the best single compilation of such estimates, the pilot study has also illustrated the limitations which still exist in making such estimates. The results should therefore be viewed as a first step for use by policy-makers and others involved in air quality management. These data can support regulatory decisions if used in conjunction with other sources of quality-assured data.

The Great Lakes states, along with the Great Lakes Commission, are now working to compile an eight-state air toxic inventory using the experience of the pilot study to improve their efforts. The full eight-state inventory, using calendar year 1993 data, is expected to be completed in late summer, 1996. Through this continuing effort, the mechanism has been established to compile and maintain an inventory which will continue to improve in quality until it will support sound regulatory decisions.

Bharat Mathur	Felicia R. George	Donald F. Theiler
Chief	Assistant Commissioner	Director
Bureau of Air	Office of Air Management	Bureau of Air Management
Illinois EPA	Indiana DEM	Wisconsin DNR

Dedication

This report is dedicated to the memory of Tom Lahre. As the primary contact to the pilot study from the Urban Area Sources Program of the U.S. Environmental Protection Agency, Tom worked closely with the state subcommittee members and Great Lakes Commission staff up until his death in September 1995. He was a dedicated professional and a good friend to us all. We miss him and hope that we have lived up to the high professional standards that he set for himself and for those with whom he worked.

Executive Summary

The purpose of the Southwest Lake Michigan (SWLM) Pilot Study was to a) inventory small point and area sources of toxic air emissions from the combined urban areas of Chicago, Gary and Milwaukee (see Figure 1-1, page 1); b) test the *Air Toxics Emissions Inventory Protocol for the Great Lakes States;* and c) design and test an automated emissions estimation and data management system that could be used in later years in developing larger, multistate, Great Lakes regionwide inventories.

Importantly, emissions from "major sources," as defined by the Clean Air Act, were not inventoried and estimated and are therefore not documented in the regional summary. Consequently, the ratio of area to major source emissions in the study area is not available and the tables and charts provided herein should not be construed to represent an estimate of total emissions of the subject hazardous air pollutants released in the study area. Under the terms of the Clean Air Act (CAA), which defines major sources in terms of quantity, the sources inventoried in the SWLM study are accurately described as "area sources."

The SWLM study began in October 1993 with primary funding provided by the U.S. Environmental Protection Agency (U.S. EPA). The study built upon four previous years of effort by the Great Lakes states, funded by the states themselves through the Great Lakes Protection Fund.

This report is but one of six products of the SWLM study. The complete product package includes:

This report, titled *The Southwest Lake Michigan Pilot Study: Developing an Inventory of Toxic Air Emissions from Area Sources in the Chicago, Milwaukee and Gary Urban Areas, 1993*;

Regional Air Pollutant Inventory Developmen

Gary and Milwaukee urban areas represent the best single compilation of such estimates. The scope of the project did not allow the states to undertake a massive discovery effort; instead, the states used available 1993 calendar year process data, emission factors and reported information. The SWLM study objective was to enhance current inventory capabilities, resolve procedures and protocol issues across several states, and develop and test an automated emission estimation and inventory system. In the process, the urban area source inventory for the SWLM study area was compiled.

In brief, the pilot study should be viewed as an initial effort to bridge the gap between the *science* of inventorying toxic air emissions and the public policy *debate* concerning how these emissions affect human health and the environment and how they should be addressed. Follow-up by U.S. EPA and the states is necessary to make further progress toward meeting the goals of Section 112 of the CAA. The SWLM pilot study states recommend that regulatory decisions not be based on this data unless more compelling research is completed or accessed to warrant such action.

The following are the specific sections of the CAA, as amended in 1990, addressed by the SWLM study:

Section 112(m) Great Waters and the Great Lakes Toxic Substances Control Agreement: The Great Lakes states made significant progress toward meeting the goals of the governors' agreement and CAA Section 112(m) by developing the Regional Air Pollutant Inventory Development System (RAPIDS) and testing the *Air Toxics Emissions Inventory Protocol for the Great Lakes States*. The RAPIDS software, and the accompanying protocol will be used by all eight Great Lakes states in future years to jointly conduct point and area source inventories of the 49 target compounds identif d6a19 Table 2-1.

The *Air Toxics Emissions Inventory Protocol for the Great Lakes States*, finalizd6a19 June 1994, provides instructions for the states to follow to ensure the completeness, accuracy, consistency and quality of the regional toxic emissions inventory. Each state prepare6a1ts portion of the SWLM pilot inventory 19 the manner outlind6a19 the protocol, and provided a quality assurance check o9 their state-specific emissions data and estimates to ensure the highest possible quality database.

Rather than comparing one state's emissions against another state's results, the focus of the pilot study was to prepare a reliable and technically accurate inventory for the southwest Lake Michigan region as a whole, and to outlind areas where improvements are needd6a19 overall methodology and implementation.

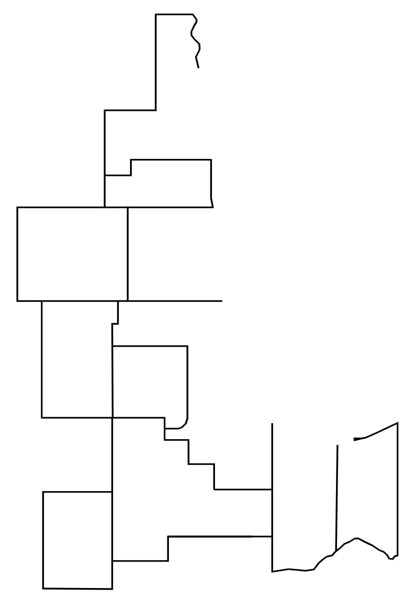
Development of RAPIDS has bee9 the key to the effort to develop a comprehensive, accurate, and consistent urban area air toxic emissions inventory across three states.

As a multistate, regional effort, a high level of coordination and communication was necessary to ensure consistency among the three statesa19 terms of data management, methodology, calculation methods, and other issues. To facilitate the necessary communication o9 these issues, a Southwest Lake Michigan Pilot Study Subcommittee was established by the Great Lakes Commission's Regional Emission Inventory of Toxic Air Contaminants Steering Committee. During the course of the SWLM study, the subcommittee communicated via daily e-mail exchanges, conference calls o9 a weekly or biweekly basis, and monthly or bimonthly in-perso9 meetings to oversee contractor development of the inventory software, and to resolve outstanding issues and inconsistencies among the three statesacontributing to the pilot study.

During the course of this study, the Southwest Lake Michigan Subcommittee worked closely with the project software development contractor, Radian Corporation, to develop and test RAPIDS. The effort represents the first attempt to prepare software for estimating toxic pollutant emissions o9 a multistate basis. RAPIDS is a client/server system consisting of an ORACLE back-end database designd6ausing ORACLE CASE tools, and a "suite" of front-end applications developd6ausing various software tools (primarily PowerBuilder and SAS). The software takes full advantage of new Internet/Great Lakes Information Network (GLIN) connections betwee9 the states, Great Lakes Commission, and the U.S. EPA GLNPO office in Chicago.

Finally, a Quality Assurance/Quality Control (QA/QC) Committee was formed to review the pilot study report, establish QA/QC criteria for use by the three states, and ensure the report provides an accurate and useful summary of toxic air emissions at the regional level.

The tables and charts presentd6a19 Section 4, *Results*, provide the results of the regional inventory for the southwest Lake Michigan pilot study area. It is important to note that, as a pilot study, the subcommittee has refraind6afrom interpreting the results orafrom drawing majoraconclusions that might have policy implications. I9 addition, the subcommittee finds that, beyond the actual results,



documentation may be downloaded from the Internet at the site: ftp.great-lakes.net/pub/RAPIDS/production/.

2. Objectives

The federal incentive for the project was to assist the U.S. EPA in meeting requirements of Section 112 of the Clean Air Act (CAA). This project report documents substantive progress toward meeting the urban area goals of the CAA Sections 112(c)(6) and 112(k) and the Great Lakes goals of Section 112(m).

URBAN AREA SOURCE EMISSIONS ESTIMATION GOAL UNDER THE CLEAN AIR ACT

Sections 112(c)(6) and 112(k) of the CAA require U.S. EPA, through its Urban Area Source Program, to identify "not less than 30 hazardous air pollutants which, as a result of emissions from area sources, present the greatest threat to public health in the largest number of urban areas." U.S. EPA also must list and regulate the categories and subcategories of area sources that contribute 90 percent of the emissions of each of the 30 or more hazardous air pollutants. Furthermore, U.S. EPA

Section 112(c)(6) specified the need to list categories and subcategories of sources emitting the following pollutants: alkylated lead compounds, polycyclic organic matter (POM), hexachlorobenzene, mercury, polychlorinated

The Great Lakes region had an additional incentive to undertake the SWLM project. The development of multistate client/server toxic air emission inventory software and procedures goes a long way toward meeting provisions of the Council of Great Lakes Governors' Toxic Substances Control Agreement (governors' agreement) of 1986, The goal of Section 112(m) of the CAA, Atmospheric Deposition to Great Lakes and Coastal Waters, is to conduct a program to identify and assess the extent of atmospheric deposition of hazardous air pollutants (and at the discretion of the administrator, other air pollutants) to the Great Lakes, the Chesapeake Bay, Lake Champlain and coastal waters. As part of this program, the U.S. EPA is charged with investigating the source or sources of any pollution to the Great Lakes which is attributable to atmospheric deposition.

The Great Lakes states made significant progress toward meeting the goals of the governors' agreement and CAA Section 112(m) by developing the Regional Air Pollutant Inventory Development System (RAPIDS) and testing the *Air Toxics Emissions Inventory Protocol for the Great Lakes States*. The RAPIDS software, and the accompanying protocol will be used by all eight

	Pollutant	Toxic List			CAS #
		[1]Great Waters	[2]Great Lakes Commission	[3]CAA 112(c)(6)	

3. Methodology

The SWLM study concentrated on locating significant sources not currently regulated under the CAA. These sources include many traditionally unregulated sites with relatively small gas-fired, procedures used to collect data and determine emissions.

The protocol is not intended to replace the IPP, but does include most of the above information. By focusing on the procedures that the participating states must follow to compile their portion of the regional database, the protocol assigns responsibilities and procedures (joint, state, Great Lakes Commission, U.S. EPA GLNPO); outlines procedures to identify and locate emission sources of target compounds; guides selection of specific emission estimation techniques; instructs states on compiling and updating the regional repository at GLNPO; outlines quality assurance/quality control procedures for emission data and estimates; and identifies and explains the full suite of automated tools available for developing the regional inventory (RAPIDS, GLC-FIRE, Version 3.0, and others).

The protocol describes the two emission calculation approaches as follows:

- **Facility source approach:** Separately identify each device/process at each facility source and calculate its emissions (often referred to as a facility/point source approach); and

- **Area source approach:** Aggregate all similar or identical device/processes within a defined area and calculate their total emissions directly using the appropriate surrogate activity data (the source in this case is the area in which all of the devices are found, usually an entire county).

The area source approach is generally used for sources that are small and numerous, such as gasoline stations and dry cleaning establishments. These are not included as facility sources because the effort required to gather and estimate emissions for each individual facility is beyond the resources available for inventory development efforts. Some area sources, such as consumer products, have no analog as a facility source.

The protocol refers to certain software tools (e.g. the Regional Air Pollutant Inventory Development System, RAPIDS, discussed below) that can be used to prepare a state or province's portion of the regional inventory. However, the protocol procedures, if followed, will result in emissions data and estimates that are compatible and consistent, whether or not these software tools are used.

DEVELOPING AND TESTING CLIENT/SERVER EMISSION ESTIMATION AND INVENTORY SOFTWARE: RAPIDS

Development of the Regional Air Pollutant Inventory Development System (RAPIDS) has been the key to the effort to develop a comprehensive, accurate and consistent urban area air toxic emissions inventory across three states.

During the course of this study, the Southwest Lake Michigan Subcommittee worked closely with the project software development contractor, Radian Corporation, to develop and test RAPIDS. The among their respective inventories by following the *Air Toxics Emissions Inventory Protocol for the Great Lakes States* (developed to help the eight Great Lakes states prepare a comprehensive, regional

accurate and useful summary of toxic air emissions at the regional level. Members of the SWLM Regional QA/QC subcommittee are listed in Appendix H. Minutes of this committee's meetings and all e-mail transactions have been archived by the Great Lakes Commission.

4. Results

URBAN AREA SOURCE EMISSIONS ESTIMATION GOAL UNDER THE 1990 CAA

The results summarized below should be viewed as a first step for use by policy-makers and others involved in air quality management. These data can support regulatory decisions if used in conjunction with other sources of quality-assured data. With these results, and an enhanced understanding of current inventory capabilities, additional questions can be asked, issues can be more precisely framed, and the goals and objectives of future inventory efforts can be specified in greater detail. In short, the pilot study should be viewed as an initial effort to bridge the gap between the *science* of inventorying toxic air emissions and the public policy *debate* concerning how these emissions affect human health and the environment and how they should be addressed.

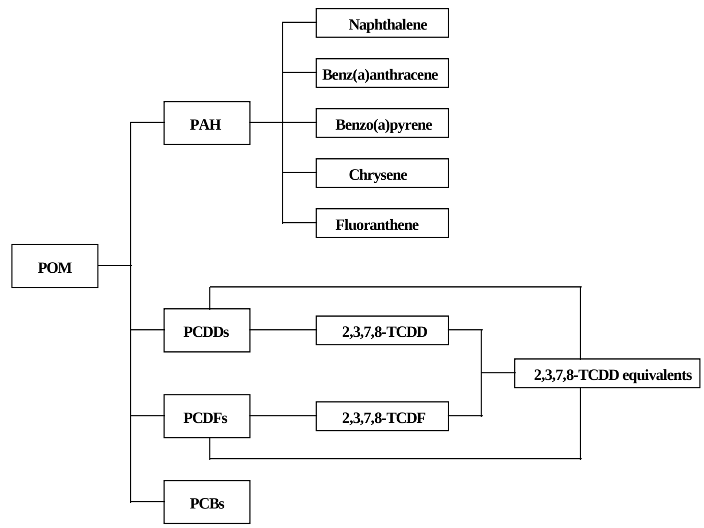
The tables and charts beginning on page 28 provide the results of the regional inventory for the southwest Lake Michigan pilot study area. It is important to note that, as a pilot study, the subcommittee has refrained from interpreting the results or from drawing major conclusions that might have policy implications. In addition, the subcommittee finds that, beyond the actual results, the *process* of compiling the regional inventory has, itself, proven extremely valuable as a means of resolving the many technical, methodological, and policy-related issues that impact a multi-state, regional toxic air emissions inventory. Important lessons have been learned, and while these may not be immediately apparent from the tables and charts below, they will nonetheless be put to use in compiling the full, eight-state inventory for the Great Lakes region.

Perhaps the most important outcome of the project is that the SWLM pilot study illustrated the serious shortcomings which still exist in the emissions inventory estimates (see regional results page 28), and suggested necessary steps that must be made to ensure data quality for estimating various pollutant groupings (see Section 5, *Conclusions*).

Southwest Lake Michigan Urban Area Source Inventory

PAH emission estimates should include total emissions for several pollutants (subsets), a number of which were separately inventoried in this study. Figure 4-1 shows the hierarchy of POM and PAH compounds. Similarly, total chrome should include emission totals for chrome VI, a separately inventoried pollutant. Total emissions for PAH should equal or exceed the sum of all PAH compounds; and total chrome emissions should exceed emission estimations for chrome VI. However, emission factors in FIRE Version 3.0 may exist in one of three combinations: 1) factors for PAH and factors for associated compounds; 2) factors just for PAH; or 3) factors just for some of the associated compounds. A similar situation occurs with chrome and chrome VI.

Figure 4-1:Hierarchy of POM Compounds in the Target Compounds List of the Regional Air Toxic Emissions Inventory



Source: Chun Yi Wu, State of Minnesota, Pollution Control Agency, Air Toxic Unit, 1995

The Quality Assurance/Quality Control Committee expected that emissions estimates for POM, PAH and the PAH subsets would relate to one another as follows:

POM PAH naphthalene + benz(a)anthracene + benzo(a)pyrene + chrysene + fluoranthene

In fact, due to the availability and use of selected emission factors, naphthalene emission estimates exceeded PAH emission estimates. A similar error occurred in the chromium and hexavalent chrome emission estimates. The SWLM pilot study subcommittee recognizes the discrepancies in these totals and has drafted methodology, presented in Section 5, *Conclusions*, to rectify this error. The next step for improving the pollutant subset estimation methodology in the protocol is review and refinement by the eight Great Lakes states, Ontario and U.S. EPA; upon consensus approval by the eight Great Lakes states the methodology will be added to the protocol.

CAA Section 112(k) Area Source Program: Toxic Emissions from Urban Area Sources

The SWLM pilot study emissions inventory for small point and area sources in the Chicago, down further, doing so would focus attention on a level of detail that may not be appropriate at this point in the study process.

Appendix E provides the carcinogenicity ratings for the pollutants inventoried in the SWLM project, based on U.S. EPA's Integrated Risk Information System (IRIS) Database. Ratings in the IRIS database are based on agency consensus positions on the potential adverse human health effects of approximately 500 substances, updated monthly. The carcinogenicity ratings provided in Appendix E are from September 1995.

