Support Document for the Development of Generic Numerical Standards and Risk Assessment Procedures

The Voluntary Action Program
Division of Environmental Response & Revitalization
Ohio Environmental Protection Agency

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This document was prepared as supplemental guidance to accompany the administrative rules for the Ohio Environmental Protection Agency's Voluntary Action Program concerning generic numerical standards (Ohio Administrative Code 3745-300-08) and property-specific risk assessment procedures (Ohio Administrative Code 3745-300-09). This guidance is effective upon the adoption of these rules and all other Voluntary Action Program rules filed with the Ohio General Assembly Joint Committee on Agency Rule Review into Section 3745-300 of the Ohio Administrative Code.

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Regularly updated information regarding the Voluntary Action Program is available from the VAP home page: http://www.epa.ohio.gov/derr/volunt/volunt.aspx.

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Part A: Calculation of generic numerical standards

Generic numerical standards are listed in OAC 3745-300-08 Appendix A. For chemicals without generic numerical standards, standards should be derived in accordance with OAC 3745-300-09 and chemical and physical data and toxicity data should be obtained from the hierarchy of sources (p. 31).

All of the following equations have been described elsewhere (1)(2)(3)(4)(5)(6). The equations are reproduced in the current document primarily for convenience; however, in some instances they have been modified to remain consistent with specific rule language.

Please note that the generic numerical standards and their development are often similar to the regional screening levels (RSLs) that are generated and regularly updated by the U.S. EPA (6). In fact, many of the exposure factors and mathematical constructs used by the RSLs were used to generate generic numerical standards. However, unlike the RSLs, the generic numerical standards developed by Ohio EPA are cleanup goals, not screening levels. A volunteer or certified professional should not attempt to derive a property-specific cleanup standard in accordance with OAC 3745-300-09 using the RSLs without consulting this document and Ohio EPA. Risk and hazard goals, climate-specific constants, exposure factors, toxicities, and numerous other parameters are specific to the VAP and are often different from the RSLs.

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(1) U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. EPA/540/1-89/002.
(2) U.S. EPA 2004. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part E). Final. OSWER 9285.7-02.
(3) U.S. EPA 2009. Risk assessment guidance for Superfund Volume 1: Human health evaluation manual (Part E). Final. OSWER 9285.7-82.
(4) U.S. EPA. 1996. Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. Washington, DC. OSWER No. 9355.4-17A.
(5) U.S. EPA 2002. Supplemental guidance for developing soil screening levels for Superfund sites. OSWER 9355.4-24.
(6) U.S. EPA 2013. Regional screening level (RSL) user's guide (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/usersguide.htm accessed May 2013).

1. Calculation of generic numerical direct-contact soil standards

The generic numerical direct-contact soil standards in Tables I, II, and II of OAC 3745-300-08 Appendix A were calculated deterministically using point values to describe each potential exposure scenario. This is different from previous generic numerical soil direct-contact standards that were calculated probabilistically utilizing Monte Carlo Simulation (MCS) as a technique to model heterogeneous human receptor populations. Standards generated in accordance with OAC 3745-300-09 may be calculated probabilistically or deterministically. Regardless of the approach, probabilistic or deterministic, the mathematical models used to generate soil standards are intended to simulate the mass of chemicals transported from soil to receptor, the mass transfer of chemicals through human epithelial barriers, and the soil concentration at which an adverse human health effect may occur.

The standards for single chemical noncarcinogens and the standards for single chemical carcinogens in OAC 3745-300-08 Appendix A are equal target concentrations in soil calculated using the following equation. A chemical's total target concentration in soil for a given endpoint is comprised of three exposure pathways: incidental ingestion of soil, inhalation of particles emitted from soil, and dermal contact with soil. The final generic numerical soil direct-contact standard for a single chemical reported in OAC 3745-300-08 Appendix A is a chemical's lowest standard for a single chemical or soil saturation value. If a chemical's target concentration in soil for a particular endpoint exceeded unity (1E+06 mg/kg), the target concentration was reported as 1E+06 mg/kg.

Equation 1: Target concentration in soil for any endpoint

$$TCS_{total} = \frac{1}{\left(\frac{1}{TCS_{oral}}\right) + \left(\frac{1}{TCS_{inhalation}}\right) + \left(\frac{1}{TCS_{dermal}}\right)}$$

TCS_{total} = Total target concentration in soil (mg/kg)
TCS_{oral} = Target concentration in soil for oral pathway (mg/kg)
$TCS_{inhalation}$ = Target concentration in soil for inhalation pathway (mg/kg)
TCS_{dermal} = Target concentration in soil for dermal pathway (mg/kg)

The target concentrations in soil reflect cumulative effects of multiple exposure pathways. If warranted by property-specific conditions such as engineering controls, specific pathways may be eliminated. In addition to cumulative effects through multiple intake pathways, the cumulative effects of multiple contaminants must be considered. To address this concern, adjustments are made to individual target concentrations such that the total hazard index for the non-cancer endpoint and the target risk goal for the combined carcinogenic and mutagenic endpoints do not exceed the appropriate levels indicated in OAC 3745-300-08 and OAC 3745-300-09. For non-carcinogens, grouping contaminants based on target organs and mechanism of action may be appropriate and result in the derivation of multiple hazard indices.

1.1 Non-carcinogenic endpoint

The following equations were used to determine non-carcinogenic target concentrations in soil for oral, inhalation, and dermal pathways. These pathways were combined using Equation 1 (p. 6) to calculate a total target concentration in soil for each chemical. See Table 1 (p. 32) for all chemical-specific parameters and Table 4 (p. 42) for all scenario and receptor-specific parameters.

Exposure factors for a child receptor (AF_c, ATN_c, BW_c, ED_c, IRS_c, SAS_c) were used for all pathways with a non-carcinogenic endpoint in the residential land use scenario because this results in the most conservative non-carcinogenic target concentrations in soil.

Equation 2: Non-carcinogenic target concentration in soil for oral pathway

For residential and commercial/industrial land use and construction/excavation activities:

$$TCS_{oral} = \frac{THQ \times ATN \times BW}{EF \times ED \times \left(\frac{1}{RfD}\right) \times IRS \times CF \times FC}$$

TCS_{oral} = Target concentration in soil for oral pathway (mg/kg)
THQ = Target hazard quotient (THQ = 1)
ATN = Non-carcinogenic averaging time (days) (scenario and receptor-specific)
BW = Body weight (kg) (scenario and receptor-specific)
EF = Exposure frequency (days/year) (scenario-specific)
ED = Exposure duration (years) (scenario and receptor-specific)
RfD = Oral reference dose (mg/kg-day) (chemical-specific)
IRS = Soil ingestion rate (mg/day) (scenario and receptor-specific)
CF = Conversion factor (CF = 1E-06 kg/mg)
FC = Fraction contaminated (FC = 0.5)

Equation 3: Non-carcinogenic target concentration in soil for inhalation pathway

For residential and commercial/industrial land use and construction/excavation activities:

$$TCS_{inhalation} = \frac{THQ \times ATN}{EF \times ED \times ETA \times \left(\frac{1\ day}{24\ hours}\right) \times \left(\frac{1}{RfC}\right) \times \left(\frac{1}{VF} + \frac{1}{PEF}\right) \times FC}$$

$TCS_{inhalation}$ = Target concentration in soil for inhalation pathway (mg/kg)
THQ = Target hazard quotient (THQ = 1)
ATN = Non-carcinogenic averaging time (days) (scenario and receptor-specific)
EF = Exposure frequency (days/year) (scenario-specific)
ED = Exposure duration (years) (scenario and receptor-specific)
ETA = Air exposure time (hours/day) (scenario-specific)
RfC = Reference concentration (mg/m^3) (chemical-specific)
VF = Volatilization factor (m^3/kg) (chemical and scenario-specific)
PEF = Particulate emission factor (m^3/kg) (scenario-specific)
FC = Fraction contaminated (FC = 0.5)

Equation 4: Non-carcinogenic target concentration in soil for dermal pathway

For residential and commercial/industrial land use and construction/excavation activities:

$$TCS_{dermal} = \frac{THQ \times ATN \times BW}{EF \times ED \times \left(\frac{GIABS}{RfD}\right) \times AF \times SAS \times ABS \times CF \times FC}$$

TCS_{dermal} = Target concentration in soil for dermal pathway (mg/kg)
THQ = Target hazard quotient (THQ = 1)
ATN = Non-carcinogenic averaging time (days) (scenario and receptor-specific)
BW= Body weight (kg) (scenario and receptor-specific)
EF = Exposure frequency (days/year) (scenario-specific)
ED = Exposure duration (years) (scenario and receptor-specific)
RfD = Oral reference dose (mg/kg-day) (chemical-specific)
GIABS = Gastrointestinal absorption factor (chemical-specific)
AF = Soil to skin adherence factor (scenario and receptor-specific)
SAS = Skin surface area exposed to soil (scenario and receptor-specific)
ABS = Dermal absorption factor (chemical-specific)
CF = Conversion factor (CF = 1E-06 kg/mg)
FC = Fraction contaminated (FC = 0.5)

1.2 Carcinogenic endpoint

The following equations were used to determine carcinogenic target concentrations in soil for oral, inhalation, and dermal pathways. These pathways were combined using Equation 1 (p. 6) to calculate a total target concentration in soil for each chemical. See Table 1 (p. 32) for all chemical-specific parameters and Table 4 (p. 42) for all scenario and receptor-specific parameters.

Mutagenicity is a special instance of carcinogenicity. A chemical is considered to be mutagenic if it is explicitly stated that the chemical is carcinogenic by a mutagenic mode of action in the chemical's toxicological profile in IRIS. If a chemical is mutagenic according to IRIS, the mutagenic equations are used to determine carcinogenic target concentrations in soil for residential land use only. Because age-dependent adjustment factors are applied to receptor populations between the ages of 0 and 16 years, consideration of the mutagenic mode of action is not applicable to commercial/industrial land use or construction/excavation activities.

The generic numerical standards in OAC 3745-300-08 Appendix A consider acrylamide, methylene chloride, trichloroethylene (p. 46), and vinyl chloride (p. 48) to be mutagenic. Standards generated in accordance with OAC 3745-300-09 must consult the toxicity hierarchy (p. 33) and, if a slope factor and/or inhalation unit risk is derived from IRIS, must determine whether or not the chemical is carcinogenic by a mutagenic mode of action.

Equation 5: Carcinogenic target concentration in soil for oral pathway

<u>For residential land use (non-mutagenic mode of action):</u>

$$TCS_{oral} = \frac{TCR \times ATC}{SF \times EF \times IFS_{adj} \times CF \times FC}$$

$$where\ IFS_{adj} = \left[\frac{ED_c \times IRS_c}{BW_c}\right] + \left[\frac{ED_a \times IRS_a}{BW_a}\right]$$

<u>For commercial/industrial land use and construction/excavation activities:</u>

$$TCS_{oral} = \frac{TCR \times ATC \times BW}{SF \times EF \times ED \times IRS \times CF \times FC}$$

<u>For residential land use (mutagenic mode of action):</u>

$$TCS_{oral} = \frac{TCR \times ATC}{SF \times EF \times IFSM_{adj} \times CF \times FC}$$

$$where\ IFSM_{adj} = \left(\frac{ED_{0-2} \times IRS_c \times 10}{BW_c}\right) + \left(\frac{ED_{2-6} \times IRS_c \times 3}{BW_c}\right) + \left(\frac{ED_{6-16} \times IRS_a \times 3}{BW_a}\right) + \left(\frac{ED_{16-30} \times IRS_a \times 1}{BW_a}\right)$$

TCS_{oral} = Target concentration in soil for oral pathway (mg/kg)
TCR = Target cancer risk (TCR = 10^{-5})
ATC = Carcinogenic averaging time (ATC = 25,550 days)
SF = Slope factor ($(mg/kg\text{-}day)^{-1}$) (chemical-specific)
EF = Exposure frequency (scenario-specific)
IFS_{adj} = Age-adjusted soil ingestion factor (mg-year/kg-day)
CF = Conversion factor (CF = 1E-06 kg/mg)
FC = Fraction contaminated (FC = 0.5)
ED = Exposure duration (years) (scenario and receptor-specific)
IRS = Soil ingestion rate (mg/day) (scenario and receptor-specific)
BW = Body weight (kg) (scenario and receptor-specific)
$IFSM_{adj}$ = Mutagenic age-adjusted soil ingestion factor (mg-year/kg-year)

Equation 6: Carcinogenic target concentration in soil for inhalation pathway

<u>For residential land use (non-mutagenic mode of action), commercial/industrial land use, and construction/excavation activities:</u>

$$TCS_{inhalation} = \frac{TCR \times ATC}{IUR \times \left(\frac{10^3\ \mu g}{1\ mg}\right) \times EF \times ED \times ETA \times \left(\frac{1\ day}{24\ hours}\right) \times \left(\frac{1}{VF} + \frac{1}{PEF}\right) \times FC}$$

<u>For residential land use (mutagenic mode of action):</u>

$$TCS_{inhalation} = \frac{TCR \times ATC}{EF \times ETA \times \left(\frac{1\ day}{24\ hours}\right) \times IURM_{adj} \times \left(\frac{10^3\ \mu g}{1\ mg}\right) \times \left(\frac{1}{VF} + \frac{1}{PEF}\right) \times FC}$$

$$where\ IURM_{adj} = (ED_{0-2} \times IUR \times 10) + (ED_{2-6} \times IUR \times 3) + (ED_{6-16} \times IUR \times 3) + (ED_{16-30} \times IUR \times 1)$$

$TCS_{inhalation}$ = Target concentration in soil for inhalation pathway (mg/kg)
TCR = Target cancer risk (TCR = 10^{-5})
ATC = Carcinogenic averaging time (ATC = 25,550 days)
IUR = Inhalation unit risk ($(\mu g/m^3)^{-1}$) (chemical-specific)
EF = Exposure frequency (scenario-specific)
ED = Exposure duration (years) (scenario and receptor-specific)
ETA = Air exposure time (hours/day) (scenario-specific)
VF = Volatilization factor (m^3/kg) (chemical-specific)
PEF = Particulate emission factor (m^3/kg) (scenario-specific)
FC = Fraction contaminated (FC = 0.5)
$IURM_{adj}$ = Mutagenic age-adjusted inhalation unit risk factor ($(\mu g/m^3)^{-1}$)

Equation 7: Carcinogenic target concentration in soil for dermal pathway

<u>For residential land use (non-mutagenic mode of action):</u>

$$TCS_{dermal} = \frac{TCR \times ATC}{\left(\frac{SF}{GIABS}\right) \times EF \times DFS_{adj} \times ABS \times CF \times FC}$$

$$where\ DFS_{adj} = \left[\frac{ED_c \times SAS_c \times AF_c}{BW_c}\right] + \left[\frac{ED_a \times SAS_a \times AF_a}{BW_a}\right]$$

<u>For commercial/industrial land use and construction/excavation activities:</u>

$$TCS_{dermal} = \frac{TCR \times ATC \times BW}{EF \times ED \times \left(\frac{SF}{GIABS}\right) \times AF \times SAS \times CF \times FC}$$

<u>For residential land use (mutagenic mode of action):</u>

$$TCS_{dermal} = \frac{TCR \times ATC}{\left(\frac{SF}{GIABS}\right) \times EF \times DFSM_{adj} \times ABS \times CF \times FC}$$

$$where\ DFSM_{adj} = \left(\frac{ED_{0-2} \times AF_c \times SAS_c \times 10}{BW_c}\right) + \left(\frac{ED_{2-6} \times AF_c \times SAS_c \times 3}{BW_c}\right) + \left(\frac{ED_{6-16} \times AF_a \times SAS_a \times 3}{BW_a}\right) + \left(\frac{ED_{16-30} \times AF_a \times SAS_a \times 1}{BW_a}\right)$$

TCS_{dermal} = Target concentration in soil for dermal pathway (mg/kg)
TCR = Target cancer risk (TCR = 10^{-5})
ATC = Carcinogenic averaging time (ATC = 25,550 days)
SF = Slope factor ((mg/kg-day)$^{-1}$) (chemical-specific)
GIABS = Gastrointestinal absorption factor (dimensionless) (chemical-specific)
EF = Exposure frequency (days/year) (scenario-specific)
DFS_{adj} = Age-adjusted dermal soil contact factor (mg-year/kg-day)
ABS = Dermal absorption factor (dimensionless) (chemical-specific)
CF = Conversion factor (CF = 1E-06 kg/mg)
FC = Fraction contaminated (FC = 0.5)
ED = Exposure duration (years) (receptor-specific)
SAS = Skin surface area exposed to soil (cm^2) (receptor-specific)
AF = Soil to skin adherence factor (dimensionless) (receptor-specific)
BW = Body weight (kg) (receptor-specific)
$DFSM_{adj}$ = Mutagenic age-adjusted dermal soil contact factor (mg-year/kg-day)

1.4 Volatilization factor

Equation 8: Volatilization factor

For residential and commercial/industrial land use:

$$VF = \frac{\frac{Q}{C_w} \times (3.14 \times D_A \times T)^{\frac{1}{2}} \times \left(\frac{1\ m^2}{10^4\ cm^2}\right)}{(2 \times \rho_b \times D_A)}$$

$$where\ \frac{Q}{C_{wind}} = A \times e^{\frac{[(ln\, A_{site}) - B]^2}{C}}$$

$$where\ D_A = \frac{\left(\theta_a{}^{\frac{10}{3}} \times D_{ia} \times H'\right) + \left(\frac{\theta_w{}^{\frac{10}{3}} \times D_{iw}}{n^2}\right)}{(\rho_b \times K_d + \theta_w + \theta_a \times H')}$$

Parameter		Default value	Reference
VF	Volatilization factor (m^3/kg)	*chemical-specific*	Equation 6 (2)
Q/C_{wind}	Inverse of the ratio of the geometric mean air concentration to the emission flux at the center of a square source	Calculated; 85.63 g/m^2-s per kg/m^3	Exhibit D-2 (1)
D_A	Apparent diffusivity (cm^2/s)	*chemical-specific*	Equation 6 (2)
T	Exposure interval for volatilization	9.5E+08 seconds	p. 24 (2)
ρ_b	Dry soil bulk density	1.5 kg/L	p. 24 (2)
A, B, C	Volatilization factor dispersion constants for Q/C_{wind}	A = 12.8612, B = 20.5164, C = 237.2798	Exhibit D-2 (Cleveland, OH) (1)
A_{site}	Area of site	0.5 acres	p. B-8 (1)
θ_a	Air-filled soil porosity	0.28	p. 24 (2)
D_{ia}	Diffusivity in air (cm^2/s)	*chemical-specific*	-
H'	Henry's law constant (dimensionless)	*chemical-specific*	-
θ_w	Water-filled soil porosity	0.15	p. 24 (2)
D_{iw}	Diffusivity in water (cm^2/s)	*chemical-specific*	-
n	Total soil porosity	0.43	p. 24 (2)
ρ_b	Dry soil bulk density	1.5 kg/L	p. 24 (2)
K_d	Soil-water partition coefficient (L/kg)	*chemical-specific*	-

(1) U.S. EPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. December 2002.
(2) U.S. EPA. 1996. Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. Washington, DC. OSWER No. 9355.4-17A.

Equation 9: Subchronic volatilization factor

For construction/excavation activities:

$$VF_{subchronic} = \left[\frac{(3.14 \times D_A \times T)^{\frac{1}{2}}}{2 \times \rho_b \times D_A}\right] \times \left(\frac{1\ m^2}{10^4\ cm^2}\right) \times \frac{Q}{C_{sa}} \times \frac{1}{F_D}$$

$$where\ D_A = \frac{\left(\theta_a^{\frac{10}{3}} \times D_{ia} \times H'\right) + \left(\frac{\theta_w^{\frac{10}{3}} \times D_{iw}}{n^2}\right)}{(\rho_b \times K_d + \theta_w + \theta_a \times H')}$$

$$where\ \frac{Q}{C_{sa}} = A \times e^{\frac{[(ln\,A_c)-B]^2}{C}}$$

$$where\ F_D = 0.1852 + \frac{5.3537}{t_c} + \frac{-9.6318}{{t_c}^2}$$

Parameter		Default value	Reference
$VF_{subchronic}$	Subchronic volatilization factor (m^3/kg)	Calculated; *chemical-specific*	Equation 5-14 (1)
D_A	Apparent diffusivity (cm^2/s)	Calculated; *chemical-specific*	Equation 5-14 (1)
T	Total time over which construction occurs	3.1536E+07 seconds (a)	-
ρ_b	Dry soil bulk density	1.5 g/cm^3	p. 24 (2)
Q/C_{sa}	Inverse of the ratio of the 1-h geometric mean air concentration to the volatilization flux at the center of a square site	Calculated; 14.31 g/m^2-s per kg/m^3	Equation E-15 (1)
F_D	Dispersion correction factor	Calculated; 0.187	Equation E-16 (1)
θ_a	Air-filled soil porosity	0.28	p. 24 (2)
D_{ia}	Diffusivity in air (cm^2/s)	*chemical-specific*	-
H'	Henry's law constant (dimensionless)	*chemical-specific*	-
θ_w	Water-filled soil porosity	0.15	p. 24 (2)
D_{iw}	Diffusivity in water (cm^2/s)	*chemical-specific*	-
n	Total soil porosity	0.43	p. 24 (2)
K_d	Soil-water partition coefficient (L/kg)	*chemical-specific*	-
A, B, C	Volatilization factor dispersion constants for Q/C_{sa}	A = 2.4538, B = 17.5660, C = 189.0426	p. E-17 (1)
A_c	Areal extent of contamination	0.5 acres	p. 5-20 (1)
t_c	Duration of construction	2,880 hours (b)	-

(1) U.S. EPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. December 2002.
(2) U.S. EPA. 1996. Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. Washington, DC. OSWER No. 9355.4-17A.

(a) T = ED (1 year) x 365 days/year x 24 hours/day x 3,600 seconds/day = 3.1536E+07 seconds
(b) t_c = ED (1 year) x 120 days/year x 24 hours/day = 2,880 hours

1.5 Particulate emission factor

Equation 10: Particulate emission factor

For residential and commercial/industrial land use:

$$PEF = \frac{Q}{C_w} \times \frac{\left(\frac{3{,}600\ seconds}{1\ hour}\right)}{0.036 \times (1 - V) \times \left(\frac{U_m}{U_t}\right)^3 \times F(x)}$$

$$where\ \frac{Q}{C_{wind}} = A \times e^{\frac{[(ln\, A_{site}) - B]^2}{C}}$$

Parameter		Default	Reference
PEF	Particulate emission factor	Calculated; 9.50E+08 m^3/kg	Equation 10 (2)
Q/C_{wind}	Inverse of the ratio of the geometric mean air concentration to the emission flux at the center of a square source	Calculated; 85.63 g/m^2-s per kg/m^3	Exhibit D-2 (1)
V	Fraction of vegetative cover	0.5	p. 32 (2)
U_m	Mean annual wind speed	4.83 m/s	p. D-6 (Cleveland, OH) (2)
U_t	Equivalent threshold value of wind speed at 7 m	11.32 m/s	p. D-6 (Cleveland, OH) (2)
F(x)	Function dependent on U_m/U_t	0.232	p. D-6 (Cleveland, OH) (2)
A, B, C	Volatilization factor dispersion constants for Q/C_{wind}	A = 12.8612, B = 20.5164, C = 237.2798	Exhibit D-2 (Cleveland, OH) (1)
A_{site}	Area of site	0.5 acres	p. 32 (2)

(1) U.S. EPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. December 2002.
(2) U.S. EPA. 1996. Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. Washington, DC. OSWER No. 9355.4-17A.

Equation 11: Subchronic particulate emission factor

For construction/excavation activities:

$$PEF_{subchronic} = \frac{(PEF_{urt} + PEF_{other})}{2}$$

$PEF_{subchronic}$ = Subchronic particulate emission factor activities (m^3/kg)
PEF_{urt} = Particulate emission factor for unpaved road traffic (m^3/kg) (Equation 12 on p. 15)
PEF_{other} = Particulate emission factor for wind erosion and other construction activities (m^3/kg) (Equation 13 on p. 16)

Equation 12: Particulate emission factor for unpaved road traffic

$$PEF_{urt} = \left(\frac{Q}{C_{sr}}\right) \times \left(\frac{1}{F_D}\right) \times \frac{(T \times A_R)}{\left\{\frac{\left[2.6 \times \left(\frac{s}{12}\right)^{0.8} \left(\frac{W}{s_{road}}\right)^{0.4}\right]}{\left(\frac{M_{dry}}{0.2}\right)^{0.3}} \times \frac{(365-p)}{365} \times 281.9 \times (\sum VKT)_{fleet}\right\}}$$

$$where\ \frac{\mathrm{Q}}{C_{sr}} = \mathrm{A} \times \exp\left[\frac{(\ln \mathrm{A_{site}} - \mathrm{B})^2}{\mathrm{C}}\right]$$

$$where\ F_D = 0.1852 + \frac{5.3537}{t_c} + \frac{-9.6318}{(t_c)^2}$$

Parameter		Default	Reference
PEF_{urt}	Particulate emission factor for unpaved road traffic	Calculated; 9.10E+05 m^3/kg	Equation E-18 (1)
Q/C_{sr}	Inverse of the 1-h geometric mean air concentration to the emission flux along a straight road segment bisecting a square site	Calculated; 16.40 g/m^2-s per kg/m^3	Equation E-16 (1)
F_D	Dispersion correction factor	Calculated; 0.191	Equation E-16 (1)
T	Total time over which construction occurs	3.456E+06 seconds (a)	-
A_R	Surface area of contaminated road segment	Calculated; 868 m^2 (b)	p.E-27 (1)
s_{road}	Road surface silt content	8.5%	p. E-20 (1)
W	Mean vehicle weight	8 tons	p. E-20 (1)
M_{dry}	Road surface material moisture content	0.2%	p. E-20 (1)
p	Mean number of days with at least 0.01 inches of precipitation	120 days	Exhibit E-4 (1)
$(\Sigma VKT)_{fleet}$	Sum of fleet kilometers traveled	Calculated; 512 km (c)	p. E-27 (1)
A, B, C	Volatilization factor dispersion constants for Q/C_{sr}	A = 12.9351, B = 5.7383, C = 71.7711	p. E-22 (1)
A_{site}	Area of site	5.0 acres	p. E-27 (1)
t_c	Duration of construction	960 hours (d)	-

(1) U.S. EPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. December 2002.

(a) T = ED (1 year) x 120 days/year x 8 hours/day x 3600 seconds/day = 3.456E+06 seconds
(b) A_R = 20 ft x 467 ft x 0.092903 m^2/ft^2 = 868 m^2
(c) ΣVKT_{fleet} = (30 vehicles x 467 ft/day x 120 days x 3,281 ft/km = 512 km
(d) t_c = ED (1 year) x 120 days/year x 8 hours/day = 960 hours

Equation 13: Particulate emission factor for wind erosion and other construction activities

$$PEF_{other} = \frac{Q}{C_{sa}} \times \frac{1}{F_D} \times \frac{1}{< J'_T >}$$

$$where\ \frac{\mathrm{Q}}{C_{sa}} = \mathrm{A} \times \exp\left[\frac{(\ln \mathrm{A_c} - \mathrm{B})^2}{\mathrm{C}}\right]$$

$$where\ F_D = 0.1852 + \frac{5.3537}{t_c} + \frac{-9.6318}{(t_c)^2}$$

Parameter		Default value	Reference
PEF_{other}	Particulate emission factor for wind erosion and other construction activities	Calculated; 2.59E+07 m^3/kg	Equation E-26 (1)
Q/C_{sa}	Inverse of the 1-h geometric mean air concentration and the volatilization flux at the center of a square emission source	Calculated; 9.44 g/m^2-s per kg/m^3	Equation E-15 (1)
F_D	Dispersion correction factor	Calculated; 0.191	Equation E-16 (1)
$<J'_T>$	Total time-averaged PM_{10} unit emission flux for construction activities other than traffic on unpaved roads	Equation 14 on p. 17	-
A, B, C	Volatilization factor dispersion constants for Q/C_{sa}	A = 2.4538, B = 17.5660, C = 189.0426	p. E-17 (1)
A_c	Areal extent of contamination	5 acres	p. E-28 (1)
t_c	Duration of construction	960 hours (a)	-

(1) U.S. EPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. December 2002.

(a) t_c = ED (1 year) x 120 days/year x 8 hours/day = 960 hours

Equation 14: Total time-averaged PM_{10} unit emission flux for construction activities other than traffic on unpaved roads

$$< J'_T > \; = \; \frac{\left(M_{wind} + M_{excav} + M_{doz} + M_{grade} + M_{till}\right)}{(A_c \times ED)}$$

$$where\ M_{wind} = 0.036 \times (1 - V) \times \left(\frac{U_m}{U_t}\right)^3 \times F(x) \times A_{surf} \times ED \times \left(\frac{8{,}760\ hours}{1\ year}\right)$$

$$where\ M_{excav} = 0.35 \times 0.0016 \times \frac{\left(\frac{U_m}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \times \rho_{soil} \times A_{excav} \times d_{excav} \times N_{dump} \times \left(\frac{10^3\ g}{1\ kg}\right)$$

$$where\ M_{doz} \; = 0.75 \times \frac{0.45(s_{soil})^{1.5}}{(M)^{1.4}} \times \frac{(\sum VKT)_{doz}}{S_{doz}} \times \frac{10^3\ g}{1\ kg}$$

$$where\ M_{grade} \; = 0.60 \times 0.0056(S_{doz})^{\ 2.0} \times (\Sigma\ VKT)_{grade} \times \frac{10^3\ g}{1\ kg}$$

$$where\ M_{till} = 1.1\ (s_{till})^{0.6} \times A_{till} \times \left(\frac{4{,}047 m^2}{1\ acre}\right) \times \left(\frac{10^{-4}\ ha}{1\ m^2}\right) \times \left(\frac{10^3 g}{1\ kg}\right) \times N_{till}$$

Equation 14 is continued on the next page.

