Air Toxics Source Review Guide

Minnesota Pollution Control Agency

February 1991
Version 2.1

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MPCA AIR TOXICS SOURCE REVIEW GUIDE

VERSION 2.1

ERRATA

Table C

1. The SER for vinyl chloride that appears in Table C, p. 27 of version 2.1 (3.3E-2 ton/year), is incorrect.

   The correct SER for vinyl chloride is 3.3E-1 ton/year.

   (Error discovered 3/1/91)

2. The CAS number for 1,2-dichloroethane, a.k.a. ethylene dichloride, is incorrectly listed in Table C, p. 26 of version 2.1 as 75-34-3. (CAS 75-34-3 correctly identifies 1,1-dichloroethane in Table B, p. 24).

   The correct CAS number for 1,2-dichloroethane is 107-06-2.

   The AAL and SER for 1,2-dichloroethane given on p. 26, Table C, version 2.1 (3.8E-1 μg/m3 and 5.2E-2 ton/year, respectively) are correct and based on those given in version 1 of the Source Review Guide.

   (Error discovered 7/22/91)

AIR TOXICS SOURCE REVIEW GUIDE, VERSION 2.1

PREFACE

Version 2.1 of the Air Toxics Source Review Guide supersedes the draft version 2. Major changes from version 1 to version 2.1 include:

1. revised decision sequence for facility toxics review (Figure 1, Version 2.1)

2. general language and text revisions; e.g., replacement of the term "acceptable ambient level" (Version 1) with the term "allowable ambient level" (Version 2.1); Step 11 - Emission Rate Decrease for noncarcinogens

3. revised emissions inventory and screening forms (Forms 1-3, Version 2.1)

4. revisions to tables A-C:

   - CAS numbers
   - newly included chemicals, Table A (methyl ethyl ketone, high aromatic solvent, isobutanol)
   - revised values, Table A (n-butanol, n-butyl acetate)
   - newly included chemicals, Table B (ethylbenzene, VM&P naphtha, n-propanol, n-butanol, 1,3-dichloropropene, n-hexane, hydrogen chloride, hydrogen sulfide)
   - newly included chemical, Table C (Freon 113); newly included SERs and AALs
   - revised units, Table A and Table B (pound/hour, ton/year, $\mu g/m^3$)
   - consistent scientific notation

5. Appendix 1 (formerly table D, version 1)

6. Appendix 2 (expanded air dispersion modeling guidance; elimination of Michigan Dilution Factor matrix)

7. Appendix 3 (derivation of allowable ambient levels (AALs), tables A-C)

Tables 1 and 2 (facility rankings) were not modified in Version 2.1, but will be updated in the future to reflect more recent data.

Revisions have been carefully proofread, but transcription errors remain a possibility. Air Toxics Staff would greatly appreciate prompt reporting of any error or obvious inconsistency between Version 1 and Version 2.1.

PLEASE NOTE: As version 2.1 was being finalized, MPCA air toxics staff were developing a voluntary reduction exemption for the Air Toxics Source Review Guide. It would be similar to that in the 1990 Clean Air Act Amendments, which allows a 6-year time extension for compliance if the source achieved a 90% reduction in non-particulate or a 95% reduction in particulate emissions, based on 1987 levels. This exemption will be considered by the MPCA Board Air Quality Committee, and will be effective immediately if approved. Since such approval had not yet occurred when version 2.1 of this Guide was finalized, please contact MPCA air toxics staff for current guidance if such an exemption could affect your air toxics review.

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LIST OF ACRONYMS

AAL	allowable ambient level
ACGIH	American Conference of Governmental Industrial Hygienists
AL	action level
AQD	Air Quality Division (MPCA)
BACT	best available control technology
BART	best available reduction technology
CTC	Control Technology Center (U.S. EPA)
EPA	Environmental Protection Agency (U.S.)
HI	hazard index
LAER	lowest achievable emission rate
MPCA	Minnesota Pollution Control Agency
PM	particulate matter
PM10	particulate matter < 10 microns
PSD	prevention of significant deterioration
SARA	Superfund Amendments and Reauthorization Act
SER	significant emission rate
VOC	volatile organic compound

Figure 1

Detailed Flow Chart for Air Toxics Review

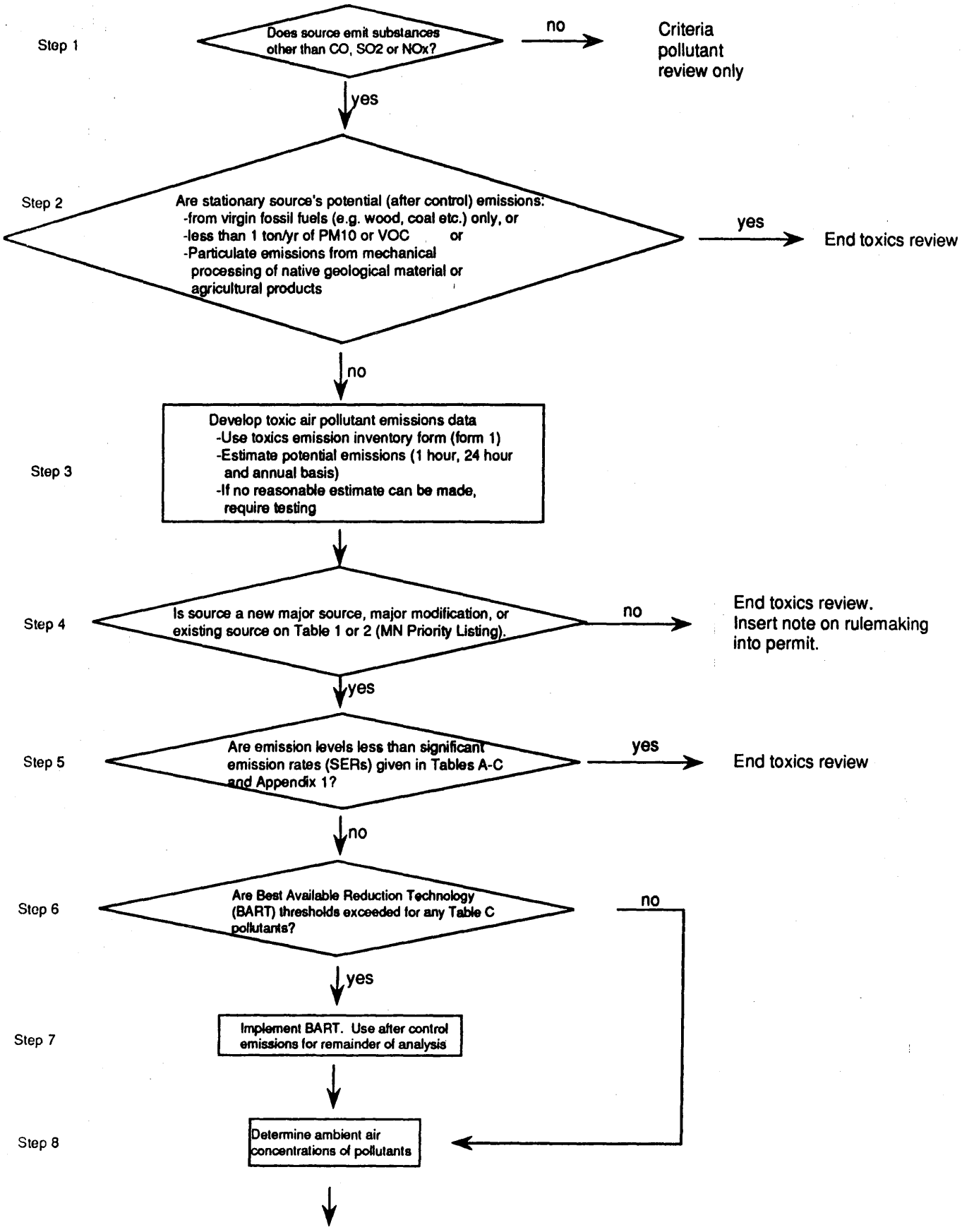
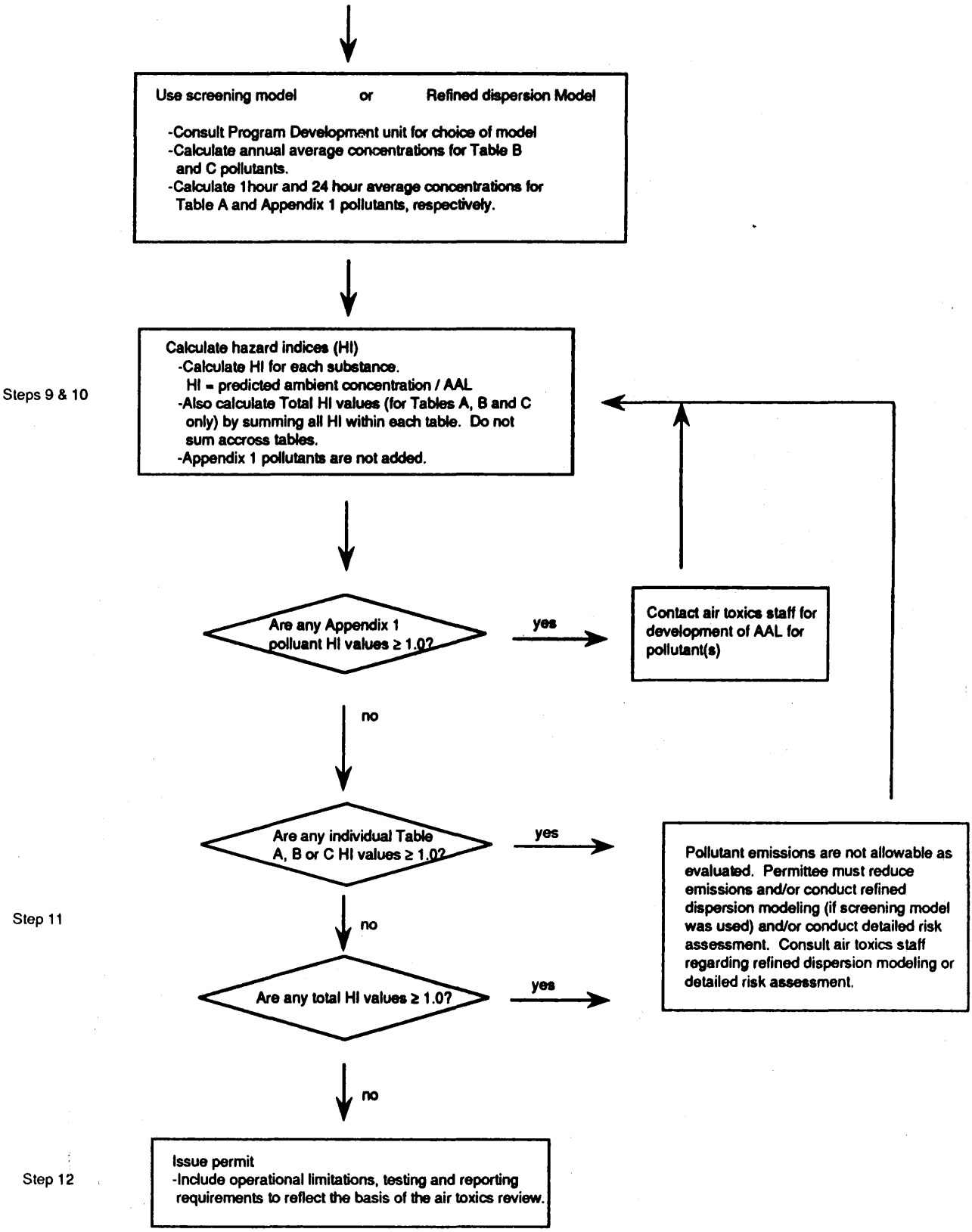


Figure 1 - continued
Detailed Flow Chart for Air Toxics Review



PURPOSE

This document is intended to be used as a guide to judging the acceptability of air emissions for which no adequate ambient air standards currently exist. These "non-criteria" or "toxic" air pollutants, despite the lack of specific standards, must be addressed in a variety of regulatory settings.

