# Technical Guidelines
# for Air Management Regulation VI

**By**

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**Department of Public Health**
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## I. Toxic Air Contaminants and Reporting Thresholds

Toxic air contaminants, also known as air toxics, are man-made or natural pollutants that when emitted into the air may have adverse health effects as determined from human and animal exposure studies. Air Management Regulation (AMR) VI, as amended, incorporates a list of two hundred and seventeen (217) air pollutants and pollutant groups that are designed as air toxics by the Air Pollution Control Board pursuant to Phila. Code Sec. 3-201(3). This list incorporates nearly all one hundred eighty seven (187) pollutants that are classified as hazardous air pollutants (HAPs) by U.S. EPA pursuant to Section 112 of the Clean Air Act, and includes additional air pollutants that have been determined to have adverse health effects by Air Management Service (AMS), taking into consideration the hazardous air pollutants listed by the New Jersey Department of Environmental Protection.

As per AMR VI Sec. III.C.(2), AMS is required to establish a reporting threshold for each of the designated air toxics. The reporting threshold is the annual emission rate level (tons per year or pounds per year), that when exceeded, a health risk analysis is necessary. The reporting thresholds for all the designated air toxics are provided in Table 1 below. The *Health Risk Assessment Technical Support Document for Air Management Regulation VI Amendment* describes how these reporting thresholds were established.

**Table 1. List of Toxic Air Contaminants (Air Toxics) and Reporting Thresholds**

| No. | CAS Number | Toxic Air Contaminant / HAP | Reporting Threshold (pounds/year) |
|---|---|---|---|
| 1 | 75070 | Acetaldehyde | 24 |
| 2 | 60355 | Acetamide | 2.7 |
| 3 | 75058 | Acetonitrile | 2000 |
| 4 | 98862 | Acetophenone | 1 |
| 5 | 53963 | 2-Acetylaminofluorene | 0.04 |
| 6 | 107028 | Acrolein | 1 |
| 7 | 79061 | Acrylamide | 0.5 |
| 8 | 79107 | Acrylic acid | 53 |
| 9 | 107131 | Acrylonitrile | 1 |
| 10 | 107051 | Allyl chloride | 9 |
| 11 | 92671 | 4-Aminobiphenyl | 0.01 |
| 12 | 62533 | Aniline | 33 |
| 13 | 90040 | o-Anisidine | 1.3 |
| 14 | 140578 | Aramite | 7.5 |
| 15 | 1332214 | Asbestos (1) | 0.007 |
| 16 | 71432 | Benzene | 7 |
| 17 | 92875 | Benzidine (4,4'-Biphenyldiamine) | 0.001 |

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|---|---|---|---|
| 18 | 98077 | Benzotrichloride | 0.015 |
| 19 | 100447 | Benzyl chloride (Chloromethylbenzene) | 1 |
| 20 | 92524 | Biphenyl | 21 |
| 21 | 117817 | Bis(2-ethylhexyl) phthalate (DEHP) | 22 |
| 22 | 542881 | Bis(chloromethyl)ether | 0.001 |
| 23 | 75252 | Bromoform | 48 |
| 24 | 106945 | 1-Bromopropane | 2000 |
| 25 | 106990 | 1,3-Butadiene | 1.8 |
| 26 | 156627 | Calcium cyanamide | 2000 |
| 27 | 133062 | Captan | 80 |
| 28 | 63252 | Carbaryl | 2000 |
| 29 | 75150 | Carbon disulfide | 2000 |
| 30 | 56235 | Carbon tetrachloride (Tetrachloromethane) | 9 |
| 31 | 463581 | Carbonyl sulfide | 530 |
| 32 | 120809 | Catechol | 1000 |
| 33 | 133904 | Chloramben | 200 |
| 34 | 57749 | Chlordane | 0.5 |
| 35 | 7782505 | Chlorine | 10 |
| 36 | 79118 | Chloroacetic acid | 20 |
| 37 | 532274 | 2-Chloroacetophenone | 1.6 |
| 38 | 108907 | Chlorobenzene | 2000 |
| 39 | 510156 | Chlorobenzilate (Ethyl-4,4'-dichlorobenzilate) | 1.7 |
| 40 | 67663 | Chloroform (Trichloromethane) | 2.3 |
| 41 | 107302 | Chloromethyl methyl ether (CMME) | 0.08 |
| 42 | 126998 | Chloroprene (2-Chloro-1,3-butadiene) | 0.12 |
| 43 | | Cresols (Cresylic acid, Cresol mixers) | 2000 |
| 44 | 95487 | o-Cresol | 2000 |
| 45 | 108394 | m-Cresol | 2000 |
| 46 | 106445 | p-Cresol | 2000 |
| 47 | 98828 | Cumene | 2000 |
| 48 | 72559 | DDE (Dichlorodiphenyldichloroethylene) | 0.5 |
| 49 | 50293 | DDT/DDD | 0.5 |
| 50 | 334883 | Diazomethane | 200 |
| 51 | 132649 | Dibenzofurans | 1000 |