Equation 14: Total time-averaged PM10 unit emission flux for construction activities other than traffic on unpaved roads (continued)

Parameter		Default value	Reference
$<J'_T>$	Total time-averaged PM_{10} unit emission flux for construction activities other than unpaved road traffic	Calculated; 1.91E-06 g/m^2-s	Equation E-25 (1)
M_{wind}	Unit mass emitted from wind erosion	Calculated; 1.15E+05 g	Equation E-20 (1)
M_{excav}	Unit mass emitted from excavation soil dumping	Calculated; 1.72E+03 g	Equation E-21 (1)
M_{doz}	Unit mass emitted from dozing operations	Calculated; 7.37E+07 g	Equation E-22 (1)
M_{grade}	Unit mass emitted from grading operations	Calculated; 1.08E+04 g	Equation E-23 (1)
M_{till}	Unit mass emitted from tilling operations	Calculated; 5.04E+03 g	Equation E-24 (1)
A_c	Areal extent of contamination	20,235 m^2	p. E-28 (1)
ED	Exposure duration	1 year	-
V	Fraction of vegetative cover	0	p. E-23 (1)
U_m	Mean annual wind speed (Cleveland, OH)	4.83 m/s	p. D-6 (2)
U_t	Equivalent threshold value of wind speed at 7 m (Cleveland, OH)	11.32 m/s	p. D-6 (2)
F(x)	Function dependent on U_m/U_t (Cleveland, OH)	0.232	p. D-6 (2)
A_{surf}	Areal extent of site with surface contamination	20,235 m^2	p. E-28 (1)
0.35	PM_{10} particle size multiplier	-	p. E-23 (1)
M	Gravimetric soil moisture content	12%	p. E-23 (1)
ρ_{soil}	In-site soil density	1.68 mg/m^3	p. E-24 (1)
A_{excav}	Areal extent of excavation	4,047 m^2	p. E-28 (1)
d_{excav}	Depth of excavation	1 m	p. E-28 (1)
N_{dump}	Number of times soil is dumped	2	p. E-24 (1)
0.75	PM_{10} scaling factor	-	p. E-24 (1)
s_{soil}	Soil silt content	6.9%	p. E-24 (1)
$(\Sigma VKT)_{doz}$	Sum of dozing kilometers traveled	24.79 km	p. E-28 (1)
S_{doz}	Average dozing speed	11.4 kph	p. E-24 (1)
0.60	PM_{10} scaling factor	-	p. E-24 (1)
S_{grade}	Average grading speed	11.4 kph	p. E-24 (1)
$(\Sigma VKT)_{grade}$	Sum of grading kilometers traveled	24.79 km	p. E-28 (1)
s_{till}	Soil silt content for tilling	18%	p. E-25 (1)
A_{till}	Areal extent of tilling	1 acre	p. E-28 (1)
N_{till}	Number of times soil is tilled	2	p. E-25 (1)

(1) U.S. EPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. December 2002.
(2) U.S. EPA. 1996. Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. Washington, DC. OSWER No. 9355.4-17A.

1.6 Soil saturation

It is recognized that in some instances, risk-based generic numerical soil direct-contact standards may exceed soil saturation levels. Under these conditions, it is possible that health hazards beyond chemical toxicity (e.g. flammability) may exist. Moreover, the ability to accurately predict receptor uptake levels from free phase chemical contamination based upon any of the preceding mathematical models becomes highly problematic because free phase chemical contamination has not been incorporated into these models. Soil saturation levels are not calculated for chemicals that may be present in the solid phase at ambient soil temperature. Chemicals are considered to be present in the solid phase at ambient soil temperature if they have a melting point above 20°C (Table C-3 (1)). For all other chemicals, soil saturation levels are calculated using the following equation. See Table 1 (p. 32) for all chemical-specific parameters and Table 4 (p. 42) for all scenario and receptor-specific parameters.

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(1) U.S. EPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. December 2002.

Equation 15: Soil saturation concentration

$$\boldsymbol{C_{sat} = \left(\frac{S}{\rho_b}\right) \times (K_d \times \rho_b + \theta_w + H' \times \theta_a)}$$

Symbol	Definition	Default	Reference
C_{sat}	Soil saturation concentration (mg/kg)	Calculated; *chemical-specific*	Equation 9 (1)
S	Solubility in water (mg/L-water)	*chemical-specific*	-
ρ_b	Dry soil bulk density	1.5 kg/L	p. 24 (1)
K_d	Soil-water partition coefficient (L/kg)	*chemical-specific*	-
θ_w	Water-filled soil porosity	0.15	p. 24 (1)
H'	Henry's law constant (dimensionless)	*chemical-specific*	-
θ_a	Air-filled soil porosity	0.28	p. 24 (1)

(1) U.S. EPA. 1996. Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. Washington, DC. OSWER No. 9355.4-17A.

2. Calculation of generic indoor air standards due to vapor intrusion

Generic indoor air standards due to vapor intrusion are listed for the first time in OAC 3745-300-08 Appendix A. These standards were calculated deterministically for volatile compounds. Standards generated in accordance with OAC 3745-300-09 may be calculated probabilistically or deterministically. Regardless of the approach, probabilistic or deterministic, the mathematical models used to generate generic numerical indoor air standards from vapor intrusion are intended to account for the uptake of chemicals for the inhalation exposure pathway.

The standards for single chemical noncarcinogens and the standards for single chemical carcinogens in OAC 3745-300-08 Appendix A are equal to the non-carcinogenic target concentrations in air and the carcinogenic target concentrations in air calculated using the following equations. Unlike soil and groundwater, the inhalation exposure pathway is the only relevant exposure pathway for air; therefore, there is no need to combine exposure pathways to determine a chemical's target concentration in air. The final generic air standard due to vapor intrusion for a single chemical reported in OAC 3745-300-08 Appendix A is a chemical's lowest standard for a single chemical.

2.1 Non-carcinogenic endpoint

The following equations were used to determine non-carcinogenic target concentrations in air. See Table 1 (p. 32) for all chemical-specific parameters and Table 4 (p. 42) for all scenario and receptor-specific parameters.

Exposure factors for a child receptor (AF_c, ATN_c, BW_c, ED_c, IRS_c, SAS_c) were used because this results in the most conservative non-carcinogenic target concentration in air.

Equation 16: Non-carcinogenic target concentration in air

<u>For residential land use and commercial/industrial land use:</u>

$$TCA = \frac{THQ \times ATN \times \left(\frac{10^3\ \mu g}{1\ mg}\right)}{EF \times ED \times ETA \times \left(\frac{1\ day}{24\ hours}\right) \times \left(\frac{1}{RfC}\right)}$$

TCA = Target concentration in air (μg/m^3)
THQ = Target hazard quotient (THQ = 1)
ATN = Non-carcinogenic averaging time (days) (scenario and receptor-specific)
EF = Exposure frequency (days/year) (scenario-specific)
ED = Exposure duration (years) (scenario and receptor-specific)
ETA = Air exposure time (hours/day) (scenario-specific)
RfC = Reference concentration (mg/m^3) (chemical-specific)

2.2 Carcinogenic endpoint

The following equations were used to determine carcinogenic target concentrations in air. See Table 1 (p. 32) for all chemical-specific parameters and Table 4 (p. 42) for all scenario and receptor-specific parameters.

Mutagenicity is a special instance of carcinogenicity. A chemical is considered to be mutagenic if it is explicitly stated that the chemical is carcinogenic by a mutagenic mode of action in the chemical's toxicological profile in IRIS. If a chemical is mutagenic according to IRIS, the mutagenic equations are used to determine carcinogenic target concentrations in air for residential land use only. Because age-dependent adjustment factors are applied to receptor populations between the ages of 0 and 16 years, consideration of the mutagenic mode of action is not applicable to commercial/industrial land use.

The generic numerical standards in OAC 3745-300-08 Appendix A consider acrylamide, methylene chloride, trichloroethylene (p. 46), and vinyl chloride (p. 48) to be mutagenic. Standards generated in accordance with OAC 3745-300-09 must consult the toxicity hierarchy (p. 33) and, if an inhalation unit risk is derived from IRIS, must determine whether or not the chemical is carcinogenic by a mutagenic mode of action.

Equation 17: Carcinogenic target concentration in air

<u>For residential land use (non-mutagenic mode of action) and commercial/industrial land use:</u>

$$TCA = \frac{TCR \times ATC}{EF \times ED \times ETA \times \left(\frac{1\ day}{24\ hours}\right) \times IUR}$$

<u>For residential land use (mutagenic mode of action):</u>

$$TCA = \frac{TCR \times ATC}{EF \times ET \times \left(\frac{1\ day}{24\ hours}\right) \times IURM_{adj}}$$

$$where\ IURM_{adj} = (ED_{0-2} \times IUR \times 10) + (ED_{2-6} \times IUR \times 3) + (ED_{6-16} \times IUR \times 3) + (ED_{16-30} \times IUR \times 1)$$

TCA = Target concentration in air (μg/m^3)
TCR = Target cancer risk (TCR = 10^{-5})
ATC = Carcinogenic averaging time (ATC = 25,550 days)
EF = Exposure frequency (days/year) (scenario-specific)
ED = Exposure duration (years) (scenario and receptor-specific)
ETA = Air exposure time (hours/day) (scenario-specific)
IUR = Inhalation unit risk factor ((μg/m^3)$^{-1}$) (chemical-specific)
$IURM_{adj}$ = Mutagenic inhalation unit risk factor ((μg/m^3)$^{-1}$) (chemical-specific)

3. Calculation of generic unrestricted potable use standards for groundwater

The generic unrestricted potable use standards for groundwater listed in OAC 3745-300-08 Appendix A were calculated deterministically, except for those based on maximum contaminant levels (MCLs) established in the National Primary Drinking Water Regulations. This is different from previous risk-based generic unrestricted potable use standards for groundwater that were calculated probabilistically, utilizing Monte Carlo Simulation (MCS) as a technique to model heterogeneous human receptor populations exposed through each potential exposure scenario. Standards generated in accordance with OAC 3745-300-09 may be calculated probabilistically or deterministically. Regardless of the approach, probabilistic or deterministic, the mathematical models are intended to account for the uptake of chemicals for all relevant exposure pathways.

The standards for single chemical noncarcinogens and the standards for single chemical carcinogens in OAC 3745-300-08 Appendix A are equal to the non-carcinogenic target concentrations in groundwater and the carcinogenic target concentrations in groundwater calculated using the following equations. A chemical's total target concentration in groundwater for a given endpoint is comprised of three exposure pathways: ingestion of groundwater, inhalation of volatiles from groundwater, and dermal contact with groundwater. Generic unrestricted potable use standards for groundwater are based upon the residential land use scenario.

If an MCL for a chemical does not exist, the final generic unrestricted potable use standard for a single chemical reported in OAC 3745-300-08 Appendix A is that chemical's lowest standard for a single chemical. Chemicals with risk-based standards for a single chemical are subject to multiple chemical adjustments.

If an MCL for a chemical does exist, then the MCL is that chemical's final generic unrestricted potable use standard for a single chemical reported in OAC 3745-300-08 Appendix A. Chemicals with a generic unrestricted potable use standard for a single chemical based on an MCL should not be included in multiple chemical adjustments.

Equation 18: Target concentration in groundwater for any endpoint

$$TCG_{total} = \frac{1}{\left(\frac{1}{TCG_{oral}}\right) + \left(\frac{1}{TCG_{inhalation}}\right) + \left(\frac{1}{TCG_{dermal}}\right)}$$

TCG_{total} = Target concentration in groundwater for all pathways (µg/L)
TCG_{oral} = Target concentration in groundwater for oral pathway (µg/L)
$TCG_{inhalation}$ = Target concentration in groundwater for inhalation pathway (µg/L)
TCG_{dermal} = Target concentration in groundwater for dermal pathway (µg/L)

3.1 Non-carcinogenic endpoint

The following equations were used to determine target concentrations in groundwater for oral, inhalation, and dermal pathways. The dermal pathway was calculated for chemicals within the effective predictive domain (EPD) (1). These pathways were combined using Equation 18 to calculate a single-chemical non-carcinogenic generic numerical standard for each chemical when applicable. See Table 1 (p. 32) for all chemical-specific parameters and Table 4 (p. 42) for all scenario and receptor-specific parameters.

Exposure factors for a child receptor (AF_c, ATN_c, BW_c, ED_c, IRS_c, SAS_c) were used to develop target concentrations for all non-carcinogenic pathways in the residential land use scenario because this results in the most conservative non-carcinogenic target concentrations in groundwater.

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(1) U.S. EPA 2004. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part E, Supplemental) Final. OSWER 9285.7-02.

Equation 19: Non-carcinogenic target concentration in groundwater for oral pathway

$$TCG_{oral} = \frac{THQ \times ATN_c \times BW_c \times \left(\frac{10^3\ \mu g}{1\ mg}\right)}{EF \times ED_c \times \left(\frac{1}{RfD}\right) \times IRW_c}$$

TCG_{oral} = Target concentration in groundwater for oral pathway (µg/L)
THQ = Target hazard quotient (THQ = 1)
ATN = Non-carcinogenic averaging time (days) (scenario-specific)
BW = Body weight (kg) (receptor-specific)
EF = Exposure frequency (days/year) (scenario-specific)
ED = Exposure duration (years) (receptor-specific)
RfD = Oral reference dose (mg/kg-day) (chemical-specific)
IRW = Water ingestion rate (L/day) (receptor-specific)

Equation 20: Non-carcinogenic target concentration in groundwater for inhalation pathway

$$TCG_{inhalation} = \frac{THQ \times ATN_c \times \left(\frac{10^3\ \mu g}{1\ mg}\right)}{EF \times ED_c \times ETA_c \times \left(\frac{1\ day}{24\ hours}\right) \times \left(\frac{1}{RfC}\right) \times K}$$

$TCG_{inhalation}$ = Target concentration in groundwater for inhalation pathway (µg/L)
THQ = Target hazard quotient (THQ = 1)
ATN = Non-carcinogenic averaging time (days) (scenario-specific)
EF = Exposure frequency (days/year) (scenario-specific)
ED = Exposure duration (years) (receptor-specific)
ETA = Air exposure time (hours/day) (receptor-specific)
RfC = Reference concentration (mg/m^3) (chemical-specific)
K = Andelman volatilization factor (K = 0.5 L/m^3)

Equation 21: Non-carcinogenic target concentration in groundwater for dermal pathway

<u>For organic chemicals if $ETW_c \leq t^*$:</u>

$$TCG_{dermal} = \frac{DA_{event} \times \left(\frac{10^3 cm}{1\ L}\right)}{2 \times FA \times K_p \times \sqrt{\frac{6 \times \tau_{event} \times ETW_c}{\pi}}}$$

<u>For organic chemicals if $ETW_c > t^*$:</u>

$$TCG_{dermal} = \frac{DA_{event} \times \left(\frac{10^3 cm}{1\ L}\right)}{FA \times K_p \times \left[\left(\frac{ETW_c}{1+B}\right) + 2 \times \tau_{event} \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

<u>For inorganic chemicals:</u>

$$TCG_{dermal} = \frac{DA_{event} \times \left(\frac{10^3 cm}{1\ L}\right)}{K_p \times ETW_c}$$

ETW = Water event duration (hours/event) (receptor-specific)
t* = Time to reach a steady state (hours) (Equation 27 on p. 29)
TCG_{dermal} = Target concentration in groundwater for dermal pathway (µg/L)
DA_{event} = Absorbed dose per event (µg/cm^2-event) (Equation 28 on p. 30)
FA = Fraction absorbed (dimensionless) (chemical-specific)
K_p = Dermal permeability coefficient (cm/hour) (chemical-specific)
τ_{event} = Lag time per event (hours/event) (Equation 26 on p. 29)
B = Ratio of the permeability coefficient across the stratum corneum vs. the permeability coefficient across the viable epidermis (Equation 25 on p. 29)

3.2 Carcinogenic endpoint

The following equations were used to determine target concentrations in groundwater for oral, inhalation, and dermal pathways. The dermal pathway was calculated for chemicals within the effective predictive domain (EPD) (1). These pathways were combined using Equation 18 to calculate a single-chemical carcinogenic generic numerical standard for each chemical when applicable. See Table 1 (p. 32) for all chemical-specific parameters and Table 4 (p. 42) for all scenario and receptor-specific parameters.

Mutagenicity is a special instance of carcinogenicity. A chemical is considered to be mutagenic if it is explicitly stated that the chemical is carcinogenic by a mutagenic mode of action in the chemical's toxicological profile in IRIS. If a chemical is mutagenic according to IRIS, the mutagenic equations are used to determine carcinogenic target concentrations in groundwater.

The generic numerical standards in OAC 3745-300-08 Appendix A consider acrylamide, methylene chloride, trichloroethylene (p. 46), and vinyl chloride (p. 48) to be mutagenic; however, because MCLs exist for trichloroethylene and vinyl chloride, risk-based standards are not generated for these two chemicals. Standards generated in accordance with OAC 3745-300-09 must consult the toxicity hierarchy (p. 33) and, if a slope factor and/or inhalation unit risk is derived from IRIS, must determine whether or not the chemical is carcinogenic by a mutagenic mode of action.

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(1) U.S. EPA 2004. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part E, Supplemental) Final. OSWER 9285.7-02.

Equation 22: Carcinogenic target concentration in groundwater for oral pathway

For chemicals with a non-mutagenic mode of action:

$$TCG_{oral} = \frac{TCR \times ATC \times \left(\frac{10^3 \mu g}{1\, mg}\right)}{SF \times EF \times IFW_{adj}}$$

$$where\ IFW_{adj} = \left(\frac{ED_c \times IRW_c}{BW_c}\right) + \left(\frac{ED_a \times IRW_a}{BW_a}\right)$$

For chemicals with a mutagenic mode of action:

$$TCG_{oral} = \frac{TCR \times ATC \times \left(\frac{10^3 \mu g}{1\, mg}\right)}{SF \times EF \times IFWM_{adj}}$$

$$where\ IFWM_{adj} = \left(\frac{ED_{0-2} \times IRW_c \times 10}{BW_c}\right) + \left(\frac{ED_{2-6} \times IRW_c \times 3}{BW_c}\right) + \left(\frac{ED_{6-16} \times IRW_a \times 3}{BW_a}\right) + \left(\frac{ED_{16-30} \times IRW_a \times 1}{BW_a}\right)$$

TCG_{oral} = Target concentration in groundwater for oral pathway (µg/L)
TCR = Target cancer risk (TCR = 10^{-5})
ATC = Carcinogenic averaging time (ATC = 25,550 days)
SF = Slope factor ($(mg/kg\text{-}day)^{-1}$) (chemical-specific)
EF = Exposure frequency (days/year) (scenario-specific)
$IFWM_{adj}$ = Mutagenic age-adjusted groundwater ingestion factor (mg/day)
ED = Exposure duration (years) (receptor-specific)
IRW = Water ingestion rate (L/day) (receptor-specific)
BW = Body weight (kg) (receptor-specific)
IFW_{adj} = Age-adjusted groundwater ingestion factor (mg/day)

Equation 23: Carcinogenic target concentration in groundwater for inhalation

For chemicals with a non-mutagenic mode of action:

$$TCG_{inhalation} = \frac{TCR \times ATC}{IUR \times EF \times ED \times ETA \times \left(\frac{1\ day}{24\ hours}\right) \times K}$$

For chemicals with a mutagenic mode of action:

$$TCG_{inhalation} = \frac{TCR \times ATC}{EF \times ET \times \left(\frac{1\ day}{24\ hours}\right) \times IURM_{adj} \times K}$$

$$where\ IURM_{adj} = (ED_{0-2} \times IUR \times 10) + (ED_{2-6} \times IUR \times 3) + (ED_{6-16} \times IUR \times 3) + (ED_{16-30} \times IUR \times 1)$$

$TCG_{inhalation}$ = Target concentration in groundwater for inhalation pathway (µg/L)
TCR = Target cancer risk (TCR = 10^{-5})
ATC = Carcinogenic averaging time (ATC = 25,550 days)
IUR = Inhalation unit risk ($(\mu g/m^3)^{-1}$) (chemical-specific)
EF = Exposure frequency (days/year) (scenario-specific)
ED = Exposure duration (years) (scenario-specific)
ETA = Air exposure time (hours/day) (scenario-specific)
K = Andelman volatilization factor (K = 0.5 L/m^3)
$IURM_{adj}$ = Mutagenic inhalation unit risk factor ($(\mu g/m^3)^{-1}$) (chemical-specific)

Equation 24: Carcinogenic target concentration in groundwater for dermal pathway

For organic chemicals with a non-mutagenic mode of action if $ETW_{adj} \leq t^*$:

$$TCG_{dermal} = \frac{DA_{event} \times \left(\frac{10^3 cm}{1\ L}\right)}{2 \times FA \times K_p \times \sqrt{\frac{6 \times \tau_{event} \times ETW_{adj}}{\pi}}}$$

For organic chemicals with a non-mutagenic mode of action if $ETW_{adj} > t^*$:

$$TCG_{dermal} = \frac{DA_{event} \times \left(\frac{10^3 cm}{1\ L}\right)}{FA \times K_p \times \left[\left(\frac{ETW_{adj}}{1+B}\right) + 2 \times \tau_{event} \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

For inorganic chemicals with a non-mutagenic mode of action:

$$TCG_{dermal} = \frac{DA_{event} \times \left(\frac{10^3 cm}{1\ L}\right)}{K_p \times ETW_{adj}}$$

$$where\ ETW_{adj} = \frac{(ETW_c \times ED_c) + (ETW_a \times ED_a)}{ED_c + ED_a}$$

For all chemicals with a mutagenic mode of action:

$$TCG_{dermal} = \frac{DA_{event} \times \left(\frac{10^3 cm}{1\ L}\right)}{K_p \times ETWM_{adj}}$$

$$where\ ETWM_{adj} = \frac{(ETW_c \times ED_c + ETW_a \times ED_a)}{(ED_c + ED_a)}$$

ETW_{adj} = Age-adjusted water event duration (hours/event)
t* = time to reach a steady state (hours) (Equation 27 on p. 29)
TCG_{dermal} = Target concentration in groundwater for dermal pathway (µg/L)
DA_{event} = Absorbed dose per event (µg/cm^2-event) (Equation 28 on p. 30)
FA = Fraction absorbed (dimensionless) (chemical-specific)
K_p = Dermal permeability coefficient (cm/hour) (chemical-specific)
τ_{event} = Lag time per event (hours/event) (Equation 26 on p. 29)
B = Ratio of the permeability coefficient across the stratum corneum vs. the permeability coefficient across the viable epidermis (Equation 25 on p. 29)
ETW = Water exposure event duration (hours/event) (receptor-specific)
ED = Exposure duration (years) (receptor-specific)
$ETWM_{adj}$ = Mutagenic age-adjusted water event duration (hours/event)

3.4 Supporting equations

The following equations support those used to determine target concentrations in groundwater for oral, inhalation, and dermal pathways. See Table 1 (p. 32) for all chemical-specific parameters and Table 4 (p. 42) for all scenario and receptor-specific parameters.

Equation 25: Ratio of the permeability coefficient across the stratum corneum vs. the permeability coefficient across the viable epidermis

$$\mathrm{B} = \mathrm{K_p} \times \frac{\sqrt{\mathrm{MW}}}{2.6}$$

B = Ratio of the permeability coefficient across the stratum corneum vs. the permeability coefficient across the viable epidermis (dimensionless)
K_p = Dermal permeability coefficient (cm/hour) (chemical-specific)
MW = Molecular weight (g/mole) (chemical-specific)

Equation 26: Lag time per event

$$\tau_{\mathrm{event}} = \frac{{I_{SC}}^2}{(6 \times \mathrm{D_{sc}})}$$

$$where\ D_{sc} = l_{sc} \times 10^{(-2.80 - 0.0056 \times MW)}$$

τ_{event} = Lag time per event (hours/event)
I_{SC} = Apparent thickness of the stratum corneum (I_{SC} = 0.001 cm)
D_{sc} = Effective diffusion coefficient for chemical transfer through the stratum corneum (dimensionless)
MW = Molecular weight (g/mole) (chemical-specific)

Equation 27: Time to reach a steady state

$$If\ B \leq 0.6,\ then\ t^* = 2.4 \times \tau_{event}$$

$$If\ B > 0.6,\ then\ t^* = 6 \times \tau_{event} \times \left(b - \sqrt{b^2 - c^2}\right)$$

$$where\ b = \frac{2 \times (1+b)^2}{\pi} - c\ and\ c = \frac{1 + 3 \times B + 3 \times B^2}{3 \times (1+B)}$$

B = Ratio of the permeability coefficient across the stratum corneum vs. the permeability coefficient across the viable epidermis (dimensionless) (Equation 25 on p. 29)
t* = time to reach a steady state (hours)
τ_{event} = Lag time per event (hours/event) (Equation 26 on p. 29)

Equation 28: Absorbed dose per event

For non-carcinogenic endpoint:

$$DA_{event} = \frac{THQ \times ATN_c \times \left(\frac{10^3 \mu g}{1\ mg}\right) \times BW_c}{\left(\frac{1}{RfD \times GIABS}\right) \times EVW \times ED_c \times EF \times SAW_c}$$

For carcinogenic endpoint (non-mutagenic mode of action):

$$DA_{event} = \frac{TCR \times ATC \times \left(\frac{10^3 \mu g}{1\ mg}\right)}{\left(\frac{SF}{GIABS}\right) \times EF \times DFW_{adj}}$$

$$where\ DFW_{adj} = \left(\frac{EVW \times ED_c \times SAW_c}{BW_c}\right) + \left(\frac{EVW \times ED_a \times SAW_a}{BW_a}\right)$$

For carcinogenic endpoint (mutagenic mode of action):

$$DA_{event} = \frac{TCR \times ATC \times \left(\frac{10^3 \mu g}{1\ mg}\right)}{\left(\frac{SF}{GIABS}\right) \times EF \times DFWM_{adj}}$$

$$where\ DFSM_{adj} = \left(\frac{ED_{0-2} \times EVW \times SAW_c \times 10}{BW_c}\right) + \left(\frac{ED_{2-6} \times EVW \times SAW_c \times 3}{BW_c}\right) + \left(\frac{ED_{6-16} \times EVW \times SAW_a \times 3}{BW_a}\right) + \left(\frac{ED_{16-30} \times EVW \times SAW_a \times 1}{BW_a}\right)$$

DA_{event} = Absorbed dose per event (µg/cm^2-event)
THQ = Target hazard quotient (THQ = 1)
ATN~~C~~ = Non-carcinogenic averaging time (days) (scenario-specific)
BW = Body weight (kg) (receptor-specific)
RfD = Oral reference dose (mg/kg-day) (chemical-specific)
GIABS = Gastrointestinal absorption factor (chemical-specific)
ED = Exposure duration (years) (receptor-specific)
EVW = Water event frequency (events/day) (receptor-specific)
EF = Exposure frequency (days/year) (scenario-specific)
SAW = Skin surface area exposed to water (cm^2) (receptor-specific)
TCR = Target cancer risk (TCR = 10^{-5})
ATC = Carcinogenic averaging time (ATC = 25,550 days)
SF = Slope factor ((mg/kg-day)$^{-1}$) (chemical-specific)
DFW_{adj} = Age-adjusted water dermal contact factor (cm^2-event/kg)
$DFWM_{adj}$ = Mutagenic age-adjusted water dermal contact factor (cm^2-event/kg)

Part B: Chemical-specific parameters

All chemical-specific parameters, including toxicities, used to develop the generic numerical standards are summarized in Table 1 (p. 32).

The development of reliable cleanup standards is dependent upon several sets of data describing the physical/chemical properties of each chemical, the uptake of chemicals by a receptor from contaminated media, and possible adverse health effect due to exposure. The development of generic numerical standards utilized source hierarchies for chemical/physical data and toxicity data. These source hierarchies should be used when generating standards in accordance with OAC 3745-300-09.

1. Physical/chemical data

The physical/chemical parameters that were used to develop the generic numerical standards and the supporting reference(s), in order of decreasing preference for each parameter, appear in Table 1 (p. 32). Physical/chemical data appear in Table 2 (p.33).