Table 4-2: Regional Toxic Air Emissions by Inventoried Source for the Southwest Lake Michigan

tables to the regional repository located at GLNPO.

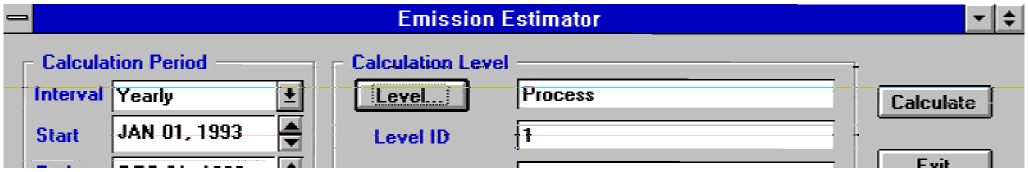
Data Import and *Data Export* client applications that facilitate the import of emissions data and estimates maintained by the states external to RAPIDS into the back-end database, and which facilitate the export of data from the back-end database into ASCII files (i.e., import file format).

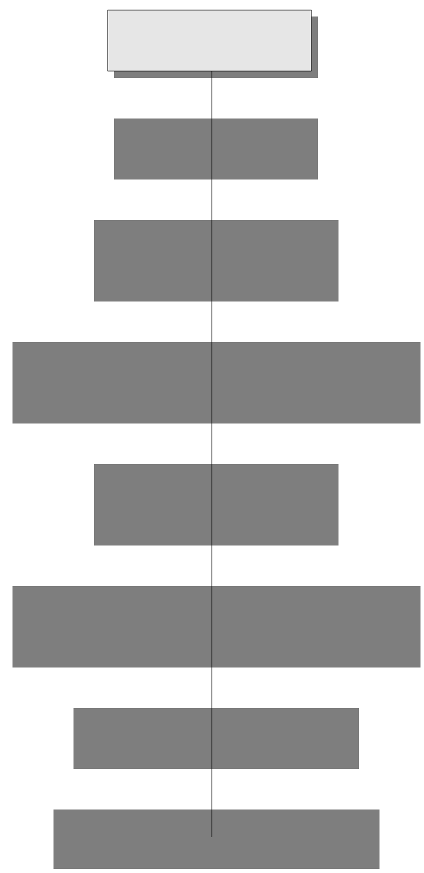
A *FIRE Upload* client/application (this application is under development) that will upload the emission factors contained in FIRE (Factor Information Retrieval System) into a reference table used to calculate emissions. FIRE is an emission factor database repository developed by U.S. EPA. The emission factors contained in FIRE have been incorporated into RAPIDS and used within the system to compute emission estimates for certain source categories.

A set of *Data Entry* client/applications developed in PowerBuilder that consist of various forms/screens to enter different types of emissions data, and emission estimates derived external to RAPIDS.

Emission Estimator client/application that allows the user to compute emission estimates using a variety of emission estimation techniques (e.g., product of activity data and an approved emission factor, speciation of either particulate matter or VOC emission estimates or user-defined algorithms) that match pre-established SCC/compound-specific methodologies listed in the protocol. (The protocol is a comprehensive document that describes the methodologies the participating states will use to compile the regional inventory, including the procedures to resolve differences of opinion.) A sample emission estimation screen is depicted in Figure 4-3 and shows the various options available to the user for estimating emissions.

A *QC Checker* client/application that performs various statistical checks on the emissions data and estimates contained in the ORACLE back-end database. Due to time constraints, the states did not test the automated QC Checker during the SWLM pilot project. Section 5, *Conclusions*, provides further discussion of the QC Checker. Figure 5-1 shows a sample QC


Emission Estimator
Calculation Period
Interval
Yearly
Start
JAN 01, 1993
Calculation Level
Level...
Process
Level ID
1
Calculate



le field, is used to store information on a data item. This is a means of providing complete information on the data item of interest, including the context (when, where and subject material), confidentiality, and reference information (other documents, who and when the data were entered). This is referred to as a "flexible attribute" format, which contrasts with the fixed attributes used in most other data models (see discussion below on the activity record structure).

Only a single source table, a single device table and a single process table is needed to contain data on all types of sources, devices and processes, including both point and area sources.

Entities can be grouped as needed and activity records can be associated with such groups (e.g., a group of related processes in use during an operating scenario).

Activity Record Structure

The traditional data modeling approach for storing the value of a data item in a database is the use of a fixed attribute field for that data item. That field is included in a table along with other data items used to quantify or qualify the object of interest. For example, the value of temperature of a process would have a field called TEMPERATURE included in a table for the subject process; the units (Fahrenheit or Celsius) would not be coded but would be implied and listed in the data dictionary for the database.

Conventional Approach (Fixed Attribute)

Floating Roof Tank Table, Period=1993

Device ID	Height (ft)	Diameter (ft)	Color	Seals
1	57	200	White	Y
2	40	105	Blue	N
.	.	.	.	.
.	.	.	.	.

RAPIDS Approach (Flexible Attribute)

Device Table, Device ID=1, (Device Code=Floating Roof Tank)

Start Date/Time	End Date/Time	Metric	Value	Units
1-1-90		Height	57	ft
1-1-90		Diameter	200	ft
1-1-90	7-7-93	Color	Blue	
7-7-93		Color	White	
7-7-93		Seal	Y	

stream or material activity data record is associated (e.g., an emittant, product, fuel, chemical or liquid waste);

Value Type--a code identifying the basis on which a production or emission rate value was developed (allowed, maximum, minimum, average, design capacity or potential this field is blank for actual data);

Value--the data quantifying or qualifying the activity data (including numeric and text information);

Units--a code for the units of the activity data value (if any);

it is an area source (i.e., a group of dry cleaning equipment associated with a group of dry cleaning facilities) or a point source (i.e., a specific piece of dry cleaning equipment at a specific dry cleaning facility).

Common Treatment of Point and Area Sources

One of the unique features of RAPIDS is its common treatment of point and area emission sources. In most systems/databases, point and area sources are treated differently, and the resulting emission estimates are typically stored in separate databases, one for point sources and another for areas sources.

RAPIDS treats all source types, whether they are point or area (or even mobile), in the same manner. The key to the common treatment of point and area sources is the ability of RAPIDS to accommodate groups of sources, devices and/or processes. A source can be an industrial facility, such as a large dry cleaning facility or a utility (examples of typical point sources), or using the grouping capability of RAPIDS, a group of small dry cleaners. A device can be a piece of stationary industrial equipment, such as the equipment used to dry clean clothes or a boiler, or, again, using the grouping capability, a group of dry cleaning equipment, a group of boilers at an industrial facility or a group of fuel burning equipment associated with a group of homes.

An example of how RAPIDS would treat dry cleaners as an area source is as follows. The user would create a source group that included all dry cleaners in a given county. Then a device group that included all dry cleaning equipment associated with the dry cleaning establishments that were members of the above mentioned source group would be created. Following this paradigm, a process group would be created for the above mentioned device group with input and output streams. The emissions associated with the group of dry cleaning establishments would be stored on the output stream of the process group.

This formulation allows the user the flexibility to treat large dry cleaning facilities as discrete point sources and the remaining smaller dry cleaning establishments in a county as a group of sources. Treating point and area source types the same, both in the structure of the database and the codes used for these types (see below), facilitates reconciliation between these two types of emission sources. Double counting of emissions can be easily avoided as the emissions associated with the large dry cleaning facility can be subtracted from the emissions associated with the source group. In this manner, all typical area source categories can be accommodated using the same source/device/process/stream paradigm used to characterize typical point sources. Instead of using point and area sources, the user simply decides when it is more convenient to store and manage information at the "member" (i.e., a discrete source/device/process) or the "group" (i.e., a group of source/device/processes) level. Different treatments can be used for different purposes. For the dry cleaning example, risk assessment studies may require treating even small dry cleaners as discrete sources; however, photochemical modeling studies might only need to characterize emissions from dry cleaners at the county level (i.e., a group of dry cleaning establishments located in a given county).

Overview of Emission Estimation in RAPIDS

The RAPIDS data model allows for very complex material flow relations among devices. The Emission Estimator was designed to track and record the amount of a material of interest (i.e.,

The method(s) applicable to any source, device, process and material are identified in the protocol document and then incorporated into RAPIDS. This helps ensure consistency among all users in calculating emission estimates for a given source category.

Pie charts were not created for the following 19 pollutants due to the lack of inventoried source data:

Atrazine
Chlordane
Coke oven
Diethylhexyl phthalate
Di-n-butyl phthalate
Di-n-octyl phthalate
Dioxins; 2,3,7,8, equivalent
Heptachlor
Hexachlorobenzene
Hexachlorobutadiene
Hexachloroethane
Alkylated Pb compounds
Methoxychlor
Parathion
Pentachloronitrobenzene
Pentachlorophenol
2,4,5 Trichlorophenol
2,4,6 Trichlorophenol
Trifluralin

5. Conclusions

The three states that conducted the SWLM study believe that the toxic air emission estimates contained in Section 4, *Results*, of this report and available for U.S. EPA and Great Lakes state online review at the regional repository at the U.S. EPA Great Lakes National Program Office in Chicago, represent the best single compilation of such estimates.

The pilot study's conclusions focus on ways to improve the emission estimation protocol, enhance quality control of multistate toxic inventories of emissions from large and small sources, streamline automated procedures and outline next steps in reaching the goal of institutionalizing a full eight-state toxic air emissions inventory. The emission estimates provided herein must be viewed as a pilot effort; area source emission estimation techniques for urban areas in the Great Lakes region will improve over time as the lessons learned in this effort are incorporated by the states and as new emission factors are propagated for the toxics of interest.

During the next few years, the Great Lakes states will be working together to inventory the target list of toxics from all sources in the region. Once the eight-state, regionwide inventory is completed and quality assured, the compiled data can be used to support studies on the relative impacts of the inventoried emissions and regulatory decisions.

IMPLICATIONS FOR THE PROTOCOL

The pilot study provided a trial run for the *Great Lakes Air Toxics Emissions Inventory Protocol*. The three states that participated in the pilot study used the protocol in developing their portions of the pilot inventory. With this experience, the protocol can be refined to address issues that arose during the pilot study.

Pollutant Subsets

It will most likely be necessary to add a whole section to the protocol on pollutant categories and how to reconcile automated estimates with what is known about the "real world" emission of these pollutants, including how to interpret the data. The minimum goal of the SWLM pilot study was to use emission factors to estimate emissions of hazardous air pollutants. Going to the next level would involve rectifying the group/group members relationships. The following is draft methodology, prepared by the SWLM states, that will be considered by the Great Lakes Commission Regional Emissions Inventory of Toxic Air Contaminants Steering Committee.

Draft Methodology for Quality Assurance/Quality Control of Pollutant Subsets for the Air Toxics Emissions Inventory Protocol for the Great Lakes States

Quality Assurance/Quality Control

A comprehensive Quality Assurance/Quality Control (QA/QC) Plan is included as Appendix A of the protocol. Chapters 4 and 5 of the QA/QC Plan include a variety of statistical checks on the quality of the numerical inventory results and stipulate that the RAPIDS software may be used as the tool for making these checks.

The automated QA/QC checks built into the RAPIDS software were not fully developed and tested at the time the states prepared their pilot inventories. Other QA/QC checks in RAPIDS (e.g. SIC validation checks) were implemented and proved to be valuable. Therefore, many of the specific statistical checks prescribed in the protocol were not performed as part of the pilot inventory effort. However, each state made significant efforts to manually check the quality of their data before including it in this report. Furthermore, each state adhered to those portions of the QA/QC Plan which did not require the use of automated statistical checks. Finally, the states have formed a committee to direct additional analysis of the data (see Appendix H). The QA/QC committee will further define the manual checks necessary to ensure an accurate regional inventory.

The efficacy of the RAPIDS automated QA/QC checks cannot be evaluated at this time; thus, the pilot states are currently unable to completely evaluate the effectiveness and usefulness of the QA/QC portion of the protocol. This should be a higher priority during Phase Three of the regional inventory effort.

Consistency Across Source Categories Inventoried by the States

The protocol indicates that in order for a state's inventory to be considered complete, the inventory must be comprehensive; that is, it must include emission estimates from every source/source category believed to emit one or more of the target pollutants.

The states compiling this pilot inventory faced time and resource constraints that made it impossible for any of them to develop comprehensive inventories that fully satisfy the protocol. Each state did the most comprehensive inventory it could, given these constraints. Consequently, the specific categories inventoried by each state varied, for at least two reasons. First, some states had access to readily available data (e.g., gasoline service station sales) that other states did not have. And second, some states already had in-state initiatives (e.g., toxic emission reporting rules), which overlapped with the goals of this inventory and allowed them to provide more extensive data.

One implication of this finding is that the states participating in the regional inventory in Phase Three should consider dropping the comprehensiveness *requirement* from the protocol in favor of *minimum criteria for acceptance*. In other words, the states should reach agreement every time an inventory is prepared on what the minimum criteria are for completeness, then encourage each other to exceed the stated minimums. This approach was adopted in the pilot effort and each state was able to exceed the minimum criteria for acceptance.

IMPLICATIONS FOR RAPIDS

As with the protocol, the pilot study provided an opportunity to utilize the RAPIDS software in a multistate emissions inventory effort. The three states used the system in compiling their portion of the pilot inventory. During the course of the SWLM project, the states took the RAPIDS software all the way from data model design through software development to testing and implementation. Considering the tight time line of the project and the large software design, development and testing task, some components of the RAPIDS software were not tested to the extent the states would have preferred. Those components requiring further development and testing include: QC Checker, RAPIDS-to-AIRS Facility Subsystem (AFS) upload and automated FIRE upload.

The Great Lakes states have agreed to optimize the speed of the Emission Estimation module designed under the SWLM project. Work is already underway to optimize the speed of the import/export module. This work should be completed in late 1995 or early 1996.

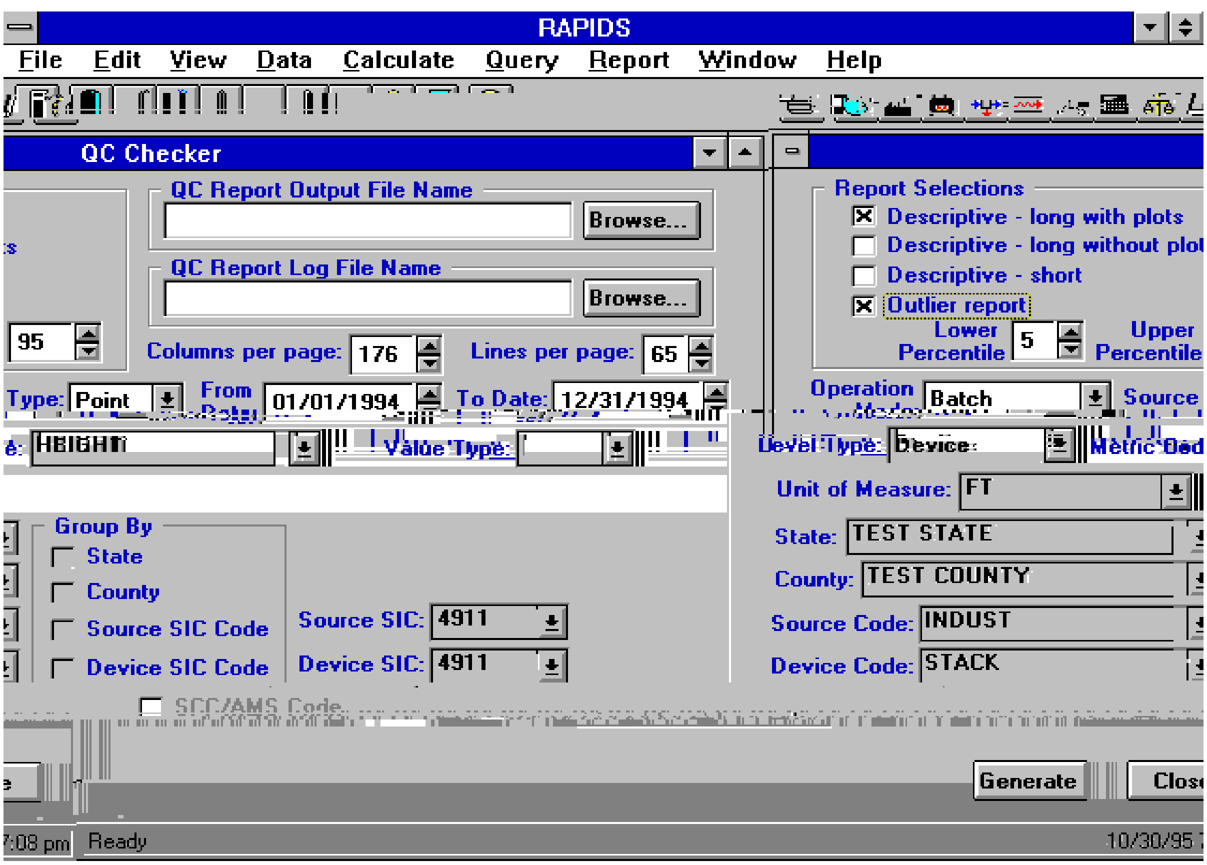
Minnesota has taken the lead in developing an AFS-to-RAPIDS converter. This module should prove useful for a number of jurisdictions interested in exporting AIRS data to the RAPIDS system and then working from there to estimate toxic emissions.