| | | | |
|---|---|---|---|
| 52 | 96128 | 1,2-Dibromo-3-chloropropane | 0.03 |
| 53 | 84742 | Dibutylphthalate | 2000 |
| 54 | 106467 | 1,4-Dichlorobenzene | 4.8 |
| 55 | 91941 | 3,3-Dichlorobenzidine | 0.16 |
| 56 | 111444 | Dichloroethyl ether (Bis(2-chloroethyl) ether) | 0.16 |
| 57 | 542756 | 1,3-Dichloropropene | 13 |
| 58 | 62737 | Dichlorvos | 0.6 |
| 59 | 60571 | Dieldrin | 0.012 |
| 60 | 111422 | Diethanolamine | 160 |
| 61 | 121697 | N,N-Dimethylaniline | 200 |
| 62 | 64675 | Diethyl sulfate | 200 |
| 63 | 119904 | 3,3-Dimethoxybenzidine | 20 |
| 64 | 60117 | 4-Dimethyl aminoazobenzene | 0.04 |
| 65 | 119937 | 3,3′-Dimethyl benzidine (o-Tolidine) | 2 |
| 66 | 79447 | Dimethyl carbamoyl chloride | 0.014 |
| 67 | 68122 | Dimethyl formamide | 1600 |
| 68 | 57147 | 1,1-Dimethyl hydrazine (Asymmetric dimethyl hydrazine) | 0.1 |
| 69 | 131113 | Dimethyl phthalate | 2000 |
| 70 | 77781 | Dimethyl sulfate | 0.013 |
| 71 | 534521 | 4,6-Dinitro-o-cresol | 20 |
| 72 | 51285 | 2,4-Dinitrophenol | 200 |
| 73 | 121142 | 2,4-Dinitrotoluene | 0.6 |
| 74 | 123911 | 1,4-Dioxane (1,4-Diethyleneoxide) | 11 |
| 75 | 122667 | 1,2-Diphenylhydrazine | 0.25 |
| 76 | 106898 | Epichlorohydrin (1-Chloro-2,3-epoxypropane) | 44 |
| 77 | 106887 | 1,2-Epoxybutane | 1060 |
| 78 | 140885 | Ethyl acrylate | 425 |
| 79 | 100414 | Ethyl benzene | 21 |
| 80 | 51796 | Ethyl carbamate (Urethane) | 0.18 |
| 81 | 75003 | Ethyl chloride (Chloroethane) | 2000 |
| 82 | 106934 | Ethylene dibromide (1,2-Dibromoethane) | 0.09 |
| 83 | 107062 | Ethylene dichloride (1,2-Dichloroethane) | 2 |
| 84 | 107211 | Ethylene glycol | 2000 |

| | | | |
|---|---|---|---|
| 85 | 151564 | Ethylene imine (Aziridine) | 0.003 |
| 86 | 75218 | Ethylene oxide | 0.01 |
| 87 | 96457 | Ethylene thiourea (1,3-Ethylene-2-thiourea) | 4 |
| 88 | 75343 | Ethylidene dichloride (1,1-Dichloroethane) | 33 |
| 89 | 50000 | Formaldehyde | 4 |
| 90 | 76448 | Heptachlor | 0.04 |
| 91 | 118741 | Hexachlorobenzene | 0.12 |
| 92 | 87683 | Hexachlorobutadiene (Hexachloro-1,3-butadiene) | 2.4 |
| 93 | 608731 | Hexachlorocyclohexane [technical grade] | 0.1 |
| 94 | 58899 | *gamma*-Hexachlorocyclohexane (Lindane) | 0.17 |
| 95 | 77474 | Hexachlorocyclopentadiene | 11 |
| 96 | 67721 | Hexachloroethane | 4.8 |
| 97 | 822060 | Hexamethylene-1,6-diisocyanate | 0.5 |
| 98 | 680319 | Hexamethylphosphoramide | 2 |
| 99 | 110543 | Hexane | 2000 |
| 100 | 302012 | Hydrazine (Diamine) | 0.01 |
| 101 | 7647010 | Hydrogen chloride (Hydrochloric acid) | 1060 |
| 102 | 7664393 | Hydrogen fluoride (Hydrofluoric acid) | 200 |
| 103 | 123319 | Hydroquinone | 200 |
| 104 | 78591 | Isophorone | 2000 |
| 105 | 108316 | Maleic anhydride | 37 |
| 106 | 67561 | Methanol | 2000 |
| 107 | 72435 | Methoxychlor | 2000 |
| 108 | 74839 | Methyl bromide (Bromomethane) | 265 |
| 109 | 74873 | Methyl chloride (Chloromethane) | 29 |
| 110 | 71556 | Methyl chloroform (1,1,1-Trichloroethane) | 2000 |
| 111 | 60344 | Methyl hydrazine | 0.05 |
| 112 | 74884 | Methyl iodide (Iodomethane) | 200 |
| 113 | 108101 | Methyl isobutyl ketone (MIBK; Hexone) | 2000 |
| 114 | 624839 | Methyl isocyanate | 53 |
| 115 | 80626 | Methyl methacrylate | 2000 |
| 116 | 1634044 | Methyl tert butyl ether (MTBE) | 200 |

| | | | |
|---|---|---|---|
| 117 | 101144 | 4,4-Methylene bis(2-chloraniline) | 0.12 |
| 118 | 75092 | Methylene chloride (Dichloromethane) | 2000 |
| 119 | 101779 | 4,4'-Methylene dianiline | 0.12 |
| 120 | 101688 | 4,4-Methylene diphenyl diisocyanate (MDI) | 4.5 |
| 121 | 91203 | Naphthalene | 1.6 |
| 122 | 98953 | Nitrobenzene | 1.3 |
| 123 | 92933 | 4-Nitrobiphenyl | 200 |
| 124 | 100027 | 4-Nitrophenol | 1000 |
| 125 | 79469 | 2-Nitropropane | 0.02 |
| 126 | 55185 | N-Nitrosodiethylamine | 0.001 |
| 127 | 62759 | N-Nitrosodimethylamine | 0.004 |
| 128 | 59892 | N-Nitrosomorpholine | 0.03 |
| 129 | 684935 | N-Nitroso-N-methylurea | 0.002 |
| 130 | 56382 | Parathion | 20 |
| 131 | 82688 | Pentachloronitrobenzene (Quintobenzene) | 60 |
| 132 | 87865 | Pentachlorophenol | 10 |
| 133 | 108952 | Phenol | 2000 |
| 134 | 106503 | p-Phenylenediamine | 2000 |
| 135 | 75445 | Phosgene | 16 |
| 136 | 7803512 | Phosphine | 16 |
| 137 | 7723140 | Phosphorus | 3.7 |
| 138 | 85449 | Phthalic anhydride | 1060 |
| 139 | 1336363 | Polychlorinated biphenyls (PCBs; Aroclors) | 0.5 |
| 140 | 1120714 | 1,3-Propane sultone (3-Hydroxyl-1-propane sulfonic acid sulfone) | 0.08 |
| 141 | 57578 | *beta*-Propiolactone (3-Hydroxypropanoic acid lactone) | 0.01 |
| 142 | 123386 | Propionaldehyde | 425 |
| 143 | 114261 | Propoxur (Baygon) | 2000 |
| 144 | 78875 | Propylene dichloride (1,2-Dichloropropane) | 5.3 |
| 145 | 75569 | Propylene oxide (1,2-Epoxypropane) | 14 |
| 146 | 75558 | 1,2-Propylenimine (2-Methyl aziridine) | 0.6 |
| 147 | 91225 | Quinoline | 0.05 |

