The Transport and Deposition of Persistent Toxic Substances to the Great Lakes

II. Review of the Status and Capabilities

of U.S. and Canadian Emissions Inventories

for Binational Virtual Elimination Substances

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by

Mark Cohen
Center for the Biology of Natural Systems (CBNS)
Queens College, City University of New York

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Preface

This report was commissioned by the IJC International Air Quality Advisory Board. It represents the second in a series of five closely related reports prepared for the Board. The first report deals with the potential for long range atmospheric transport of persistent toxic substances. The third and fourth reports deal with modeling the atmospheric transport and deposition of persistent toxic substances to the Great Lakes and monitoring of persistent toxic substance in the Great Lakes region, respectively. The fifth report is a summary of the first four reports.

These reports were prepared as background documents for the IJC-sponsored Joint International Air Quality Board and Great Lakes Water Quality Board Workshop on Significant Sources, Pathways and Reduction/Elimination of Persistent Toxic Substances, held May 21-22, in Romulus Michigan.

The material presented here was collected and analyzed during the period from October 1996 through May 1997.

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Executive Summary

This report examines the potential for long range atmospheric transport and the status of emissions inventories of a group of persistent toxic substances identified by the Binational Virtual Elimination Strategy (BVES) for pollutants of concern in the Great Lakes Basin:

Alkylated lead	3,3'-Dichlorobenzidene
Mercury	4,4'-Methylene bis (2-Chloroaniline)
Cadmium	4-Bromophenyl Phenyl Ether
Tributyltin	Hexachloro-1,3-Butadiene
Aldrin	1,4-Dichlorobenzene
Dieldrin	Tetrachlorobenzenes
DDT	Pentachlorobenzene
DDD	Hexachlorobenzene
DDE	PCDD/F's
Mirex	PCB's
Toxaphene	Dinitropyrenes
Endrin	Benzo[a]Pyrene
Heptachlor	Phenanthrene
Heptachlor Epoxide	Anthracene
Hexachlorocyclohexanes	Benz[a]Anthracene
Methoxychlor	Perylene
Pentachlorophenol	Benzo[g,h,i]Perylene
Octachlorostyrene	PAH's (as a group)

In this analysis, the available emissions inventories that deal with the BVES compounds/groups are evaluated. The following inventories were available and evaluated:

National Toxics Inventory (U.S.)
National Mercury Report to Congress (U.S.)
U.S. Clean Air Act, Section 112(c)(6) Report
Locating and Estimating Air Emissions Document Series (U.S.)
Canada Ontario Agreement Reports
Environment Canada Inventories
Ortech Inventory for Ontario and Eastern North America (Canada)

Each of these inventories was evaluated by asking the following set of questions:

1. Are all relevant source classes considered?
2. Is each included source class comprehensively treated?
3. What is the geographic resolution of the emissions inventory?
4. What is the temporal resolution of the emissions inventory?

5. To what extent are emissions estimates for specific, individual point source facilities based on actual measurements, and if any are, how adequate is the documentation?
6. Is there documentation of the use of emissions factors, and if they are used, is adequate information provided about the emissions factors?
7. Are key characteristics of each source documented?
8. Are any modeling-relevant details about the emissions provided?
9. In what form(s) is the inventory available, and are there any problems with the available form(s)?
10. Is the inventory publicly available? To what extent is information about emissions from individual facilities publicly available?

Based on these evaluations, it was possible to develop approximate ratings of the degree to which the several inventories approximate the ideal requirements. These ratings have been used to generate the overall status of the U.S. and Canadian inventories of the BVES compounds/ groups.

Very few inventories and/or inventory details could be obtained during this analysis, for various reasons, including (a) the inventory was not yet available; (b) the inventory and/or inventory details were confidential; (c) or resources to provide inventory and/or inventory details were not available. Thus, it is difficult to assess accuracy of the inventories or the potential ability of the inventories to serve as input to comprehensive source-receptor modeling analyses.

Confidentiality issues emerged as a significant impediment to the ability of some of the inventories to be useful to independent researchers and the public. In addition, for many compounds, there appears to be only a very limited number of emissions measurements (or none) from many (or all) source classes.

Some of the BVES compounds do not appear to be covered by any current inventory or any inventory currently being developed, or are covered in only a very limited way. These include, at least, the following: speciated Mercury emissions; Tributyltin compounds; Alkylated Lead; Pentachlorophenol; Tetrachlorobenzenes; Pentachlorobenzene; PCB's; Dinitropyrenes; 4-Bromophenyl Phenyl Ether; 3,3'-Dichlorobenzidene; Octachlorostyrene; and emissions from past uses of the following banned or restricted biocides: Aldrin / Dieldrin; Chlordane; DDT / DDD / DDE; Endrin; Heptachlor / Heptachlor Epoxide; Methoxychlor; Mirex; and Toxaphene.

In addition, the available inventories for PCDD/F have either insufficient geographic resolution or incomplete speciation. Thus, none of the inventories for PCDD/F examined in this analysis appear to be suitable for use as input to a comprehensive atmospheric fate and transport model. Also, available inventories for pentachlorophenol appear to be substantially incomplete, as emissions from in-use and discarded treated wood are not included.

The compounds with perhaps the most sophisticated available inventories appear to be cadmium, several of the PAH compounds, and perhaps 1,4 dichlorobenzene.

Thus, for most of the BVES compounds, there is little information currently available that could be used as inputs to comprehensive air pollution modeling. In most cases, the information that does exist is of uncertain quality because of a lack of quality assurance and documentation.

A. Introduction

In order to develop policies for reducing the loadings of pollutants to the Great Lakes or any other receptor, it is obviously important to know where the loadings are coming from. The loadings of contaminants in Great Lakes waters, sediments, and biota can be affected by a number of different pathways:

- Atmospheric deposition (and possibly revolatilization)

- Waterborne loadings arising from industrial or residential discharges, surface runoff, and groundwater flow

    - Discharges directly to a given Lake
    - Loadings due to current discharges to tributaries feeding a given Lake
    - Loadings due to contaminated sediment transport in tributaries feeding a given Lake, reflecting past discharges.

This analysis is focusing exclusively on the air pathway for pollutant loadings. It is important to note that waterborne loadings can contribute significant quantities of pollutants to the Great Lakes, and in order to understand sources of pollution to the Lakes, they must be fully considered.

The first step in determining the sources of air pollutant deposition to the Great Lakes is determining the emissions to the air of each relevant pollutant. The status of air emissions inventories of pollutants of immediate concern to the IJC is the subject of this section of the analysis, and will be explored in detail below.

In order to determine the fraction of the pollution emitted from each source that is eventually deposited into a given Lake, one must in most cases model the atmospheric fate and transport of emitted pollutants from each source, keeping track of the amount that is deposited in each Lake. This was the basic approach attempted for dioxins, furans, and hexachlorobenzene in a recent analysis of loadings to the Great Lakes (Cohen et al., 1995). An evaluation of various modeling approaches to elucidating the source-receptor relationships for the air deposition pathway will be the subject of a subsequent analysis.

The present analysis is limited to emissions inventories in the United States and Canada. For some of the pollutants considered in this analysis (e.g., hexachlorobenzene - “HCB”), the atmospheric distribution following emission can be considered to be global. To account for the atmospheric concentrations of such a pollutant at any given location, one would need to know the information about emissions worldwide. Consideration of only sources in the U.S. and Canada would not be a complete analysis. This was found, for example, by Cohen et al. (1995) for HCB. In this analysis, only sources of HCB in the U.S. and Canada were considered. Although there were substantial uncertainties in the emissions inventory, and, less

substantial but still significant uncertainties in the modeling methodologies, it was not possible to account for measured atmospheric concentrations of HCB in the Great Lakes region solely arising from sources in the U.S. and Canada.

B. General Comments on Air Emissions Inventories and their Evaluation

The ideal emissions inventory would be based on continuous monitoring of emissions from all possible sources of a particular compound. This ideal is obviously impossible to attain. Various methodologies of approximating emissions must be used.

Air emissions are typically classified as being point, area, or mobile. The inclusion of a particular source type into one or another of these categories can change from inventory to inventory. For example, one inventory might treat medical waste incinerators -- which are fairly numerous -- as an area source, aggregated, say, on a county or state level. Another inventory might treat medical waste incinerators as point sources, i.e., with emissions estimates and specific locations for each individual incinerator.

Inventories are used for many purposes. A particular interest in relation to this analysis is that inventories be usable as inputs for models of atmospheric fate and transport. In the following list, a general set of criteria is presented against which inventories can be evaluated.

This list has been prepared from the point of view of a potential user of a given inventory as an input for modeling, although most of the items in the following list are applicable to inventories for *any* use. That is, if someone was going to use a given inventory as an input for a modeling analysis, the following list details the issues and concerns that they might have. This list is based on the experience of the author and his colleagues at the Center for the Biology of Natural Systems at Queens College in attempting to develop emissions inventories for PCDD/F and hexachlorobenzene for use as input to atmospheric fate and transport models. In essence, these are the considerations that guide our own inventory development, and, which guide our evaluation of the potential usefulness to us of inventories developed by others.

Criteria for Evaluating Air Emissions Inventories, Including Their Potential Usefulness as Inputs to Atmospheric Fate and Transport Models.

1. The inventory should be comprehensive in its consideration of potential source classes.

a. All potential source classes should be included.

b. If a potential source class is missing from the inventory, this should be clearly stated.

c. For any such missing sources, an attempt should be made to make an order-of-magnitude estimate of the relative significance of missing sources

2. The inventory should be complete in its estimates for the emissions from each potential source class.

a. There should be adequate explanation of the degree of confidence placed in the completeness of the inventory for each source class. For example, if the inclusion of entities in the inventory is based on frequent facility inspections, then this would be important to know. In contrast, if facilities have not been inspected or contacted in any way, then this would also be important to know.

3. The geographical resolution of the emissions estimates should be as high as possible, for it is always possible to aggregate data for a particular purpose if desired, but, it is difficult if not impossible to *dis*-aggregate emissions estimates.

a. For area sources, county level data are better than state level data, etc.

b. For point sources, facility level data are better than county level data, etc.

4. The temporal resolution of the emissions estimates should be as high as possible.

a. Some sources have significant diurnal, weekly, and/or seasonal variations. Often, such variations are important in modeling exercises. Thus, time resolution information should be included to the greatest extent possible.

b. At the very least, the year for which the estimate is being made for should be indicated.

5. Emissions estimates from point sources should be to the largest extent possible based on actual measurements from the facility.

a. For point sources, this is generally the preferred estimation methodology. Emissions so estimated should be clearly marked in the inventory.

b. Statistical summaries of the measurement data should be included in the inventory (e.g., the number, duration, range, average, standard deviation). Obviously, the more measurements that the emissions estimate is based on, the better.

c. Uncertainties in the measurements should be clearly explained and quantified.

d. There should be adequate evidence presented to assess the degree of representativeness of the measurement data; obviously, the more representative the data the better.

e. A range in emissions estimates should be presented based on the range in the measured emissions and also the uncertainty in the measurements themselves.

6. Documentation of the use of emissions factors should be provided, and if they are used, adequate information should be provided about them. The documentation should answer the following questions:

a. If an emissions factor is used, is this so indicated?

b. Is the emissions factor given? Is there a reference given for the factor? Is the reference accessible?

c. Is there adequate documentation of exactly what type of facility, process, feedstock and pollution control situation the emissions factor applies to, and, the degree to which the particular source in question matches this emissions situation?

d. Is there information included about how many source tests the emissions factor is based on?

e. What is the variability of these source tests? Is the variability in the source tests reflected in an estimated uncertainty or emissions range in the inventory?

7. Key characteristics of each source should be detailed, including:

a. the throughput (e.g., for an incinerators, this might be tons of waste burned per day), and the source and time-period of the throughput information;

b. air pollution control equipment;

c. process information particularly relevant to emissions;

d. other descriptors as appropriate (SIC code, SCC code, etc.)

8. **Details about the emissions should be provided, including answers to the following questions which may be of particular importance if the inventory is to be used as an input for modeling:**

   a. What form is the pollutant emitted in (vapor phase? particle phase?)

   b. If emitted as particles, what is the size distribution?

   c. What is the temperature of the emissions?

   d. What is the height of the emissions?

   e. What is the gas exit velocity of the emissions?