As of this writing, each of the eight Great Lakes states is expected to run a copy of the RAPIDS software in their air quality management agency. The software will be used to calculate toxic air emissions and provide internal quality assurance checks on the state data generated externally. Each state will use the RAPIDS-to-GLNPO upload mechanism to transmit point and area source data to the regional repository at the U.S. EPA GLNPO office.

QC Checker

The QC Checker screen depicted in Figure 5-1 shows the various options available to the user for performing these statistical checks. The efficacy of the RAPIDS automated QA/QC checks cannot be

Figure 5-1: Sample RAPIDS QC Checker Screen



revised definitions that enhance their internal consistency. The updated SCC-AMS codes and definitions are included with the factor data in FIRE.

Emission Factor Development

The Great Lakes states are using emission factors from FIRE Version 3.0. The states recognize that, in some cases, the emission factors in FIRE are not specific enough to be fully applicable to the different chemical forms of certain pollutants. In some cases, it is not certain if an emission factor is for a pollutant or for one of its compounds. For example, it is not clear whether the emission factor in FIRE for SCC 10100202 (for mercury of 1.6e-5 lb/million BTU heat input) includes only elemental mercury, mercury contained in the compound, specific compounds of mercury or all compounds of mercury. This issue will require further consideration by the states.

Automated FIRE Upload

At the present time, the RAPIDS system cannot execute a direct upload of FIRE data. The following discussion presents some of the options the states will consider during the next phase of the project.

The most important FIRE data structure modifications are inclusion of fields that facilitate automated uploading of FIRE emission factors into RAPIDS. These changes were made by EPA in response to GLC/state requests to modify FIRE to facilitate the import of emission factors into RAPIDS. These fields, which are used by RAPIDS, are:

denominator unit (ef_units_d); and

Emission calculations made using the Emission Estimator Application use the emission factors found in the RAPIDS Factor Table. Replacing previous FIRE factors with updated FIRE factors in RAPIDS will result in having calculated emissions for which the emission factor used is no longer in the database.

One possible solution is that the emission factors that are replaced could continue to be stored in RAPIDS by specifying a start date/time and end date/time over which those factors are valid. Unfortunately, there is currently no way to specify a start date/time and an end date/time for factors in RAPIDS. With the addition of start date/time and stop date/time fields to RAPIDS, the software will be able to store all emission factors (as well as any other factors that have a date range) ever used. Outdated factors will be able to be viewed along with current factors to identify changes that have occurred to these factors as the data in FIRE evolves.

The FIRE Upload Application would need to be run separately by each RAPIDS user in order to

6. Appendices

Data that existed in the EIS as of December 31, 1993, were downloaded into the FoxPro files. These data covered the entire state. Separate files were created for the data for the pilot study counties. A program was then run to read the FoxPro database and create another FoxPro database that had the fields and structure of RAPIDS. Once that file had been created, a tab-delimited file was created for import into RAPIDS. Because of the large volume of data, the import files were separated by county.

Computerized Annual Emission Reporting System (CAERS): Within the Bureau of Air, the Compliance and Systems Management Section maintains the Computerized Annual Emission Reporting System database (CAERS). This database is written in Oracle and resides on a separate server on the Bureau's LAN. This database maintains much of the same data as the EIS. The database structure of the EIS and CAERS are very similar.

In addition to the EIS data stored in CAERS, source-reported data (facility emissions, emission point emissions, operating hours, operating rates) are also maintained. This type of data exists for the calendar years of 1992, 1993, and 1994.

The detail of source-reported data varies depending upon the location and the potential emissions of the source. Sources located outside the ozone nonattainment areas (Cook, DuPage, Jersey, Kane, Data enter the Toxic Emission Inventory by way of permit review. If a permit under review has emissions of a toxic material, the appropriate data are sent to the Technical Support Unit where a preliminary screening is done. The appropriate data are then entered into the system. The data provided to the database are based on permit application data and not actual usage data and are not specific for a year. In addition, the inventory is by no means complete. Updates to the database are made only at the time of permit renewal, normally every five years in Illinois. Since Illinois has no regulations dealing with emissions of toxic pollutants, no emissions of toxic materials were calculated by the Permittee or the Permit Section. Data were only provided in the cases where the specific pollutant being emitted was simple to determine.

For the above reasons, the Toxic Emission Inventory was not used in the initial compilation of the inventory. The Toxic Emission Inventory will serve as a good QA/QC check for the Great Lakes Toxic Inventory. Results obtained using RAPIDS can be compared to data existing in the Toxic Emission Inventory. The Toxic Emission Inventory could also be searched by pollutant to identify additional sources.

Ozone Regional Computer Inventory System (ORCIS): Within the Bureau of Air, the Air Quality Planning Section maintains an emission inventory named ORCIS. This database is written in FoxPro and stores information specific to the 1990 base-year ozone inventory. Therefore, it was not used as a source to identify sources or calculate emissions. It should be noted that data for ORCIS were originally downloaded from the EIS.

TRI Data: The Office of Chemical Safety, under the Environmental Programs Section maintains the Toxic Release Inventory (TRI) data. The database is not directly accessible to the Bureau of Air. The data included in the TRI database are specific to the TRI reporting requirement and do not include any appropriate key information to relate the TRI database to the EIS. For this reason, the TRI database was not used to identify sources. This database will be a good QA/QC check for the Great Lakes Toxic Emission Inventory, and EIS, when the time permits.

Area Source Database: Within the Bureau of Air, the Air Quality Planning Section maintains an emission inventory dealing with area source emissions. This inventory is maintained in a spreadsheet and stores information specific to the 1990 base-year ozone inventory. Therefore, it was not used as a source to identify sources or calculate emissions. Toxic pollutant emissions from mobile sources are not part of the scope of the pilot study and therefore are not included in this report.

CALCULATION METHODS

The following is an overview of how point source emission estimates were calculated for each source category. The tables list the number of sources and the number of emission points, as well as the number of each emitting less than 25 tons per years. The text then lists the SCC codes used for the source category and the resulting emission factors obtained from the GLC-FIRE Version 3.0 database.

External Combustion - Natural Gas Firing

	Sources <25 tons/year	All Sources
Number of Sources	215	1603

Total Emission Points	639	4956

Data were obtained from the EIS for Cook, DuPage, Grundy, Kane, Lake, McHenry and Will Counties for emission points that had an SCC of 10100601, 10100602, 10100604, 10200601-10200604, 10300601-10300603, 10500106 and 10500206. Permitting of external combustion emission points is required for boilers that have a heat input of one million BTU/hour or greater. This would account for the great number of emission points. Sources too small to be included in this category will be covered under area source emissions for natural gas combustion.

The GLC-FIRE database was then queried to obtain emission factors for the SCC range. The emission factors found were for mercury (SCC - 10100601) and POM (SCC - 10200601). It was assumed that the emission factors for these pollutant/SCC combinations also applied to all the SCCs identified above.

The emission factors identified were in terms of pounds of pollutant per 10^{12} BTU input. The EIS does not directly store this type of data. To determine the heat input in terms of BTUs, the operating rate (units of million cubic feet) were multiplied by the heat content (BTU/cubic foot) and then converted. This number was then multiplied by the emission factor to obtain the emission rate. The specific emission factors used for the point sources are listed below beginning with Table 2-9.

External Combustion - Fuel Oil Firing

	Sources <25 tons/year	All Sources
Number of Sources	254	411
Total Emission Points	429	874

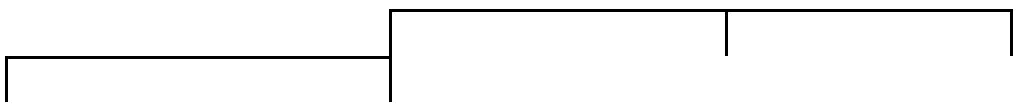
Data were obtained from the EIS for Cook, DuPage, Grundy, Kane, Lake, McHenry and Will Counties for emission points that had an SCC of 10100401, 10100404, 10100405, 10100406, 10100501, 10100504, 10100505, 10200401, 10200404, 10200405, 10200501, 10200504, 10200505, 10300401, 10300404, 10300501, 10300501, 10500105 and 10500205. Permitting of external combustion emission points is required for boilers that have a heat input of one million BTU/hour or greater. This would account for the great number of emission points. Sources too small to be included in this category will be covered under area source emissions for fuel oil combustion.

The GLC-FIRE database was then queried to obtain emission factors for the SCC numbers listed above. Emission factors were found for the SCCs of 10100401, 10100404, 10200401, 10300401, 10100405, 10100501, 10200501 and 10300501.

The SCCs of 10100401, 10100404, 10200401 and 10300401 are similar processes, so the emission factors for the SCC 10100401 were used since they had a higher factor quality.

The SCCs of 10100405, 10100405, 10200404 and 10300404 are similar processes, so the emission factors for the SCC 10100405 were assumed to apply to the other SCCs of this group.

The SCCs 10100501, 10200501, 10300501, 10500105 and 10500205 are similar processes, so the emission factors for SCC 10100501 were assumed to apply to the other SCCs of this group. There was no emission factor for hexavalent chrome for this group of SCCs, so an emission factor was



Internal Combustion

	Sources <25 tons/year	All Sources
Number of Sources	9	46
Total Emission Points	19	203

Data were obtained from the EIS for Cook, DuPage, Grundy, Kane, Lake, McHenry and Will Counties for emission points that had an SCC of 2xxxxxxx. Permitting of internal combustion emission points is required for combustion points that have a heat input of 1500 horsepower or greater. This is approximately equal to 3.8 million BTU/hr, so it is possible many internal combustion sources have not been inventoried.

The GLC-FIRE database was then queried to obtain emission factors for the SCC numbers listed above. Emission factors were found for the SCCs (that occurred in the EIS) of 20100101, 20200102, 20200201 and 20200202.

Emission factors were found for the pollutants arsenic, cadmium, total chrome, cobalt, copper, lead, manganese, mercury and nickel for the SCC 20100101. The SCCs of 20100102, 20200101 and 20200102 are similar processes that did not have emission factors, so the emission factors of 20100101 were assumed to apply. In the case of SCC 20200102, there was an emission factor for mercury, so this emission factor was used.

Emission factors were found for the pollutants cadmium, total chrome, copper, manganese, mercury, nickel and phenol for the SCC 20200201. The SCCs of 20100201, 20100202 and 20200202 are similar processes that did not have emission factors, so the emission factors of 20200201 were assumed to apply. In the case of SCC 20200202, there were emission factors for ethylbenzene and mercury, so these emission factors were used.

The emission factors identified were typically in terms of pounds of pollutant per 10^6 (or 10^{12}) BTU input. The EIS does not directly store this type of data. To determine the heat input in terms of BTUs, the operating rate was multiplied by the heat content and then converted. This number was then multiplied by the emission factor to obtain the emission rate. A density of 7.88 and 7.05 lb/gal was assumed for residual oil and distillate oil, respectively, when converting emission units that fired oil.

Chemical Manufacturing

No sources were inventoried for the chemical manufacturing SCCs (301xxxxx). These sources should be over 25 tons/year and have a Maximum Achievable Control Technology (MACT) category established for them.

Food and Agriculture

Data were obtained from the EIS for Cook, DuPage, Grundy, Kane, Lake, McHenry and Will Counties for emission points that had an SCC between 30300801 and 30300899. The GLC-FIRE database was then queried to obtain emission factors for the SCC range.

To calculate uncontrolled emissions, the operating rate from the EIS was multiplied by the appropriate emission factor. When calculating emissions from emission points that had a control device associated with it, the pollutant removal efficiency was assumed to be equivalent to the particulate removal efficiency from the EIS.

The emission factor for cadmium for SCC 30300813 was a controlled emission factor (ESP). A removal efficiency of 95% was assumed to calculate an uncontrolled emission factor.

Primary Met9sion fao2nt remduh it, 2 Gb- PcCeeluh it, 2 Gb0 -3.51 12 307.8 .835ln7.525o2l5o2 e

The emission factor for total chrome for SCC 30500201 was a controlled emission factor (scrubber). A removal efficiency of 90% was assumed to calculate an uncontrolled emission factor.

The emission factor for hexavalent chrome for SCC 30500201 was a controlled emission factor (scrubber). A removal efficiency of 90% was assumed to calculate an uncontrolled emission factor.

The emission factor for POM for SCC 30500201 was a controlled emission factor (cyclone plus scrubber). A removal efficiency of 95% was assumed to calculate an uncontrolled emission factor.

Mineral Products - Concrete Batching

	Sources <25 tons/year	All Sources
Number of Sources	117	128
Total Emission Points	401	448

Data were obtained from the EIS for Cook, DuPage, Grundy, Kane, Lake, McHenry and Will Counties for emission points that had an SCC between 30501101 and 30501199. The GLC-FIRE database was then queried to obtain emission factors for the SCC range.

To calculate uncontrolled emissions, the operating rate from the EIS was multiplied by the appropriate emission factor. When calculating emissions from emission points that had a control device associated with it, the pollutant removal efficiency was assumed to be equivalent to the particulate removal efficiency from the EIS.

Organic Solvent Evaporation - Dry Cleaning

	Sources <25 tons/year	All Sources
Number of Sources	137	145
Total Emission Points	189	205

Data were obtained from the EIS for Cook, DuPage, Grundy, Kane, Lake, McHenry and Will Counties for emission points that had an SCC of 40100101 or 40100103. The emission rate of volatile organic material was then taken directly from the EIS to represent the emissions of perchloroethylene.

In the cases where there was control equipment, the removal efficiency for perchloroethylene was assumed to be equivalent to the removal efficiency of volatile organic material from the EIS.

The data obtained from the EIS is not representative of the entire population of dry cleaners. For sources using less than 360 gallons of perchloroethylene per year, a permit is not required. Since a permit is not required, very few dry cleaners exist in the stationary point source inventory. Where data does exist, it is out of date. Many dry cleaners have switched to dry-to-dry machines, greatly reducing emissions. As part of the NESHAP, extensive data are being made available regarding dry cleaners. This data will be evaluated an placed in the inventory and this report.

Organic Solvent Evaporation - Degreasers

	Sources <25 tons/year	All Sources
Number of Sources	182	240
Total Emission Points	244	376

Data were obtained from the EIS for Cook, DuPage, Grundy, Kane, Lake, McHenry and Will Counties for emission points that had an SCC of 40100202, 40100203, 40100204, 40100205, Coun8ies fo Con ty an directlythe EIS 6or CDuPage, Organicsdy (b Kane, Lake, McHenry and Will08 Tw[(Coun8ies f

Number of Transfer Machines: 105

The perchloroethylene consumption and dry cleaning equipment (machine type, number of machines and control equipment type) data were obtained from the 1993 Initial Notification Report submitted by dry cleaning establishments as required under the NESHAP standard. This included 2990 sources.

Perchloroethylene emissions were calculated by using the emission factor 0.7 lb perchloroethylene emitted per lb of perchloroethylene used for dry-to-dry machines. For transfer machines, a value of 0.82 was used. In the cases where a source had both types of equipment, the perchloroethylene usage was split evenly among the machines.

RESULTS

The tables below provide the results of Illinois' toxic emissions pilot inventory for the source categories listed above. The results are not analyzed, nor is there a determination of significant digits. The EIS can maintain emission estimates to four decimal places, so that precision was maintained. For dioxins and furans, the emission rate was extended to eight decimal places due to the extremely low emission rates obtained for those pollutants. The tables summarize the results according to county emissions, SIC emissions and pollutant emissions.

Data have been provided both for sources with criteria pollutant emissions less than 25 tons/year and for all sources for the county emission summary and pollutant emission summary. Data for the SIC emission summary were only provided for sources emitting less than 25 tons/year of criteria pollutants due to the extreme length. Data for emissions by SIC for all sources are available.

County Emission Summary: Table A-1 is a summary, by county, of the emissions calculated for

Appendix B: Indiana Toxic Emissions Inventory

BACKGROUND

Indiana prepared an inventory of toxic emissions for minor point sources for calendar year 1993 for Lake and Porter counties, located along the southwest shore of Lake Michigan. The two-county area has a 1990 population of 604,526, representing 6 percent of the total population of the overall study area. The table below provides a brief demographic overview of the two counties included in Indiana’s portion of the regional inventory.

Demographic Characteristics for the Indiana Region of the Southwest Lake Michigan Air Toxics Pilot Study Area

	Lake Co.	Porter Co.
Total population, 1990	475,594	128,932
Urban population, 1990	453,887	86,403
Rural population, 1990	21,707	42,529

Source: U.S. Bureau of the Census

Despite limited resources, the *Air Toxics Emissions Protocol* was followed as much as possible. Previous to this project, Indiana did not have a database of toxic estimates for the 49 compounds covered by the pilot study. The RAPIDS software, available information from existing emissions statement databases, and the Factor Information Retrieval System (FIRE), Version 3.0, were used to calculate emissions for the inventory.

DATA SOURCES

The initial list of sources was taken from an emissions statements database similar in structure and content to AIRS (Aerometric Information Retrieval System). This database contains facilities required to report criteria pollutant emissions. Confidence in the data are substantial as data submitted by each facility are certified by the state and local agency inspectors and used as fee billing information. This list was reduced to include only minor sources that have actual annual emissions of less than 25 tons total criteria pollutants.