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|---|---|---|---|
| 148 | 106514 | Quinone | 1000 |
| 149 | 100425 | Styrene | 93 |
| 150 | 96093 | Styrene oxide | 1.2 |
| 151 | 2699798 | Sulfuryl fluoride | 2000 |
| 152 | 1746016 | 2,3,7,8-Tetrachlorodibenzo(p)dioxin (2,3,7,8-TCDD; Dioxin) | 0.0000014 |
| 153 | 79345 | 1,1,2,2-Tetrachloroethane | 0.9 |
| 154 | 127184 | Tetrachloroethylene (Perchloroethylene) | 9 |
| 155 | 7550450 | Titanium tetrachloride | 5.3 |
| 156 | 108883 | Toluene | 2000 |
| 157 | 95807 | 2,4-Toluene diamine (2,4-Diaminotoluene) | 0.05 |
| 158 | 584849 | 2,4-Toluene diisocyanate | 3.7 |
| 159 | 95534 | o-Toluidine | 1 |
| 160 | 8001352 | Toxaphene | 0.17 |
| 161 | 120821 | 1,2,4-Trichlorobenzene | 106 |
| 162 | 79005 | 1,1,2-Trichloroethane | 3.3 |
| 163 | 79016 | Trichloroethylene | 10 |
| 164 | 95954 | 2,4,5-Trichlorophenol | 200 |
| 165 | 88062 | 2,4,6-Trichlorophenol | 17 |
| 166 | 121448 | Triethylamine | 370 |
| 167 | 1582098 | Trifluralin | 24 |
| 168 | 540841 | 2,2,4-Trimethylpentane | 1000 |
| 169 | 108054 | Vinyl acetate | 2000 |
| 170 | 593602 | Vinyl bromide (Bromoethene) | 1.7 |
| 171 | 75014 | Vinyl chloride | 6 |
| 172 | 75354 | Vinylidene chloride (1,1-Dichloroethylene) | 2000 |
| 173 | | Xylenes (mixed isomers) | 2000 |
| 174 | 95476 | o-Xylenes | 2000 |
| 175 | 108380 | m-Xylenes | 2000 |
| 176 | 106423 | p-Xylenes | 2000 |
| *Chemical Compound Groups* | | | |
| 177 | | Antimony compounds (2) | 1000 |
| 178 | 7783702 | Antimony pentafluoride | 20 |
| 179 | 1309644 | Antimony trioxide | 11 |
| 180 | 1345046 | Antimony trisulfide | 20 |

| | | | |
|---|---|---|---|
| 181 | | Arsenic compounds (2) | 0.01 |
| 182 | 7784421 | Arsine | 0.01 |
| 183 | | Beryllium compounds (2) | 0.02 |
| 184 | | Cadmium compounds (2) | 0.01 |
| 185 | 130618 | Cadmium oxide | 0.01 |
| 186 | | Chromium VI (Total) (2) | 0.0045 |
| 187 | 744084 | Cobalt metal and compounds (2) | 0.006 |
| 188 | 10210681 | Cobalt carbonyl | 0.006 |
| 189 | 62207765 | Fluomine | 0.006 |
| 190 | | Coke oven emissions (2) | 0.09 |
| 191 | | Cyanide compounds (including Hydrogen cyanide) (2) | 42 |
| 192 | 94757 | 2,4-D, salts and esters (2) | 2000 |
| 193 | | Glycol ethers (2) | 2000 |
| 194 | 111762 | Ethylene glycol monobutyl ether (2-Butoxyethanol; EGBE) | 2000 |
| 195 | 110805 | Ethylene glycol monoethyl ether (2-Ethoxy ethanol) | 1800 |
| 196 | 111159 | Ethylene glycol monoethyl ether acetate | 685 |
| 197 | 109864 | Ethylene glycol monomethyl ether (2-Methoxy ethanol) | 455 |
| 198 | | Lead and compounds (2) | 2 |
| 199 | 78002 | Tetraethyl lead | 2 |
| 200 | 7439965 | Manganese and compounds (2) | 0.8 |
| 201 | 12108133 | Methylcyclopentadienyl manganese | 0.8 |
| 202 | | Mercury compounds (2) | 2 |
| 203 | 7439976 | Mercury (inorganic) | 1.6 |
| 204 | | Nickel compounds (2) | 0.2 |
| 205 | 13463393 | Nickel carbonyl | 0.2 |
| 206 | 1313991 | Nickel oxide | 0.2 |
| 207 | | Polycyclic organic matter (POM) & Polycyclic aromatic hydrocarbons (PAHs) (2) | 2 |
| 208 | 56553 | Benz(a)anthracene | 0.4 |
| 209 | 225514 | BenzIacridine | 2 |
| 210 | 50328 | Benzo(a)pyrene (3,4-benzopyrene) | 0.05 |
| 211 | 205992 | Benzo(b)fluoranthene | 0.4 |
| 212 | | Selenium compounds (2) | 1060 |

| | | | |
|---|---|---|---|
| 213 | 7783075 | Hydrogen selenide | 25 |
| 214 | 7488564 | Selenium sulfide (mono- and di-) | 20 |
| 215 | 13410010 | Sodium selenate | 20 |
| 216 | 10102188 | Sodium selenite | 20 |
| 217 | | Total dioxin and furans (3) | 0.00012 |

(1) Also see Philadelphia Department of Public Health Asbestos Control Regulation.

(2) Indicating a chemical compound group; some compounds or subgroups included in this group may also be individually named in this table.