9. **The inventory should be available in the different kinds of forms which might be needed by a potential user.**

   a. The inventory should be made available in both electronic and hard copy forms.

   b. Electronic versions of the inventory should be carefully prepared so that they will be readily accessible to a wide range of computer/software platforms.

   c. Overall summaries of the data in the inventory, in hard copy and/or electronic forms, are also useful

10. **The inventory — including details about emissions from individual facilities — should be publicly available, for at least three reasons:**

    a. The public has a right to know what is known and what is known and what is not known about emissions that might affect their health.

    b. Citizens and independent researchers can perform useful quality control functions. For example, they can quickly assess whether a particular source of interest to them is included in a given inventory. If it is not included, they can notify the inventory creator about the omission. Inventories created at a distance are always vulnerable to inaccuracies; people who live near the source and/or who are particularly knowledgeable about a given source will sometimes have information that can improve the quality of an inventory.

    c. Independent researchers need access to the emissions inventory data for modeling and other analytical purposes. Such researchers can make useful scientific and policy-related contributions.

C. Emissions Inventories Considered in this Study

In the table below (which is continued on the next page), the inventories available for consideration in this analysis are listed.

Table 1. Emissions Inventories Available for Consideration in this Analysis

Emissions Inventory	Region	Notes
National Toxics Inventory • Pope, A., D. Epperson, et al. (1996). An Inventory of Air Toxics Emissions in the United States. Research Triangle Park, NC, U.S.EPA Office of Air Quality Planning & Standards; Eastern Research Group, Inc. • ERG (1996). National Toxics Inventory (NTI) Data Documentation. Morrisville, NC. Eastern Research Group, Inc.	U.S.	This inventory contains geographically resolved emissions estimates for a range of compounds. For this analysis, only county-totals for different source classes were available; facility-specific details or documentation were not available, although they may be available in the future.
National Mercury Report to Congress • U.S.EPA (1996b). Mercury Study Report to Congress. Volume II: An Inventory of Anthropogenic Mercury Emissions in the United States. SAB Review Draft. Research Triangle Park, NC, EPA Office of Air Quality Planning and Standards & Office of Research and Development, EPA-452/R-96-001b.	U.S.	National emissions estimates are presented. Some geographically resolved emissions information is given.
U.S. Clean Air Act, Section 112(c)(6) • U.S.EPA (1996a). Emissions Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)/2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. Draft Report. Research Triangle Park, NC. Emission Factor & Inventory Group and Visibility & Ecosystem Protection Group.	U.S.	National emissions estimates are presented.
Locating and Estimating Air Emissions from Sources of... (Document Series) • L&E-Cadmium (1993). EPA-454/R-93-040. • L&E-Chlorobenzenes (1994). EPA-454/R-93-044. • L&E-Dioxins (1997). EPA 454/R-97-003. • L&E-POM (1994). EPA Contract # 68-D2-0160. • L&E-Lead (1996). EPA Contract # 68-D2-0160. • L&E-Mercury (1997). EPA-454/R-97-012. • L&E-PCB's (1987). EPA-450/R-84-007n.	U.S.	Detailed information on emissions factors is generally given. In more recent publications, national emissions estimates are given. Facility-specific information is given for a few source categories for a few pollutants.

Table 1. Emissions Inventories Available for Consideration in this Analysis

Emissions Inventory	Region	Notes
Canada Ontario Agreement (COA) — Sources, Releases, and Loadings for COA Substances... • Brown, P. and N. Thornton (1996). Tier I and II Substance Profiles per Canada - Ontario Agreement Respecting the Great Lakes Basin: Update, Environment Canada (Pollution Prevention and Abatement Division, Ontario Region); Ontario Ministry of Environment and Energy (Program Development Branch & Pollution Prevention Office). • Putnam, D. L. (1995). Sources, Releases and Loadings -- Preliminary Estimates for COA (Canada Ontario Agreement) Substances, prepared for Environment Canada, Environmental Protection Branch, Pollution Prevention and Abatement Division, Ontario Region, Under Contract # KE409-4-0261. Newmarket, Ontario, Environmental Quality Systems.	Ontario	As with other inventories considered, this inventory is undergoing development. Different levels of geographical resolution for different compounds; some have facility-specific resolution; some compounds have province-total estimates.
Environment Canada inventories for selected heavy metals and persistent organic pollutants • Environment Canada (1996). Inventory information assembled and supplied for this project by David Niemi.	Canada	Inventories for cadmium and mercury contain substantial geographical resolution, but, much of the information is confidential. Similar spatially-resolved inventories for PAH's may also exist, but were not made available. Inventories for most other organic pollutants were made available only on a province-wide basis.
Ortech Inventories • Johnson, N. D., M. T. Scholtz, et al. (1992). MOE Toxic Chemical Emission Inventory for Ontario and Eastern North America, prepared for Air Resources Branch, Ontario Ministry of the Environment. Mississauga, Ontario, Ortech, International. Final Report Number P.92-T61-5429/OG. • Scholtz et al. (1997). Pesticide Emissions Modelling: Development of a North American Pesticides Emissions Inventory. Canadian Global Emissions Interpretation Centre. Ortech; Environment Canada Atmospheric Environment Service.	Ontario and Eastern North America Canada and the U.S.	Overall emissions estimates for a range of pollutants are included. Estimation details, included in confidential Appendices to this report, are not available to the public or independent researchers, and were not made available for this analysis. The only BVES compound with emissions estimates in this new inventory is lindane (γ-hexachlorocyclohexane). Emissions factors are presented for chlordane, hexachlorobenzene, aldrin, dieldrin, DDT and metabolites, mirex, toxaphene, endrin, heptachlor; however, emissions estimates for these compounds were not made, as estimates were only made for in-use compounds. Estimates for several in-use non-BVES biocides are presented, however, including atrazine, 2,4-D, trifluralin, endosulfan, metolachlor, triallate, and metribuzin.
Great Lakes Regional Toxics Inventory • Consortium of Groups, including the Great Lakes Commission, the U.S. EPA, others; Contact: Great Lakes Commission, Ann Arbor, Michigan	Great Lakes Region	An initial inventory, the **Southwest Lake Michigan Urban Air Toxics Emissions Inventory** has been prepared, including area sources in the Chicago, Milwaukee, and Gary Urban Areas. A broader inventory is being developed and is expected to be available soon. The inventory will primarily be based on information provided by each of the Great Lakes states and Ontario. Some facility-specific details will be held confidential.

D. Emissions Inventories Not Considered in this Study

There are a number of other emissions inventory projects which were not included in this analysis for various reasons. The reasons for exclusion were generally either that:

(a) the inventory was not yet available, or

(b) the inventory was used as an input to another inventory which *was* included, and thus its inclusion would be redundant

Table 2. Emissions Inventories Not Considered Explicitly in this Analysis

Name of Inventory; Responsible Agency/Organization	Inventory Region	Reason for Exclusion
Toxics Release Inventory U.S. EPA	U.S.	The 1993 version of this inventory was used as a base inventory for the U.S. EPA National Toxics Inventory, an inventory which is being considered in this analysis
"Dioxin Inventory Project" U.S. EPA National Center for Environmental Assessment; contacts include: Duane Winters & David Cleverly, USEPA Washington D.C.	U.S.	Inventory is not yet available; it may be available sometime in 1997
Canadian Dioxin Emissions Inventory (Federal/Provincial Task Force on PCDD/F's) (Co-Chair: Raouf Morcos, Envr. Canada)	Canada	This inventory is currently being developed and is expected to be available sometime in 1998. Preliminary information from this inventory effort was used in the inventories prepared by Envr. Canada (1996) for this analysis.
Commission for Environmental Cooperation Inventories including the North American Pollutant Release Inventory and other projects (NAFTA environmental commission)	Canada, U.S. and Mexico	Inventories for one or more compounds are being developed. These inventories are not available at this time. It is expected that the emissions inventory information will be available in the future.
National Pollutant Release Inventory Environment Canada	Canada	Relevant information from this inventory was used in the Environment Canada inventories that *were* included in this evaluation. Thus, it was not deemed necessary to include this inventory.
Strategic Options Process (SOP) for the Reduction of Toxics Environment Canada	Canada	Information from this program was used [CHECK] in the Environment Canada inventories that *were* included in this evaluation. Thus, it was not deemed necessary to include this inventory information separately.
Inventories being developed by the Ontario Ministry of Environment and Energy (OMOEE) Contact: Peter Wong	Ontario (only?)	This inventory is not yet available.

E. Summary of Coverage of Chemicals in Inventories Considered in this Evaluation

In the table below, a summary is given of the coverage of targeted chemicals by each inventory that was considered.

Table 3. Summary of Coverage of Chemicals in Inventories Considered in this Evaluation
(see notes at end of table for abbreviations and explanation of codes used)

Chemical or Group	Level	Notes	Emissions Inventory							
			United States				U.S. & Canada		Canada	
			NTI	112c6	Natl Hg	L & E	GLRTI	Ortech	Envr Can	COA
METALS / ORGANOMETALLICS										
Alkylated Lead	I	e g	**a**	**a**		**a**	**a**			**a**
Mercury	I	d g	**a**	**a**	**a**	**a**	**a**		**a**	**a**
Cadmium	II	d g	**a**			**a**	**a**		**a**	**a**
Tributyltin	II									**a**
ORGANOCHLORINE BIOCIDES										
Aldrin / Dieldrin	I	g						**a**	**a**	
DDT / DDD / DDE	I							**a**	**a**	
Mirex	I							**a**	**a**	
Toxaphene	I	g						**a**	**a**	
Endrin	II							**a**	**a**	
Heptachlor / Heptachlor Epoxide	II		**a**					i		
Hexachlorocyclohexanes	II	h	**a**					**f**	**a**	
Methoxychlor	II		**a**				**a**	**a**		
Pentachlorophenol	II	g	**a**				**a**		**a**	**a**

Table 3. Summary of Coverage of Chemicals in Inventories Considered in this Evaluation
(see notes at end of table for abbreviations and explanation of codes used)

Chemical or Group	Level	Notes	Emissions Inventory							
			United States				U.S. & Canada		Canada	
			NTI	112c6	Natl Hg	L & E	GLRTI	Ortech	Envr Can	COA
INDUSTRIAL / MISCELLANEOUS										
Octachlorostyrene	I									**a**
3,3'-Dichlorobenzidene	II	g	**a**							**a**
4,4'-Methylene bis (2-Chloroaniline)	II	d g	**a**							**a**
4-Bromophenyl Phenyl Ether	II									
Hexachloro-1,3-Butadiene	II		**a**				**a**			
CHLOROBENZENES										
1,4-dichlorobenzene	II	d g	**a**			**a**				**a**
Tetrachlorobenzenes	II		**b**			**a**				
Pentachlorobenzene	II		**b**			**a**				
Hexachlorobenzene	I	g	**a**	**a**		**a**	**a**	i	**a**	**a**
POLYCHLORINATED DIBENZO-P-DIOXINS & DIBENZOFURANS (PCDD/F'S)										
PCDD/F's	I		**a**	**a**		**a**	**a**	**a**	**a**	**a**
POLYCHLORINATED BIPHENYLS (PCB'S)										
PCB's	I	g	**a**	**a**		**a**	**a**	**a**	**a**	

Table 3. Summary of Coverage of Chemicals in Inventories Considered in this Evaluation

(see notes at end of table for abbreviations and explanation of codes used)

Chemical or Group	Level	Notes	Emissions Inventory							
			United States				U.S. & Canada		Canada	
			NTI	112c6	Natl Hg	L & E	GLRTI	Ortech	Envr Can	COA
POLYCYCLIC AROMATIC HYDROCARBONS										
Dinitropyrenes	II							**a**		**a**
Benzo [a] Pyrene	I	h	**a**	c		**a**	**a**	**a**	c	**a**
Phenanthrene	II	h	**a**	c		**a**		**a**	c	
Anthracene	II	d g	**a**	c		**a**	c	**a**	c	**a**
Benz [a] Anthracene	II	h	**a**	c		**a**	**a**	**a**	c	
Perylene	II					**a**		**a**	c ?	
Benzo [g,h,i] Perylene	II		**a**	c		**a**	c	**a**	c	
PAH's as a group	II		**a**	**a**		**a**	**a**	**a**	**a**	**a**

Notes for above Table:

a. Included in inventory
b. Chlorobenzenes as a group included in inventory; this group would include this compound.
c. PAH's included as a group in this inventory; this group include this compound
d. a Canadian National Pollutant Release Inventory (NPRI) compound
e. "Lead and its compounds" included in Canadian National Pollutant Release Inventory
f. Lindane (γ-Hexachlorocyclohexane). An updated inventory for lindane was recently released (Scholtz et al., 1997)
g. included in U.S. Toxics Release Inventory (1993)
h. proposed addition to U.S. Toxics Release Inventory (as reported in Putnam, 1995)
i. only emissions factors are presented.