Table 1: Summary of all chemical-specific parameters

Parameter		Reference(s) in order of decreasing preference
ABS	Dermal absorption factor (dimensionless)	Exhibit 3-4 (3)
B	Ratio of the permeability coefficient across the stratum corneum vs. the permeability coefficient across the viable epidermis (dimensionless)	Calculated; Equation A.1 (3)
D_A	Apparent diffusivity (cm^2/s)	Calculated; Equation 6 (11)
DA_{event}	Absorbed dose per event ($\mu g/cm^2$-event)	Calculated; Equation 3.2 – 3.4 (3)
D_{ia}	Diffusivity in air (cm^2/s)	(1); Exhibit C-1 (2)
D_{iw}	Diffusivity in water (cm^2/s)	(1); Exhibit C-1 (2)
D_{sc}	Effective diffusion coefficient for chemical transfer through the stratum corneum (dimensionless)	Calculated; Equation A.2 – A.3 (3)
EPD	Effective predictive domain (dimensionless)	Calculated; Equation 3.9 & 3.10 (3)
FA	Fraction absorbed (dimensionless)	Calculated; Exhibit B-3 (3)
GIABS	Gastrointestinal absorption factor (dimensionless)	Exhibit 4-1 (3)
H'	Henry's law constant (dimensionless) (at 25°C unless otherwise stated in the source)	(4i); Exhibit C-1 (2); (5i); (4ii); (6)
IUR	Inhalation unit risk ($(\mu g/m^3)^{-1}$)	p. 36 of this document
K_d	Soil-water partition coefficient (cm^3/g)	Calculated for organics (K_{oc} x f_{oc}); Exhibit C-4 (pH 6.8) (2) or (10) for inorganics
K_{oc}	Organic carbon partition coefficient (L/kg) (b)	(4ii); Exhibit C-1 (2); (5ii); (4i); (5i)
K_p	Dermal permeability coefficient (cm/hr)	(4ii); Appendix B (3)
MP	Melting point (°C)	(4i); Exhibit C-3 (2); (7); (8); (9); (4ii)
MW	Molecular weight (g/mole)	(4); (7); (8); (9); (5)
RfC	Reference concentration (mg/m^3)	p. 36 of this document
RfD	Oral reference dose (mg/kg-day)	p. 36 of this document
S	Solubility in water (mg/L) (at 25°C unless otherwise stated in the source)	(4i); Table 36 (12); (7); (5i); (8); (11); (5ii); (4ii); (6)
SF	Slope factor ($(mg/kg\text{-}day)^{-1}$)	p. 36 of this document
t*	Time to reach a steady state (hours)	Calculated; Equation A.5 – A.8 (3)
τ_{event}	Lag time per event (hours/event)	Calculated; Equation A.4 (3)
VF	Volatilization factor (chemical and scenario-specific)	Calculated; p. 12 - 13 of this document

(1) WATER9.
(2) U.S. EPA 2002. Supplemental guidance for developing soil screening levels for Superfund sites. OSWER 9355.4-24.
(3) U.S. EPA 2004. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part E) Final. OSWER 9285.7-02.
(4) The Estimation Programs Interface (EPI) Suite™. U.S. EPA and Syracuse Research Corporation. (i = experimental values, ii = estimated values)
(5) Yaws' Handbook of Thermodynamic and Physical Properties of Chemical Compounds. (i = experimental values, ii = estimated values)
(6) PHYSPROP Database. Syracuse Research Corporation (SRC).
(7) CRC Handbook of Chemistry and Physics.
(8) Perry's Chemical Engineers' Handbook.
(9) Baes, C.F. 1984.
(10) U.S. EPA 1996. Soil Screening Guidance (Technical Background Document. EPA/540/R-95/128.

Table 2: Physical/chemical data

Chemical	CAS Number	MW (g/mol)	key	Melting Point (°C)	key	Henry's Law Constant (unitless)	key	Air Diffusivity (cm^2/s)	key	Water Diffusivity (cm^2/s)	key	Koc (L/kg)	key	Kd (cm^3/g)	key	Solubility in Water (mg/L)	key	Kp (cm/hr)	key
Acenaphthene	83-32-9	154.21	(4)	93.4	(4)	7.52E-03	(4)	5.06E-02	(1)	8.33E-06	(1)	5.03E+03	(4)	3.02E+01	(11)	3.90E+00	(4)	8.60E-02	(4)
Acetaldehyde	75-07-0	44.05	(4)	-123	(4)	2.73E-03	(4)	1.28E-01	(1)	1.35E-05	(1)	1.00E+00	(4)	6.00E-03	(11)	1.00E+06	(4)	5.27E-04	(4)
Acetone	67-64-1	58.08	(4)	-98.3	(4)	1.43E-03	(4)	1.06E-01	(1)	1.15E-05	(1)	2.36E+00	(4)	1.42E-02	(11)	1.00E+06	(4)	5.12E-04	(4)
Acetonitrile	75-05-8	41.05	(4)	-45	(4)	1.41E-03	(4)	1.34E-01	(1)	1.41E-05	(1)	4.67E+00	(4)	2.80E-02	(11)	1.00E+06	(4)	5.48E-04	(4)
Acetophenone	98-86-2	120.15	(4)	20	(4)	4.25E-04	(4)	6.52E-02	(1)	8.72E-06	(1)	5.19E+01	(4)	3.11E-01	(11)	6.13E+03	(4)	3.72E-03	(4)
Acetylaminofluorene, 2-	53-96-3	223.28	(4)	193	(4)	7.85E-09	(4)	5.16E-02	(1)	6.03E-06	(1)	2.21E+03	(4)	1.32E+01	(11)	8.46E+00	(4)	1.25E-02	(3)
Acrolein	107-02-8	56.06	(4)	-87.7	(4)	4.99E-03	(4)	1.12E-01	(1)	1.22E-05	(1)	1.00E+00	(4)	6.00E-03	(11)	2.12E+05	(4)	7.48E-04	(4)
Acrylamide	79-06-1	71.08	(4)	84.5	(4)	6.95E-08	(4)	1.10E-01	(1)	1.33E-05	(1)	5.69E+00	(4)	3.42E-02	(11)	3.90E+05	(4)	2.24E-04	(4)
Acrylic Acid	79-10-7	72.06	(4)	13.5	(4)	1.51E-05	(4)	1.03E-01	(1)	1.20E-05	(1)	1.44E+00	(4)	8.64E-03	(11)	1.00E+06	(4)	1.05E-03	(4)
Acrylonitrile	107-13-1	53.06	(4)	-83.5	(4)	5.64E-03	(4)	1.14E-01	(1)	1.23E-05	(1)	8.51E+00	(4)	5.11E-02	(11)	7.45E+04	(4)	1.16E-03	(4)
Aldicarb	116-06-3	190.26	(4)	99	(4)	5.89E-08	(4)	3.19E-02	(1)	7.25E-06	(1)	2.46E+01	(4)	1.48E-01	(11)	6.03E+03	(4)	7.55E-04	(4)
Aldicarb Sulfone	1646-88-4	222.26	(4)	140	(4)	1.38E-07	(4)	5.18E-02	(1)	6.05E-06	(1)	1.00E+01	(4)	6.00E-02	(11)	1.00E+04	(4)	3.71E-05	(4)
Aldrin	309-00-2	364.92	(4)	240	(4)	1.80E-03	(4)	3.72E-02	(1)	4.35E-06	(1)	8.20E+04	(4)	4.92E+02	(11)	1.70E-02	(4)	2.93E-01	(4)
Allyl Alcohol	107-18-6	58.08	(4)	-129	(4)	2.04E-04	(4)	1.10E-01	(1)	1.21E-05	(1)	1.90E+00	(4)	1.14E-02	(11)	1.00E+06	(4)	9.59E-04	(4)
Allyl Chloride	107-05-1	76.53	(4)	-135	(4)	4.50E-01	(4)	9.36E-02	(1)	1.08E-05	(1)	3.96E+01	(4)	2.38E-01	(11)	3.37E+03	(4)	1.12E-02	(4)
Aluminum Phosphide	20859-73-8	57.96	(4)	2550	(7)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.00E-03	(3)
Aminobiphenyl, 4-	92-67-1	169.23	(4)	53.5	(4)	7.07E-06	(4)	6.21E-02	(1)	7.26E-06	(1)	2.47E+03	(4)	1.48E+01	(11)	1.29E+02	(4)	1.40E-02	(4)
Ammonium Sulfamate	7773-06-0	114.124	(7)	205	(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.47E+05	(4)	1.00E-03	(3)
Aniline	62-53-3	93.13	(4)	-6	(4)	8.26E-05	(4)	8.30E-02	(1)	1.01E-05	(1)	7.02E+01	(4)	4.21E-01	(11)	3.60E+04	(4)	1.86E-03	(4)
Anthracene	120-12-7	178.24	(4)	215	(4)	2.27E-03	(4)	3.90E-02	(1)	7.85E-06	(1)	1.64E+04	(4)	9.82E+01	(11)	4.34E-02	(4)	1.42E-01	(4)
Antimony (metallic)	7440-36-0	121.76	(7)	631	(7)	NA	NA	NA	NA	NA	NA	NA	NA	4.50E+01	(2)	NA	NA	1.00E-03	(3)
Antimony Trioxide	1309-64-4	291.52	(4)	570	(7)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.00E-03	(3)
Aroclor 1016	12674-11-2	257.55	(4)	101	(4)	8.18E-03	(4)	4.69E-02	(1)	5.48E-06	(1)	4.77E+04	(4)	2.86E+02	(11)	4.20E-01	(4)	3.05E-01	(4)
Aroclor 1221	11104-28-2	188.66	(4)	34	(4)	3.01E-02	(4)	5.78E-02	(1)	6.75E-06	(1)	8.40E+03	(4)	5.04E+01	(11)	1.50E+01	(4)	1.68E-01	(4)
Aroclor 1232	11141-16-5	188.66	(4)	34	(4)	3.01E-02	(4)	5.78E-02	(1)	6.75E-06	(1)	8.40E+03	(4)	5.04E+01	(11)	1.45E+00	(4)	1.68E-01	(4)
Aroclor 1242	53469-21-9	291.99	(4)	122	(4)	7.77E-03	(4)	4.32E-02	(1)	5.04E-06	(1)	7.81E+04	(4)	4.69E+02	(11)	2.77E-01	(4)	5.45E-01	(4)
Aroclor 1248	12672-29-6	291.99	(4)	122	(4)	1.80E-02	(4)	4.32E-02	(1)	5.04E-06	(1)	7.65E+04	(4)	4.59E+02	(11)	1.00E-01	(4)	4.75E-01	(4)
Aroclor 1254	11097-69-1	326.44	(4)	135	(4)	1.16E-02	(4)	4.01E-02	(1)	4.68E-06	(1)	1.31E+05	(4)	7.83E+02	(11)	4.30E-02	(4)	7.51E-01	(4)
Aroclor 1260	11096-82-5	395.33	(4)	164	(4)	1.37E-02	(4)	3.53E-02	(1)	4.12E-06	(1)	3.50E+05	(4)	2.10E+03	(11)	1.44E-02	(4)	9.86E-01	(4)
Arsenic, Inorganic	7440-38-2	74.922	(7)	-117	(4)	NA	NA	NA	NA	NA	NA	NA	NA	2.90E+01	(2)	NA	NA	1.00E-03	(3)
Auramine	492-80-8	267.38	(4)	136	(4)	1.49E-07	(4)	4.58E-02	(1)	5.35E-06	(1)	4.46E+03	(4)	2.67E+01	(11)	1.00E+04	(4)	1.11E-02	(3)
Baygon	114-26-1	209.25	(4)	87	(4)	5.85E-08	(4)	2.57E-02	(1)	6.58E-06	(1)	6.00E+01	(4)	3.60E-01	(11)	1.86E+03	(4)	1.07E-03	(4)
Benomyl	17804-35-2	290.32	(4)	140	(4)	2.02E-10	(4)	4.33E-02	(1)	5.06E-06	(1)	3.36E+02	(4)	2.02E+00	(11)	3.80E+00	(4)	9.43E-04	(4)
Benz[a]anthracene	56-55-3	228.3	(4)	84	(4)	4.91E-04	(4)	5.09E-02	(1)	5.94E-06	(1)	1.77E+05	(4)	1.06E+03	(11)	9.40E-03	(4)	5.52E-01	(4)
Benzene	71-43-2	78.11	(4)	5.5	(4)	2.27E-01	(4)	8.95E-02	(1)	1.03E-05	(1)	1.46E+02	(4)	8.75E-01	(11)	1.79E+03	(4)	1.49E-02	(4)
Benzenethiol	108-98-5	110.17	(4)	-14.9	(4)	1.37E-02	(4)	7.29E-02	(1)	9.45E-06	(1)	2.34E+02	(4)	1.40E+00	(11)	8.35E+02	(4)	1.78E-02	(4)
Benzidine	92-87-5	184.24	(4)	120	(4)	2.88E-09	(4)	3.51E-02	(1)	7.48E-06	(1)	1.19E+03	(4)	7.14E+00	(11)	3.22E+02	(4)	1.13E-03	(4)
Benzo[a]pyrene	50-32-8	252.32	(4)	177	(4)	1.87E-05	(4)	4.76E-02	(1)	5.56E-06	(1)	5.87E+05	(4)	3.52E+03	(11)	1.62E-03	(4)	7.13E-01	(4)
Benzo[b]fluoranthene	205-99-2	252.32	(4)	168	(4)	2.69E-05	(4)	4.76E-02	(1)	5.56E-06	(1)	5.99E+05	(4)	3.60E+03	(11)	1.50E-03	(4)	4.17E-01	(4)
Benzo[k]fluoranthene	207-08-9	252.32	(4)	217	(4)	2.39E-05	(4)	4.76E-02	(1)	5.56E-06	(1)	5.87E+05	(4)	3.52E+03	(11)	8.00E-04	(4)	6.91E-01	(4)
Benzoic Acid	65-85-0	122.12	(4)	122	(4)	1.56E-06	(4)	7.02E-02	(1)	9.79E-06	(1)	1.66E+01	(4)	9.93E-02	(11)	3.40E+03	(4)	5.65E-03	(4)
Benzotrichloride	98-07-7	195.48	(4)	-5	(4)	1.06E-02	(4)	3.13E-02	(1)	7.75E-06	(1)	1.00E+03	(4)	6.01E+00	(11)	5.30E+01	(4)	4.87E-02	(4)
Benzyl Chloride	100-44-7	126.59	(4)	-45	(4)	1.68E-02	(4)	6.34E-02	(1)	8.81E-06	(1)	4.46E+02	(4)	2.68E+00	(11)	5.25E+02	(4)	1.03E-02	(4)
Beryllium and compounds	7440-41-7	9.01	(4)	986	(4)	NA	NA	NA	NA	NA	NA	NA	NA	7.90E+02	(2)	NA	NA	1.00E-03	(3)
Biphenyl, 1,1'-	92-52-4	154.21	(4)	69	(4)	1.26E-02	(4)	4.71E-02	(1)	7.56E-06	(1)	5.13E+03	(4)	3.08E+01	(11)	6.94E+00	(4)	9.43E-02	(4)
Bis(2-chloro-1-methylethyl) ether	108-60-1	171.07	(4)	-97	(4)	3.03E-03	(4)	3.99E-02	(1)	7.36E-06	(1)	8.29E+01	(4)	4.98E-01	(11)	1.70E+03	(4)	7.64E-03	(4)
Bis(2-chloroethoxy)methane	111-91-1	173.04	(4)	-32	(4)	1.57E-04	(4)	6.12E-02	(1)	7.15E-06	(1)	1.44E+01	(4)	8.63E-02	(11)	7.80E+03	(4)	1.22E-03	(4)
Bis(2-chloroethyl)ether	111-44-4	143.01	(4)	-51.9	(4)	6.95E-04	(4)	5.67E-02	(1)	8.71E-06	(1)	3.22E+01	(4)	1.93E-01	(11)	1.72E+04	(4)	1.78E-03	(4)
Bis(2-ethylhexyl)phthalate	117-81-7	390.57	(4)	-55	(4)	1.10E-05	(4)	1.73E-02	(1)	4.18E-06	(1)	1.20E+05	(4)	7.18E+02	(11)	2.70E-01	(4)	1.13E+00	(4)
Bis(chloromethyl)ether	542-88-1	114.96	(4)	-41.5	(4)	1.78E-01	(4)	7.63E-02	(1)	1.04E-05	(1)	9.70E+00	(4)	5.82E-02	(11)	2.20E+04	(4)	8.55E-04	(4)
Bromodichloromethane	75-27-4	163.83	(4)	-57	(4)	8.67E-02	(4)	5.63E-02	(1)	1.07E-05	(1)	3.18E+01	(4)	1.91E-01	(11)	3.03E+03	(4)	4.02E-03	(4)
Bromoform	75-25-2	252.73	(4)	8	(4)	2.19E-02	(4)	3.57E-02	(1)	1.04E-05	(1)	3.18E+01	(4)	1.91E-01	(11)	3.10E+03	(4)	2.35E-03	(4)
Bromomethane	74-83-9	94.94	(4)	-93.7	(4)	3.00E-01	(4)	1.00E-01	(1)	1.35E-05	(1)	1.32E+01	(4)	7.93E-02	(11)	1.52E+04	(4)	2.84E-03	(4)
Butadiene, 1,3-	106-99-0	54.09	(4)	-109	(4)	3.01E+00	(4)	1.00E-01	(1)	1.03E-05	(1)	3.96E+01	(4)	2.38E-01	(11)	7.35E+02	(4)	1.64E-02	(4)
Butanol, N-	71-36-3	74.12	(4)	-89.8	(4)	3.60E-04	(4)	9.00E-02	(1)	1.01E-05	(1)	3.47E+00	(4)	2.08E-02	(11)	6.32E+04	(4)	2.31E-03	(4)
Butyl Benzyl Phthlate	85-68-7	312.37	(4)	-35	(2)	5.15E-05	(4)	2.08E-02	(1)	5.17E-06	(1)	7.16E+03	(4)	4.29E+01	(11)	2.69E+00	(4)	3.85E-02	(4)
Cacodylic Acid	75-60-5	138	(4)	195	(4)	NA	NA	7.11E-02	(1)	8.31E-06	(1)	4.39E+01	(4)	2.63E-01	(11)	2.00E+06	(4)	4.60E-04	(4)
Cadmium	7440-43-9	112.41	(4)	321	(4)	NA	NA	NA	NA	NA	NA	NA	NA	7.50E+01	(2)	NA	NA	1.00E-03	(3)
Calcium Cyanide	592-01-8	92.11	(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.00E-03	(3)
Captan	133-06-2	300.59	(4)	178	(4)	2.86E-07	(4)	2.62E-02	(1)	6.90E-06	(1)	2.52E+02	(4)	1.51E+00	(11)	5.10E+00	(4)	2.34E-03	(4)
Carbaryl	63-25-2	201.23	(4)	145	(4)	1.34E-07	(4)	2.74E-02	(1)	7.12E-06	(1)	3.55E+02	(4)	2.13E+00	(11)	1.10E+02	(4)	4.31E-03	(4)
Carbofuran	1563-66-2	221.26	(4)	151	(4)	1.26E-07	(4)	2.56E-02	(1)	6.57E-06	(1)	9.53E+01	(4)	5.72E-01	(11)	3.20E+02	(4)	3.13E-03	(4)
Carbon Disulfide	75-15-0	76.13	(4)	-112	(4)	5.89E-01	(4)	1.06E-01	(1)	1.30E-05	(1)	2.17E+01	(4)	1.30E-01	(11)	2.16E+03	(4)	1.14E-02	(4)
Carbon Tetrachloride	56-23-5	153.82	(4)	-23	(4)	1.13E+00	(4)	5.71E-02	(1)	9.78E-06	(1)	4.39E+01	(4)	2.63E-01	(11)	7.93E+02	(4)	1.63E-02	(4)
Carbosulfan	55285-14-8	380.55	(4)	176	(4)	2.09E-05	(4)	1.82E-02	(1)	4.44E-06	(1)	1.20E+04	(4)	7.18E+01	(11)	3.00E-01	(4)	5.79E-02	(4)
Chloramben	133-90-4	206.03	(4)	200	(4)	1.58E-09	(4)	5.45E-02	(1)	6.36E-06	(1)	2.14E+01	(4)	1.28E-01	(11)	7.00E+02	(4)	2.01E-03	(4)
Chlordane	57-74-9	409.78	(4)	106	(4)	1.99E-03	(4)	3.44E-02	(1)	4.02E-06	(1)	3.38E+04	(4)	2.03E+02	(11)	5.60E-02	(4)	1.07E-01	(4)
Chlordecone (Kepone)	143-50-0	490.64	(4)	350	(4)	2.20E-06	(4)	1.96E-02	(1)	4.91E-06	(1)	1.75E+04	(4)	1.05E+02	(11)	2.70E+00	(4)	1.09E-02	(4)
Chlorine	7782-50-5	70.91	(4)	-101	(4)	4.78E-01	(6)	NA	NA	NA	NA	NA	NA	2.50E-01	(9)	6.30E+03	(4)	1.00E-03	(3)
Chloro-1,3-butadiene, 2-	126-99-8	88.54	(4)	-130	(4)	2.29E+00	(4)	8.41E-02	(1)	1.00E-05	(1)	6.07E+01	(4)	3.64E-01	(11)	8.37E+02	(4)	2.38E-02	(4)
Chloro-2-methylaniline HCl, 4-	3165-93-3	178.06	(4)	164	(4)	5.89E-12	(4)	6.00E-02	(1)	7.01E-06	(1)	3.52E+02	(4)	2.11E+00	(11)	1.16E+02	(4)	1.80E-05	(4)
Chloroacetic Acid	79-11-8	94.5	(4)	63	(4)	3.79E-07	(4)	9.38E-02	(1)	1.21E-05	(1)	1.44E+00	(4)	8.64E-03	(11)	8.58E+05	(4)	6.47E-04	(4)
Chloroacetophenone, 2-	532-27-4	154.6	(4)	56.5	(4)	1.35E-04	(4)	5.22E-02	(1)	8.73E-06	(1)	9.89E+01	(4)	5.93E-01	(11)	1.10E+03	(8)	4.06E-03	(4)
Chloroaniline, p-	106-47-8	127.57	(4)	72.5	(4)	4.74E-05	(4)	7.04E-02	(1)	1.03E-05	(1)	1.13E+02	(4)	6.76E-01	(11)	3.90E+03	(4)	4.96E-03	(4)
Chlorobenzene	108-90-7	112.56	(4)	-45.2	(4)	1.27E-01	(4)	7.21E-02	(1)	9.48E-06	(1)	2.34E+02	(4)	1.40E+00	(11)	4.98E+02	(4)	2.82E-02	(4)
Chlorobenzilate	510-15-6	325.19	(4)	37	(4)	2.96E-06	(4)	2.18E-02	(1)	5.48E-06	(1)	1.54E+03	(4)	9.23E+00	(11)	1.30E+01	(4)	3.31E-02	(4)
Chloroform	67-66-3	119.38	(4)	-63.6	(4)	1.50E-01	(4)	7.69E-02	(1)	1.09E-05	(1)	3.18E+01	(4)	1.91E-01	(11)	7.95E+03	(4)	6.83E-03	(4)
Chloromethane	74-87-3	50.49	(4)	-97.7	(4)	3.61E-01	(4)	1.24E-01	(1)	1.36E-05	(1)	1.32E+01	(4)	7.93E-02	(11)	5.32E+03	(4)	3.28E-03	(4)
Chloromethyl Methyl Ether	107-30-2	80.51	(4)	-104	(4)	1.24E-02	(4)	9.50E-02	(1)	1.13E-05	(1)	5.32E+00	(4)	3.19E-02	(11)	1.92E+05	(4)	9.05E-04	(4)
Chloronaphthalene, Beta-	91-58-7	162.62	(4)	61	(4)	1.31E-02	(4)	4.47E-02	(1)	7.73E-06	(1)	2.48E+03	(4)	1.49E+01	(11)	1.17E+01	(4)	7.49E-02	(4)
Chlorophenol, 2-	95-57-8	128.56	(4)	9.8	(4)	4.58E-04	(4)	6.61E-02	(1)	9.48E-06	(1)	3.07E+02	(4)	1.84E+00	(11)	1.13E+04	(4)	7.99E-03	(4)
Chlorpyrifos	2921-88-2	350.59	(4)	42	(4)	1.20E-04	(4)	3.82E-02	(1)	4.47E-06	(1)	7.28E+03	(4)	4.37E+01	(11)	1.12E+00	(4)	3.34E-02	(4)
Chromium(III), Insoluble Salts	16065-83-1	52	(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.80E+06	(2)	NA	NA	1.00E-03	(3)
Chromium(VI)	18540-29-9	52	(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.90E+01	(2)	1.69E+06	(7)	2.00E-03	(3)
Chromium, Total	7440-47-3	52	(4)	1910	(7)	NA	NA	NA	NA	NA	NA	NA	NA	1.80E+06	(2)	NA	NA	1.00E-03	(3)
Chrysene	218-01-9	228.3	(4)	258	(4)	2.14E-04	(4)	2.61E-02	(1)	6.75E-06	(1)	1.81E+05	(4)	1.08E+03	(11)	2.00E-03	(4)	5.96E-01	(4)
Copper	7440-50-8	63.55	(4)	1080	(7)	NA	NA	NA	NA	NA	NA	NA	NA	3.50E+01	(11)	NA	NA	1.00E-03	(3)
Copper Cyanide	544-92-3	89.56	(4)	474	(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.30E+01	(4)	1.00E-03	(3)
Cresol, m-	108-39-4	108.14	(4)	11.8	(4)	3.50E-05	(4)	7.29E-02	(1)	9.32E-06	(1)	3.00E+02	(4)	1.80E+00	(11)	2.27E+04	(4)	7.77E-03	(4)
Cresol, o-	95-48-7	108.14	(4)	29.8	(4)	4.91E-05	(4)	7.28E-02	(1)	9.32E-06	(1)	3.07E+02	(4)	1.84E+00	(11)	2.59E+04	(4)	7.66E-03	(4)
Cresol, p-	106-44-5	108.14	(4)	35.5	(4)	4.09E-05	(4)	7.24E-02	(1)	9.24E-06	(1)	3.00E+02	(4)	1.80E+00	(11)	2.15E+04	(4)	7.54E-03	(4)
Cresol, p-chloro-m-	59-50-7	142.59	(4)	67	(4)	1.00E-04	(4)	6.96E-02	(1)	8.13E-06	(1)	4.92E+02	(4)	2.95E+00	(11)	3.83E+03	(4)	2.85E-02	(4)
Cresols	1319-77-3	108.14	(4)	29.8	(4)	4.91E-05	(4)	8.37E-02	(1)	9.78E-06	(1)	3.07E+02	(4)	1.84E+00	(11)	2.59E+04	(4)	7.66E-03	(4)
Crotonaldehyde, trans-	123-73-9	70.09	(4)	-76.5	(4)	7.93E-04	(4)	9.59E-02	(1)	1.08E-05	(1)	1.79E+00	(4)	1.08E-02	(11)	1.50E+05	(4)	1.59E-03	(4)
Cumene	98-82-8	120.2	(4)	-96	(4)	4.70E-01	(4)	6.03E-02	(1)	7.86E-06	(1)	6.98E+02	(4)	4.19E+00	(11)	6.13E+01	(4)	8.97E-02	(4)
Cyanide (CN-)	57-12-5	27.03	(4)	-13.4	(4)	5.44E-03	(4)	2.11E-01	(1)	2.46E-05	(1)	NA	NA	9.90E+00	(2)	1.00E+06	(4)	1.00E-03	(3)
Cyanogen	460-19-5	52.04	(4)	-27.9	(4)	2.21E-01	(4)	1.24E-01	(1)	1.38E-05	(1)	NA	NA	NA	NA	9.49E+03	(5)	8.90E-04	(3)
Cyanogen Bromide	506-68-3	105.92	(4)	52	(7)	1.00E+00	(4)	9.84E-02	(1)	1.41E-05	(1)	NA	NA	NA	NA	NA	NA	2.55E-04	(3)
Cyanogen Chloride	506-77-4	61.47	(4)	-6.5	(7)	7.87E-02	(5)	1.21E-01	(1)	1.42E-05	(1)	NA	NA	NA	NA	3.00E+04	(5)	3.94E-04	(3)
Cyclohexane	110-82-7	84.16	(4)	6.6	(4)	6.13E+00	(4)	8.00E-02	(1)	9.11E-06	(1)	1.46E+02	(4)	8.75E-01	(11)	5.50E+01	(4)	1.02E-01	(4)
Cyclohexanone	108-94-1	98.15	(4)	-31	(4)	3.68E-04	(4)	7.68E-02	(1)	9.38E-06	(1)	1.74E+01	(4)	1.04E-01	(11)	2.50E+04	(4)	1.52E-03	(4)
Dalapon	75-99-0	142.97	(4)	-5	(4)	2.31E-06	(4)	6.01E-02	(1)	9.41E-06	(1)	3.23E+00	(4)	1.94E-02	(11)	5.02E+05	(4)	8.15E-04	(4)
DDD	72-54-8	320.05	(4)	110	(4)	2.70E-04	(4)	4.06E-02	(1)	4.74E-06	(1)	1.18E+05	(4)	7.05E+02	(11)	9.00E-02	(4)	2.51E-01	(4)
DDE, p,p'-	72-55-9	318.03	(4)	89	(4)	1.70E-03	(4)	4.08E-02	(1)	4.76E-06	(1)	1.18E+05	(4)	7.05E+02	(11)	4.00E-02	(4)	5.45E-01	(4)
DDT	50-29-3	354.49	(4)	109	(4)	3.40E-04	(4)	3.79E-02	(1)	4.43E-06	(1)	1.69E+05	(4)	1.01E+03	(11)	5.50E-03	(4)	6.28E-01	(4)
Diallate	2303-16-4	270.22	(4)	25	(4)	1.55E-04	(4)	4.55E-02	(1)	5.31E-06	(1)	6.44E+02	(4)	3.87E+00	(11)	1.40E+01	(4)	4.60E-02	(4)
Diazinon	333-41-5	304.35	(4)	87.6	(4)	4.62E-06	(4)	2.10E-02	(1)	5.23E-06	(1)	3.03E+03	(4)	1.82E+01	(11)	4.00E+01	(4)	1.04E-02	(4)
Dibenz[a,h]anthracene	53-70-3	278.36	(4)	270	(4)	5.76E-06	(4)	4.46E-02	(1)	5.21E-06	(1)	1.91E+06	(4)	1.15E+04	(11)	2.49E-03	(4)	9.53E-01	(4)
Dibromo-3-chloropropane, 1,2-	96-12-8	236.33	(4)	6	(4)	6.01E-03	(4)	3.21E-02	(1)	8.90E-06	(1)	1.16E+02	(4)	6.95E-01	(11)	1.23E+03	(4)	6.85E-03	(4)
Dibromochloromethane	124-48-1	208.28	(4)	-20	(4)	3.20E-02	(4)	3.66E-02	(1)	1.06E-05	(1)	3.18E+01	(4)	1.91E-01	(11)	2.70E+03	(4)	2.89E-03	(4)
Dibromoethane, 1,2-	106-93-4	187.86	(4)	9.9	(4)	2.66E-02	(4)	4.30E-02	(1)	1.04E-05	(1)	3.96E+01	(4)	2.38E-01	(11)	3.91E+03	(4)	2.78E-03	(4)
Dibromomethane (Methylene Bromide)	74-95-3	173.84	(4)	-52.5	(4)	3.36E-02	(4)	5.51E-02	(1)	1.19E-05	(1)	2.17E+01	(4)	1.30E-01	(11)	1.19E+04	(4)	2.23E-03	(4)
Dibutyl Phthalate	84-74-2	278.35	(4)	-35	(4)	7.40E-05	(4)	2.14E-02	(1)	5.33E-06	(1)	1.16E+03	(4)	6.94E+00	(11)	1.12E+01	(4)	4.20E-02	(4)
Dicamba	1918-00-9	221.04	(4)	115	(4)	8.91E-08	(4)	2.92E-02	(1)	7.80E-06	(1)	2.90E+01	(4)	1.74E-01	(11)	8.31E+03	(4)	2.65E-03	(4)
Dichloro-2-butene, 1,4-	764-41-0	125	(4)	-48	(4)	2.71E-02	(4)	6.65E-02	(1)	9.29E-06	(1)	1.32E+02	(4)	7.89E-01	(11)	5.80E+02	(4)	1.66E-02	(4)
Dichlorobenzene, 1,2-	95-50-1	147	(4)	-16.7	(4)	7.85E-02	(4)	5.62E-02	(1)	8.92E-06	(1)	3.83E+02	(4)	2.30E+00	(11)	1.56E+02	(4)	4.46E-02	(4)
Dichlorobenzene, 1,4-	106-46-7	147	(4)	52.1	(4)	9.85E-02	(4)	5.50E-02	(1)	8.68E-06	(1)	3.75E+02	(4)	2.25E+00	(11)	8.13E+01	(4)	4.53E-02	(4)
Dichlorobenzidine, 3,3'-	91-94-1	253.13	(4)	132	(4)	1.64E-07	(2)	4.75E-02	(1)	5.55E-06	(1)	3.19E+03	(4)	1.91E+01	(11)	3.10E+00	(4)	1.28E-02	(4)
Dichlorodifluoromethane	75-71-8	120.91	(4)	-158	(4)	1.40E+01	(4)	7.60E-02	(1)	1.08E-05	(1)	4.39E+01	(4)	2.63E-01	(11)	2.80E+02	(4)	8.95E-03	(4)
Dichloroethane, 1,1-	75-34-3	98.96	(4)	-96.9	(4)	2.30E-01	(4)	8.36E-02	(1)	1.06E-05	(1)	3.18E+01	(4)	1.91E-01	(11)	5.04E+03	(4)	6.75E-03	(4)