The most common use for this guide will be in issuing and reissuing permits for air emission facilities. It is hoped that the guide will enable both Minnesota Pollution Control Agency (MPCA) staff and MPCA clientele to understand the general framework of a non-criteria emissions review and hence foster uniformity in application. MPCA clients should benefit by being able to better anticipate the need for emission reduction and avoid last minute, costly delays. This document is a guideline for reviewing sources of non-criteria pollutants. Because it is a guideline, its application to specific sources can be modified where appropriate.

Users of the guide should be aware that the listed chemicals and criteria levels will change with time. The listings will be improved as more sophisticated information regarding the allowable levels becomes available. Chemicals will be added to or deleted from the list as their importance for Minnesota sources becomes more or less apparent. Users should verify acceptable levels, etc. with each use of the guide.

OVERVIEW

The air toxics source assessment process is best described as a three stage process: 1) emission quantification, 2) control equipment evaluation, and 3) ambient concentration prediction and evaluation. The Regulatory Compliance Section staff are generally responsible for reviewing the first two stages and the Program Development Section staff are generally responsible for reviewing the third stage. The permittee is required to perform the original analysis. There are feedback loops, however, in the process, so that cooperation and understanding of all functions is needed by all parties.

Figure 1 is a flow chart that outlines the steps involved in the review. An effort has been made to include escape mechanisms to limit review of sources that are clearly of a type or size expected to have little chance of posing a significant health or environmental risk.

The emission quantification process (steps 2-3) should be conducted for all sources permitted by the MPCA. Due to resource constraints, only the larger sources will initially proceed beyond this point to a control technology determination and risk assessment.

Four categories of chemicals are considered in the review (see Tables A, B, C, and Appendix 1). Table A chemicals are chemicals which are associated with acute temporary irritant effects and for which MPCA has established reference concentrations. Table B chemicals are chemicals associated with chronic but non-cancerous health effects and for which detailed reviews have been conducted and appropriate threshold (reference) concentrations established. Table C chemicals are known or suspected human carcinogens and food chain accumulating chemicals subject to the Great Lakes States Air Permitting Agreement. Appendix 1 chemicals are those non-carcinogens which have not been reviewed in depth by

staff toxicologists and therefore have allowable concentrations based on occupational exposure limits. As more chemicals are reviewed in detail using risk assessment procedures, the Appendix 1 chemicals will be moved to Table A or Table B. Because virtually all chemicals have several potential toxic effects, depending on concentration and duration of exposure, many chemicals will appear on more than one list.

The general control philosophy embodied in the guideline is a requirement for control based upon the outcome of a risk screening. In addition, there is an up front requirement for best available reduction technology (BART) for new or existing sources with large emissions of Table C pollutants. This BART requirement (defined later) should be applied before risks from the source are calculated.

INITIAL SCREENING (STEPS 1-2)

Steps 1 and 2 determine which sources need to proceed to toxic emission evaluation. It should be assumed that all stationary sources should proceed unless specifically exempted. If the stationary source emits only SO2, NOx, or CO, no air toxics review is needed. If the stationary source consists only of boilers or other combustion sources burning only a virgin fossil fuel, no review is needed. If the stationary source emissions result only from handling or mechanical processing of unadulterated native geological or agricultural materials, no review is needed. Finally, if the stationary source emissions of Particulate Matter (PM) or Volatile Organic Compounds (VOC) are less than 1 ton/year each, no review is needed. All other stationary sources must proceed to Step 3. A stationary source consisting of a combination of exempt emissions units is also exempt.

EMISSION QUANTIFICATION (Step 3)

Step 3 is identification and quantification of the stationary source's non-criteria emissions. This step requires familiarity with the source type and operation and should be performed by a staff person or consulting engineer. An effort should be made to identify and quantify all non-criteria emissions. Use the Air Toxics Emissions Inventory Form (Form 1).

Several informational sources should be consulted in doing this emissions quantification. The community right to know (SARA Section 313) inventory contains source- provided information on emissions. If the source is included in this inventory, it will provide a good starting point for the emission review. Keep in mind, however, that these data are not quality assured. If the inventory data are found to be in error, please indicate improved estimates of actual emissions on the Air Toxics Emissions Inventory Review Form. This information will be used to compile an MPCA air toxics inventory. Past inventories from the facility could also be considered.

In addition to the federal inventory, there are guidance documents, emission factors and the EPA Control Technology Center (CTC) Hotline which may be of help in identifying appropriate controls and in quantifying emissions. MPCA air toxics staff may be consulted to access these sources of information.

When mixtures (e.g. stoddard solvent, VM&P naphtha, mixed xylenes) are used, the chemical composition of the mixture should be determined and emissions quantified on the basis of the chemicals actually emitted, not the mixture itself. The mixture's material safety data sheet (MSDS) should identify its chemical composition and assist in this estimate.

If no reasonable judgment can be made regarding emissions from existing information sources, and there is reason to suspect a significant emission of a non-criteria pollutant, testing should be required of the source or a similar source under the permittee's control. Completion of the non-criteria review will follow receipt of the test data.

DETERMINATION OF NEED FOR FURTHER REVIEW (Steps 4-5)

Step 4 is a determination of which sources proceed to a control technology requirement and/or additional review. Current resource constraints within the AQD dictate that only new stationary sources with potential criteria pollutant emissions greater than 100 tons/yr (tpy), major modifications subject to PSD regulations, modifications resulting in an increase in potential emissions of greater than 100 tpy, and high priority existing stationary sources, undergo further review. Those sources not reviewed at this time should receive their permits but will made aware through the following notice in their permit that non-criteria emissions from their facility were not reviewed when their permit was issued and therefore further review and/or control technology may be required in the future.

> "The Permittee is hereby notified that MPCA is in the process of developing rules relating to non-criteria pollutant (air toxics) emissions and the permit may be modified to be consistent with the new rules."

At this time only a limited number of existing sources, specifically, those on the attached Priority Lists, (Tables 1 and 2) are being considered to be high priority existing stationary sources requiring air toxics emissions review. Table 1 consists of stationary sources emitting carcinogens. Table 2 consists of stationary sources emitting non-carcinogens. These tables were derived from review of 1988 SARA Section 313 data reports (right to know) and weighted by toxicity. If a source within the top 25 sources on the list is being reviewed for permit reissuance, the source may, if time permits, receive further review. This decision will be made on a case by case basis.

Step 5 compares the emission levels determined in Step 3 with significant emission rates (SER) in Tables A-C and the action level (AL) in Appendix 1. If no TLV is available for the chemical, consult MPCA air toxics staff for guidance. The SERs and ALs were determined by calculating the emission levels that would result in the Allowable Ambient Levels (AAL) using a worst case dispersion model. If source emissions exceed the SER or AL for any chemical, the analysis should proceed; otherwise no further analysis is required. This comparison is done on Form 2. If the source is found to emit significant quantities of a chemical not covered by Tables A-C or Appendix 1, consult with MPCA air toxics staff to determine whether further analysis of this chemical is necessary.

DETERMINATION OF NEED FOR REDUCTION TECHNOLOGY - CARCINOGENS (Step 6)

Step 6 is a determination of whether BART is needed for the source. If the source's potential (after control) emissions of a Table C chemical exceed the BART thresholds established in Table C, a BART review should be performed for the source emitting that chemical. BART level control should be implemented before the risks from the facility are calculated. This "control before risk analysis" decision has been made because of the non-threshold nature of the environmental effects caused by Table C pollutants. Even though emissions of a given chemical do not cause excessively high risk near the facility, they can increase overall cancer in the population or bioaccumulate through the food chain.

Step 7 is the BART analysis. The term BART is used rather than BACT to emphasize the option of process changes which substitute or reduce emissions as an alternative to add-on controls. The definition of BART for this guideline is:

> "That process technology, emissions control technology, operation and maintenance procedure, other measure, or combination thereof, that results in the maximum degree of emission reduction that the MPCA determines, on a case-by-case basis, is achievable by a stationary source, for each toxic air pollutant discharged, taking into account environmental effects, including the potency and toxicity of each toxic air pollutant discharged as well as technical and economic feasibility and energy costs."

A BART analysis should be performed in a similar manner to a BACT analysis; however, including in-plant process changes results in an increase in complexity of the associated cost analyses. Detailed guidance on the procedure for BART will follow; however, a few points should be made here. When determining costs for various reduction technologies, capital costs must be estimated on an equitable basis. For example:

1. If add-on control technologies are the only options appropriately considered, costs for just the control technologies will be compared.

2. If the comparison includes alternatives of control technology, and process modification, or combinations of the two, the costs of the basic process equipment may have to be included in the comparison. If the basic process equipment is constant amongst alternatives, it will not be included in the analysis. However, if the basic process equipment varies amongst alternatives, then either:

   a. The total cost of the equipment will be included in each alternative, including those alternatives where only add-on control is considered,

   Or

   b. The difference in cost of the equipment shall be included in the appropriate alternative.

3. The same analysis as discussed in Item #2 shall apply to operation and maintenance costs where process modifications such as different operation, maintenance, or raw materials costs are to be considered.

Based on #1-#3 above, the applicant will determine a cost per ton of toxic air pollutant removed for each alternative.

Normalized cost (toxicity weighted) should be used to determine economic feasibility. Normalized cost is the cost per ton removed (determined above) multiplied by the AAL for the toxic air pollutant under review.

Over time, the Agency will develop a list of normalized costs incurred for control of various industries. This list will then be used in determining when control is economical.

Process changes involving emission reduction should not result in significant increases in the emissions of other Table C chemicals, nor in a significant increase in the hazard index for non-carcinogens.

Some EPA guidance is available to aid in a BART determination. The EPA CTC Hotline and the EPA BACT/LAER clearinghouse may be of some assistance.

AMBIENT CONCENTRATION PREDICTION (Step 8)

Step 8 determines ambient concentrations resulting from emission rates determined in Steps 3 and 7. Further guidance on this Step is contained in Appendix 2. The source may use a screening technique such as EPA "SCREEN" or another screening model selected in conjunction with MPCA staff to approximate worst case ambient concentrations. Multiple emission points of the same chemical may be considered by adding results from individual emission points or by modeling all emissions from the emission point with the least dispersive ("worst case") release parameters. However, these approaches will result in an overestimate of aggregate concentration.

If a source does not meet AALs using the screening modeling techniques or if the screening procedures cannot be used, then a refined EPA guideline model should be used to more accurately predict ambient concentrations. This will generally require consultation with air quality modeling staff. (Refer to Appendix 2 for details).

AIR TOXICS EVALUATION (Steps 9-10)

The last part of the air toxics review process is the comparison of predicted ambient levels to risk assessment based allowable ambient levels (AAL's) (Tables A, B or C), or action levels (Appendix 1).