(3) As defined in Interim Procedures for Estimating Risks Associated with Exposure to Mixtures of Chlorinated-p- Dioxins and Dibenzofurans (CDDs and CDFs), March 1989 update, EPA-625/3-89/016, available from www.epa.gov/nscep; https://archive.epa.gov/raf/web/html/cdd-cdf.html

## II. Overview – Toxic Air Contaminants Health Risk Assessment

A health risk assessment is a scientific process used to estimate the probability of adverse health effects resulting from human exposure to hazardous substance. AMS utilizes health risk assessments to evaluate any remaining health risk, known as residual health risk, posed by air toxic emissions from certain air pollution sources that have otherwise implemented emission controls, work practices, and other requirements specified by applicable City, Commonwealth, and Federal authorities.

As per AMR VI. Secs. II, III, a health risk assessment may be required along with any Installation Permit application[1] or Plan Approval application for the construction / modification of air pollution sources where the emission of air toxics will exceed specified reporting thresholds. A facility wide health risk assessment is also required for any Title V operating permit application (initial) received on and after January 1, 2022 if the facility-wide potential emission of at least one toxic air contaminate is above the reporting threshold. See AMR VI. Secs. II, III.

Instructions on how to perform the required health risk assessment; calculate the cancer risks and non-cancer health quotients; and interpret the results of the assessments are provided in Section III of the Guidelines below, and in Appendix A. Sources that must submit an air toxics notice pursuant to AMR VI. Sec. II. but are otherwise exempt from a health risk assessment are listed in Appendix B of these Guidelines. This list consists of sources for which AMS has performed a general health risk assessment and determined that a risk assessment for these sources is not required. Appendix C contains a glossary of the various terms used in these Guidelines.

[1] Note: As per AMR VI. Sec. II.C., no air toxics notice, and health risk assessment, is required for the following Installation Permits Applications - Complex Source Permits, Mechanical Ventilation System for Automotive Facilities Permits, and Dust Control Permits.

## III. Health Risk Assessment

### A. Risk Screening

An initial risk screening analysis must be performed for any new or modified air pollution source that will emit air toxics in excess of the reporting thresholds provided in Table I in Section I. This risk screening analysis can be performed either by using: 1) AMS's Risk Screening Workbook or via 2) running the EPA air quality screening model, AERSCREEN, for the source.

**Note: Risk screening is required for new or modified sources where an applicant seeks Installation Permits or Plan Approvals from AMS. Applicants seeking an initial Title V permit should proceed to Section III.D.**

### A.1. Risk Screening – Using the Risk Screening Workbook

The Risk Screening Workbook is a Microsoft Excel workbook that calculates the worst-case cancer and non-cancer health quotients from a source's air toxics emissions, based on applicant inputted data. The Risk Screening Workbook incorporates assumptions, derived from air quality dispersion modeling and dose response factors, to produce conservative risk assessment estimates for a particular emission point. It is, therefore, an easy-to-use tool that simplifies the risk assessment screening process for the permit applicants. **The risk screening workbook may only be used for air pollution sources that emit air toxics through exhaust stacks that are > 15 ft in height.** A screening, air quality dispersion model must be performed for all other sources as provided in Section III.A.2.

The Risk Screening Workbook consists of three separate worksheets, as indicated by the tabs at the bottom of the workbook. The first worksheet contains instructions. The second worksheet, called the risk worksheet, handles the risk screening data input and calculations. The third worksheet, called the CAS Index, contains a numerical listing of all the Chemical Abstracts Service (CAS) numbers for the designated air toxics. The CAS Index worksheet also contains synonyms for certain air toxics. The applicant must complete a Risk Screening Workbook for each exhaust stack or emissions point to be included in the newly constructed or modified air pollution source.

For a particular exhaust stack or emission point, the applicants must enter the stack height (ft), the distance from the stack to the closest facility property line (ft), the chemical-specific annual emission rate Q (tons/year) and the chemical-specific maximum short-term emission rate $Q_h$ (lbs/hr) in the risk worksheet. All source-specific information entered by the applicant must be consistent with the information provided in the attendant Installation Permit, Plan Approval, or Title V permit application. Screening results will be calculated automatically and displayed in the risk worksheet.

The screening results provided for each exhaust stack or emission point will indicate whether any further risk assessment will be required. If the screening results for any air toxic emitted by a particular stack is "Negl" (Negligible), no further evaluation is needed.[2] If the screening result shows "FER," further evaluation in the form of a refined risk assessment as described in Section III.B. below is required.

### A.2. Risk Screening – Air Quality Modeling (AERSCREEN)

In the event where the Risk Screening Workbook cannot be used, the required risk screening must be performed via AERSCREEN air quality dispersion modeling. The latest AERSCREEN modeling program, and attendant instructions for running the modeling program can be found on U.S. EPA's website:

https://www.epa.gov/scram/air-quality-dispersion-modeling-screening-models

Applicants must use AERSCREEN to estimate the worst-case, ambient air concentrations of air toxics that will be emitted from the source, and then calculate the attendant cancer risk and non-cancer hazard quotients. All source-specific information entered by the applicant to perform this analysis consistent with the information provided in the attendant Installation Permit or Plan Approval application. Formulas for the cancer health risk and non-cancer hazard quotients calculation are provided in Appendix A, Step 4, Equations 1, 2 and 3. Unit Risk Factor **(**URF) and Reference Concentration (RfC) values needed to perform these calculations are found in the Risk Screening Workbook, risk worksheet.

**Note: In the event that an air toxic has both long-term and short-term non-cancer RfCs listed in the risk worksheet, then** –

1) An annual pollutant emission rate should be used to model the maximum annual (long-term) ambient concentration, and calculate the long-term hazard quotient using the long-term RfC; and
2) A short-term, hourly pollutant emission rate should be used to model the maximum short-term ambient concentration and calculate the short-term hazard quotient using the short-term RfC.