Abbreviations for Inventories:

NTI = USEPA National Toxics Inventory
112c6 = USEPA Clean Air Act Section 112(c)(6)
Natl Hg = USEPA National Mercury Study
L & E = USEPA document series: Locating & Estimating Air Emissions from Sources of...
Envr Can = Canadian Inventories based on Environment Canada databases and information, prepared for this analysis by David Niemi and Marc Deslauriers of Environment Canada
GLRTI = Great Lakes Regional Air Toxics Emissions Inventory, coordinated by the Great Lakes Commission
Ortech = Ontario and Eastern North America Inventory prepared by Ortech for OMOEE; for the emissions of lindane (γ-HCH), and the emissions factors for heptachlor and HCB, Scholtz et al. (1997) was used.
COA = Canada Ontario Agreement Inventory prepared by David Putnam

F. Summary of Inventory Evaluations

In this section, evaluations of the inventories are summarized.

In Table 4, each of the inventories is evaluated relative to the criteria presented in Section B., above. This evaluation summary is based on more detailed evaluations of the inventories presented in the Appendices.

In Table 5, a summary of the availability of inventories suitable for use with comprehensive atmospheric fate and transport models is presented. In this evaluation, it was assumed that geographical resolution of equal to or better than about 100 km was required, and, that at least 75% of the expected emissions were required to be accounted for in the inventory. Additionally, if speciation of emissions is believed to be critically important to the modeling (e.g., individual estimates for different PCDD/F congeners), then the emissions inventory must be speciated. If these three criteria are met, then, the inventory is considered to be useful for comprehensive atmospheric fate and transport modeling.

It was not possible in the time frame for this project to fully evaluate each inventory for each compound for each potential source class. Thousands of such evaluations would be required. Moreover, for each substance for which there are multiple inventories, it would be worthwhile to quantitatively compare the different inventories. Time constraints did not allow this to be accomplished.

In the evaluations below, illustrative examples are given of apparent strengths and weaknesses of a given inventory.

The evaluations of the inventories have been made relative to the form in which they were supplied. In some cases, it is likely that perceived shortcomings may not be fundamentally inherent to the inventory. Many of the apparent problems may be able to be resolved with additional time and interaction with the inventory developers. For most of the inventories considered, additional information was requested, but, was not able to be supplied for one or more reasons. In sum, the evaluations been made — from the point of view of a potential user of the inventory, for example, as input to an atmospheric fate and transport model — based on what was ultimately available, in hand, at the time this evaluation was being completed.

It is acknowledged that the creation and documentation of emissions inventories are rather formidable tasks. Substantial resources are required which may not always be available. It must be stressed that any criticisms of inventories considered in this analysis are made in a constructive spirit.

Table 4. Summary of Inventory Evaluations for Each Targeted Compound Covered by Each Inventory Considered in this Evaluation

EMISSIONS INVENTORY SCORES

- Scores range from 0 - 9, 0 being "worst" and 9 being "ideal"
- If no actual emissions data appear to be available, "x" is entered
- If there are data, then:
  - First Digit = Completeness of Source Classes
  - Second Digit = Completeness of Each Included Class
  - Third Digit = Geographical Resolution of Available Emissions Data
  - Fourth Digit = Level of Documentation

Chemical or Group	Level	United States				U.S. and Canada		Canada	
		NTI	112c6	Natl Hg	L & E	GLRTI	Ortech	Envr Can	COA
METALS / ORGANOMETALLICS									
Alkylated Lead	I	**5881**	**3713**		**5718**	**?**			**8815**
Total Mercury	I	**8881**	**8818**	**8838**	**8848**	**?**		**8897**	**8815**
Mercuric Chloride ($HgCl_2$)	I	**1181**	**x**	**x**	**x**	**x**		**x**	**x**
Cadmium	II	**8781**			**8838**	**?**		**8897**	**8815**
Tributyltin	II								**8815**
ORGANOCHLORINE BIOCIDES									
Aldrin / Dieldrin	I						**x**	**5515**	
DDT / DDD / DDE	I						**x**	**5515**	
Mirex	I						**x**	**5515**	
Toxaphene	I						**x**	**5515**	
Endrin	II						**x**	**5515**	
Heptachlor / Heptachlor Epoxide	II	**3781**							
Hexachlorocyclohexanes	II	**3381**					**6538**	**7837**	
Methoxychlor	II	**3781**				**?**	**6838**		
Pentachlorophenol	II	**3781**				**?**		**8837**	**8815**

Table 4. Summary of Inventory Evaluations for Each Targeted Compound Covered by Each Inventory Considered in this Evaluation

EMISSIONS INVENTORY SCORES

- Scores range from 0 - 9, 0 being "worst" and 9 being "ideal"
- If no actual emissions data appear to be available, "x" is entered
- If there are data, then:
  - First Digit = Completeness of Source Classes
  - Second Digit = Completeness of Each Included Class
  - Third Digit = Geographical Resolution of Available Emissions Data
  - Fourth Digit = Level of Documentation

Chemical or Group	Level	United States				U.S. and Canada		Canada	
		NTI	112c6	Natl Hg	L & E	GLRTI	Ortech	Envr Can	COA
INDUSTRIAL / MISCELLANEOUS									
Octachlorostyrene	I								**8815**
3,3'-Dichlorobenzidene	II	**7181**							**8815**
4,4'-Methylene bis (2-Chloroaniline)	II	**5181**							**8815**
4-Bromophenyl Phenyl Ether	II								
Hexachloro-1,3-Butadiene	II	**5781**				**?**			
CHLOROBENZENES									
1,4-dichlorobenzene	II	**8781**			**7727**				**8815**
Tetrachlorobenzenes	II				**x**				
Pentachlorobenzene	II				**x**				
Hexachlorobenzene	I	**5831**	**7713**		**x**	**?**		**8837**	**8815**
POLYCHLORINATED DIBENZO-P-DIOXINS & DIBENZOFURANS (PCDD/F'S)									
2,3,7,8-TCDD/F	I	**a**	**8718**		**8838**		**6738**	**?**	**x**
other PCDD/F congeners	I	**2381**	**x**		**8838**		**6738**	**?**	**x**
Total Toxic Equivalents	I	**6681**	**8718**		**8838**	**?**	**6738**	**8837**	**8815**
POLYCHLORINATED BIPHENYLS (PCB'S)									
PCB's	I	**4881**	**5713**		**5618**	**?**	**7838**	**5735**	

Table 4. Summary of Inventory Evaluations for Each Targeted Compound Covered by Each Inventory Considered in this Evaluation

EMISSIONS INVENTORY SCORES

- Scores range from 0 - 9, 0 being "worst" and 9 being "ideal"
- If no actual emissions data appear to be available, "x" is entered
- If there are data, then:
  - First Digit = Completeness of Source Classes
  - Second Digit = Completeness of Each Included Class
  - Third Digit = Geographical Resolution of Available Emissions Data
  - Fourth Digit = Level of Documentation

Chemical or Group	Level	United States				U.S. and Canada		Canada	
		NTI	112c6	Natl Hg	L & E	GLRTI	Ortech	Envr Can	COA
POLYCYCLIC AROMATIC HYDROCARBONS									
Dinitropyrenes	II						**0**		**8815**
Benzo [a] Pyrene	I	**8781**	**0**		**8828**	**?**	**8838**		**8815**
Phenanthrene	II	**7781**	**0**		**8828**		**8838**		
Anthracene	II	**8781**	**0**		**8828**	**?**	**8838**		**8815**
Benz [a] Anthracene	II	**8781**	**0**		**8828**	**?**	**8838**		
Perylene	II				**8828**		**8838**		
Benzo [g,h,i] Perylene	II	**7781**	**0**		**8828**	**?**	**8838**		
PAH's as a group	II	**8881**	**8718**		**8828**	**?**	**8838**	**8837**	**8815**

Abbreviations for Inventories:

NTI = USEPA National Toxics Inventory
112c6 = USEPA Clean Air Act Section 112(c)(6)
Natl Hg = USEPA Mercury Study Report to Congress
L & E = USEPA document series: Locating & Estimating Air Emissions from Sources of...
Envr Can = Canadian Inventories based on Environment Canada databases and information, prepared for this analysis by David Niemi and Marc Deslauriers of Environment Canada
GLRTI = Great Lakes Regional Air Toxics Emissions Inventory, coordinated by the Great Lakes Commission (no evaluation was made as inventory is not yet available)
Ortech = Ontario and Eastern North America Inventory prepared by Ortech for OMOEE; for lindane (γ-HCH), Scholtz et al. (1997) was used.
COA = Canada Ontario Agreement Inventories, 1995 and 1996

Notes:

(a) This inventory lists emissions for "2,3,7,8-TCDD", but, the emissions amounts presented appear to be for total 2,3,7,8-TCDD toxic equivalents; data are presented for 2,3,7,8-TCDF, however.

Table 5. Availability of Inventories Suitable for Use with Comprehensive Atmospheric Fate and Transport Models

Chemical or Group	Level	Emissions Inventory Evaluations of Suitability for Use with Comprehensive Atmospheric Fate and Transport Models (inventory must be complete, geographically resolved, and speciated when necessary): **A:** apparently suitable **B:** somewhat suitable, but with some problems **C:** possibly suitable, with significant problems **D:** marginally useful for comprehensive models x: the inventory covered this compound, but the coverage was not useful for comprehensive atmospheric fate and transport modeling applications.							
		United States				U.S. & Canada		Canada	
		NTI	112c6	Natl Hg	L & E	GLRTI	Ortech	Envr Can	COA
METALS / ORGANOMETALLICS									
Alkylated Lead	I	**B**	x		x	**?**			x
Mercury	I	**C**	x	**D**	x	**?**		**C**	x
Cadmium	II	**A**			x	**?**		**A**	x
Tributyltin	II								x
ORGANOCHLORINE BIOCIDES									
Aldrin / Dieldrin	I						x	x	
DDT / DDD / DDE	I						x	x	
Mirex	I						x	x	
Toxaphene	I						x	x	
Endrin	II						x	x	
Heptachlor / Heptachlor Epoxide	II	x							
Hexachlorocyclohexanes	II	x					**B**	x	
Methoxychlor	II	x				**?**	x		
Pentachlorophenol	II	x				**?**		x	x

Table 5. Availability of Inventories Suitable for Use with Comprehensive Atmospheric Fate and Transport Models

Chemical or Group	Level	Emissions Inventory Evaluations of Suitability for Use with Comprehensive Atmospheric Fate and Transport Models (inventory must be complete, geographically resolved, and speciated when necessary): **A:** apparently suitable **B:** somewhat suitable, but with some problems **C:** possibly suitable, with significant problems **D:** marginally useful for comprehensive models x: the inventory covered this compound, but the coverage was not useful for comprehensive atmospheric fate and transport modeling applications.							
		United States				U.S. & Canada		Canada	
		NTI	112c6	Natl Hg	L & E	GLRTI	Ortech	Envr Can	COA
INDUSTRIAL / MISCELLANEOUS									
Octachlorostyrene	I								x
3,3'-Dichlorobenzidene	II	x							x
4,4'-Methylene bis (2-Chloroaniline)	II	x							x
4-Bromophenyl Phenyl Ether	II								
Hexachloro-1,3-Butadiene	II	**B**				**?**			
CHLOROBENZENES									
1,4-dichlorobenzene	II	**A**			x				x
Tetrachlorobenzenes	II				x				
Pentachlorobenzene	II				x				
Hexachlorobenzene	I	**B**	x		x	**?**		x	x
POLYCHLORINATED DIBENZO-P-DIOXINS & DIBENZOFURANS (PCDD/F'S)									
PCDD/F's	I	**C**	x		x	**?**	x	x	x
POLYCHLORINATED BIPHENYLS (PCB'S)									
PCB's	I	**D**	x		x	**?**	x	x	

Table 5. Availability of Inventories Suitable for Use with Comprehensive Atmospheric Fate and Transport Models

Chemical or Group	Level	Emissions Inventory Evaluations of Suitability for Use with Comprehensive Atmospheric Fate and Transport Models (inventory must be complete, geographically resolved, and speciated when necessary): **A:** apparently suitable **B:** somewhat suitable, but with some problems **C:** possibly suitable, with significant problems **D:** marginally useful for comprehensive models x: the inventory covered this compound, but the coverage was not useful for comprehensive atmospheric fate and transport modeling applications.							
		United States				U.S. & Canada		Canada	
		NTI	112c6	Natl Hg	L & E	GLRTI	Ortech	Envr Can	COA
POLYCYCLIC AROMATIC HYDROCARBONS									
Dinitropyrenes	II						x		x
Benzo [a] Pyrene	I	**A**			x	**?**	x		x
Phenanthrene	II	**A**			x		x		
Anthracene	II	**A**			x		x		x
Benz [a] Anthracene	II	**A**			x	**?**	x		
Perylene	II				x		x		
Benzo [g,h,i] Perylene	II	**A**			x		x		
PAH's as a group	II	**A**	x		x	**?**	x	x	x

Abbreviations for Inventories:

NTI = USEPA National Toxics Inventory
112c6 = USEPA Clean Air Act Section 112(c)(6)
Natl Hg = USEPA National Mercury Study
L & E = USEPA document series: Locating & Estimating Air Emissions from Sources of...
Envr Can = Canadian Inventories based on Environment Canada databases and information, prepared for this analysis by David Niemi and Marc Deslauriers of Environment Canada
GLRTI = Great Lakes Regional Air Toxics Emissions Inventory, coordinated by the Great Lakes Commission
Ortech = Ontario and Eastern North America Inventory prepared by Ortech for OMOEE
COA = Canada Ontario Agreement Inventory prepared by David Putnam

G. Summary

Very few inventories and/or inventory details could be obtained during this analysis, for various reasons, including:

- the inventory was not yet available;
- the inventory and/or inventory details were confidential;
- resources to provide inventory and/or inventory details were not available.