Table 2: Physical/chemical data (continued)

Chemical	CAS Number	MW (g/mol)	key	Melting Point (°C)	key	Henry's Law Constant (unitless)	key	Air Diffusivity (cm^2/s)	key	Water Diffusivity (cm^2/s)	key	Koc (L/kg)	key	Kd (cm^3/g)	key	Solubility in Water (mg/L)	key	Kp (cm/hr)	key
Dichloroethane, 1,2-	107-06-2	98.96	(4)	-35.5	(4)	4.82E-02	(4)	8.57E-02	(1)	1.10E-05	(1)	3.96E+01	(4)	2.38E-01	(11)	8.60E+03	(4)	4.20E-03	(4)
Dichloroethylene, 1,1-	75-35-4	96.94	(4)	-123	(4)	1.07E+00	(4)	8.63E-02	(1)	1.10E-05	(1)	3.18E+01	(4)	1.91E-01	(11)	2.42E+03	(4)	1.17E-02	(4)
Dichloroethylene, 1,2-trans-	156-60-5	96.94	(4)	-57	(4)	1.67E-01	(4)	8.76E-02	(1)	1.12E-05	(1)	3.96E+01	(4)	2.38E-01	(11)	4.52E+03	(4)	1.10E-02	(4)
Dichlorophenol, 2,4-	120-83-2	163	(4)	45	(4)	1.75E-04	(4)	4.86E-02	(1)	8.68E-06	(1)	4.92E+02	(4)	2.95E+00	(11)	4.50E+03	(4)	2.06E-02	(4)
Dichlorophenoxy Acetic Acid, 2,4-	94-75-7	221.04	(4)	141	(4)	1.45E-06	(4)	5.20E-02	(1)	6.07E-06	(1)	2.96E+01	(4)	1.78E-01	(11)	6.77E+02	(4)	6.64E-03	(4)
Dichloropropane, 1,2-	78-87-5	112.99	(4)	-100	(4)	1.15E-01	(4)	7.33E-02	(1)	9.73E-06	(1)	6.07E+01	(4)	3.64E-01	(11)	2.80E+03	(4)	7.53E-03	(4)
Dichloropropane, 1,3-	142-28-9	112.99	(4)	-99.5	(4)	3.99E-02	(4)	7.39E-02	(1)	9.82E-06	(1)	7.22E+01	(4)	4.33E-01	(11)	2.75E+03	(4)	7.76E-03	(4)
Dichloropropene, 1,3-	542-75-6	110.97	(4)	-50	(4)	1.45E-01	(4)	7.63E-02	(1)	1.01E-05	(1)	7.22E+01	(4)	4.33E-01	(11)	2.80E+03	(4)	8.34E-03	(4)
Dichlorvos	62-73-7	220.98	(4)	-60	(4)	2.35E-05	(4)	2.79E-02	(1)	7.33E-06	(1)	5.40E+01	(4)	3.24E-01	(11)	8.00E+03	(4)	8.04E-04	(4)
Dieldrin	60-57-1	380.91	(4)	226	(4)	4.09E-04	(4)	2.33E-02	(1)	6.01E-06	(1)	2.01E+04	(4)	1.21E+02	(11)	1.95E-01	(4)	3.26E-02	(4)
Diethanolamine	111-42-2	105.14	(4)	28	(4)	1.58E-09	(4)	7.68E-02	(1)	9.82E-06	(1)	1.00E+00	(4)	6.00E-03	(11)	1.00E+06	(4)	4.51E-05	(4)
Diethyl Phthalate	84-66-2	222.24	(4)	-40.5	(4)	2.49E-05	(4)	2.61E-02	(1)	6.72E-06	(1)	1.05E+02	(4)	6.29E-01	(11)	1.08E+03	(4)	3.60E-03	(4)
Diethylstilbestrol	56-53-1	268.36	(4)	171	(4)	2.37E-10	(4)	4.57E-02	(1)	5.34E-06	(1)	2.74E+05	(4)	1.64E+03	(11)	1.20E+01	(4)	1.14E-01	(4)
Dihydrosafrole	94-58-6	164.21	(4)	43.5	(4)	6.75E+00	(4)	6.34E-02	(1)	7.40E-06	(1)	2.07E+02	(4)	1.24E+00	(11)	5.77E+00	(4)	4.52E-02	(4)
Dimethoate	60-51-5	229.25	(4)	52	(4)	9.93E-09	(4)	2.61E-02	(1)	6.74E-06	(1)	1.28E+01	(4)	7.66E-02	(11)	2.33E+04	(4)	2.67E-04	(4)
Dimethoxybenzidine, 3,3'-	119-90-4	244.3	(4)	137	(4)	1.91E-09	(4)	4.86E-02	(1)	5.68E-06	(1)	5.09E+02	(4)	3.05E+00	(11)	6.00E+01	(4)	1.06E-03	(4)
Dimethylamino azobenzene [p-]	60-11-7	225.3	(4)	117	(4)	9.57E-06	(4)	5.13E-02	(1)	6.00E-06	(1)	2.03E+03	(4)	1.22E+01	(11)	2.30E-01	(4)	9.43E-02	(4)
Dimethylaniline, N,N-	121-69-7	121.18	(4)	2.5	(4)	2.32E-03	(4)	6.25E-02	(1)	8.31E-06	(1)	7.87E+01	(4)	4.72E-01	(11)	1.45E+03	(4)	1.12E-02	(4)
Dimethylbenz(a)anthracene, 7,12-	57-97-6	256.35	(4)	123	(4)	1.54E-04	(4)	4.71E-02	(1)	5.50E-06	(1)	4.94E+05	(4)	2.96E+03	(11)	6.10E-02	(4)	4.08E-01	(4)
Dimethylbenzidine, 3,3'-	119-93-7	212.3	(4)	132	(4)	3.31E-09	(4)	5.34E-02	(1)	6.24E-06	(1)	3.19E+03	(4)	1.91E+01	(11)	1.30E+03	(4)	3.62E-03	(4)
Dimethylformamide	68-12-2	73.1	(4)	-60.4	(4)	3.02E-06	(4)	9.72E-02	(1)	1.12E-05	(1)	1.00E+00	(4)	6.00E-03	(11)	1.00E+06	(4)	1.30E-04	(4)
Dimethylhydrazine, 1,2-	540-73-8	60.1	(4)	-9	(4)	2.84E-06	(4)	1.06E-01	(1)	1.16E-05	(1)	1.49E+01	(4)	8.92E-02	(11)	1.00E+06	(4)	3.17E-04	(4)
Dimethylphenol, 2,4-	105-67-9	122.17	(4)	24.5	(4)	3.89E-05	(4)	6.22E-02	(1)	8.31E-06	(1)	4.92E+02	(4)	2.95E+00	(11)	7.87E+03	(4)	1.09E-02	(4)
Dinitrobenzene, 1,2-	528-29-0	168.11	(4)	119	(4)	2.18E-06	(4)	4.47E-02	(1)	8.25E-06	(1)	3.59E+02	(4)	2.15E+00	(11)	1.33E+02	(4)	2.37E-03	(4)
Dinitrobenzene, 1,3-	99-65-0	168.11	(4)	90	(4)	2.00E-06	(4)	4.85E-02	(1)	9.21E-06	(1)	3.52E+02	(4)	2.11E+00	(11)	5.33E+02	(4)	1.74E-03	(4)
Dinitrobenzene, 1,4-	100-25-4	168.11	(4)	174	(4)	1.51E-05	(4)	4.92E-02	(1)	9.38E-06	(1)	3.52E+02	(4)	2.11E+00	(11)	6.90E+01	(4)	1.67E-03	(4)
Dinitro-o-cyclohexyl Phenol, 4,6-	131-89-5	266.26	(4)	107	(4)	1.38E-09	(4)	4.59E-02	(1)	5.36E-06	(1)	1.65E+04	(4)	9.92E+01	(11)	1.50E+01	(4)	2.75E-02	(4)
Dinitrophenol, 2,4-	51-28-5	184.11	(4)	116	(4)	3.52E-06	(4)	4.07E-02	(1)	9.08E-06	(1)	4.61E+02	(4)	2.76E+00	(11)	2.79E+03	(4)	1.87E-03	(4)
Dinitrotoluene Mixture, 2,4/2,6-	25321-14-6	182.14	(4)	60	(4)	1.62E-05	(4)	5.91E-02	(1)	6.91E-06	(1)	5.87E+02	(4)	3.52E+00	(11)	2.70E+02	(4)	4.16E-03	(4)
Dinitrotoluene, 2,4-	121-14-2	182.14	(4)	71	(4)	2.21E-06	(4)	3.75E-02	(1)	7.90E-06	(1)	5.76E+02	(4)	3.45E+00	(11)	2.00E+02	(4)	3.08E-03	(4)
Dinitrotoluene, 2,6-	606-20-2	182.14	(4)	66	(4)	3.05E-05	(4)	3.70E-02	(1)	7.76E-06	(1)	5.87E+02	(4)	3.52E+00	(11)	1.82E+02	(10)	3.70E-03	(4)
Dinoseb	88-85-7	240.22	(4)	40	(4)	1.86E-05	(4)	2.53E-02	(1)	6.52E-06	(1)	4.29E+03	(4)	2.58E+01	(11)	5.20E+01	(4)	1.63E-02	(4)
Dioxane, 1,4-	123-91-1	88.11	(4)	11.8	(4)	1.96E-04	(4)	8.74E-02	(1)	1.05E-05	(1)	2.63E+00	(4)	1.58E-02	(11)	1.00E+06	(4)	3.32E-04	(4)
Diphenylhydrazine, 1,2-	122-66-7	184.24	(4)	131	(4)	1.95E-05	(4)	3.43E-02	(1)	7.25E-06	(1)	1.51E+03	(4)	9.03E+00	(11)	2.21E+02	(4)	1.30E-02	(4)
Diquat	85-00-7	344.05	(4)	337	(4)	5.81E-12	(4)	2.08E-02	(1)	5.19E-06	(1)	9.27E+03	(4)	5.56E+01	(11)	7.08E+05	(4)	2.44E-07	(4)
Disodium phosphate	7558-79-4	141.96	(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.00E-03	(3)
Disulfoton	298-04-4	274.39	(4)	-25	(4)	8.83E-05	(4)	2.25E-02	(1)	5.67E-06	(1)	8.38E+02	(4)	5.03E+00	(11)	1.63E+01	(4)	2.12E-02	(4)
Diuron	330-54-1	233.1	(4)	158	(4)	2.06E-08	(4)	5.02E-02	(1)	5.86E-06	(1)	1.09E+02	(4)	6.55E-01	(11)	4.20E+01	(4)	4.66E-03	(4)
Endosulfan	115-29-7	406.92	(4)	106	(4)	2.66E-03	(4)	2.25E-02	(1)	5.76E-06	(1)	6.76E+03	(4)	4.06E+01	(11)	3.25E-01	(4)	2.86E-03	(4)
Endothall	145-73-3	186.17	(4)	144	(4)	1.57E-14	(4)	3.67E-02	(1)	8.18E-06	(1)	1.94E+01	(4)	1.16E-01	(11)	1.00E+05	(4)	2.63E-03	(4)
Endrin	72-20-8	380.91	(4)	226	(4)	4.09E-04	(4)	3.62E-02	(1)	4.22E-06	(1)	2.01E+04	(4)	1.21E+02	(11)	2.50E-01	(4)	3.26E-02	(4)
(4)chlorohydrin	106-89-8	92.53	(4)	-26	(4)	1.24E-03	(4)	8.89E-02	(1)	1.11E-05	(1)	9.91E+00	(4)	5.94E-02	(11)	6.59E+04	(4)	9.44E-04	(4)
Epoxybutane, 1,2-	106-88-7	72.11	(4)	-150	(4)	7.36E-03	(4)	9.29E-02	(1)	1.04E-05	(1)	9.91E+00	(4)	5.94E-02	(11)	9.50E+04	(4)	2.31E-03	(4)
Ethion	563-12-2	384.46	(4)	-13	(4)	1.55E-05	(4)	1.95E-02	(1)	4.81E-06	(1)	8.82E+02	(4)	5.29E+00	(11)	2.00E+00	(4)	2.55E-02	(4)
Ethoxyethanol, 2-	110-80-5	90.12	(4)	-70	(4)	1.92E-05	(4)	8.18E-02	(1)	9.73E-06	(1)	1.00E+00	(4)	6.00E-03	(11)	1.00E+06	(4)	3.00E-04	(4)
Ethyl Acetate	141-78-6	88.11	(4)	-83.6	(4)	5.48E-03	(4)	8.23E-02	(1)	9.70E-06	(1)	5.58E+00	(4)	3.35E-02	(11)	8.00E+04	(4)	1.53E-03	(4)
Ethyl Acrylate	140-88-5	100.12	(4)	-71.2	(4)	1.39E-02	(4)	7.45E-02	(1)	9.12E-06	(1)	1.07E+01	(4)	6.39E-02	(11)	1.50E+04	(4)	3.24E-03	(4)
Ethyl Chloride	75-00-3	64.52	(4)	-139	(4)	4.54E-01	(4)	1.04E-01	(1)	1.16E-05	(1)	2.17E+01	(4)	1.30E-01	(11)	6.71E+03	(4)	6.07E-03	(4)
Ethyl Ether	60-29-7	74.12	(4)	-116	(4)	5.03E-02	(4)	8.52E-02	(1)	9.36E-06	(1)	9.70E+00	(4)	5.82E-02	(11)	6.04E+04	(4)	2.35E-03	(4)
Ethyl Methacrylate	97-63-2	114.15	(4)	-67.1	(4)	2.34E-02	(4)	6.53E-02	(1)	8.38E-06	(1)	1.67E+01	(4)	1.00E-01	(11)	5.40E+03	(4)	6.98E-03	(4)
Ethylbenzene	100-41-4	106.17	(4)	-94.9	(4)	3.22E-01	(4)	6.85E-02	(1)	8.46E-06	(1)	4.46E+02	(4)	2.68E+00	(11)	1.69E+02	(4)	4.93E-02	(4)
Ethylene Diamine	107-15-3	60.1	(4)	11.1	(4)	7.07E-08	(4)	1.09E-01	(1)	1.22E-05	(1)	1.49E+01	(4)	8.92E-02	(11)	1.00E+06	(4)	3.18E-05	(4)
Ethylene Glycol	107-21-1	62.07	(4)	-13	(4)	2.45E-06	(4)	1.17E-01	(1)	1.36E-05	(1)	1.00E+00	(4)	6.00E-03	(11)	1.00E+06	(4)	8.77E-05	(4)
Ethylene Oxide	75-21-8	44.05	(4)	-112	(4)	6.05E-03	(4)	1.34E-01	(1)	1.45E-05	(1)	3.24E+00	(4)	1.94E-02	(11)	1.00E+06	(4)	5.60E-04	(4)
Ethylene Thiourea	96-45-7	102.15	(4)	203	(4)	1.37E-05	(4)	8.69E-02	(1)	1.02E-05	(1)	1.30E+01	(4)	7.78E-02	(11)	2.00E+04	(4)	1.52E-04	(4)
Ethyleneimine	151-56-4	43.07	(4)	-77.9	(4)	4.95E-04	(4)	1.33E-01	(1)	1.42E-05	(1)	9.04E+00	(4)	5.43E-02	(11)	1.00E+06	(4)	5.81E-04	(4)
Fluoranthene	206-44-0	202.26	(4)	108	(4)	3.62E-04	(4)	2.76E-02	(1)	7.18E-06	(1)	5.55E+04	(4)	3.33E+02	(11)	2.60E-01	(4)	3.08E-01	(4)
Fluorene	86-73-7	166.22	(4)	115	(4)	3.93E-03	(4)	4.40E-02	(1)	7.89E-06	(1)	9.16E+03	(4)	5.50E+01	(11)	1.69E+00	(4)	1.10E-01	(4)
Fluorine (Soluble Fluoride)	7782-41-4	38	(4)	-220	(4)	NA	NA	NA	NA	NA	NA	NA	NA	1.50E+02	(9)	1.69E+00	(4)	1.00E-03	(3)
Formaldehyde	50-00-0	30.03	(4)	-92	(4)	1.38E-05	(4)	1.67E-01	(1)	1.74E-05	(1)	1.00E+00	(4)	6.00E-03	(11)	4.00E+05	(4)	1.82E-03	(4)
Formic Acid	64-18-6	46.03	(4)	8.3	(4)	6.83E-06	(4)	1.48E-01	(1)	1.72E-05	(1)	1.00E+00	(4)	6.00E-03	(11)	1.00E+06	(4)	3.78E-04	(4)
Furan	110-00-9	68.08	(4)	-85.6	(4)	2.21E-01	(4)	1.03E-01	(1)	1.17E-05	(1)	8.00E+01	(4)	4.80E-01	(11)	1.00E+04	(4)	5.05E-03	(4)
Furfural	98-01-1	96.09	(4)	-38.1	(4)	1.54E-04	(4)	8.53E-02	(1)	1.07E-05	(1)	6.08E+00	(4)	3.65E-02	(11)	7.41E+04	(4)	8.48E-04	(4)
Glycidyl	765-34-4	72.06	(4)	-62	(4)	3.21E-05	(4)	1.06E-01	(1)	1.26E-05	(1)	1.00E+00	(4)	6.00E-03	(11)	1.00E+06	(4)	5.16E-04	(4)
Guthion	86-50-0	317.32	(4)	73	(4)	9.77E-07	(4)	2.33E-02	(1)	5.96E-06	(1)	5.19E+01	(4)	3.12E-01	(11)	2.09E+01	(4)	1.75E-03	(4)
Heptachlor	76-44-8	373.32	(4)	95.5	(4)	1.20E-02	(4)	2.23E-02	(1)	5.70E-06	(1)	4.13E+04	(4)	2.48E+02	(11)	1.80E-01	(4)	1.43E-01	(4)
Heptachlor Epoxide	1024-57-3	389.32	(4)	160	(4)	8.59E-04	(4)	3.56E-02	(1)	4.16E-06	(1)	1.01E+04	(4)	6.07E+01	(11)	2.00E-01	(4)	2.09E-02	(4)
Hexachlorobenzene	118-74-1	284.78	(4)	232	(4)	6.95E-02	(4)	2.90E-02	(1)	7.85E-06	(1)	6.20E+03	(4)	3.72E+01	(11)	6.20E-03	(4)	2.54E-01	(4)
Hexachlorobutadiene	87-68-3	260.76	(4)	-21	(4)	4.21E-01	(4)	2.67E-02	(1)	7.03E-06	(1)	8.45E+02	(4)	5.07E+00	(11)	3.20E+00	(4)	8.10E-02	(4)
Hexachlorocyclohexane, Alpha-	319-84-6	290.83	(4)	113	(4)	2.10E-04	(4)	4.33E-02	(1)	5.06E-06	(1)	2.81E+03	(4)	1.68E+01	(11)	2.00E+00	(4)	2.06E-02	(4)
Hexachlorocyclohexane, Beta-	319-85-7	290.83	(4)	113	(4)	2.10E-04	(4)	2.77E-02	(1)	7.40E-06	(1)	2.81E+03	(4)	1.68E+01	(11)	2.40E-01	(4)	2.06E-02	(4)
Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	290.83	(4)	113	(4)	2.10E-04	(4)	4.33E-02	(1)	5.06E-06	(1)	2.81E+03	(4)	1.68E+01	(11)	7.30E+00	(4)	2.06E-02	(4)
Hexachlorocyclohexane, Technical	608-73-1	290.83	(4)	113	(4)	2.10E-04	(4)	4.33E-02	(1)	5.06E-06	(1)	2.81E+03	(4)	1.68E+01	(11)	8.00E+00	(4)	2.06E-02	(4)
Hexachlorocyclopentadiene	77-47-4	272.77	(4)	-9	(4)	1.10E+00	(4)	2.72E-02	(1)	7.22E-06	(1)	1.40E+03	(4)	8.42E+00	(11)	1.80E+00	(4)	1.03E-01	(4)
Hexachloroethane	67-72-1	236.74	(4)	187	(4)	1.59E-01	(4)	3.21E-02	(1)	8.89E-06	(1)	1.97E+02	(4)	1.18E+00	(11)	5.00E+01	(4)	4.15E-02	(4)
Hexachlorophene	70-30-4	406.91	(4)	167	(4)	2.24E-11	(4)	3.46E-02	(1)	4.04E-06	(1)	6.69E+05	(4)	4.01E+03	(11)	1.40E+02	(4)	8.36E-01	(4)
Hexamethylene Diisocyanate, 1,6-	822-06-0	168.2	(4)	-67	(4)	1.96E-03	(4)	4.04E-02	(1)	7.23E-06	(1)	4.82E+03	(4)	2.89E+01	(11)	1.79E+02	(4)	2.37E-02	(4)
Hexamethylphosphoramide	680-31-9	179.2	(4)	7.2	(4)	2.92E-10	(4)	3.48E-02	(1)	6.87E-06	(1)	1.00E+01	(4)	6.00E-02	(11)	1.00E+06	(4)	2.37E-04	(4)
Hexane, N-	110-54-3	86.18	(4)	-95.3	(4)	7.36E+01	(4)	7.31E-02	(1)	8.17E-06	(1)	1.32E+02	(4)	7.89E-01	(11)	9.50E+00	(4)	2.01E-01	(4)
Hexanedioic Acid	124-04-9	146.14	(4)	153	(4)	1.93E-10	(4)	5.77E-02	(1)	9.17E-06	(1)	2.43E+01	(4)	1.46E-01	(11)	3.08E+04	(4)	2.68E-04	(4)
Hydrazine	302-01-2	32.05	(4)	2	(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.00E+06	(4)	4.36E-05	(3)
Hydrogen Chloride	7647-01-0	35.45	(4)	-114	(7)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.00E-03	(3)
Hydrogen Cyanide	74-90-8	27.03	(4)	-13.4	(4)	5.44E-03	(4)	1.68E-01	(1)	1.68E-05	(1)	NA	NA	9.90E+00	(2)	1.00E+06	(4)	1.00E-03	(3)
Hydrogen Fluoride	7664-39-3	20.01	(4)	-83.4	(7)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.00E-03	(3)
Hydrogen Sulfide	7783-06-4	34.08	(4)	-85.5	(7)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.37E+06	(8)	1.00E-03	(3)
Hydroquinone	123-31-9	110.11	(4)	172	(4)	1.93E-09	(4)	7.98E-02	(1)	1.07E-05	(1)	2.41E+02	(4)	1.44E+00	(11)	7.20E+04	(4)	9.31E-04	(4)
Indeno[1,2,3-cd]pyrene	193-39-5	276.34	(4)	164	(4)	6.56E-05	(2)	4.48E-02	(1)	5.23E-06	(1)	3.47E+06	(2)	2.08E+04	(11)	2.20E-05	(10)	1.04E+00	(3)
Isobutyl Alcohol	78-83-1	74.12	(4)	-108	(4)	4.00E-04	(4)	8.97E-02	(1)	1.00E-05	(1)	2.92E+00	(4)	1.75E-02	(11)	8.50E+04	(4)	1.92E-03	(4)
Isophorone	78-59-1	138.21	(4)	-8.1	(4)	2.72E-04	(4)	5.25E-02	(1)	7.53E-06	(1)	6.52E+01	(4)	3.91E-01	(11)	1.20E+04	(4)	3.54E-03	(4)
Kerb	23950-58-5	256.13	(4)	155	(4)	3.99E-07	(4)	4.71E-02	(1)	5.50E-06	(1)	4.05E+02	(4)	2.43E+00	(11)	1.50E+01	(4)	1.09E-02	(4)
Lead acetate	301-04-2	325.29	(4)	327	(4)	NA	NA	3.34E-02	(1)	9.57E-06	(1)	1.00E+00	(4)	6.00E-03	(11)	4.43E+05	(7)	2.08E-05	(4)
Lead and Compounds	7439-92-1	207.2	(4)	328	(4)	NA	NA	NA	NA	NA	NA	NA	NA	9.00E+02	(9)	NA	NA	1.00E-04	(3)
Lead subacetate	1335-32-6	805.7	(4)	157	(4)	NA	NA	2.19E-02	(1)	2.56E-06	(1)	1.04E+01	(4)	6.22E-02	(11)	6.30E+04	(7)	1.03E-10	(4)
Malathion	121-75-5	330.35	(4)	2.8	(4)	2.00E-07	(4)	2.10E-02	(1)	5.24E-06	(1)	3.13E+01	(4)	1.88E-01	(11)	1.43E+02	(4)	8.12E-04	(4)
Maleic Anhydride	108-31-6	98.06	(4)	52.8	(4)	1.61E-04	(4)	8.84E-02	(1)	1.14E-05	(1)	1.00E+00	(4)	6.00E-03	(11)	1.63E+05	(8)	5.25E-03	(4)
Maleic Hydrazide	123-33-1	112.09	(4)	306	(4)	1.08E-09	(4)	8.17E-02	(1)	9.55E-06	(1)	3.30E+00	(4)	1.98E-02	(11)	4.51E+03	(4)	1.02E-04	(4)
Malononitrile	109-77-3	66.06	(4)	32	(4)	5.36E-06	(4)	1.15E-01	(1)	1.36E-05	(1)	3.33E+00	(4)	2.00E-02	(11)	1.33E+05	(4)	2.66E-04	(4)
Mercury and Compounds	7439-97-6	200.59	(4)	-38.8	(4)	4.67E-01	(2)	3.07E-02	(2)	6.30E-06	(2)	NA	NA	5.20E+01	(2)	6.00E-02	(4)	1.00E-03	(3)
Methacrylonitrile	126-98-7	67.09	(4)	-35.8	(4)	1.01E-02	(4)	9.64E-02	(1)	1.06E-05	(1)	1.31E+01	(4)	7.83E-02	(11)	2.54E+04	(4)	1.86E-03	(4)
Methanol	67-56-1	32.04	(4)	-97.6	(4)	1.86E-04	(4)	1.58E-01	(1)	1.65E-05	(1)	1.00E+00	(4)	6.00E-03	(11)	1.00E+06	(4)	3.19E-04	(4)
Methomyl	16752-77-5	162.21	(4)	78	(4)	8.05E-10	(4)	4.76E-02	(1)	8.37E-06	(1)	1.00E+01	(4)	6.00E-02	(11)	5.80E+04	(4)	4.82E-04	(4)
Methoxychlor	72-43-5	345.66	(4)	87	(4)	8.30E-06	(4)	2.21E-02	(1)	5.59E-06	(1)	2.69E+04	(4)	1.61E+02	(11)	1.00E-01	(4)	4.28E-02	(4)
Methyl Ethyl Ketone (2-Butanone)	78-93-3	72.11	(4)	-86.6	(4)	2.33E-03	(4)	9.14E-02	(1)	1.02E-05	(1)	4.51E+00	(4)	2.71E-02	(11)	2.23E+05	(4)	9.62E-04	(4)
Methyl Hydrazine	60-34-4	46.07	(4)	-52.4	(4)	1.29E-06	(4)	1.29E-01	(1)	1.40E-05	(1)	1.33E+01	(4)	7.99E-02	(11)	1.00E+06	(4)	1.73E-04	(4)
Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	100.16	(4)	-84	(4)	5.64E-03	(4)	6.98E-02	(1)	8.35E-06	(1)	1.26E+01	(4)	7.56E-02	(11)	1.90E+04	(4)	3.19E-03	(4)
Methyl Isocyanate	624-83-9	57.05	(4)	-45	(4)	3.79E-02	(4)	1.17E-01	(1)	1.31E-05	(1)	3.96E+01	(4)	2.38E-01	(11)	4.83E+04	(4)	2.50E-03	(4)
Methyl Methacrylate	80-62-6	100.12	(4)	-48	(4)	1.30E-02	(4)	7.50E-02	(1)	9.21E-06	(1)	9.14E+00	(4)	5.48E-02	(11)	1.50E+04	(4)	3.55E-03	(4)
Methyl Parathion	298-00-0	263.21	(4)	35.5	(4)	4.09E-06	(4)	2.50E-02	(1)	6.44E-06	(1)	7.29E+02	(4)	4.38E+00	(11)	3.77E+01	(4)	4.16E-03	(4)
Methyl tert-Butyl Ether (MTBE)	1634-04-4	88.15	(4)	-109	(4)	2.40E-02	(4)	7.53E-02	(1)	8.59E-06	(1)	1.16E+01	(4)	6.94E-02	(11)	5.10E+04	(4)	2.11E-03	(4)
Methyl-5-Nitroaniline, 2-	99-55-8	152.15	(4)	106	(4)	7.93E-07	(4)	6.67E-02	(1)	7.79E-06	(1)	1.79E+02	(4)	1.07E+00	(11)	6.13E+02	(4)	3.84E-03	(4)
Methylaniline Hydrochloride, 2-	636-21-5	143.62	(4)	-16.3	(4)	8.09E-05	(4)	6.93E-02	(1)	8.09E-06	(1)	1.15E+02	(4)	6.90E-01	(11)	1.66E+04	(4)	2.96E-03	(4)
Methylcholanthrene, 3-	56-49-5	268.36	(4)	180	(4)	2.14E-04	(4)	2.41E-02	(1)	6.14E-06	(1)	9.62E+05	(4)	5.77E+03	(11)	2.90E-03	(4)	9.03E-01	(4)
Methylene Chloride	75-09-2	84.93	(4)	-95.1	(4)	1.33E-01	(4)	9.99E-02	(1)	1.25E-05	(1)	2.17E+01	(4)	1.30E-01	(11)	1.30E+04	(4)	3.54E-03	(4)
Methylene-bis(2-chloroaniline), 4,4'-	101-14-4	267.16	(4)	110	(4)	4.66E-10	(4)	4.58E-02	(1)	5.35E-06	(1)	5.70E+03	(4)	3.42E+01	(11)	1.39E+01	(4)	1.97E-02	(4)
Methylenebisbenzenamine, 4,4'-	101-77-9	198.27	(4)	92.5	(4)	6.46E-10	(4)	5.59E-02	(1)	6.53E-06	(1)	2.13E+03	(4)	1.28E+01	(11)	1.00E+03	(4)	1.38E-03	(4)
Methylenediphenyl Diisocyanate	101-68-8	250.26	(4)	38	(4)	3.66E-05	(4)	2.42E-02	(1)	6.15E-06	(1)	2.85E+05	(4)	1.71E+03	(11)	1.84E+00	(4)	1.81E-01	(4)
Methylnaphthalene, 1-	90-12-0	142.2	(4)	34	(4)	2.10E-02	(4)	5.28E-02	(1)	7.85E-06	(1)	2.53E+03	(4)	1.52E+01	(11)	2.58E+01	(4)	9.31E-02	(4)
Methylnaphthalene, 2-	91-57-6	142.2	(4)	34.4	(4)	2.12E-02	(4)	5.24E-02	(1)	7.78E-06	(1)	2.48E+03	(4)	1.49E+01	(11)	2.46E+01	(4)	9.17E-02	(4)
Methyl-N-nitro-N-nitrosoguanidine, N-	70-25-7	147.09	(4)	118	(4)	4.99E-11	(4)	6.82E-02	(1)	7.97E-06	(1)	7.20E+01	(4)	4.32E-01	(11)	1.00E+06	(4)	5.72E-05	(4)
Naled	300-76-5	380.79	(4)	27	(4)	2.66E-03	(4)	2.46E-02	(1)	6.43E-06	(1)	1.27E+02	(4)	7.60E-01	(11)	1.50E+00	(4)	9.44E-05	(4)