Table A and B AALs were determined by searches of the toxicology literature, determination of effect, low effect or no effect levels, and modification of these values with uncertainty factors. AALs may also result from EPA, MPCA, or industry toxicology reviews.

Table C chemicals are known or suspected human carcinogens and chemicals known to bioaccumulate. Where a Table C chemical has a potency slope, an AAL has been

determined. In the case of food chain accumulating chemicals, the AAL has been determined based upon these effects. The AAL for alternate pathway chemicals may be overly stringent if the critical pathway is not present in the area (e.g. water bodies and dioxin, child play areas and lead).

Appendix 1 chemical action levels (AL's) are based upon the ACGIH 8-hour Threshold Limit Values (TLVs) with an uncertainty factor of 1000. The ALs should be compared with predicted 24 hour concentrations. This is a worst case regulatory factor based upon comparison of AALs of fully reviewed chemicals with their TLVs. As more in-depth reviews are completed on Appendix 1 chemicals, they will be moved to Table A, B, and/or C.

Steps 9 and 10 compare the calculated ambient concentrations to AALs or AL's and account for potential additive effects of pollutants originating from the source. First, the Hazard Index (HI) is determined for each pollutant. This is done on Form 3 by dividing the ambient concentration determined in steps 5-10 by the AAL or AL.

If the resulting HI value for an Appendix 1 chemical (based on an AL) is greater than 1, contact MPCA Air Toxics staff. Air Toxics Staff will then proceed to determine an AAL (Table A, B, or C) value for this chemical and the Hazard Index calculation will be repeated.

If any HI value is greater than 1 after changes are made due to use of Appendix 1 AL's (discussed in previous paragraph), then the permittee must propose changes to reduce each HI to less than 1. Refer to step 11.

In addition to each individual HI being <1, additive HIs for tables A, B, and C each must be <1 as well. This step takes the conservative approach of adding hazard indices (concentration/AAL) for multiple pollutants within each table. Since this guideline assumes that long-term, acute, and carcinogenic effects are not additive, no consideration is given to additive effects across tables. Also, HI values determined from appendix 1 actin levels are not considered additive.

The consideration of table A, B and C pollutants as additive (within tables) is in order to take account of uncertainties in the toxicological data base. It is likely that many substances demonstrate interactive health effects. However, studies on these interactions in humans are very limited in number.

Therefore, unless it can be demonstrated that 2 or more substances do not exhibit interactive toxic effects, additivity of HI values within tables should be assumed. An individual or total HI value of 1.0 or greater should not be allowed. A permittee may at this point decide to reduce emissions of pollutants (see step 11). Prior to this, however, a permittee may elect to conduct refined dispersion modeling if a screening analysis was originally performed (see appendix 2). A permittee may also elect to conduct a detailed risk assessment in an attempt to demonstrate that no adverse human health or environmental impacts are likely to result from operation of the facility. A detailed risk assessment may consist of evaluating toxicity mechanisms and target organs to show non-additivity of pollutants. It may also evaluate toxicity literature to revisit the numerical value of an allowable ambient level. A detailed risk assessment may also consist of a multipathway exposure assessment of pollutant emissions.

DETERMINATION OF NEED FOR EMISSION RATE DECREASE - Non-Carcinogens (Step 11)

If the HI determination made in Steps 9 and 10 results in any individual or additive HI being greater than 1, the permittee must propose methods to decrease emission rates.

The permittee may first propose to limit operations via restrictions on capacity or hours of operation. If such operation limitations can be agreed upon, this is acceptable. Final ambient concentrations and associated hazard indicies should be determined. Limitations must be contained in the resulting air emission permit and must have associated recordkeeping requirements to insure compliance.

If operational limitations are not sufficient or cannot be agreed upon, then the permittee must perform an analysis of methods to decrease mass emissions to achieve an HI less than 1. That analysis must include the potential for emission reductions through pollution prevention and add-on control technology.

Pollution prevention is defined by the 1990 Minnesota Toxic Pollution Prevention Act:

> "Pollution prevention" or "prevent pollution" means eliminating or reducing at the source the use, generation, or release of toxic pollutants, hazardous substances, and hazardous wastes."

Further; reduce, reducing, or reduction is defined by the same legislation:

> "Reduce", "reducing", or "reduction" means lessening the quantity or toxicity of toxic pollutants, hazardous substances, and hazardous wastes used, generated, or released at the source. Methods of reducing pollution include but are not limited to, process modification, inventory control measures, feedstock substitutions, various housekeeping and management practices, and improved efficiency of machinery. Decreases in quantity or toxicity are not reductions where the decrease is solely the result of a decrease in the output of the facility."

The permittee shall prepare and submit to MPCA staff for review, an analysis of options and associated costs for pollution prevention measures and add-on control technologies. The permittee shall make a proposal for reduction based on the analysis. MPCA staff shall review the analysis and proposed option and shall make a determination as to the acceptability of the proposal on a case-by-case basis. The determination shall consider economics and feasibility of pollution prevention and control options.

The use of changes in release parameters (stack height) is not considered a pollution prevention or control technology measure. Site specific conditions such as horizontal releases or stub stacks (less than 10 feet in height above a roof) or other such physical parameters that may cause a severe downwash problem (e.g. when Shulman-Scire building wake effects are invoked), may justify modification of dispersion parameters (e.g. extending stacks); however, emissions reductions must also be evaluated.

PERMITTING (Step 12)

Step 12 is issuance of the permit to a source that has passed all of steps 1-11 of the Guideline. Operational limitations, testing, and reporting requirements, similar to those for criteria pollutants, should be included to reflect the basis of the air toxics review and to create enforceable limitations.

A copy of Forms 1-3 for each facility must be returned to MPCA air toxics staff. Any questions regarding appropriate use of this procedure should also be referred to MPCA air toxics staff.

Form 1

Air Toxics Emission Inventory Form

Facility Name_____ Permit or File Number_____ Date review completed_____

Facility Address_____ Operation Schedule hr/dy_____dy/wk_____wk/yr_____ Reviewer_____

_____ Will permit limit operation to schedule above? yes / no / na[1]

Emission Point[2]	Release Parameters[3]					Process Equipment[4]		Chemical	Control Equipment		Estimated Maximum Emission Rate			
	Building dimensions[7]	Stack height(ft)	Velocity (ft/m)	Temp. (°F)	Stack Diameter (ft)	Equipment	Maximum Capacity		Type	Efficiency	lb/hr[5]	lb/day[6]	ton/yr	Basis for Estimate

Notes:

1. Maximum emissions will be based on 8760 hr/yr (24 hr/d, 7d/wk, 52wk/yr) unless limited by permit.. All calculations should use 8760 hr/yr unless limited.
2. Emission points include stacks, vents and other fugitive or direct sources. Use stack ID's as appropriate (company or permit ID).
3. Please attach maps showing location of facility and location of emission points.
4. List each process contributing to that emission point separately.
5. The lb/hr emission rate should reflect the maximum 1-hr emission rate regardless of annual operation schedule.
6. The lb/day emission rate should reflect the 24 hr/day operation unless limited on a daily basis in permit.
7. List height (H), width (W) and length (L) of the subject building. Include "H", "W" and "L" to define each listing. Dimensions of other nearby buildings may be necessary as well (refer to appendix 2).

Form 2

Significant Emission Rate Screening

Facility Name_____ Address_____ Date review completed_____
Permit or File number_____ _____ Reviewer_____

Chemical	CAS #	Maximum Aggregate Emissions			Significant Emisison Rate In units of:			Table/ Appendix	Table/ Appendix Date	SER Exceeded	BART level exceeded
		lbs/hr	lb/day	ton/yr	lb/hr	lb/day	ton/yr			Y/N	Y/N/NA

Form 3

Allowable Ambient Level Screening

Facility Name_____ Address_____ Date review completed_____

Permit or File Number_____ _____ Reviewer_____

Chemical	CAS #	Predicted Maximum Concentration ($\mu g/m^3$)			Allowable Ambient Level ($\mu g/m^3$)				Hazard Index			
					Table			Appen-dix 1	Table			Appen-dix 1
		1-hour average	annual average	24-hour average	A	B	C		A	B	C	
								Totals				

TABLES 1 AND 2
MINNESOTA PRIORITY LISTINGS

TOXIC RELEASE INVENTORY DATA
TOP AIR EMITTERS OF SELECTED COMPOUNDS IN MINNESOTA

Section 313 of Superfund Amendment and Reauthorization Act (SARA) Title III requires manufacturers with Standard Industrial Classification codes 20-39 to submit an annual report of releases to all environmental media. This reporting requirement currently applies only to those facilities with ten or more full-time employees that manufactured or processed more than 25,000 pounds or otherwise used more than 10,000 pounds of specified chemicals in 1989 and subsequent years.

In order to prioritize large and potentially problematic Minnesota sources of certain compounds reported under Section 313, a review of its Toxic Release Inventory (TRI) data for calendar year 1988 was conducted. For prioritization purposes, we believe the procedure described below is informative and appropriate.

Two separate rankings of TRI data were conducted. The first (Table 1) is a ranking of the top carcinogen emitters. Carcinogen emissions were normalized by multiplying the quantity emitted by the appropriate unit risk estimate (URE). The carcinogens selected for this study are those for which EPA has derived UREs (June 1988) and are included on the Section 313 Toxic Chemical list (January 1987). For the complete list, see the footnote of Table 1.

The second ranking (Table 2) is a list of the top emitters of selected noncarcinogens. To account for differences in the potency of noncarcinogens, emissions were weighted by dividing the total quantity emitted to air by a chronic, noncancer health criteria (the Table B Acceptable Ambient Level, Air Toxics Source Review Guide, Version 1). These health criteria are based on the lowest observed adverse effect level (LOAEL) and the no observed adverse effect level (NOAEL). The criteria consider a variety of noncancer health effects such as hearing loss, blood effects, liver effects, and male sterility. Although this range of chronic effects may not be strictly comparable, it was decided that for the present review, such a weighting is appropriate. The compounds selected for this review appear in the January 1987 list of Section 313 Toxic Chemicals, and are listed in the footnote of Table 2.

The lists in Tables 1 and 2 do not include all pollutants or facilities contained in the TRI database, but the procedure used could be applied to any reporting facility. We are currently targeting the top 10-20 on each list for review. Consult the Minnesota Department of Public Safety, Emergency Response Commission (612/643-3000) for a complete copy of the TRI inventory.

It is important to consider the limitations of the TRI data. First, the majority of reported data is based on estimates and not on actual measurements. The accuracy of the reported data is therefore unverified. Second, not all toxic chemicals or sources of toxic chemical releases are covered under Section 313. Only manufacturing facilities meeting the criteria stated above are required to report. Third, the data estimate annual emissions, with no information on release rates, stack parameters or population distribution in the vicinity of the facility. Thus, it is impossible to determine human exposures or resulting health effects from these data alone.