Thus, it is difficult to assess accuracy of the inventories or the potential ability of the inventories to serve as input to comprehensive source-receptor modeling analyses.

Confidentiality of inventories appears to be a significant issue, particularly for some of the Canadian inventory data.

For many (or all) compounds, there appears to be only a very limited number of emissions measurements (or none) from many (or all) source classes. The inadequacy of the current database of emissions factors for many compounds has also been noted by the U.S. EPA (1996c).

Some of the BVES compounds do not appear to be covered by any current inventory or any inventory currently being developed, or are covered in only a very limited way. These include, at least, the following:

- Speciated mercury emissions, e.g., $HgCl_2$, etc.
- Tributyltin compounds
- Alkylated Lead
- Pentachlorophenol
- Tetrachlorobenzenes
- Pentachlorobenzene
- PCB's
- Dinitropyrenes
- 4-Bromophenyl Phenyl Ether
- 3,3'-Dichlorobenzidene
- Octachlorostyrene

and emssions from past use of the following banned or restricted biocides:

- Aldrin / Dieldrin
- Chlordane
- DDT / DDD / DDE
- Endrin
- Heptachlor / Heptachlor Epoxide
- Methoxychlor
- Mirex
- Toxaphene

In addition, the available inventories for PCDD/F have either insufficient geographic resolution or incomplete speciation. Thus, none of the inventories for PCDD/F examined in this analysis appear to be suitable for use as input to a comprehensive atmospheric fate and transport model.

Available inventories for pentachlorophenol appear to be substantially incomplete, as emissions from in-use and discarded treated wood are not included.

The compounds with perhaps the most sophisticated available inventories appear to be cadmium, several of the PAH compounds, and perhaps 1,4 dichlorobenzene.

In sum, for most of the BVES compounds, there is little information currently available that could be used as inputs to comprehensive air pollution modeling. In most cases, the information that does exist is of uncertain quality because of a lack of quality assurance and documentation.

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Appendices

Detailed Emissions Inventory Evaluations

Appendix 1.
U.S. EPA National Toxics Inventory (Version 2.1)

- Pope, A., D. Epperson, et al. (1996). An Inventory of Air Toxics Emissions in the United States. Research Triangle Park, NC, U.S.EPA Office of Air Quality Planning & Standards; Eastern Research Group, Inc.

- ERG (1996). National Toxics Inventory (NTI) Data Documentation. Morrisville, NC. Eastern Research Group, Inc.

- Summary of National Toxics Inventory Emissions (tons/yr), June 4, 1996, Version 02: Date: 5-01-96 [Descending NTI Source Category Emissions per Pollutant]

1. Are All Relevant Source Classes Considered?

This question is addressed in the table below.

U.S. EPA National Toxics Inventory, Version 2.1: Are All Relevant Source Classes Considered?			
Chemical or Group	**Level**	**Are All Relevant Source Classes Considered?**	**Notes**
METALS / ORGANOMETALLICS			
Alkylated Lead	I	does not appear to be complete	Only two source categories included: aviation gasoline distribution and non-road mobile vehicles. One significant omission may be aviation combustion of leaded gasoline.
Mercury and Mercury Compounds	I	appears to be relatively complete for total mercury, but, very incomplete for mercuric chloride.	There are 145 source categories included for mercury and only 5 source categories included for mercuric chloride.
Cadmium and Cadmium Compounds	II	appears to be relatively complete for total cadmium; however, individual cadmium species are not included in this inventory.	
Tributyltin	II	*not included in this inventory*	

U.S. EPA National Toxics Inventory, Version 2.1: Are All Relevant Source Classes Considered?			
Chemical or Group	**Level**	**Are All Relevant Source Classes Considered?**	**Notes**
ORGANOCHLORINE BIOCIDES			
Aldrin / Dieldrin	I	*not included in this inventory*	
DDT / DDD / DDE	I	*not included in this inventory*	
Mirex	I	*not included in this inventory*	
Toxaphene	I	*not included in this inventory*	
Endrin	II	*not included in this inventory*	
Heptachlor / Heptachlor Epoxide	II	does not appear to be complete	One emissions entry only, ascribed to SIC 2865: cyclic crudes and intermediates.
Hexachlorocyclohexanes	II	does not appear to be complete	Six industrial emissions sources indicated
Methoxychlor	II	does not appear to be complete	One emissions category, relating to production of agricultural chemicals is included; emissions from current or past uses do not appear to be included.
Pentachlorophenol	II	may be moderately complete	However, emissions from in-use treated wood products are not included.

U.S. EPA National Toxics Inventory, Version 2.1: Are All Relevant Source Classes Considered?			
Chemical or Group	**Level**	**Are All Relevant Source Classes Considered?**	**Notes**
INDUSTRIAL / MISCELLANEOUS			
Octachlorostyrene	I	*not included in this inventory*	
3,3'-Dichlorobenzidene	II	may be moderately complete; difficult to assess	Two categories of printing listed as sources; it is unclear if these are the only usage categories for this dye component
4,4'-Methylene bis (2-Chloroaniline)	II	difficult to assess, but does not appear to be complete	Only one industrial source category listed, the manufacture of electronic connectors. However, MBOCA has reportedly been used primarily as a curing agent for isocyanate-containing polymers, and even though it is reportedly no longer produced in the U.S., approximately 2 million pounds were imported into the U.S. in 1991 (ATSDR: MBOCA, 1994).
4-Bromophenyl Phenyl Ether	II	*not included in this inventory*	
Hexachloro-1,3-Butadiene	II	difficult to assess, but does not appear to be complete	Emissions from hazardous waste incineration do not appear to be included. Substantial quantities of HCBD are produced during the manufacture of certain chlorinated solvents, and is typically incinerated. Since the incineration will not be 100% complete, it is likely that some HCBD will be emitted from this source.
CHLOROBENZENES			
1,4-dichlorobenzene	II	appears to be relatively complete	
Tetrachlorobenzenes	II	*not included in this inventory*	
Pentachlorobenzene	II	*not included in this inventory*	
Hexachlorobenzene	I	does not appear to be complete	Incineration sources appear to be missing, including, for example, hazardous waste, municipal waste and medical waste incinerators

U.S. EPA National Toxics Inventory, Version 2.1: Are All Relevant Source Classes Considered?			
Chemical or Group	**Level**	**Are All Relevant Source Classes Considered?**	**Notes**
POLYCHLORINATED DIBENZO-P-DIOXINS & DIBENZOFURANS (PCDD/F'S)			
PCDD/F's	I	appears to be relatively complete for 2,3,7,8-TCDD and 2,3,7,8-TCDF, but, very incomplete for other PCDD/F congeners	Based on the data presented, the listing for 2,3,7,8-TCDD appears to be for total 2,3,7,8-TCDD Toxic Equivalents -- a much different entity than 2,3,7,8-TCDD alone. Unfortunately this is not noted in the database. Iron Sintering facilities do not appear to be included. These may be a major source. Their lack of inclusion is not indicated in the inventory. Sources that emit 2,3,7,8-TCDD will also emit other PCDD/F congeners. These are toxic and their emissions can create significant exposure risks. Different congeners behave differently in the environment, and so, it is necessary to take these differences into account in models. Thus, it is important to have information on emissions rates for the different congeners.
POLYCHLORINATED BIPHENYLS (PCB'S)			
PCB's	I	does not appear to be complete	Emissions from past use and disposal are not included. In addition, emissions from spills and accidents do not appear to be included. These two types of emissions sources may be the most significant sources for PCB emissions.

U.S. EPA National Toxics Inventory, Version 2.1: Are All Relevant Source Classes Considered?			
Chemical or Group	**Level**	**Are All Relevant Source Classes Considered?**	**Notes**
POLYCYCLIC AROMATIC HYDROCARBONS			
Dinitropyrenes	II	*not included in this inventory*	
Benzo [a] Pyrene	I	appears to be relatively complete	81 source categories are included
Phenanthrene	II	appears to be moderately complete	39 source categories are included. Given that most sources emitting Benzo[a]Pyrene would also emit Phenanthrene, the fact that there are only about ½ the number of source categories for Phenanthrene suggests that there may be many missing sources for this compound.
Anthracene	II	appears to be moderately complete	61 source categories are included.
Benz [a] Anthracene	II	appears to be relatively complete	74 source categories are included.
Perylene	II	*not included in this inventory*	
Benzo [g,h,i] Perylene	II	appears to be moderately complete	30 source categories are included.
PAH's as a group	II	appears to be moderately complete	150 source categories are included in a "total PAH" pollutant category; 46 categories are included for the EPA-defined 16-PAH group emissions; 40 categories are included for the EPA-defined 7-PAH group.

2. Is Each Included Source Class Comprehensively Treated?

It is difficult to tell how comprehensively each source class is treated, because individual facilities are not listed; emissions are aggregated by county in most cases, and by state in some cases. However, some observations can be made. These are summarized in the following table.

U.S. EPA National Toxics Inventory, Version 2.1: Is Each Included Source Class Comprehensively Treated?			
Chemical or Group	**Level**	**Is Each Included Source Class Comprehensively Treated?**	**Notes**
METALS / ORGANOMETALLICS			
Alkylated Lead	I	apparently comprehensive for the two source classes included	972 counties with emissions from aviation gas distribution, and 3141 counties with emissions from non-road mobile vehicles.
Mercury and Mercury Compounds	I	apparently comprehensive for most or all source classes included for mercury	• For major source categories, treatment appears very comprehensive; • for minor source categories, treatment may be less comprehensive. • Very little data included for mercuric chloride.
Cadmium and Cadmium Compounds	II	apparently comprehensive for most source categories, with a few possible exceptions as noted at right	Examples of possible incomplete source categories: • Only 2 counties with cadmium emissions from secondary lead smelting, but, 225 counties emitting lead from this source type; • Only 10 counties with cadmium emissions from plating and polishing (seems too small).
Tributyltin	II	*not included in this inventory*	

U.S. EPA National Toxics Inventory, Version 2.1: Is Each Included Source Class Comprehensively Treated?			
Chemical or Group	**Level**	**Is Each Included Source Class Comprehensively Treated?**	**Notes**
ORGANOCHLORINE BIOCIDES			
Aldrin / Dieldrin	I	*not included in this inventory*	
DDT / DDD / DDE	I	*not included in this inventory*	
Mirex	I	*not included in this inventory*	
Toxaphene	I	*not included in this inventory*	
Endrin	II	*not included in this inventory*	
Heptachlor / Heptachlor Epoxide	II	possibly comprehensive	Only 1 county is reported for emissions, but, this source category may be for manufacture or packaging of this compound, and there may indeed be only one location where this is done.
Hexachlorocyclohexanes	II	does not appear to be comprehensive	For each of the 6 source categories listed, there is only one county with reported emissions. Each of these categories appears fairly general, and so, it is unlikely that there is only 1 county for each that would generate emissions.
Methoxychlor	II	possibly comprehensive	Only 2 counties are reported for emissions, but, this source category may be for manufacture or packaging of this compound, and there may indeed be only a few locations where this is done.
Pentachlorophenol	II	possibly comprehensive	27 counties in 15 states are included for emissions from the wood preserving source category, the largest included source category. This seems low, but, may be complete; without methodological details, it is difficult to determine how complete this category is.