Table 2: Physical/chemical data (continued)

Chemical	CAS Number	MW (g/mol)	key	Melting Point (°C)	key	Henry's Law Constant (unitless)	key	Air Diffusivity (cm^2/s)	key	Water Diffusivity (cm^2/s)	key	Koc (L/kg)	key	Kd (cm^3/g)	key	Solubility in Water (mg/L)	key	Kp (cm/hr)	key
Naphthalene	91-20-3	128.18	(4)	80.2	(4)	1.80E-02	(4)	6.05E-02	(1)	8.38E-06	(1)	1.54E+03	(4)	9.26E+00	(11)	3.10E+01	(4)	4.66E-02	(4)
Naphthylamine, 2-	91-59-8	143.19	(4)	113	(4)	3.31E-06	(4)	6.45E-02	(1)	1.04E-05	(1)	2.48E+03	(4)	1.49E+01	(11)	1.89E+02	(4)	8.07E-03	(4)
Nickel Carbonyl	13463-39-3	170.734	(7)	-19.3	(7)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.80E+02	(8)	1.00E-03	(3)
Nickel Soluble Salts	7440-02-0	58.69	(4)	1460	(7)	NA	NA	NA	NA	NA	NA	NA	NA	6.50E+01	(2)	NA	NA	2.00E-04	(3)
Nitroaniline, 4-	100-01-6	138.13	(4)	146	(4)	5.15E-08	(4)	6.37E-02	(1)	9.75E-06	(1)	1.09E+02	(4)	6.55E-01	(11)	7.28E+02	(4)	2.21E-03	(4)
Nitrobenzene	98-95-3	123.11	(4)	5.7	(4)	9.81E-04	(4)	6.81E-02	(1)	9.45E-06	(1)	2.26E+02	(4)	1.36E+00	(11)	2.09E+03	(4)	5.41E-03	(4)
Nitroglycerin	55-63-0	227.09	(4)	13.5	(4)	3.54E-06	(4)	2.90E-02	(1)	7.74E-06	(1)	1.16E+02	(4)	6.95E-01	(11)	1.38E+03	(4)	9.94E-04	(4)
Nitropropane, 2-	79-46-9	89.09	(4)	-91.3	(4)	4.87E-03	(4)	8.47E-02	(1)	1.02E-05	(1)	3.08E+01	(4)	1.85E-01	(11)	1.70E+04	(4)	2.06E-03	(4)
Nitrosodiethanolamine, N-	1116-54-7	134.14	(4)	81.5	(4)	9.32E-15	(4)	7.25E-02	(1)	8.47E-06	(1)	1.00E+00	(4)	6.00E-03	(11)	1.00E+06	(4)	2.47E-05	(3)
Nitrosodiethylamine, N-	55-18-5	102.14	(4)	-15.6	(4)	1.48E-04	(4)	7.38E-02	(1)	9.13E-06	(1)	8.29E+01	(4)	4.98E-01	(11)	1.06E+05	(4)	8.72E-04	(4)
Nitrosodimethylamine, N-	62-75-9	74.08	(4)	-39.1	(4)	7.44E-05	(4)	9.88E-02	(1)	1.15E-05	(1)	2.28E+01	(4)	1.37E-01	(11)	1.00E+06	(4)	2.51E-04	(4)
Nitroso-di-N-butylamine, N-	924-16-3	158.25	(4)	28.2	(4)	5.40E-04	(4)	6.49E-02	(1)	7.59E-06	(1)	9.15E+02	(4)	5.49E+00	(11)	1.27E+03	(4)	1.13E-02	(4)
Nitroso-di-N-propylamine, N-	621-64-7	130.19	(4)	6.81	(4)	2.20E-04	(4)	5.64E-02	(1)	7.76E-06	(1)	2.75E+02	(4)	1.65E+00	(11)	1.30E+04	(4)	2.33E-03	(4)
Nitrosodiphenylamine, N-	86-30-6	198.23	(4)	143	(4)	2.05E-04	(2)	5.59E-02	(1)	6.53E-06	(1)	2.63E+03	(4)	1.58E+01	(11)	3.50E+01	(4)	1.45E-02	(4)
Nitrosomorpholine [N-]	59-89-2	116.12	(4)	29	(4)	1.00E-06	(4)	7.98E-02	(1)	9.33E-06	(1)	2.25E+01	(4)	1.35E-01	(11)	1.00E+06	(4)	1.78E-04	(4)
Nitroso-N-ethylurea, N-	759-73-9	117.11	(4)	99	(4)	5.40E-09	(4)	7.94E-02	(1)	9.27E-06	(1)	2.10E+01	(4)	1.26E-01	(11)	1.30E+04	(4)	4.90E-04	(4)
Nitroso-N-methylurea, N-	684-93-5	103.08	(4)	124	(4)	4.05E-09	(4)	8.64E-02	(1)	1.01E-05	(1)	1.10E+01	(4)	6.60E-02	(11)	1.44E+04	(4)	3.95E-04	(4)
Nitrosopiperidine [N-]	100-75-4	114.15	(4)	6.83	(4)	3.45E-05	(4)	6.99E-02	(1)	9.18E-06	(1)	1.68E+02	(4)	1.01E+00	(11)	7.65E+04	(4)	6.22E-04	(4)
Nitrosopyrrolidine, N-	930-55-2	100.12	(4)	-3.09	(4)	2.00E-06	(4)	8.00E-02	(1)	1.01E-05	(1)	9.19E+01	(4)	5.51E-01	(11)	1.00E+06	(4)	3.21E-04	(4)
Nitrotoluene, o-	88-72-2	137.14	(4)	-10	(4)	5.11E-04	(4)	5.88E-02	(1)	8.67E-06	(1)	3.71E+02	(4)	2.22E+00	(11)	6.50E+02	(4)	8.99E-03	(4)
Nitrotoluene, p-	99-99-0	137.14	(4)	51.6	(4)	2.30E-04	(4)	5.74E-02	(1)	8.41E-06	(1)	3.63E+02	(4)	2.18E+00	(11)	4.42E+02	(4)	1.00E-02	(4)
Octamethylpyrophosphoramide	152-16-9	286.25	(4)	17	(4)	2.58E-15	(4)	2.15E-02	(1)	5.37E-06	(1)	2.01E+01	(4)	1.21E-01	(11)	1.00E+06	(4)	8.30E-06	(4)
Octyl Phthalate, di-N-	117-84-0	390.57	(4)	-4	(4)	1.05E-04	(4)	3.56E-02	(1)	4.15E-06	(1)	1.41E+05	(4)	8.45E+02	(11)	2.20E-02	(4)	2.43E+00	(4)
Oxamyl	23135-22-0	219.26	(4)	101	(4)	9.69E-09	(4)	2.35E-02	(1)	5.87E-06	(1)	1.00E+01	(4)	6.00E-02	(11)	2.80E+05	(4)	4.49E-05	(4)
Parathion	56-38-2	291.26	(4)	6.1	(4)	1.22E-05	(4)	2.29E-02	(1)	5.82E-06	(1)	2.42E+03	(4)	1.45E+01	(11)	1.10E+01	(4)	1.28E-02	(4)
Pentachlorobenzene	608-93-5	250.34	(4)	86	(4)	2.87E-02	(4)	2.94E-02	(1)	7.95E-06	(1)	3.71E+03	(4)	2.22E+01	(11)	8.31E-01	(4)	1.68E-01	(4)
Pentachloroethane	76-01-7	202.3	(4)	-29	(4)	7.93E-02	(4)	3.15E-02	(1)	8.57E-06	(1)	1.36E+02	(4)	8.17E-01	(11)	4.80E+02	(4)	1.58E-02	(4)
Pentachloronitrobenzene	82-68-8	295.34	(4)	144	(4)	1.81E-03	(4)	2.63E-02	(1)	6.92E-06	(1)	6.00E+03	(4)	3.60E+01	(11)	4.40E-01	(4)	4.18E-02	(4)
Pentachlorophenol	87-86-5	266.34	(4)	174	(4)	1.00E-06	(4)	2.95E-02	(1)	8.01E-06	(1)	4.96E+03	(4)	2.98E+01	(11)	1.40E+01	(4)	1.27E-01	(4)
Phenacetin	62-44-2	179.22	(4)	138	(4)	8.71E-09	(4)	5.98E-02	(1)	6.98E-06	(1)	4.10E+01	(4)	2.46E-01	(11)	7.66E+02	(4)	1.73E-03	(4)
Phenol	108-95-2	94.11	(4)	40.9	(4)	1.36E-05	(4)	8.34E-02	(1)	1.03E-05	(1)	1.87E+02	(4)	1.12E+00	(11)	8.28E+04	(4)	4.34E-03	(4)
Phenylenediamine, p-	106-50-3	108.14	(4)	146	(4)	3.63E-08	(4)	8.37E-02	(1)	9.78E-06	(1)	3.38E+01	(4)	2.03E-01	(11)	3.70E+04	(4)	2.45E-04	(4)
Phenylmercuric Acetate	62-38-4	336.74	(4)	153	(4)	2.31E-08	(4)	3.93E-02	(1)	4.59E-06	(1)	5.64E+01	(4)	3.39E-01	(11)	4.37E+03	(4)	5.99E-05	(4)
Phorate	298-02-2	260.37	(4)	-15	(7)	1.79E-04	(4)	2.33E-02	(1)	5.90E-06	(1)	4.60E+02	(4)	2.76E+00	(11)	5.00E+01	(4)	1.26E-02	(4)
Phosgene	75-44-5	98.92	(4)	-118	(4)	6.83E-01	(4)	8.93E-02	(1)	1.17E-05	(1)	1.00E+00	(4)	6.00E-03	(11)	6.83E+03	(5)	1.47E-04	(4)
Phosphine	7803-51-2	34	(4)	-133	(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.30E+00	(4)	1.00E-03	(3)
Phosphoric Acid	7664-38-2	98	(4)	42.4	(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.48E+06	(7)	1.00E-03	(3)
Phosphorus, White	7723-14-0	30.974	(7)	-133	(4)	NA	NA	NA	NA	NA	NA	NA	NA	3.50E+00	(9)	3.30E+00	(4)	1.00E-03	(3)
Phthalic Anhydride	85-44-9	148.12	(4)	131	(4)	6.66E-07	(4)	5.95E-02	(1)	9.75E-06	(1)	1.00E+01	(4)	6.00E-02	(11)	6.20E+03	(4)	2.67E-03	(4)
Polychlorinated Biphenyls, Total	1336-36-3	291.99	(4)	122	(4)	7.77E-03	(4)	4.32E-02	(1)	5.04E-06	(1)	7.81E+04	(4)	4.69E+02	(11)	7.00E-01	(6)	5.45E-01	(4)
Potassium Cyanide	151-50-8	65.12	(4)	634	(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.20E+05	(4)	2.00E-03	(3)
Potassium Silver Cyanide	506-61-6	199	(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.00E-03	(3)
Propargite	2312-35-8	350.48	(4)	173	(4)	2.62E-05	(4)	1.94E-02	(1)	4.78E-06	(1)	3.67E+04	(4)	2.20E+02	(11)	2.15E-01	(4)	3.56E-02	(4)
Propargyl Alcohol	107-19-7	56.06	(4)	-51.8	(4)	4.70E-05	(4)	1.17E-01	(1)	1.31E-05	(1)	1.90E+00	(4)	1.14E-02	(11)	1.00E+06	(4)	4.24E-04	(4)
Propham	122-42-9	179.22	(4)	87.3	(4)	7.52E-06	(4)	3.58E-02	(1)	7.11E-06	(1)	2.19E+02	(4)	1.31E+00	(11)	1.79E+02	(4)	8.26E-03	(4)
Propionaldehyde	123-38-6	58.08	(4)	-80	(4)	3.00E-03	(4)	1.10E-01	(1)	1.22E-05	(1)	1.00E+00	(4)	6.00E-03	(11)	3.06E+05	(4)	1.82E-03	(4)
Propylene Oxide	75-56-9	58.08	(4)	-112	(4)	2.85E-03	(4)	1.09E-01	(1)	1.19E-05	(1)	5.19E+00	(4)	3.12E-02	(11)	5.90E+05	(4)	7.74E-04	(4)
Pyrene	129-00-0	202.26	(4)	151	(4)	4.87E-04	(4)	2.78E-02	(1)	7.25E-06	(1)	5.43E+04	(4)	3.26E+02	(11)	1.35E-01	(4)	2.01E-01	(4)
Pyridine	110-86-1	79.1	(4)	-41.6	(4)	4.50E-04	(4)	9.31E-02	(1)	1.09E-05	(1)	7.17E+01	(4)	4.30E-01	(11)	1.00E+06	(4)	1.52E-03	(4)
Quinoline	91-22-5	129.16	(4)	-14.8	(4)	6.83E-05	(4)	6.18E-02	(1)	8.69E-06	(1)	1.54E+03	(4)	9.26E+00	(11)	6.11E+03	(4)	6.59E-03	(4)
Safrole	94-59-7	162.19	(4)	11.2	(4)	3.71E-04	(4)	4.42E-02	(1)	7.59E-06	(1)	2.07E+02	(4)	1.24E+00	(11)	5.90E+00	(4)	1.13E-02	(3)
Selenious Acid	7783-00-8	128.97	(4)	70	(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.00E+05	(8)	1.00E-03	(3)
Selenium	7782-49-2	78.96	(7)	-65.7	(4)	NA	NA	NA	NA	NA	NA	NA	NA	5.00E+00	(2)	NA	NA	1.00E-03	(3)
Silver	7440-22-4	107.87	(4)	962	(7)	NA	NA	NA	NA	NA	NA	NA	NA	8.30E+00	(2)	NA	NA	6.00E-04	(3)
Silver Cyanide	506-64-9	133.89	(4)	474	(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.30E+01	(4)	1.00E-03	(3)
Sodium Azide	26628-22-8	65.01	(4)	300	(7)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.08E+05	(7)	1.00E-03	(3)
Sodium Cyanide	143-33-9	49.01	(4)	563	(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.82E+05	(7)	1.00E-03	(3)
Sodium Fluoride	7681-49-4	41.99	(4)	993	(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.22E+04	(4)	1.00E-03	(3)
Sodium Fluoroacetate	62-74-8	100.03	(4)	201	(4)	4.46E-05	(4)	8.82E-02	(1)	1.03E-05	(1)	1.44E+00	(4)	8.64E-03	(11)	1.11E+06	(4)	1.32E-06	(4)
Sodium tripolyphosphate	7758-29-4	367.86	(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.00E-03	(3)
Strychnine	57-24-9	334.42	(4)	287	(4)	2.44E-12	(4)	2.21E-02	(1)	5.58E-06	(1)	5.40E+03	(4)	3.24E+01	(11)	1.60E+02	(4)	3.99E-04	(4)
Styrene	100-42-5	104.15	(4)	-31	(4)	1.12E-01	(4)	7.11E-02	(1)	8.78E-06	(1)	4.46E+02	(4)	2.68E+00	(11)	3.10E+02	(4)	3.72E-02	(4)
Sulfuric Acid	7664-93-9	98.07	(4)	10.3	(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.00E+06	(4)	1.00E-03	(3)
TCDD, 2,3,7,8-	1746-01-6	321.98	(4)	305	(4)	2.04E-03	(4)	4.70E-02	(1)	4.73E-06	(1)	2.49E+05	(4)	1.49E+03	(11)	2.00E-04	(4)	8.08E-01	(4)
Tetrachlorobenzene, 1,2,4,5-	95-94-3	215.89	(4)	140	(4)	4.09E-02	(4)	3.19E-02	(1)	8.75E-06	(1)	2.22E+03	(4)	1.33E+01	(11)	5.95E-01	(4)	1.17E-01	(4)
Tetrachloroethane, 1,1,1,2-	630-20-6	167.85	(4)	-70.2	(4)	1.02E-01	(4)	4.82E-02	(1)	9.10E-06	(1)	8.60E+01	(4)	5.16E-01	(11)	1.07E+03	(4)	1.59E-02	(4)
Tetrachloroethane, 1,1,2,2-	79-34-5	167.85	(4)	-43.8	(4)	1.50E-02	(4)	4.89E-02	(1)	9.29E-06	(1)	9.49E+01	(4)	5.70E-01	(11)	2.83E+03	(4)	6.94E-03	(4)
Tetrachloroethylene	127-18-4	165.83	(4)	-22.3	(4)	7.24E-01	(4)	5.05E-02	(1)	9.46E-06	(1)	9.49E+01	(4)	5.70E-01	(11)	2.06E+02	(4)	3.34E-02	(4)
Tetrachlorophenol, 2,3,4,6-	58-90-2	231.89	(4)	70	(4)	3.61E-04	(4)	5.03E-02	(1)	5.88E-06	(1)	2.97E+03	(4)	1.78E+01	(11)	2.30E+01	(4)	7.10E-02	(4)
Tetraethyl Dithiopyrophosphate	3689-24-5	322.31	(4)	-32.3	(4)	1.82E-04	(4)	2.12E-02	(1)	5.28E-06	(1)	2.66E+02	(4)	1.59E+00	(11)	3.00E+01	(4)	1.09E-02	(4)
Tetraethyl Lead	78-00-2	323.45	(4)	-136	(4)	2.32E+01	(4)	2.46E-02	(1)	6.40E-06	(1)	6.48E+02	(4)	3.89E+00	(11)	2.90E-01	(4)	1.37E-02	(4)
Tetrahydrofuran	109-99-9	72.11	(4)	-108	(4)	2.88E-03	(4)	9.54E-02	(1)	1.08E-05	(1)	1.08E+01	(4)	6.45E-02	(11)	1.00E+06	(4)	1.25E-03	(4)
Thallium (Soluble Salts)	7440-28-0	204.38	(4)	304	(4)	NA	NA	NA	NA	NA	NA	NA	NA	7.10E+01	(2)	NA	NA	1.00E-03	(3)
Thiofanox	39196-18-4	218.32	(4)	57	(4)	3.84E-07	(4)	5.24E-02	(1)	6.12E-06	(1)	7.24E+01	(4)	4.34E-01	(11)	5.20E+03	(4)	6.27E-03	(4)
Thiophanate, Methyl	23564-05-8	342.39	(4)	172	(4)	4.95E-08	(4)	3.88E-02	(1)	4.54E-06	(1)	3.27E+02	(4)	1.96E+00	(11)	2.66E+01	(4)	1.60E-04	(4)
Thiram	137-26-8	240.42	(4)	156	(4)	7.44E-06	(4)	2.56E-02	(1)	6.59E-06	(1)	6.11E+02	(4)	3.67E+00	(11)	3.00E+01	(4)	9.90E-04	(4)
Titanium Tetrachloride	7550-45-0	189.68	(4)	-25.7	(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.00E-03	(3)
Toluene	108-88-3	92.14	(4)	-94.9	(4)	2.71E-01	(4)	7.78E-02	(1)	9.20E-06	(1)	2.34E+02	(4)	1.40E+00	(11)	5.26E+02	(4)	3.11E-02	(4)
Toluidine, p-	106-49-0	107.16	(4)	243	(4)	8.26E-05	(4)	7.12E-02	(1)	8.98E-06	(1)	1.13E+02	(4)	6.76E-01	(11)	6.50E+03	(4)	3.29E-03	(4)
Toxaphene	8001-35-2	413.82	(4)	65	(2)	2.45E-04	(4)	3.42E-02	(1)	4.00E-06	(1)	7.72E+04	(4)	4.63E+02	(11)	7.40E-01	(10)	5.18E-02	(4)
Triallate	2303-17-5	304.66	(4)	29	(4)	4.91E-04	(4)	2.25E-02	(1)	5.67E-06	(1)	1.01E+03	(4)	6.05E+00	(11)	4.00E+00	(4)	3.49E-02	(4)
Trichlorobenzene, 1,2,4-	120-82-1	181.45	(4)	17	(4)	5.81E-02	(4)	3.96E-02	(1)	8.40E-06	(1)	1.36E+03	(4)	8.14E+00	(11)	4.90E+01	(4)	7.05E-02	(4)
Trichloroethane, 1,1,1-	71-55-6	133.41	(4)	-30.4	(4)	7.03E-01	(4)	6.48E-02	(1)	9.60E-06	(1)	4.39E+01	(4)	2.63E-01	(11)	1.29E+03	(4)	1.26E-02	(4)
Trichloroethane, 1,1,2-	79-00-5	133.41	(4)	-36.6	(4)	3.37E-02	(4)	6.69E-02	(1)	1.00E-05	(1)	6.07E+01	(4)	3.64E-01	(11)	4.59E+03	(4)	5.04E-03	(4)
Trichloroethylene	79-01-6	131.39	(4)	-84.7	(4)	4.03E-01	(4)	6.87E-02	(1)	1.02E-05	(1)	6.07E+01	(4)	3.64E-01	(11)	1.28E+03	(4)	1.16E-02	(4)
Trichlorofluoromethane	75-69-4	137.37	(4)	-111	(4)	3.97E+00	(4)	6.54E-02	(1)	1.00E-05	(1)	4.39E+01	(4)	2.63E-01	(11)	1.10E+03	(4)	1.27E-02	(4)
Trichlorophenol, 2,4,5-	95-95-4	197.45	(4)	69	(4)	6.62E-05	(4)	3.14E-02	(1)	8.09E-06	(1)	1.78E+03	(4)	1.07E+01	(11)	1.20E+03	(4)	3.62E-02	(4)
Trichlorophenol, 2,4,6-	88-06-2	197.45	(4)	69	(4)	1.06E-04	(4)	3.14E-02	(1)	8.09E-06	(1)	1.78E+03	(4)	1.07E+01	(11)	8.00E+02	(4)	3.46E-02	(4)
Trichlorophenoxyacetic Acid, 2,4,5-	93-76-5	255.49	(4)	153	(4)	1.91E-06	(4)	4.72E-02	(1)	5.51E-06	(1)	1.07E+02	(4)	6.42E-01	(11)	2.78E+02	(4)	9.14E-03	(4)
Trichlorophenoxypropionic acid, -2,4,5	93-72-1	269.51	(4)	182	(4)	3.70E-07	(4)	4.55E-02	(1)	5.32E-06	(1)	1.75E+02	(4)	1.05E+00	(11)	7.10E+01	(4)	1.61E-02	(4)
Triethylamine	121-44-8	101.19	(4)	-115	(4)	6.09E-03	(4)	6.64E-02	(1)	7.86E-06	(1)	5.08E+01	(4)	3.05E-01	(11)	6.86E+04	(4)	3.90E-03	(4)
Trifluralin	1582-09-8	335.29	(4)	49	(4)	4.21E-03	(4)	3.94E-02	(1)	4.60E-06	(1)	1.64E+04	(4)	9.83E+01	(11)	1.84E-01	(4)	7.28E-02	(4)
Trimethylbenzene, 1,2,4-	95-63-6	120.2	(4)	-43.8	(4)	2.52E-01	(4)	6.07E-02	(1)	7.92E-06	(1)	6.14E+02	(4)	3.69E+00	(11)	5.70E+01	(4)	8.57E-02	(4)
Trinitrobenzene, 1,3,5-	99-35-4	213.11	(4)	122	(4)	2.66E-07	(4)	2.90E-02	(1)	7.69E-06	(1)	1.68E+03	(4)	1.01E+01	(11)	2.78E+02	(4)	6.07E-04	(4)
Trisodium phosphate	7601-54-9	163.94	(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.00E-03	(3)
Urethane	51-79-6	89.09	(4)	49	(4)	2.63E-06	(4)	8.48E-02	(1)	1.02E-05	(1)	1.21E+01	(4)	7.28E-02	(11)	4.80E+05	(4)	3.94E-04	(4)
Vanadium Pentoxide	1314-62-1	181.88	(4)	681	(7)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.00E+02	(7)	1.00E-03	(3)
Vinyl Acetate	108-05-4	86.09	(4)	-93.2	(4)	2.09E-02	(4)	8.49E-02	(1)	1.00E-05	(1)	5.58E+00	(4)	3.35E-02	(11)	2.00E+04	(4)	1.57E-03	(4)
Vinyl Bromide	593-60-2	106.95	(4)	-138	(4)	5.03E-01	(4)	8.62E-02	(1)	1.17E-05	(1)	2.17E+01	(4)	1.30E-01	(11)	1.04E+04	(4)	4.35E-03	(4)
Vinyl Chloride	75-01-4	62.5	(4)	-154	(4)	1.14E+00	(4)	1.07E-01	(1)	1.20E-05	(1)	2.17E+01	(4)	1.30E-01	(11)	8.80E+03	(4)	8.38E-03	(4)
Warfarin	81-81-2	308.34	(4)	161	(4)	1.13E-07	(4)	4.16E-02	(1)	4.86E-06	(1)	4.26E+02	(4)	2.56E+00	(11)	1.70E+01	(4)	1.82E-03	(4)
Xylenes	1330-20-7	106.17	(4)	-25.2	(4)	2.12E-01	(4)	8.47E-02	(1)	9.90E-06	(1)	3.83E+02	(4)	2.30E+00	(11)	1.06E+02	(4)	5.00E-02	(4)
Zinc and Compounds	7440-66-6	65.38	(8)	420	(4)	NA	NA	NA	NA	NA	NA	NA	NA	6.20E+01	(2)	NA	NA	6.00E-04	(3)
Zinc Cyanide	557-21-1	117.43	(4)	80	(8)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.71E+04	(4)	6.00E-04	(3)
Zinc Phosphide	1314-84-7	258.175	(7)	1160	(7)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.00E-04	(3)

Key

(1) WATER9
(2) U.S. EPA 2002. Supplemental guidance for developing soil screening levels for Superfund sites. OSWER 9355.4-24
(3) U.S. EPA 2004. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part E) Final. OSWER 9285.7-02.
(4) The Estimation Programs Interface (EPI) Suite™. U.S. EPA and Syracuse Research Corporation.
(5) Yaws' Handbook of Thermodynamic and Physical Properties of Chemical Compounds.
(6) PHYSPROP Database. Syracuse Research Corporation (SRC).
(7) CRC Handbook of Chemistry and Physics.
(8) Perry's Chemical Engineers' Handbook.
(9) Baes, C.F. 1984.
(10) U.S. EPA 1996. Soil Screening Guidance (Technical Background Document. EPA/540/R-95/128.
(11) Calculated as $K_{oc} \times f_{oc}$.