Table 1

SECTION 313: TOXIC RELEASE INVENTORY DATA
TOP AIR EMITTERS OF CARCINOGENIC COMPOUNDS* IN MINNESOTA-1988

TOP AIR EMITTERS OF CARCINOGENIC COMPOUNDS* NORMALIZED TO UNIT RISK ESTIMATES (USEPA, JUNE 7, 1988)

COMPANY	AQ PERMIT	NORMALIZED CARCINOGENICITY FACTOR			STAFF INITIALS
		COMPOUND	QTY(LB/YR) X UNIT RISK ESTIMATE	FACTOR	
1. Koch Refining Company St. Paul, MN Dakota County	yes STATUS: under review	formaldehyde	110,000(1.3x10e-5)	1.430	GJP
		benzene	70,200(8.3x10e-6)	.583	
		trichloroethylene	3,300(1.7x10e-6)	.006	
		ethylene dibromide	5(2.2x10e-4)	.001	
		beryllium	1(2.4x10e-3)	.002	
		chromium*	1300(1.2x10e-2)	15.600	
			TOTAL	17.622	
2. North Star Steel Co. MN St. Paul, Minnesota Ramsey County	yes STATUS: under review	chromium*	1,106(1.2x10e-2)	13.272	LAB
3. SB Foot Tanning Company Red Wing, MN Goodhue County	no STATUS: no current permit	chromium cmpds*	862(1.2x10e-2)	10.344	DLB
		tetrachloroethylene	17,051(5.8x10e-7)	.010	
		methylene chloride	16,213(4.7x10e-7)	.008	
			TOTAL	10.362	
4. Boise-Cascade Paper Group International Falls, MN Koochiching County	yes STATUS: 1989 permit	chloroform	203,000(2.3x10e-5)	4.670	ELH
5. The MacGillis & Gibbs Co. New Brighton, MN Ramsey County	no STATUS: no current permit	arsenic compounds	250(4.3x10e-3)	1.075	new listing
		chromium compounds*	250(1.2x10e-2)	3.000	
			TOTAL	4.075	
6. Ashland Petroleum St. Paul Park, MN Ramsey County	yes STATUS: 1987 permit	1,3-butadiene	910(2.8x10e-4)	.254	JML
		chromium*	250(1.2x10e-2)	3.0	
		benzene	13,500(8.3x10e-6)	.112	
				3.366	
7. D.S. Manufacturing Pine Island, MN Goodhue County	no STATUS: no permit	chloroform	92,000(2.3x10e-5)	2.116	new listing
8. Potlach Corporation Bemidji, MN Hubbard County	yes STATUS: current permit	formaldehyde	158,397(1.3x10e-5)	2.059	LAB
9. Northwood Panelboard Co. Solway, MN Beltrami County	yes STATUS: under review	formaldehyde	156,999(1.3x10e-5)	2.041	LAB
10. Potlach Oxboard Plant Cook, MN St. Louis County	yes STATUS: current permit	formaldehyde	144,410(1.3x10e-5)	1.877	LAB
11. Potlach Corp.	yes	chloroform	60,000(2.3x10e-5)	1.38	LAB

Cloquet, MN Carlton County	STATUS: under review				
12. Louisiana-Pacific Corp. Two Harbors, MN Lake County	yes STATUS: current permit	formaldehyde	74,126(1.3x10e-5)	.964	LAB
13. Charles B. Edwards & Co., Inc New Hope, MN Hennepin County	no STATUS: no permit	chromium compounds*	77(1.2x10e-2)	.924	new listing
14. Blandin Wood Products Grand Rapids, MN Itasca County	yes STATUS: under review	formaldehyde	65,840(1.3x10e-5)	.856	LAB
15. 3M Mag Media & Consumer Hutchinson, MN McLeod County	yes STATUS: 1987 permit	chromium*	57(1.2x10e-2)	.684	JML
16. Gopher Smelting and Refining Eagan, MN Dakota County	yes STATUS: under review	arsenic	134(4.3x10e-3)	.576	LAB
17. Sheldahl, Inc Northfield, MN Rice County	yes STATUS: under review	methylene chloride trichloroethylene TOTAL	776,000(4.7x10e-7) 14,250(1.7x10e-6)	.365 .024 .389	JAS
18. 3M St. Paul Tape & Abr. St. Paul, MN Ramsey County	yes STATUS: no current permit	formaldehyde	28,250(1.3x10e-5)	.367	ELH
19. 3M Chemolite Cottage Grove, MN Washington County	yes STATUS: no current permit	methylene chloride benzene ethylene dichloride formaldehyde TOTAL	29,970(4.7x10e-7) 1,120(8.3x10e-6) 12,083(2.6x10e-5) 1,200(1.3x10e-5)	.014 .009 .314 .016 .353	ELH
20. Unisys- Shepard Rd.-CSD St. Paul, MN Ramsey County	yes STATUS: no current permit	methylene chloride trichloroethylene TOTAL	274,460(4.7x10e-7) 113,512(1.7x10e-6)	.129 .193 .322	JML
21. Snyder General Corporation Faribault, MN Rice County	no STATUS: no permit	trichloroethylene	133,632(1.7x10e-6)	.227	new listing
22. Wolkerstorfer New Brighton, MN Ramsey County	yes STATUS: no current permit	methylene chloride trichloroethylene TOTAL	44,000(4.7x10e-7) 100,000(1.7x10e-6)	.021 .170 .191	JML
23. Bayliner Marine Corp. Pipestone, MN Pipestone County	no STATUS: no permit	methylene chloride styrene TOTAL	190,570(4.7x10e-7) 143,760(5.7x10e-7)	.090 .082 .172	unassigned
24. Superior Plating Minneapolis, MN Hennepin County	no STATUS: no curent	trichloroethylene	94,900(1.7x10e-6)	.160	LAB

	permit				
25. Honeywell TCAAP New Brighton, MN Ramsey County	no STATUS: no permit	trichloroethylene	43,100(1.7x10e-6)	.073	JAS
26. Glasstite, Inc Dunnell, MN Martin County	no STATUS: no permit	styrene	101,096(5.7x10e-7)	.058	unassigned
27. Bluewater Marine of N. Am. Mora, MN Kanabec County	no STATUS: no permit	styrene	82,500(5.7x10e-7)	.047	new listing
28. Hitchcock Industries Minneapolis, MN Hennepin County	no STATUS: no permit	tetrachloroethylene	79,790(5.8x10e-7)	.046	MFS
29. Upsher-Smith Labs Minneapolis, MN Hennepin County	no STATUS: no permit	methylene chloride	94,000(4.7x10e-7)	.044	unassigned
30. Wet Jet International Paynesville, MN Stearns County	no STATUS: no permit	styrene	72,594(5.7x10e-7)	.041	new listing
31. Diversified Products, Inc Wyoming, MN Chisago County	yes STATUS: 1989 permit	styrene	69,674(5.7x10e-7)	.040	PAS
32. Control Data Corporation St. Louis Park, MN Hennepin County	no STATUS: no permit	methylene chloride	83,200(4.7x10e-7)	.039	unassigned
33. Buckbee-Mears, St.Paul St. Paul, MN Ramsey County	no STATUS: no permit	methylene chloride	56,400(4.7x10e-7)	.027	new listing

* Assumes that all chromium is hexavalent chromium

** The carcinogens summed for this study are the pollutants for which EPA has derived cancer unit risk estimates (June 1988) and are included on the Section 313 Toxic Chemical list (January 1987):
Acetaldehyde, Acrylonitrile, Arsenic, Asbestos, Benzene, Beryllium, 1,3-Butadiene, Cadmium, Carbon tetrachloride, Chloroform, Chromium (VI), 1,2-Dichloroethane, 1,1-Dichloroethylene, Epichlorohydrin, Ethylene dibromide, Ethylene oxide, Formaldehyde, Hexachlorobenzene, Methylene chloride, Nickel, Propylene oxide, Styrene, Tetrachloroethylene, Trichloroethylene, Vinyl chloride

Table 2

SARA TITLE III SECTION 313: TOXIC RELEASE INVENTORY DATA
TOP AIR EMITTERS OF SELECTED NONCARCINOGENIC COMPOUNDS** IN MINNESOTA-1988

TOP AIR EMIITERS OF NONCARCINOGENIC COMPOUNDS WEIGHTED TO CHRONIC TOXICITY HEALTH CRITERIA

COMPANY	AQ PERMIT	WEIGHTED CHRONIC TOXICITY FACTOR			STAFF INITS.
		COMPOUND	QTY(LB/YR) / HEALTH CRITERIA	WEIGHTED FACTOR	
1. 3M St. Paul Tape & Abrasives St. Paul ,MN Ramsey County	yes STATUS: not current	2-ethoxyethanol	365,129 / .016	2.28x10e7	ELH
		xylene	552,200 / .59	9.36x10e5	
		n-butanol	59,250 / .058	1.02x10e6	
		ethyl benzene	20,750 / .30	6.92x10e4	
		MIBK	23,600 / .037	6.38x10e5	
		toluene	2,343,500 /2.0	1.17x10e6	
		MEK	370,500 / .53	6.99x10e5	
			TOTAL	2.74x10e7	
2. 3M Mag Media & Consumer Prod. Hutchinson, MN Mc Leod County	yes STATUS: 1987	MEK	11,058,639 / .53	2.09x10e7	JML
		MIBK	24,907 / .037	6.73x10e5	
		toluene	4,878,054 /2.0	2.44x10e6	
		ethyl benzene	26,283 / .30	8.76x10e4	
		xylene	109,721 / .59	1.86x10e5	
			TOTAL	2.43x10e7	
3. Crown Cork and Seal Company Lakeville, MN Dakota County	no STATUS: under review	n-butanol	218,000 / .058	3.76x10e6	LAB
		MEK	9,900 / .53	1.87x10e4	
		glycol ethers*	270,000 / .022	1.23x10e7	
			TOTAL	1.61x10e7	
4. Ford Twin Cities Assm Plant St. Paul, MN Ramsey County	yes STATUS: under review	glycol ethers*	118,000 / .022	5.36x10e6	ELH
		ethyl benzene	135 / .30	4.50x10e2	
		xylene	850,000 / .59	1.44x10e6	
		toluene	164,000 /2.0	8.20x10e4	
		n-butanol	130,260 / .058	2.25x10e6	
		2-ethoxyethanol	21,000 / .016	1.31x10e6	
		MEK	21,700 / .53	4.09x10e4	
		MIBK	23,300 / .037	6.30x10e5	
			TOTAL	1.11x10e7	
5. American National Can Co. St. Paul, MN Ramsey County	yes STATUS: application in-house, under review	glycol ethers*	139,139 / .022	6.32x10e6	ELH
		n-butanol	175,732 / .058	3.03x10e6	
		toluene	4,226 /2.0	2.11x10e3	
		MEK	4,663 / .53	8.80x10e3	
			TOTAL	9.32x10e6	
6. Andersen Corporation Bayport, MN Washington Coounty	yes STATUS: no current permit	xylene	730,000 / .59	1.24x10e6	ELH
		ethyl benzene	180,000 / .30	6.00x10e5	
		MIBK	210,000 / .037	5.68x10e6	
		toluene	88,000 /2.0	4.40x10e4	
		MEK	19,000 / .53	3.58x10e4	
			TOTAL	7.59x10e6	
7. SB Foot Tanning Co. Red Wing, MN	no STATUS:	glycol ethers*	100,614 / .022	4.57x10e6	DLB
		xylene	31,237 / .59	5.29x10e4	