For the pilot study the primary interest is sources that are not applicable to Maximum Achievable Control Technology (MACT) standards, further reducing the number of sources included. Residential woodburning stoves were included to help keep the inventory consistent with the other pilot states' inventories. The information included in the inventory is limited to that which was available to staff and to sources for which Source Classification Codes (SCC) codes can be identified. The results listed below have not been reviewed by the individual plants for accuracy and, consequently, should be used with caution. Mobile and area sources (i.e., dry cleaners and gas stations) were not included as part of Indiana’s contribution to the pilot study.

Information from the emissions inventory database was used to calculate toxic emissions for the processes within each facility. One disadvantage of using a criteria pollutant database for information is that the volatile organic compounds (VOCs) emissions are not broken down into the speciated compounds, and the fuel process rates are not always descriptive enough to be used with FIRE emission factors. Also, not enough information is provided on control efficiencies for air toxic compound emissions. The inventory data include the process description, SCC codes, and fuel process rates for each process within a facility. All SCC's of the selected sources are matched against available emission factors from FIRE Version 3.0 and then only these sources are included in the inventory. Most of the emission factors for the 49 GLC compounds are from FIRE. If a source-specific emission factor for lead was available for a particular source, then that emission factor was used.

The total number of sources in the point source inventory for Lake and Porter counties is under 200. This number may appear low in relation to Illinois and Wisconsin and the relative population levels in the three states. As noted in the introduction, differences among the three states' inventories may result from differing reporting requirements. Indiana's pilot inventory staff have reviewed this issue and verified the accuracy of their methodologies and calculations; the details in this regard are available in Indiana's project documentation file.

CALCULATION METHODS

The type of calculation method used throughout the inventory is generic emission factor, as referenced in the protocol. For all the sources calculated with results included in the inventory, this method is Priority 1. The priority numbers are used to determine which estimation method is best for that particular process, with 1 being the best choice. No speciation mass fractions are used to calculate emissions. Also, no mass balance methodology is used because, where this was a Priority 1

SIC Code: 2951
Number of Sources: 1
Pollutants: POM

Rotary Dryers

SIC Code: 2951
Number of Sources: 7
Pollutants: arsenic, benz(a)anthracene, benzo(a)pyrene, cadmium, chromium, chromium VI, chrysene, copper, fluoranthene, lead, manganese, mercury, naphthalene, nickel, PAH, POM

Drum Dryers

SIC Code: 2951
Number of Sources 1
Pollutants: arsenic, benz(a)anthracene, benzo(a)pyrene, cadmium, chromium, chromium VI, chrysene, copper, fluoranthene, manganese, mercury, naphthalene, nickel, TCE, 111

Wood Incineration

SIC Code: 3341
Number of Sources: 1
Pollutants: benz(a)anthracene, benzo(a)pyrene, fluoranthene

The source has a control device and the emission factors are uncontrolled, so it is assumed that the 70% overall control efficiency for PM could also be applied to these emissions.

Secondary Metal Production - Al Smelting Furnace

SIC Code: 3341
Number of Sources: 1
Pollutants: cadmium, lead, nickel

Distillate Boilers

SIC Codes: 2992, 2821, and 3312
Number of Sources: 3
Pollutants: arsenic, cadmium, lead, manganese, mercury, nickel, chromium, POM

SIC Code: 3341

Pollutants: arsenic, benz(a)anthracene, benzo(a)pyrene, cadmium, chromium, chromium VI, chrysene, cobalt, fluoranthene, manganese, mercury, naphthalene, nickel

Chemical Manufacturing - Inorganic Pigments

SIC Code: 2819
Number of Sources: 2
Pollutants: lead

Electric Induction Furnaces

SIC Code: 3316
Number of Sources: 1
Pollutants: Manganese

Area: Residential Woodburning Stoves

The wood consumption rate for woodburning stoves is taken from the *Draft Indiana Greenhouse Gas Emissions and Sinks: Estimates for 1990* (IDEM, Nov. 1994). The annual fuel consumption is calculated using heating degree days and the number of housing units using wood as the primary fuel. The following SCC/AMS codes are associated with this process: 2104008010, 2104008050, and 10100903. Emissions are calculated for the following pollutants: arsenic, benz(a)anthracene, benzo(a)pyrene, cadmium, chromium, chromium VI, chrysene, cobalt, fluoranthene, manganese, mercury, naphthalene, nickel, PAH, PCDD, PCDF, Phenol, TCDD, 2378, and TCDF, 2378. Residential woodburning does not have an SIC code because it is not an industrial activity. SIC code 9999 will be used to identify this source.

RESULTS

The top five pollutants for small point sources, with respect to annual quantity emitted, are lead, manganese, nickel, polycyclic organic matter (POM), and naphthalene. Four source categories are represented in the inventory: petroleull be Ties are cadt candustrias, wlll be T[(ood ad)-0oodb.8es arheisal Mes boi Mes aood conbestron iA205 1 Tes a0120503.angfacturing -(301%%%%%

Table B-2: Porter County IN, Toxic Emissions Sorted by SIC and Pollutant (lbs)

	2821	2951	9999	Total
Arsenic	0.0012	0.119	0.418	0.54
Benz(a)anthracene		0.0123	4.75	4.76
Benzo(a)pyrene		0.0027	28.5	28.50
Cadmium	0.0031	0.9826	0.095	1.08
Chromium	0.0135	0.3528	0	0.37
Chromium VI		0.0669	0.2185	0.29
Chrysene		0.0069	47.5	47.51
Cobalt			0.6175	0.62
Copper		0.5377		0.54
Fluoranthene		0.0434	38	38.04
Lead	0.0025	0.3687		0.37

Appendix C: Wisconsin Toxic Emissions Inventory

BACKGROUND

The State of Wisconsin conducted its air toxic emissions inventory for the pilot study in Milwaukee, Racine and Kenosha counties for calendar year 1993. With a 1990 population of 1,262,490, the three-county area represents 14 percent of the total population of the overall study area. The table below provides a brief demographic overview of the three counties included in Wisconsin's portion of the regional inventory.

Demographic Characteristics for the Wisconsin Region of the Southwest Lake Michigan Air Toxics Pilot Study Area

	Kenosha Co.	Milwaukee Co.	Racine Co.
Total population, 1990	128,181	959,275	175,034
Urban population, 1990	101,076	959,275	138,943
Rural population, 1990	27,105	0	36,091

Source: U.S. Bureau of the Census

The area sources inventoried are divided in two classes: individual "small" (or "minor") point sources that emit less that ten tons per year of any of the 49 pollutants; and "traditional" area sources. Wisconsin followed the *Air Toxics Emissions Inventory Protocol* in developing its contribution to the pilot study, as well the Factor Information Retrieval System (FIRE) and the Reference Tables in the Regional Air Pollution Inventory Development System (RAPIDS). An evaluation of the protocol document and an assessment of the emission estimation techniques used in the project are provided below.

DATA SOURCES

The majority of the emission sources included in the Wisconsin inventory were collected by the Wisconsin Department of Natural Resources (DNR) as part of its annual air emissions inventory process. State regulation, ch. NR 438, Wis. Adm. Code, requires detailed annual emission reports from any source with total, actual, annual emissions above a reporting threshold. The reporting threshold varies for each of the 500+ air contaminants covered by the rule, from as little as 0.0001 lb/yr for 2,3,7,8-TCDD to as much as 100,000 tons per year (TPY) for carbon dioxide. For most contaminants the reporting threshold is 3 TPY or less. As a result, Wisconsin's "point source" emissions inventory contains data from many sources that are traditionally considered "area sources" (i.e., minor sources emitting less than 10 TPY of a toxic contaminant).

For purposes of the pilot study, however, only data for the smaller point sources in Wisconsin's emissions inventory were included. Specifically, the scope was limited to point sources with actual annual emissions below 10 tons for each hazardous air pollutant covered by the Clean Air Act. The rationale for this decision is that sources with emissions above that level should be regulated by a federal MACT standard (Maximum Achievable Control Technology) for air toxics, while the Urban Area Study that the pilot study supports is intended to identify smaller “area” sources that might otherwise go unregulated.

Wisconsin’s annual emissions inventory is not limited to any particular type of industry or process. If the total emissions for a source exceed the reporting threshold for a given pollutant, the source is required to provide information on any process emitting any amount of that pollutant. All SIC and SCC codes are, in theory, covered by this effort. In practice, many SIC and SCC codes are not responsible for air emissions above any of the reporting thresholds. In the Wisconsin pilot inventory, a few of these types of sources have been inventoried using area-source methods. Wisconsin’s air emissions inventory rule includes all 49 pollutants covered by pilot study.

Each December, Wisconsin DNR mails hard copy and/or electronic update forms to every source on the existing emissions inventory. Sources are asked to update any out-of-date information and ente[(em)85gc ai

Landfill Gas - Combustion and Fugitive Emissions

Landfill gas is produced by the anaerobic decomposition of organic materials, such as paper, food waste, yard waste, etc. Landfill gas production begins one to two years after waste placement, and may last from 10-60 years. Wisconsin requires that all landfills (operational or not) recover landfill methane for energy use, or flare the methane to reduce greenhouse gas emissions.

Source Identification

Protocol Section 3.2.1-SIC Codes
SIC code 4953- REFUSE SYSTEMS. This includes the category LANDFILL, SANITARY: Operation of.

Protocol Section 3.2.2-SCC/AMS Codes
SCC 50200601-Waste Gas Flares-provides emission factors [lb/MMBTU] for: benz(a)anthracene, benzo(a)pyrene, carbon tetrachloride, chrysene, fluoranthene, methylene chloride, naphthalene, PCBs, TCDD 2378, TCDF 2378, tetrachloroethene, 111 trichloroethane, trichloroethylene.

Protocol Section 3.2.3-New SCC/AMS Codes
The existing SCC/AMS codes adequately cover this category.

Protocol Section 3.3-Pollutants
13 pollutants were identified: arsenic, benz(a)anthracene, benzo(a)pyrene, carbon tetrachloride, chrysene, fluoranthene, methylene chloride, naphthalene, PCBs, TCDD 2378, TCDF 2378, tetrachloroethene, 111 trichloroethane, trichloroethylene.

Protocol Section 3.4-Identifying Facilities
While a complete inventory of operational landfill sites exists, comprehensive information on landfill sites that have closed up to 60 years ago does not exist. Wisconsin's total methane landfill gas produced (cu.ft.) was found from a Wisconsin Greenhouse Gas study (PSC/WDNR, 1995).

Air Toxic Emission Estimation

Protocol Section 4.1-Temporal Resolution
Methane production is presented for 1990 and 1995 in the Greenhouse Gas Emission study. The Wisconsin DNR Greenhouse Gas Group's database provided methane production for 1993. Methane production is assumed to be constant throughout the year.

Protocol Section 4.1- Spatial Resolution
The methane produced in the state was disaggregated to each county by the county's population fraction of the state.

Protocol Section 4.2-Emission Estimation Techniques (EETs)
Protocol Section 4.3-Overall Inventory Development
Protocol Section 4.4-Activity and Emission Units
Protocol Section 4.5-Scale-up for Missing Sources

The county methane volumes were doubled to account for CO_2 produced along with the methane, which is vented, rather than flared. The numbers were doubled again, to reflect the standard collection efficiency of 50%-- that is, 50% is collected and flared, while 50% escapes the flaring process despite the best available technology. When required, the methane was converted from cubic feet to MMBTU assuming $5*10^{-4}$ MMBTU per cuft. Emission factors from FIRE were then applied.

Sample Calculations

Emissions by county were calculated as follows:

When using SCC 50200601 emission factors, County_Emis =

Wis_methane_flared * 4 * 5E-4 MMBTU/cu ft * County_pop_fraction * Emis_factor [lbs/MMBTU]

When using SCC 50200601 emission factors, County_Emis =

Wis_methane_flared * 4 * County_pop_fraction * Emis_factor[lbs/cu.ft.]

Results

	Kenosha (pounds)	Milwaukee (pounds)	Racine (pounds)

U.S. EPA. Air Emissions from Municipal Solid Waste Landfills- Background Information for Proposed Standards and Guidelines. EPA-450/3-90-011a. March 1991.

Evaluation of Protocol and Recommendations

The methodology of using emission factors (AP-42) for methane combustion is unsatisfactory for total landfill emissions. The emissions reported only represent toxics from the combustion and release of landfill gasses (CO_2 and CH_4.) A much larger source of air toxics from landfill sites may be from the volatilization of solvent and petroleum wastes, and heavy metals airborne in dust. Emissions are highly dependent on the content of the waste.

Residential Woodburning

The Source Summary Database was used to construct a list of potential, expected target compounds emitted due to residential woodburning. Seven AMS codes were searched for residential woodburning and 17 expected pollutant emissions were identified. A search of the Source Summary Database for pollutants emitted from industrial wood-fired boilers (10100903) located an additional 7 possible target compounds.

Expected target compound emissions identified are:

SCC Code 2104008%%	SCC Code 10100903
1. 2,3,7,8 TCDD	1. Arsenic
2. 2,3,7,8 TCDF	2. Chromium VI
3. PCDD total	3. Cobalt
4. PCDF total	4. Lead
5. Ethelbenzene	5. POM
6. Benzo(a)pyrene	6. Mercury
7. Benz(a)anthracene	7. PCB
8. Cadmium	
9. Chromium	
10. Copper	
11. Manganese	
12. Naphthalene	
13. Phenol	
14. Chrysene	
15. Fluoranthene	
16. Nickel	
17. PAH's	

In order to compile the most extensive estimate of emissions due to residential woodburning in the state, Wisconsin's methods deviated from the protocol in that all AMS codes were applied, in order of relevance, when calculating emissions. In the case of calculating emissions from wood-burning stoves, for example, factors found in the AMS codes 2104008010, 2104008050, and 10100903 were included.

Emission factors for 22 of the 24 total pollutants were gathered from the FIRE database. Benz(a)anthracene, benzo(a)pyrene, cadmium, chromium, chrysene, copper, fluoranthene, manganese, naphthalene, nickel, phenol, and PAH factors were obtained for AMS code 2104008050--Non-catalytic wood stoves-general.

2,3,7,8 TCDD, 2,3,7,8 TCDF, PCDD total, and PCDF total were obtained for AMS code 2104008010--Residential wood stoves general. Finally, emission factors for arsenic, chrome VI, cobalt, lead, mercury and POM were obtained from SCC 10100903--wood fired boilers.

Protocol Section 3.4-Identifying Facilities
1994 survey information (T. Mace, personal communication) regarding the volume of wood (in cords) burned in each Wisconsin Forest Survey Unit was provided for the pilot study. This information was provided as volume burned in stoves, furnaces, fireplace inserts, fireplaces, and combinations. Survey information contained the volume of wood (cords) burned for pleasure (all categories), secondary heat, and primary heat (Mace pers. comm.).

Air Toxic Emission Estimation

Protocol Section 4.1-Temporal Resolution
The data set quantifying residential wood use in Wisconsin is based on annual estimates of consumption by users. It is reasonable to assume that all residential woodburning occurs between September and April (six months). It was decided that the most accurate method of estimating wood use in subsequent years is to adjust the data set to reflect the number of heating-degree days for the given year of estimation. Data pertaining to residential wood use is not frequently gathered and may be scarce in other states.

Protocol Section 4.1-Spatial Resolution
Wood use estimates from Forest Survey Units were disaggregate to a county by county basis for calculation of emission estimates.

Protocol Section 4.2-Emission Estimation Techniques (EETs)
Protocol Section 4.3-Overall Inventory Development
Protocol Section 4.4-Activity and Emission Units
Protocol Section 4.5-Scale-up for Missing Sources
Expected pollutants located in the SSD are listed below. Emission factors, if available, were obtained from the most recent version of the FIRE database. No information is available on the proportion of the population with emission controls (catalytic wood stoves), or the effectiveness of these control measures over time. The population of catalytic wood stoves was assumed to be zero.

The estimates developed for the amount of wood burned are a representation of the total wood burned in each county. Therefore, no scale-up for missing sources is necessary. There is no possibility that emissions from residential woodburning were double counted.

1994 survey information regarding the volume of wood (in cords) burned in each Wisconsin Forest Survey Unit was supplied. This information was provided as volume burned in stoves, furnaces, fireplace inserts, fireplaces, and combinations. Survey information also contained the volume of wood (cords) burned for pleasure (all categories), secondary heat, and primary heat (Mace pers. comm.). Since the protocol dictates that counties serve as the functional unit, Forest Survey Unit data were disaggregate to county level as follows:

Pleasure and primary/secondary heating use was divided within each county based on the fraction of wood burned in wood-burning stoves, wood-burning furnaces, fireplaces with inserts, fireplaces (no insert), and firepits within the Forest Survey unit. Cords of wood burned in stoves, furnaces and fireplace inserts were summed, and wood burned in fireplaces, firepits, and combinations were summed. Emission factors of these two groups were assumed to be characterized as wood burning stoves and fireplaces.

The volume of wood was converted to weight, assuming 1.8 tons/cord (Mace pers. comm.) and normalized for the difference in heating degree days in 1993 compared to 1994- giving an estimate of 1993 consumption (Wisconsin Department of Administration 1994).

Cords of wood burned for pleasure were assumed to be proportional to the amount of single family detached housing in each county compared to the Forest Survey Unit total and that the number of fireplaces is equally distributed among counties. Cords burned for pleasure use in each county were calculated by multiplying the proportion of detached housing units in each county (U.S. Department of Commerce, Bureau of the Census 1990) relative to the survey unit total by the total number of cords burned for pleasure in the Forest Survey Unit.