U.S. EPA National Toxics Inventory, Version 2.1: Is Each Included Source Class Comprehensively Treated?			
Chemical or Group	**Level**	**Is Each Included Source Class Comprehensively Treated?**	**Notes**
INDUSTRIAL / MISCELLANEOUS			
Octachlorostyrene	I	*not included in this inventory*	
3,3'-Dichlorobenzidene	II	does not appear to be comprehensive	Emissions from only 1 county are reported for each of the two printing-related source categories included in the inventory. This would seem to be very incomplete.
4,4'-Methylene bis (2-Chloroaniline)	II	does not appear to be comprehensive	Emissions from only 1 county are reported for the 1 source category included.
4-Bromophenyl Phenyl Ether	II	*not included in this inventory*	
Hexachloro-1,3-Butadiene	II	may be comprehensive for the source categories included	

U.S. EPA National Toxics Inventory, Version 2.1: Is Each Included Source Class Comprehensively Treated?			
Chemical or Group	**Level**	**Is Each Included Source Class Comprehensively Treated?**	**Notes**
CHLOROBENZENES			
1,4-dichlorobenzene	II	apparently complete for the main source category; may be less comprehensive for other source categories	• Only 20 counties with reported emissions from POTW's; • only 1 county with reported emissions from sewage sludge incinerators; • there is 1 county with large reported emissions from plating — if this is valid, there would probably be other such sources.
Tetrachlorobenzenes	II	*not included in this inventory*	
Pentachlorobenzene	II	*not included in this inventory*	
Hexachlorobenzene	I	apparently complete for main source category, pesticide application, but there is a question about the total amount estimated to be emitted from this category; less comprehensive for other categories	• Emissions from all states are reported for pesticide application, indicating relatively complete coverage for this significant source. The emissions reported, 202 tons, is approximately 150 times that estimated by Cohen et al. (1995) for this source. Since methodological details are not available, it is difficult to determine the reasons for this difference. • There is only 1 county with reported emissions for Portland Cement Kilns

U.S. EPA National Toxics Inventory, Version 2.1: Is Each Included Source Class Comprehensively Treated?			
Chemical or Group	**Level**	**Is Each Included Source Class Comprehensively Treated?**	**Notes**
POLYCHLORINATED DIBENZO-P-DIOXINS & DIBENZOFURANS (PCDD/F'S)			
PCDD/F's	I	Apparently complete for many source categories, but apparently incomplete for a few source categories	• There are only 2 counties with reported emissions for Portland Cement Kilns. There are over 100 cement kiln facilities in the U.S., and they are spread widely throughout the country. Thus, the there appears to be many missing facilities. • A similar problem appears to exist for industrial coal combustion, with only 1 county with reported emissions. • Emissions for on-road mobile vehicles reported as 0.1 g TEQ/yr, substantially less than other inventories for this source category. • Only 4 counties reported for "other biological waste incineration," but with PCB emissions, 1573 counties are included for this category.
POLYCHLORINATED BIPHENYLS (PCB'S)			
PCB's	I	Apparently complete for most of the source categories that are included	• "Electric services" are included as a source category, with 1 county with reported emissions; if this category represents emissions from PCB-containing electric transformers, then it would be substantially incomplete. • Only 2 counties included with emissions from Portland Cement Kilns.

U.S. EPA National Toxics Inventory, Version 2.1: Is Each Included Source Class Comprehensively Treated?			
Chemical or Group	**Level**	**Is Each Included Source Class Comprehensively Treated?**	**Notes**
POLYCYCLIC AROMATIC HYDROCARBONS			
Dinitropyrenes	II	*not included in this inventory*	
Benzo [a] Pyrene	I	Apparently complete for many source categories, except for a few (see examples at right)	• Utility Oil combustion: only 7 counties; • Industrial Residual Oil combustion: only 4 counties; • Industrial Wood Waste combustion: only 6 counties; • Portland Cement Kilns: only 2 counties;
Phenanthrene	II	Apparently complete for most of the source categories included, except for few (see examples at right)	• Industrial Wood Waste combustion: only 1 county; • Commerical/Institutional Distillate Oil combustion: only 1 county
Anthracene	II	Apparently complete for most of the source categories included, except for a few (see examples at right)	• Industrial Residual Oil combustion: only 2 counties; • Commerical/Institutional Distillate Oil combustion: only 1 county • Industrial wood waste combustion: only 3 counties; • Other biological incineration: only 1 county
Benz [a] Anthracene	II	Apparently complete for most of the source categories included, except for a few (see examples at right)	similar apparently incomplete categories as other PAH's above
Perylene	II	*not included in this inventory*	
Benzo [g,h,i] Perylene	II	Apparently complete for most of the source categories included	Commerical/Institutional Distillate Oil combustion: only 1 county

U.S. EPA National Toxics Inventory, Version 2.1: Is Each Included Source Class Comprehensively Treated?			
Chemical or Group	**Level**	**Is Each Included Source Class Comprehensively Treated?**	**Notes**
PAH's as a group	II	16-PAH and 7-PAH pollutant categories apparently complete for most source categories included.	"PAH total" pollutant category very incomplete for most source categories

3. What is the Geographical Resolution of the Emissions Inventory?

Data are reported at the county level for most source classes, and at the state level for some source categories, e.g., mobile sources.

Without individual facilities listed, it is essentially impossible to check the adequacy of the database, or, make any changes or improvements to the database. Thus, for example, if new information about an emissions factor became available for a particular type of incinerator, and, one wanted to modify the emissions inventory to incorporate this new information, it would be essentially impossible to do so with the inventory in its existing form.

The county level resolution would generally be acceptable — in most cases — as input to long-range transport models, however, as exact source locations are not necessarily crucial when one is considering atmospheric fate and transport over 1000's and 10,000's of kilometers. Similarly, county level resolution would probably be satisfactory, in most cases, for consideration of the impacts of emissions on the Great Lakes, even for counties relatively close to any given Lake. For counties adjacent to a given Lake, it probably would be helpful to have better geographical resolution, as input to short range models.

4. What is the Temporal Resolution of the Emissions Inventory?

The documentation for the inventory states that the 1993 TRI (U.S.EPA Toxics Release Inventory) was the starting point, but, that estimates for other years were also included for some sources. Thus, there is no consistent time frame for the inventory, and the documentation acknowledges this. Unfortunately, there is no indication in the database of what years various entries refer to.

5. To What Extent are Emissions Estimates for Specific, Individual Point Source Facilities based Actual Measurements, and, If Any Are, How Adequate is the Documentation?

The database does not describe whether an emissions estimate is based on actual measurements or on an emissions factor.

As such, no information on source tests is included.

6. Is There Documentation of the Use of Emissions Factors, and if they are Used, Is Adequate Information Provided about the Emissions Factors?

The database does not describe whether the emissions estimates are based on emissions factors or other methods. As such, no information on the emissions factors is given.

7. Are Key Characteristics of Each Source Documented?

The database does not include any information about specific sources.

Throughput information, even for aggregated sources, is not given.

SIC codes and SCC codes are given, but, the treatment is inconsistent. Many entries do not have one or both of the codes.

8. Are Any Modeling-Relevant Details about the Emissions Provided?

There are no modeling relevant details given, such as the form that the pollutant is emitted in, the particle size distribution of particle associated emissions (if applicable), the temperature, height, and exit velocity of the stack gases or emissions point.

9. In What Form(s) is the Inventory Available, and are there any Problems with the Available Form(s)?

The inventory is currently available as a set of database or ASCII files.

The ASCII version of the main emissions inventory file is on the order of 186 megabytes in size.

The ASCII version is aligned by columns, and comma delimited. Unfortunately, in some of the files, commas also appear in the fields themselves. Thus, the choice of commas as delimiters was unfortunate and created data processing difficulties.

A summary of the database was eventually provided for this analysis.

10. Is the Inventory Publicly Available? To What Extent is Information about Emissions from Individual Facilities Publicly Available?

The inventory appears to be publicly available, or, will apparently be made available in the future.

As mentioned above, individual facilities are not identified in the database.

Appendix 2.
Environment Canada Inventory
for Selected Metals and Persistent Organic Pollutants
(Assembled for this Project By David Niemi, of Environment Canada)

1. Are All Relevant Source Classes Considered?

The inventory appears to be relatively complete in its coverage of source categories.

For dioxins, emissions were provided in terms of Toxic Equivalents. This is certainly a useful way to summarize the data. However, for modeling purposes, congener-specific emissions estimates need to be made, as different congeners will have different atmospheric fate and transport behavior. For some source classes of dioxins and furans, e.g., oil and coal combustion, some congener specific data was provided.

For banned pesticides, no attempt was made to consider releases from past usage, although it is certainly acknowledged that this would be a difficult task, and, a common problem for most, if not all, currently existing inventories.

2. Is Each Included Source Class Comprehensively Treated?

Persistent Organic Pollutants:

For the persistent organic compounds included, it is difficult to tell how comprehensively each source class is treated, because individual facilities are generally not listed. Facility level information may exist in the database — for some types of facilities — but, it was not generally transmitted for analysis in this project.

Backup information was provided, however, for a few types of sources. For example:

- A consultant report giving details on emissions from municipal solid waste incineration was provided.
- A medical waste incinerator list was provided for one province (Manitoba) but not for any other provinces.

Metals (Cd and Hg)

The coverage appears to be relatively complete. A facility-specific inventory is provided which would allow an independent check on the comprehensiveness of the inventory.

For mercury, a draft report describing certain strengths and weaknesses of the inventory was provided.

3. What is the Geographical Resolution of the Emissions Inventory?

Data are reported at the facility level for Hg and Cd

Data are reported at the province level for most source classes of persistent organics considered

The lack of facility level data for most of the persistent organic emissions estimates means that it is difficult to check the adequacy of the database, or, make any changes or improvements to the database. Thus, for example, if new information about an emissions factor became available for a particular type of incinerator, and, one wanted to modify the emissions inventory to incorporate this new information, it would be essentially impossible to do so with the inventory in its existing form.

The province level resolution reported for the organics is less than ideal as inputs to models attempting to assess the impact of emissions on the Great Lakes.

4. What is the Temporal Resolution of the Emissions Inventory?

An overall summary table for persistent organics provided with the inventory states that the estimates are for 1990. Some of the data in the supporting information, however, may be from different years. It does not appear clear -- in the data provided -- which data refer to which year, although this uncertainty could probably be resolved by additional consultation with David Niemi (who assembled the information).

The underlying database may have some information about the seasonal variation in emissions, but, no information regarding this was supplied. If such information is available, it would be of interest.

5. To What Extent are Emissions Estimates for Specific, Individual Point Source Facilities based Actual Measurements, and, If Any Are, How Adequate is the Documentation?

Some of the data are apparently based on actual measurements, and at least a portion of these are indicated as such.

No information on source tests is included, however, such as the number of tests or the variability in the measured emissions.

6. Is There Documentation of the Use of Emissions Factors, and if they are Used, Is Adequate Information Provided about the Emissions Factors?

The database does give references for some of the emissions factors used. However, details on the emissions factors used are not generally given (with a few exceptions).

7. Are Key Characteristics of Each Source Documented?

For organics, the database does not generally include information about specific sources. One exception is a report on municipal waste combustion that was provided.

Throughput information, even for aggregated sources, is not generally given, although, it is sometimes given (e.g, for mobile sources).

SIC codes and SCC codes are given for the metals inventories.

8. Are Any Modeling-Relevant Details about the Emissions Provided?

There are no modeling-relevant details given, such as the form in which the pollutant is emitted, the size distribution of particle-associated emissions (if applicable), the temperature, height, and exit velocity of the stack gases or emissions point. It is possible that some of this information (e.g., height of stack and exit velocity) may exist in the database. If so, it would be useful.

9. In What Form(s) is the Inventory Available, and are there any Problems with the Available Form(s)?

The inventory was provided to this project in a set of Lotus 123 spreadsheets.

The were *some* gaps in the documentation of the spreadsheets, but, it was clear that a substantial effort had been made to provide documentation. Obviously, if there had been more time available for the project, these gaps could have been resolved.

10. Is the Inventory Publicly Available? To What Extent is Information about Emissions from Individual Facilities Publicly Available?

The facility-specific information in the inventory is restricted by a confidentiality agreement. It does not appear to be publicly available.

Appendix 3.
U.S. Clean Air Act, Section 112(c)(6) Inventories

- U.S.EPA (1996a). Emissions Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)/2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. Draft Report. Research Triangle Park, NC. Emission Factor & Inventory Group and Visibility & Ecosystem Protection Group.

1. Are All Relevant Source Classes Considered?

The inventory appears to be relatively complete in its coverage of many source categories. However, apparent shortcomings include the following:

Dioxins and Furans

For dioxins, emissions were provided for 2,3,7,8-TCDD, 2,3,7,8-TCDF, and for total PCDD/F expressed as 2,3,7,8-TCDD Toxic Equivalents (TEQ). This is certainly a useful way to summarize the data. However, for modeling purposes, congener-specific emissions estimates need to be made, as different congeners will have different atmospheric fate and transport behavior.

PCB's

There appear to be significant gaps in the coverage for several source classes. The following classes are acknowledged not to be included, for reasons of a lack of data:

- Treatment, Storage, and Disposal Facilities and Landfills
- Superfund Sites
- Steel and Iron Reclamation (Auto Scrap Burning)
- Accidental Releases (PCB Spills and Leaks and Transformer Fires)
- Environmental Sinks of Past PCB Contamination

Alkylated Lead

The EPA estimates that national emissions of Tetraethyl Lead (TEL) and Tetramethyl Lead (TML) were 811 pounds and 481 pounds, respectively, in 1990.