Goodhue County	no current permit	toluene	46,746 /2.0	2.34x10e4	
		n-butanol	16,052 / .058	2.77x10e5	
		MEK	12,836 / .53	2.42x10e4	
		1,1,1-trichloroethane	17.051 / .57	2.99x10e4	
		MIBK	42,369 / .037	1.15x10e6	
			TOTAL	6.13x10e6	
8. 3M Industrial Abr. Div. Alexandria, MN Douglas County	yes STATUS: 1988 permit	2-ethoxyethanol	84,250 / .016	5.27x10e6	JHL
9 .WCI Freezer Division St. Cloud, MN Stearns County	no STATUS: application under review, no current permit	xylene	445,000 / .59	7.54x10e5	JAS
		glycol ethers*	16,400 / .022	7.45x10e5	
		toluene	16,700 /2.0	8.35x10e3	
		n-butanol	85,600 / .058	1.48x10e6	
			TOTAL	2.98x10e6	
10.Crystal Cabinet Works, Inc Princeton, MN Sherburne County	yes STATUS: 1986 permit	MEK	12,439 / .53	2.35x10e4	JAS
		MIBK	22,327 / .037	6.03x10e5	
		xylene	185,887 / .59	3.15x10e5	
		toluene	69,010 /2.0	3.45x10e4	
		ethylene glycol monobutyl ether	42,235 / .022	1.92x10e6	
			TOTAL	2.90x10e6	
11.Brown Printing Co. Waseca, MN Waseca County	yes STATUS: 1988 permit	glycol ethers*	64,000 / .022	2.91x10e6	JAS
12.3M Chemolite Center Cottage Grove, MN Washington County	yes STATUS: no current permit	MEK	722,800 / .53	1.36x10e6	ELH
		ethyl benzene	1,600 / .30	5.33x10e3	
		1,1,1-trichloroethane	31,200 / .57	5.47x10e4	
		MIBK	22,040 / .037	5.96x10e5	
		toluene	1,182,800 /2.0	5.91x10e5	
		2-ethoxyethanol	1,900 / .016	1.19x10e5	
		xylene	6,590 / .59	1.12x10e4	
		n-butanol	165 / .058	2.84x10e3	
		glycol ethers*	54 / .022	2.45x10e3	
			TOTAL	2.75x10e6	
13.American National Can Co. Savage, MN Scott County	yes STATUS: application received, under review	n-butanol	16,431 / .058	2.83x10e5	ELH
		MEK	19,427 / .53	3.67x10e4	
		glycol ethers*	44,272 / .022	2.01x10e6	
			TOTAL	2.33x10e6	
14.Sheldahl, Inc Northfield, MN Rice County	yes STATUS: under review	MEK	87,750 / .53	1.66x10e5	JAS
		toluene	11,250 /2.0	5.63x10e3	
		1,1,1-trichloroethane	35,750 / .57	6.27x10e4	
		glycol ethers*	42,500 / .022	1.93x10e6	
			TOTAL	2.16x10e6	
15.Riviera Cabinets, Inc. Red Wing, MN Goodhue County	no STATUS: no current permit	glycol ethers*	23,510 / .022	1.07x10e6	ELH
		toluene	55,808 /2.0	2.79x10e4	
		MIBK	27,731 / .037	7.49x10e5	
		MEK	29,626 / .53	5.59x10e4	
		xylene	27,241 / .59	4.62x10e4	

			TOTAL	1.94x10e6	
16. Federal Hoffman, Inc Anoka, MN Anoka County	yes STATUS: no current permit	toluene n-butanol xylene	12,590 /2.0 81,850 / .058 160,550 / .59	6.30x10e3 1.41x10e6 2.72x10e3	JML/ LAB
			TOTAL	1.69x10e6	
17. Naval Systems Div. of FMC Fridley, MN Anoka County	no STATUS: no permit	1,1,1-trichloroethane n-butanol MEK	141,948 / .57 34,566 / .058 35,615 / .53	2.49x10e5 5.96x10e5 6.72x10e4	new listing
			TOTAL	9.12x10e5	
18. Electrostatic Finishing, Inc Minneapolis, MN Hennepin County	no STATUS: no current permit	toluene xylene MEK ethyl benzene n-butanol	34,946 /2.0 133,841 / .59 171,897 / .53 19,026 / .30 12,760 / .058	1.75x10e4 2.27x10e5 3.24x10e5 6.34x10e4 2.20x10e5	JAS
			TOTAL	8.52x10e5	
19. 3M Center Maplewood, MN Ramsey County	yes STATUS: no current permit	MEK xylene glycol ethers* toluene 1,1,1-trichloroethane	80,600 / .53 1,700 / .59 12,500 / .022 26,000 /2.0 8,200 / .57	1.52x10e5 2.88x10e3 5.61x10e5 1.30x10e4 1.44x10e4	ELH
			TOTAL	7.51x10e5	
20. ICI Composites, Inc. (Fiberite) Winona, MN	yes STATUS: under review	MEK 1,1,1-trichloroethane	263,000 / .53 135,000 / .57	4.96x10e5 2.38x10e5	LAB
			TOTAL	7.34x10e5	
21. The Press, Inc. Chanhassen, MN Hennepin County	yes STATUS: 1985 permit	glycol ethers*	15,558 / .022	7.07x10e5	JML
22. Ceram-Traz Corporation Osseo, MN Hennepin County	no STATUS: no permit	xylene MIBK toluene MEK glycol ethers*	1,500 / .59 1,500 / .037 2,050 /2.0 500 / .53 500 / .022	2.54x10e3 4.05x10e4 1.03x10e3 9.43x10e2 2.27x10e4	new listing
			TOTAL	6.63x10e5	
23. Northern Engraving Corporation Spring Grove, MN Hennepin County	yes STATUS: 1986 permit	toluene MEK glycol ethers*	13,200 /2.0 17,000 / .53 12,700 / .022	6.60x10e3 3.21x10e4 5.77x10e5	CES
			TOTAL	6.15x10e5	
24. Honeywell Twin Cities Army New Brighton, MN Ramsey County	no STATUS: no application	xylene MIBK MEK toluene 1,1,1-trichloroethane	16,600 / .59 16,800 / .037 28,900 / .53 20,400 /2.0 27,700 / .57	2.81x10e4 4.54x10e5 5.45x10e4 1.02x10e4 4.86x10e4	JAS
			TOTAL	5.95x10e5	
25. Streater/Joyce, 411 First	no	toluene	15,459 /2.0	7.73x10e3	DLB

lbert Lea, MN Freeborn, MN	STATUS: no permit	MIBK MEK xylene n-butanol	17,228 / .037 3,618 / .53 41,165 / .59 2,475 / .058	TOTAL	4.66x10e5 6.83x10e3 6.98x10e4 4.27x10e4 5.93x10e5	
26. Koch Refining Company St. Paul, MN Ramsey County	yes STATUS: under review	1,1,1-trichloroethane ethyl benzene toluene xylene	30,000 / .57 35,000 / .30 204,000 /2.0 186,000 / .59	TOTAL	5.26x10e4 1.17x10e5 1.02x10e5 3.15x10e5 5.87x10e5	GJP
27. Thermo King Corporation Minneapolis, MN Hennepin County	no STATUS: no current permit	xylene 1,1,1-trichloroethane	201,750 / .59 127,250 / .57	TOTAL	3.42x10e5 2.23x10e5 5.65x10e5	DLB
28. The Printer, Inc. Maple Grove, MN Hennepin County	yes STATUS: 1985 permit	glycol ethers*	11,766 / .022		5.35x10e5	JML
29. Onan Mfg. Facility Fridley, MN Anoka County	no STATUS: no current permit	ethyl benzene 1,1,1-trichloroethane xylene	9,400 / .30 120,000 / .57 160,000 / .59	TOTAL	3.13x10e4 2.11x10e5 2.71x10e5 5.13x10e5	LAB
30. Honeywell, Inc.-Residential Golden Valley, MN Hennepin County	no STATUS: no current permit	toluene MEK 1,1,1-trichloroethane	45,000 /2.0 8,700 / .53 200,000 / .57	TOTAL	2.25x10e4 1.64x10e4 3.51x10e5 3.90x10e5	MFS
31. American National Can Company Minneapolis, MN	yes STATUS: 1987 permit	MEK toluene	142,857 / .53 226,623 /2.0	TOTAL	2.70x10e5 1.13x10e5 3.83x10e5	CES
32. Crown Cork and Seal Co., Inc Faribault, MN Rice County	no STATUS: no current permit	xylene MEK toluene MIBK n-butanol	3,675 / .59 9,115 / .53 16,693 /2.0 9,428 / .037 2,838 / .058	TOTAL	6.23x10e3 1.72x10e4 8.35x10e3 2.55x10e5 4.89x10e4 3.36x10e5	LAB
33. Irathane Systems, Inc. Hibbing, MN St. Louis County	no STATUS: no current permit	MIBK xylene	10,750 / .037 23,200 / .59	TOTAL	2.91x10e5 3.93x10e4 3.30x10e5	JML
34. Gross-Given Mfg. Co. St. Paul, MN Ramsey County	no	methyl ethyl ketone xylene toluene	27,447 / .53 139,442 / .59 18,520 /2.0	TOTAL	5.23x10e4 2.37x10e5 9.39x10e3 2.99x10e5	
35. Valley Craft, Inc Lake City, MN Wabasha County	no STATUS: no	toluene n-butanol xylene	17,147 /2.0 11,794 / .058 50,100 / .59		8.57x10e3 2.03x10e5 8.49x10e4	new listing

	permit			TOTAL	2.97x10e5	
36. Minnesota Valley Engineering New Prague, MN	no STATUS: no permit	MEK 1,1,1-trichloroethane	6,400 / .53 160,000 / .57	TOTAL	1.21x10e4 2.81x10e5 2.93x10e5	new listing
37. Waldorf Corporation St. Paul, MN	yes STATUS: 1986 permit	toluene glycol ethers*	324,687 /2.0 2,821 / .022	TOTAL	1.62x10e5 1.28x10e5 2.91x10e5	unassigned
38. Unisys-Shepard Rd.-CSD St. Paul, MN Ramsey County	yes STATUS: no current permit	1,1,1-trichloroethane MEK	138,576 / .57 23,154 / .53	TOTAL	2.43x10e5 4.37x10e4 2.87x10e5	JML
39. Crenlo, Inc Rochester, MN Olmsted County	yes STATUS: 1986 permit	glycol ethers* MEK toluene xylene	4,300 / .022 13,500 / .53 6,800 /2.0 4,000 / .59	TOTAL	1.95x10e5 2.55x10e4 3.40x10e3 6.78x10e3 2.30x10e5	JAS
40. Graco, Inc Minneapolis, MN Hennepin County	no STATUS: no permit	toluene xylene 1,1,1-trichloroethane	16,959 /2.0 20,787 / .59 75,056 / .57	TOTAL	8.38x10e3 3.52x10e4 1.32x10e5 1.76x10e5	new listing
41. Flour City Arch. Metal Minneapolis, MN	no STATUS: no permit	1,1,1-trichloroethane MEK	72,000 / .57 21,000 / .53	TOTAL	1.26x10e5 3.96x10e4 1.66x10e5	JAS
42. E.R. Carpenter Co., Inc. Albert Lea, MN Freeborn, MN	no STATUS: no permit	1,1,1-trichloroethane	68,054 / .57		1.19x10e5	new listing
43. Ashland Petroleum, St. Paul Ref. St. Paul Park, MN Washington County	yes STATUS: 1987 permit	xylene toluene ethyl benzene	46,280 / .59 27,300 /2.0 6,525 / .30	TOTAL	7.84x10e4 1.37x10e4 2.18x10e4 1.14x10e5	JML
44. McNeilus Truck & Mfg. Dodge Center, MN Dodge County	no	xylene toluene	45,222 / .59 59,809 /2.0	TOTAL	7.66x10e4 2.99x10e4 1.07x10e5	
45. Streater/Joyce, 408 First Albert Lea, MN Freeborn County	no STATUS: no permit	toluene MIBK xylene MEK	61,756 /2.0 1,783 / .037 3,248 / .59 8,071 / .53	TOTAL	3.09x10e4 4.82x10e4 5.51x10e3 1.52x10e4 9.98x10e4	new listing
46. OTC Division, SPX Corp. Owatonna, MN Steele County	yes STATUS: partially permitted	toluene MEK xylene	15,400 /2.0 2,450 / .53 43,400 / .59	TOTAL	7.70x10e3 4.62x10e3 7.36x10e4 8.59x10e4	ELH