Cords of wood burned for primary or secondary heat was assumed to be proportional to the number of households in the county that are primarily heated by wood compared to the total

County	Benz(a)anthracene	8.964	5.015	13.979
	Benzo(a)pyrene	53.783	30.092	83.875
	Cd	0.179	0.100	0.280
	Cr	0.00E+00	0.00E+00	0.00E+00
	Chrome VI	0.412	0.231	0.643
	Chrysene	89.639	50.153	139.792
	Co	1.165	0.652	1.817
	Cu	3.048	1.705	4.753
	Fluoranthene	71.711	40.123	111.834
	Pb	9.860	5.517	15.377
	Mn and compounds	1.255	0.702	1.957
	Hg	0.058	0.033	0.091
	Naphthalene	1290.8	722.21	2013.00
	Ni and compounds	0.179	0.100	0.280
	phenol	71.711	40.123	111.834
	PCDDs	0.026	0.004	0.040
	PCDFs	0.143	2.51E-3	0.22
	PAHs	4481.93	2507.66	6989.59
	POM	25.995	14.544	22.36
	TCDD 2378	6.63E-05	1.40E-04	2.07E-04
	TCDF 2378	0.004	0.002	0.006

		Wood stoves (pounds)	Fireplaces (pounds)	TOTAL (pounds)
Milwaukee County	Arsenic	1.000	2.219	3.219
	Benz(a)anthracene	11.367	25.214	36.581
	Benzo(a)pyrene	68.204	151.282	219.486
	Cd	0.227	0.504	0.732
	Cr	0.00E+00	0.00E+00	0.00E+00
	Chrome VI	0.523	1.160	1.683
	Chrysene	113.673	252.137	365.810
	Co	1.478	3.278	4.756
	Cu	3.865	8.573	12.438
	Fluoranthene	90.938	201.709	292.648
	Pb	12.504	27.735	40.239
	Mn and compounds	1.591	3.530	5.121
	Hg	0.074	0.164	0.238
	Naphthalene	1636.89	3630.77	5267.66
	Ni and compounds	0.227	0.504	0.732
	phenol	90.938	201.709	292.648
	PCDDs	0.033	0.018	0.106
	PCDFs	0.181	1.3E-2	0.585
	PAHs	5683.65	12606.83	18290.48
	POM	32.965	73.120	58.53
	TCDD 2378	8.41E-05	7.06E-04	7.90E-04
	TCDF 2378	0.005	0.011	0.016

		Wood stoves (pounds)	Fireplaces (pounds)	TOTAL (pounds)
Racine	Arsenic	1.183	0.572	1.755

Benzo(a)pyrene	80.664	38.973	119.637
Cd	0.269	0.130	0.399
Cr	0.00E+00	0.00E+00	0.00E+00
Chrome VI	0.618	0.299	0.917
Chrysene	134.440	64.955	199.395
Co	1.748	0.844	2.592
Cu	4.571	2.208	6.779
Fluoranthene	107.552	51.964	159.516
Pb	14.788	7.145	21.933
Mn and compounds	1.882	0.909	2.792
Hg	0.087	0.042	0.130
Naphthalene	1935.93	935.34	2871.28
Ni and compounds	0.269	0.130	0.399
phenol	107.552	51.964	159.516
PCDDs	0.039	0.005	0.056
PCDFs	0.214	3.2E-03	0.319
PAHs	6721.99	3247.73	9969.73
POM	38.988	18.837	31.9
TCDD 2378	9.95E-05	1.82E-04	2.81E-04
TCDF 2378	0.006	0.003	0.009

References

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Evaluation of Protocol and Recommendations

Wisconsin deviated from the protocol in two instances. The Source Summary Database (SSD) was searched for a variety of process related SCC/AMS codes. The SCC/AMS codes were used burning stoves, fireplaces, and also wood-fired boilers were combined when producing emission estimations.

Including this composite of process-related emission factors results in the most complete estimates of emissions from residential wood use possible. It is recommended that other states follow this procedure of including emission factors derived for related processes for residential woodburning, and possibly in other cases, if the situation warrants.

Data quantifying residential wood fuel use may be limited or difficult to locate in other states. However, in Wisconsin, residential wood is a contributor to local air pollution. Other states are recommended to investigate the opportunity to obtain data for residential woodburning, to include this source in their toxic emission inventory.

Commercial Dry Cleaning Operations

Perchloroethylene (PERC, tetrachloroethene, tetrachloroethylene) is one of the most common solvents used by dry cleaning establishments. This section focuses on emissions from commercial facilities. The sources of emissions in dry cleaning operations are process vents from machines, equipment leaks and clothing transfer.

Two basic types of dry cleaning machines are considered: vented "dry-to-dry" and "transfer." Transfer machines have a separate washer and dryer; clothes have to be manually transferred from washer to dryer. Dry-to-dry machines combine the washer and dryer into one piece of equipment, eliminating the transfer step. Basic control devices for these machines are refrigerated condensers and carbon absorbers.

Source Identification

Protocol Section 3.2.1-SIC Codes
Dry Cleaning establishments are grouped under SIC code 7211 - Laundry, Cleaning, and Garment Services.

Protocol Section 3.2.2-SCC/AMS Codes
Protocol Section 3.3-Pollutants
The SSCs that describe PERC evaporation from dry cleaning operations are 40100101 (unit of activity in lbs PERC/lbs clothes) and 40100103 (unit of activity: lbs PERC/ton solvent consumed).

Protocol Section 3.4-Identifying Facilities
The PERC consumption and dry cleaning equipment (machine type and number, and control equipment type) data were obtained from the 1993 Initial Notification Report submitted by dry cleaning establishments as required under the NESHAP standard. The information collected from the initial notification document provided data for a total of 94 facilities that reported PERC as their main dry cleaning agent. Of the 94 facilities, 65 were located in Milwaukee County, 16 in Racine and 13 in Kenosha County.

Air Toxic Emission Estimation

Protocol Section 4.1-Temporal Resolution

For Kenosha County, Dry-to-dry machines, with emission controls:
Emissions = 1901 gal * 13.55 lb/gal * [0.52] = 13394 lbs.

For Kenosha County, Dry-to-dry machines, with no emission control:
Emissions = 394 gal * 13.55 lb/gal * [0.70] = 3737 lbs.

Results

County M394 ga-0.0006 04 T4eca/TTica.02 Tc0 Tw 69.72BT12 0 0 12 162 618.36 Tm2700006 Tc-0

The primary SIC code for this category is 5541 (Gasoline Service Stations). There are no other applicable SIC codes.

Protocol Section 3.2.2-SCC/AMS Codes
The RAPIDS SCC/AMS table was used to identify appropriate SCC and AMS codes for this source category. Filtering on SOURCE CODE = "COM/INS,SIC5541" yielded the following results:

1. Gasoline Retail Operations (SCCs 4-06-003-%%). Also known as Stage I, this refers to emissions from filling of storage tanks at gas stations. Specific codes are -01,-02,-05,-06,-07,-99.

2. Filling Vehicle Gas Tanks (SCCs 4-06-004-%%). Also known as Stage II, this refers to emissions from vehicle refueling at gas stations. Specific codes are -01,-02,-03,-99.

3. Petroleum & Petroleum Product Storage, Gasoline Service Stations (AMSs 25 st9AP6erations

average monthly sales of unleaded gasoline (i.e., diesel not included) for a 24-month period covering 1991 and 1992. This database is considered to be the most accurate and complete electronically-available database on this subject in the State. It includes over 400 gas stations in the three county study area.

Emission Estimation

Protocol Section 4.1 -Temporal Resolution
Monthly gasoline sales for the inventory year (1993) were assumed to be identical to monthly sales over the two-year period represented in the database (1991-1992). Furthermore, each facility in the database was assumed to have been in business for the entirety of 1993. Monthly average sales numbers in the database are therefore multiplied by 12 to get total 1993 sales estimates for the sources in the database.

Protocol Section 4.1 -Spatial Resolution
Even though data are available at the source level for non-attainment counties, gasoline stations were treated as county-wide area sources in this study for the following reasons:

1. Other states will probably treat gas stations as an area source (data consistency);
2. Wisconsin will have to treat gas stations in ozone attainment counties as an area source (data consistency);
3. In the judgement of the Wisconsin inventory preparers, the end use of the SWLM inventory does not demand point source accuracy for these sources.

Protocol Section 4.3 -EETs
Table 4-3 of the protocol indicates that emission factors are to be used as the first priority to estimate emissions from SCC-AMS codes 4-06-%%%-%%.

For 4-06-003-%%, emission factors are available for 1,2-dichloroethane and ethylbenzene. However, the ethylbenzene factor in RAPIDS appears to be in error. It is expressed as lb/gal gas when it correctly should be lb/1000gal gas, as corrected in FIRE 1994. As for 4-06-004-%%, emission factors are only available for 1,2-dichloroethane.

A source-specific speciation profile was found in Table 3-2 of EPA's Stage II Technical Guidance (EPA-450/3-91-022a, November 1991). Since the profile in S'fgCIATEiserted aC,and che fountieg rmission frompoint source .

Protocol Section 4.13-2Emssion fCnthrol

(Stage 1.) It was considered most consistent with the protocol to avoid the use of emission factors that include controls. Uncontrolled emission factors were used, and a control efficiency was back-calculated by comparing the uncontrolled and controlled emission factors in FIRE. This results in an estimated control efficiency of 95.5%, which is consistent with AP-42 (Stage I vapor recovery control typically 93 to 100% effective). This assumes that the control efficiency for volatile HAPs is identical to that for total VOC.

(Stage 2.) The DNR only approves Stage 2 vapor recovery devices certified by the California Air Resources Board (CARB) and CARB only certifies devices that are 95% effective or better. The control efficiency for the pilot study inventory for Stage II processes with vapor recovery devices was assumed to be 95%. Again, this assumes that the control efficiency for volatile HAPs is identical to that for total VOC. Most service stations did not have Stage 2 vapor recovery in place for the inventory year, 1993. Emission estimates are made based on vapor recovery installation dates as recorded in the state's compliance tracking database.

Protocol Section 4.3 -Scale-Up For Missing Sources
As expected, less than a 100% response was received to the information request that was used to generate the gas station database. After months of follow-up, data are still being added. More than 90% of the sources are now estimated to be in the database. Taking a conservative approach, 10% of the sources that should be in the database were assumed not to be, and therefore the throughput data were scaled up appropriately. Furthermore, the data are based on responses to a notification requirement which did not apply to sources with tanks smaller than 2000 gallons. Based on Table 4-3 from EPA's Stage II Technical Guidance, 2.4% of gasoline sales were estimated to come from sources with tanks smaller than 2000 gallons. An additional adjustment was made to the throughput to account for these unregulated small sources.

Sample Calculations

(1) Estimated average monthly gasoline sales from stations in DNR Database (MONAVG):

Kenosha	4,924,245.4 gal
Milwaukee	26,286,881.2 gal
Racine	5,011,560.3 gal

(2) Estimated Annual Gasoline Sales for ALL Stations (TOTAL):

Annualize, Scale-Up for Missing Sources, Scale-Up for Unregulated Small Sources.
i.e., TOTAL = MONAVG*12*1.100*1.024

Kenosha	66,560,041 gal/yr
Milwaukee	355,314,516 gal/yr
Racine	67,740,258 gal/yr

(3) Estimated throughput for Stage 1 displacement losses:

a. Uncontrolled sources (2.4% of all sales, i.e., ST1U = TOTAL*0.024)

Kenosha	1,597,441 gal/yr
Milwaukee	8,527,548 gal/yr

Racine 1,625,766 gal/yr

b. Controlled sources (ST1C = TOTAL-ST1U)

Kenosha	64,962,600 gal/yr
Milwaukee	346,786,968 gal/yr
Racine	66,114,492 gal/yr

(4) Estimated throughput for Stage 2 displacement losses:

a. Controlled sources (ST2C; estimate based on compliance tracking database)

Kenosha	6,410,157 gal/yr
Milwaukee	45,399,805 gal/yr
Racine	6,526,695 gal/yr

b. Uncontrolled sources (TOTAL-ST2C)

Kenosha	60,149,884 gal/yr
Milwaukee	309,914,711 gal/yr
Racine	61,213,563 gal/yr

(5) Estimated Stage 1 Displacement Emissions:

CE = 0.000 for uncontrolled splash-fill
CE = 0.955 for controlled submerged-fill

a. 1,2-Dichloroethane

EF = 1.53E-06 lb/gal for uncontrolled splash-fill
EF = 9.76E-07 lb/gal for uncontrolled submerged-fill

Kenosha: 1.53E-06 * 1,597,441 = 2.4441 lb (from uncontrolled sources)
9.76E-07 * 64,962,600 * (1-0.955) = 2.8532 lb (from controlled sources)

Milw.: 1.53E-06 * 8,527,548 = 13.0471 lb (from uncontrolled sources)
9.76E-07 * 346,786,968 * (1-0.955) = 15.2309 lb (from controlled sources)

Racine: 1.53E-06 * 1,625,766 = 2.4874 lb (from uncontrolled sources)
9.76E-07 * 66,114,492 * (1-0.955) = 2.9037 lb (from controlled sources)

b. Ethylbenzene (based on source-specific speciation)

EF = 0.001 * EF_{VOC}
EF_{VOC} = 0.0115 lb/gal for uncontrolled splash-fill
EF_{VOC} = 0.0073 lb/gal for uncontrolled submerged-fill
EF = 1.15E-05 lb/gal for uncontrolled splash-fill
EF = 7.3E-06 lb/gal for uncontrolled submerged-fill

Kenosha: 1.15E-05 * 1,597,441 = 18.3706 lb (from uncontrolled sources)
7.3E-06 * 64,962,600 * (1-0.955) = 21.3402 lb (from controlled sources)

Milw.: 1.15E-05 * 8,527,548 = 98.0668 lb (from uncontrolled sources)
7.3E-06 * 346,786,968 * (1-0.955) = 113.9195 lb (from controlled sources)

Racine: 1.15E-05 * 1,625,766 = 18.6963 lb (from uncontrolled sources)

7.3E-06 * 66,114,492 * (1-0.955) = 21.7186 lb (from controlled sources)

c. Naphthalene (based on source-specific speciation)

$EF = 0.005 * EF_{VOC}$
EF_{VOC} = 0.0115 lb/gal for uncontrolled splash-fill
EF_{VOC} = 0.0073 lb/gal for uncontrolled submerged-fill
EF = 5.75E-05 lb/gal for uncontrolled splash-fill
EF = 3.65E-05 lb/gal for uncontrolled submerged-fill

Kenosha: 5.75E-05 * 1,597,441 = 91.8529 lb (from uncontrolled sources)
3.65E-05 * 64,962,600 * (1-0.955) = 106.7011 lb (from controlled sources)

Milw.: 5.75E-05 * 8,527,548 = 490.3340 lb (from uncontrolled sources)
3.65E-05 * 346,786,968 * (1-0.955) = 569.5976 lb (from controlled sources)

Racine: 5.75E-05 * 1,625,766 = 93.4815 lb (from uncontrolled sources)
3.65E-05 * 66,114,492 * (1-0.955) = 108.5931 lb (from controlled sources)

(6) Estimated Stage 2 Displacement and Spillage Emissions:

CE = 0.000 for displacement losses from uncontrolled vehicle refueling
CE = 0.950 for displacement losses from controlled vehicle refueling
Throughput for spillage emissions = TOTAL

a. 1,2-Dichloroethane

EF = 1.46E-06 lb/gal for displacement losses from vehicle refueling
EF = 8.85E-08 lb/gal for spillage losses

Kenosha: 1.46E-06 * 60,149,884 = 87.8188 lb (displacement - uncontrolled sources)
1.46E-06 * 6,410,157 * (1-0.95) = 0.4679 lb (displacement - controlled sources)
8.85E-08 * 66,560,041 = 5.8906 lb (spillage from all sources)

Milw.: 1.46E-06 * 309,914,711 = 452.4755 lb (displacement - uncontrolled sources)
1.46E-06 * 45,399,805 * (1-0.95) = 3.3142 lb (displacement - controlled sources.)
8.85E-08 * 355,314,516 = 31.4453 lb (spillage from all sources)

Racine: 1.46E-06 * 61,213,563 = 89.3718 lb (displacement - uncontrolled sources)
1.46E-06 * 6,526,695 * (1-0.95) = 0.4764 lb (displacement - controlled sources)
8.85E-08 * 67,740,258 = 5.9950 lb (spillage from all sources)

b. Ethylbenzene (based on source-specific speciation)

$EF = 0.001 * EF_{VOC}$
EF_{VOC} = 1.1E-02 lb/gal for displacement losses from vehicle refueling
EF_{VOC} = 7.0E-04 lb/gal for spillage losses
EF = 1.1E-05 lb/gal for displacement losses from vehicle refueling
EF = 7.0E-07 lb/gal for spillage losses

Kenosha: 1.1E-05 * 60,149,884 = 661.6487 lb (displacement - uncontrolled sources)
1.1E-05 * 6,410,157 * (1-0.95) = 3.5256 lb (displacement - controlled sources)
7.0E-07 * 66,560,041 = 46.5920 lb (spillage from all sources)

WDNR Study: Hazardous Air Pollutant Emission from Wastewater Treatment Plants (1990). The Wisconsin report uses data from the previous report scaled-up for 1993 population figures.