If the cancer risk for each air toxic emitted from the source is $\leq$ 1 in a million ($1 \times 10^{-6}$) AND the applicable non-cancer hazard quotient $\leq$ 1, the health risk for the source is considered negligible and no further evaluation is necessary. In the event that cancer risks for any air toxic emitted is > 1 in a million ($1 \times 10^{-6}$) AND / OR the applicable non-cancer hazard quotient is > 1, then a refined risk assessment must be performed as specified in Section B of these Guidelines.

### B. Refined Risk Assessment

[2] A "Negl" result means the cancer risk from the emission of an air toxic from a particular stack or emission point is $\leq$ 1 in a million ($1 \times 10^{-6}$) and the non-cancer hazard quotient is $\leq$ 1.

**Note: Refined Risk Assessment is required for new or modified sources where an applicant seeks Installation Permits or Plan Approvals from AMS. Applicants seeking an initial Title V permit should proceed to Section III.D.**

The refined risk assessment consists of a refined atmospheric dispersion modeling analysis for air pollution sources that estimates ambient air concentrations of emitted air toxics more accurately than the methods described in Section III.A. This analysis relies on using stack- and source-specific data as well as representative meteorological data, as input into U.S. EPA's AERMOD air quality dispersion model. All source-specific information for this analysis must be consistent with the information provided in the attendant Installation Permit or Plan Approval application.

The refined risk assessment process evaluates cancer risk, as well as short- and long-term non-carcinogenic risks and must be calculated in accordance with Appendix A for each air toxic emitted from a source. These health risks must be determined:

1) at the modeling receptor with the highest predicted air concentration based on 5 years' meteorological data (AERMOD modeling); and
2) at sensitive or vulnerable receptors (such as nearest residence, daycare centers, hospitals, nursing homes, playgrounds, etc.) located within the defined modeling grid.

All applicants must submit an atmospheric dispersion modeling protocol in accordance with procedures outlined by U.S. EPA for AERMOD air quality dispersion modeling. Program files and instructions for performing AERMOD modeling can be found on U.S. EPA's website:
https://www.epa.gov/scram/air-quality-dispersion-modeling

Note: Other air quality dispersion models or use of source-specific ambient air monitoring / fenceline monitoring data, may only be used in the refined risk assessment evaluation if first approved by AMS.

## C. Risk Management Guidelines – New and Modified Sources (Installation Permits / Plan Approvals)

AMS's risk management guidelines for individual new or modified sources, pursuant to AMR VI, are summarized below in Tables 2 and 3.

**Table 2. Cancer Risk Guidelines for New or Modified Sources**

| Risk Level | Outcome |
|---|---|
| Risk ≤ 1 in a million ($1x10^{-6}$) | Negligible risk. |
| 1 in a million < Risk < 100 in a million | Case-by-case review (See Section IV). |
| Risk ≥ 100 in a million ($1x10^{-4}$) | Unacceptable risk; source poses an undue health hazard |

**Table 3. Long-and Short-Term Non-Cancer Hazard Quotient Guidelines for New or Modified Sources**

| Risk Level | Outcome |
|---|---|
| Hazard Quotient ≤ 1 | Negligible risk. |
| Hazard Quotient > 1 | Risk Mitigation Plan required (See Section IV). |

If all cancer risk and non-cancer hazard quotients calculated for all the air toxics emitted are deemed "negligible" pursuant to Tables 2 and 3, no further action is required. See Appendix A, Step 4 for rounding of the hazard quotient value.

Figure 1 illustrates the workflow of health risk assessment for individual sources in Installation Permit and Plan Approval applications.

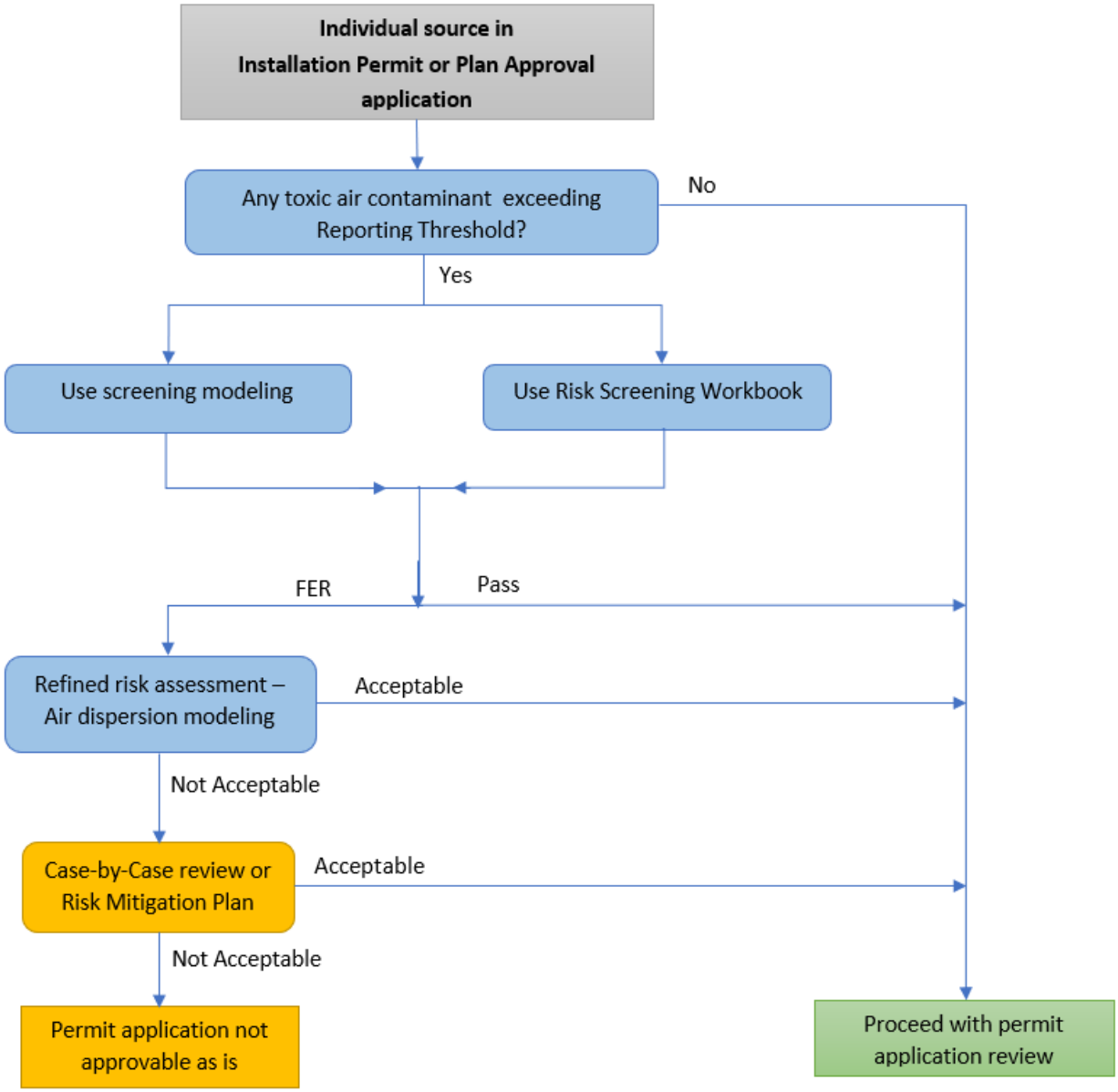


**Figure 1. Workflow of air toxics health risk assessment for individual sources in Installation Permit and Plan Approval applications**

## D. Title V Facility-Wide Risk Assessment

A facility-wide heath risk assessment is required for all air toxics emitted from all air pollution sources operated as part of a Title V facility. This analysis must be performed anytime an applicant seeks an initial Title V permit for a facility where air toxics will be emitted in excess of the reporting thresholds.

Applicants performing a facility-wide risk assessment must submit an atmospheric dispersion modeling protocol to AMS that is in accordance with procedures outlined in the U.S. EPA's air quality dispersion modeling guidelines available at https://www.epa.gov/scram/air-quality-dispersion-modeling. This modeling protocol must estimate the impact of each toxic air contaminant that will be emitted from all stacks / emission points within the facility in accordance with the cancer risk and non-cancer hazard quotient methodology provided in Appendix A to these Guidelines.

All source-specific information entered by the applicant to perform the facility-wide health risk assessment must be consistent with the information provided in the attendant Title V permit application. Applicants may opt to use Risk Screening Workbook discussed in Section III.A.1 when applicable, as a preliminary tool to conduct screening for facility-wide risk assessment of air toxic emissions.

**Note: The atmospheric dispersion modeling protocol required by this section must be approved by AMS before the facility-wide health risk assessment is performed.**

### D.1. Title V Facility-Wide Risk Assessment Guidelines

AMS's risk management guidelines for Title V facilities are summarized below in Tables 4 and 5.

**Table 4. Title V Facility-Wide Cancer Risk Guidelines**

| Risk Level | Outcome |
|---|---|
| Risk ≤ 10 in a million ($1x10^{-5}$) | Negligible risk. |
| 10 in a million < Risk < 100 in a million | Risk Mitigation Plan required (see Section IV). |
| Risk ≥ 100 in a million ($1x10^{-4}$) | Unacceptable risk; facility poses an undue health hazard |

**Table 5. Title V Facility-Wide Long- and Short-Term Non-Cancer Risk Guidelines**

| Risk Level | Outcome |
|---|---|
| Hazard Quotient ≤ 1 | Negligible risk. |

| | |
|---|---|
| Hazard Quotient > 1 | Risk Mitigation Plan required (see Section IV). |

If all cancer risk and non-cancer hazard quotients calculated for all the air toxics emitted are deemed "negligible" pursuant to Tables 4 and 5, no further action is required. Figure 2 illustrates the workflow of facility wide risk assessment. See Appendix A, Step 4 for rounding of the hazard quotient value.

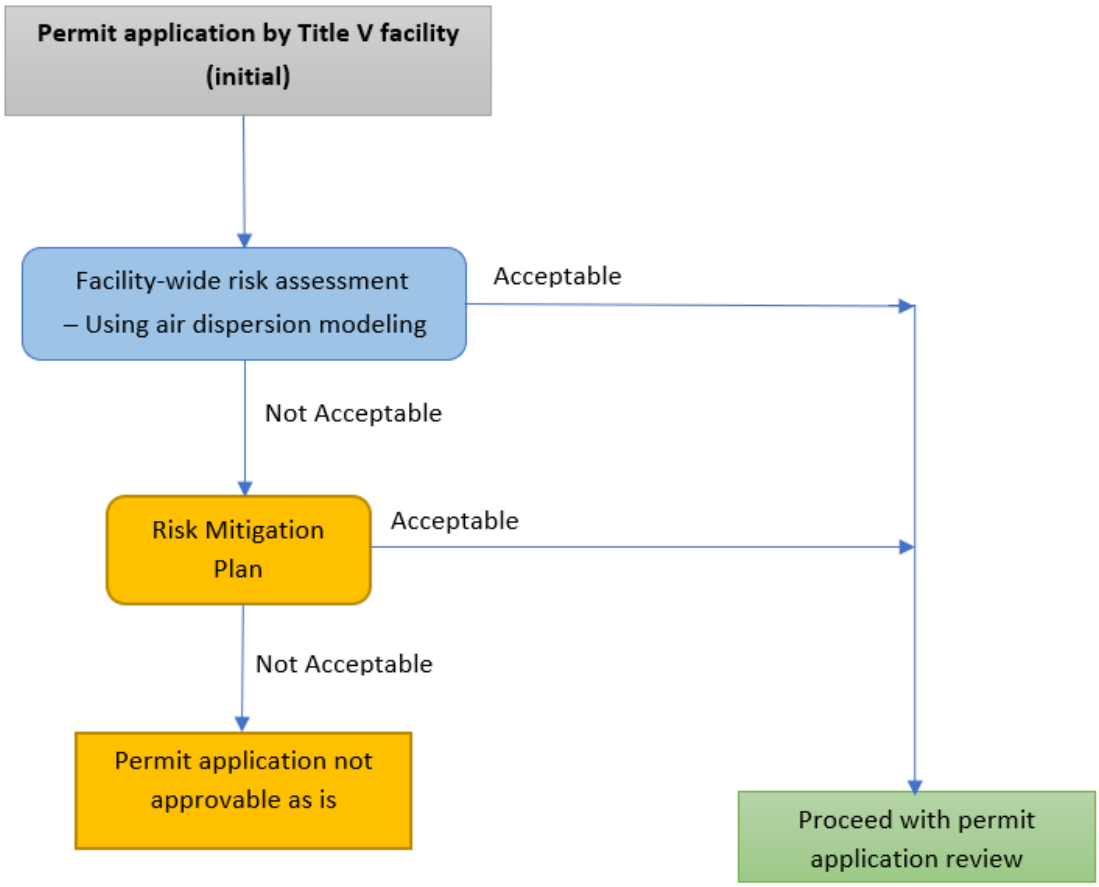


**Figure 2. Workflow of facility-wide air toxics health risk assessment for Title V permit applications**

## IV. Risk Mitigation Plan

In the event that Risk Mitigation Plan is called for, the applicant must develop a plan that documents and describes how the health risks posed by air toxics emissions from a new / modified air pollution source, or Title V facility, will be minimized and managed. This Risk Mitigation Plan must account for locations where the modeled, maximum air toxic(s) concentration occur as demonstrated by the refined risk assessment / Title V facility-wide risk assessment, and the overall impact of such emissions on the sensitive receptor population. The Risk Mitigation Plan must also account for the uncertainties associated with the health risk assessment procedures; applicant's / operator's compliance history if any; and include a cost benefit analysis of any adopted health risk mitigation measures. Such risk mitigation measures can include, but are not limited to –

- Adoption of additional air pollution controls to lower air toxic emissions that are not otherwise required by other air pollution authorities;

- Modifying stack / emission point parameters to increase dispersion (for example, increase the stack height); and / or

- Adoption of changes in operation in a manner to eliminate the inhalation pathway for sensitive receptors

If approved by AMS, the Risk Mitigation Plan will be incorporated into the respective Installation Permit, Plan Approval, or Title V permit. Failure to develop an acceptable Risk Mitigation Plan will result in the denial of the respective Installation Permit, Plan Approval, or Title V permit.

# APPENDIX A

# THE RISK ASSESSMENT PROCESS

In 1986, the U.S. EPA established risk assessment guidelines in order to provide consistency and technical support between U.S. EPA and other regulatory agencies. The guidelines were based on recommendations from the National Research Council (NRC 1983). NRC divided the risk assessment process into four steps, which are described below.

**Step 1 - Hazard Identification**

Hazard identification is the process used to determine the potential human health effects from exposure to an air toxic. This is based on information provided by the scientific literature. For air toxics sources, hazard identification involves identifying whether a hazard exists, and if so, identifying the exact pollutants of concern. Hazard identification takes into consideration whether a pollutant is a potential human carcinogen or is associated with other types of adverse health effects. For hazard identification in relation to an air permit, the following are considered:

A. Which contaminants will be emitted from the source;
B. Which of these contaminants have known health effects; and
C. The specific toxicological effects of these air toxics.

**Step 2 - Dose-Response Assessment**

Dose-response assessment is the characterization of the relationship between a chemical (air toxic) exposure, or dose, and the incidence and severity of an adverse health effect. It takes into consideration factors that influence this relationship, including intensity and pattern of exposure, and age and lifestyle variables that may affect susceptibility. It may also involve extrapolation from high-dose to low-dose responses, and from animal to human responses. This information is gathered from epidemiological or laboratory studies done by federal or state agencies, health organizations, academic institutions, and others.

Dose-response assessment as utilized in the air permitting process involves the quantification (in terms of severity or likelihood) of toxicological effects of individual chemicals on humans. The dose-response relationship is evaluated differently for carcinogenic (cancer-causing) and non-carcinogenic substances.

For carcinogens, it is assumed that there is a linear relationship between an increase in dose or exposure concentration and an increase in cancer risk. This is expressed as a **potency slope** or **slope factor** (SF), in units “per milligram (of chemical) per kilogram (of body weight) per day” or (/mg/kg/day).

To evaluate health risks from inhalation of carcinogenic substances, U.S. EPA and other

regulatory agencies use potency slopes to develop **unit risk factors** (URFs). A URF can be defined as the upper-bound excess probability of contracting cancer as the result of a lifetime of exposure to a carcinogen at a concentration of 1 $\mu g/m^3$ in air. URF units are "per microgram (of chemical) per cubic meter (of air)" or $(\mu g/m^3)^{-1}$.

For inhalation effects from non-carcinogens, dose-response data are used to develop **reference concentrations** (RfCs), for both long-term (chronic) and short-term exposures. Unlike carcinogens, non-carcinogens are assumed to have thresholds for adverse effects, meaning that injury does not occur until exposure has reached or exceeded some concentration (a threshold). An RfC is derived from a no-observed adverse effect level (NOAEL) or lowest-observed adverse effect level (LOAEL) determined through human or animal exposure studies. Since actual thresholds for the general population cannot be precisely determined, uncertainty or safety factors are applied to the NOAEL or LOAEL. This assures that the RfC is set at a level that is expected to be protective of sensitive populations (the elderly, infirm, or very young). Short-term RfCs are developed to prevent health effects from exposure periods of 24 hours or less. RfCs are expressed in units of $\mu g/m^3$ (Note: California's air program refers to these values as "Reference Exposure Levels (RELs)," while U.S. EPA uses the term RfC.).

To establish URFs, RfCs, and SFs, toxicological studies are evaluated by groups assigned for this purpose within U.S. EPA and other agencies. These risk values are then usually peer-reviewed and gathered into databases. U.S. EPA maintains the Integrated Risk Information System (IRIS), which is available on-line at http://www.epa.gov/iris. Another primary source of risk data is the California Office of Environmental Health Hazard Assessment (OEHHA). Their data is available on-line at http://www.oehha.ca.gov/.

### Step 3 - Exposure Assessment

The exposure assessment step determines the extent (intensity, frequency, and duration, or dose) of human exposure to a chemical in the environment. There are three components to the exposure assessment:

A. Estimation of the maximum quantity of each pollutant emitted from the source of concern (based on data from previously existing sources or engineering estimates);

B. For each contaminant emitted from a source, estimation of the resulting maximum annual average and (where applicable) maximum short-term average ambient air concentrations, using dispersion models, or air impact values based on dispersion models; and

C. Estimation of the amount of contaminant taken in by a human receptor.

### Step 4 - Risk Characterization

Risk characterization is the final step in risk assessment. At this step, human health risk is calculated and described based on the information gathered in the first three steps. The risk characterization also includes some consideration of uncertainty, scientific judgment, and the major assumptions that were made, especially regarding exposure.

Human health risk estimates for inhalation of a carcinogen are based on the following calculation:

**Cancer Risk = C x URF** - Equation 1

where:

C = Annual maximum ambient air concentration of the pollutant ($\mu g/m^3$), based on annual emission rate;

URF = pollutant-specific inhalation unit risk factor $(\mu g/m^3)^{-1}$

Human health risk estimates for inhalation of a non-carcinogen are based on the following calculations.

For long-term non-cancer risk:

**Hazard Quotient = C/RfC** - Equation 2

where:

C = Annual maximum ambient air concentration of the pollutant ($\mu g/m^3$), based on annual emission rate;

RfC = Long-term pollutant-specific reference concentration ($\mu g/m^3$).

For short-term non-cancer risk:

**Hazard Quotient $_{(ST)}$ = Cst/RfCst** - Equation 3

where:

$C_{st}$ = Short-term maximum ambient air concentration of the pollutant ($\mu g/m^3$), based on short-term emission rate;

$RfC_{st}$ = Short-term pollutant-specific reference concentration ($\mu g/m^3$).

The averaging time for non-carcinogen concentrations can be long-term (annual) and/or short-term (a specific number of hours), depending on the basis of the reference dose. Both a long-term and a short-term non-cancer hazard quotient should be evaluated for an air toxic if it has both long-term and short-term RfC values established.

The hazard quotient is commonly rounded to one significant figure. The rounding should be done only in the final results, not in the intermediate calculations (see U.S. EPA reference). However, AMS may require that the first decimal place in the value be kept (for example, 1.4) when health risks at sensitive or vulnerable receptors (such as nearest residence, daycare centers, hospitals, nursing homes, playgrounds, etc.) are evaluated.

# APPENDIX B

## TOXIC AIR CONTAMINANT EMISSION SOURCES THAT DO NOT REQUIRE A RISK ANALYSIS

AMS has determined that the potential toxic air contaminant emissions for the following sources are below the threshold levels in Table 1. Applicants seeking an Installation Permit, Plan Approval, or Title V permit for such sources who must submit the notice of air toxic emissions required by AMR VI Sec. II. but need not perform a health risk assessment are listed below:

(i) Gasoline stations with no more than 1,900,000 gallons per year throughput;

(ii) Internal combustion engines with a capacity rating of no more than 2500 horsepower that burn No. 2 oil (including diesel) and can operate no more than 500 hours per year;

(iii) Spray paint booths operated by auto body shops that use no more than 250 gallons per year of coatings and solvent combined that emit less than 21 pounds per year of ethyl benzene.

AMS has performed a health risk analysis in the following sources and determined that risk levels are acceptable. Applicants seeking an Installation Permit, Plan Approval, or Title V permit for such sources who must submit the notice of air toxic emissions required by AMR VI Sec. II. but need not perform a health risk assessment are listed below:

(iv) Boilers and heaters with no more than 50 million BTU per hour capacity, burning No. 2 fuel oil or natural gas, and with an exhaust stack at least 20-foot tall and at least 10 feet away from the facility property line; or

# APPENDIX C

# ACRONYMS & GLOSSARY

**Air Toxics**: Also known as toxic air pollutants. These are chemicals that cause or may cause serious effects in humans and may be emitted into the air in quantities that are large enough to cause adverse health effects. These effects cover a wide range of conditions from lung irritation to birth defects to cancer. Health concerns may be associated with both short and long-term exposures to these pollutants. Many are known to have respiratory, neurological, immune or reproductive effects, particularly for more susceptible sensitive populations such as children.

**Carcinogen**: A chemical for which there is some evidence (either in animals or humans) that it may cause cancer.

**CAS Number:** A unique number used to identify a particular chemical substance, established by the Chemical Abstracts Service of the American Chemical Society.

**Department**: City of Philadelphia Department of Public Health.

**Exposure**: Contact with a substance through inhalation, ingestion, or some other means for a specific period of time.

**Hazardous Air Pollutant (HAP)**: In general, a hazardous air pollutant is an "air toxic." Specifically, this also refers to any of the 187 air toxic pollutants listed in the 1990 federal Clean Air Act amendments.

**Hazard Quotient**: An estimate of the potential for a detrimental non-cancer health effect from exposure to a chemical.

**Non-carcinogen**: A pollutant that can cause adverse health effects other than cancer.

**Reference Concentration (RfC)**: An estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure (expressed as an air pollutant concentration) to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of harmful effects during a lifetime. It can be derived from various types of human or animal data, with uncertainty factors generally applied to reflect limitations of the data used.

**Slope Factor (SF):** An upper-bound, approximating a 95% confidence limit, on the increased cancer risk from a lifetime exposure to an agent. This estimate is usually expressed in units of

proportion (of a population) affected per mg/kg-day.

**Unit Risk Factor (URF)**: The upper-bound excess lifetime cancer risk estimated to result from continuous exposure to a chemical at a concentration of 1 $\mu g/m^3$ in air. For example, if a chemical's URF is $2 \times 10^{-6}$ (per $\mu g/m^3$), then a person exposed daily for a lifetime to 1 µg of the chemical in 1 cubic meter of air would have an increased risk of cancer equal to 2 in a million.

**U.S. EPA**: The United States Environmental Protection Agency.