47. Midwest Electric Mankato, MN Blue Earth County	no STATUS: no permit	1,1,1-trichloroethane	48,250 / .57		8.46x10e4	new listing
48. Continental Machines, Inc. Savage, MN Scott County	no STATUS: no permit	1,1,1-trichloroethane	47,126 / .57		8.27x10e4	unassigned
49. Honeywell, Inc., Ridgeway Pkwy Minneapolis, MN Hennepin County	no STATUS: no permit	1,1,1-trichloroethane	47,000 / .57		8.25x10e4	MFS
50. Control Data Corp. 80th St. Bloomington, MN Hennepin County	no STATUS: no permit	1,1,1-trichloroethane	42,000 / .57		7.37x10e4	unassigned
51. Rosemount, Inc Eden Prarie, MN Hennepin County	no STATUS: no permit	1,1,1-trichloroethane	41,000 / .57		7.19x10e4	new listing
52. Van Dale Inc. Long Lake, MN Hennepin County	no STATUS: no permit	toluene xylene	19,394 /2.0 36,301 / .59	 TOTAL	9.70x10e3 6.15x10e4 7.12x10e4	JAS
53. Deluxe Check Printers-Shoreview Shoreview, MN Ramsey County	yes STATUS: 1988 permit	1,1,1-trichloroethane	39,912 / .57		7.00x10e4	JML
54. Sheller-Globe Engineered Polym Mora, MN Kanabec County	yes STATUS: 1989 permit	MEK	36,075 / .53		6.81x10e4	BG
55. Knapp Woodworking, Inc. Minneapolis, MN Anoka County	no STATUS: no permit	toluene MEK	9,017 /2.0 30,560 / .53	 TOTAL	4.50x10e3 5.77x10e4 6.22x10e4	new listing
56. Globe Tool & Mfg. Co. Minneapolis, MN Hennepin County	no STATUS: application received	1,1,1-trichloroethane	33,788 / .57		5.93x10e4	JAS
57. IBM Rochester, MN Olmsted County	yes STATUS: 1985 permit	1,1,1-trichloroethane	32,100 / .57		5.63x10e4	JAS
58. Control Data Corp., Eden Prarie Eden Prarie, MN Hennepin County	no STATUS: no permit	1,1,1-trichloroethane	32,000 / .57		5.61x10e4	new listing
59. The Gillette Co., St. Paul St. Paul, MN Ramsey County	yes STATUS: 1987 permit	1,1,1-trichloroethane	31,400 / .57		5.51x10e4	JML
60. Control Data Corp., Arden Hills Arden Hills, MN Ramsey County	no STATUS: no permit	1,1,1-trichloroethane	31,200 / .57		5.47x10e4	new listing
61. Metalurgical, Inc Minneapolis, MN Hennepin County	no STATUS: no permit	1,1,1-trichloroethane	31,000 / .57		5.44x10e4	new listing

62. Trinity Industries, Inc New London, MN Kandiyohi County	no STATUS: no permit	xylene	29,774 / .59	5.05x10e4	new listing
63. Buckbee-Mears, St. Paul St. Paul, MN Ramsey County	no STATUS: no permit	1,1,1-trichloroethane	27,000 / .57	4.74x10e4	new listing
64. Acrometal Companies, Inc Brainerd, MN Crow Wing County	no STATUS: no permit	1,1,1-trichloroethane	26,600 / .59	4.67x10e4	new listing
65. Hard Chrome, Inc Minneapolis, MN Hennepin County	no STATUS: no permit	1,1,1-trichloroethane	25,000 / .57	4.39x10e4	JML
66. 3M Fairmont, MN Martin County	no STATUS: no current permit	toluene	80,754 /2.0	4.04x10e4	ELH

*= The health criteria for glycol ethers was assumed to be that for ethylene glycol monobutyl ether (butyl cellosolve).
**= The noncarcinogenic compounds selected for this review are compounds that can cause adverse chronic health impacts (other than cancer) that also have health criteria values:
n-butanol, 2-ethoxyethanol, ethyl benzene, glycol ethers, methyl ethyl ketone, methyl isobutyl ketone, n-propanol, toluene, 1,1,1-trichloroethane, xylene

Table A

Allowable Ambient Air Levels and Significant Emission Rates
for Acute Effects

CAS number	pollutant	allowable ambient level (one hour average, µg/m3)	significant emission rate (pound/hour)
67-64-1	acetone	1.2E+4	4.8E+0
	aliphatic naphtha	6.7E+4	2.7E+1
628-63-7	n-amyl acetate	5.3E+3	2.1E+0
71-43-2	benzene	1.6E+3	6.3E-1
71-36-3	n-butanol	7.6E+2	3.0E-1
111-76-2	2-butoxyethanol (ethylene glycol monobutyl ether)	4.7E+3	1.9E+0
123-86-4	n-butyl acetate	9.5E+3	3.8E+0
64-17-5	ethanol	2.6E+4	1.0E+1
141-78-6	ethyl acetate	1.4E+4	5.6E+0
100-41-4	ethylbenzene	4.4E+3	1.7E+0
50-00-0	formaldehyde	4.1E+1	1.6E-2
142-82-5	heptane	4.0E+4	1.6E+1
	high aromatic solvent	3.3E+3	1.3E+0
123-51-3	isoamyl alcohol	3.6E+3	1.4E+0
78-83-1	isobutanol	3.0E+4	1.2E+1
67-63-0	isopropanol	9.8E+3	4.0E+0
98-82-8	isopropyl benzene	1.0E+4	4.1E+0
67-56-1	methanol	2.6E+3	1.0E+0
78-93-3	methyl ethyl ketone	2.7E+3	1.1E+0
	2-methyl hexane	5.0E+4	2.0E+1
	3-methyl hexane	5.0E+4	2.0E+1
108-10-1	methyl isobutyl ketone	4.1E+3	1.7E+0
107-87-9	methyl propyl ketone	7.0E+3	2.9E+0
107-98-2	propylene glycol monomethyl ether	3.7E+3	1.5E+0
108-88-3	toluene	3.8E+3	1.5E+0
8032-32-4	VM&P naphtha	6.6E+3	2.7E+0
various	xylene (mixed)	4.4E+3	1.8E+0

Note: based on second highest 1-hour concentration (see discussion). Subject to change; consult Program Development Unit for current version.

Table B

Allowable Ambient Air Levels and Significant Emission Rates for Chronic Noncarcinogenic Effects

CAS number	pollutant	allowable ambient level (annual average, µg/m3)	significant emission rate (ton/year)
75-07-0	acetaldehyde	4.0E+1	5.6E+0
	acetone cyanohydrin	1.0E+2	1.4E+1
98-86-2	acetophenone	2.0E-2	2.7E-3
107-02-8	acrolein	1.0E-1	1.4E-2
7664-41-7	ammonia	3.6E+2	4.9E+1
7440-39-3	barium	5.0E-2	6.8E-3
74-83-9	bromomethane	6.0E+0	8.0E-1
71-36-3	n-butanol	5.8E+1	7.9E+0
75-15-0	carbon disulfide	1.0E+1	1.4+0
108-90-7	chlorobenzene	2.0E+1	2.7E+0
67-66-3	chloroform	8.0E+0	1.1E+0
	2-chloropropane	3.0E+2	4.1E+1
98-82-8	cumene	9.0E+0	1.2E+0
542-92-7	cyclopentadiene	3.0E+2	4.1E+1
95-50-1	1,2-dichlorobenzene	2.0E+2	2.7E+1
106-46-7	1,4-dichlorobenzene	7.0E+2	9.5E+1
75-71-8	dichlorodifluoromethane	2.0E+2	2.7E+1
75-34-3	1,1-dichloroethane	5.0E+2	6.8E+1
542-75-6	1,3-dichloropropene	7.5E+0	9.5E-1
77-73-6	dicyclopentadiene	2.0E-1	2.7E-2
124-40-3	dimethylamine	2.0E+0	2.7E1-1
106-89-8	epichlorohydrin	3.0E-1	4.2E-2
110-80-5	2-ethoxyethanol	1.6E+1	2.2E+0
100-41-4	ethylbenzene	3.0E+2	4.1E+1
107-15-3	ethylenediamine	1.0E+2	1.4E+1
111-76-2	ethylene glycol monobutyl ether (2-butoxyethanol)	2.2E+1	3.0E+0
98-01-1	furfural	5.0E+1	6.8E+0
77-47-4	hexachlorocyclopentadiene	7.0E-2	9.5E-3
110-54-3	n-hexane	2.0E+2	2.7E+1
7647-01-0	hydrogen chloride	7.0E+0	9.5E-1
7783-06-4	hydrogen sulfide	9.0E-1	1.2E-1
7439-96-5	manganese	1.0E+0	1.4E-1
126-98-7	methacrylonitrile	7.0E-1	9.5E-2
101-68-8	methylene bisphenyl isocyanate	1.0E+0	1.4E-1
109-86-4	2-methoxyethanol	1.0E+1	1.4E+0
78-93-3	methyl ethyl ketone	5.3E+2	7.3E+1
108-10-1	methyl isobutyl ketone	3.7E+1	5.2E+0
98-83-9	methyl styrene	4.0E+1	5.5E+0
98-95-3	nitrobenzene	2.0E+0	2.7E-1
71-23-8	n-propanol	2.5E+3	3.4E+2
57-55-6	propylene glycol	6.0E+3	8.2E+2

Table B - continued

Allowable Ambient Air Levels and Significant Emission Rates
for Chronic Noncarcinogenic Effects

CAS number	pollutant	allowable ambient level (annual average, µg/m3)	significant emission rate (ton/year)
107-98-2	propylene glycol monomethyl ether	6.6E+2	9.0E+1
7782-49-2	selenium	4.0E+0	5.5E-1
109-99-9	tetrahydrofuran	7.0E+1	9.4E+0
108-88-3	toluene	1.5E+3	2.1E+2
120-82-1	1,2,4-trichlorobenzene	9.0E+0	1.2E+0
71-55-6	1,1,1-trichloroethane	1.0E+3	1.4E+2
75-69-4	trichlorofluoromethane	7.0E+2	9.5E+1
8032-32-4	VM&P naphtha	5.0E+2	6.8E+1
various	xylene (mixed)	2.0E+2	2.7E+1

Note: based on highest annual average. Subject to change; consult Program Development Unit for current version.