While roughly 1% of the alkyl-lead compounds added to fuels are emitted to the atmosphere during fuel transport and handling processes (Grandjean and Nielsen, 1979), approximately 0.3 - 3% of the lead emitted from vehicles burning leaded gasoline is emitted as organo-lead compounds, including tetra-alkyl lead and ionic alkyl-lead compounds (Hewitt and Rashed, 1988).

It is stated that insufficient information exists to develop credible national emissions estimates from aircraft, on-road vehicles, and alkylated lead production. Of these the EPA suggests that evaporative and combustion emissions from aircraft may be the most significant source. It is helpful that the inventory acknowledges this shortcoming.

A simple calculation can be made to make a crude estimate of this un-included source. This inventory cites a total amount of aviation gasoline use of 322,629,000 gallons per year. Assuming a lead content of 4 grams per gallon (as is done in the inventory), the total amount of

lead in this amount of gasoline would be 1.29e+09 grams. Using the rough emissions estimate for vehicles of 0.3 - 3% of the lead being emitted as organolead compounds in the exhaust, a crude estimate of 3.87e+06 - 3.87e+07 grams (8,500 — 85,000 lbs) of lead in organolead emissions per year can be obtained. Assuming the "average" compound emitted is TEL, then the weight ratio of TEL to lead would be 323.4 / 207.2 = 1.56. Thus, this would correspond, roughly, to an emissions of TEL of 13,000 - 130,000 lbs/year. This can be compared to the total estimated emissions of TEL and TML in the EPA inventory of 810 lbs/year of TEL and 481 lbs/year of TML. Even if the emissions of organolead from aircraft are proportionately 10 - 100 times lower than comparable emissions from motor vehicles, this source would appear to be very significant.

2. Is Each Included Source Class Comprehensively Treated?

For 2,3,7,8-TCDD, 2,3,7,8-TCDF, and PAH's, there is a great deal of detail provided regarding the methodology of the emissions estimates.

- Lists of sources are not provided, however, and it is difficult to assess the adequacy of the data.

- Based on ongoing work being performed at CBNS, it is believed that there are major uncertainties in the medical waste incinerator inventory used for PCDD/F in this document.

For mercury, hexachlorobenzene, alkylated lead, and PCB's, the reader is referred to background report(s)s for details of the analysis.

The mercury report cited is the Mercury Study Report to Congress (included in this analysis).

The HCB reports cited include:

- Estimation of National Hexachlorobenzene Emissions for 1990, Final Report, prepared by TRC Environmental Corporation for the U.S. EPA's Office of Air Quality Planning and Standards, under contract 68-D9-0173, October 1993.

- Hexachlorobenzene Emissions Database as Developed From the Pesticide Use Database (RRF), Bill Benjey, U.S. EPA, Research Triangle Park, NC, 1993.

The details of the Alkylated Lead inventory are stated to be contained in the following report:

- Estimation of Alkylated Lead Emissions, Final Report, prepared by TRC Environmental Corporation for the U.S. EPA's Office of Air Quality Planning and Standards, under contract 68-D9-0173, September 1993.

Certain details of the emissions estimates for PCB's are provided in the document; for other details, the reader is referred to the following reports:

- Memorandum from Joe Mangino, Lauren Elmore, Peter Keller, Kevin Hastings, and Glenn Rives, Radian Corporation, to Anne Pope, OAQPS/EIB/EPA. "Inventory Plan for Section 112(c)(6) Pollutants." September 30, 1993.

- Memorandum from Lauren Elmore, Radian Corporation, to Anne Pope, EIB/EPA, and Tom Lahre, PAB/EPA. "Status of PCB Data Search and Analysis." June 10, 1993.

- U.S. EPA 1994: Estimating Exposure to Dioxin-Like Compounds. Vol. I: Executive Summary. Vol. II: Properties, Sources, Occurrence and Background Exposures. Vol. III: Site-Specific Assessment Procedures. External Review Draft, EPA/600/6-88-005Ca,b & c, June (Washington, DC: Office of Research & Development).

Except for the first background report (for Mercury) and the last background report (for Dioxin-Like compounds), the above background documents were unavailable.

3. What is the Geographical Resolution of the Emissions Inventory?

Where information is provided, data are reported at the national level. This resolution is obviously of limited usefulness as an input to air pollution models.

The lack of facility level data for most of the persistent organic emissions estimates means that it is difficult to check the adequacy of the database, or, make any changes or improvements to the database. Thus, for example, if new information about an emissions factor became available for a particular type of incinerator, and, one wanted to modify the emissions inventory to incorporate this new information, it would be essentially impossible to do so with the inventory in its existing form.

4. What is the Temporal Resolution of the Emissions Inventory?

For most of the emissions estimates in the inventory, 1990 was chosen as the "inventory year".

5. To What Extent are Emissions Estimates for Specific, Individual Point Source Facilities based Actual Measurements, and, If Any Are, How Adequate is the Documentation?

No facility specific estimates are provided.

6. Is There Documentation of the Use of Emissions Factors, and if they are Used, Is Adequate Information Provided about the Emissions Factors?

One of the strongest aspects of this inventory is its detailed description of the emissions factors for dioxins, PAH's, and PCB's used in the analysis.

While complete details are not given, some details are provided, and extensive references are listed.

One apparent weakness of this inventory is that the range or uncertainty in emissions is not given.

7. Are Key Characteristics of Each Source Documented?

Throughput information, even for aggregated sources, is not generally given, although, it is sometimes given (e.g, for mobile sources).

Overall breakdowns for pollution control equipment and process types are frequently given, as they are generally required to justify the selection of the chosen emissions factor.

8. Are Any Modeling-Relevant Details about the Emissions Provided?

There are no modeling relevant details given, such as the form that the pollutant is emitted in, the particle size distribution of particle associated emissions (if applicable), the temperature, height, and exit velocity of the stack gases or emissions point.

9. In What Form(s) is the Inventory Available, and are there any Problems with the Available Form(s)?

The inventory was downloaded off the EPA's Technology Transfer Network.

10. Is the Inventory Publicly Available? To What Extent is Information about Emissions from Individual Facilities Publicly Available?

The inventory itself is publicly available. There is no facility-specific information in the inventory.

Appendix 4.
U.S. EPA: Mercury Study Report to Congress

- U.S.EPA (1996b). Mercury Study Report to Congress. Volume II: An Inventory of Anthropogenic Mercury Emissions in the United States. SAB Review Draft. Research Triangle Park, NC, EPA Office of Air Quality Planning and Standards & Office of Research and Development, EPA-452/R-96-001b.

1. Are All Relevant Source Classes Considered?

This inventory appears to be relatively comprehensive in its consideration of sources. A commendable feature is the acknowledgment of sources that it is *not* considering, something that most inventories examined in this analysis do not do. These acknowledged omissions include mobile sources, agricultural burning, landfills, sludge application, residential woodstoves, mercury compounds production, byproduct coke production, petroleum refining, and zinc mining.

2. Is Each Included Source Class Comprehensively Treated?

Each included source category appears to be comprehensively treated.

3. What is the Geographical Resolution of the Emissions Inventory?

State level data presented for utility, commercial/institutional, and residential boilers,

State level information is given for medical waste incinerators and crematories, but only national emissions total are given. National emissions estimates for medical waste incinerators were allocated to counties based on the number of hospital beds per county. County data are not presented in the inventory, however. National emissions estimates for crematories were allocated to counties on a per capita basis. Again, however, county level data are not presented.

Facility level names, locations, and capacity are given for municipal waste incinerators and sewage sludge incinerators, primary lead smelters and refiners, carbon black production, byproduct coke production, but only national emissions totals are given.

Facility level emissions are presented in the inventory for mercury cell chlor-alkali production facilities, primary copper smelting, button cell battery production (TRI emissions only), mercury compounds production (TRI emissions only), and geothermal power plants.

Only national emissions estimates are given for hazardous waste incinerators, secondary mercury production, cement manufacturing, lime producing plants, electrical apparatus manufacturing, thermometer manufacturing, gold mines, petroleum refining.

Nationwide estimates were allocated to counties based on population or other activity units for latex paint application, mercury lamp breakage, general laboratory usage, and dental preparation.

4. What is the Temporal Resolution of the Emissions Inventory?

The inventory is presented as annual emissions, over the generalized time period from 1990-1993.

5. To What Extent are Emissions Estimates for Specific, Individual Point Source Facilities based Actual Measurements, and, If Any Are, How Adequate is the Documentation?

There are some emissions estimates that are based on actual measurements identified in the inventory. There is very little documentation regarding these estimates, however, such as variations in repeated measurements, etc.

6. Is There Documentation of the Use of Emissions Factors, and if they are Used, Is Adequate Information Provided about the Emissions Factors?

When emissions factors are used, it is indicated in the inventory. In some cases, there are useful discussions regarding the degree of validity and representativeness of the emissions factor used.

7. Are Key Characteristics of Each Source Documented?

In some cases, as mentioned above in the answer to question (3), facility level throughput is given. However, there is little or no facility level pollution control information given in the inventory.

8. Are Any Modeling-Relevant Details about the Emissions Provided?

There are essentially no modeling relevant details provided, e.g., proportions of different mercury species being emitted, emissions height and temperature, emissions velocity, etc.

9. In What Form(s) is the Inventory Available, and are there any Problems with the Available Form(s)?

The inventory was made available to this project as a paper copy of a Science Advisory Board Review Draft. Future versions of the inventory may be available in electronic form.

10. Is the Inventory Publicly Available? To What Extent is Information about Emissions from Individual Facilities Publicly Available?

Since the inventory reviewed was a Science Advisory Board Review Draft, it is unclear how much of the inventory will eventually be made public. It is likely that most or all of the information described above will be made public. As described above, there are some facility specific details in the inventory, but, not for all sources.

Appendix 5.
U.S. EPA: Locating and Estimating Air Emissions from Sources of... ("L & E" Document Series)

- L&E-Cadmium (1993). Locating and Estimating Air Emissions from Sources of Cadmium and Cadmium Compounds. Research Triangle Park, NC, U.S. EPA Office of Air Quality Planning and Standards. EPA-454/R-93-040.

- L&E-Chlorobenzenes (1994). Locating and Estimating Air Emissions from Sources of Chlorobenzenes (Revised). Research Triangle Park, NC, U.S. EPA Office of Air Quality Planning and Standards. EPA-454/R-93-044.

- L&E-Dioxins (1997). Locating and Estimating Air Emissions from Sources of Dioxins and Furans. Research Triangle Park, NC, U.S. EPA Office of Air Quality Planning and Standards. EPA-454/R-97-003.

- L&E-POM (1994). Locating and Estimating Air Emissions from Sources of Polycyclic Organic Matter, November 1994 Draft Report prepared by Radian Corporation. Research Triangle Park, NC, U.S. EPA Office of Air Quality Planning and Standards. EPA Contract # 68-D2-0160.

- L&E-Lead (1996). Locating and Estimating Air Emissions from Sources of Lead and Lead Compounds, July 1996 Draft prepared for the U.S. EPA by Eastern Research Group. Research Triangle Park, NC, U.S. EPA Office of Air Quality Planning and Standards. EPA Contract # 68-D2-0160.

- L&E-Mercury (1997). Locating and Estimating Air Emissions from Sources of Mercury and Mercury Compounds. Research Triangle Park, NC, U.S. EPA Office of Air Quality Planning and Standards. EPA-454/R-97-012.

- L&E-PCB's (1987). Locating and Estimating Air Emissions from Sources of Polychlorinated Biphenyls (PCB). Research Triangle Park, NC, U.S. EPA Office of Air Quality Planning and Standards. EPA-450/R-84-007n.

1. Are All Relevant Source Classes Considered?

Locating and Estimating Air Emissions from Sources of ...	Are All Relevant Source Classes Considered?
Cadmium	The major source classes appear to be considered.
Chlorobenzenes (a)	**1,4-Dichlorobenzene:** The major source classes appear to be considered.
	Hexachlorobenzene: The major source classes appear to be omitted, including HCB-contaminated pesticide use and waste combustion. For a few types of waste combustion, emissions factors for total chlorobenzenes are listed, but, no factors for HCB are listed for any type of waste combustion. In fact, in the summary of emissions factors presented (Appendix C) there do not appear to be *any* emissions factors for HCB included.
Dioxins	Many source classes are included in this inventory. However, while their emissions are discussed, emissions estimates are not made for any of the following potentially significant source classes due to a lack of data: residential waste combustion (e.g., backyard burning); industrial/commercial waste combustion; iron sintering; industrial/commercial coal combustion; hog fuel and sludge combustion at pulp and paper mills; landfill gas flares; asphalt mixing plants; accidental fires involving PVC or PCB's or other chlorinated compounds; waste oil combustion; aircraft burning leaded gasoline; and organic chemical manufacturing.
Polycyclic Organic Matter	The major source classes appear to be considered.
Lead (only information on alkylated lead was considered in this analysis)	Alkylated lead emissions from the use of leaded fuels are not included, other than the distribution of such fuels.
Mercury	Most or all significant source classes appear to be considered.
PCB's	Some significant source classes are considered, including two very significant sources that are generally ignored in inventories of PCB's: emissions from past releases and from spill and leaks. Actual emissions estimates are only made for some of the spill/leak category of sources, but, the document contains a very useful discussion and presentation of available data for these difficult-to-quantify sources. While sewage sludge incinerators and PCB-waste incinerators are included, many PCDD/F sources which are likely to emit PCB's are not included, such as medical waste incinerators, cement kilns, metallurgical processes, fuel combustion, and others.

(a) the BVES compounds 1,4 dichlorobenzene and hexachlorobenzene are treated in this document; the BVES compounds pentachlorobenzene and the tetrachlorobenzenes are *not* considered in this document.

2. Is Each Included Source Class Comprehensively Treated?

Locating and Estimating Air Emissions from Sources of ...	Is Each Included Source Class Comprehensively Treated?
Cadmium	Apparently comprehensive for most or all major source categories included.
Chlorobenzenes (a)	**1,4-Dichlorobenzene:** for the two major emissions sources, use of 1,4-DCB as a moth control pesticide and a space deodorant, mass-balance-based total emissions estimates were implied. The report states that 4.5 million kg of 1,4-DCB was used as a moth control substance in 1988, and that in this use, essentially all of the compound is emitted. The report further states that 6.8 million kg were used as a space deodorant in 1988 and that 90% of this is released to the air during use and 10% is released to the water or land, depending on whether it is used as a toilet deodorant or a garbage deodorant (emissions of 1,4-DCB to the air from such releases to the water or land are not included in this inventory, except that a generalized chlorobenzene emissions factor for POTW's is given.)
	Hexachlorobenzene: no emission information is given for HCB, other than to say that emissions will be insignificant for the minor sources that are discussed.
Dioxins	There appears to be relatively complete coverage for the source categories that are included, except that the emissions estimates for many source categories are relatively low compared to other emissions inventories. For example, emissions from large municipal waste combustors was estimated at only 731 g TEQ per year for 1995. Also, the total for cement kilns burning hazardous waste was only estimated to be on the order of 60 g TEQ per year. There may be substantial uncertainties in the national emissions estimates made for medical waste incineration, as the underlying data on throughput, pollution control equipment, and emissions factors are poorly understood at present. The estimate presented here is at the low end of estimates that have been made, and is consistent with an estimate made by the American Hospital Association. As mentioned above in the Table for Question 1, there are some sources whose emissions are discussed but with no emissions estimates.
Polycyclic Organic Matter	National emissions estimate are made using national throughput or activity estimates and emissions factor estimates. The estimates for national throughput and/or activity appear to be comprehensive, and so, the national emissions estimates derived from them would appear to be reasonably complete. Different sets of PAH's are included for each source category. Thus, there are not emissions estimates for each PAH considered for each source category included in this inventory.

Locating and Estimating Air Emissions from Sources of ...	**Is Each Included Source Class Comprehensively Treated?**
Lead (only information on alkylated lead was considered in this analysis)	For the one major source that was included, leaded fuel distribution, the inventory appears to be comprehensive, although a previous inventory is cited for the results (Clayton, 1993).
Mercury	National emissions estimate are made using national throughput or activity estimates and emissions factor estimates. The estimates for national throughput and/or activity appear to be comprehensive, and so, the national emissions estimates derived from them would appear to be reasonably complete. For many source classes, lists of facilities with capacities are provided. Emissions estimates are not made for some source classes due to a lack of data. One limitation of this inventory is that only total mercury emissions are presented. Information on emissions rates for different species, such as mercuric chloride ($HgCl_2$) are not given.
PCB's	For some of the sources that are considered, comprehensive lists of facilities are included. However, in most cases, only emissions factors are given and not emissions, and data on throughput is not provided to allow an estimate of emissions. Thus, there are very few actual emissions estimates in this document. Some of the only emissions estimates presented are for some categories of leaks and spills, which, as mentioned above, is a commendable feature of this inventory.

(a) the BVES compound 1,4 dichlorobenzene and hexachlorobenzene are treated in this document; the BVES compounds pentachlorobenzene and the tetrachlorobenzenes are *not* considered in this document.

3. What is the Geographical Resolution of the Emissions Inventory?

Locating and Estimating Air Emissions from Sources of ...	What is the Geographical Resolution of the Emissions Inventory?
Cadmium	Nationwide estimates are given for most source classes included. In addition, for a few source classes, facility level estimates are given. Generally, these facility-level emissions are based on 1990 Toxic Release Inventory submissions by the emitting facilities themselves.
Chlorobenzenes (a)	1,4-Dichlorobenzene: nationwide totals are implied for two of the major emissions sources.
Dioxins	For almost all sources categories, only national emissions estimates are given. Facility specific information on emission from municipal waste incinerators is provided. A list of secondary lead smelters in the U.S. is given, but only names and locations are presented, with no additional characteristics of the facilities. Some general regional indications about the geographical distribution of prescribed burning and forest fires are presented. Statewide total numbers of facilties and capacities are given for portland cement kilns, but, these are not sufficient to make state emissions estimates as necessary details regarding pollution control and fuel characteristics are not included.
Polycyclic Organic Matter	National emissions estimates are given for the total 16-PAH and total 7-PAH categories. Individual emissions factors for many PAH's are given for several source categories, and, these could be used to create national emissions estimates for these individual PAH compounds. For many source categories, lists of facilities are presented, but only names and locations are generally provided. Thus, facility specific emissions estimates cannot be made with the information provided.
Lead (only information on alkylated lead was considered in this analysis)	Only total national emissions are given.
Mercury	For many source classes, lists of facilities with locations, capacities, and/or process information are given. Facility specific emissions are not estimated, however. Only national emissions estimates are provided.
PCB's	In general, this document gives emissions factors and not emissions. However, national emissions estimates for some categories of spill and leaks are given.

(a) The only BVES chlorobenzene compound actually treated in this document is 1,4 dichlorobenzene; pentachlorobenzene and the tetrachlorobenzenes are *not* considered in this document; the document states that hexachlorobenzene will be considered, but, but it is not included in any significant way; see the Tables for Questions 1 and 2 above.

4. What is the Temporal Resolution of the Emissions Inventory?

Locating and Estimating Air Emissions from Sources of ...	What is the Temporal Resolution of the Emissions Inventory?
Cadmium	The data are generally presented as annual emissions for 1990.
Chlorobenzenes (a)	For the two major sources presented (emissions from use as a moth control and space deodorant) annual emissions data are implied for 1988.
Dioxins	Annual emissions estimates are presented. Although it is problematical that estimates for different source categories are made for different years, it is helpful that this issue is acknowledged and documented in this inventory.
Polycyclic Organic Matter	Annual emissions estimates are presented. Although it is problematical that estimates for different source categories are made for different years, it is helpful that this issue is acknowledged and documented in this inventory.
Lead (only information on alkylated lead was considered in this analysis)	Annual emissions estimates are presented for 1990.
Mercury	Annual emissions estimates are presented for the years 1994-1995.
PCB's	For the one set of spill/leak estimates given, annual totals are given for a non-specific year.

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5. To What Extent are Emissions Estimates for Specific, Individual Point Source Facilities based Actual Measurements, and, If Any Are, How Adequate is the Documentation?

Locating and Estimating Air Emissions from Sources of ...	To What Extent are Emissions Estimates for Specific, Individual Point Source Facilities based Actual Measurements, and, If Any Are, How Adequate is the Documentation?
Cadmium	A strength of this document is the presentation of a great deal of testing data on a wide variety of sources. In some cases, even the *ranges* of multiple tests on a given facility are presented, a very useful but typically omitted level of detail. These data are used to estimate emissions factors.
Chlorobenzenes (a)	The emissions estimates from the major sources of 1,4-DCB are generally based on a mass balance approach.
Dioxins	Emissions estimates for large municipal waste combustors appear to be based on actual emissions measurements at facilities, when available. Test data on one or more actual facilities are presented for other source categories and are utilized in estimation of emissions factors for many of these source categories.
Polycyclic Organic Matter	No facility-specific emissions estimates are provided.
Lead (only information on alkylated lead was considered in this analysis)	Apparently, for the one major source included, actual measurements were not made; the emissions were based on a emissions factors, presumably, from an earlier study (Clayton, 1993).
Mercury	No facility-specific emissions estimates are provided.
PCB's	There are measurement-based emissions factor data in this document for several source categories, including PCB-waste incineration, municipal waste incineration, sewage sludge incineration, PCB-contaminated soil, and PCB transformer fires..

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6. Is There Documentation of the Use of Emissions Factors, and if they are Used, Is Adequate Information Provided about the Emissions Factors?

Locating and Estimating Air Emissions from Sources of ...	Is There Documentation of the Use of Emissions Factors, and if they are Used, Is Adequate Information Provided about the Emissions Factors?
Cadmium	As mentioned above in the Table for Question #5, this document has a great deal of test data in it, and these data are used to estimate emissions factors. Of all the inventories of cadmium examined in this analysis, this has by far the most information regarding the basis for emissions factors used. In general, a key strength of the L&E documents tends to be their presentation and discussion of emissions factors.
Chlorobenzenes (a)	The emissions estimates from the major sources of 1,4-DCB are generally based on a mass balance approach.
Dioxins	This document contains a great deal of information regarding the estimation of emissions factors from available source test data. One limitation to these data is that generally only average emissions factors are presented and not ranges.
Polycyclic Organic Matter	Emissions factors are used to estimate national emissions. The derivation of these emissions factors are well documented. One limitation to these data is that generally only average emissions factors are presented and not ranges.
Lead (only information on alkylated lead was considered in this analysis)	The emissions are based on an algorithm to estimate a temperature-dependent emissions factor. Information on how this algorithm was derived would presumably be presented in the cited source (Clayton, 1993).
Mercury	Emissions factors are used to estimate national emissions. The derivation of these emissions factors are well documented. One limitation to these data is that for most source classes, only average emissions factors are presented and not ranges. For a few source classes, ranges in measured emissions factors are presented.
PCB's	There are several data sets for emissions presented. However, information on throughput is not generally given and so these emissions factor data are not generally used to create emissions estimates.

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7. Are Are Key Characteristics of Each Source Documented?

Locating and Estimating Air Emissions from Sources of ...	Are Are Key Characteristics of Each Source Documented?
Cadmium	For some facilities, one or more key characteristics are included, such as throughput, process information, and pollution control equipment.
Chlorobenzenes (a)	The major sources (moth control and space deodorant use) are too ubiquitous to be detailed.
Dioxins	As noted above, facility specific information is not presented in this document, other than for municipal waste incinerators. However, for the purposes of the national estimates, total throughput estimates are presented for many source categories. These are used in conjunction with the estimated emission factors to create national emissions estimates.
Polycyclic Organic Matter	Facility-specific information is not provided. However, for the purposes of the national estimates, total throughput estimates are presented for many source categories. These are used in conjunction with the estimated emission factors to create national emissions estimates.
Lead (only information on alkylated lead was considered in this analysis)	No facility specific information is given for the one major source category included.
Mercury	Facility specific information is generally not provided. For a few source classes, lists of facilities are included, and, for some of these lists, capacity and/or throughput information is given. For the purposes of the national estimates, total throughput estimates are presented for many source categories. These are used in conjunction with the estimated emission factors to create national emissions estimates.
PCB's	Little information about specific sources are presented. For example, throughputs or amounts treated are not included. Thus, it is impossible to estimate emissions from the data provided.

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8. Are Any Modeling-Relevant Details about the Emissions Provided?

Locating and Estimating Air Emissions from Sources of ...	Are Any Modeling-Relevant Details about the Emissions Provided?
Cadmium	Some general modeling-related emissions details are provided. For example, it is stated that cadmium will probably be emitted in fine particulate form. However, speciation details of major emissions sources are not generally provided, e.g., the proportion of cadmium emitted as cadmium chloride.
Chlorobenzenes (a)	No facility-specific or general modeling-related emissions details are provided.
Dioxins	Congener-specific generalized emissions factor information is presented for many source classes. This is extremely useful, as modeling of PCDD/F is best done on a congener-specific basis (the different congeners behave very differently in the environment, and their individual characteristics must be accounted for). Particle size information regarding emissions is not included. Stack height, temperature, or velocity information is not included.
Polycyclic Organic Matter	For many sources, information about particle size of emitted polycyclic organic matter is included. Data regarding individual species are include for most of the source categories considered. Facility-specific information is not provided, however.
Lead (only information on alkylated lead was considered in this analysis)	No facility-specific or general modeling-related emissions details are provided.
Mercury	No facility-specific or general modeling-related emissions details are provided. The lack of speciation information is particularly problematical, as different mercury species may have dramatically different atmospheric fates.
PCB's	No facility-specific or general modeling-related emissions details are provided. With PCB's, it would be useful, for example, to know something about the congener profile of emitted material. There are 209 PCB congeners and physical-chemical properties vary from congener to congener. To model these releases, one would most likely have to use a congener-specific approach. This would be difficult in the absence of any congener-specific emissions information.

(a) The only BVES chlorobenzene compound actually treated in this document is 1,4 dichlorobenzene; pentachlorobenzene and the tetrachlorobenzenes are *not* considered in this document; the document states that hexachlorobenzene will be considered, but, but it is not included in any significant way; see the Tables for Questions 1 and 2 above.

9. In What Form(s) is the Inventory Available, and are there any Problems with the Available Form(s)?

Locating and Estimating Air Emissions from Sources of ...	In What Form(s) is the Inventory Available, and are there any Problems with the Available Form(s)?
Cadmium	This inventory is available as a paper copy and can be downloaded from the U.S.EPA's web site.
Chlorobenzenes (a)	This inventory is available as a paper copy.
Dioxins	This inventory is available as a paper copy and can be downloaded from the U.S. EPA's web site.
Polycyclic Organic Matter	This inventory is available as a paper copy and can be downloaded from the U.S. EPA's web site.
Lead (only information on alkylated lead was considered in this analysis)	This inventory is available as a paper copy and can be downloaded from the U.S. EPA's web site.
Mercury	This inventory is available as a paper copy and can be downloaded from the U.S. EPA's web site.
PCB's	This inventory is available as a paper copy, but does not seem to be available on the U.S. EPA's web site

(a) The only BVES chlorobenzene compound actually treated in this document is 1,4 dichlorobenzene; pentachlorobenzene and the tetrachlorobenzenes are *not* considered in this document; the document states that hexachlorobenzene will be considered, but, but it is not included in any significant way; see the Tables for Questions 1 and 2 above.

10. Is the Inventory Publicly Available? To What Extent is Information about Emissions from Individual Facilities Publicly Available?

Locating and Estimating Air Emissions from Sources of ...	Is the Inventory Publicly Available? To What Extent is Information about Emissions from Individual Facilities Publicly Available?
Cadmium	This document is publicly available. For some source classes, lists of facilities are provided. These lists contain the names and locations and in some cases, contain capacity or throughput information and/or emissions estimates.
Chlorobenzenes (a)	This document is publicly available.
Dioxins	This document is publicly available. Information is provided which is relevant to estimating facility-specific emissions from municipal waste incinerators.
Polycyclic Organic Matter	This document is publicly available. No facility specific information is provided, other than lists of facilities for some source classes. These lists, if they are accurate, might be a useful starting point to create a geographically resolved inventory. However, details on individual facilities are often difficult to obtain, even if one knows that the facility exists.
Lead (only information on alkylated lead was considered in this analysis)	This document is publicly available.
Mercury	This document is publicly available. Lists of facilities are provided for some source classes; in some of these lists, throughputs or capacities are given.
PCB's	This document is publicly available.

(a) The only BVES chlorobenzene compound actually treated in this document is 1,4 dichlorobenzene; pentachlorobenzene and the tetrachlorobenzenes are *not* considered in this document; the document states that hexachlorobenzene will be considered, but, but it is not included in any significant way; see the Tables for Questions 1 and 2 above.

Appendix 6.
Canada Ontario Agreement (COA) —
Sources, Releases, and Loadings for COA Substances...

- Brown, P. and N. Thornton (1996). Tier I and II Substance Profiles per Canada - Ontario Agreement Respecting the Great Lakes Basin: Update, Environment Canada (Pollution Prevention and Abatement Division, Ontario Region); Ontario Ministry of Environment and Energy (Program Development Branch & Pollution Prevention Office).

- Putnam, D. L. (1995). Sources, Releases and Loadings -- Preliminary Estimates for COA (Canada Ontario Agreement) Substances, prepared for Environment Canada, Environmental Protection Branch, Pollution Prevention and Abatement Division, Ontario Region, Under Contract # KE409-4-0261. Newmarket, Ontario, Environmental Quality Systems.

1. Are All Relevant Source Classes Considered?

This inventory does a better job that most of those considered here in attempting to be comprehensive in its coverage of source categories. For example, an estimate for alkyl lead emissions from aircraft is included in this inventory, a category ignored in other inventories. This inventory does not include emissions of pentachlorophenol from treated wood, but, at least this omission is acknowledged.

2. Is Each Included Source Class Comprehensively Treated?

This inventory was prepared through a synthesis of a great deal of other inventory information assembled in Ontario, and, appears to be relatively comprehensive.

3. What is the Geographical Resolution of the Emissions Inventory?

While some facility-level information was evidently utilized in preparing this inventory, only province-level totals are presented for each source class.

4. What is the Temporal Resolution of the Emissions Inventory?

The estimated emissions are presented as annual release estimates; in some cases the year for which the estimate applies is noted, in some cases the year is not provided.

5. To What Extent are Emissions Estimates for Specific, Individual Point Source Facilities based Actual Measurements, and, If Any Are, How Adequate is the Documentation?

Some of the estimated emissions do appear to have been based on actual test data, and some of these data are included in this inventory.

6. Is There Documentation of the Use of Emissions Factors, and if they are Used, Is Adequate Information Provided about the Emissions Factors?

This is a synthesis document, relying in many cases on earlier inventories. These earlier inventories are cited, but, little information is provided regarding the methodologies used in their estimates.

7. Are Key Characteristics of Each Source Documented?

Very little facility specific information is provided.

8. Are Any Modeling-Relevant Details about the Emissions Provided?

There are essentially no modeling relevant details provided, e.g., speciation of emissions, particle sizes of emissions, emissions height and temperature, emissions velocity, etc.

9. In What Form(s) is the Inventory Available, and are there any Problems with the Available Form(s)?

This inventory is available as a paper copy. An electronic version of the spreadsheet-based estimates was requested, but, was not provided.

10. Is the Inventory Publicly Available? To What Extent is Information about Emissions from Individual Facilities Publicly Available?

As mentioned above, there are very little data regarding individual facilities included in this inventory. The inventory itself, however, appears to be publicly available.

Appendix 7.
Ortech Inventory for Ontario and Eastern North America

- Johnson, N. D., M. T. Scholtz, et al. (1992). MOE Toxic Chemical Emission Inventory for Ontario and Eastern North America, prepared for Air Resources Branch, Ontario Ministry of the Environment. Mississauga, Ontario, Ortech, International. Final Report Number P.92-T61-5429/OG.

1. Are All Relevant Source Classes Considered?

This inventory is apparently comprehensive in its inclusion of source classes. Emissions from past use of biocides are not included. Although they are included for PAH emissions, PCDD/F emissions estimates are not made for several potentially significant soruce categories, including a range of metallurgical processes, industrial wood waste combustion, heavy duty diesel vehicles, and residential waste incineration (backyard burning),

2. Is Each Included Source Class Comprehensively Treated?

Details of this inventory are regarded as being confidential. The summary information provided suggests that the inventory is relatively comprehensive.

3. What is the Geographical Resolution of the Emissions Inventory?

Gridded color-coded maps with a resolution of approximately 127 km (and finer for portions of Ontario) are included for the total estimated emissions, but, not for different source categories. Total emissions estimates are presented for Ontario and "Eastern North America," comprising the eastern half of the U.S. and Canada.

4. What is the Temporal Resolution of the Emissions Inventory?

The data provided in the publicly available portion of the inventory inventory is stated to be annual emissions for 1985. It is stated that the inventory database for many source categories contains more highly temporally resolved data, e.g., day of the week variation.

5. To What Extent are Emissions Estimates for Specific, Individual Point Source Facilities based Actual Measurements, and, If Any Are, How Adequate is the Documentation?

Some of the data may be based on actual measurements, but it is difficult to tell as details are not generally provided. Most of the estimates appear to be based on emissions factors.

6. Is There Documentation of the Use of Emissions Factors, and if they are Used, Is Adequate Information Provided about the Emissions Factors?

Useful discussions of emissions factors are provided. In some cases, information about the ranges of measured factors is included. These types of data were not included in most of the inventories considered here.

7. Are Key Characteristics of Each Source Documented?

Source-specific information is not included in the publicly available version of this inventory. The actual inventory, which is confidential, does apparently contain information about individual

point sources.

8. Are Any Modeling-Relevant Details about the Emissions Provided?

As mentioned above, source-specific information is not included in the publicly available version of this inventory. The actual inventory, which is confidential, does apparently contain some modeling relevant information about individual point sources, including stack height. However, particle size of emissions does not appear to be included.

9. In What Form(s) is the Inventory Available, and are there any Problems with the Available Form(s)?

The inventory was only made available as a paper copy of the summary volume. The actual inventory is contained in a detailed set of appendices and electronic files; these are confidential and could not be released, even though the data are presumably for 1985 and thus over 10 years old.

10. Is the Inventory Publicly Available? To What Extent is Information about Emissions from Individual Facilities Publicly Available?

The summary data are publicly available, but, facility specific details are not.

Appendix 8.
Great Lakes Regional Air Toxics Inventory, coordinated by the Great Lakes Commission

This inventory is currently under development. To obtain information, answers to a set of questions were requested from the coordinators of this inventory, and answers were kindly provided (Carol Ratza, 1997, personal communication).

This inventory will cover New York, Pennsylvania, Ohio, Michigan, Indiana, Illinois, Minnesota, Wisconsin, and the Province of Ontario.

1. Are All Relevant Source Classes Considered?

It is difficult to evaluate the inventory relative to this question at this point. The inventory coordinators state that emissions of pesticides will likely be limited to manufacturing sources, and acknowledge that this will leave out the major source of pesticide emissions, i.e., pesticide application.

2. Is Each Included Source Class Comprehensively Treated?

When the inventory is available, it may be judged relative to this question. At this time, it is not possible to make any determination.

3. What is the Geographical Resolution of the Emissions Inventory?

The coordinators state that facility-level information will be available for most point sources, although they report that some states will only provide emissions information with county level resolution. The coordinators state the sources treated as “area sources” include POTW’s and a number of other sources. The categorization of POTW’s as an area source is perhaps a limitation, as these are fairly large, significant facilities.

4. What is the Temporal Resolution of the Emissions Inventory?

The temporal resolution of the inventory will be annual. There are no current plans to introduce seasonal, weekly, or diurnal variations in the emissions estimates. Currently, an attempt is being made to put together a base inventory for the year 1993. The first update is planned to be an inventory for the year 1995. It is stated that some states will provide operating schedule information to the inventory. This could be used to increase the temporal resolution of the inventory, when it is available..

5. To What Extent are Emissions Estimates for Specific, Individual Point Source Facilities based Actual Measurements, and, If Any Are, How Adequate is the Documentation?

The coordinators state the some of the data in the inventory will be based on reported emissions test data, depending on data availability. It is stated that details of the measurements will not be included in the database.

6. Is There Documentation of the Use of Emissions Factors, and if they are Used, Is Adequate Information Provided about the Emissions Factors?

The coordinators state that the method of estimating emissions will be given in the inventory for any emissions estimate, e.g., whether the estimate is based on an emissions factor, a mass balance, a source-specific emissions factor, etc. Emissions factors will be referenced to their origin in other other databases (e.g., EPA's FIRE database and RAPIDS Protocol Tables).

7. Are Key Characteristics of Each Source Documented?

In most cases, information about throughput, pollution control, and key process parameters will be provided if available. However, the coordinators state that in some cases, this information will be unavailable in the inventory because of confidentiality concerns.

8. Are Any Modeling-Relevant Details about the Emissions Provided?

Information about the form in which the pollutant is emitted (e.g., gas, particle, particle size) will not be included. In some cases, information about the temperature, height, and velocity of the emissions will be included, depending on whether this information is made available by a given state or province.

9. In What Form(s) is the Inventory Available, and are there any Problems with the Available Form(s)?

The inventory will eventually be available in both hardcopy and electronic form. The database will be accessible using the RAPIDS database system or any database system capable of reading ORACLE tables. There will be both summary-level and detail-level information available.

10. Is the Inventory Publicly Available? To What Extent is Information about Emissions from Individual Facilities Publicly Available?

Access to the database will be able to be obtained after approval by the Great Lakes Commission and the technical steering committee of the Great Lakes Air Toxics Emissions Inventory Project. The coordinators state that all portions of the inventory will be available to the public and to independent researchers.