2. Toxicity data

To develop generic numerical standards for residential and commercial/industrial land uses, the following sources, in order of decreasing preference, were used to determine chronic toxicity values. To develop generic numerical standards for construction/excavation activities, the following sources, in order of decreasing preference, were also used to determine subchronic toxicity values. However, if a chronic toxicity value is provided by IRIS and it is explicitly stated that an uncertainty factor was applied to account for subchronic-to-chronic extrapolation, then this uncertainty factor was removed to generate a subchronic toxicity value. If no subchronic value was available in the following sources, the appropriate chronic value was used with no adjustment. When generating property-specific standards in accordance with OAC 3745-300-09, the most current update of the most preferred source should be consulted. Toxicity data appear in Table 3 (p. 38).

1. U.S. EPA's Integrated Risk Information System (IRIS). IRIS is considered to be the most reliable source of toxicity information.

2. Provisional Peer Reviewed Toxicity Values (PPRTVs) derived by U.S. EPA's Superfund Health Risk Technical Support Center (STSC) for the EPA Superfund Program.

3. Minimal Risk Levels from the Agency for Toxic Substances and Disease Registry (ATSDR).

4. California Environmental Protection Agency's Office of Environmental Health Hazard Assessment's Chronic Reference Exposure Levels (RELs) from February 2012 and Cancer Potency Values from July 21, 2009 with updates in 2011 for dioxin/furans and dioxin-like PCBs.

5. U.S. EPA Superfund Program's Health Effects Assessment Summary (HEAST).

Pathway-specific toxicity values for dermal exposure are seldom available. In the absence of pathway-specific toxicity values or information indicating that a particular pathway may not be applicable for a chemical, extrapolated toxicity values may be used. It is important to note, however, that direct route-to-route extrapolation may not be appropriate, particularly when original data are based upon studies employing administered rather than absorbed doses. In these instances, variability in chemical specific absorption efficiencies among different absorptive epithelial could result in invalid or highly uncertain toxicity values. Thus, appropriate route-to-route extrapolation should be confirmed by Ohio EPA Division of Environmental Response and Revitalization.

With regard to extrapolation of oral toxicity values to dermal exposure pathways, an oral toxicity value needs to be adjusted for the dermal pathway with a gastrointestinal absorption factor (GIABS) only when the gastrointestinal absorption of a chemical from a medium similar to the one utilized in the critical study is significantly less than 100%; otherwise, in the absence of a chemical-specific GIABS, oral toxicity values derived from studies using administered dose assume a default gastrointestinal absorption efficiency of 100% (GIABS of 1.0). The recommendation to assume 100% absorption is based on review of the literature where it has been found that organic chemicals are generally well absorbed (> 50%) across the gastrointestinal tract. Although a wider range of absorption efficiencies have been reported for

inorganic chemicals, the recommendation is to assume 100% absorption for inorganics lacking a chemical-specific GIABS. Therefore, a reference dose (or slope factor) derived from an administered dose critical study should be multiplied by a chemical-specific or default (1.0) GIABS such that the reference dose (or slope factor) is adjusted to account for the absorbed dose. See Table 3 (p. 38) for the recommended GIABS for each chemical used to generate the generic numerical standards in OAC 3745-300-08.

Oral slope factors and reference doses are generally not extrapolated to assess inhaled exposures for chemicals lacking inhalation toxicity values. However, for pathways where inhalation is the only exposure route (e.g. vapor intrusion), it may be appropriate to extrapolate slope factors or reference doses to inhalation unit risks or reference concentrations. Ohio EPA Division of Environmental Response and Remediation should be consulted to confirm whether extrapolation of an oral toxicity value to an inhalation toxicity value is appropriate.

Table 3: Toxicity data

Chemical	CAS Number	Chronic Toxicity Values								Subchronic Toxicity Values				VOC	Mutagen	GIABS	ABS
		SF (mg/kg-day)$^{-1}$	key	IUR (µg/m^3)$^{-1}$	key	RfD (mg/kg-day)	key	RfC (mg/m^3)	key	RfD (mg/kg-day)	key	RfC (mg/m^3)	key				
Acenaphthene	83-32-9	NA	NA	NA	NA	6.0E-02	I	NA	NA	6.0E-01	P	NA	NA	V		1	0.13
Acetaldehyde	75-07-0	NA	NA	2.2E-06	I	NA	NA	9.0E-03	I	NA	NA	9.0E-02	I*	V		1	0
Acetone	67-64-1	NA	NA	NA	NA	9.0E-01	I	3.1E+01	A	2.7E+00	I*	3.1E+01	A	V		1	0
Acetonitrile	75-05-8	NA	NA	NA	NA	NA	NA	6.0E-02	I	NA	NA	5.0E-01	H	V		1	0
Acetophenone	98-86-2	NA	NA	NA	NA	1.0E-01	I	NA	NA	1.0E+00	I*	NA	NA	V		1	0
Acetylaminofluorene, 2-	53-96-3	3.8E+00	C	1.3E-03	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Acrolein	107-02-8	NA	NA	NA	NA	5.0E-04	I	2.0E-05	I	4.0E-03	A	2.0E-04	I*	V		1	0
Acrylamide	79-06-1	5.0E-01	I	1.0E-04	I	2.0E-03	I	6.0E-03	I	1.0E-03	A	NA	NA	NV	M	1	0.1
Acrylic Acid	79-10-7	NA	NA	NA	NA	5.0E-01	I	1.0E-03	I	2.0E-01	P	3.0E-03	I*	NV		1	0.1
Acrylonitrile	107-13-1	5.4E-01	I	6.8E-05	I	4.0E-02	A	2.0E-03	I	1.0E-02	A	NA	NA	V		1	0
Aldicarb	116-06-3	NA	NA	NA	NA	1.0E-03	I	NA	NA	1.0E-03	H	NA	NA	NV		1	0.1
Aldicarb Sulfone	1646-88-4	NA	NA	NA	NA	1.0E-03	I	NA	NA	NA	NA	NA	NA	NV		1	0.1
Aldrin	309-00-2	1.7E+01	I	4.9E-03	I	3.0E-05	I	NA	NA	4.0E-05	P	NA	NA	NV		1	0.1
Allyl Alcohol	107-18-6	NA	NA	NA	NA	5.0E-03	I	NA	NA	5.0E-02	I*	NA	NA	NV		1	0.1
Allyl Chloride	107-05-1	2.1E-02	C	6.0E-06	C	NA	NA	1.0E-03	I	NA	NA	1.0E-02	I*	V		1	0
Aluminum Phosphide	20859-73-8	NA	NA	NA	NA	4.0E-04	I	NA	NA	4.0E-04	H	NA	NA	NV		1	0
Aminobiphenyl, 4-	92-67-1	2.1E+01	C	6.0E-03	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Ammonium Sulfamate	7773-06-0	NA	NA	NA	NA	2.0E-01	I	NA	NA	2.0E+00	I*	NA	NA	NV		1	0
Aniline	62-53-3	5.7E-03	I	1.6E-06	C	7.0E-03	P	1.0E-03	I	NA	NA	1.0E-02	I*	NV		1	0.1
Anthracene	120-12-7	NA	NA	NA	NA	3.0E-01	I	NA	NA	3.0E+00	I*	NA	NA	V		1	0.13
Antimony (metallic)	7440-36-0	NA	NA	NA	NA	4.0E-04	I	NA	NA	4.0E-04	P	NA	NA	NV		0.15	0
Antimony Trioxide	1309-64-4	NA	NA	NA	NA	NA	NA	2.0E-04	I	NA	NA	6.0E-04	I*	NV		0.15	0
Aroclor 1016	12674-11-2	7.0E-02 (a)	I	2.0E-05 (a)	I	7.0E-05	I	NA	NA	2.1E-04	I*	NA	NA	NV		1	0.14
Aroclor 1221	11104-28-2	2.0E+00 (a)	I	5.7E-04 (a)	I	NA	NA	NA	NA	NA	NA	NA	NA	V		1	0.14
Aroclor 1232	11141-16-5	2.0E+00 (a)	I	5.7E-04 (a)	I	NA	NA	NA	NA	NA	NA	NA	NA	V		1	0.14
Aroclor 1242	53469-21-9	2.0E+00 (a)	I	5.7E-04 (a)	I	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.14
Aroclor 1248	12672-29-6	2.0E+00 (a)	I	5.7E-04 (a)	I	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.14
Aroclor 1254	11097-69-1	2.0E+00 (a)	I	5.7E-04 (a)	I	2.0E-05	I	NA	NA	6.0E-05	I*	NA	NA	NV		1	0.14
Aroclor 1260	11096-82-5	2.0E+00 (a)	I	5.7E-04 (a)	I	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.14
Arsenic, Inorganic	7440-38-2	1.5E+00	I	4.3E-03	I	3.0E-04	I	1.5E-05	C	NA	NA	NA	NA	NV		1	0.03
Auramine	492-80-8	8.8E-01	C	2.5E-04	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Baygon	114-26-1	NA	NA	NA	NA	4.0E-03	I	NA	NA	NA	NA	NA	NA	NV		1	0.1
Benomyl	17804-35-2	NA	NA	NA	NA	5.0E-02	I	NA	NA	NA	NA	NA	NA	NV		1	0.1
Benz[a]anthracene	56-55-3	7.3E-01	E	1.1E-04	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.13
Benzene	71-43-2	5.5E-02 (b)	I	7.8E-06 (b)	I	4.0E-03	I	3.0E-02	I	1.0E-02	P	9.0E-02	I*	V		1	0
Benzenethiol	108-98-5	NA	NA	NA	NA	1.0E-03	P	NA	NA	1.0E-02	P	NA	NA	V		1	0
Benzidine	92-87-5	2.3E+02	I	6.7E-02	I	3.0E-03	I	NA	NA	3.0E-03	H	NA	NA	NV		1	0.1
Benzo[a]pyrene	50-32-8	7.3E+00	I	1.1E-03	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.13
Benzo[b]fluoranthene	205-99-2	7.3E-01	E	1.1E-04	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.13
Benzo[k]fluoranthene	207-08-9	7.3E-02	E	1.1E-04	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.13
Benzoic Acid	65-85-0	NA	NA	NA	NA	4.0E+00	I	NA	NA	4.0E+00	P	NA	NA	NV		1	0.1
Benzotrichloride	98-07-7	1.3E+01	I	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	V		1	0
Benzyl Chloride	100-44-7	1.7E-01	I	4.9E-05	C	2.0E-03	P	1.0E-03	P	2.0E-03	P	4.0E-03	P	V		1	0
Beryllium and compounds	7440-41-7	NA	NA	2.4E-03	I	2.0E-03	I	2.0E-05	I	5.0E-03	H	NA	NA	NV		0.01	0
Biphenyl, 1,1'-	92-52-4	8.0E-03	I	NA	NA	5.0E-01	I	NA	NA	1.0E-01	P	NA	NA	V		1	0
Bis(2-chloro-1-methylethyl) ether	108-60-1	7.0E-02	H	1.0E-05	H	4.0E-02	I	NA	NA	NA	NA	NA	NA	V		1	0
Bis(2-chloroethoxy)methane	111-91-1	NA	NA	NA	NA	3.0E-03	P	NA	NA	3.0E-02	P	NA	NA	NV		1	0.1
Bis(2-chloroethyl)ether	111-44-4	1.1E+00	I	3.3E-04	I	NA	NA	NA	NA	NA	NA	NA	NA	V		1	0
Bis(2-ethylhexyl)phthalate	117-81-7	1.4E-02	I	2.4E-06	C	2.0E-02	I	NA	NA	2.0E-01	I*	NA	NA	NV		1	0.1
Bis(chloromethyl)ether	542-88-1	2.2E+02	I	6.2E-02	I	NA	NA	NA	NA	NA	NA	NA	NA	V		1	0
Bromodichloromethane	75-27-4	6.2E-02	I	3.7E-05	C	2.0E-02	I	NA	NA	8.0E-03	P	NA	NA	V		1	0
Bromoform	75-25-2	7.9E-03	I	1.1E-06	I	2.0E-02	I	NA	NA	2.0E-01	I*	NA	NA	NV		1	0.1
Bromomethane	74-83-9	NA	NA	NA	NA	1.4E-03	I	5.0E-03	I	1.4E-02	I*	1.0E-01	P	V		1	0
Butadiene, 1,3-	106-99-0	3.4E+00	C	3.0E-05	I	NA	NA	2.0E-03	I	NA	NA	NA	NA	V		1	0
Butanol, N-	71-36-3	NA	NA	NA	NA	1.0E-01	I	NA	NA	1.0E+00	I*	NA	NA	NV		1	0.1
Butyl Benzyl Phthlate	85-68-7	1.9E-03	P	NA	NA	2.0E-01	I	NA	NA	2.0E+00	I*	NA	NA	NV		1	0.1
Cacodylic Acid	75-60-5	NA	NA	NA	NA	2.0E-02	A	NA	NA	NA	NA	NA	NA	NV		1	0.1
Cadmium	7440-43-9	NA	NA	1.8E-03	I	1.0E-03	I	1.0E-05	A	NA	NA	NA	NA	NV		0.03	0
Calcium Cyanide	592-01-8	NA	NA	NA	NA	1.0E-03	I	NA	NA	1.0E-02	I*	NA	NA	NV		1	0
Captan	133-06-2	2.3E-03	C	6.6E-07	C	1.3E-01	I	NA	NA	1.3E-01	H	NA	NA	NV		1	0.1
Carbaryl	63-25-2	NA	NA	NA	NA	1.0E-01	I	NA	NA	1.0E-01	H	NA	NA	NV		1	0.1
Carbofuran	1563-66-2	NA	NA	NA	NA	5.0E-03	I	NA	NA	5.0E-03	H	NA	NA	NV		1	0.1
Carbon Disulfide	75-15-0	NA	NA	NA	NA	1.0E-01	I	7.0E-01	I	1.0E-01	H	2.1E+00	I*	V		1	0
Carbon Tetrachloride	56-23-5	7.0E-02	I	6.0E-06	I	4.0E-03	I	1.0E-01	I	1.2E-02	I*	1.9E-01	A	V		1	0
Carbosulfan	55285-14-8	NA	NA	NA	NA	1.0E-02	I	NA	NA	NA	NA	NA	NA	NV		1	0.1
Chloramben	133-90-4	NA	NA	NA	NA	1.5E-02	I	NA	NA	NA	NA	NA	NA	NV		1	0.1
Chlordane	57-74-9	3.5E-01 (c)	I	1.0E-04 (c)	I	5.0E-04 (c)	I	7.0E-04 (c)	I	6.0E-04	A	2.0E-04	A	NV		1	0.04
Chlordecone (Kepone)	143-50-0	1.0E+01	I	4.6E-03	C	3.0E-04	I	NA	NA	5.0E-04	A	NA	NA	NV		1	0.1
Chlorine	7782-50-5	NA	NA	NA	NA	1.0E-01	I	1.5E-04	A	NA	NA	5.8E-03	A	NV		1	0
Chloro-1,3-butadiene, 2-	126-99-8	NA	NA	3.0E-04	I	2.0E-02	H	2.0E-02	I	2.0E-02	H	7.0E-02	H	V		1	0
Chloro-2-methylaniline HCl, 4-	3165-93-3	4.6E-01	H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Chloroacetic Acid	79-11-8	NA	NA	NA	NA	2.0E-03	H	NA	NA	2.0E-02	H	NA	NA	NV		1	0.1
Chloroacetophenone, 2-	532-27-4	NA	NA	NA	NA	NA	NA	3.0E-05	I	NA	NA	NA	NA	NV		1	0.1
Chloroaniline, p-	106-47-8	2.0E-01	P	NA	NA	4.0E-03	I	NA	NA	5.0E-04	P	NA	NA	NV		1	0.1
Chlorobenzene	108-90-7	NA	NA	NA	NA	2.0E-02	I	5.0E-02	P	2.0E-01	I*	5.0E-01	P	V		1	0
Chlorobenzilate	510-15-6	1.1E-01	C	3.1E-05	C	2.0E-02	I	NA	NA	2.0E-02	H	NA	NA	NV		1	0.1
Chloroform	67-66-3	3.1E-02	C	2.3E-05	I	1.0E-02	I	9.8E-02	A	1.0E-01	A	2.4E-01	A	V		1	0
Chloromethane	74-87-3	NA	NA	NA	NA	NA	NA	9.0E-02	I	NA	NA	9.0E-01	I*	V		1	0
Chloromethyl Methyl Ether	107-30-2	2.4E+00	C	6.9E-04	C	NA	NA	NA	NA	NA	NA	NA	NA	V		1	0
Chloronaphthalene, Beta-	91-58-7	NA	NA	NA	NA	8.0E-02	I	NA	NA	8.0E-01	I*	NA	NA	V		1	0
Chlorophenol, 2-	95-57-8	NA	NA	NA	NA	5.0E-03	I	NA	NA	5.0E-02	I*	NA	NA	V		1	0
Chlorpyrifos	2921-88-2	NA	NA	NA	NA	1.0E-03	A	NA	NA	3.0E-03	A	NA	NA	NV		1	0.1
Chromium(III), Insoluble Salts	16065-83-1	NA	NA	NA	NA	1.5E+00	I	NA	NA	1.5E+00	H	5.0E-03	A	NV		0.01	0
Chromium(VI)	18540-29-9	5.0E-01	J	8.4E-02 (d)	I	3.0E-03	I	1.0E-04	I	9.0E-03	I*	3.0E-02	I*	NV		0.03	0
Chromium, Total	7440-47-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NV		0.01	0
Chrysene	218-01-9	7.3E-03	E	1.1E-05	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.13
Copper	7440-50-8	NA	NA	NA	NA	4.0E-02 (e)	H	NA	NA	1.0E-02	A	NA	NA	NV		1	0
Copper Cyanide	544-92-3	NA	NA	NA	NA	5.0E-03	I	NA	NA	5.0E-02	I*	NA	NA	NV		1	0
Cresol, m-	108-39-4	NA	NA	NA	NA	5.0E-02	I	6.0E-01	C	5.0E-01	I*	NA	NA	NV		1	0.1
Cresol, o-	95-48-7	NA	NA	NA	NA	5.0E-02	I	6.0E-01	C	5.0E-01	I*	NA	NA	NV		1	0.1
Cresol, p-	106-44-5	NA	NA	NA	NA	1.0E-01	A	6.0E-01	C	2.0E-02	P	NA	NA	NV		1	0.1
Cresol, p-chloro-m-	59-50-7	NA	NA	NA	NA	1.0E-01	A	NA	NA	NA	NA	NA	NA	NV		1	0.1
Cresols	1319-77-3	NA	NA	NA	NA	1.0E-01	A	6.0E-01	C	1.0E-01	A	NA	NA	NV		1	0.1
Crotonaldehyde, trans-	123-73-9	1.9E+00	H	NA	NA	1.0E-03	P	NA	NA	1.0E-02	P	NA	NA	V		1	0
Cumene	98-82-8	NA	NA	NA	NA	1.0E-01	I	4.0E-01	I	3.0E-01	I*	4.0E+00	I*	V		1	0
Cyanogen	460-19-5	NA	NA	NA	NA	1.0E-03	I	NA	NA	1.0E-02	I*	NA	NA	V		1	0
Cyanogen Bromide	506-68-3	NA	NA	NA	NA	9.0E-02	I	NA	NA	9.0E-02	H	NA	NA	V		1	0
Cyanogen Chloride	506-77-4	NA	NA	NA	NA	5.0E-02	I	NA	NA	5.0E-02	H	NA	NA	V		1	0
Cyclohexane	110-82-7	NA	NA	NA	NA	NA	NA	6.0E+00	I	NA	NA	1.8E+01	P	V		1	0
Cyclohexanone	108-94-1	NA	NA	NA	NA	5.0E+00	I	7.0E-01	P	2.0E+00	P	7.0E+00	P	NV		1	0.1
Dalapon	75-99-0	NA	NA	NA	NA	3.0E-02	I	NA	NA	3.0E-02	H	NA	NA	NV		1	0.1
DDD	72-54-8	2.4E-01	I	6.9E-05	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
DDE, p,p'-	72-55-9	3.4E-01	I	9.7E-05	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
DDT	50-29-3	3.4E-01	I	9.7E-05	I	5.0E-04	I	NA	NA	5.0E-04	A	NA	NA	NV		1	0.03
Diallate	2303-16-4	6.1E-02	H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Diazinon	333-41-5	NA	NA	NA	NA	7.0E-04	A	NA	NA	2.0E-03	A	NA	NA	NV		1	0.1
Dibenz[a,h]anthracene	53-70-3	7.3E+00	E	1.2E-03	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.13
Dibromo-3-chloropropane, 1,2-	96-12-8	8.0E-01	P	6.0E-03	P	2.0E-04	P	2.0E-04	I	2.0E-03	P	2.0E-03	I*	V		1	0
Dibromochloromethane	124-48-1	8.4E-02	I	2.7E-05	C	2.0E-02	I	NA	NA	2.0E-01	I*	NA	NA	V		1	0.1
Dibromoethane, 1,2-	106-93-4	2.0E+00	I	6.0E-04	I	9.0E-03	I	9.0E-03	I	NA	NA	2.0E-03	H	V		1	0
Dibromomethane (Methylene Bromide)	74-95-3	NA	NA	NA	NA	1.0E-02	H	NA	NA	NA	NA	NA	NA	V		1	0
Dibutyl Phthalate	84-74-2	NA	NA	NA	NA	1.0E-01	I	NA	NA	3.0E-01	I*	NA	NA	NV		1	0.1
Dicamba	1918-00-9	NA	NA	NA	NA	3.0E-02	I	NA	NA	3.0E-02	H	NA	NA	NV		1	0.1
Dichloro-2-butene, 1,4-	764-41-0	NA	NA	4.2E-03	P	NA	NA	NA	NA	NA	NA	NA	NA	V		1	0
Dichlorobenzene, 1,2-	95-50-1	NA	NA	NA	NA	9.0E-02	I	2.0E-01	H	6.0E-01	A	2.0E+00	H	V		1	0
Dichlorobenzene, 1,4-	106-46-7	5.4E-03	C	1.1E-05	C	7.0E-02	A	8.0E-01	I	7.0E-02	A	2.4E+00	I*	V		1	0
Dichlorobenzidine, 3,3'-	91-94-1	4.5E-01	I	3.4E-04	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Dichlorodifluoromethane	75-71-8	NA	NA	NA	NA	2.0E-01	I	NA	NA	NA	NA	NA	NA	V		1	0
Dichloroethane, 1,1-	75-34-3	5.7E-03	C	1.6E-06	C	2.0E-01	P	NA	NA	2.0E+00	P	NA	NA	V		1	0

Table 3: Toxicity data (continued)

Chemical	CAS Number	Chronic Toxicity Values								Subchronic Toxicity Values				VOC	Mutagen	GIABS	ABS
		SF $(mg/kg\text{-}day)^{-1}$	key	IUR $(\mu g/m^3)^{-1}$	key	RfD (mg/kg-day)	key	RfC (mg/m^3)	key	RfD (mg/kg-day)	key	RfC (mg/m^3)	key				
Dichloroethane, 1,2-	107-06-2	9.1E-02	I	2.6E-05	I	NA	NA	7.0E-03	P	NA	NA	7.0E-02	P	V		1	0
Dichloroethylene, 1,1-	75-35-4	NA	NA	NA	NA	5.0E-02	I	2.0E-01	I	9.0E-03	H	7.9E-02	A	V		1	0
Dichloroethylene, 1,2-trans-	156-60-5	NA	NA	NA	NA	2.0E-02	I	6.0E-02	P	2.0E-01	I*	7.9E-01	A	V		1	0
Dichlorophenol, 2,4-	120-83-2	NA	NA	NA	NA	3.0E-03	I	NA	NA	2.0E-02	P	NA	NA	NV		1	0.1
Dichlorophenoxy Acetic Acid, 2,4-	94-75-7	NA	NA	NA	NA	1.0E-02	I	NA	NA	1.0E-02	H	NA	NA	NV		1	0.05
Dichloropropane, 1,2-	78-87-5	3.6E-02	C	1.0E-05	C	9.0E-02	A	4.0E-03	I	7.0E-02	A	1.2E-02	I*	V		1	0
Dichloropropene, 1,3-	142-28-9	NA	NA	NA	NA	2.0E-02	P	NA	NA	2.0E-01	P	NA	NA	V		1	0
Dichloropropene, 1,3-	542-75-6	1.0E-01	I	4.0E-06	I	3.0E-02	I	2.0E-02	I	4.0E-02	A	3.6E-02	A	V		1	0
Dichlorvos	62-73-7	2.9E-01	I	8.3E-05	C	5.0E-04	I	5.0E-04	I	3.0E-03	A	2.7E-03	A	NV		1	0.1
Dieldrin	60-57-1	1.6E+01	I	4.6E-03	I	5.0E-05	I	NA	NA	1.0E-04	A	NA	NA	NV		1	0.1
Diethanolamine	111-42-2	NA	NA	NA	NA	2.0E-03	P	2.0E-04	P	2.0E-02	P	2.0E-03	P	NV		1	0.1
Diethyl Phthalate	84-66-2	NA	NA	NA	NA	8.0E-01	I	NA	NA	8.0E+00	I*	NA	NA	NV		1	0.1
Diethylstilbestrol	56-53-1	3.5E+02	C	1.0E-01	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Dihydrosafrole	94-58-6	4.4E-02	C	1.3E-05	C	NA	NA	NA	NA	NA	NA	NA	NA	V		1	0.1
Dimethoate	60-51-5	NA	NA	NA	NA	2.0E-04	I	NA	NA	2.0E-04	H	NA	NA	NV		1	0.1
Dimethoxybenzidine, 3,3'-	119-90-4	1.1E+01	P	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Dimethylamino azobenzene [p-]	60-11-7	4.6E+00	C	1.3E-03	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Dimethylaniline, N,N-	121-69-7	NA	NA	NA	NA	2.0E-03	I	NA	NA	2.0E-02	H	NA	NA	V		1	0
Dimethylbenz(a)anthracene, 7,12-	57-97-6	2.5E+02	C	7.1E-02	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.13
Dimethylbenzidine, 3,3'-	119-93-7	1.1E+01	P	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Dimethylformamide	68-12-2	NA	NA	NA	NA	1.0E-01	P	3.0E-02	I	3.0E-01	P	9.0E-02	I*	NV		1	0.1
Dimethylhydrazine, 1,2-	540-73-8	5.5E+02	C	1.6E-01	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Dimethylphenol, 2,4-	105-67-9	NA	NA	NA	NA	2.0E-02	I	NA	NA	6.0E-02	I*	NA	NA	NV		1	0.1
Dinitrobenzene, 1,2-	528-29-0	NA	NA	NA	NA	1.0E-04	P	NA	NA	1.0E-03	P	NA	NA	NV		1	0.1
Dinitrobenzene, 1,3-	99-65-0	NA	NA	NA	NA	1.0E-04	I	NA	NA	1.0E-03	I*	NA	NA	NV		1	0.1
Dinitrobenzene, 1,4-	100-25-4	NA	NA	NA	NA	1.0E-04	P	NA	NA	1.0E-03	P	NA	NA	NV		1	0.1
Dinitro-o-cyclohexyl Phenol, 4,6-	131-89-5	NA	NA	NA	NA	2.0E-03	I	NA	NA	2.0E-02	I*	NA	NA	NV		1	0.1
Dinitrophenol, 2,4-	51-28-5	NA	NA	NA	NA	2.0E-03	I	NA	NA	2.0E-02	I*	NA	NA	NV		1	0.1
Dinitrotoluene Mixture, 2,4/2,6-	25321-14-6	6.8E-01	I	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Dinitrotoluene, 2,4-	121-14-2	3.1E-01	C	8.9E-05	C	2.0E-03	I	NA	NA	2.0E-03	A	NA	NA	NV		1	0.1
Dinitrotoluene, 2,6-	606-20-2	1.5E+00	P	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Dinoseb	88-85-7	NA	NA	NA	NA	1.0E-03	I	NA	NA	1.0E-03	H	NA	NA	NV		1	0.1
Dioxane, 1,4-	123-91-1	1.0E-01	I	5.0E-06	I	3.0E-02	I	3.0E-02	I	5.0E-01	A	7.2E-01	A	NV		1	0.1
Diphenylhydrazine, 1,2-	122-66-7	8.0E-01	I	2.2E-04	I	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Diquat	85-00-7	NA	NA	NA	NA	2.2E-03	I	NA	NA	NA	NA	NA	NA	NV		1	0.1
Disodium phosphate	7558-79-4	NA	NA	NA	NA	4.9E+01	P	NA	NA	4.9E+01	P	NA	NA	NV		1	0
Disulfoton	298-04-4	NA	NA	NA	NA	4.0E-05	I	NA	NA	9.0E-05	A	NA	NA	NV		1	0.1
Diuron	330-54-1	NA	NA	NA	NA	2.0E-03	I	NA	NA	NA	NA	NA	NA	NV		1	0.1
Endosulfan	115-29-7	NA	NA	NA	NA	6.0E-03	I	NA	NA	5.0E-03	A	NA	NA	NV		1	0.1
Endothall	145-73-3	NA	NA	NA	NA	2.0E-02	I	NA	NA	2.0E-02	H	NA	NA	NV		1	0.1
Endrin	72-20-8	NA	NA	NA	NA	3.0E-04	I	NA	NA	2.0E-03	A	NA	NA	NV		1	0.1
Epichlorohydrin	106-89-8	9.9E-03	I	1.2E-06	I	6.0E-03	P	1.0E-03	I	6.0E-03	P	1.0E-02	P	V		1	0
Epoxybutane, 1,2-	106-88-7	NA	NA	NA	NA	NA	NA	2.0E-02	I	NA	NA	NA	NA	V		1	0
Ethion	563-12-2	NA	NA	NA	NA	5.0E-04	I	NA	NA	2.0E-03	A	NA	NA	NV		1	0.1
Ethoxyethanol, 2-	110-80-5	NA	NA	NA	NA	9.0E-02	P	2.0E-01	I	1.0E-01	P	2.0E+00	I*	NV		1	0.1
Ethyl Acetate	141-78-6	NA	NA	NA	NA	9.0E-01	I	7.0E-02	P	9.0E+00	I*	7.0E-01	P	V		1	0
Ethyl Acrylate	140-88-5	4.8E-02	H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	V		1	0
Ethyl Chloride	75-00-3	NA	NA	NA	NA	NA	NA	1.0E+01	I	NA	NA	4.0E+00	P	V		1	0
Ethyl Ether	60-29-7	NA	NA	NA	NA	2.0E-01	I	NA	NA	2.0E+00	I*	NA	NA	V		1	0
Ethyl Methacrylate	97-63-2	NA	NA	NA	NA	9.0E-02	H	3.0E-01	P	NA	NA	3.0E+00	P	V		1	0
Ethylbenzene	100-41-4	1.1E-02	C	2.5E-06	C	1.0E-01	I	1.0E+00	I	1.0E+00	I*	9.0E+00	P	V		1	0
Ethylene Diamine	107-15-3	NA	NA	NA	NA	9.0E-02	P	NA	NA	2.0E-01	P	NA	NA	NV		1	0.1
Ethylene Glycol	107-21-1	NA	NA	NA	NA	2.0E+00	I	4.0E-01	C	8.0E-01	A	NA	NA	NV		1	0.1
Ethylene Oxide	75-21-8	3.1E-01	C	8.8E-05	C	NA	NA	3.0E-02	C	NA	NA	1.6E-01	A	V		1	0
Ethylene Thiourea	96-45-7	4.5E-02	C	1.3E-05	C	8.0E-05	I	NA	NA	8.0E-05	H	NA	NA	NV		1	0.1
Ethyleneimine	151-56-4	6.5E+01	C	1.9E-02	C	NA	NA	NA	NA	NA	NA	NA	NA	V		1	0.1
Fluoranthene	206-44-0	NA	NA	NA	NA	4.0E-02	I	NA	NA	1.2E-01	I*	NA	NA	NV		1	0.13
Fluorene	86-73-7	NA	NA	NA	NA	4.0E-02	I	NA	NA	4.0E-01	I*	NA	NA	V		1	0.13
Fluorine (Soluble Fluoride)	7782-41-4	NA	NA	NA	NA	6.0E-02	I	1.3E-02	C	6.0E-02	H	NA	NA	NV		1	0
Formaldehyde	50-00-0	NA	NA	1.3E-05	I	2.0E-01	I	9.8E-03	A	3.0E-01	A	3.7E-02	A	NV		1	0.1
Formic Acid	64-18-6	NA	NA	NA	NA	9.0E-01	P	NA	NA	9.0E-01	P	NA	NA	NV		1	0.1
Furan	110-00-9	NA	NA	NA	NA	1.0E-03	I	NA	NA	1.0E-02	I*	NA	NA	V		1	0
Furfural	98-01-1	NA	NA	NA	NA	3.0E-03	I	5.0E-02	H	3.0E-02	I*	5.0E-01	H	NV		1	0.1
Glycidyl	765-34-4	NA	NA	NA	NA	4.0E-04	I	1.0E-03	H	4.0E-03	I*	1.0E-02	H	NV		1	0.1
Guthion	86-50-0	NA	NA	NA	NA	3.0E-03	A	1.0E-02	A	3.0E-03	A	1.0E-02	A	NV		1	0.1
Heptachlor	76-44-8	4.5E+00	I	1.3E-03	I	5.0E-04	I	NA	NA	1.0E-04	A	NA	NA	NV		1	0.1
Heptachlor Epoxide	1024-57-3	9.1E+00	I	2.6E-03	I	1.3E-05	I	NA	NA	1.3E-05	H	NA	NA	NV		1	0.1
Hexachlorobenzene	118-74-1	1.6E+00	I	4.6E-04	I	8.0E-04	I	NA	NA	1.0E-05	P	NA	NA	NV		1	0.1
Hexachlorobutadiene	87-68-3	7.8E-02	I	2.2E-05	I	1.0E-03	P	NA	NA	1.0E-03	P	NA	NA	NV		1	0.1
Hexachlorocyclohexane, Alpha-	319-84-6	6.3E+00	I	1.8E-03	I	8.0E-03	A	NA	NA	NA	NA	NA	NA	NV		1	0.1
Hexachlorocyclohexane, Beta-	319-85-7	1.8E+00	I	5.3E-04	I	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	1.1E+00	C	3.1E-04	C	3.0E-04	I	NA	NA	3.0E-03	I*	NA	NA	NV		1	0.04
Hexachlorocyclohexane, Technical	608-73-1	1.8E+00	I	5.1E-04	I	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Hexachlorocyclopentadiene	77-47-4	NA	NA	NA	NA	6.0E-03	I	2.0E-04	I	1.8E-02	I*	1.1E-01	A	NV		1	0.1
Hexachloroethane	67-72-1	4.0E-02	I	1.1E-05	C	7.0E-04	I	3.0E-02	I	2.1E-03	I*	3.0E-01	I*	NV		1	0.1
Hexachlorophene	70-30-4	NA	NA	NA	NA	3.0E-04	I	NA	NA	9.0E-04	I*	NA	NA	NV		1	0.1
Hexamethylene Diisocyanate, 1,6-	822-06-0	NA	NA	NA	NA	NA	NA	1.0E-05	I	NA	NA	2.1E-04	A	V		1	0
Hexamethylphosphoramide	680-31-9	NA	NA	NA	NA	4.0E-04	P	NA	NA	4.0E-03	P	NA	NA	NV		1	0.1
Hexane, N-	110-54-3	NA	NA	NA	NA	6.0E-02	H	7.0E-01	I	3.0E-01	P	2.1E+00	I*	V		1	0
Hexanedioic Acid	124-04-9	NA	NA	NA	NA	2.0E+00	P	NA	NA	2.0E+00	P	NA	NA	NV		1	0.1
Hydrazine	302-01-2	3.0E+00	I	4.9E-03	I	NA	NA	3.0E-05	P	NA	NA	9.0E-05	P	NV		1	0
Hydrogen Chloride	7647-01-0	NA	NA	NA	NA	NA	NA	2.0E-02	I	NA	NA	NA	NA	NV		1	0
Hydrogen Cyanide	74-90-8	NA	NA	NA	NA	6.0E-04	I	8.0E-04	I	6.0E-03	I*	2.4E-03	I*	V		1	0
Hydrogen Fluoride	7664-39-3	NA	NA	NA	NA	4.0E-02	C	1.4E-02	C	NA	NA	NA	NA	NV		1	0
Hydrogen Sulfide	7783-06-4	NA	NA	NA	NA	NA	NA	2.0E-03	I	NA	NA	2.8E-02	A	NV		1	0
Hydroquinone	123-31-9	6.0E-02	P	NA	NA	4.0E-02	P	NA	NA	4.0E-01	P	NA	NA	NV		1	0.1
Indeno[1,2,3-cd]pyrene	193-39-5	7.3E-01	E	1.1E-04	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.13
Isobutyl Alcohol	78-83-1	NA	NA	NA	NA	3.0E-01	I	NA	NA	3.0E+00	I*	NA	NA	NV		1	0.1
Isophorone	78-59-1	9.5E-04	I	NA	NA	2.0E-01	I	2.0E+00	C	2.0E+00	I*	NA	NA	NV		1	0.1
Kerb	23950-58-5	NA	NA	NA	NA	7.5E-02	I	NA	NA	7.5E-02	H	NA	NA	NV		1	0.1
Lead acetate	301-04-2	2.8E-01	C	8.0E-05	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Lead and Compounds	7439-92-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0
Lead subacetate	1335-32-6	3.8E-02	C	1.1E-05	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Malathion	121-75-5	NA	NA	NA	NA	2.0E-02	I	NA	NA	2.0E-02	A	NA	NA	NV		1	0.1
Maleic Anhydride	108-31-6	NA	NA	NA	NA	1.0E-01	I	7.0E-04	C	1.0E-01	H	NA	NA	NV		1	0.1
Maleic Hydrazide	123-33-1	NA	NA	NA	NA	5.0E-01	I	NA	NA	5.0E-01	H	NA	NA	NV		1	0.1
Malononitrile	109-77-3	NA	NA	NA	NA	1.0E-04	P	NA	NA	1.0E-03	P	NA	NA	NV		1	0.1
Mercury and Compounds	7439-97-6	NA	NA	NA	NA	NA	NA	3.0E-04	I	NA	NA	3.0E-04	H	V		1	0
Methacrylonitrile	126-98-7	NA	NA	NA	NA	1.0E-04	I	3.0E-02	P	1.0E-03	I*	3.0E-01	P	V		1	0
Methanol	67-56-1	NA	NA	NA	NA	2.0E+00	I	2.0E+01	I	5.0E+00	H	NA	NA	NV		1	0.1
Methomyl	16752-77-5	NA	NA	NA	NA	2.5E-02	I	NA	NA	2.5E-02	H	NA	NA	NV		1	0.1
Methoxychlor	72-43-5	NA	NA	NA	NA	5.0E-03	I	NA	NA	5.0E-03	A	NA	NA	NV		1	0.1
Methyl Ethyl Ketone (2-Butanone)	78-93-3	NA	NA	NA	NA	6.0E-01	I	5.0E+00	I	2.0E+00	H	1.0E+00	H	V		1	0
Methyl Hydrazine	60-34-4	NA	NA	NA	NA	1.0E-03	P	NA	NA	1.0E-03	P	NA	NA	NV		1	0.1
Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	NA	NA	NA	NA	8.0E-02	H	3.0E+00	I	8.0E-01	H	8.0E-01	H	V		1	0
Methyl Isocyanate	624-83-9	NA	NA	NA	NA	NA	NA	1.0E-03	C	NA	NA	NA	NA	V		1	0.1
Methyl Methacrylate	80-62-6	NA	NA	NA	NA	1.4E+00	I	7.0E-01	I	8.0E-02	H	NA	NA	V		1	0
Methyl Parathion	298-00-0	NA	NA	NA	NA	2.5E-04	I	NA	NA	7.0E-04	A	NA	NA	NV		1	0.1
Methyl tert-Butyl Ether (MTBE)	1634-04-4	1.8E-03	C	2.6E-07	C	NA	NA	3.0E+00	I	NA	NA	2.5E+00	A	V		1	0
Methyl-5-Nitroaniline, 2-	99-55-8	9.0E-03	P	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Methylaniline Hydrochloride, 2-	636-21-5	1.3E-01	C	3.7E-05	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Methylcholanthrene, 3-	56-49-5	2.2E+01	C	6.3E-03	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Methylene Chloride	75-09-2	2.0E-03	I	1.0E-08	I	6.0E-03	I	6.0E-01	I	6.0E-02	H	1.0E+00	A	V	M	1	0
Methylene-bis(2-chloroaniline), 4,4'-	101-14-4	1.0E-01	P	4.3E-04	C	2.0E-03	P	NA	NA	2.0E-03	P	NA	NA	NV		1	0.1
Methylenebisbenzenamine, 4,4'-	101-77-9	1.6E+00	C	4.6E-04	C	NA	NA	2.0E-02	C	NA	NA	NA	NA	NV		1	0.1
Methylenediphenyl Diisocyanate	101-68-8	NA	NA	NA	NA	NA	NA	6.0E-04	I	NA	NA	2.0E-05	H	NV		1	0.1
Methylnaphthalene, 1-	90-12-0	2.9E-02	P	NA	NA	7.0E-02	A	NA	NA	NA	NA	NA	NA	V		1	0.13
Methylnaphthalene, 2-	91-57-6	NA	NA	NA	NA	4.0E-03	I	NA	NA	4.0E-03	P	NA	NA	V		1	0.13
Methyl-N-nitro-N-nitrosoguanidine, N-	70-25-7	8.3E+00	C	2.4E-03	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Naled	300-76-5	NA	NA	NA	NA	2.0E-03	I	NA	NA	NA	NA	NA	NA	NV		1	0.1

Table 3: Toxicity data (continued)

Chemical	CAS Number	Chronic Toxicity Values								Subchronic Toxicity Values				VOC	Mutagen	GIABS	ABS
		SF $(mg/kg\text{-}day)^{-1}$	key	IUR $(\mu g/m^3)^{-1}$	key	RfD (mg/kg-day)	key	RfC (mg/m^3)	key	RfD (mg/kg-day)	key	RfC (mg/m^3)	key				
Naphthalene	91-20-3	NA	NA	3.4E-05	C	2.0E-02	I	3.0E-03	I	2.0E-01	I*	NA	NA	V		1	0.13
Naphthylamine, 2-	91-59-8	1.8E+00	C	NA	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Nickel Carbonyl	13463-39-3	NA	NA	NA	NA	1.1E-02	C	1.4E-05	C	NA	NA	NA	NA	NV		0.04	0
Nickel Soluble Salts	7440-02-0	NA	NA	2.6E-04	C	2.0E-02	I	9.0E-05	A	2.0E-02	H	2.0E-04	A	NV		0.04	0
Nitroaniline, 4-	100-01-6	2.0E-02	P	NA	NA	4.0E-03	P	6.0E-03	P	1.0E-02	P	2.0E-02	P	NV		1	0.1
Nitrobenzene	98-95-3	NA	NA	4.0E-05	I	2.0E-03	I	9.0E-03	I	6.0E-03	I*	2.0E-02	H	V		1	0
Nitroglycerin	55-63-0	1.7E-02	P	NA	NA	1.0E-04	P	NA	NA	1.0E-04	P	NA	NA	NV		1	0.1
Nitropropane, 2-	79-46-9	NA	NA	2.7E-03	H	NA	NA	2.0E-02	I	NA	NA	2.0E-02	H	V		1	0
Nitrosodiethanolamine, N-	1116-54-7	2.8E+00	I	8.0E-04	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Nitrosodiethylamine, N-	55-18-5	1.5E+02	I	4.3E-02	I	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Nitrosodimethylamine, N-	62-75-9	5.1E+01	I	1.4E-02	I	8.0E-06	P	NA	NA	8.0E-06	P	NA	NA	NV		1	0.1
Nitroso-di-N-butylamine, N-	924-16-3	5.4E+00	I	1.6E-03	I	NA	NA	NA	NA	NA	NA	NA	NA	V		1	0
Nitroso-di-N-propylamine, N-	621-64-7	7.0E+00	I	2.0E-03	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Nitrosodiphenylamine, N-	86-30-6	4.9E-03	I	2.6E-06	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Nitrosomorpholine [N-]	59-89-2	6.7E+00	C	1.9E-03	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Nitroso-N-ethylurea, N-	759-73-9	2.7E+01	C	7.7E-03	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Nitroso-N-methylurea, N-	684-93-5	1.2E+02	C	3.4E-02	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Nitrosopiperidine [N-]	100-75-4	9.4E+00	C	2.7E-03	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Nitrosopyrrolidine, N-	930-55-2	2.1E+00	I	6.1E-04	I	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Nitrotoluene, o-	88-72-2	2.2E-01	P	NA	NA	9.0E-04	P	NA	NA	1.0E-02	P	NA	NA	V		1	0
Nitrotoluene, p-	99-99-0	1.6E-02	P	NA	NA	4.0E-03	P	NA	NA	4.0E-03	P	NA	NA	NV		1	0.1
Octamethylpyrophosphoramide	152-16-9	NA	NA	NA	NA	2.0E-03	H	NA	NA	2.0E-03	H	NA	NA	NV		1	0.1
Octyl Phthalate, di-N-	117-84-0	NA	NA	NA	NA	1.0E-02	P	NA	NA	1.0E-01	P	NA	NA	NV		1	0.1
Oxamyl	23135-22-0	NA	NA	NA	NA	2.5E-02	I	NA	NA	NA	NA	NA	NA	NV		1	0.1
Parathion	56-38-2	NA	NA	NA	NA	6.0E-03	H	NA	NA	6.0E-03	H	NA	NA	NV		1	0.1
Pentachlorobenzene	608-93-5	NA	NA	NA	NA	8.0E-04	I	NA	NA	8.0E-03	I*	NA	NA	NV		1	0.1
Pentachloroethane	76-01-7	9.0E-02	P	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Pentachloronitrobenzene	82-68-8	2.6E-01	H	NA	NA	3.0E-03	I	NA	NA	3.0E-03	H	NA	NA	NV		1	0.1
Pentachlorophenol	87-86-5	4.0E-01	I	5.1E-06	C	5.0E-03	I	NA	NA	1.0E-03	A	NA	NA	NV		1	0.25
Phenacetin	62-44-2	2.2E-03	C	6.3E-07	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Phenol	108-95-2	NA	NA	NA	NA	3.0E-01	I	2.0E-01	C	6.0E-01	H	NA	NA	NV		1	0.1
Phenylenediamine, p-	106-50-3	NA	NA	NA	NA	1.9E-01	H	NA	NA	NA	NA	NA	NA	NV		1	0.1
Phenylmercuric Acetate	62-38-4	NA	NA	NA	NA	8.0E-05	I	NA	NA	8.0E-05	H	NA	NA	NV		1	0.1
Phorate	298-02-2	NA	NA	NA	NA	2.0E-04	H	NA	NA	2.0E-04	H	NA	NA	NV		1	0.1
Phosgene	75-44-5	NA	NA	NA	NA	NA	NA	3.0E-04	I	NA	NA	9.0E-04	I*	V		1	0
Phosphine	7803-51-2	NA	NA	NA	NA	3.0E-04	I	3.0E-04	I	3.0E-04	H	3.0E-03	I*	NV		1	0
Phosphoric Acid	7664-38-2	NA	NA	NA	NA	4.9E+01	P	1.0E-02	I	4.9E+01	P	1.0E-01	I*	NV		1	0
Phosphorus, White	7723-14-0	NA	NA	NA	NA	2.0E-05	I	NA	NA	2.0E-04	A	NA	NA	NV		1	0
Phthalic Anhydride	85-44-9	NA	NA	NA	NA	2.0E+00	I	2.0E-02	C	2.0E+00	H	1.2E-01	H	NV		1	0.1
Polychlorinated Biphenyls, Total	1336-36-3	2.0E+00 (f)	I	5.4E-04 (f)	I	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.14
Potassium Cyanide	151-50-8	NA	NA	NA	NA	2.0E-03	I	NA	NA	2.0E-02	I*	NA	NA	NV		1	0
Potassium Silver Cyanide	506-61-6	NA	NA	NA	NA	5.0E-03	I	NA	NA	5.0E-02	I*	NA	NA	NV		0.04	0
Propargite	2312-35-8	NA	NA	NA	NA	2.0E-02	I	NA	NA	NA	NA	NA	NA	NV		1	0.1
Propargyl Alcohol	107-19-7	NA	NA	NA	NA	2.0E-03	I	NA	NA	2.0E-02	I*	NA	NA	NV		1	0.1
Propham	122-42-9	NA	NA	NA	NA	2.0E-02	I	NA	NA	2.0E-01	I*	NA	NA	NV		1	0.1
Propionaldehyde	123-38-6	NA	NA	NA	NA	NA	NA	8.0E-03	I	NA	NA	8.0E-02	I*	V		1	0
Propylene Oxide	75-56-9	2.4E-01	I	3.7E-06	I	NA	NA	3.0E-02	I	NA	NA	3.0E-02	H	V		1	0
Pyrene	129-00-0	NA	NA	NA	NA	3.0E-02	I	NA	NA	3.0E-01	I*	NA	NA	V		1	0.13
Pyridine	110-86-1	NA	NA	NA	NA	1.0E-03	I	NA	NA	1.0E-02	I*	NA	NA	V		1	0
Quinoline	91-22-5	3.0E+00	I	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Safrole	94-59-7	2.2E-01	C	6.3E-05	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Selenious Acid	7783-00-8	NA	NA	NA	NA	5.0E-03	I	NA	NA	5.0E-03	H	NA	NA	NV		1	0
Selenium	7782-49-2	NA	NA	NA	NA	5.0E-03	I	2.0E-02	C	5.0E-03	H	NA	NA	NV		1	0
Silver	7440-22-4	NA	NA	NA	NA	5.0E-03	I	NA	NA	5.0E-03	H	NA	NA	NV		0.04	0
Silver Cyanide	506-64-9	NA	NA	NA	NA	1.0E-01	I	NA	NA	1.0E-01	H	NA	NA	NV		0.04	0
Sodium Azide	26628-22-8	NA	NA	NA	NA	4.0E-03	I	NA	NA	4.0E-02	I*	NA	NA	NV		1	0
Sodium Cyanide	143-33-9	NA	NA	NA	NA	1.0E-03	I	NA	NA	1.0E-02	I*	NA	NA	NV		1	0
Sodium Fluoride	7681-49-4	NA	NA	NA	NA	5.0E-02	A	1.3E-02	C	NA	NA	NA	NA	NV		1	0
Sodium Fluoroacetate	62-74-8	NA	NA	NA	NA	2.0E-05	I	NA	NA	2.0E-04	I*	NA	NA	NV		1	0.1
Sodium tripolyphosphate	7758-29-4	NA	NA	NA	NA	4.9E+01	P	NA	NA	4.9E+01	P	NA	NA	NV		1	0
Strychnine	57-24-9	NA	NA	NA	NA	3.0E-04	I	NA	NA	3.0E-03	I*	NA	NA	NV		1	0.1
Styrene	100-42-5	NA	NA	NA	NA	2.0E-01	I	1.0E+00	I	2.0E+00	I*	3.0E+00	I*	V		1	0
Sulfuric Acid	7664-93-9	NA	NA	NA	NA	NA	NA	1.0E-03	C	NA	NA	NA	NA	NV		1	0
TCDD, 2,3,7,8-	1746-01-6	1.3E+05	C	3.8E+01	C	7.0E-10	I	4.0E-08	C	2.0E-08	A	NA	NA	NV		1	0.03
Tetrachlorobenzene, 1,2,4,5-	95-94-3	NA	NA	NA	NA	3.0E-04	I	NA	NA	3.0E-03	I*	NA	NA	NV		1	0.1
Tetrachloroethane, 1,1,1,2-	630-20-6	2.6E-02	I	7.4E-06	I	3.0E-02	I	NA	NA	9.0E-02	P	NA	NA	V		1	0
Tetrachloroethane, 1,1,2,2-	79-34-5	2.0E-01	I	5.8E-05	C	2.0E-02	I	NA	NA	5.0E-02	I	NA	NA	V		1	0
Tetrachloroethylene	127-18-4	2.1E-03	I	2.6E-07	I	6.0E-03	I	4.0E-02	I	1.0E-01	H	NA	NA	V		1	0
Tetrachlorophenol, 2,3,4,6-	58-90-2	NA	NA	NA	NA	3.0E-02	I	NA	NA	3.0E-01	I*	NA	NA	NV		1	0.1
Tetraethyl Dithiopyrophosphate	3689-24-5	NA	NA	NA	NA	5.0E-04	I	NA	NA	5.0E-03	I*	NA	NA	NV		1	0.1
Tetraethyl Lead	78-00-2	NA	NA	NA	NA	1.0E-07	I	NA	NA	1.0E-06	I*	NA	NA	NV		1	0.1
Tetrahydrofuran	109-99-9	NA	NA	NA	NA	9.0E-01	I	2.0E+00	I	NA	NA	NA	NA	V		1	0.1
Thallium (Soluble Salts)	7440-28-0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0
Thiofanox	39196-18-4	NA	NA	NA	NA	3.0E-04	H	NA	NA	3.0E-04	H	NA	NA	NV		1	0.1
Thiophanate, Methyl	23564-05-8	NA	NA	NA	NA	8.0E-02	I	NA	NA	NA	NA	NA	NA	NV		1	0.1
Thiram	137-26-8	NA	NA	NA	NA	5.0E-03	I	NA	NA	6.0E-03	H	NA	NA	NV		1	0.1
Titanium Tetrachloride	7550-45-0	NA	NA	NA	NA	NA	NA	1.0E-04	A	NA	NA	1.0E-02	A	NV		1	0
Toluene	108-88-3	NA	NA	NA	NA	8.0E-02	I	5.0E+00	I	8.0E-01	I*	5.0E+00	P	V		1	0
Toluidine, p-	106-49-0	3.0E-02	P	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Toxaphene	8001-35-2	1.1E+00	I	3.2E-04	I	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Triallate	2303-17-5	NA	NA	NA	NA	1.3E-02	I	NA	NA	1.3E-02	H	NA	NA	NV		1	0.1
Trichlorobenzene, 1,2,4-	120-82-1	2.9E-02	P	NA	NA	1.0E-02	I	2.0E-03	P	1.0E-01	I*	2.0E-02	P	V		1	0
Trichloroethane, 1,1,1-	71-55-6	NA	NA	NA	NA	2.0E+00	I	5.0E+00	I	7.0E+00	I	5.0E+00	I	V		1	0
Trichloroethane, 1,1,2-	79-00-5	5.7E-02	I	1.6E-05	I	4.0E-03	I	NA	NA	4.0E-02	I*	NA	NA	V		1	0
Trichloroethylene	79-01-6	4.6E-02 (g)	I	4.1E-06 (g)	I	5.0E-04	I	2.0E-03	I	NA	NA	NA	NA	V	M	1	0
Trichlorofluoromethane	75-69-4	NA	NA	NA	NA	3.0E-01	I	7.0E-01	H	7.0E-01	H	1.0E+00	P	V		1	0
Trichlorophenol, 2,4,5-	95-95-4	NA	NA	NA	NA	1.0E-01	I	NA	NA	1.0E+00	I*	NA	NA	NV		1	0.1
Trichlorophenol, 2,4,6-	88-06-2	1.1E-02	I	3.1E-06	I	1.0E-03	P	NA	NA	NA	NA	NA	NA	NV		1	0.1
Trichlorophenoxyacetic Acid, 2,4,5-	93-76-5	NA	NA	NA	NA	1.0E-02	I	NA	NA	1.0E-01	H	NA	NA	NV		1	0.1
Trichlorophenoxypropionic acid, -2,4,5	93-72-1	NA	NA	NA	NA	8.0E-03	I	NA	NA	8.0E-03	H	NA	NA	NV		1	0.1
Triethylamine	121-44-8	NA	NA	NA	NA	NA	NA	7.0E-03	I	NA	NA	7.0E-02	I*	V		1	0
Trifluralin	1582-09-8	7.7E-03	I	NA	NA	7.5E-03	I	NA	NA	7.5E-03	H	NA	NA	NV		1	0.1
Trimethylbenzene, 1,2,4-	95-63-6	NA	NA	NA	NA	NA	NA	7.0E-03	P	NA	NA	7.0E-02	P	V		1	0
Trinitrobenzene, 1,3,5-	99-35-4	NA	NA	NA	NA	3.0E-02	I	NA	NA	5.0E-04	H	NA	NA	NV		1	0.02
Trisodium phosphate	7601-54-9	NA	NA	NA	NA	4.9E+01	P	NA	NA	4.9E+01	P	NA	NA	NV		1	0
Urethane	51-79-6	1.0E+00	C	2.9E-04	C	NA	NA	NA	NA	NA	NA	NA	NA	NV		1	0.1
Vanadium Pentoxide	1314-62-1	NA	NA	8.3E-03	P	9.0E-03	I	7.0E-06	P	NA	NA	1.0E-04	P	NV		0.03	0
Vinyl Acetate	108-05-4	NA	NA	NA	NA	1.0E+00	H	2.0E-01	I	1.0E+00	H	3.5E-02	A	V		1	0
Vinyl Bromide	593-60-2	NA	NA	3.2E-05	H	NA	NA	3.0E-03	I	NA	NA	3.0E-03	H	V		1	0
Vinyl Chloride	75-01-4	7.2E-01 (h)	I	4.4E-06 (h)	I	3.0E-03	I	1.0E-01	I	NA	NA	7.7E-02	A	V	M	1	0
Warfarin	81-81-2	NA	NA	NA	NA	3.0E-04	I	NA	NA	3.0E-04	H	NA	NA	NV		1	0.1
Xylenes	1330-20-7	NA	NA	NA	NA	2.0E-01	I	1.0E-01	I	4.0E-01	P	3.0E-01	I*	V		1	0
Zinc and Compounds	7440-66-6	NA	NA	NA	NA	3.0E-01	I	NA	NA	3.0E-01	A	NA	NA	NV		1	0
Zinc Cyanide	557-21-1	NA	NA	NA	NA	5.0E-02	I	NA	NA	5.0E-02	H	NA	NA	NV		1	0
Zinc Phosphide	1314-84-7	NA	NA	NA	NA	3.0E-04	I	NA	NA	3.0E-03	I*	NA	NA	NV		1	0

Notes:

(a) The slope factor and inhalation unit risk for Arochlor 1016 are the lowest risk values given on IRIS.
The slope factor and inhalation unit risk for all other Arochlors are the high risk values given on IRIS.

(b) The slope factor and inhalation unit risk for benzene are the highest values of the ranges given on IRIS.

(c) The toxicity values shown for chlordane are for technical chlordane (CAS # 12789-03-6) on IRIS.

(d) The inhalation unit risk for chromium (VI) on IRIS is multiplied by 7 because the ratio of Cr(VI):Cr(III) of 1:6 is used to estimate the unknown ratio used to derive the inhalation unit risk.

(e) The RfD for copper is derived from a drinking water standard of 1.3 mg/L by backing out the adult exposure assumtions (e.g. body weight of 70 kg, ingestion rate of 2 L/day)
used to calculate the drinking water standard, so it can be used for other media.

(f) The slope factor and inhalation unit risk for total PCBs are the high risk values given on IRIS.

(g) The slope factor and inhalation unit risk for trichloroethylene represent the sum of risk estimates from 3 individual types of cancer.
Please refer to Part D, Section 3 of the Support Document for additional information regarding trichloroethylene.

(h) The slope factor and inhalation unit risk for vinyl chloride are the values for continuous exposure during adulthood.
Please refer to Part D, Section 4 of the Support Document for additional information regarding vinyl chloride.

Key		
I = IRIS	H = HEAST	V = Volatile
I* = IRIS with UF for subchronic to chronic removed	J = New Jersey	NV = Not Volatile
P = PPRTV	E = Environmental Criteria Assessment Office	M = Mutagen
A = ATSDR	O = EPA Office of Water	
C = Cal EPA	NA = Not Applicable/Available	

Part C: Scenario and receptor-specific parameters

A summary of the exposure factors used to develop generic numerical standards appear in Table 4 (p. 42).

1. Exposure frequency for construction/excavation activities

An exposure frequency of 120 days/year for construction/excavation activities was chosen by Ohio EPA on the basis of best professional judgment. This exposure frequency is representative of the majority of activities that occur during development and redevelopment activities at a property including but not limited to maintenance and installation of building footers and foundations, grading, and general construction on the property. This exposure frequency is also protective of short term construction/excavation activities including but not limited to maintenance and installation of utility lines, sewer maintenance, and small construction projects.

2. Fraction contaminated

The fraction contaminated (FC) term represents the proportion of soil that is contaminated by the chemical(s) of concern at the property. The FC term assumes random activity and exposure patterns for a particular receptor at the property. An FC term equal to 0.5 was used to calculate all pathway-specific target soil concentrations for residential land use, commercial/industrial land use, and construction/excavation activities.

A property-specific FC term can be constructed in accordance with OAC 3745-300-09 for each chemical of concern, or groups of chemicals of concern, which are associated with a particular identified area(s) or exposure unit(s). If a property-specific FC term is determined separately for each chemical of concern, a property-specific FC term must be determined on the basis of all identified areas or exposure units on the property for which the chemical of concern has been identified and from which the exposure point concentration has been determined. Alternatively, the property-specific FC term may consider the spatial distribution of the chemical(s) of concern and the receptor activity patterns on the property. The basis of receptor activity patterns and their relationship to the identified area(s) or exposure unit(s) must be performed in accordance with OAC 3745-300-09(D)(3)(b)(iv)(b).

Table 4: Summary of all scenario and receptor-specific parameters

Parameter		Residential land use		Commercial/ industrial land use	Construction/ excavation activities	Reference
		a = adult	c = child			
AF	Soil to skin adherence factor	0.07	0.2	0.2	0.3	Exhibit 3-3 & Exhibit 3-5 (5)
ATC	Carcinogenic averaging time	25,550 days (a)				p. 6-23 (2)
ATNC	Non-carcinogenic averaging time	-	2,190 days (b)	9,125 days (c)	365 days (d)	p. 6-23 (2)
BW	Body weight	70 kg	15 kg	70 kg	70 kg	p. 15 (3)
ED	Exposure duration	30 years (a = 24 years, c = 6 years) (e)		25 years	1 year	p. 15 (3)
EF	Exposure frequency	350 days/year		250 days/year	120 days/year	p. 15 (3); p. 41 of this document
ETA	Air exposure time	24 hours/day		8 hours/day	8 hours/day	Table 1 (4)
ETW	Water exposure time	0.58 hour/event	1 hour/event	-	-	Exhibit 3-2 (5)
EVW	Water event frequency	1 event/day		-	-	Exhibit 3-2 (5)
FC	Fraction contaminated	0.5				p. 41 of this document
IRS	Soil ingestion rate	100 mg/day	200 mg/day	50 mg/day	200 mg/day	p. 15 (3); Table 5-1 (6)
IRW	Water ingestion rate	2 L/day	1 L/day	-	-	Exhibit 6-11 (2); (7)
PEF	Particulate emission factor	9.50E+08		9.50E+08	1.34E+07	p. 14 - 17 of this document
SAS	Skin surface area exposed to soil	5,700 cm^2	2,800 cm^2	3,300 cm^2	3,300 cm^2	Exhibit 1-2 (1)
SAW	Skin surface area exposed to water	18,000 cm^2	6,600 cm^2	-	-	Exhibit 3-2 (5)
TCR	Target cancer risk	1×10^{-5}				VAP default
THQ	Target hazard quotient	1				VAP default
VF	Volatilization factor	*Scenario and chemical-specific*				p. 12 - 13 of this document

(1) U.S. EPA 2002. Supplemental guidance for developing soil screening levels for Superfund sites. OSWER 9355.4-24.
(2) U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. EPA/540/1-89/002.
(3) U.S. EPA 1991. Human health evaluation manual. Supplemental guidance: "Standard default exposure factors". OSWER Directive 9285.6-03.
(4) U.S. EPA 2013. Regional screening level (RSL) user's guide (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/usersguide.htm accessed May 2013).
(5) U.S. EPA 2004. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part E, Supplemental) Final. OSWER 9285.7-02.
(6) U.S. EPA 2011. Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/R-09/052F.
(7) U.S. EPA 1989a. Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/8-89/043.

(a) ATC = lifetime (70 years) x 365 days/year = 25,550 days
(b) ATNC = ED (6 years) x 365 days/year = 2,190 days
(c) ATNC = ED (25 years) x 365 days/year = 9,125 days
(d) ATNC = ED (1 year) x 365 days/year = 365 days
(e) ED_{0-2} = 2 years, ED_{2-6} = 4 years, ED_{6-16} = 10 years, ED_{16-30} = 14 years

Part D: Chemical-specific generic numerical standards

1. Arsenic

Arsenic target concentrations in soil for oral pathways are calculated with a relative bioavailability factor of 0.6 for residential land use, commercial/industrial land use, and construction/excavation activities (1).

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(1) U.S. EPA 2012. Compilation and review of data on relative bioavailability of arsenic in soil. OSWER 9200.1-113.

2. Lead

Lead has important non-cancer adverse health effects; however, unlike most chemicals, lead does not appear to have a threshold exposure level and must be evaluated differently. In the absence of toxicological benchmarks for lead (i.e. a slope factor or reference dose), the generally accepted methodology for evaluating exposure to lead is the comparison of estimated blood lead (PbB) concentrations from media exposures with PbBs considered to be indicative of adverse health effects. Using this approach, Ohio EPA has developed soil generic numerical standards for residential land use, commercial/industrial land use, and construction/excavation activities in the VAP. The information provided in this section may also be used to evaluate lead in a property-specific risk assessment in accordance with OAC 3745-300-09. Further information regarding lead modeling can be obtained from the following website: http://www.epa.gov/superfund/health/contaminats/lead/pbrisk.htm.

Because the soil generic numerical standards for lead are developed differently, lead should be evaluated individually as a chemical and should not be included in multiple chemical adjustments for cumulative risk calculations.

Because lead is not volatile at ambient temperatures, air generic numerical standards for lead were not calculated. Because an MCL has been established for lead, a risk-based unrestricted potable use standard for lead was not calculated.

2.1 Residential land use

The soil generic numerical standard protective of a child receptor in a residential land use scenario is 400 mg/kg for lead. This value is the U.S. EPA-recommended screening level for lead in residential soils. The value is recommended by (1) the Toxic Substances Control Act (TSCA) Section 403 guidance from the Office of Prevention, Pesticides, and Toxic Substances and (2) the Office of Solid Waste and Emergency Response Guidance.

Children are regarded as a sensitive subpopulation with regard to lead toxicity. The U.S. EPA derived this recommended lead screening level by use of the Integrated Exposure Uptake Biokinetic Model (IEUBK) developed for children (1)(2). The model uses four interrelated modules to estimate blood lead (PbB) levels in children exposed to lead-contaminated media. The modules account for exposure, uptake, and the biokinetics of lead in the body and predict a probability distribution of PbB levels. From this distribution, the model estimates the risk that a child's PbB will exceed a level of concern, which is typically considered to be 10 µg/dL. The basis of the 400 mg/kg screening level was the use of the IEUBK Model with default input values for the physiological parameters (e.g. soil ingestion rates, absorption, and bioavailability)

and media concentrations (i.e. drinking water, air, diet, dust, etc.). Under these default conditions and including an approximately 400 mg/kg level of lead in the soil, the model predicts that no more than 5% of the modeled population would exceed a target PbB of 10 µg/dL.

Ohio EPA reevaluated the IEUBK model defaults (i.e. soil ingestion rates, dietary lead levels, etc.). In addition, model runs were evaluated assuming no more than 10% of a modeled population would exceed PbB concentrations 10 µg/dL. Although the resulting soil concentrations varied somewhat (some higher, some lower), the variability in the modeling results was considered trivial and therefore 400 mg/kg has been retained as the generic direct contact soil standard for lead for residential land use in the VAP.

Volunteers or certified professionals electing to perform a property-specific risk assessment for lead in a residential land use scenario in accordance with 3745-300-09 are required to use the IEUBK model to determine risks to children from exposures to lead. Changes to the U.S. EPA default values, however, should be approached with caution. Ohio EPA will require valid, defensible, site-specific information and monitoring data to support any changes in the recommended default values.

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(1) U.S. EPA 1994. Guidance manual for the IEUBK model for lead in children. OSWER 9285.7-15-1.
(2) U.S. EPA 2002. Reference manual: Documentation of updates for the IEUBK model for lead in children. OSWER 9285.7-44.

2.2 Commercial/industrial land use

The generic numerical soil direct-contact standard protective of an adult receptor in a commercial/industrial land use scenario is 800 mg/kg for lead. This value was derived using U.S. EPA methodology.

The U.S. EPA's Technical Review Workgroup for Lead has developed an approach for assessing risks associated with adult exposures to lead in soil and establishing cleanup goals that will protect adults and fetuses from lead in soil (1). This guidance does not recommend a specific target soil lead cleanup level, but proposes a methodology that allows for the input of either property-specific data or default values to assess risk and develop property-specific cleanup goals. The methodology is intended for use until an integrated exposure biokinetic model for adults is developed by the U.S. EPA. Although it is acknowledged that the other adult lead models are available and useable, the U.S. EPA concludes that this Adult Lead Model is the most appropriate methodology for modeling adult exposures to lead for scenarios, primarily occupational, where relatively steady patterns of exposure are or are expected to occur.

Ohio EPA adopted the U.S. EPA's Adult Lead Model as its preferred methodology for calculating generic numerical standards for adult populations and recommends its use in any property-specific evaluation of lead risks for a number of technical reasons that include the following: the inclusion of inter-individual variability within the exposed population; the inclusion of assumptions regarding existing baseline blood lead levels; the explicit protection of the developing fetus of a worker as the most sensitive subpopulation; the acceptance of the model's use in the scientific and regulatory communities; and the level of peer review and technical support documentation developed for the model. The spreadsheets used by Ohio EPA to generate standards, along with the technical documentation supporting the input parameters, can be found on the U.S. EPA Technical Review Workgroup for Lead website:

http://www.epa.gov/superfund/health/contaminants/lead/products.htm. The following parameters have VAP-specific values that vary from the defaults used in the Adult Lead Model.

Individual blood lead geometric standard deviation (GSD_i): The U.S. EPA acknowledges that there is uncertainty associated with this parameter and recommends that site-specific blood lead data be collected whenever possible. Since this is not possible in the development of a generic standard, the U.S. EPA recommends the default value of 2.1 to be used in the GNS derivation (1). This value represents the GSD_i for diverse, urban populations. This information is from analysis of blood lead concentration data collected in the NHANES III data collection effort (2).

Exposure frequency (EF): The exposure frequency used is 250 days/year. This is consistent with the commercial/industrial land use scenario in the VAP (Table 4 on p. 42).

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(1) U.S. EPA 2003. Recommendations of the Technical Review Workgroup for Lead for an approach to assessing risks associated with adult exposures to lead in soil. EPA-540-R-03-001.
(2) Brody, DJ, Pirkle, JL, Kramer, RA, Flegal, KM, Matte, TD, Gunter, EW, and Paschal, DC. 1994. Blood lead levels in the U.S. population. Phase 1 of the third National Health and Nutrition Examination Survey (NHNES III, 1998 to 1991). JAMA 272(4): 277-283.

2.3 Construction/excavation activities

The generic numerical soil direct-contact standard protective of an adult receptor engaging in construction/excavation activities is 400 mg/kg for lead. This value was derived using the same U.S. EPA methodology used to derive the generic numerical soil direct-contact standard for commercial/industrial land use. The following parameters have VAP-specific values that vary from the defaults used in the Adult Lead Model.

Individual blood lead geometric standard deviation (GSD_i): The U.S. EPA acknowledges that there is uncertainty associated with this parameter and recommends that site-specific blood lead data be collected whenever possible. Since this is not possible in the development of a generic standard, the U.S. EPA recommends the default value of 2.1 to be used in the GNS derivation (1). This value represents the GSD_i for diverse, urban populations. This information is from analysis of blood lead concentration data collected in the NHANES III data collection effort (2).

Exposure frequency (EF): The exposure frequency used is 120 days/year. This is consistent with the construction/excavation activities scenario in the VAP (Table 4 on p. 42).

Soil ingestion rate (IRS): The soil ingestion rate used is 200 mg/day. This is consistent with the construction/excavation activities scenario in the VAP (Table 4 on p. 42).

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(1) U.S. EPA 2003. Recommendations of the Technical Review Workgroup for Lead for an approach to assessing risks associated with adult exposures to lead in soil. EPA-540-R-03-001.
(2) Brody, DJ, Pirkle, JL, Kramer, RA, Flegal, KM, Matte, TD, Gunter, EW, and Paschal, DC. 1994. Blood lead levels in the U.S. population. Phase 1 of the third National Health and Nutrition Examination Survey (NHNES III, 1998 to 1991). JAMA 272(4): 277-283.

3. Trichloroethylene

The toxicological review for trichloroethylene (TCE) by IRIS recommends that liver and non-Hodgkin lymphoma due to TCE exposure be addressed as a carcinogen with a non-mutagenic mode of action and that kidney risk due to TCE exposure be assessed as a carcinogen with a mutagenic mode of action. The slope factor (SF) and the inhalation unit risk (IUR) for liver and non-Hodgkin lymphoma are 3.7E-02 $(mg/kg\text{-}day)^{-1}$ and 3.1E-06 $(\mu g/m^3\text{-}day)^{-1}$, respectively. The SF and the IUR for kidney cancer are 9.3E-02 $(mg/kg\text{-}day)^{-1}$ and 1.0E-06 $(\mu g/m^3\text{-}day)^{-1}$, respectively (a). Because age-dependent adjustment factors are applied to receptor populations between the ages of 0 and 16 years, consideration of the mutagenic mode of action is not applicable to commercial/industrial land use or construction/excavation activities. The toxicity values used for commercial/industrial land use or construction/excavation activities represent the sums of the values for the for the individual cancer types (1).

The following equations were used to generate the carcinogenic target concentration in soil and the carcinogenic target concentration in air for residential land use. Because an MCL has been established for TCE, a risk-based carcinogenic target concentration in groundwater was not calculated for TCE.

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(1) U.S. EPA 2011. Toxicological Review of Trichloroethylene. EPA/635/R-09/011F.

(a) For property-specific risk assessments in accordance with OAC 3745-300-09, the most up to date toxicity values and related recommendations should be used.

3.1 Carcinogenic target concentration in soil (residential land-use)

Special considerations for TCE were only necessary when determining the carcinogenic target concentration in soil for residential land use; in which case, the following steps were performed.

1. Equation 5 (p. 9), Equation 6 on (p. 10), and Equation 7 (p. 11) were used to determine carcinogenic (non-mutagenic mode of action) target concentrations in soil for the oral, inhalation, and dermal pathways. Equation 1 (p. 6) was used to determine the total carcinogenic (non-mutagenic mode of action) target concentration in soil, which accounts for liver and non-Hodgkin lymphoma risk due to TCE exposure.

2. Equation 5 (p. 9), Equation 6 on (p. 10), and Equation 7 (p. 11) were used to determine carcinogenic (mutagenic mode of action) target concentrations in soil for the oral, inhalation, and dermal pathways. Equation 1 (p. 6) was used to determine the total carcinogenic (mutagenic mode of action) target concentration in soil, which accounts for kidney risk due to TCE exposure.

3. To combine the two carcinogenic target concentrations in soil, Equation 29 (p. 47) was used to sum the reciprocals of the carcinogenic target concentrations in soil before inverting back to the final carcinogenic target concentration in soil.

Equation 29: TCE carcinogenic target concentration in soil

For residential land use:

$$TCS_{total} = \frac{1}{\left(\frac{1}{TCS_{total-cancer}}\right) + \left(\frac{1}{TCS_{total-mutagen}}\right)}$$

TCS_{total} = Carcinogenic target concentration in soil (mg/kg)
$TCS_{total\text{-}cancer}$ = Carcinogenic (non-mutagenic mode of action) target concentration in soil (mg/kg)
$TCS_{total\text{-}mutagen}$ = Carcinogenic (mutagenic mode of action) target concentration in soil (mg/kg)

3.2 Carcinogenic target concentration in air (residential land use)

Special considerations for TCE were only necessary when determining the carcinogenic target concentration in air for residential land use; in which case, the following steps were performed.

1. Equation 17 (p. 21) was used to determine the carcinogenic (non-mutagenic mode of action) target concentration in air.

2. Equation 17 (p. 21) was used to determine the carcinogenic (mutagenic mode of action) target concentration in air.

3. To combine the two carcinogenic target concentrations in soil, the reciprocals of the two carcinogenic target concentrations in air were summed before inverting back to the final carcinogenic target concentration in air.

Equation 30: TCE carcinogenic target concentration in air

For residential land use:

$$TCA_{total} = \frac{1}{\left(\frac{1}{TCA_{total-cancer}}\right) + \left(\frac{1}{TCA_{total-mutagen}}\right)}$$

TCA_{total} = Final carcinogenic target concentration in air (mg/kg)
$TCA_{total\text{-}cancer}$ = Carcinogenic (non-mutagenic mode of action) target concentration in air (mg/kg)
$TCA_{total\text{-}mutagen}$ = Carcinogenic (mutagenic mode of action) target concentration in air (mg/kg)

4. Vinyl chloride

The toxicological review of vinyl chloride by IRIS presents two types of toxicity values - “continuous lifetime exposure during adulthood” and “continuous lifetime exposure from birth” slope factors and inhalation unit risks. The “continuous lifetime exposure during adult hood” slope factor and inhalation unit risk were chosen in order to generate carcinogenic target concentrations in soil and air for commercial/industrial land use and construction/excavation activities with no adjustment (a). Special considerations for vinyl chloride were necessary for residential land use in order to account early-life susceptibility to vinyl chloride. As shown in the equations below, the adult life-segment is pro-rated for exposure time, and child life-segment is not pro-rated to account for early-life susceptibility. Both life segments use the toxicity values for continuous lifetime exposure during adulthood. This method is used because studies have shown that the effects of early-life exposure are both qualitatively and quantitatively different, and the exact time-frame of early-life susceptibility is not known (1).

Because an MCL has been established for vinyl chloride, a risk-based unrestricted potable use standard for vinyl chloride was not calculated.

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(1) U.S. EPA 2000. Toxicological Review of Vinyl Chloride. EPA/635R-00/004.

(a) For property-specific risk assessments in accordance with OAC 3745-300-09, the most up to date toxicity values and related recommendations should be used.

4.1 Carcinogenic target concentration in soil (residential land use)

The following equations were used to calculate the carcinogenic target concentrations in soil for the oral, inhalation, and dermal pathways. The carcinogenic target concentrations in soil for vinyl chloride calculated using the following equations were then combined using Equation 1 (p. 6).

Equation 31: Vinyl chloride carcinogenic target concentration in soil for oral pathway

For residential land use:

$$TCS_{oral} = \frac{TCR \times \left(\frac{1}{FC}\right)}{\left[\left(\frac{SF \times EF \times IFS_{adj} \times CF}{ATC}\right) + \left(\frac{SF \times IRS_c \times CF}{BW_c}\right)\right]}$$

$$where\ IFS_{adj} = \left[\frac{ED_c \times IRS_c}{BW_c}\right] + \left[\frac{ED_a \times IRS_a}{BW_a}\right]$$

TCS_{oral} = Target concentration in soil for oral pathway (mg/kg)
TCR = Target cancer risk (TCR = 10^{-5})
FC = Fraction contaminated (FC = 0.5)
SF = Slope factor ((mg/kg-day)$^{-1}$) (chemical-specific)
EF = Exposure frequency (days/year) (scenario-specific)
IFS_{adj} = Age-adjusted soil ingestion factor (mg/day)
CF = Conversion factor (CF = 1E-06 kg/mg)
ATC = Carcinogenic averaging time (ATC = 25,550 days)
IRS = Soil ingestion rate (mg/day) (receptor-specific)
BW = Body weight (kg) (receptor-specific)
ED = Exposure duration (years) (receptor-specific)

Equation 32: Vinyl chloride carcinogenic target concentration in soil for inhalation pathway

For residential land use:

$$TCS_{inhalation} = \frac{TCR \times \left(\frac{1}{FC}\right)}{\left\{\left[\frac{IUR \times EF \times ED_r \times ETA}{ATC \times VF \times \left(\frac{1\ mg}{10^3\ \mu g}\right) \times \left(\frac{24\ hours}{1\ day}\right)}\right] + \left[\frac{IUR}{VF \times \left(\frac{1\ mg}{10^3\ \mu g}\right)}\right]\right\}}$$

$TCS_{inhalation}$ = Target concentration in soil for inhalation pathway (mg/kg)
TCR = Target cancer risk (TCR = 10^{-5})
FC = Fraction contaminated (FC = 0.5)
IUR = Inhalation unit risk (($\mu g/m^3$)$^{-1}$) (chemical-specific)
EF = Exposure frequency (days/year) (scenario-specific)
ED = Exposure duration (years) (scenario-specific)
ETA = Air exposure time (hours/day) (scenario-specific)
ATC = Carcinogenic averaging time (ATC = 25,550 days)
VF = Volatilization factor (m^3/kg) (chemical and scenario-specific)

Equation 33: Vinyl chloride carcinogenic target concentration in soil for dermal pathway

For residential land use:

$$TCS_{dermal} = \frac{TCR \times \frac{1}{FC}}{\left\{\left[\frac{\left(\frac{SF}{GIABS}\right) \times EF \times DFS_{adj} \times ABS \times CF}{ATC}\right] + \left[\frac{\left(\frac{SF}{GIABS}\right) \times AF_c \times SAS_c \times ABS \times CF}{BW_c}\right]\right\}}$$

$$where\ DFS_{adj} = \left[\frac{ED_c \times SAS_c \times AF_c}{BW_c}\right] + \left[\frac{ED_a \times SAS_a \times AF_a}{BW_a}\right]$$

TCS_{dermal} = Target concentration in soil for dermal pathway (mg/kg)
TCR = Target cancer risk (TCR = 10^{-5})
FC = Fraction contaminated (FC = 0.5)
SF = Slope factor ((mg/kg-day)$^{-1}$) (chemical-specific)
GIABS = Gastrointenstinal absorption factor (chemical-specific)
EF = Exposure frequency (days/year) (scenario-specific)
DFS_{adj} = Age-adjusted dermal contact factor (mg-year/kg-day)
ABS = Dermal absorption factor (dimensionless) (chemical-specific)
CF = Conversion factor (CF = 1E-06 kg/mg)
ATC = Carcinogenic averaging time (ATC = 25,550 days)
AF = Soil to skin adherence factor (dimensionless) (receptor-specific)
SAS = Skin surface area exposed to soil (cm^2) (receptor-specific)
BW = Body weight (kg) (receptor-specific)
ED = Exposure duration (years) (receptor-specific)

4.2 Carcinogenic target concentration in air (residential land use)

The following equation was used to calculate the carcinogenic target concentration in air.

Equation 34: Vinyl chloride carcinogenic target concentration in air

For residential land use:

$$TCA = \frac{TCR}{\left\{IUR + \left[\frac{IUR \times EF \times ED \times ETA \times \left(\frac{1\ day}{24\ hours}\right)}{ATC}\right]\right\}}$$

TCA = Target concentration in air (µg/m^3)
TCR = Target cancer risk (TCR = 10^{-5})
IUR = Inhalation unit risk ((µg/m^3)$^{-1}$) (chemical-specific)
EF = Exposure frequency (days/year) (scenario-specific)
ED = Exposure duration (years) (scenario-specific)
ETA = Air exposure time (hours/day) (scenario-specific)
ATC = Carcinogenic averaging time (ATC = 25,550 days)

5. Total petroleum hydrocarbons (TPH)

The generic numerical standards for petroleum at residential or commercial/industrial properties are the standards established in rules adopted under division (B) of 3737.882 of the Ohio Revised Code, as provided in division (B)(1) of 3746.04 of the Ohio Revised Code. The State Fire Marshal's Bureau of Underground Storage Tank Regulations administers the rules adopted under division (B) of 3737.882 of the Ohio Revised Code.

For properties in which the petroleum standard is developed through a property-specific risk assessment, soil saturation concentrations of total petroleum hydrocarbons (TPH) must be determined. The saturation limits are given in OAC 3745-300-09 and are listed in Table 5 (p. 51).

Table 5: Total petroleum hydrocarbon soil saturation concentrations

Petroleum fraction	**Residual concentrations (mg/kg)**		
	Sand and gravel or unknown soil type *K_V: 10^{-3} – 10^{-4} cm/s*	**Silty/clayey sand** *K_V: 10^{-4} – 10^{-5} cm/s*	**Glacial till & silty clay** *K_V: < 10^{-5} cm/s*
Light (C_6-C_{12})	1,000	5,000	8,000
Middle (C_{10}-C_{20})	2,000	10,000	20,000
Heavy (C_6-C_{12})	5,000	20,000	40,000

Where mg/kg means milligrams per kilogram, K_V means vertical hydraulic conductivity of the unsaturated soil, cm/s means centimeters per second, and C_x means carbon chain length.

The information used to obtain the petroleum fraction saturation values was condensed during the original VAP rule development (1996) from the American Petroleum Institute (1993), which cited residual liquid hydrocarbon concentrations found in Mercer and Cohen (1990). The values were not directly obtained from the literature, but are interpolated values from a simplified matrix of soil types and petroleum fractions. Carbon ranges for TPH were changed during the 2009 VAP rule revision to comport with the carbon ranges used by BUSTR in their Corrective Action rule.