Table C

Allowable Ambient Levels and Significant Emission Rates
for Carcinogens and Environmentally Persistent Chemicals

CAS Number	pollutant	allowable ambient level (annual avg., µg/m3)	significant emission rate (ton/year)	new source BART threshold (ton/year)	existing source BART threshold (ton/year)
75-07-0	acetaldehyde	4.5E+0	6.3E-1	2.0	5.0
107-13-1	acrylonitrile	1.5E-1	2.1E-2	1.0	5.0
7440-38-2	*arsenic	2.3E-5	3.2E-6	0.1	5.0
	asbestos	4.3E-7	6.8E-8	**	**
71-43-2	benzene	1.2E+0	1.6E-1	1.0	5.0
50-32-8	*benzo[a]-pyrene	5.9E-5	8.6E-6	0.1	5.0
7440-41-7	beryllium	4.2E-3	5.6E-4	0.1	5.0
106-99-0	1,3-butadiene	3.6E-2	4.9E-3	0.1	5.0
7440-43-9	***cadmium	5.6E-4	7.8E-5	0.1	5.0
56-23-5	carbon tetrachloride	6.7E-1	9.0E-2	1.0	5.0
67-66-3	chloroform	4.3E-1	5.9E-2	1.0	5.0
7440-47-3	***chromium	8.3E-5	1.2E-5	0.1	5.0
	coke oven emissions	1.6E-2	2.2E-3	0.1	5.0
106-93-4	1,2-dibromo-ethane	4.6E-2	6.3E-3	0.1	5.0
75-34-3	1,2-dichloro-ethane	3.8E-1	5.2E-2	1.0	5.0
75-35-4	1,1-dichloro-ethylene	2.0E-1	2.7E-2	1.0	5.0
106-89-8	epichlorohy-drin	8.3E+0	1.2E+0	2.0	5.0
75-21-8	ethylene oxide	1.0E-1	1.4E-2	0.1	5.0
50-00-0	formaldehyde	7.7E-1	1.0E-1	1.0	5.0
76-13-1	Freon 113 (1,1,2-trichloro-1,2,2 trifluoroethane)	****	****	1.0	5.0
118-74-1	*hexachloro-benzene	2.0E-4	2.9E-5	0.1	5.0

* These chemicals are known to persist and/or bioaccumulate in the environment. To take account of this phenomenon, AALs and SERs based on inhalation exposure alone has been lowered by a factor of 100 in deriving the values listed here.

** Case by case review (except waste combustors and asbestos NESHAP sources).

*** These chemicals are believed to be carcinogenic only through inhalation exposure. However, they are known to persist and/or bioaccumulate in the environment. In order to account for this, AALs and SERs based on inhalation exposure alone have been lowered by a factor of 10 in deriving the values listed here

**** These chemicals are known to persist and/or bioaccumulate in the environment. Further, it is not possible with available information to develop an AAL for these chemicals. Air Toxics Staff should be consulted if emissions of these pollutants are anticipated.

Note: based on highest annual average. Subject to change; consu ogram Development Unit for current version.

Table C - continued

Allowable Ambient Levels and Significant Emission Rates
for Carcinogens and Environmentally Persistent Chemicals

CAS Number	pollutant	allowable ambient level (annual avg., µg/m3)	significant emission rate (ton/year)	new source BART threshold (ton/year)	existing source BART threshold (ton/year)
7439-92-1	lead	****	****	1.0	5.0
7439-97-6	mercury	****	****	0.1	5.0
75-09-2	methylene chloride/ dichloromethane	2.1E+1	2.9E+0	5.0	10.0
7440-02-0	nickel	4.2E-2	5.6E-3	0.1	5.0
1336-36-3	polychlorinated biphenyls	****	****	0.1	5.0
75-56-9	propylene oxide	2.7E+0	3.8E-1	2.0	5.0
100-42-5	styrene	1.8E+1	2.5E+0	5.0	10.0
	*****dioxin/dibenzofuran	3.0E-10	4.2E-11	**	**
127-18-4	tetrachloro-ethylene	1.7E+1	2.3E+0	5.0	10.0
79-01-6	trichloroethylene	5.9E+0	8.0E-1	2.0	5.0
75-01-4	vinyl chloride	2.4E+0	3.3E-2	2.0	5.0

** Case by case review (except waste combustors and asbestos NESHAP sources).

**** These chemicals are known to persist and/or bioaccumulate in the environment. Further, it is not possible with available information to develop an AAL for these chemicals. Air Toxics Staff should be consulted if emissions of these pollutants are anticipated.

***** Dioxins and dibenzofurans are known to be very persistent and bioaccumulative in the environment. To account for this, the AAL and SER based on inhalation alone has been lowered by a factor of 1000 in deriving the values listed here.

Note: based on highest annual average. Subject to change; consult Program Development Unit for current version.

APPENDIX 1
(formerly Table D)

DETERMINATION OF ACTION LEVEL (AL) FOR EMITTED CHEMICALS NOT LISTED IN TABLES A, B, OR C

Chemicals not listed in Tables A, B or C will be initially reviewed based on a value used to assess workplace chemical exposures: the Threshold Limit Value-Time Weighted Average (TLV-TWA, referred to here as the TLV and expressed as mg/m3). The TLV is taken from the most recent version of "Threshold Limit Values and Biological Exposure Indicies", published annually by the American Conference of Governmental Industrial Hygienists (ACGIH). According to ACGIH, TLVs "refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect." TLVs are used in computing the AL, as described below.

PROCEDURE:

1. Determine the AL:

$$\text{AL (mg/m3)} = \text{TLV} / 1000$$

2. Determine Significant Emission Rate (SER):

$$\text{SER (pounds/day)} = 44.3(\text{AL in mg/m3})^*$$

EXAMPLE: cyclohexane; the TLV for cyclohexane is 1,050 mg/m3. Thus,

$$\text{AL} = \frac{1{,}050 \text{ mg/m3}}{1{,}000} = 1.05 \text{ mg/m3}$$

$$\text{SER} = (44.3)1.05 = 46.4 \text{ lbs/day}$$

RATIONALE:

The AL is a regulatory screening level used by MPCA AQD staff to determine whether further analysis is needed. (Appendix 3 discusses the basis for defining the AL = TLV/1000). The ALs are used in calculation of a hazard index (see steps 9 and 10, Figure 2, Air Toxics Source Review Guide). If a hazard index greater than 1 is calculated for an Appendix 1 chemical, that chemical will be referred to AQD staff for determination of a health-based level, similar to that found in Tables A, B, and C. This level will be used in any further evaluation. The factor 44.3 reflects a worst case air dispersion and dilution model in converting ALs to SERs. This is the same input modeling scenario as that of Tables A, B, and C, utilizing the result for a 24-hour averaging period.

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* The factor 44.3 represents "worst case" dilution and is used to determine an ambient concentration from an emission rate. This procedure is discussed in Appendix 2 of this Guide, p. 32, under "Significant Emission Rates".

APPENDIX 2

AIR QUALITY DISPERSION MODELING OF AIR TOXICS

This appendix is intended to give guidance on procedures for performing air dispersion modeling of air toxics emissions. It is not intended to provide complete or detailed information on models or techniques. Such information can be found in the cited reference material. The goal here is to outline a general strategy which can be used by facilities subject to regulation, consultants, MPCA staff and others.

Any dispersion modeling analysis requires input information consisting of emissions estimates, stack/release parameters, and receptor parameters. Refined analyses will also require meteorological data. The first step in evaluating the environmental impacts of an air toxics release often involves a screening approach. The idea is to use a simplified approach which saves time and effort while still addressing the pertinent questions.

Many screening approaches are available, but all of them tend to make assumptions which overestimate impacts. If the impacts estimated in the screening approach are deemed too high, refinements in the modeling analysis may be made. Alternatively, emissions may be reduced so that the screening model estimates of impacts are no longer deemed excessive. If the analysis proceeds to the highest level of refinement, and impacts are still excessive, emission reductions will be required. Since the modeling analysis is based upon specified emission rates and release parameters, permit conditions which restrict the facility to these operating conditions will typically be included.

The MPCA adheres to U.S. EPA modeling guidance (EPA, 1986) for conducting dispersion modeling analyses of all sources, including sources of air toxics.

Screening Approaches

Numerous screening models are available from a variety of sources. For example, the state of New York developed a nomograph (NYDEC, 1986) for estimating air concentrations of toxics, and the state of Michigan developed a dilution factor matrix (MI-DNR, 1989) for air toxics which can be used with a hand calculator. Other states such as Wisconsin, Massachusetts, and California have adopted their own air toxics dispersion modeling policies which rely heavily on EPA guidance. The Federal Republic of Germany uses a Gaussian nomograph in their technical instructions for air quality control. Other screening models can be found in the open literature.

The EPA models, SCREEN or PTPLU, are recommended for conducting screening dispersion analyses of air toxics emissions in Minnesota. The use of an alternate model should be approved by the MPCA prior to submission of a source review.

The SCREEN model (U.S. EPA, 1988) may be obtained on diskette from the National Technical Information Service (NTIS), Springfield, VA 22161. Purchasers of the SCREEN model from NTIS may obtain future revisions to the model from NTIS. The model and revisions are also available at no charge from the Support Center for Regulatory Air Models (SCRAM) electronic bulletin board (919/541-5742; line

settings: 8 data bits, no parity, 1 stop bit, 1200 or 2400 baud; in the first call the user provides registration information; the system operator will then register the user to allow full access to the BBS services, usually by the next business day).

The averaging time is an important consideration. Some models, like SCREEN or PTPLU, predict a maximum 1-hour average concentration. Extrapolation to a longer averaging time may be done using the following conversion factors:

predicted 1-hour average concentration from screening model	x	multiplying factor	=	concentration for averaging time
		0.9		3 hours
		0.7		8 hours
		0.4		24 hours
		0.1		1 year

It is not possible to convert long-term averages to shorter time periods.

The most straightforward case for application of a screening model is that of a single pollutant emitted from a single stack. In this case no simplifying assumptions are required to apply the model. However, the majority of facilities requiring review of air toxics emissions will emit more than one pollutant from more than one emission point. For these facilities the use of simplifying assumptions may provide an efficient way to conduct a screening analysis of emissions of air toxics. Most simplifying assumptions will lead to an overestimate of ambient air concentrations, and in no case should any assumptions be used which lead to underestimates! Simplifying assumptions should be discussed with and approved by the MPCA before use.

Many screening models do not use actual meteorological data but instead use assumed, "worst-case" meteorological conditions. These models typically predict the highest pollutant concentration at given distances from the source, independent of direction. Receptor distances should be chosen so that the highest pollutant concentration is captured in the analysis (see General Considerations). When screening analyses are used, the highest predicted pollutant concentration should be used when assessing the acceptability of the impacts.

In the case of a source emitting multiple pollutants from several sources, the most simplified approach would be to assume that all of the pollutants are emitted from a single source. If this assumption is made the source must be given the least dispersive release characteristics of any of the sources, and it must be located as close as any source to the nearest receptor. This type of analysis must also be done with a model (such as SCREEN) which accounts for only the distance and not the direction between source and receptor. Of course, this approach will tend to overestimate impacts. If the impacts are found to be excessive, the modeling analysis may be refined or emissions may be reduced.

There are several possible methods for refinements of the screening analysis. For example, if a subset of the pollutants is responsible for the vast majority of an unacceptable impact (i.e. contribute most of the hazard index), then the

sources emitting these pollutants may be modeled individually. For each pollutant in the subset, the resulting maximum predicted concentration from each stack should then be added (regardless of where the maximum occurred). This methodology will still overestimate pollutant concentrations since the predicted maxima may not occur at the same receptor; however, it is a refinement of the single stack approach and may result in acceptable impacts.

A further refinement is to conduct a screening model analysis of all emission points and then add the maximum predicted impacts for each pollutant (again regardless of location).