Source Identification

Protocol Section 3.2.1-SIC Codes
SIC code 4952 was used in covering sewerage systems in reporting of POTW air emissions.

Protocol Section 3.2.2-SCC/AMS Codes
When searching for potential pollutants SCC 501007%%, which was found in the FIRE database, was used.

Protocol Section 3.2.3-New SCC/AMS Codes
No new SCC's are required.

Protocol Section 3.3-Pollutants
A search of the Source Summary Database located 23 (from the GLC list of 49) possible toxic emissions.

Protocol Section 3.4-Identifying Facilities
Generally, there is one POTW in each county, with some of the heavily populated counties having more. In the 1990 report POTW's were identified. Larger POTW's are required to report as point sources and consequently were not included in the pilot study report. In the spatial scope of this project there were two POTW's for which estimates were made: 1) Kenosha County and 2) Racine County.

Air Toxic Emission Estimation

Protocol Section 4.1-Temporal Resolution
Emission estimates are presented on an annual basis.

Protocol Section 4.1-Spatial Resolution
Emission estimates are presented at the individual POTW level. Emissions from each POTW are then included in the county-wide estimate. In the counties in this report there is one POTW per county.

Protocol Section 4.2-Emission Estimation Techniques (EETs)
Process simulation software (NOCEPM model) was used in the 1990 report to estimate emissions at POTW's. Input data for the process simulation was provided by the POTW's to the DNR. The inflow to POTW's was assumed to be the same in 1993 as when the estimates were produced. The estimated amount of toxics emitted by the increased population was then estimated.

Protocol Section 4.3-Overall Inventory Development
Protocol Section 4.4-Activity and Emission Units
Protocol Section 4.5-Scale-up for Missing Sources
In the estimate of 1993 emissions from POTW's, data collected previously, available in an existing Wisconsin database, was used. All estimates were provided in pounds produced annually. No scale-up for missing sources is considered necessary.

Sample Calculations

Estimated methylene chloride emissions at the Kenosha County POTW 1993

Estimated methylene chloride emissions in 1986 = 683 lbs

Population increase 1986-1993 = 5.94%

Methylene chloride emission estimate for 1993 = 683 x 1.0594 = 723.6 lbs

Results

Only one POTW (in Kenosha County) reported emissions of any toxics in the protocol. Estimated emission for 1993 was calculated to be 723.6 lbs of methylene chloride.

References

WDNR Bureau of Air Management. 1990. Hazardous Air Pollutant Emissions from Wastewater Treatment Plants. Pub. AM 050-090.

Non-road Engines

Emissions from non-road engines includes diesel engines (construction equipment), gasoline four-stroke engines (construction equipment, lawn and garden equipment,"inboard" boat motors, etc.), and gasoline two-stroke engines ("outboard" boat motors, lawn and garden equipment, snowmobiles, etc...).

Information regarding emission factors for these sources is sparse. A literature search was perthesebP sourcerfor

For outboard motors, SAE paper No. 740737, No. 901597, and the U.S. EPA Non-Road study were used to determine Hydrocarbons. Particulate matter was estimated.

CARB particulate speciation profile No. 115 (Static IC Engines-Gasoline) provided chromium, cobalt, copper, manganese, nickel. CARB VOC speciation profile No. 502 (Non-Catalyst Light Duty Vehicles- Exhaust) provided ethylbenzene.

For two-stroke engines, information from U.S. EPA (Stage II vehicle refueling) was used to determine naphthalene and 1,2 dichloroethane, based on ethylbenzene.

Pollutants Identified for Non-road Engines

Pollutants Identified	Diesel Engines	Two-Stroke Engines	Four-Stroke Engines
Arsenic	X	--	--
Benz(a)anthracene	X	X	X
Benzo(a)pyrene	X	X	X
Cadmium	X	--	--
Chromium	X	X	X
Chrysene	X	X	X
Cobalt	X	X	X
Copper	X	X	X
Dioxins*	--	--	--
Ethylbenzene	X	X	X
Fluoranthene	X	X	X
Lead	X	--	--
Manganese & comps	X	X	X
Mercury	X	--	--
Naphthalene	X	X	X
Nickel & comps.	X	X	X
PAHs	X	X	X

* Dioxins are expected; no reliable emission factor could be determined

GLEI Protocol Section 3.4-Identifying Facilities

Information regarding diesel engine population, two-stroke motors except for snowmobiles and recreational marine, and four-stroke motors except for recreational marine, were obtained from the Wisconsin DNR-Bureau of Air Management (WDNR).

Information regarding recreational marine use came from the Wisconsin DNR-Bureau of Air Management and Bureau of Research (WDNR 1993 and WDNR 1991).

Information regarding snowmobile use came from the Wisconsin DNR-Bureau of Community Assistance (WDNR 1995) and Wisconsin Department of Development, Division of Tourism (Tourism 1993).

Air Toxic Emission Estimation

GLEI Protocol Section 4.1-Temporal Resolution

are expected to drop 90% and marine engines by 70%, the U.S. EPA does not expect the complete turnover of pre-standard engines until the year 2020, at the earliest (WDNR 1994).

GLEI Protocol Section 4.3-Overall Inventory Development
Development of Emission Factors:

Diesel emission factors were selected from FIRE SIC 20200102 (reciprocating diesel engines) when available, from SIC 20100101 (diesel/fuel oil turbines) when no better data were available, and speciated from VOC and PM emission factors from SIC 20200102.

Diesel Emission Factors

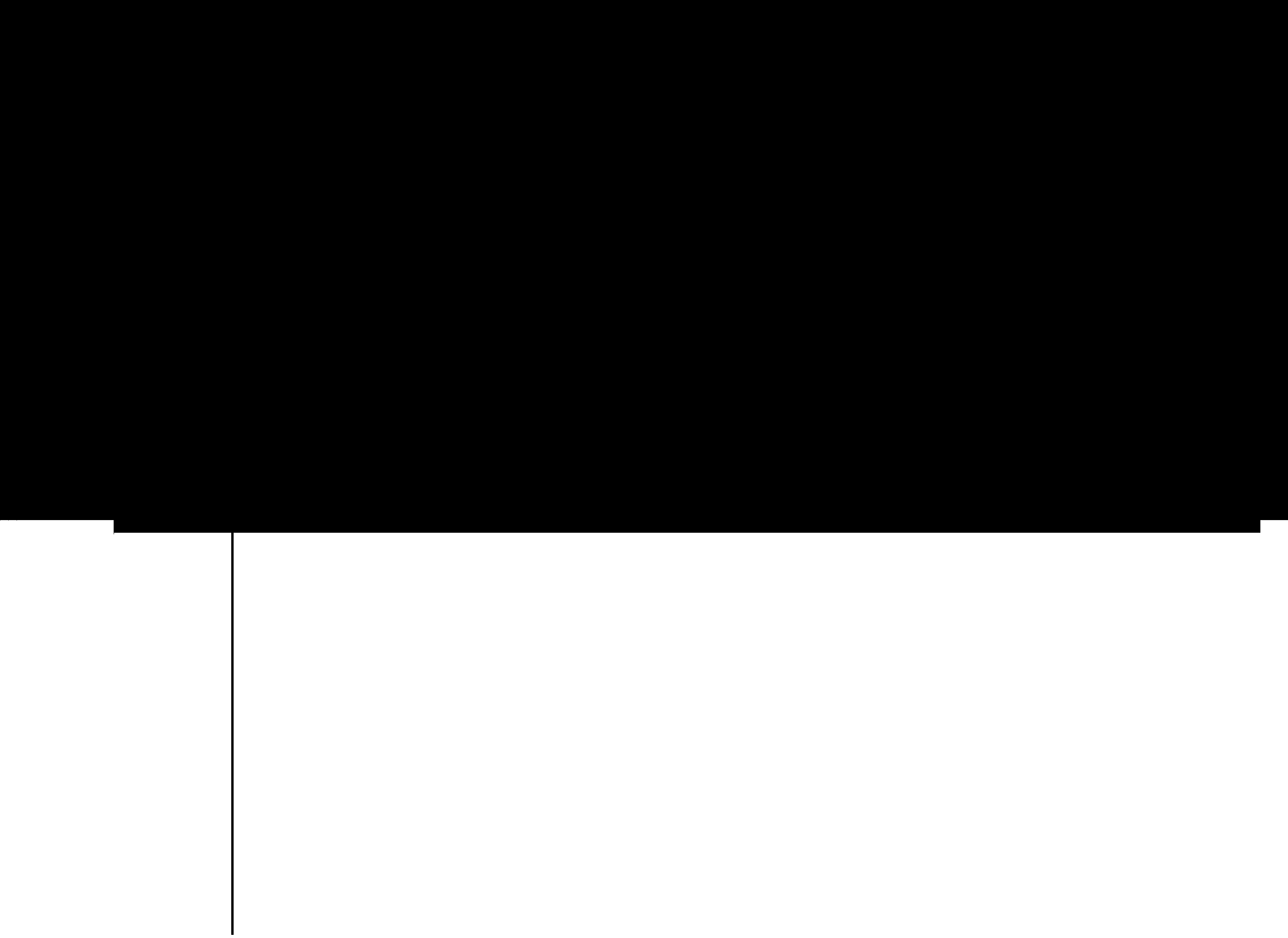
Compound	SIC 20200102 (lb/MMBTU)	SIC20100101 (lb/MMBTU)	derived from PM species 118 (lb/MMBTU)	derived from VOC species 561 (lb/MMBTU)	FACTOR USED: (lb/MMBTU)
Arsenic		4.90E-06	9.30E-07		4.90E-06

Cr		4.70E-05	2.79E-06		4.70E-05
Chrysene	3.53E-07				3.53E-07
Co		9.10E-06	1.86E-06		9.10E-06

Cu		1.30E-03	9.30E-05		1.30E-03
1,2 Dichloroethane					
Dioxins; 2378 Equiv					

Ethylbenzene					

Mn and compounds			7.13E-06		7.13E-06
Hg	3.01E-07		7.75E-06		7.75E-06
Naphthalene	8.48E-05				8.48E-05



particulate matter0.10					

Arsenic				
Benz(a)anthracene	1.68E-05	1.68E-05	1.68E-05	1.68E-05

Benzo(a)pyren	1.34E-05	1.34E-05	1.34E-05	1.34E-05
Cd				

Cr	3.00E-05	3.12E-04	3.00E-05	1.00E-04
Chrysene	2.74E-05	2.74E-05	2.74E-05	2.74E-05

Co	3.00E-05	3.12E-04	3.00E-05	1.00E-04
Cu	3.00E-05	3.12E-04	3.00E-05	1.00E-04

1,2 Dichloroethane					
Dioxins; 2378 Equiv					

Ethylbenzene	4.74E-02	1.80E-01	4.07E-02	4.22E-02
Fluoranthene	1.41E-04	1.41E-04	1.41E-04	1.41E-04

Pb				
Mn and compounds	3.00E-05	3.12E-04	3.00E-05	1.00E-04

Mercury				
Naphthalene	4.08E-03	4.08E-03	4.08E-03	4.08E-03

VOC	6.68	24.37	5.5	5.70
particulate matter	0.06	0.62	0.06	0.20

hydrocarbons	6.68	24.37	5.5	5.70

Emissions for small four-stroke engines use the "generic car-like" emissions as a baseline when no better emission factors could be determined.

SAE paper No. 910560 (White, Carroll and Hare) presents hydrocarbon and particulate matter data for three different walk-behind mowers, all around 4 HP. These emissions were averaged for hydrocarbon and particulate matter emission factor for four-stroke engines less than 4.5 HP. Hydrocarbon and particulate matter emission factors were also given for four-stroke 12 HP and 18 HP utility engines.

	generic-	5hp	0.8hp	6.4 HPave use	65hp	Wis. SIP

Compound

Arsenic						

Benz(a)anthracene	1.68E-05	1.68E-05	1.68E-05	1.68E-05	1.68E-05	4.57E-07

Benzo(a)pyrene	1.34E-05	1.34E-05	1.34E-05	1.34E-05	1.34E-05	3.64E-07

Cd						

Cr	3.00E-05	3.55E-03	2.25E-03	3.07E-03	3.19E-03	4.98E-05

Chrysene	2.74E-05	2.74E-05	2.74E-05	2.74E-05	2.74E-05	7.44E-07

Co	3.00E-05	3.55E-03	2.25E-03	3.07E-03	3.19E-03	4.98E-05

Cu	3.00E-05	3.55E-03	2.25E-03	3.07E-03	3.19E-03	4.98E-05

1,2 Dichloroethane		1.24E-01	1.12E-01	5.90E-02	8.18E-02	1.28E-03

Ethylbenzene	4.74E-02	1.38E+00	1.24E+00	6.60E-01	9.10E-01	1.42E-02

Fluoranthene	1.41E-04	1.41E-04	1.41E-04	1.41E-04	1.41E-04	3.84E-06

Pb						

Mn and compounds	3.00E-05	3.55E-03	2.25E-03	3.07E-03	3.19E-03	4.98E-05

Hg						

Naphthalene	4.08E-03	9.30E-01	8.40E-01	4.40E-01	6.15E-01	9.60E-03

Ni and compounds	3.00E-05	3.55E-03	2.25E-03	3.07E-03	3.19E-03	4.98E-05

PAHs	3.89E-04	3.98E-04	3.98E-04	3.98E-04	3.98E-04	1.08E-05

particulate matter	0.06	7.1	4.5	6.13	6.38	0.1

hydrocarbons	6.68	186	168	88.6	123	1.92

Emissions for two-stroke engines use the "generic car-like" four-stroke emissions as a base when no better emission factors could be determined.

SAE paper No. 910560 (White, Carroll and Hare) presents hydrocarbon and particulate matter emission factors for a 5 HP walk behind mower and a 0.8 HP string trimmer.

SAE paper No. 740735 (Hare, Springer and Huls) presents hydrocarbon and particulate matter emission factors for a variety of snowmobiles. The 32 HP Arctic Cat 440 (Kawasaki), running at an average of 6.4 HP was selected to represent Wisconsin's snowmobiles.

SAE paper No. 740735 (Hare, Springer and Huls) presents hydrocarbon emission factors for a variety of two-stroke outboard motors. The 65 and federal supported snowmobile trail miles per county. The average snowmobile is assumed to operate 60 hours per year (SAE No. 740735). This is in close agreement with industry estimates of an average of 63 gallons of gasoline consumed per snowmobile per year (Klim).

For both two- and four-stroke engine inventories, emission factors from the most similarly sized engine of the same type were used.

GLEI Protocol Section 4.5-Scale-up for Missing Sources
No scale-up for missing sources is considered necessary.

Sample Calculations

The calculations appear simple, because many details were handled when compiling the emission factors.

$$\text{Weight of pollutant j} = \text{Activity}_j * \text{Ef}_j$$

Results

Emissions from Off-road Diesel Engines

Compound	Kenosha	Milwaukee	Racine	TOTAL

	(pounds)	(pounds)	(pounds)	(pounds)

Arsenic	0.59	4.40	0.80	5.79

Benz(a)anthracene	0.20	1.51	0.28	1.99

Benzo(a)pyrene	0.02	0.17	0.03	0.22

Cadmium	2.49	18.66	3.40	24.55

Chromium	5.64	42.22	7.70	55.56

Chrysene	0.04	0.32	0.06	0.42

Cobalt	1.09	8.17	1.49	10.76

Copper	156	1,168	213	1,537

1,2 Dichloroethane				

Ethylbenzene	2,312	17,300	3,157	22,768

Fluoranthene	0.9	6.8	1.2	9.00

Lead	7.0	52.1	9.5	68.56

Mercury	0.9	7.0	1.3	9.16

Naphthalene	10.2	76.2	13.9	100.25

PAHs	20.16	150.90	27.53	198.60

VOC	3,852,728	28,832,868	5,260,986	37,946,583

Emissions from Two-stroke Engines, Not Including Recreational Marine or Snowmobile

Compound	Kenosha	Milwaukee	Racine	TOTAL
	(pounds)	(pounds)	(pounds)	(pounds)

Benz(a)anthracene	0.09	0.66	0.12	0.87

Benzo(a)pyrene	0.07	0.53	0.10	0.69

Cadmium					

Chromium	16.24	121.54	22.18	159.96

Chrysene	0.14	1.07	0.20	1.41

33033.93740

1,2 dichloroethane	354	2,648	483	3485

Ethylbenzene	3,952	29,577	5,397	38,926

Fluoranthene	0.74	5.53	1.01	7.27

Lead					

Mn and compounds	16.24	121.54	22.18	159.96

Mercury					

Naphthalene	2,642	19,774	3,608	26,025

Ni and compounds	16.24	121.54	22.18	159.96

PAHs	2.08	15.60	2.85	20.53

hydrocarbons	531,177	3,975,201	725,335	5,231,713

Emissions from Four-stroke Engines, Not Including Recreational Marine or Snowmobile

Compound	Kenosha	Milwaukee	Racine	TOTAL

	(pounds)	(pounds)	(pounds)	(POUNDS)

Benz(a)anthracene	0.25	1.90	0.35	2.50

Benzo(a)pyrene	0.20	1.51	0.28	1.99

Cadmium				

Cr	1.29	9.63	1.76	12.68

Chrysene	0.41	3.09	0.56	4.07

Co	1.29	9.63	1.76	12.68

Cu	1.29	9.63	1.76	12.68

1,2 dichloroethane				

Ethylbenzene	988	7,394	1,349	9,731

Fluoranthene	2.13	15.93	2.91	20.96

Lead					

Mercury					

Naphthalene	62.58	460.83	84.08	606.49

Ni and compounds	1.29	9.63	1.76	12.68

PAHs	6.01	44.95	8.20	59.16

particulate matter	2,575	19,270	3,516	25,361

Compound	Kenosha	Milwaukee	Racine	TOTAL
	(pounds)	(pounds)	(pounds)	(pounds)

Benz(a)anthracene	0.11	0.03	0.08	0.23

Benzo(a)pyrene	0.09	0.03	0.07	0.18

Cadmium				

Chromium	12.11	3.80	9.16	25.07

Chrysene	0.18	0.06	0.14	0.37

Cobalt	12.11	3.80	9.16	25.07

Copper	12.11	3.80	9.16	25.07

1,2 Dichloroethane	311	97	235	643

Ethylbenzene	3,458	1,084	2,615	7,157

Fluoranthene	0.93	0.29	0.71	1.93

Lead				

Mn and compounds	12.11	3.80	9.16	25.07

Mercury				

Naphthalene	2336.48	732.57	1766.56	4,836

Ni and compounds	12.11	3.80	9.16	25.07

PAHs	2.63	0.82	1.99	5.44

particulate matter	24,229	7,597	18,319	50,145

hydrocarbons	467,297	146,514	353,311	967,122

Emissions from Four-stroke Recreational Marine

Compound	Kenosha	Milwaukee	Racine	TOTAL

Benzo(a)pyrene	0.12	0.18	0.14	0.44

Cadmium					

Chromium	0.27	0.40	0.32	1.00

Chrysene	0.25	0.37	0.29	0.91

Cobalt	0.27	0.40	0.32	1.00

Copper	0.27	0.40	0.32	1.00

1,2 Dichloroethane				

Ethylbenzene	428	637	511	1,575

Fluoranthene	1.28	1.90	1.52	4.70

Mn and compounds	0.27	0.40	0.32	1.00

Mercury				

Naphthalene	36.77	54.75	43.90	135.42

PAHs	3.59	5.34	4.28	13.21

particulate matter	541	806	646	1,993

hydrocarbons	60,244	89,696	71,921	221,861

Snowmobile Emissions

Compound	Kenosha	Milwaukee	Racine	TOTAL

	(pounds)	(pounds)	(pounds)	(pounds)

Benz(a)anthracene	0.01	0.002	0.02	0.04

Benzo(a)pyrene	0.01	0.002	0.02	0.03

Cadmium				

Chromium	2.3	0.3	4.0	6.66

Chrysene	0.02	0.003	0.04	0.06

Cobalt	2.3	0.3	4.0	6.66

Copper	2.3	0.3	4.0	6.66

Fluoranthene	0.1	0.02	0.2	0.31

Lead				

Mn and compounds	2.3	0.3	4.0	6.66

Mercury					

Ni and compounds	2.3	0.3	4.0	6.66

PAHs	0.3	0.05	0.5	0.88

particulate matter	4,663	697	7,954	13,313

hydrocarbons	67,393	10,073	114,960	192,425

Total Emissions from All Non-road Engines

Compound	Kenosha	Milwaukee	Racine	TOTAL

	(pounds)	(pounds)	(pounds)	(pounds)

Arsenic	0.6	4.4	0.8	5.8

Benz(a)anthracene	0.8	4.3	1.0	6.2

Benzo(a)pyrene	0.5	2.4	0.6	3.6

Cd	2.5	18.7	3.4	25

Cr	37.9	177.9	45.1	261

Chrysene	1.0	4.9	1.3	7.3

Co	33.3	143.9	38.9	216

Cu	188.3	1,303.4	250.5	1,742

1,2 dichlorethane	709.6	2,752.1	794.8	4,256

Ethylbenzene	11,639.5	56,066.6	13,884.0	81,590

Fluoranthene	6.1	30.5	7.6	44

Pb	7.0	52.1	9.5	69

Mn	33.1	142.1	38.6	214

Hg	0.9	7.0	1.3	9.2

Naphthalene	5,422.0	21,148.7	6,087.5	32,658

Ni and compounds	176.3	1,213.6	234.1	1,624

PAHs	34.8	217.7	45.4	298

PM	101,697.2	549,907.1	125,597.2	777,202

HC	5,113,563.0	34,062,588.6	6,710,480.3	45,886,632

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Evaluation of Protocol and Recommendations

The protocol is satisfactory for the calculation of emissions from non-road engines. The difficulty is a lack of accepted emission factors and accepted average duty cycles for these engines.

The best conservative calculations used in developing Wisconsin's portion of the regional inventory indicate that emissions from this source are worth consideration. More investigation and research about emissions from small engines (and internal combustion engines in general), as well as the typical conditions under which these engines operate, is indicated.

RESULTS

The complete results for Wisconsin are summarized in Tables C-1, C-2 and C-3 beginning on page 270. The tables list emissions sorted by SIC and pollutant (in pounds) for Kenosha, Milwaukee, and Racine counties, respectively. Table C-4 lists the total emissions of each pollutant by county and for the three-county area.

Table C-2: Milwaukee County WI, Emissions by SIC

		SIC Code								
	Compound (POUNDS)	2099	2434	2541	2671	2752	2816	2851	2869	2891
1	Arsenic	7.6E-06								
2	Atrazine									
3	Benz(a)anthracene									
4	Benzo(a)pyrene									
5	Cadmium	1.92E-05								
6	Carbon tetrachloride									
7	Chlordane									
8	Chromium									
9	Chrome VI						21.45	1.0		
10	Chrysene									
11	Cobalt									
12	Coke oven emiss.									
13	Copper	5.10E-04								
14	1,2 Dichloroethane									
15	Diethylhexyl phthalate									
16	Di-n-butyl phthalate									
17	Di-n-octyl phthalate									
18	Dioxins; 2378 Equiv									
19	Ethylbenzene			1.0	43.1	1,342		6,212		
20	Fluoranthene									

Table C-2: Milwaukee County WI, Emissions by SIC

	Compound (POUNDS)	SIC Code 3462	3471	3479	3499	3519	3532	3541	3565	3567
1	Arsenic	0.9								
2	Atrazine									
3	Benz(a)anthracene									
4	Benzo(a)pyrene									
5	Cadmium	0.74	3.73			21				
6	Carbon tetrachloride									
7	Chlordane									
8	Chromium									
9	Chrome VI		18.2	293.3	1.22	144				
10	Chrysene									
11	Cobalt									
12	Coke oven emiss.									
13	Copper	13.1		0.14						
14	1,2 Dichloroethane									
15	Diethylhexyl phthalate									
16	Di-n-butyl phthalate									
17	Di-n-octyl phthalate									
18	Dioxins; 2378 Equiv									
19	Ethylbenzene				752.03	7,836				
20	Fluoranthene									
21	Heptachlor									
22	Hexachlorobenzene									
23	Hexachlorobutadiene									
24	Hexachloroethane									
25	Lead			0.09	133.38					
26	Alkylated Pb compounds									
27	Manganese & compounds	1.2		0.24	9.28		2,259			
28	Mercury									
29	Methoxychlor									
30	Methylene Chloride			18,240		13,086	10,247		1,671	
31	Naphthalene			156.61	11,688					1,853
32	Nickel & compounds	59.5				197.37	202			
33	Parathion									
34	Pentachloronitrobenzene									
35	Pentachlorophenol									
36	phenol									
37	PCBs									
38	PCDDs									
39	PCDFs									
40	PAHs									
41	POM									
42	TCDD 2378									
43	TCDF 2378									
44	Tetrachloroethylene (PERC)									
45	Trichlorethene		7,560							
46	111 trichloroethane	9,900			22,352			18,878	11,336	
47	245 trichlorophenol									
48	246 trichlorophenol									
49	Trifluralin									

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Table C-3: Racine County WI, Emissions by SIC

		SIC Code							
	Compound (POUNDS)	3069	3325	3398	3499	3523	3639	3714	3931
1	Arsenic								
2	Atrazine								
3	Benz(a)anthracene								
4	Benzo(a)pyrene								
5	Cadmium								
6	Carbon tetrachloride								
7	Chlordane								
8	Chromium								
9	Chrome VI								
10	Chrysene								
11	Cobalt								
12	Coke oven emiss.								
13	Copper		321						
14	1,2 Dichloroethane								
15	Diethylhexyl phthalate								
16	Di-n-butyl phthalate								
17	Di-n-octyl phthalate								
18	Dioxins; 2378 Equiv								
19	Ethylbenzene					13,302			
20	Fluoranthene								
21	Heptachlor								
22	Hexachlorobenzene								
23	Hexachlorobutadiene								
24	Hexachloroethane								
25	Lead								
26	Alkylated Pb compounds								
27	Manganese & compounds								
28	Mercury								
29	Methoxychlor								
30	Methylene Chloride	34,669							
31	Naphthalene		2,905						
32	Nickel & compounds								
33	Parathion								
34	Pentachloronitrobenzene								
35	Pentachlorophenol								
36	phenol			4,338					
37	PCBs								
38	PCDDs								
39	PCDFs								
40	PAHs								
41	POM								
42	TCDD 2378								
43	TCDF 2378								
44	Tetrachloroethylene (PERC)	2,848							
45	Trichlorethene	11,338			6,884			14,682	6,680
46	111 trichloroethane	426					9,699		15,919
47	245 trichlorophenol								
48	246 trichlorophenol								
49	Trifluralin								

SIC	DESCRIPTION
1061	Ferroalloy Ores Exc Vanadium
108	Metal Mining Services
1081	Metal Mining Services
109	Miscellaneous Metal Ores
1092	Mercury Ores
1094	Uranium-radium-vanadium Ores
1099	Metal Ores Nec
1111	Anthracite
1112	Anthracite Mining Services
12	Coal Mining
1211	Bituminous Coal and Lignite
1213	Bituminous & Lignite Mine Serv
122	Bituminous Coal and Lignite Mining
1221	Bituminous Coal & Lignite - Surface
1222	Bituminous Coal & Lignite - Underground
123	Anthracite Mining
1231	Anthracite Mining
124	Coal Mining Services
1241	Coal Mining Services
13	Oil and Gas Extraction
131	Crude Petroleum and Natural Gas
1311	Crude Petroleum & Natural Gas
132	Natural Gas Liquids
1321	Natural Gas Liquids
138	Oil and Gas Field Services
1381	Drilling Oil and Gas Wells
1382	Oil and Gas Exploration Service
1389	Oil and Gas Field Services Nec
14	Mining and Quarrying of Nonmetallic Minerals
141	Dimension Stone
1411	Dimension Stone
142	Crushed & Broken Stone, Including Riprap
1422	Crushed and Broken Limestone
1423	Crushed and Broken Granite
1429	Crushed and Broken Stone Nec
144	Sand and Gravel
1442	Construction Sand and Gravel
1446	Industrial Sand
145	Clay, Ceramic, and Refractory Minerals
1452	Bentonite
1453	Fire Clay
1454	Fullers Earth
1455	Kaolin and Ball Clay
1459	Clay and Related Minerals Nec
147	Chemical & Fertilizer Mineral Mining
1472	Barite
1473	Fluorspar
1474	Potash Soda & Borate Minerals
1475	Phosphate Rock
1476	Rock Salt
1477	Sulfur
1479	Chemical and Fertilizer Mining
148	Nonmetallic Minerals Services, Except Fuels
1481	Nonmetallic Minerals Services
149	Miscellaneous Nonmetallic Minerals, Except Fuels
1492	Gypsum
1496	Talc Soapstone & Pyrophyllite
1499	Nonmetallic Minerals, Nec
15	Building Construction-general Contractors & Bldrs
152	Gen Building Contractors-residential Buildings
1521	Single-family Housing Construction
1522	Residential Construction Nec
153	Operative Builders
1531	Operative Builders
154	Gen Building Contractors-nonresidential Buildings
1541	Industrial Building/warehouses
1542	Nonresidential Construction Nec
16	Heavy Construction Other than Bldg Constr-contract
161	Highway & Street Construction, Except Elevated Highway
1611	Highway and Street Construction
162	Heavy Construction, Except Highway & Street Construction
1622	Bridge Tunnel & Elevated Hgwy
1623	Water Sewer and Utility Lines
1629	Heavy Construction Nec
17	Construction-special Trade Contractors
171	Plumbing, Heating, and Air-conditioning
1711	Plumbing Heating Air Conditionresidential Construction Nec

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5 1541 iWorklite
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SIC	DESCRIPTION
2032	Canned Specialties
2033	Canned Fruits and Vegetables
2034	Dehydrated Fruits Vegs Soups
2035	Pickles Sauces and Salad Dress
2037	Frozen Fruits and Vegetables
2038	Frozen Specialties
204	Grain Mill Products
2041	Flour & Other Grain Mill Prod
2042	Grain Mill Products
2043	Cereal Breakfast Foods
2044	Rice Milling
2045	Blended and Prepared Flour
2046	Wet Corn Milling
2047	Dog Cat and Other Pet Food
2048	Prepared Feeds Nec
205	Bakery Products
2051	Bread Cake and Related Product
2052	Cookies and Crackers
2053	Frozen Bakery Products, Except Bread
206	Sugar and Confectionery Products
2061	Raw Cane Sugar
2062	Cane Sugar Refining
2063	Beet Sugar
2064	Candy and Other Confectionery Products
2065	Confectionery Products
2066	Chocolate and Cocoa Products
2067	Chewing Gum
2068	Salted and Roasted Nuts and Seeds
207	Fats and Oils
2074	Cottonseed Oil Mills
2075	Soybean Oil Mills
2076	Vegetable Oil Mills Nec
2077	Animal and Marine Fats and Oil
2079	Shortening and Cooking Oils
208	Beverages
2082	Malt Beverages
2083	Malt
2084	Wines Brandy & Brandy Spirits
2085	Distilled Liquor Except Brandy
2086	Bottled and Canned Soft Drinks
2087	Flavoring Extracts and Syrups,nec
209	Misc Food Preparations & Kindred Products
2091	Canned and Cured Seafoods
2092	Fresh or Frozen Packaged Fish
2095	Roasted Coffee
2096	Potato Chips and Similar Snacks
2097	Manufactured Ice
2098	Macaroni and Spaghetti
2099	Food Preparations Nec
21	Tobacco Products
211	Cigarettes
2111	Cigarettes
212	Cigars
2121	Cigars
213	Chewing and Smoking Tobacco and Snuff
2131	Chewing and Smoking Tobacco
214	Tobacco Stemming and Redrying
2141	Tobacco Stemming and Redrying
22	Textile Mill Products
221	Broadwoven Fabric Mills, Cotton
2211	Weaving Mills, Cotton

SIC	DESCRIPTION
222	Broadwoven Fabric Mills, Manmade Fiber & Silk
2221	Weaving Mills, Synthetics
223	Broadwoven Fabric Mills, Wool (Including Dyeing & Finishing)
2231	Weaving & Finishing Mills Wool
224	Narrow Fabric & Smallwares Mills: Cotton, Wool, Silk, & Manmade Fiber
2241	Narrow Fabric Mills
225	Knitting Mills
2251	Women's Hosiery, Except Socks
2252	Hosiery, Nec
2253	Knit Outerwear Mills
2254	Knit Underwear Mills
2257	Circular Knit Fabric Mills
2258	Warp Knit Fabric Mills
2259	Knitting Mills, Nec
226	Dyeing & Finishing Textiles, Except Wool Fabrics & Knit Goods
2261	Finishing Plants, Cotton
2262	Finishing Plants, Synthetics
2269	Finishing Plants, Nec
227	Carpets and Rugs
2271	Woven Carpets and Rugs
2272	Tufted Carpets and Rugs
2273	Carpets and Rugs
2279	Carpets and Rugs, Nec
228	Yarn and Thread Mills
2281	Yarn Mills, Except Wool
2282	Throwing and Winding Mills
2283	Wool Yarn Mills
2284	Thread Mills
229	Miscellaneous Textile Goods
2291	Felt Goods Exc Woven Felt/hats
2292	Lace Goods

SIC	DESCRIPTION
234	Undergarments: Women, Misses, Childrens, & Infants
2341	Women's & Children's Underwear
2342	Brassieres and Allied Garments
235	Hats, Caps, and Millinery
2351	Millinery
2352	Hats & Caps Exc Millinery
2353	Hats, Caps and Millinery
236	Outerwear: Girls, Children, & Infants
2361	Children's Dresses and Blouses
2363	Children's Coats and Suits
2369	Children's Outerwear, Nec
237	Fur Goods
2371	Fur Goods
238	Miscellaneous Apparel & Accessories
2381	Fabric Dress and Work Gloves
2384	Robes and Dressing Gowns
2385	Waterproof Outergarments
2386	Leather & Sheep Lined Clothing
2387	Apparel Belts
2389	Apparel and Accessories, Nec
239	Misc Fabricated Textile Products
2391	Curtains and Draperies
2392	House Furnishings, Nec
2393	Textile Bags

Textile Bag3ss, Nec i-d 4

2517	Wood TV and Radio Cabinets
2519	Household Furniture, Nec
252	Office Furniture
2521	Wood Office Furniture
2522	Metal Office Furniture
253	Public Building & Related Furniture
2531	Public Building & Related Furniture
254	Partitions, Shelving, Lockers, & Office & Store Fixtures
2541	Wood Partitions and Fixtures
2542	Metal Partitions and Fixtures
259	Miscellaneous Furniture and Fixtures
2591	Drapery Hardware/blinds/shades
2599	Furniture and Fixtures, Nec
26	Paper and Allied Products
261	Pulp Mills
2611	Pulp Mills
262	Paper Mills
2621	Paper Mills Exc Building Paper
263	Paperboard Mills
2631	Paperboard Mills
2641	Paper Coating and Glazing
2642	Envelopes
2643	Bags, Except Textile Bags
2645	Die-cut Paper and Board
2646	Pressed and Molded Pulp Goods
2647	Sanitary Paper Products
2648	Stationery Products
2649	Converted Paper Products, Nec
265	Paperboard Containers and Boxes
2651	Folding Paperboard Boxes
2652	Set-upoducts, Nec

295	Asphalt Paving and Roofing Materials
2951	Paving Mixtures and Blocks
2952	Asphalt Felts and Coatings
299	Misc Petroleum and Coal Products
2992	Lubricating Oils and Greases
2999	Petroleum and Coal Products, Nec
30	Rubber and Miscellaneous Plastics Products
301	Tires and Inner Tubes
3011	Tires and Inner Tubes
302	Rubber and Plastics Footwear
3021	Rubber and Plastics Footwear
3031	Reclaimed Rubber
3041	Rubber & Plastics Hose and Belting

3592	Carburetors, Pistons, Rings, & Valves
3593	Fluid Power Cylinders and Actuators
3594	Fluid Power Pumps and Motors
3596	Scales and Balances, Except Laboratory
3599	Machinery Exc Electrical Nec
36	Electronic & Other Electrical Equipment &

3931	Musical Instruments
394	Dolls, Toys, Games and Sporting and Athletic Goods
3942	Dolls
3944	Games/toys/children's Vehicles
3949	Sporting & Athletic Goods Nec
395	Pens, Pencils, and Other Artists' Materials
3951	Pens and Mechanical Pencils
3952	Lead Pencils and Art Goods
3953	Marking Devices
3955	Carbon Paper and Inked Ribbons
396	Costume Jewelry and Notions, Except Precious Metal
3961	Costume Jewelry
3962	Artificial Flowers
3963	Buttons
3964	Needles, Pins, and Fasteners
3965	Fasteners, Buttons, Needles and Pins

4723	Freight Transport Arrangement
4724	Travel Agencies
4725	Tour Operators
4729	Passenger Transport Management, Nec
473	Freight and Cargo Transportation Arrangement
4731	Freight Transportation Management
474	Rental of Railroad Cars
4741	Rental of Railroad Cars
4742	Railroad Car Rental with Serv
4743	Railroad Rental Car W/o Serv
478	Miscellaneous Transportation Services
4782	Inspection & Weighing Services
4783	Packing and Crating
4784	Fixed Facilities for Vehicles
4785	Inspection and Fixed Facilities
4789	Transportation Services, Nec
48	Communications
481	Telephone Communications
4811	Telephone Communication
4812	Radio Telephone Communications
4813	Telephone Communications, Except Radio
482	Telegraph and Other Message Communications
4821	Telegraph Communication
4822	Telegraph and Other Communications
483	Radio & Television Broadcasting Stations
4832	Radio Broadcasting
4833	Television Broadcasting
484	Cable and Other Pay Television Services
4841	Cable and Other Pay TV Services
489	Communications Services, Nec
4899	Communication Services, Nec
49	Electric, Gas and Sanitary Services
491	Electric Services
4911	Electric Services
492	Gas Production and Distribution
4922	Natural Gas Transmission
4923	Gas Transmission and Distribution
4924	Natural Gas Distribution
4925	Gas Production/distribution
493	Combination Electric, Gas, and Other Utility Services
4931	Elec & Other Services Combined
4932	Gas & Other Services Combined
4939	Combination Utility Services
494	Water Supply
4941	Water Supply
4950	Sanitary Services
4952	Sewerage Systems
4953	Refuse Systems
4959	Sanitary Services, Nec
496	Steam and Air-conditioning Supply
4961	Steam Supply
497	Irrigation Systems
4971	Irrigation Systems
50	Wholesale Trade-durable Goods
501	Motor Vehicles, Parts, and Supplies
5012	Autos & Other Motor Vehicles
5013	Automotive Parts and Supplies
5014	Tires and Tubes
5015	Motor Vehicle Parts, Used

SIC DESCRIPTION

502	Furniture and Homefurnishings
5021	Furniture
5023	Home Furnishings
503	Lumber and Construction Materials

5144	Poultry and Poultry Products
5145	Confectionery
5146	Fish and Seafoods
5147	Meats and Meat Products
5148	Fresh Fruits and Vegetables
5149	Groceries and Related Products
515	Farm-product Raw Materials
5152	Cotton
5153	Grain
5154	Livestock
5159	Farm-product Raw Materials, Nec
516	Chemicals and Allied Products
5161	Chemicals and Allied Products
5162	Plastics Materials and Basic Shapes
5169	Chemicals and Allied Products, Nec
517	Petroleum and Petroleum Products
5171	Petroleum Bulk Stations & Terminals
5172	Petroleum Products, Nec
518	Beer, Wine, and Distilled Alcoholic Beverages
5181	Beer and Ale
5182	Wines and Distilled Beverages
519	Misc Nondurable Goods
5191	Farm Supplies
5192	Books, Periodicals and Newspapers
5193	Flowers and Florists Supplies
5194	Tobacco and Tobacco Products
5198	Paints, Varnishes, and Supplies
5199	Nondurable Goods, Nec
52	Building Materials, Hardware, Garden Supply, Mobil
521	Lumber and Other Building Materials Dealers
5211	Lumber and Other Building Materials
523	Paint, Glass, and Wallpaper Stores
5231	Paint, Glass, and Wallpaper Stores
525	Hardware Stores
5251	Hardware Stores
526	Retail Nurseries, Lawn & Garden Supply Stores
5261	Retail Nurseries and Garden Stores
527	Mobile Home Dealers
5271	Mobile Home Dealers
53	General Merchandise Stores
531	Department Stores
5311	Department Stores
533	Variety Stores
5331	Variety Stores
539	Misc. General Merchandise Stor
5399	Misc. General Merchandise Stores
54	Food Stores
541	Grocery Stores
5411	Grocery Stores
542	Meat and Seafood Markets, Including Freezer Provisioners
5421	Meat and Fish Markets
5422	Freezer and Locker Meat Provisions
5423	Meat and Fish (Seafood) Market
543	Fruit and Vegetable Markets
5431	Fruit Stores and Vegetable Markets
544	Candy, Nut, and Confectionery Stores
5441	Candy, Nut, and Confectionery

SIC	**DESCRIPTION**
545	Dairy Products Stores

5451	Dairy Products Stores
546	Retail Bakeries
5461	Retail Bakeries
5462	Retail Bakeries-baking and Selling
5463	Retail Bakeries-selling Only
5490	Miscellaneous Food Stores
5499	Miscellaneous Food Stores
55	Automotive Dealers and Gasoline Service Stations
551	Motor Vehicle Dealers (New & Used)
5511	New and Used Car Dealers
552	Motor Vehicle Dealers (Used Only)
5521	Used Car Dealers
553	Auto and Home Supply Stores
5531	Auto and Home Supply Stores
554	Gasoline Service Stations
5541	Gasoline Service Stations
555	Boat Dealers
5551	Boat Dealers
556	Recreational Vehicle Dealers
5561	Recreational Vehicle Dealers
557	Motorcycle Dealers
5571	Motorcycle Dealers
559	Automotive Dealer, Nec
5599	Automotive Dealers, Nec
56	Apparel and Accessory Stores
561	Men's & Boys' Clothing & Accessory Stores
5611	Men's & Boys' Clothing & Accessory Stores
562	Women's Clothing Stores
5621	Women's Ready-to-wear Stores
563	Women's Accessory & Specialty Stores
5631	Women's Accessory and Specialty Stores
5632	Women's Accessory and Specialty Stores
564	Children's & Infants' Wear Stores
5641	Children's and Infants' Wear Stores
565	Family Clothing Stores
5651	Family Clothing Stores
566	Shoe Stores
5661	Shoe Stores
5681	Furriers and Fur Shops
569	Misc Apparel & Accessory Stores
5699	Miscellaneous Apparel & Access
57	Home Furniture, Furnishings & Equipment Stores
571	Home Furniture & Furnishings Stores
5712	Furniture Stores
5713	Floor Covering Stores
5714	Drapery and Upholstery Stores
5719	Misc Home Furnishings Stores
572	Household Appliance Stores
5722	Household Appliance Stores
573	Radio, Television, Consumer Electronics, and Music Stores
5731	Radio, Television and Electronic Stores
5732	Radio and Television Stores
5733	Music Stores
5734	Computer and Software Stores
5735	Record and Prerecorded Tape Stores
5736	Musical Instrument Stores
58	Eating and Drinking Places
581	Eating and Drinking Places

SIC	**DESCRIPTION**
5812	Eating Places

5813	Drinking Places
59	Miscellaneous Retail
591	Drug Stores and Proprietary Stores
5912	Drug Stores and Proprietary Stores
592	Liquor Stores
5921	Liquor Stores
593	Used Merchandise Stores
5931	Used Merchandise Stores
5932	Used Merchandise Stores
594	Misc Shopping Goods Stores
5941	Sporting Goods and Bicycle Shops
5942	Book Stores
5943	Stationery Stores
5944	Jewelry Stores
5945	Hobby, Toy, and Game Shops
5946	Camera & Photographic Supply Stores
5947	Gift, Novelty, and Souvenir Shops
5948	Luggage and Leather Goods Stor
5949	Sewing, Needlework, and Piece Goods Stores
596	Nonstore Retailers
5961	Mail Order Houses
5962	Merchandising Machine Operator
5963	Direct Selling Organizations
598	Fuel Dealers
5982	Fuel and Ice Dealers, Nec
5983	Fuel Oil Dealers
5984	Liquefied Petroleum Gas Dealers
5989	Fuel Dealers, Nec
599	Retail Stores, Nec
5992	Florists
5993	Cigar Stores and Stands
5994	News Dealers and Newsstands
5995	Optical Goods Stores
5999	Miscellaneous Retail Stores, N
60	Depository Institutions
601	Central Reserve Depository Institutions
6011	Federal Reserve Banks
6019	Central Reserve Depository, Nec
602	Commercial Banks
6021	National Commercial Banks
6022	State Banks, Federal Reserve
6023	State Banks, Not Fed. Reserve,
6024	State Banks, Not Fed Res., Not
6025	National Banks, Federal Reserve
6026	National Banks, Not Fed. Res.,
6027	National Banks, Not Fdic
6028	Private Banks, Not Incorp., No
6029	Commercial Banks, Nec
603	Savings Institutions
6032	Mutual Savings Banks, Federal
6033	Mutual Savings Banks, Nec
6034	Mutual Savings Banks, Not Fdic
6035	Federal Savings Institutions
6036	Savings Institutions, Except Federal
6042	Nondeposit Trusts, Federal Res
6044	Nondeposit Trusts, Not Fdic
6052	Foreign Exchange Establishment
6054	Safe Deposit Companies
6055	Clearinghouse Associations
6056	Corporations for Banking Abroad

SIC	**DESCRIPTION**
6059	Functions Related to Banking,

606	Credit Unions
6061	Federal Credit Unions
6062	State Credit Unions
608	Foreign Banking and Branches & Agencies of Foreign Banks
6081	Foreign Bank and Branches and Agencies
6082	Foreign Trade and International Banks
609	Depository Banking Functions
6091	Nondeposit Trust Facilities
6099	Functions Related to Deposit Banking
61	Nondepository Credit Institutions
611	Federal & Federally-sponsored Credit Agencies
6111	Federal and Federally-sponsored Credit
6112	Rediscounting, Not for Agriculture
6113	Rediscounting, for Agriculture
6122	Federal Saving & Loan Associations
6123	State Associations, Insured
6124	State Associations, Noninsured
6125	State Associations, Noninsured
6131	Agricultural Credit Institutions
614	Personal Credit Institutions
6141	Personal Credit Institutions
6142	Federal Credit Unions
6143	State Credit Unions
6144	Nondeposit Industrial Loan Companies
6145	Licensed Small Loan Lenders
6146	Installment Sales Finance Companies
6149	Misc. Personal Credit Institutions
615	Business Credit Institutions
6153	Short-term Business Credit
6159	Misc Business Credit Institute
616	Mortgage Bankers and Brokers
6162	Mortgage Bankers and Correspondents
6163	Loan Brokers
62	Security & Commodity Brokers, Dealers, Exchanges
621	Security Brokers, Dealers, & Flotation Companies
6211	Security Brokers and Dealers
622	Commodity Contracts Brokers & Dealers
6221	Commodity Contracts Brokers, Dealers
623	Security and Commodity Exchanges
6231	Security and Commodity Exchanges
628	Exchange of Security and Commodity Services
6281	Security and Commodity Service
6282	Investment Advice
6289	Security and Commodity Services, Nec
63	Insurance Carriers
631	Life Insurance
6311	Life Insurance
632	Accident & Health Insurance & Medical Service Plans
6321	Accident and Health Insurance
6324	Hospital and Medical Service Plans
633	Fire, Marine, and Casualty Insurance
6331	Fire, Marine, and Casualty Ins
635	Surety Insurance
6351	Surety Insurance
636	Title Insurance

SIC	**DESCRIPTION**
6361	Title Insurance

637 Pension, Health, and Welfare Funds
6371 Pension, Health, and Welfare Funds
639 Insurance Carriers, Nec
6399 Insurance Carriers, Nec
64 Insurance Agents, Brokers and Service
641 Insurance Agents, Brokers, and Service
6411 Insurance Agents, Brokers & Service
65 Real Estate
651 Real Estate Operators (Exceptrvice
Developers) & Lessors
6512 Nonresidential Building Operators
6513 Apartment Building Operators
6514 Dwelling Operators, Exc. Apart

7376	Computer Facilities Management
7377	Computer Rental and Leasing
7378	Computer Maintenance and Repair
7379	Computer Related Services, Nec
738	Miscellaneous Business Services
7381	Detective and Armored Car Services
7382	Security Systems Services
7383	News Syndicate
7384	Photofinishing Laboratories
7389	Business Services, Nec
7391	Research & Development Laboratories
7392	Management and Public Relations
7393	Detective and Protective Services
7394	Equipment Rental and Leasing
7395	Photofinishing Laboratories
7396	Trading Stamp Services
7397	Commercial Testing Laboratories
7399	Business Services, Nec
75	Automotive Repair, Services & Parking
751	Automotive Rental and Leasing, Without Drivers
7512	Passenger Car Rental and Leasing
7513	Truck Rental and Leasing
7514	Passenger Car Rental
7515	Passenger Car Leasing
7519	Utility Trailer Rental
752	Automobile Parking
7521	Automobile Parking
7523	Parking Lots
7525	Parking Structures
753	Automotive Repair Shops
7531	Top and Body Repair Shops

8093	Specialty Outpatient Clinics, Nec
8099	Health and Allied Services, Nec
81	Legal Services
811	Legal Services
8111	Legal Services
82	Educational Services
821	Elementary and Secondary Schools
8211	Elementary and Secondary Schools
822	Colleges, Universities, Professional Schools, & Junior Colleges
8221	Colleges and Universities, Nec
8222	Jofessional Sch Ju .1733 TD0.001 gal Services

9511 Air, Water & Solid Waste Management
9512 Land, Mineral, Wildlife Conservation
953 Housing & Urban Development Programs
Administration
9531 Housing Programs

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	Pollutant	Key for USEPA IRIS Ratings	CAS #
	Phenanthrene	D	85-01-8
	Anthracene	D	120-12-7
	Fluoranthene	D	206-44-0
	Pyrene	D	129-00-0
	Benzo(ghi)perylene	D	191-24-2
	Benz(a)anthracene	B2	56-55-3
	Chrysene	B2	218-01-9
	Benzo(b)fluoranthene	B2	205-99-2
	Benzo(k)fluoranthene	B2	207-08-9
	Benzo(a)pyrene	B2	50-32-8
	Dibenz(a,h)anthracene	B2	53-70-3
	Indeno(1,2,3-cd)pyrene	B2	193-39-5

**Not specifically listed or rated in IRIS, but CDD's and CDF's are regarded as likely to present a cancer hazard to humans in the U.S. EPA draft reassessment for 2,3,7,8-TCDD and related compounds.

Key
A=human carcinogen
B=probable human carcinogen
B1=limited human evidence
B2=sufficient evidence in animals, inadequate evidence in humans
C=possible human carcinogen
D=not classifiable as to human carcinogenicity
E=evidence of non-carcinogenicity for humans

Ratings are from U.S. EPA's Integrated Risk Information System (IRIS) database, containing agency consensus positions on the potential adverse human health effects of approximately 500 substances, updated monthly. The ratings provided above are from September 1995.

Appendix F

Great Lakes Commission Regional Emission Inventory of Toxic Air Contaminants Steering Committee

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Appendix H

Southwest Lake Michigan Pilot Study Quality Assurance/Quality Control Committee

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