In any of the above screening approaches (as well as in the refined analyses) an emission rate of 1.0 grams per second (unit emissions) may be substituted for the actual emission rate and a unit impact calculated. Actual impacts may be calculated later by multiplying the unit impacts by the actual emission rate (in grams per second). If unit emissions are used for a source with more than one emission point, great care must be taken in developing the actual impacts.

Refined Analyses

The MPCA follows EPA guidelines (U.S. EPA, 1986) in conducting air dispersion modeling of emissions of air toxics. While this modeling guidance is much too lengthy to discuss here, a few relevant points are worth mentioning.

Five complete, individual years of meteorological data should be used in all refined analyses. Models which use joint frequency distributions of wind speed, wind direction, and stability as inputs (e.g. ISCLT) should be run on five individual one-year frequency distributions rather than one frequency distribution covering five years.

Finally, the EPA guideline models do not consider wet deposition and do not adequately treat dry deposition. Analyses which include wet and/or dry deposition of pollutants should only be attempted in consultation with MPCA staff.

General Considerations

Receptors should be placed to capture the highest pollutant concentrations occurring in the ambient air (i.e. anywhere the public has access, meaning everywhere outside fenced company property). In cases where building wake effects are not a consideration, 100 meter spacing of receptors is usually appropriate. When building wake effects are considered and when an emission point is located near the fenced property boundary, a more dense (e.g. 25 meter) spacing of receptors may be necessary to capture the highest pollutant concentrations.

Regardless of whether a screening model or a refined model is used, the emission rate should be matched to the modeled averaging time. In each case the maximum emission rate allowable under the proposed permit for a given averaging time should be used in the modeling analysis. For example, in modeling a one-hour average concentration, the peak emission rate allowable for one hour should be the model input. In modeling an annual average concentration, the maximum allowable annual emission rate should be used.

Air toxics emissions considered in a modeling analysis should include all sources at a facility. Emissions which cannot be characterized as a "point" source in the modeling analysis should be included as a "volume" or "area" source. Fugitive emissions should be included in the analysis.

The use of enhanced dispersion (e.g. a taller stack) is not a recommended remedy for achieving a satisfactory hazard index rating. Pollution prevention and emission reductions are the preferred techniques. Enhanced dispersion may be considered in conjunction with emission reductions in exceptional cases (e.g. for stacks subject to the Shulman-Scire building wake effects algorithm in ISC or SCREEN). However, sources emitting carcinogens and environmentally persistent pollutants will not be given credit for using enhanced dispersion to achieve a satisfactory hazard index rating.

The highest predicted concentration should be used for annual analyses and short-term screening analyses. When 24-hour or shorter averaging times are considered via a refined model, then the highest second-highest predicted concentration should be used in the impact assessment.

Regulatory default model options should be used whenever applicable.

Significant Emission Rates

Tables A, B, and C of this Source Review Guide contain significant emission rates (SERs). These SERs were determined by an MPCA modeling analysis (Pratt, 1989). The modeling analysis considered three "worst case" sources consisting of small buildings with short stacks and non-dispersive stack parameters. One of the sources was characterized without building wake effects, one with Huber-Synder building wake effects, and one with Shulman-Scire building wake effects. Each of the three sources was modeled with SCREEN, ISCST, and ISCLT. One-hour, 8-hour, 24-hour, and annual average concentrations were calculated, depending upon the model capabilities. For the refined (ISC) models, five individual years of meteorological data (1982-1986) were used.

Dilution factors were calculated based upon the highest predicted concentrations in the modeling results. A significant emission rate was calculated for each substance in the tables from the dilution factor and the allowable ambient concentration for that substance.

References

MI-DNR (Michigan Department of Natural Resources), 1989, Final Report of the Michigan Air Toxics Policy Committee, A Proposed Strategy for Processing Air Quality Permit Applications for New Emission Sources of Toxic Air Pollutants.

NYDEC (New York Department of Environmental Conservation), 1986, New York State Air Guide - 1, Guidelines for the Control of Toxic Ambient Air Contaminants.

Pratt, G.C., 1989, Recommendations on de minimis emission rates for toxic air pollutants, Minnesota Pollution Control Agency Office Memorandum.

U.S. EPA, 1986, Guideline on Air Quality Models (Revised), EPA-450/2-78-027R.

U.S. EPA, 1988, Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Draft for Public Comment, EPA-450/4-88-010.

APPENDIX 3

DEVELOPMENT OF ALLOWABLE AMBIENT LEVELS FOR SUBSTANCES IN TABLES A-C OF THE AIR TOXICS SOURCE REVIEW GUIDE

TABLE A

Table A contains chemicals for which MPCA staff have have developed short-term allowable ambient levels (AALs). AALs are chemical concentrations in air to which we believe people could be exposed without experiencing ill effects. We have developed three categories of health criteria for adverse effects that can occur under short-term (acute) exposure to chemicals:

Eye irritation: reddening or burning sensation in the eyes.

Respiratory irritation: irritation of nose, throat or lungs.

Short-term central nervous system (CNS) effects: nausea, headache or effects on motor, perceptual or cognitive function, such as decreased reaction time, change in light perception, decreased ability to do mechanical tasks.

For each of these three categories, we have a list of health criteria values. The health criteria values are developed on an as-needed basis for facility specific risk assessments. If a chemical causes eye irritation, respiratory irritation and CNS depression, and the appropriate health information is available, it will have three different short-term health criteria.

In establishing short-term health criteria, we search the biomedical literature for reports on studies in which people were exposed to known concentrations of the chemical. Usually, we use the results of human experiments. We may also use data reported from workplace settings, where workers experienced an adverse effect after exposure to a known level of a chemical. A third potential source of health criteria is the chemical's occupational exposure limit.

The level at which a chemical causes an effect is used as the starting point. For example, the chemical xylene was found to cause eye irritation in subjects (volunteers) exposed to 200 ppm (parts per million) in an exposure chamber (Nelson et al., 1943). We divide this exposure concentration by uncertainty factors to develop an eye irritancy criteria intended to protect sensitive members of the general population from eye irritation. 200 ppm is divided by an uncertainty factor of 10 to estimate a level in which non-sensitive persons would not experience eye irritation (20 ppm). We divide by an additional uncertainty factor of 10 to account for the greater sensitivity of some people in the general population to irritant effects than the 12 individuals tested in the above experiment. This gives an eye irritancy criteria value of 2 ppm (8.6 milligrams per cubic meter).

The property line concentration of xylene emitted by a facility will vary, depending on the emission level (the amount of xylene coming out of the exhaust stack), facility parameters (stack height, exit velocity, distance to property line) and climatic conditions (wind speed, barometric pressure, etc.). We divide the highest expected property line concentration by the eye irritancy

health criteria to get a "hazard index", in this case, an eye irritancy index. In a detailed risk assessment, we would add together the eye irritancy indices for each chemical emitted by the source. If the summed eye irritancy indices are greater than one, we believe that the potential for eye irritancy exists.

Table A AALs are determined from eye irritancy, respiratory irritancy, or short-term CNS health criteria, and expressed in micrograms per cubic meter. The most stringent of the three is used.

TABLE B

AALs in Table B are intended to protect against noncancer adverse effects in humans. They are derived from experimental studies of animals exposed to various air concentrations of pollutants. These AALs are intended to protect sensitive people who might be exposed for a lifetime.

In a typical experiment, groups of 10 to 25 animals might be exposed to three different concentrations, seven hours per day, five days per week. After 10 to 26 weeks, the animals are sacrificed and examined for signs of chemical toxicity. The highest exposure level at which the animals experienced no adverse effect level is called the no observed adverse effect level (NOAEL). To determine a health criteria value (AAL) for humans, the NOAEL is adjusted with uncertainty factors.

For a NOAEL of 200 ppm in animals exposed 35 hours per week (35/168) for 13 weeks, the time-adjusted NOAEL is 200 x (35/168) = 42 ppm. Three 10-fold uncertainty factors are applied:

10x Between-species variability (animal to human extrapolation)

10x Within-species variability (protection of sensitive humans)

10x Less than lifetime exposure (use of data from a 13 week exposure to protect against effects for the 70 year human lifespan)

The overall uncertainty factor is 10 x 10 x 10 = 1000. Dividing 42 ppm by 1000 gives a health criteria (AAL) of 0.042 ppm. This is converted to micrograms per cubic meter. The AALs in Table B are calculated in the same way as the sample calculation above. They are based on data from a summary document of EPA Reference Doses and Cancer Potency Slopes (U.S. EPA, 1989).

TABLE C

AALs in Table C (except for lead and mercury) correspond to EPA Unit Risk Estimates, using a lifetime upper-bound cancer risk of one in 100,000. Most of the unit risk estimates are based on animal studies. If a person was exposed to the AAL for a lifetime, his/her risk of cancer could be as high as one in 100,000. Alternatively, if 100,000 people were exposed for a lifetime to the AAL, up to one cancer case would be expected. Unit risk estimates are usually based on the results of two year animal bioassays. The results of the bioassay are adjusted mathematically to extrapolate from a high level of exposure to a low level, and to scale from animals to humans. Certain Table C chemicals are persistent carcingogens that can accumulate through the food chain (e.g. dioxin). Where possible, AALs for these chemicals will be calculated based upon all possible pathways of exposure.

Two chemicals in Table C (lead and mercury) have serious non-cancer health effects, are persistent in the environment, and have complicated exposure pathways. AALs for these chemicals will be calculated based upon detailed literature reviews.

APPENDIX 1

Action Levels (ALs) derived in Appendix 1 are based on occupational exposure limits set by the American Conference of Governmental Industrial Hygienists (ACGIH). ACGIH is a non-governmental professional association that reviews toxicology and workplace chemical exposure literature, and uses this information to set workplace exposure limits. The ACGIH Threshold Limit Value-Time Weighted Average (TLV-TWA) is a concentration that ACGIH believes most workers can be exposed to over an eight hour shift without serious adverse effects.

Because TLV-TWAs are developed for healthy workers and take into account other subjective factors, they are of limited use in setting exposure limits for the general population. In fact, ACGIH cautions that TLV-TWAs should not be used to set community exposure guidelines.

Within this guide, TLVs are not used to determine AALs as in Tables A, B and C. Instead, they are used to develop Action Levels (ALs). ALs are defined as TLV-TWA/1000. If a predicted ambient pollutant concentration exceeds an AL on a 24-hour average, the pollutant should undergo further review and AAL development. The divisor 1000 was chosen on a policy basis as an appropriate value for screening purposes.

ALs from appendix 1 are used only when no AAL exists on another table for a chemical. Without examining the documentation or primary literature behind each TLV-TWA, it cannot be determined what toxicological effect is addressed by the TLV-TWA. This adds an element of uncertainty to Appendix 1 values which does not exist in the other tables and therefore makes their use less desirable. Because of this, ALs from Appendix 1 are used only as screening values to determine the need for additional review.

References:

ACGIH, 1988. Threshold limit values and biological exposure indices for 1988-1989. American Conference of Governmental Industrial Hygienists, Cincinnati.

Nelson, K.W., J.F. Ege Jr., M. Ross, L.E. Woodman and L. Silverman, 1943. Sensory response to certain industrial solvent vapors. J. Industrial Hygiene, 25: 282-285.

U.S. EPA, 1989. Health effects assessment summary tables; first quarter FY89. Office of Research and Development, Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati.