APPENDIX C

Direct and Indirect Exposure Equations

Appendix C. Indirect Exposure Equations

Appendix C presents the equations that were used to calculate media and food concentrations of contaminants for the indirect exposure pathways. Also included in the appendix are equations used in estimating individual cancer risk and hazard quotients. Parameter values and references are presented in Appendices A and E.

The individual equations are organized into six groups. These are as follows: 1) soil concentration; 2) terrestrial food chain concentration; 3) aquatic food chain and drinking water concentration; 4) direct inhalation exposure; 5) cancer risks and hazard quotients; and 6) breastmilk exposure. Each group is discussed in a separate section in this appendix. The introduction to each section provides a brief discussion of the equations.

Equations are presented in a table format. The tables show the equations, identify the exposure scenarios, list all input parameters, and identify the default values where appropriate. The default value column of the tables may contain one of the following designations instead of (or in addition to) a default value:

- **shaded, no value**: this signifies that this row of the table describes either the parameter being calculated by the given equation or a units conversion constant in the equation.

- **modeled (see Appendix A)**: this indicates a deposition rate or air concentration, as determined by the ISCSTDFT model, as described in Section 3.

- **calculated (see Table C-x.x)**: this indicates that an equation is given for calculating the parameter in the indicated table.

- **site-specific (see Appendix A)**: this indicates that the parameter is site-specific and that no default value is considered appropriate.

- **chemical-specific (see Appendix E):** this indicates that the parameter is chemical-specific, and specific values are provided in Appendix E.

- **varies (see Appendix E):** this indicates that the parameter - typically an exposure parameter - varies, and specific values are provided in Appendix E.

1. Soil Concentration Equations

The equations in this section were used to calculate the soil concentration resulting from deposition of particle and vapor phase contaminants onto soils. The calculation of soil concentration includes a loss term that can account for loss of contaminant from the soil after deposition by several mechanisms, including leaching, erosion, runoff, degradation, and volatilization. These loss mechanisms all lower the soil concentration associated with a specific deposition rate. Although the degradation term is chemical-specific, it is set to zero for all contaminants.

Table C-1.1. Soil Concentration Due to Deposition for Carcinogenic Compounds

$$\overline{Sc} = \frac{Sc_1 \bullet (Tc - T_1) + \overline{Sc_2} \bullet (T_2 - Tc)}{T_2 - T_1} \quad for\ T_1 < Tc \leq T_2$$

$$\overline{Sc_1} = \frac{Ds}{ks \bullet (Tc - T_1)} \bullet \left[\left(Tc + \frac{\exp(-ks \bullet Tc)}{ks} \right) - \left(T_1 + \frac{\exp(-ks \bullet T_1)}{ks} \right) \right] for\ T_1 < Tc$$

$$\overline{Sc_2} = \frac{Sc_{Tc}}{ks \bullet (T_2 - Tc)} \bullet \left[1 - \exp\left(-ks \bullet (T_2 - Tc) \right) \right] for\ T_2 > Tc$$

$$Sc_{Tc} = \frac{Ds \bullet \left(1 - \exp(-ks \bullet Tc)\right)}{ks}$$

$$Ds = \frac{100 \bullet Q}{z \bullet BD} \bullet \left[F_v (0.31536 \bullet Vdv \bullet Cyv + Dywv) + (Dydp + Dywp) \bullet (1 - F_v) \right]$$

Table C-1.1 (continued)		
Parameter	**Definition**	**Values**
Sc	Average soil concentration over exposure duration (mg/kg)	
Ds	Deposition term (mg/kg-yr)	
Tc	Time period over which deposition occurs (yr)	30
Sc_{Tc}	Soil concentration at time Tc (mg/kg)	
ks	Soil loss constant (yr^{-1})	calculated (see Table C-1.2)
T_2	Length of exposure duration (yr)	scenario-specific (see Appendix E)
T_1	Time at beginning of exposure period (yr)	scenario-specific (see Appendix E)
Z	Soil mixing depth (cm)	varies (see Appendix E)
BD	Soil bulk density (g/cm^3)	1.5
0.31536	Units conversion factor (m-g-s/cm-μg-yr)	
Vdv	Dry deposition velocity (cm/s)	0.2 for Dioxins
Cyv	Normalized vapor phase air concentration ($\mu g\text{-}s/g\text{-}m^3$)	modeled (see Appendix A)
Q	Stack emissions (g/sec)	calculated (see Section IV and Appendix A)
F_v	Fraction of air concentration in vapor phase (dimensionless)	chemical-specific (see Appendix E)
Dywv	Normalized yearly wet deposition from vapor phase ($s/m^2\text{-}yr$)	modeled (see Appendix A)
Dydp	Normalized yearly dry deposition from particle phase ($s/m^2\text{-}yr$)	modeled (see Appendix A)
Dywp	Normalized yearly wet deposition from particle phase ($s/m^2\text{-}yr$)	modeled (see Appendix A)
100	Units conversion factor ($[mg\text{-}m^2]/[kg\text{-}cm^2]$)	

Table C-1.1 (continued)
Description
These equations calculate an average soil concentration over the scenario exposure duration as a result of wet and dry deposition of particles and vapors to soil. Contaminants are assumed to be incorporated only to a finite depth (the mixing depth, Z). Soil concentration as calculated from this equation may vary for each scenario depending on location in relation to the source of emissions. T_1 in these equations corresponds to Tc minus the exposure duration and, therefore, is scenario-specific.

Table C-1.1 (continued) Soil Concentration Due to Deposition for Noncarcinogenic Compounds

$$Sc_{Tc} = \frac{Ds \bullet \left(1 - \exp\left(-ks \bullet Tc\right)\right)}{ks}$$

$$Ds = \frac{100 \bullet Q}{z \bullet BD} \bullet \left[F_v\,(0.31536 \bullet Vdv \bullet Cyv + Dywv) + (Dydp + Dywp) \bullet (1 - F_v)\right]$$

Parameter	Definition	Values
Sc_{Tc}	Soil concentration at time Tc (mg/kg)	
Ds	Deposition term (mg/kg-yr)	
Tc	Time period over which deposition occurs (yr)	30
ks	Soil loss constant (yr^{-1})	calculated (see Table C-1.2)
Z	Soil mixing depth (cm)	varies (see Appendix E)
BD	Soil bulk density (g/cm^3)	1.5
0.31536	Units conversion factor (m-g-s/cm-µg-yr)	
Vdv	Dry deposition velocity (cm/s)	0.2 for Dioxins
Cyv	Normalized vapor phase air concentration (µg-s/g-m^3)	modeled (see Appendix A)
Q	Stack emissions (g/sec)	calculated (see Section IV and Appendix A)

Table C-1.1 (continued)		
Parameter	**Definition**	**Values**
F_v	Fraction of air concentration in vapor phase (dimensionless)	chemical-specific (see Appendix E)
Dywv	Normalized yearly wet deposition from vapor phase (s/m^2-yr)	modeled (see Appendix A)
Dydp	Normalized yearly dry deposition from particle phase (s/m^2-yr)	modeled (see Appendix A)
Dywp	Normalized yearly wet deposition from particle phase (s/m^2-yr)	modeled (see Appendix A)
100	Units conversion factor ([mg-m^2]/[kg-cm^2])	

Description
These equations calculate a soil concentration at time Tc as a result of wet and dry deposition of particles and vapors to soil. Contaminants are assumed to be incorporated only to a finite depth (the mixing depth, Z). Soil concentration as calculated from this equation may vary for each scenario depending on location in relation to the source of emissions.

Table C-1.2. Soil Loss Constant

$$ks = ksl + kse + ksr + ksg + ksv$$

Parameter	Definition	Values
ks	Soil loss constant due to all processes (yr^{-1})	
ksl	Loss constant due to leaching (yr^{-1})	calculated (see Table C-1.3)
kse	Loss constant due to soil erosion (yr^{-1})	0
ksr	Loss constant due to surface runoff (yr^{-1})	calculated (see Table C-1.4)
ksg	Loss constant due to degradation (yr^{-1})	0
ksv	Loss constant due to volatilization (yr^{-1})	calculated (see Table C-1.5)

Description

This equation calculates the soil loss constant, which accounts for the loss of contaminant from soil by several mechanisms. For erosion of soil from the agricultural field or home garden, the kse is set equal to 0 because soil erosion from these sites is assumed to be balanced by erosion onto these sites. The net result is no soil loss due to erosion from the home garden or agricultural field.

Table C-1.3. Loss Constant Due to Leaching

$$ksl = \frac{P + I - R - E_v}{\theta_s \cdot z \cdot [1.0 + (BD \cdot Kd_s / \theta_s)]}$$

$$Kd_s = f_{oc} \bullet K_{oc}$$

Parameter	Definition	Values
ksl	Loss constant due to leaching (yr^{-1})	
P	Average annual precipitation (cm/yr)	site-specific (see Appendix A)
I	Average annual irrigation (cm/yr)	0
R	Average annual runoff (cm/yr)	site-specific (see Appendix A)
E_v	Average annual evapotranspiration (cm/yr)	site-specific (see Appendix A)
θ_s	Soil volumetric water content (ml/cm^3)	0.2
z	Soil depth from which leaching removal occurs (cm)	varies (see Appendix E)
Kd_s	Soil-water partition coefficient (cm^3/g)	metals - see Appendix E: dioxins - calculated as above
f_{oc}	Fraction organic carbon is soil (unitless)	0.01
K_{oc}	Organic carbon partition coefficient (ml/g)	chemical-specific (see Appendix E)
BD	Soil bulk density (g/cm^3)	1.5

Description

This equation calculates the contaminant loss constant due to leaching from soil.

Table C-1.4. Loss Constant due to Runoff		
$$ksr = \frac{R}{\theta_s \cdot z} \cdot \left(\frac{1}{1 + (Kd_s \cdot BD / \theta_s)} \right)$$		
Parameter	**Definition**	**Values**
ksr	Loss constant due to runoff (yr^{-1})	
R	Average annual runoff (cm/yr)	site-specific (see Appendix A)
θ_s	Soil volumetric water content (ml/cm^3)	0.2
z	Soil mixing depth (cm)	varies (see Appendix E)
Kd_s	Soil-water partition coefficient (cm^3/g)	calculated (see Table C-1.3)
BD	Soil bulk density (g/cm^3)	1.5
Description		
This equation calculates the contaminant loss constant due to runoff from soil.		

Table C-1.5. Loss Constant due to Volatilization

$$ksv = \left[\frac{3.1536x10^{7} \cdot H}{z \cdot Kd_s \cdot R \cdot T \cdot BD}\right] \cdot \left[0.482 \cdot u^{0.78} \cdot \left(\frac{\mu_a}{\rho_a \cdot D_a}\right)^{-0.67} \cdot \left(\sqrt{\frac{4 \cdot A}{\pi}}\right)^{-0.11}\right]$$

Parameter	Definition	Values
ksv	Loss constant due to volatilization (yr^{-1})	
$3.1536x10^7$	Conversion constant (s/yr)	
H	Henry's Law constant ($atm\text{-}m^3/mol$)	chemical-specific (see Appendix E)
z	Soil mixing depth (cm)	varies (see Appendix E)
Kd_s	Soil-water partition coefficient (cm^3/g)	calculated (see Table C-1.3)
R	Universal gas constant ($atm\text{-}m^3/mol\text{-}K$)	$8.205x10^{-5}$
BD	Soil bulk density (g/cm^3)	1.5
T	Ambient air temperature (K)	site-specific (see Appendix A)
u	Average annual wind speed (m/s)	site-specific (see Appendix A)
μ_a	Viscosity of air (g/cm-s)	$1.81x10^{-4}$
ρa	Density of air (g/cm^3)	$1.2x10^{-3}$
Da	Diffusivity of contaminant in air (cm^2/s)	chemical-specific (see Appendix E)
A	Surface area of contaminated area (m^2)	varies (see Appendix E)

Table C-1.5. Loss Constant due to Volatilization
Description
This equation calculates the contaminant loss constant due to volatilization from soil. The area of contamination cited in this scenario varies for different pathways. For soil ingestion by humans, the area of contamination is assumed to be 2,000 m^2. For terrestrial food chain pathways, the area of contamination is assumed to be a 300,000 m^2 agricultural field.

2. Terrestrial Food Chain Equations

The equations in this section are used to calculate contaminant concentrations in the terrestrial food chain, which encompasses aboveground produce and root vegetables, beef, pork, milk, poultry, and eggs. Soil concentrations required as input for the calculation of the food chain concentrations are calculated as discussed in Section 1 of this appendix.

Aboveground produce may be contaminated by combustion emissions through several mechanisms, including direct deposition of contaminants onto the plant, direct uptake of vapor phase contaminants, and root uptake of contaminants deposited on the soil. Root vegetables may be contaminated via uptake of contaminants through the roots. Direct deposition and root uptake of contaminants are calculated at the location of the given scenario.

Animal tissue (beef, pork, poultry, eggs, and milk) may be contaminated through ingestion of contaminated forage, grain, silage and soil by livestock. Beef and dairy cattle ingest grain, silage, forage, and soil. Hogs ingest grain, silage, and soil. Chickens raised by the subsistence farmer are assumed to be free range chickens and consume 10% of their diet as contaminated soil. Chickens raised by the typical farmer are assumed not to be free range. These chickens consume contaminated grain but no soil.

The contamination of plant matter consumed by livestock differs depending on the type of plant. Forage, which includes pasture grass and hay, and silage may be contaminated by combustion emissions through direct deposition of contaminants onto the plant, direct uptake of vapor phase contaminants, and root uptake of contaminants deposited on the soil. Grain is assumed to be protected and, thus, is contaminated by root uptake of contaminants in soil. Direct deposition and root uptake of contaminants are calculated at the location of the given scenario.

Table C-2.1. Vegetative Concentration Due to Direct Deposition

$$Pd = \frac{1000 \cdot Q \cdot (1 - F_v) \cdot [Dydp + (Fw \cdot Dywp)] \cdot Rp \cdot [(1.0 - exp(-kp \cdot Tp)]}{Yp \cdot kp}$$

Parameter	Definition	Values
Pd	Concentration in plant due to direct deposition (mg/kg DW)	
1000	Units conversion factor (mg/g)	
Q	Stack emissions (g/sec)	calculated (see Section IV and Appendix A)
F_v	Fraction of air concentration in vapor phase (dimensionless)	chemical-specific (see Appendix E)
Dydp	Normalized yearly dry deposition from particle phase (s/m^2-yr)	modeled (see Appendix A)
Fw	Fraction of wet deposition that adheres to plant (dimensionless)	chemical-specific (see Appendix E)
Dywp	Normalized yearly wet deposition from particle phase (s/m^2-yr)	modeled (see Appendix A)
Rp	Interception fraction of edible portion of plant (dimensionless)	varies (see Appendix E)
kp	Plant surface loss coefficient (yr^{-1})	18
Tp	Length of plant exposure to deposition of edible portion of plant, per harvest (yrs)	varies (see Appendix E)
Yp	Yield or standing crop biomass of the edible portion of the plant (kg DW/m^2)	varies (see Appendix E)

Description

This equation calculates the contaminant concentration in aboveground vegetables, forage, and silage due to wet and dry deposition of contaminant on the plant surface. This equation is not used for grain because it is considered a protected species.

Table C-2.2. Vegetative Concentration Due to Air-to-Plant Transfer

$$Pv = Q \cdot F_v \cdot \frac{Cyv \cdot Bv \cdot VG_{ag}}{\rho_a}$$

Parameter	Definition	Values
Pv	Concentration of pollutant in the plant due to air-to-plant transfer (mg/kg Dw)	
Q	Stack emissions (g/sec)	calculated (see Section IV and Appendix A)
F_v	Fraction of air concentration in vapor phase (dimensionless)	chemical-specific (see Appendix E)
Cyv	Normalized vapor phase air concentration (µg-sec/g-m^3)	modeled (see Appendix A)
Bv	Air-to-plant biotransfer factor ([mg pollutant/kg plant tissue DW]/[µg pollutant/g air])	chemical-specific (see Appendix E)
VG_{ag}	Empirical correction factor for aboveground produce (dimensionless)	varies according to produce and chemical (See Appendix E)
ρ_a	Density of air (g/m^3)	1.2×10^3

Description

This equation calculates the contaminant concentration in aboveground vegetation, forage, and silage due to direct uptake of vapor phase contaminants into the plant leaves. This equation is not used for grain because it is considered a protected species.

Table C-2.3. Aboveground Vegetation Concentration Due to Root Uptake

$$Pr = Sc \cdot Br$$

Parameter	Definition	Values
Pr	Concentration of pollutant in the plant due to direct uptake from soil (mg/kg Dw)	
Sc	Average soil concentration of pollutant over exposure duration (mg/kg)	calculated (see Table C-1.1)
Br	Plant-soil bioconcentration factor for aboveground vegetation [µg/g DW]/[µg/g soil]	chemical-specific (see Appendix E)

Description

This equation calculates the contaminant concentration in aboveground produce, forage, grain, and silage due to direct uptake of contaminants from soil.

Table C-2.4. Root Vegetable Concentration Due to Root Uptake

$$Pr_{bg} = \frac{Sc \bullet RCF \bullet VG_{bg}}{Kd_s} \quad (Dioxins)$$

$$Pr_{bg} = Sc \bullet Br \quad (Metals)$$

Parameter	Definition	Values
Pr_{bg}	Concentration of pollutant in below ground plant parts due to root uptake (for dioxins (mg/kg Fw); for metals (mg/kg Dw))	
Sc	Soil concentration of pollutant (mg/kg)	calculated (see Table C.1-1)
Kd_s	Soil-water partition coefficient (ml/g)	calculated (see Table C-1.3)
RCF	Ratio of concentration in roots to concentration in soil pore water ([mg pollutant/kg plant tissue FW] / [µg pollutant/ml pore water])	chemical-specific (see Appendix E)
VG_{bg}	Empirical correction factor for root vegetables (unitless)	0.01
Br	Plant-soil bioconcentration factor for root vegetables [µg/g Dw] / [µg/g soil]	chemical-specific (see Appendix E)

Description

This equation calculates the contaminant concentration in root vegetables due to uptake from the soil water.

Table C-2.5. Beef Concentration Due to Plant and Soil Ingestion

$$A_{beef} = \left(\sum F_i \, Qp_i \bullet P_i + Qs \bullet S_c\right) \bullet Ba_{beef}$$

Parameter	Definition	Values
A_{beef}	Concentration of pollutant in beef (mg/kg Fw)[1]	
F_i	Fraction of plant grown on contaminated soil and eaten by the animal (dimensionless) for each plant type.	1
Qp_i	Quantity of plant matter eaten by the animal each day (kg plant tissue DW/d) for each plant type	varies for each plant type and between subsistence and typical farmers (see Appendix E)
P_i	Total concentration of pollutant in the each plant type eaten by the animal (mg/kg Dw) P = Pd + Pv + Pr. Pd and Pv are not used for grain.	calculated (see Tables C-2.1, C-2.2, C-2.3)
Qs	Quantity of soil eaten by the animal (kg soil/d)	varies between typical and subsistence (see Appendix E)
Sc	Soil concentration (mg/kg)	calculated (see Table C-1.1)
Ba_{beef}	Biotransfer factor for beef (d/kg)	chemical-specific (see Appendix E)

Description

This equation calculates the concentration of contaminant in beef from ingestion of forage, grain, silage, and soil.

[1] For the chemicals selenium and cadmium, the concentration in beef is in (mg/kg Dw).

Table C-2.6. Milk Concentration Due to Plant and Soil Ingestion

$$A_{milk} = \left(\sum F_i \bullet Qp_i \bullet P_i + Qs \bullet Sc\right) \bullet Ba_{milk}$$

Parameter	Definition	Values
A_{milk}	Concentration of pollutant in milk (mg/kg Fw)[2]	
F_i	Fraction of plant grown on contaminated soil and eaten by the animal (dimensionless) for each plant type.	1
Qp_i	Quantity of plant matter eaten by the animal each day (kg plant tissue DW/d) for each plant type	varies for each plant type and between subsistence and farmers (see Appendix E)
P_i	Total concentration of pollutant in the each plant type eaten by the animal (mg/kg) P = Pd + Pv + Pr. Pd and Pv are not used for grain.	calculated (see Tables C-2.1, C-2.2, C-2.3)
Qs	Quantity of soil eaten by the animal (kg soil/d)	varies between subsistence and typical farmers (see Appendix E)
Sc	Soil concentration (mg/kg)	calculated (see Table C-1.1)
Ba_{milk}	Biotransfer factor for milk (d/kg)	chemical-specific (see Appendix E)

Description

This equation calculates the concentration of contaminant in milk from ingestion of forage, silage, grain, and soil.

[2] For the chemicals selenium and cadmium, the concentration in milk is in (mg/kg Dw).

Table C-2.7. Pork Concentration Due to Plant and Soil Ingestion		
$$A_{pork} = \left(\sum F_i \bullet Qp_i \bullet P_i + Qs \bullet Sc\right) Ba_{pork}$$		
Parameter	**Definition**	**Values**
A_{pork}	Concentration of pollutant in pork (mg/kg Fw)[3]	
F_i	Fraction of plant grown on contaminated soil and eaten by the animal (dimensionless) for each plant type.	1
Qp_i	Quantity of plant matter eaten by the animal each day (kg plant tissue DW/d) for each plant type	varies for each plant type (see Appendix E)
P_i	Total concentration of pollutant due to root uptake in grain and silage eaten by the animal (mg/kg Dw). P = Pd + Pv + Pr. Pd and Pv are not used for grain.	calculated (see Table C-2.3)
Qs	Quantity of soil eaten by the animal (kg soil/d)	0.37 (see Appendix E)
Sc	Soil concentration (mg/kg)	calculated (see Table C-1.1)
Ba_{pork}	Biotransfer factor for pork (d/kg)	chemical-specific (see Appendix E)
Description		
This equation calculates the concentration of contaminant in pork from ingestion of grain, silage, and soil. Forage ingestion was not used because hogs are not grazing animals.		

[3] For the chemicals selenium and cadmium, the concentration in pork is in (mg/kg Dw).

Table C-2.8 Concentration in Eggs due to Soil Uptake by Free Range Chickens - Subsistence Poultry Farmer

$$A_{eggs} = S_c \bullet Fd \bullet BCF_{egg}$$

Parameter	Definition	Values
A_{eggs}	Concentration of pollutant in eggs (mg/kg Fw)	
S_c	Concentration of congener in soil (mg/kg)	calculated (see Table C-1.1)
Fd	Fraction of diet that is soil (dimensionless)	0.1
BCF_{egg}	Bioconcentration factor for congener in eggs (unitless)	chemical-specific (see Appendix E)

Description

This equation calculates the concentration in eggs due to ingestion of contaminated soil by the free range chickens raised by the subsistence poultry farmer.

Table C-2.9 Concentration in Poultry Meat due to Soil Uptake by Free Range Chickens - Subsistence Poultry Farmer

$$A_{poultry} = S_c \bullet Fd \bullet BCF_{chick}$$

Parameter	Definition	Values
$A_{poultry}$	Concentration of pollutant in poultry meat (mg/kg Fw)	
S_c	Concentration of congener in soil (mg/kg)	calculated (see Table C-1.1)
Fd	Fraction of diet that is soil (dimensionless)	0.1
BCF_{chick}	Bioconcentration factor for congener in thigh meat	chemical-specific (see Appendix E)

Description

This equation calculates the concentration in poultry meat due to ingestion of contaminated soil by the free range chickens raised by the subsistence poultry farmer.

Table C-2.10. Concentration in Eggs due to Grain Uptake from Chickens - Typical Poultry Farmer

$$A_{eggs} = Pr \bullet BCF_{egg}$$

Parameter	Definition	Values
A_{eggs}	Concentration of pollutant in eggs (mg/kg Fw)	
Pr	Concentration of congener in grain (mg/kg). Pd and Pv are not used for grain	calculated (see Table C-1.3)
BCF_{egg}	Bioconcentration factor for congener in eggs	chemical-specific (see Appendix E)

Description

This equation calculates the concentration in eggs due to ingestion of contaminated grain by chickens raised by the typical poultry farmer.

Table C-2.11. Concentration in Poultry Meat due to Grain Uptake from Chickens - Typical Poultry Farmer

$$A_{poultry} = Pr \bullet BCF_{chick}$$

Parameter	Definition	Values
$A_{poultry}$	Concentration of pollutant in poultry meat (mg/kg Fw)	
Pr	Concentration of congener in grain (mg/kg). Pd and Pv are not used for grain	calculated (see Table C-1.3)
BCF_{chick}	Bioconcentration factor for congener in thigh meat (unitless)	chemical-specific (see Appendix E)

Description

This equation calculates the concentration in poultry meat due to ingestion of contaminated grain by chickens raised by the typical poultry farmer.

3. Aquatic Food Chain and Drinking Water Equations

Equations for the aquatic food chain were used to calculate the contaminant concentration in the waterbody partitioned between dissolved phase, suspended sediment, and benthic sediment. Contaminant concentrations in fish were calculated from the contaminant concentrations in the waterbody, either dissolved or total water column concentrations or sediment concentrations.

Prior to calculating a load to the waterbody, the contaminant concentration of soil in the watershed was calculated using equations C-3.1 to C-3.5. The deposition rates and air concentration of vapors used in the calculations were aerally averaged over each watershed.

Five pathways caused contaminant loading of the waterbody: 1) direct deposition; 2) runoff from impervious surfaces within the watershed; 3) runoff from pervious surfaces within the watershed; 4) soil erosion from the watershed; and 5) direct diffusion of dry vapor phase contaminant into the surface water. Other pathways were omitted or their contributions were assumed to be negligible compared with the pathways being evaluated. Although internal transformation could be considered as a waterbody loading pathway, this pathway was also omitted. Instead, the effects of transformation processes for constituents that were transformed (e.g., inorganic mercury to methyl mercury) were implicit in the waterbody to fish tissue partitioning factor (e.g., the bioaccumulation factor for mercury).

The total waterbody concentration (in the water column and sediments) from the waterbody load was calculated and partitioned into a dissolved water concentration, a total water column concentration, and a bed sediment concentration. Only one of these three concentrations was calculated for each chemical. Chemical dissipation from within the waterbody was also considered, specifically the dissipation due to volatilization and burial in benthic sediment.

The dissolved water concentration was used to calculate the exposure due to drinking water ingestion, because the drinking water was assumed to be treated to remove suspended particles before consumption. The fish concentration was calculated from the total water column concentration, the dissolved water concentration, or the bed sediment concentration using a bioconcentration factor, a bioaccumulation factor, or a sediment bioaccumulation factor, as appropriate.

Table C-3.1. Soil Concentration Due to Deposition for Carcinogenic Compounds

$$\overline{Sc} = \frac{\overline{Sc_1} \bullet (Tc - T_1) + \overline{Sc_2} \bullet (T_2 - Tc)}{T_2 - T_1} \quad for\ T_1 < Tc \leq T_2$$

$$\overline{Sc_1} = \frac{Ds}{ks \bullet (Tc - T_1)} \bullet \left[\left(Tc + \frac{\exp(-ks \bullet Tc)}{ks} \right) - \left(T_1 + \frac{\exp(-ks \bullet T_1)}{ks} \right) \right] \quad for\ T_1 < Tc$$

$$\overline{Sc_2} = \frac{Sc_{Tc}}{ks \bullet (T_2 - Tc)} \bullet \left[1 - \exp\left(-ks \bullet (T_2 - Tc) \right) \right] \quad for\ T_2 > Tc$$

$$Sc_{Tc} = \frac{Ds \bullet \left(1 - \exp(-ks \bullet Tc) \right)}{ks}$$

$$Ds = \frac{100 \bullet Q}{z \bullet BD} \bullet \left[F_v (0.31536 \bullet Vdv \bullet Cywv + Dywwv) + Dytwp \bullet (1 - F_v) \right]$$

Parameter	Definition	Values
Sc	Average soil concentration over exposure duration (mg/kg)	
Ds	Deposition term (mg/kg-yr)	
Tc	Time period over which deposition occurs (yr)	30
Sc_{Tc}	Soil concentration at time Tc (mg/kg)	
ks	Soil loss constant (yr^{-1})	calculated (see Table C-1.2)

Table C-3.1 (continued)		
Parameter	**Definition**	**Values**
T_2	Lenght of exposure duration (yr)	scenario-specific (see Appendix E)
T_1	Time at beginning of exposure period (yr)	scenario-specific (see Appendix E)
Z	Soil mixing depth (cm)	1
BD	Soil bulk density (g/cm^3)	1.5
0.31536	Units conversion factor (m-g-s/cm-µg-yr)	
Vdv	Dry deposition velocity (cm/s)	0.2 for Dioxins
Cywv	Spatially averaged period average unit emission vapor phase air concentration (µg-s/g-m^3)	modeled (see Appendix A)
Q	Stack emissions (g/sec)	calculated (see Section IV and Appendix A)
F_v	Fraction of air concentration in vapor phase (dimensionless)	chemical-specific (see Appendix E)
Dywwv	Spatially averaged annualized period average unit emission vapor phase wet deposition (s/m^2-yr)	modeled (see Appendix A)
Dytwp	Spatially averaged annualized period average unit emission particle phase total (wet and dry) deposition (s/m^2-yr)	modeled (see Appendix A)
100	Units conversion factor ([mg-m^2]/[kg-cm^2])	

Description
These equations calculate an average soil concentration as a result of wet and dry deposition of particles and vapors onto soil. Contaminants are assumed to be incorporated only to a finite depth (the mixing depth, Z).

Table C-3.1. (continued) Soil Concentration Due to Deposition for Noncarcinogenic Compounds

$$Sc_{Tc} = \frac{Ds \bullet (1 - \exp(-ks \bullet Tc))}{ks}$$

$$Ds = \frac{100 \bullet Q}{z \bullet BD} \bullet \left[F_v (0.31536 \bullet Vdv \bullet Cywv + Dywwv) + Dywtp \bullet (1 - F_v) \right]$$

Parameter	Definition	Values
Sc_{Tc}	Soil concentration at time Tc (mg/kg)	
Ds	Deposition term (mg/kg-yr)	
Tc	Time period over which deposition occurs (yr)	30
ks	Soil loss constant (yr^{-1})	calculated (see Table C-1.2)
Z	Soil mixing depth (cm)	1
BD	Soil bulk density (g/cm^3)	1.5
0.31536	Units conversion factor (m-g-s/cm-µg-yr)	
Vdv	Dry deposition velocity (cm/s)	0.2 for Dioxins
Cywv	Spatially averaged period average unit emission vapor phase air concentration (µg-s/g-m^3)	modeled (see Appendix A)
Q	Stack emissions (g/sec)	calculated (see Section IV and Appendix A)

Table C-3.1 (continued)		
Parameter	**Definition**	**Values**
F_v	Fraction of air concentration in vapor phase (dimensionless)	chemical-specific (see Appendix E)
Dywwv	Spatially averaged annualized period average unit emission vapor phase wet deposition (s/m^2-yr)	modeled (see Appendix A)
Dywtp	Spatially averaged annualized period average unit emission particle phase total (wet and dry) deposition (s/m^2-yr)	modeled (see Appendix A)
100	Units conversion factor ([mg-m^2]/[kg-cm^2])	

Description
These equations calculate a soil concentration at time Tc as a result of wet and dry deposition of particles and vapors onto soil. Contaminants are assumed to be incorporated only to a finite depth (the mixing depth, Z).

Table C-3.2. Soil Loss Constant

$$ks = ksl + kse + ksr + ksg + ksv$$

Parameter	Definition	Values
ks	Soil loss constant due to all processes (yr^{-1})	
ksl	Loss constant due to leaching (yr^{-1})	calculated (see Table C-3.3)
kse	Loss constant due to soil erosion (yr^{-1})	calculated (see Table C-3.6)
ksr	Loss constant due to surface runoff (yr^{-1})	calculated (see Table C-3.4)
ksg	Loss constant due to degradation (yr^{-1})	0
ksv	Loss constant due to volatilization (yr^{-1})	calculated (see Table C-3.5)

Description

This equation calculates the soil loss constant, which accounts for the loss of contaminant from soil by several mechanisms.

Table C-3.3. Loss Constant Due to Leaching

$$ksl = \frac{P + I - R - E_v}{\theta_s \cdot z \cdot [1.0 + (BD \cdot Kd_s / \theta_s)]}$$

$$Kd_s = f_{oc} \bullet K_{oc}$$

Parameter	Definition	Values
ksl	Loss constant due to leaching (yr^{-1})	
P	Average annual precipitation (cm/yr)	site-specific (see Appendix A)
I	Average annual irrigation (cm/yr)	0
R	Average annual runoff (cm/yr)	site-specific (see Appendix A)
E_v	Average annual evapotranspiration (cm/yr)	site-specific (see Appendix A)
θ_s	Soil volumetric water content (ml/cm^3)	0.2
z	Soil depth from which leaching removal occurs (cm)	varies (see Appendix E)
Kd_s	Soil-water partition coefficient (cm^3/g)	metals - see Appendix E: dioxins - calculated as above
f_{oc}	Fraction organic carbon is soil (unitless)	0.01
K_{oc}	Organic carbon partition coefficient (ml/g)	chemical-specific (see Appendix E)
BD	Soil bulk density (g/cm^3)	1.5

Description

This equation calculates the contaminant loss constant due to leaching from soil.

Table C-3.4. Loss Constant due to Runoff

$$ksr = \frac{R}{\theta_s \cdot z} \cdot \left(\frac{1}{1 + (Kd_s \cdot BD / \theta_s)} \right)$$

Parameter	Definition	Values
ksr	Loss constant due to runoff (yr^{-1})	
R	Average annual runoff (cm/yr)	site-specific (see Appendix A)
θ_s	Soil volumetric water content (ml/cm^3)	0.2
z	Soil mixing depth (cm)	varies (see Appendix E)
Kd_s	Soil-water partition coefficient (cm^3/g)	calculated (see Table C-3.3)
BD	Soil bulk density (g/cm^3)	1.5

Description

This equation calculates the contaminant loss constant due to runoff from soil.

Table C-3.5. Loss Constant due to Volatilization

$$ksv = \left[\frac{3.1536x10^{7} \cdot H}{z \cdot Kd_s \cdot R \cdot T \cdot BD}\right] \cdot \left[0.482 \cdot u^{0.78} \cdot \left(\frac{\mu_a}{\rho_a \cdot D_a}\right)^{-0.67} \cdot \left(\sqrt{\frac{4 \cdot A}{\pi}}\right)^{-0.11}\right]$$

Parameter	Definition	Values
ksv	Loss constant due to volatilization (yr^{-1})	
$3.1536x10^{7}$	Conversion constant (s/yr)	
H	Henry's Law constant ($atm\text{-}m^3/mol$)	chemical-specific (see Appendix E)
z	Soil mixing depth (cm)	varies (see Appendix E)
Kd_s	Soil-water partition coefficient (cm^3/g)	calculated (see Table C-3.3)
R	Universal gas constant ($atm\text{-}m^3/mol\text{-}K$)	$8.205x10^{-5}$
BD	Soil bulk density (g/cm^3)	1.5
T	Ambient air temperature (K)	site-specific (see Appendix A)
u	Average annual wind speed (m/s)	site-specific (see Appendix A)
μ_a	Viscosity of air (g/cm-s)	$1.81x10^{-4}$
ρa	Density of air (g/cm^3)	$1.2x10^{-3}$
Da	Diffusivity of contaminant in air (cm^2/s)	chemical-specific (see Appendix E)
A	Surface area of contaminated area (m^2)	varies (see Appendix E)

Table C-3.5. (continued)
Description
This equation calculates the contaminant loss constant due to volatilization from soil. For erosion into the waterbody, the area of contamination is site-specific (see Appendix A).

Table C-3.6. Soil Loss Constant Due to Erosion

$$kse = \frac{0.1 \bullet X_e \bullet SD \bullet ER}{BD \bullet z} \bullet \left(\frac{Kd_s \bullet BD}{\theta_s + (Kd_s \bullet BD)} \right)$$

Parameter	Definition	Values
kse	Loss constant due to erosion (yr^{-1})	
X_e	Unit soil loss ($kg/m^2/yr$)	calculated (see Table C-3.13)
SD	Sediment delivery ratio (unitless)	calculated (see Table C-3.14)
ER	Contaminant enrichment ratio (unitless)	3
z	Soil mixing depth (cm)	1
θ_s	Soil volumetric water content (ml/cm^3)	0.2
Kd_s	Soil-water partition coefficient (cm^3/g)	calculated (see Table C-3.3)
BD	Soil bulk density (g/cm^3)	1.5

Description

This equation calculates the contaminant loss constant due to runoff from soil.

Table C-3.7. Total Waterbody Load		
$$L_T = L_{Dep} + L_{Dif} + L_{RI} + L_R + L_E$$		
Parameter	**Definition**	**Values**
L_T	Total contaminant load to the water body (g/yr)	
L_{Dep}	Total (wet and dry) particle phase and wet vapor phase contaminant direct deposition load to waterbody (g/yr)	calculated (see Table C-3.8)
L_{Dif}	Vapor phase contaminant diffusion (dry deposition) load to waterbody (g/yr)	calculated (see Table C-3.12)
L_{RI}	Runoff load from impervious surfaces (g/yr)	calculated (see Table C-3.9)
L_R	Runoff load from pervious surfaces (g/yr)	calculated (see Table C-3.10)
L_E	Soil erosion load (g/yr)	calculated (see Table C-3.11)
Description		
This equation calculates the total average waterbody load from wet and dry vapor and particle deposition, runoff, and erosion loads.		

Table C-3.8. Deposition to Waterbody

$$L_{Dep} = Q \cdot [\, F_v \cdot Dywbwv + (1 - F_v) \cdot Dywbtp \,] \cdot WA_w$$

Parameter	Definition	Values
L_{Dep}	Total (wet and dry) particle phase and wet vapor phase contaminant direct deposition load to waterbody (g/yr)	
Q	Stack emissions (g/s)	calculated (see Section IV and Appendix A)
F_v	Fraction of air concentration in the vapor phase (unitless)	chemical-specific (see Appendix E)
Dywbwv	Normalized yearly waterbody average wet deposition from vapor phase (s/m^2-yr)	modeled (see Appendix A)
Dywbtp	Normalized yearly waterbody average total (wet and dry) deposition from particle phase (s/m^2-yr)	modeled (see Appendix A)
WA_w	Water body area (m^2)	site-specific (see Appendix A)

Description

This equation calculates the average load to the waterbody from direct deposition of wet and dry particles and wet vapors onto the surface of the waterbody.

Table C-3.9. Impervious Runoff Load to Watershed

$$L_{RI} = Q \cdot [\, F_v \cdot Dywswv + (1.0 - F_v) \cdot Dywstp \,] \cdot WA_I$$

Parameter	Definition	Values
L_{RI}	Impervious surface runoff load (g/yr)	
WA_I	Impervious watershed area receiving pollutant deposition (m^2)	site-specific (see Appendix A)
Q	Stack emissions (g/s)	calculated (see Section IV and Appendix A)
F_v	Fraction of air concentration in vapor phase (dimensionless)	chemical-specific (see Appendix E)
Dywswv	Normalized yearly watershed average wet deposition from vapor phase (s/m^2-yr)	modeled (see Appendix A)
Dywstp	Normalized yearly watershed average total (wet and dry) deposition from particle phase (s/m^2-yr)	modeled (see Appendix A)

Description

This equation calculates the average runoff load to the waterbody from impervious surfaces in the watershed from which runoff is conveyed directly to the waterbody.

Table C-3.10. Pervious Runoff Load to Waterbody

$$L_R = R \cdot (WA_L - WA_I) \cdot \frac{Sc \cdot BD}{\theta_s + Kd_s \cdot BD} \cdot 0.01$$

$$Kd_s = f_{oc} \bullet K_{oc}$$

Parameter	Definition	Values
L_R	Pervious surface runoff load (g/yr)	
R	Average annual surface runoff (cm/yr)	site-specific (see Appendix A)
Sc	Pollutant concentration in watershed soils (mg/kg)	calculated (see Table C-3.1)
BD	Soil bulk density (g/cm^3)	1.5
Kd_s	Soil-water partition coefficient (L/kg)	for metals - see Appendix E: for dioxins - calculated as above
WA_L	Total watershed area receiving pollutant deposition (m^2)	site-specific (see Appendix A)
WA_I	Impervious watershed area receiving pollutant deposition (m^2)	site-specific (see Appendix A)
0.01	Units conversion factor (kg-cm^2/mg-m^2)	
θ_s	Volumetric soil water content (cm^3/cm^3)	0.2
f_{oc}	Fraction organic carbon in soil (unitless)	0.01
K_{oc}	Organic carbon partition coefficient (ml/g)	chemical-specific (see Appendix E)

Description

This equation calculates the average runoff load to the waterbody from pervious soil surfaces in the watershed.

Table C-3.11. Erosion Load to Waterbody

$$L_E = X_e \cdot (WA_L - WA_I) \cdot SD \cdot ER \cdot \frac{Sc \cdot Kd_s \cdot BD}{\theta_s + Kd_s \cdot BD} \cdot 0.001$$

$$Kd_s = f_{oc} \bullet K_{oc}$$

Parameter	Definition	Values
L_E	Soil erosion load (g/yr)	
X_e	Unit soil loss (kg/m^2/yr)	calculated (see Table C-3.13)
Sc	Pollutant concentration in watershed soils (mg/kg)	calculated (see Table C-3.1)
BD	Soil bulk density (g/cm^3)	1.5
θ_s	Volumetric soil water content (cm^3/cm^3)	0.2
Kd_s	Soil-water partition coefficient (L/kg)	for metals see Appendix E-- for dioxins, calculated as above
WA_L	Total watershed area receiving pollutant deposition (m^2)	site-specific (see Appendix A)
WA_I	Impervious watershed area receiving pollutant deposition (m^2)	site-specific (see Appendix A)
SD	Watershed sediment delivery ratio (unitless)	calculated (see Table C-3.8)
ER	Soil enrichment ratio (unitless)	3
f_{oc}	Fraction organic carbon in soil (unitless)	0.01
K_{oc}	Organic carbon partition coefficient (ml/g)	chemical-specific (see Appendix E)
0.001	Units conversion factor ([g/kg]/[mg/kg])	

Description

This equation calculates the load to the waterbody from soil erosion.

Table C-3.12. Diffusion Load to Waterbody

$$L_{Dif} = \frac{Kv \cdot Q \cdot F_v \cdot Cywbv \cdot WA_w \cdot 10^{-6}}{\frac{H}{R \cdot T_w}}$$

Parameter	Definition	Values
L_{Dif}	Dry vapor phase contaminant diffusion load to waterbody (g/yr)	
Q	Stack emissions (g/s)	calculated (see Section IV and Appendix A)
F_v	Fraction of air concentration in vapor phase (dimensionless)	chemical-specific (see Appendix E)
Kv	Diffusive mass transfer coefficient (m/yr)	calculated (see Table C-3.19)
Cywbv	Normalized yearly watershed average vapor phase air concentration (µg-s/g-m^3)	modeled (see Appendix A)
WA_w	Waterbody surface area (m^2)	site-specific (see Appendix A)
H	Henry's Law constant (atm-m^3/mol)	chemical-specific (see Appendix E)
R	Universal gas constant (atm-m^3/mol-K)	8.205×10^{-5}
T_w	Waterbody temperature (K)	298
10^{-6}	Units conversion factor (g/µg)	

Description

This equation calculates the load to the waterbody as a result of vapor diffusion.

Table C-3.13. Universal Soil Loss Equation (USLE)

$$X_e = RF \cdot K \cdot LS \cdot C \cdot P \cdot \frac{907.18}{4047}$$

Parameter	Definition	Values
X_e	Unit soil loss (kg/m^2/yr)	
RF	USLE rainfall (or erosivity) factor (yr^{-1})	site-specific (see Appendix A)
K	USLE erodibility factor (ton/acre)	0.36
LS	USLE length-slope factor (unitless)	1.5
C	USLE cover management factor (unitless)	0.1
P	USLE supporting practice factor (unitless)	1
907.18	Conversion factor (kg/ton)	
4047	Conversion factor (m^2/acre)	

Description

This equation calculates the soil loss rate from the watershed, using the Universal Soil Loss Equation; the result is used in the soil erosion load equation.

Table C-3.14. Sediment Delivery Ratio		
$$SD = a \cdot (WA_L)^{-b}$$		
Parameter	**Definition**	**Values**
SD	Watershed sediment delivery ratio (unitless)	
WA_L	Watershed area receiving fallout (m^2)	site-specific (see Appendix A)
b	Empirical slope coefficient	0.125
a	Empirical intercept coefficient	depends on watershed area; see table below
Description		
This equation calculates the sediment delivery ratio for the watershed; the result is used in the soil erosion load equation.		

Values for Empirical Intercept Coefficient, a

Watershed area (sq. miles)	"a" coefficient (unitless)
≤ 0.1	2.1
1	1.9
10	1.4
100	1.2
1,000	0.6
1 sq. mile = 2.59×10^6 m^2	

Table C-3.15. Total Waterbody Concentration

$$C_{wtot} = \frac{L_T}{Vf_x \cdot f_{water} \cdot \left[\frac{d_w + d_b}{d_w}\right] + kwt \cdot WA_w \cdot (d_w + d_b)}$$

Parameter	Definition	Values
C_{wtot}	Total water body concentration, including water column and bed sediment (mg/L)	
L_T	Total chemical load into water body, including deposition, runoff, and erosion (g/yr)	calculated (see Table C-3.7)
Vf_x	Average volumetric flow rate through water body (m^3/yr)	site-specific (see Appendix A)
f_{water}	Fraction of total water body contaminant concentration that occurs in the water column (unitless)	calculated (see Table C-3.16)
k_{wt}	Overall total waterbody dissipation rate constant (unitless)	calculated (see Table C-3.17)
WA_w	Waterbody surface area (m^2)	site-specific (see Appendix A)
d_w	Depth of water column (m)	site-specific (see Appendix A)
d_b	Depth of upper benthic layer (m)	0.03

Description

This equation calculates the total waterbody concentration, including both the water column and the bed sediment.

Table C-3.16. Fraction in Water Column and Benthic Sediment

$$f_{water} = \frac{(1 + Kd_{sw} \cdot TSS \cdot 10^{-6}) \cdot d_w/d_z}{(1 + Kd_{sw} \cdot TSS \cdot 10^{-6}) \cdot d_w/d_z + (\theta_{bs} + Kd_{bs} \cdot BS) \cdot d_b/d_z}$$

$$f_{benth} = 1 - f_{water}$$

$$Kd_{sw} = OC_{ss} \bullet K_{oc}$$

$$Kd_{bs} = OC_{sed} \bullet K_{oc}$$

Parameter	Definition	Values
f_{water}	Fraction of total water body contaminant concentration that occurs in the water column (unitless)	
Kd_{sw}	Suspended sediment/surface water partition coefficient (L/kg)	for metals - see Appendix E: for dioxins - calculated as above
TSS	Total suspended solids (mg/L)	10
10^{-6}	Conversion factor (kg/mg)	
d_w	Depth of the water column (m)	site-specific (see Appendix A)
d_b	Depth of the upper benthic layer (m)	0.03
d_z	Total waterbody depth (m)	calculated (d_w+d_b)
θ_{bs}	Bed sediment porosity (L_{water}/L)	0.6

Table C-3.16 (continued)		
Parameter	**Definition**	**Values**
Kd_{bs}	Bed sediment/sediment pore water partition coefficient (L/kg)	for metals see Appendix E-- for dioxins, calculated as above
BS	Bed sediment concentration (g/cm^3)	1.0
K_{oc}	Organic carbon portion coefficient (ml/g)	chemical-specific (see Appendix E)
OC_{ss}	Fraction of organic carbon in suspended sediment	0.075
OC_{sed}	Fraction of organic carbon in bed sediment	0.04
f_{benth}	Fraction of total water body contaminant concentration that occurs in the benthic sediment (unitless)	

Description

These equations calculate the fraction of total waterbody concentration occurring in the water column and the bed sediments.

Table C-3.17. Overall Total Waterbody Dissipation Rate Constant

$$k_{wt} = f_{water} \cdot k_v + f_{benth} \cdot k_b$$

Parameter	Definition	Values
k_{wt}	Overall total waterbody dissipation rate constant (yr^{-1})	
f_{water}	Fraction of total waterbody contaminant concentration that occurs in the water column	calculated (see Table C-3.16)
k_v	Water column volatilization rate constant (yr^{-1})	calculated (see Table C-3.18)
f_{benth}	Fraction of total waterbody contaminant concentration that occurs in the benthic sediment	calculated (see Table C-3.16)
k_b	Benthic burial rate constant (yr^{-1})	calculated (see Table C-3.22)

Description

This equation calculates the overall dissipation rate of contaminant in surface water due to volatilization and benthic burial.

Table C-3.18. Water Column Volatilization Loss Rate Constant

$$k_v = \frac{K_v}{d_w \cdot (1 + Kd_{sw} \cdot TSS \cdot 10^{-6})}$$

Parameter	Definition	Values
k_v	Water column volatilization rate constant (yr^{-1})	
K_v	Overall transfer rate (m/yr)	calculated (see Table C-3.19)
d_w	Total water column depth (m)	site-specific (see Appendix A)
Kd_{sw}	Suspended sediment/surface water partition coefficient (L/kg)	chemical-specific (see Appendix E)
TSS	Total suspended solids (mg/L)	10
10^{-6}	Conversion factor (kg/mg)	

Description

This equation calculates the water column contaminant loss due to volatilization.

Table C-3.19. Overall Transfer Rate

$$K_v = \left[K_L^{-1} + \left(K_G \frac{H}{R \cdot T_k} \right)^{-1} \right]^{-1} \cdot \theta^{(T_k - 293)}$$

Parameter	Definition	Values
K_v	Overall transfer rate (m/yr)	
K_L	Liquid phase transfer coefficient (m/yr)	calculated (see Table C-3.20)
K_G	Gas phase transfer coefficient (m/yr)	calculated (see Table C-3.21)
H	Henry's Law constant (atm-m^3/mol)	chemical-specific (see Appendix E)
R	Universal gas constant (atm-m^3/mol-K)	8.205 x 10^{-5}
T_k	Waterbody temperature (K)	298
θ	Temperature correction factor (unitless)	1.026

Description

This equation calculates the overall transfer rate of contaminant due to volatilization from the waterbody.

Table C-3.20. Liquid Phase Transfer Coefficient

- Flowing stream or river

$$K_L = \sqrt{\frac{10^{-4} \cdot D_w \cdot u}{d_w}} \cdot 3.15x10^7$$

- Quiescent lake or pond

$$K_L = (C_d^{0.5} \cdot W) \cdot \left(\frac{\rho_a}{\rho_w}\right)^{0.5} \cdot \left(\frac{k^{0.33}}{\lambda_2}\right) \cdot \left(\frac{\mu_w}{\rho_w \cdot D_w}\right)^{-0.67} \cdot 3.15x10^7$$

Parameter	Definition	Values
K_l	Liquid phase transfer coefficient (m/yr)	
D_w	Diffusivity of chemical in water (cm^2/s)	chemical-specific (see Appendix E)
u	Current velocity (m/s)	site-specific (see Appendix A)
d_w	Total watercolumn depth (m)	site-specific (Appendix A)
C_d	Drag coefficient	0.0011
W	Wind velocity,10m above water surface (m/s)	site-specific (see Appendix A)
ρ_a	Density of air corresponding to water temperature (g/cm^3)	1.2×10^{-3}
ρ_w	Density of water corresponding to water temperature (g/cm^3)	1
k	von Karman's constant	0.4

Table C-20 (continued)		
Parameter	**Definition**	**Values**
λ_2	Dimensionless viscous sublayer thickness	4
μ_w	Viscosity of water corresponding to the water temperature (g/cm-s)	1.69×10^{-2}
3.15×10^7	Conversion constant (s/yr)	
Description		
This equation calculates the transfer rate of contaminant in the liquid phase for a flowing or quiescent system.		

Table C-3.21. Gas Phase Transfer Coefficient

- Flowing stream or river

$$K_G = 36500\ m/yr$$

- Quiescent lake or pond

$$K_G = (C_d^{0.5} \cdot W) \cdot \left(\frac{k^{0.33}}{\lambda_2}\right) \cdot \left(\frac{\mu_a}{\rho_a \cdot D_a}\right)^{-0.67} \cdot 3.15x10^7$$

Parameter	Definition	Values
K_G	Gas phase transfer coefficient (m/yr)	
C_d	Drag coefficient	0.0011
W	Wind velocity, 10 m above water surface (m/s)	site-specific (see Appendix A)
k	von Karman's constant	0.4
λ_2	Dimensionless viscous sublayer thickness	4
μ_a	Viscosity of air corresponding to the air temperature (g/cm-s)	1.81×10^{-4}
ρ_a	Density of air corresponding to water temperature (g/cm^3)	1.2×10^{-3}
D_a	Diffusivity of chemical in air (cm^2/s)	chemical-specific (see Appendix E)
$3.15x10^7$	Conversion constant (s/yr)	

Description

This equation calculates the transfer rate of contaminant in the gas phase for a flowing or quiescent system.

Table C-3.22. Benthic Burial Rate Constant

$$k_b = \left(\frac{X_e \bullet WA_L \bullet SD \bullet 10^3 - Vf_x \bullet TSS}{WA_w \bullet TSS} \right) \left(\frac{TSS \bullet 10^{-6}}{BS \bullet d_b} \right)$$

Parameter	Definition	Values
k_b	Benthic burial rate constant (yr^{-1})	
X_e	Unit soil loss ($kg/m^2/yr$)	calculated (see Table C-3.13)
WA_L	Watershed area receiving fallout (m^2)	site-specific (see Appendix A)
SD	Watershed sediment delivery ratio (unitless)	calculated (see Table C-3.14)
10^3	Conversion factor (g/kg)	
Vf_x	Average volumetric flow rate through waterbody (m^3/yr)	site-specific (see Appendix A)
TSS	Total suspended solids (mg/L) or (g/m^3)	10
WA_w	Waterbody surface area (m^2)	site-specific (see Appendix A)
BS	Benthic solids concentration (kg/L)	1
d_b	Depth of upper benthic sediment layer (m)	0.03
10^{-6}	Conversion factor (kg/mg)	

Description

This equation calculates the water column contaminant loss due to sediment burial.

Table C-3.23. Total Water Column Concentration

$$C_{wt} = f_{water} \bullet C_{wtot} \bullet \frac{d_w + d_b}{d_w}$$

Parameter	Definition	Values
C_{wt}	Total concentration in water column (mg/L)	
f_{water}	Fraction of total water body contaminant concentration that occurs in the water column (unitless)	calculated (see Table C-3.16)
C_{wtot}	Total water concentration in surface water system, including water column and bed sediment (mg/L)	calculated (see Table C-3.15)
d_b	Depth of upper benthic layer (m)	0.03
d_w	Depth of the water column (m)	site-specific (see Appendix A)

Description

This equation calculates the total water column concentration of contaminant; this includes both dissolved contaminant and contaminant sorbed to suspended solids.

Table C-3.24. Dissolved Water Concentration

$$C_{dw} = \frac{C_{wt}}{1 + Kd_{sw} \cdot TSS \cdot 10^{-6}}$$

$$Kd_{sw} = OC_{ss} \bullet K_{oc}$$

Parameter	Definition	Values
C_{dw}	Dissolved phase water concentration (mg/L)	
C_{wt}	Total concentration in water column (mg/L)	calculated (see Table C-3.23)
Kd_{sw}	Suspended sediment/surface water partition coefficient (L/kg)	metals see Appendix E dioxins, calculated as above
OC_{ss}	Fraction of organic carbon in suspended sediment	0.075
K_{oc}	Organic carbon partition coefficient (ml/g)	chemical-specific (see Appendix E)
TSS	Total suspended solids (mg/L)	10

Description

This equation calculates the concentration of contaminant dissolved in the water column.

Table C-3.25. Concentration Sorbed to Bed Sediment

$$C_{sb} = f_{benth} \bullet C_{wtot} \bullet \frac{Kd_{bs}}{\theta_{bs} + Kd_{bs} \bullet BS} \bullet \frac{d_w + d_b}{d_b}$$

$$Kd_{bs} = OC_{sed} \bullet K_{oc}$$

Parameter	Definition	Values
C_{sb}	Concentration sorbed to bed sediments (mg/kg)	
f_{benth}	Fraction of total water body contaminant concentration that occurs in the bed sediment (unitless)	calculated (see Table C-3.16)
C_{wtot}	Total water concentration in surface water system, including water column and bed sediment (mg/L)	calculated (see Table C-3.15)
d_w	Total depth of water column (m)	site-specific (see Appendix A)
d_b	Depth of the upper benthic layer (m)	0.03
θ_{bs}	Bed sediment porosity (unitless)	0.6
Kd_{bs}	Bed sediment/sediment pore water partition coefficient (L/kg)	metals see Appendix E dioxins calculated as above
K_{oc}	Organic carbon partition coefficient (ml/g)	chemical-specific (see Appendix E)
OC_{sed}	Fraction of organic carbon in bed sediment	0.04
BS	Bed sediment concentration (kg/L)	1.0

Description

This equation calculates the concentration of contaminant sorbed to bed sediments.

Table C-3.26. Fish Concentration from Dissolved Water Concentration

$$C_{fish} = C_{dw} \cdot BCF$$

Parameter	Definition	Values
C_{fish}	Fish concentration (mg/kg)	
C_{dw}	Dissolved water concentration (mg/L)	calculated (see Table C-3.24)
BCF	Bioconcentration factor (L/kg)	chemical-specific (see Appendix E)

Description

This equation calculates fish concentration from dissolved water concentration, using a bioconcentration factor.

Table C-3.27. Fish Concentration from Total Water Column Concentration		
$$C_{fish} = C_{wt} \cdot BAF$$		
Parameter	**Definition**	**Values**
C_{fish}	Fish concentration (mg/kg)	
C_{wt}	Total water column concentration (mg/L)	calculated (see Table C-3.23)
BAF	Bioaccumulation factor (L/kg)	chemical-specific (see Appendix E)
Description		
This equation calculates fish concentration from total water column concentration, using a bioaccumulation factor.		

Table C-3.28. Fish Concentration from Bed Sediments

$$C_{fish} = \frac{C_{sb} \cdot f_{lipid} \cdot BSAF}{OC_{sed}}$$

Parameter	Definition	Values
C_{fish}	Fish concentration (mg/kg)	
C_{sb}	Concentration of contaminant sorbed to bed sediment (mg/kg)	calculated (see Table C-3.25)
f_{lipid}	Fish lipid content (fraction)	0.07
BSAF	Biota to sediment accumulation factor (unitless)	chemical-specific (see Appendix E)
OC_{sed}	Fraction organic carbon in bottom sediment (unitless)	0.04

Description

This equation calculates fish concentration from bed sediment concentration, using a biota-to-sediment accumulation factor.

4. Total Air Concentration

Air concentration for direct inhalation was calculated from the sum of both the vapor phase and particle phase concentrations as seen in Table C-4.1. For each scenario considered in this analysis, risks of direct inhalation were calculated for chemicals that had inhalation health criteria or benchmarks and were emitted by the combustion source. Risk calculations for inhalation are included in Section 5 of this appendix.

Table C-4.1 Air Concentration

$$C_a = Q \cdot [F_v \cdot Cyv + (1.0 - F_v) \cdot C_{yp}]$$

Parameter	Definition	Values
C_a	Total air concentration (µg/m^3)	
Q	Stack emissions (g/s)	calculated (see Section IV and Appendix A)
F_v	Fraction of air concentration in vapor phase (dimensionless)	chemical-specific (see Appendix E)
C_{yv}	Normalized vapor phase air concentration (µg - s/g - m^3)	modeled (see Appendix A)
C_{yp}	Normalized particle phase air concentration (µg - s/g - m^3)	modeled (see Appendix A)

Description

This equation calculates the total air concentration of a constituent based on the fraction in vapor phase and the fraction in particle phase.

5. Risk Characterization

The equations in this section were used for estimating individual cancer risk and hazard quotients for the various chemicals considered in this analysis. Each table provides the mathematical form of the equation, identifies the parameters in the equation, and provides the parameter values where appropriate. The equations listed in this section were used for all scenarios. However, exposure parameters listed in the equations (the consumption rates, body weights, and exposure durations) varied between scenarios. These exposure parameters are contained in Appendix E.

For each of the scenarios, an estimate was made of the dose (or intake) of each contaminant from all oral routes of exposure. For example, for the beef subsistence farmer, the daily intake of each contaminant was calculated for soil ingestion (Table C-5.1); aboveground produce and root vegetable ingestion (Table C-5.2); beef, milk, pork, poultry, and egg ingestion (Table C-5.3); fish ingestion (Table C-5.4); and drinking water ingestion (Table C-5.5). The total daily oral intake of a contaminant was calculated by adding together the intake from each pathway (Table C-5.6). For each carcinogen, the excess lifetime individual cancer risk was calculated using the cancer slope factor and total daily intake (Table C-5.7). For each chemical with noncancer health effects, a hazard quotient (HQ) was calculated using the RfD and the total daily intake (Table C-5.8).

Individual cancer risks and hazard quotients due to direct inhalation were also calculated for each chemical. For each scenario considered in this analysis, risks of direct inhalation were calculated for chemicals that had inhalation health criteria or benchmarks and were emitted by the combustion source. Benchmarks included unit risk factors (URFs), carcinogenic slope factors (CSFs), or reference concentrations (RfCs) in IRIS[4] or HEAST[5].

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[4] Integrated Risk Information System on-line database, as described in the Federal Register of February 25, 1993 (58 FR 11490).

[5] Health Effects Assessment Summary Tables, Annual Update and Supplements thereto (U.S. EPA, 1993d, 1993e, and 1993f).

Table C-5.1. Contaminant Intake from Soil

$$I_{soil} = Sc \cdot CR_{soil} \cdot F_{soil}$$

Parameter	Description	Values
I_{soil}	Daily intake of contaminant from soil (mg/d)	
Sc	Soil concentration (mg/kg)	calculated (see Table C-1.1)
CR_{soil}	Consumption rate of soil (kg/d)	varies (see Appendix E)
F_{soil}	Fraction of consumed soil contaminated (unitless)	1

Description

This equation calculates the daily intake of contaminate from soil consumption. The soil concentration will vary with each scenario, and the soil consumption rate varies for children and adults.

Table C-5.2. Contaminant Intake from Aboveground Produce and Root Vegetable Intake

$$I_{ag} = (Pd + Pv + Pr) \cdot CR_{ag} \cdot F_{ag}$$

$$I_{bg} = Pr_{bg} \bullet CR_{bg} \bullet F_{bg}$$

Parameter	Description	Values
I_{ag}	Daily intake of contaminant from above-ground produce (mg/kg Fw)	
Pd	Concentration in aboveground produce due to deposition (mg/kg Dw)	calculated (see Table C-2.1)
Pv	Concentration in aboveground produce due to air-to-plant transfer (mg/kg Dw)	calculated (see Table C-2.2)
Pr	Concentration in aboveground produce due to root uptake (mg/kg Dw)	calculated (see Table C-2.3)
CR_{ag}	Consumption rate of aboveground produce for dioxins (kg Fw/d); metals (kg Dw/d)	varies (see Appendix E)
F_{ag}	Fraction of aboveground produce contaminated (unitless)	varies (see Appendix E)

Table C-5.2 (continued)

Parameter	Description	Values
I_{bg}	Daily intake from belowground vegetables for dioxins (mg/kg Fw); for metals (mg/kg Dw)	
Pr_{bg}	Concentration in root vegetables due to root uptake for dioxins (mg/kg Fw); for metals (mg/kg Dw)	calculated (see Table C-2.4)
CR_{bg}	Consumption rate of root vegetables for dioxins (kg Fw/d); for metals (kg Dw/d)	varies (see Appendix E)
F_{bg}	Fraction of root vegetables contaminated (unitless)	varies (see Appendix E)

Description
This equation calculates the daily intake of contaminate from ingestion of aboveground produce and root vegetables. The consumption rate varies for children and adults and for the type of produce. The contaminated fraction and the concentration in root vegetables and aboveground produce will vary with each scenario.

Table C-5.3. Contaminant Intake from Beef, Milk, Pork, Poultry and Eggs

$$I_i = A_i \bullet CR_i \bullet F_i$$

Parameter	Description	Values
I_i	Daily intake of contaminant from animal tissue *i* (mg/d)	
A_i	Concentration in animal tissue *i* (mg/kg Fw)[6]	calculated (see C-2.5 to C-2.11)
CR_i	Consumption rate of animal tissue *i* (kg Fw/d)[6]	varies (see Appendix E)
F_i	Fraction of animal tissue *i* contaminated (unitless)	varies (see Appendix E)

Description

This equation calculates the daily intake of contaminate from ingestion of animal tissue (where the "*i*" in the above equation refers to beef, milk, pork, poultry, or eggs). Intake of poultry and eggs is only applicable to dioxins. The consumption rate varies for children and adults and for the type of animal tissue. The contaminated fraction and the concentration in the animal tissue will vary with each scenario.

[6] For the metals selenium, and cadmium, the concentration in beef, milk, and pork and the consumption rate are in kilograms dry weight per day. Wet weight to dry weight conversion factors for beef and milk are 0.4 and 0.1, respectively. The pork conversion factor is assumed equal to the beef conversion factor.

Table C-5.4. Contaminant Intake from Fish

$$I_{fish} = C_{fish} \bullet CR_{fish} \bullet F_{fish}$$

Parameter	Description	Values
I_{fish}	Daily intake of contaminant from fish (mg/d)	
C_{fish}	Concentration in fish (mg/kg)	calculated (see C-3.26 to C-3.28)
CR_{fish}	Consumption rate of fish (kg/d)	varies (see Appendix E)
F_{fish}	Fraction of fish contaminated (unitless)	varies (see Appendix E)

Description

This equation calculates the daily intake of contaminate from ingestion of fish. The contaminant concentration in fish will vary for each waterbody. The consumption rate varies for children and adults and for scenario. The contaminated fraction will also vary with each scenario, with the subsistence and recreational fisher contaminated fraction equal to 1.

Table C-5.5. Contaminant Intake from Drinking Water

$$I_{dw} = C_{dw} \cdot CR_{dw} \cdot F_{dw}$$

Parameter	Description	Values
I_{dw}	Daily intake of contaminant from drinking water (mg/d)	
C_{dw}	Dissolved contaminant concentration in drinking water (mg/L)	calculated (see Table C-3.24)
CR_{dw}	Consumption rate of drinking water (L/d)	varies (see Appendix E)
F_{dw}	Fraction of drinking water contaminated (unitless)	1

Description

This equation calculates the intake of contaminate from drinking water. The contaminant concentration will vary for each waterbody. The consumption rate varies for adult and children.

Table C-5.6. Total Daily Intake

$$I = I_{soil} + I_{ag} + I_{bg} + I_{beef} + I_{milk} + I_{pork} + I_{poultry} + I_{eggs} + I_{fish} + I_{dw}$$

Parameter	Description	Values
I	Total daily intake of contaminant (mg/d)	
I_{soil}	Daily intake of contaminant from soil (mg/d)	calculated (see Table C-5.1)
I_{ag}, I_{bg}	Daily intake of contaminant from produce (mg/d)	calculated (see Table C-5.2)
I_{beef}, I_{milk}, I_{pork}, $I_{poultry}$, I_{eggs}	Daily intake of contaminant from animal tissue (mg/d)	calculated (see Table C-5.3)
I_{fish}	Daily intake of contaminant from fish (mg/d)	calculated (see Table C-5.4)
I_{dw}	Daily intake of contaminant from drinking water (mg/d)	calculated (see Table C-5.5)

Description

This equation calculates the daily intake of contaminate via all indirect pathways. Ingestion of poultry and eggs is only applicable to dioxins.

Table C-5.7. Individual Cancer Risk

$$Cancer\ Risk = \frac{I \cdot ED \cdot EF \cdot CSF}{BW \cdot AT \cdot 365}$$

Parameter	Description	Values
Cancer Risk	Individual lifetime cancer risk (unitless)	
I	Total daily intake of contaminant (mg/d)	calculated (see Table C-5.6)
ED	Exposure duration (yr)	varies (see Appendix E)
EF	Exposure frequency (day/yr)	350
BW	Body weight (kg)	varies (see Appendix E)
AT	Averaging time (yr)	70
365	Units conversion factor (day/yr)	
CSF	Oral cancer slope factor (per mg/kg/d)	chemical-specific (see Appendix E)

Description

This equation calculates the individual cancer risk from indirect exposure to carcinogenic chemicals. The body weight varies for the child and the adult. The exposure duration varies for different scenarios.

Table C-5.8. Hazard Quotient

$$HQ = \frac{I}{BW \cdot RfD}$$

Parameter	Description	Values
HQ	Hazard quotient (unitless)	
I	Total daily intake of contaminant (mg/d)	calculated (see Table C-5.6)
BW	Body weight (kg)	varies (see Appendix E)
RfD	Reference Dose (mg/kg/d)	chemical-specific (see Appendix E)

Description

This equation calculates the hazard quotient for indirect exposure to noncarcinogenic chemicals. The body weight varies for the child and the adult.

Table C-5.9 Calculation of Cancer Risk due to Direct Inhalation using CSF

$$CR = ADI \bullet CSF\,(inh)$$

$$ADI = \frac{C_a \cdot IR \cdot EF \cdot ED}{BW \cdot AT \cdot 365000}$$

$$CSF\,(inh) = URF \bullet 3500$$

Parameter	Definition	Values
ADI	Average daily intake (mg/kg/d)	
C_a	Total air concentration (µg/m^3)	calculated (see Table C-4.1)
IR	Inhalation rate (m^3/day)	scenario specific (see Appendix E)
EF	Exposure frequency (d/yr)	350
ED	Exposure duration (years)	scenario specific (see Appendix E)
BW	Body weight (Kg)	scenario specific (see Appendix E)
URF	Inhalation unit risk factor (µg/m^3)$^{-1}$	chemical-specific (see Appendix E)
3500	Factor to convert URF to CSF based on a 70 kg body weight and a 20 m^3/day inhalation rate for an adult.	
AT	Averaging time (years)	70
365,000	Units conversion factor (µg-day/mg-yr)	

Table 5-9 (continued)		
Parameter	**Definition**	**Values**
CR	Cancer risk	
CSF (inh)	Inhalation carcinogenic slope factor (per mg/kg/d)	chemical-specific (see Appendix E)
Description		
This equation calculates the cancer risk from direct inhalation of a chemical for each scenario. The exposure duration is scenario-specific. The exposure duration for inhalation is the same as the exposure duration for ingestion for all scenarios except for the high-end farmer scenarios. For these specific scenarios, the exposure duration for inhalation is equal to 30 years -- the time period of combustion -- and not to 40 years, the exposure duration for ingestion for high-end farmers.		

Table C-5.10 Hazard Quotient due to Direct Inhalation		
$$HQ = \frac{Ca}{RfC} \bullet 10^{-3}$$		
Parameter	**Definition**	**Values**
HQ	Hazard quotient via inhalation	
C_a	Total air concentration (µg/m³)	calculated (see Table C-4.1)
RfC	Reference concentration (mg/m³)	chemical-specific (see Appendix E)
10^{-3}	Units conversion factor (mg/m³)	
Description		
This equation calculates the hazard quotient for direct inhalation of a chemical.		

6. Breast Milk Exposure for Dioxins

To determine the average daily dose for a breast-feeding infant, the concentration of dioxin in the mother's milk was first determined. Nine mother scenarios were considered in the breastmilk exposure analysis, corresponding to the nine adult exposure scenarios (e.g., subsistence farmers, subsistence fisher, recreational fisher, home gardeners, and adult resident). Table C-6.1 provides equations for calculating the concentration of dioxin in maternal milk. Once the contaminant concentration in maternal milk was determined, the equation in Table C-6.2 was used to determine the average daily dose for infant exposure in pg/kg/d. The daily dose to the infant was converted to 2,3,7,8-TCDD TEQ for comparison with the background concentration of 50 pg/kg/d (16 ppt) in maternal breastmilk.

Table C-6.1. Concentration in Maternal Milk

$$C_{(milkfat)} = \frac{m \bullet 10^9 \bullet h \bullet f_1}{0.693 \bullet f_2}$$

Parameter	Description	Values
$C_{(milkfat)}$	Concentration in maternal milk (pg/kg of milkfat)	
m	Average maternal intake of dioxin (mg/d)	calculated (see Table C-5.6)
10^9	Conversion constant (pg/mg)	
h	Half-life of dioxin in adults (days)	2555
f_1	Proportion of ingested dioxin that is stored in fat (unitless)	0.9
f_2	Proportion of mother's weight that is fat (unitless)	0.3

Table C-6.2. Average Daily Dose to the Exposed Infant

$$ADD_{(infant)} = \frac{C_{(milkfat)} \cdot f_3 \cdot f_4 \cdot IR_{milk} \cdot ED}{BW_{infant} \cdot AT}$$

Parameter	Description	Values
$ADD_{(infant)}$	Average daily dose for infant exposed to contaminated breastmilk (pg/kg/d)	
$C_{(milkfat)}$	Concentration in maternal milk (pg/kg of milkfat)	calculated (see Table C-6.1)
f_3	Fraction of fat in breastmilk (unitless)	0.04
f_4	Fraction ingested contaminant which is absorbed (unitless)	0.9
IR_{milk}	Ingestion rate of breastmilk (kg/d)	0.8
ED	Exposure duration (year)	1
BW_{infant}	Body weight of infant (kg)	10
AT	Averaging time (year)	1

APPENDIX D

Input Files for ISCSTDFT Air Dispersion Modeling

Appendix D. Input Files for ISCSTDFT Air Dispersion Modeling

Appendix D contains a complete set of input files for the ISCSTDFT air dispersion modeling conducted for Case A. Air dispersion modeling for the other ten facilities was conducted in a similar manner. The results of the air modeling for each site considered for this analysis are contained in Appendix A. Presented below is an overview of the 26 files contained in this appendix.

1. ISCSTDFT Modeling of Subsistence Farmers, Home Gardeners, and the Maximum Impact Locations

Appendix D contains the six input files used in the modeling of subsistence farmers, the home gardener, and the locations of maximum combined deposition of particles and maximum air concentration of vapor. Air concentration of vapors and particles; wet, dry, and combined deposition; and wet deposition of vapors were modeled. The modeling was conducted over a polar array of receptors, along 16 radials spaced at varying distances out to 10 kilometers. Site A's stack was located at the origin of the 10-kilometer radius. ISCSTDFT results for the points of maximum combined deposition and air concentration, the closest residence, and the subsistence farmers were located using this radial array of receptors.

2. ISCSTDFT Modeling of Watersheds and Typical Scenarios

Appendix D contains the 20 input files used in the modeling of the watersheds and the typical scenarios. Air concentration of vapors and particles; wet and dry deposition of particles; and wet deposition of vapors were modeled for the typical farmers and residents. Air concentration of vapors, wet deposition of vapors, and wet and dry deposition of particles were also used for the watersheds. The modeling was conducted over a 40 by 40 kilometer area. Due to restrictions on the number of receptors that can be modeled with ISCSTDFT, the large area was divided into 4, 20 by 20 kilometer areas with receptors evenly spaced every 1000 meters. The results were averaged over the entire 40 by 40 kilometer grid for the typical scenarios and over the specific watersheds for the subsistence and recreational fishers.

```
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   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL  CONC   WETDPLT DRYDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
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** PARAMETERS:         ----  ----  ----  ----  ---
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   PARTDIAM  STACK1     15.   6.0   1.0
   MASSFRAX  STACK1   0.03   0.19  0.78
   PARTDENS  STACK1       1.      1.      1.
   PARTSLIQ  STACK1   6.7E-4  4.2E-4  0.4E-4
   PARTSICE  STACK1   6.7E-4    4.2E-4  0.4E-4
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SO FINISHED

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RE GRIDPOLR  1 DIST 3000. 4000. 5000. 10000.
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RE GRIDPOLR  1 END
RE FINISHED

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ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

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   MAXTABLE ALLAVE  50
   PLOTFILE PERIOD GROUP1 NBT5YRA.PLT
OU FINISHED
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   MODELOPT  DFAULT  RURAL  CONC WETDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

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   GAS-SCAV  STACK1 ICE 1.7E-4
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SO FINISHED

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                    2000.
RE GRIDPOLR  1 DIST 3000. 4000. 5000. 10000.
RE GRIDPOLR  1 GDIR 16 22.5 22.5
RE GRIDPOLR  1 END
RE FINISHED

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ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

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   MAXTABLE  ALLAVE  50
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OU FINISHED
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   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
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** PARAMETERS:         ----  ----  ----  ----  ---
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   PARTDIAM  STACK1     15.   6.0   1.0
   MASSFRAX  STACK1   0.03   0.19  0.78
   PARTDENS  STACK1       1.      1.      1.
   PARTSLIQ  STACK1   6.7E-4  4.2E-4 0.4E-4
   PARTSICE  STACK1   6.7E-4    4.2E-4 0.4E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

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RE GRIDPOLR  1 ORIG 0.0 0.0
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RE GRIDPOLR  1 DIST 3000. 4000. 5000. 10000.
RE GRIDPOLR  1 GDIR 16 22.5 22.5
RE GRIDPOLR  1 END
RE FINISHED

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ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

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   MAXTABLE  ALLAVE  50
   PLOTFILE  PERIOD GROUP1 NBT5YRD.PLT
OU FINISHED
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   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
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** PARAMETERS:         ----  ----  ----  ----  ---
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   PARTDIAM  STACK1     15.   6.0   1.0
   MASSFRAX  STACK1   0.03   0.19  0.78
   PARTDENS  STACK1       1.      1.      1.
   PARTSLIQ  STACK1   6.7E-4   4.2E-4  0.4E-4
   PARTSICE  STACK1   6.7E-4   4.2E-4  0.4E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
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RE GRIDPOLR  1 ORIG 0.0 0.0
RE GRIDPOLR  1 DIST 100. 150. 200. 300. 400. 500. 700. 1000. 1500.
                    2000.
RE GRIDPOLR  1 DIST 3000. 4000. 5000. 10000.
RE GRIDPOLR  1 GDIR 16 22.5 22.5
RE GRIDPOLR  1 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  50
   PLOTFILE  PERIOD GROUP1 NBT5YRDD.PLT
OU FINISHED
```

```
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   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL  WDEP  WETDPLT DRYDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
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** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
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   PARTDIAM  STACK1     15.   6.0   1.0
   MASSFRAX  STACK1   0.03   0.19  0.78
   PARTDENS  STACK1       1.     1.     1.
   PARTSLIQ  STACK1   6.7E-4  4.2E-4 0.4E-4
   PARTSICE  STACK1   6.7E-4    4.2E-4 0.4E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDPOLR  1 STA
RE GRIDPOLR  1 ORIG 0.0 0.0
RE GRIDPOLR  1 DIST 100. 150. 200. 300. 400. 500. 700. 1000. 1500.
                    2000.
RE GRIDPOLR  1 DIST 3000. 4000. 5000. 10000.
RE GRIDPOLR  1 GDIR 16 22.5 22.5
RE GRIDPOLR  1 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

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   MAXTABLE  ALLAVE  50
   PLOTFILE  PERIOD GROUP1 NBT5YRWD.PLT
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   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.    30.  309.  6.1   1.8
   GAS-SCAV  STACK1 LIQ 1.7E-4
   GAS-SCAV  STACK1 ICE 1.7E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDPOLR  1 STA
RE GRIDPOLR  1 ORIG 0.0 0.0
RE GRIDPOLR  1 DIST 100. 150. 200. 300. 400. 500. 700. 1000. 1500.
                    2000.
RE GRIDPOLR  1 DIST 3000. 4000. 5000. 10000.
RE GRIDPOLR  1 GDIR 16 22.5 22.5
RE GRIDPOLR  1 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  50
   PLOTFILE  PERIOD GROUP1 NBT5YWDV.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE    ISCSTDFT HW COMBUSTION; AIR CONCENTRATION OF PARTICLES FOR WS
               QUAD 1
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL CONC  WETDPLT DRYDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.    30.  309.  6.1   1.8
   PARTDIAM  STACK1     15.   6.0   1.0
   MASSFRAX  STACK1   0.03   0.19  0.78
   PARTDENS  STACK1       1.     1.     1.
   PARTSLIQ  STACK1   6.7E-4  4.2E-4 0.4E-4
   PARTSICE  STACK1   6.7E-4  4.2E-4 0.4E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC -20000. 21 1000. -20000. 21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS1CP.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE   ISCSTDFT HW COMBUSTION; AIR CONCENTRATION OF VAPOR FOR WS, QUAD 1
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL CONC   WETDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.    30.  309.  6.1   1.8
   GAS-SCAV  STACK1 LIQ  1.74E-4
   GAS-SCAV  STACK1 ICE  1.74E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC -20000. 21 1000. -20000. 21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS1AV.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE  ISCSTDFT HW COMBUSTION; DRY DEPOSITION OF PARTICLES FOR WS QUAD 1
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL DDEP  WETDPLT DRYDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE        EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:          ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.    30.  309.  6.1   1.8
   PARTDIAM  STACK1     15.   6.0   1.0
   MASSFRAX  STACK1   0.03   0.19  0.78
   PARTDENS  STACK1       1.      1.      1.
   PARTSLIQ  STACK1   6.7E-4  4.2E-4 0.4E-4
   PARTSICE  STACK1   6.7E-4  4.2E-4 0.4E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC -20000. 21 1000. -20000. 21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS1DDP.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE  ISCSTDFT HW COMBUSTION; WET DEPOSITION OF PARTICLES FOR WS QUAD 1
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL WDEP WETDPLT drydplt
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.    30.  309.  6.1   1.8
   PARTDIAM  STACK1     15.   6.0   1.0
   MASSFRAX  STACK1   0.03   0.19  0.78
   PARTDENS  STACK1       1.      1.      1.
   PARTSLIQ  STACK1   6.7E-4  4.2E-4 0.4E-4
   PARTSICE  STACK1   6.7E-4  4.2E-4 0.4E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC -20000. 21 1000. -20000. 21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS1WDP.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE  ISCSTDFT HW COMBUSTION; WET DEPOSITION OF VAPORS FOR WS QUAD 1
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL WDEP WETDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE        EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----   ----  ----  ---
   SRCPARAM  STACK1     1.    30.   309.  6.1   1.8
   GAS-SCAV  STACK1 LIQ  1.74E-4
   GAS-SCAV  STACK1 ICE  1.74E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC -20000. 21 1000. -20000. 21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS1DV.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE  ISCSTDFT HW COMBUSTION; AIR CONCENTRATION OF PARTICLES FOR WS
                          QUAD 2
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL CONC WETDPLT DRYDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.    30.  309.  6.1   1.8
   PARTDIAM  STACK1     15.   6.0   1.0
   MASSFRAX  STACK1   0.03   0.19  0.78
   PARTDENS  STACK1       1.     1.     1.
   PARTSLIQ  STACK1   6.7E-4  4.2E-4 0.4E-4
   PARTSICE  STACK1   6.7E-4  4.2E-4 0.4E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC -20000. 21 1000. 0.0  21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS2CP.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE  ISCSTDFT HW COMBUSTION; AIR CONCENTRATION OF VAPOR FOR WS QUAD 2
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL CONC   WETDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.    30.  309.  6.1   1.8
   GAS-SCAV  STACK1 LIQ  1.74E-4
   GAS-SCAV  STACK1 ICE  1.74E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC -20000. 21 1000. 0.0  21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS2AV.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE  ISCSTDFT HW COMBUSTION; DRY DEPOSITION OF PARTICLES FOR WS QUAD 2
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL DDEP  WETDPLT DRYDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.    30.  309.  6.1   1.8
   PARTDIAM  STACK1     15.   6.0   1.0
   MASSFRAX  STACK1   0.03   0.19  0.78
   PARTDENS  STACK1       1.      1.      1.
   PARTSLIQ  STACK1   6.7E-4  4.2E-4 0.4E-4
   PARTSICE  STACK1   6.7E-4  4.2E-4 0.4E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC -20000. 21 1000. 0.0  21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS2DDP.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE  ISCSTDFT HW COMBUSTION; WET DEPOSITION OF PARTICLES FOR WS QUAD 2
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL WDEP  WETDPLT DRYDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.    30.  309.  6.1   1.8
   PARTDIAM  STACK1     15.   6.0   1.0
   MASSFRAX  STACK1   0.03   0.19  0.78
   PARTDENS  STACK1       1.      1.      1.
   PARTSLIQ  STACK1   6.7E-4  4.2E-4 0.4E-4
   PARTSICE  STACK1   6.7E-4  4.2E-4 0.4E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC -20000. 21 1000. 0.0  21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS2WDP.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE  ISCSTDFT HW COMBUSTION; WET DEPOSITION OF VAPORS FOR WS QUAD 2
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL WDEP WETDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.    30.  309.  6.1   1.8
   GAS-SCAV  STACK1 LIQ  1.74E-4
   GAS-SCAV  STACK1 ICE  1.74E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC -20000. 21 1000. 0.0  21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS2DV.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE  ISCSTDFT HW COMBUSTION; AIR CONCENTRATION OF PARTICLES FOR WS
              QUAD 3
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL CONC WETDPLT DRYDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.    30.  309.  6.1   1.8
   PARTDIAM  STACK1     15.   6.0   1.0
   MASSFRAX  STACK1     0.03   0.19  0.78
   PARTDENS  STACK1       1.     1.     1.
   PARTSLIQ  STACK1   6.7E-4  4.2E-4 0.4E-4
   PARTSICE  STACK1   6.7E-4  4.2E-4 0.4E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC 0.0 21 1000. 0.0  21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS3CP.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE  ISCSTDFT HW COMBUSTION; AIR CONCENTRATION OF VAPOR FOR WS, QUAD 3
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL CONC WETDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.    30.  309.  6.1   1.8
   GAS-SCAV  STACK1 LIQ  1.74E-4
   GAS-SCAV  STACK1 ICE  1.74E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC 0.0 21 1000. 0.0  21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS3AV.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE  ISCSTDFT HW COMBUSTION; DRY DEPOSITION OF PARTICLES FOR WS,
              QUAD 3
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL DDEP WETDPLT DRYDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.     30.  309.  6.1   1.8
   PARTDIAM  STACK1     15.   6.0   1.0
   MASSFRAX  STACK1   0.03   0.19  0.78
   PARTDENS  STACK1       1.      1.      1.
   PARTSLIQ  STACK1   6.7E-4  4.2E-4 0.4E-4
   PARTSICE  STACK1   6.7E-4  4.2E-4 0.4E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC 0.0 21 1000. 0.0  21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS3DDP.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE  ISCSTDFT HW COMBUSTION;WET DEPOSITION OF PARTICLES FOR WS, QUAD 3
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL WDEP  WETDPLT DRYDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.    30.  309.  6.1   1.8
   PARTDIAM  STACK1     15.   6.0   1.0
   MASSFRAX  STACK1   0.03   0.19  0.78
   PARTDENS  STACK1       1.      1.      1.
   PARTSLIQ  STACK1   6.7E-4  4.2E-4 0.4E-4
   PARTSICE  STACK1   6.7E-4  4.2E-4 0.4E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC 0.0 21 1000. 0.0  21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS3WDP.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE  ISCSTDFT HW COMBUSTION; WET DEPOSITION OF VAPORS FOR WS, QUAD 3
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL WDEP WETDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.    30.  309.  6.1   1.8
   GAS-SCAV  STACK1 LIQ  1.74E-4
   GAS-SCAV  STACK1 ICE  1.74E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC 0.0 21 1000. 0.0  21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS3DV.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE  ISCSTDFT HW COMBUSTION; AIR CONCENTRATION OF PARTICLES FOR WS,
              QUAD 4
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL CONC WETDPLT DRYDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.     30.  309.  6.1   1.8
   PARTDIAM  STACK1     15.    6.0   1.0
   MASSFRAX  STACK1   0.03   0.19  0.78
   PARTDENS  STACK1       1.      1.      1.
   PARTSLIQ  STACK1   6.7E-4  4.2E-4 0.4E-4
   PARTSICE  STACK1   6.7E-4  4.2E-4 0.4E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC 0.0 21 1000. -20000. 21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS4CP.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE  ISCSTDFT HW COMBUSTION; AIR CONCENTRATION OF VAPOR FOR WS, QUAD 4
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL  CONC  WETDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.    30.  309.  6.1   1.8
   GAS-SCAV  STACK1 LIQ  1.74E-4
   GAS-SCAV  STACK1 ICE  1.74E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC 0.0 21 1000. -20000. 21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS4AV.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE  ISCSTDFT HW COMBUSTION; DRY DEPOSITION OF PARTICLES FOR WS,
              QUAD 4
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL DDEP  WETDPLT DRYDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.    30.  309.  6.1   1.8
   PARTDIAM  STACK1     15.   6.0   1.0
   MASSFRAX  STACK1   0.03   0.19  0.78
   PARTDENS  STACK1       1.      1.      1.
   PARTSLIQ  STACK1   6.7E-4  4.2E-4 0.4E-4
   PARTSICE  STACK1   6.7E-4  4.2E-4 0.4E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC 0.0 21 1000. -20000. 21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS4DDP.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE  ISCSTDFT HW COMBUSTION; WET DEPOSITION OF PARTICLES FOR WS,
              QUAD 4
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL WDEP  WETDPLT DRYDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.    30.  309.  6.1   1.8
   PARTDIAM  STACK1     15.   6.0   1.0
   MASSFRAX  STACK1   0.03   0.19  0.78
   PARTDENS  STACK1       1.      1.      1.
   PARTSLIQ  STACK1   6.7e-4   4.2e-4  0.4e-4
   PARTSICE  STACK1   6.7e-4 4.2e-4 0.4e-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC 0.0 21 1000. -20000. 21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS4WDP.PLT
OU FINISHED
```

```
CO STARTING
   TITLEONE  ISCSTDFT HW COMBUSTION; WET DEPOSITION OF VAPORS FOR WS, QUAD 4
   TITLETWO  CASE A, 5 YEARS OF MET DATA
   MODELOPT  DFAULT  RURAL WDEP WETDPLT
   AVERTIME  PERIOD
   POLLUTID  UNIT
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0
** POINT SOURCE       EMIS STACKHT TEMP  VEL  DIAM
** PARAMETERS:         ----  ----  ----  ----  ---
   SRCPARAM  STACK1     1.    30.  309.  6.1   1.8
   GAS-SCAV  STACK1 LIQ  1.74E-4
   GAS-SCAV  STACK1 ICE  1.74E-4
SO SRCGROUP  GROUP1 STACK1
SO FINISHED

RE STARTING
RE GRIDCART  WS24 STA
RE GRIDCART  WS24 XYINC 0.0 21 1000. -20000. 21 1000.
RE GRIDCART  WS24 END
RE FINISHED

ME STARTING
ME INPUTFIL  NBTR5YR.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  13970  1985
ME UAIRDATA   3937  1985
ME FINISHED

TG STARTING
TG FINISHED

OU STARTING
   RECTABLE  ALLAVE FIRST
   MAXTABLE  ALLAVE  10
   PLOTFILE  PERIOD GROUP1 BWS4DV.PLT
OU FINISHED
```

APPENDIX E

Parameter Derivation and Citations

Appendix E. Parameter Derivation and Citations

Appendix E lists the chemical specific, fate and transport, and exposure parameters used in this risk analysis. A complete list of the references for the derivation of these parameters is also included. Presented below is an overview of the information contained in this appendix.

1. Chemical Specific Parameters

Tables E-1.1 to E-1.17 contain the physical and chemical properties for the dioxin and furan congeners. Each dioxin and furan congener is considered independently in the risk assessment. Any constituent specific values for dioxins/furans not reported in this appendix were calculated using the physical and chemical properties in the tables. The information presented in the tables includes the following:

- vapor fraction (f_v)
- Henry's Law Constant (H)
- Octanol-water partition coefficient (Kow)
- soil adsorbtion coefficient (Koc)
- soil-to-plant biotransfer factor (Br)
- root concentration factor (RCF)
- air-to-plant biotransfer factor (B_{vpa})
- fish biota to sediment accumulation factor (BSAF)
- biotransfer factor for beef (B_{beef})
- biotransfer factor for milk (B_{milk})
- biotransfer factor for pork (B_{pork})
- biotransfer factor for chicken (B_{chick})
- biotransfer factor for eggs (B_{egg})
- vapor pressure (VP)
- water solubility (S)
- molecular weight (MW)
- diffusivity coefficients in water and air (D_w and D_a).

Values for sediment and soil partition coefficients (Kd_{sw}, Kd_{bs}, and Kd_s) are calculated from equations in Appendix C for the dioxin and furan congeners. Following the tables is a list of references used to obtain the chemical and physical properties. The reference numbers cited in Tables E-1.1 to E-1.17 refer to these references.

Tables E-1.18 to E-1.29 list the physical and chemical properties for the metals considered in the risk analysis. Any constituent specific values for the metals not reported in this appendix were calculated using the physical and chemical properties listed in the tables. The information presented in Tables E-1.18 to E-1.29 includes the following:

- soil-to-plant biotransfer factor (Br)
- fish biota accumulation factor (BAF)
- fish biota concentration factor (BCF)
- sediment partition coefficents (Kd_{sw} and Kd_{bs}).
- biotransfer factor for beef (B_{beef})
- biotransfer factor for milk (B_{milk})
- biotransfer factor for pork (B_{pork})
- molecular weight (MW)
- soil partition coefficients (Kd_s)

Following the tables is a list of references used to obtain the chemical and physical properties. The reference numbers cited in Tables E-1.18 to E-1.29 refer to these references.

2. Fate and Transport Parameters

Table E-2.1 contains the references and values for the fate and transport parameters used in this analysis. The parameters listed in the table are not constituent or site-specific. Constituent-specific parameters are listed in Tables E-1.1 to E-1.29. The site-specific surface water and meteorological parameters that affect fate and transport are listed in Appendix A.

3. Exposure Parameters

Tables E-3.1 and E-3.2 list the exposure parameters used in this analysis. Table E-3.1 contains exposure parameters that are not site-specific and are applicable to all eleven facilities. Table E-3.2 contains site-specific data on the fraction of consumption that was assumed to be contaminated. The values in this table were developed using production and processing data from counties within 50 kilometers of each site. Typical farmers, which were also determined from the county data, are highlighted in Table E-3.2 for each case. A complete discussion of the references and methodology used to obtain the values listed in Tables E-3.1 and E-3.2 is contained in the body of this report (Section II) and is not repeated in this appendix.

Table E-1.1. Chemical-Specific Inputs forTCDD 2,3,7,8-

Parameter	Definition	Value	Ref
Chemical/Physical Properties			
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)	5.5E-1	1
Koc	Soil Adsorbtion Coefficient (ml/g)	2.7E+6	1
Kow	Octanol-water partition coefficient (unitless)	4.4E+6	1
VP	Vapor Pressure (atm)	9.7E-13	1
SOl	Water solubility (ml/g)	1.9E-5	1
MW	Molecular Weight (g/mol)	322	1
H	Henry's Law Constant (atm-m^3/mol)	1.6E-5	1
D_a	Diffusivity in air (cm^2/sec)	4.7E-2	1
D_w	Diffusivity in water (cm^2/sec)	8.0E-6	2
Transfer Factors			
Bv	Air-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g air])	6.1E+4	24
RCF	Root concentration factor ([µg pollutant/g plant tissue FW]/[µg pollutant/g soil water])	3.9E+3	1
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	5.6E-3	3
Ba_{beef}/Ba_{pork}	Biotransfer factor for beef (day/kg)[1]	7.0E-2	23
Ba_{milk}	Biotransfer factor for milk (day/kg)	1.0E-2	5
BCF_{chick}	Biconcentration factor for TCDD-TEQ in thigh meat (unitless)	1.11	4
BCF_{egg}	Biconcentration factor for TCDD-TEQ in eggs (unitless)	1.27	4
BSAF	Fish biota to sediment accumulation factor (unitless)	9.0E-2	1
Other Parameters			
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)	6.0E-1	5
Health Benchmarks			
CSF	Cancer Slope Factor (per mg/kg/day)	156,000	6
RfD	Reference Dose (mg/kg/day)	NA	
URF	Unit Risk Factor (per µg/m^3)	NA	
RfC	Reference Concentration (mg/m^3)	NA	

[1] Pork biotransfer factor set equal to beef biotransfer factor.

Table E-1.2. Chemical-Specific Inputs for TCDF 2,3,7,8-

Parameter	Definition	Value	Ref
Chemical/Physical Properties			
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)	7.1E-1	1
Koc	Soil Adsorbtion Coefficient (ml/g)	2.1E+6	1
Kow	Octanol-water partition coefficient (unitless)	3.4E+6	1
VP	Vapor Pressure (atm)	1.2E-11	1
SOl	Water solubility (ml/g)	4.2E-4	1
MW	Molecular Weight (g/mol)	306	1
H	Henry's Law Constant (atm-m^3/mol)	8.6E-6	1
D_a	Diffusivity in air (cm^2/sec)	4.8E-2	1
D_w	Diffusivity in water (cm^2/sec)	8.0E-6	2
Transfer Factors			
Bv	Air-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g air])	8.1E+4	24
RCF	Root concentration factor ([µg pollutant/g plant tissue FW]/[µg pollutant/g soil water])	3.2E+3	1
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	6.5E-3	3
Ba_{beef}/Ba_{pork}	Biotransfer factor for beef (day/kg)[1]	1.0E-2	23
Ba_{milk}	Biotransfer factor for milk (day/kg)	3.0E-3	5
BCF_{chick}	Biconcentration factor for TCDD-TEQ in thigh meat (unitless)	0.92	7
BCF_{egg}	Biconcentration factor for TCDD-TEQ in eggs (unitless)	0.46	7
BSAF	Fish biota to sediment accumulation factor (unitless)	9.0E-2	1
Other Parameters			
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)	6.0E-1	5
Health Benchmarks			
TEQ	Toxicity Equivalency Factor	0.1	1

[1]Pork biotransfer factor set equal to beef biotransfer factor.

Table E-1.3. Chemical-Specific Inputs for PeCDD 1,2,3,7,8-

Parameter	Definition	Value	Ref
Chemical/Physical Properties			
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)	2.6E-1	1
K_{oc}	Soil Adsorbtion Coefficient (ml/g)	2.7E+6	1
K_{ow}	Octanol-water partition coefficient (unitless)	4.4E+6	1
VP	Vapor Pressure (atm)	1.2E-12	1
SOl	Water solubility (ml/g)	1.2E-4	1
MW	Molecular Weight (g/mol)	356.4	1
H	Henry's Law Constant (atm-m^3/mol)	6.2E-6	1
Da	Diffusivity in air (cm2/sec)	4.5E-2	1
Dw	Diffusivity in water (cm2/sec)	8.0E-6	2
Transfer Factors			
Bv	Air-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g air])	1.2E+5	24
RCF	Root concentration factor ([µg pollutant/g plant tissue FW]/[µg pollutant/g soil water])	3.9E+3	1
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	5.6E-3	3
Ba_{beef}/Ba_{pork}	Biotransfer factor for beef (day/kg)1	6E-2	23
Ba_{milk}	Biotransfer factor for milk (day/kg)	1E-2	5
BCF_{chick}	Biconcentration factor for TCDD-TEQ in thigh meat (unitless)	1.11	7
BCF_{egg}	Biconcentration factor for TCDD-TEQ in eggs (unitless)	1.27	7
BSAF	Fish biota to sediment accumulation factor (unitless)	9E-2	1
Other Parameters			
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)	6.0E-1	5
Health Benchmarks			
TEQ	Toxicity Equivalency Factor	0.5	1

[1] Pork biotransfer factor set equal to beef biotransfer factor.

Table E-1.4. Chemical-Specific Inputs for PeCDF 1,2,3,7,8-

Parameter	Definition	Value	Ref
Chemical/Physical Properties			
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)	4.2E-1	1
Koc	Soil Adsorbtion Coefficient (ml/g)	3.8E+6	1
Kow	Octanol-water partition coefficient (unitless)	6.2E+6	1
VP	Vapor Pressure (atm)	3.6E-12	1
SOl	Water solubility (ml/g)	2.4E-4	1
MW	Molecular Weight (g/mol)	340.4	1
H	Henry's Law Constant (atm-m3/mol)	6.2E-6	1
Da	Diffusivity in air (cm2/sec)	4.6E-2	1
Dw	Diffusivity in water (cm2/sec)	8.0E-6	2
Transfer Factors			
Bv	Air-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g air])	4.6E+5	24
RCF	Root concentration factor ([µg pollutant/g plant tissue FW]/[µg pollutant/g soil water])	5.1E+3	1
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	4.6E-3	3
Ba_{beef}/Ba_{pork}	Biotransfer factor for beef (day/kg)[1]	1.0E-2	23
Ba_{milk}	Biotransfer factor for milk (day/kg)	2.0E-3	5
BCF_{chick}	Biconcentration factor for TCDD-TEQ in thigh meat (unitless)	1.20	4
BCF_{egg}	Biconcentration factor for TCDD-TEQ in eggs (unitless)	2.50	4
BSAF	Fish biota to sediment accumulation factor (unitless)	9E-2	1
Other Parameters			
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)	6.0E-1	5
Health Benchmarks			
TEQ	Toxicity Equivalency Factor	0.05	1

[1] Pork biotransfer factor set equal to beef biotransfer.

Table E-1.5. Chemical-Specific Inputs for PeCDF 2,3,4,7,8-

Parameter	Definition	Value	Ref
Chemical/Physical Properties			
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)	3.0E-1	1
Koc	Soil Adsorbtion Coefficient (ml/g)	5.1E+6	1
Kow	Octanol-water partition coefficient (unitless)	8.3E+6	1
VP	Vapor Pressure (atm)	4.3E-12	1
SOl	Water solubility (ml/g)	2.4E-4	1
MW	Molecular Weight (g/mol)	340.4	1
H	Henry's Law Constant (atm-m^3/mol)	6.2E-6	1
D_a	Diffusivity in air (cm^2/sec)	4.6E-2	1
D_w	Diffusivity in water (cm^2/sec)	8.0E-6	2
Transfer Factors			
Bv	Air-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g air])	4.6E+5	24
RCF	Root concentration factor ([µg pollutant/g plant tissue FW]/[µg pollutant/g soil water])	6.4E+3	1
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	3.9E-3	3
Ba_{beef}/Ba_{pork}	Biotransfer factor for beef (day/kg)[1]	5.0E-2	23
Ba_{milk}	Biotransfer factor for milk (day/kg)	9.0E-3	5
BCF_{chick}	Biconcentration factor for TCDD-TEQ in thigh meat (unitless)	1.20	7
BCF_{egg}	Biconcentration factor for TCDD-TEQ in eggs (unitless)	2.50	7
BSAF	Fish biota to sediment accumulation factor (unitless)	9E-2	1
Other Parameters			
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)	6.0E-1	5
Health Benchmarks			
TEQ	Toxicity Equivalency Factor	0.5	1

[1] Pork biotransfer factor set equal to beef biotransfer factor.

Table E-1.6. Chemical-Specific Inputs for HxCDD 1,2,3,4,7,8-

Parameter	Definition	Value	Ref
Chemical/Physical Properties			
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)	7E-2	1
Koc	Soil Adsorbtion Coefficient (ml/g)	3.8E+7	1
Kow	Octanol-water partition coefficient (unitless)	6.2E+7	1
VP	Vapor Pressure (atm)	1.3E-13	1
SOl	Water solubility (ml/g)	4.4E-6	1
MW	Molecular Weight (g/mol)	390.9	1
H	Henry's Law Constant (atm-m^3/mol)	1.2E-5	1
D_a	Diffusivity in air (cm^2/sec)	4.3E-2	1
D_w	Diffusivity in water (cm^2/sec)	8.0E-6	2
Transfer Factors			
Bv	Air-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g air])	4.5E+5	24
RCF	Root concentration factor ([µg pollutant/g plant tissue FW]/[µg pollutant/g soil water])	3.0E+4	1
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	1.2E-3	3
Ba_{beef}/Ba_{pork}	Biotransfer factor for beef (day/kg)[1]	3.0E-2	23
Ba_{milk}	Biotransfer factor for milk (day/kg)	6.0E-3	5
BCF_{chick}	Biconcentration factor for TCDD-TEQ in thigh meat (unitless)	0.85	7
BCF_{egg}	Biconcentration factor for TCDD-TEQ in eggs (unitless)	1.46	7
BSAF	Fish biota to sediment accumulation factor (unitless)	4E-2	1
Other Parameters			
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)	6.0E-1	5
Health Benchmarks			
TEQ	Toxicity Equivalency Factor	0.1	1

[1] Pork biotransfer factor set equal to beef biotransfer factor.

Table E-1.7. Chemical-Specific Inputs for HxCDD 1,2,3,6,7,8

Parameter	Definition	Value	Ref
Chemical/Physical Properties			
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)	4.0E-2	1
Koc	Soil Adsorbtion Coefficient (ml/g)	1.2E+7	1
Kow	Octanol-water partition coefficient (unitless)	2.0E+7	1
VP	Vapor Pressure (atm)	4.7E-14	1
SOl	Water solubility (ml/g)	4.4E-6	1
MW	Molecular Weight (g/mol)	390.9	1
H	Henry's Law Constant (atm-m^3/mol)	1.2E-5	1
D_a	Diffusivity in air (cm^2/sec)	4.3E-2	1
D_w	Diffusivity in water (cm^2/sec)	8.0E-6	2
Transfer Factors			
Bv	Air-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g air])	4.5E+5	24
RCF	Root concentration factor ([µg pollutant/g plant tissue FW]/[µg pollutant/g soil water])	1.3E+4	1
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	2.3E-3	3
Ba_{beef}/Ba_{pork}	Biotransfer factor for beef (day/kg)[1]	3.0E-2	23
Ba_{milk}	Biotransfer factor for milk (day/kg)	5.0E-3	5
BCF_{chick}	Biconcentration factor for TCDD-TEQ in thigh meat (unitless)	0.99	7
BCF_{egg}	Biconcentration factor for TCDD-TEQ in eggs (unitless)	1.62	7
BSAF	Fish biota to sediment accumulation factor (unitless)	4E-2	1
Other Parameters			
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)	6.0E-1	5
Health Benchmarks			
TEQ	Toxicity Equivalency Factor	0.1	1

[1] Pork biotransfer factor set equal to beef biotransfer factor.

Table E.1-8. Chemical-Specific Inputs for HxCDD 1,2,3,7,8,9-

Parameter	Definition	Value	Ref
Chemical/Physical Properties			
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)	2E-2	1
Koc	Soil Adsorbtion Coefficient (ml/g)	1.2E+7	1
Kow	Octanol-water partition coefficient (unitless)	2.0E+7	1
VP	Vapor Pressure (atm)	6.4E-14	1
SOl	Water solubility (ml/g)	4.4E-6	1
MW	Molecular Weight (g/mol)	390.9	1
H	Henry's Law Constant (atm-m^3/mol)	1.2E-5	1
D_a	Diffusivity in air (cm^2/sec)	4.3E-2	1
D_w	Diffusivity in water (cm^2/sec)	8.0E-6	2
Transfer Factors			
Bv	Air-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g air])	4.5E+5	24
RCF	Root concentration factor ([µg pollutant/g plant tissue FW]/[µg pollutant/g soil water])	1.3E+4	1
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	2.3E-3	3
Ba_{beef}/Ba_{pork}	Biotransfer factor for beef (day/kg)[1]	3E-2	23
Ba_{milk}	Biotransfer factor for milk (day/kg)	6E-3	5
BCF_{chick}	Biconcentration factor for TCDD-TEQ in thigh meat (unitless)	0.50	7
BCF_{egg}	Biconcentration factor for TCDD-TEQ in eggs (unitless)	1.05	7
BSAF	Fish biota to sediment accumulation factor (unitless)	4E-2	1
Other Parameters			
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)	6.0E-1	5
Health Benchmarks			
TEF	Toxicity Equivalency Factor	0.1	1

[1] Pork biotransfer factor set equal to beef biotransfer factor.

Table E-1.9. Chemical-Specific Inputs for HxCDF 1,2,3,4,7,8

Parameter	Definition	Value	Ref
Chemical/Physical Properties			
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)	6.0E-2	1
Koc	Soil Adsorbtion Coefficient (ml/g)	1.2E+7	1
Kow	Octanol-water partition coefficient (unitless)	2.0E+7	1
VP	Vapor Pressure (atm)	3.2E-13	1
SOl	Water solubility (ml/g)	1.3E-5	1
MW	Molecular Weight (g/mol)	347.9	1
H	Henry's Law Constant (atm-m^3/mol)	1.4E-5	1
D_a	Diffusivity in air (cm^2/sec)	4.4E-2	1
D_w	Diffusivity in water (cm^2/sec)	8.0E-6	2
Transfer Factors			
Bv	Air-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g air])	1.5E+5	24
RCF	Root concentration factor ([µg pollutant/g plant tissue FW]/[µg pollutant/g soil water])	1.3E+4	1
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	2.3E-3	3
Ba_{beef}/Ba_{pork}	Biotransfer factor for beef (day/kg)[1]	4.0E-2	23
Ba_{milk}	Biotransfer factor for milk (day/kg)	7.0E-3	5
BCF_{chick}	Biconcentration factor for TCDD-TEQ in thigh meat (unitless)	0.86	7
BCF_{egg}	Biconcentration factor for TCDD-TEQ in eggs (unitless)	1.89	7
BSAF	Fish biota to sediment accumulation factor (unitless)	4E-2	1
Other Parameters			
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)	6.0E-1	5
Health Benchmarks			
TEQ	Toxicity Equivalency Factor	0.1	1

[1] Pork biotransfer factor set equal to beek biotransfer factor.

Table E-1.10. Chemical-Specific Inputs for HxCDF 1,2,3,6,7,8-

Parameter	Definition	Value	Ref
Chemical/Physical Properties			
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)	6.0E-2	1
Koc	Soil Adsorbtion Coefficient (ml/g)	1.2E+7	1
Kow	Octanol-water partition coefficient (unitless)	2.0E+7	1
VP	Vapor Pressure (atm)	2.9E-13	1
SOl	Water solubility (ml/g)	1.8E-5	1
MW	Molecular Weight (g/mol)	374.9	1
H	Henry's Law Constant (atm-m^3/mol)	6.1E-6	1
D_a	Diffusivity in air (cm^2/sec)	4.4E-2	1
D_w	Diffusivity in water (cm^2/sec)	8.0E-6	2
Transfer Factors			
Bv	Air-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g air])	1.5E+5	24
RCF	Root concentration factor ([µg pollutant/g plant tissue FW]/[µg pollutant/g soil water])	1.3E+4	1
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	2.3E-3	3
Ba_{beef}/Ba_{pork}	Biotransfer factor for beef (day/kg)[1]	3.0E-2	23
Ba_{milk}	Biotransfer factor for milk (day/kg)	6.0E-3	5
BCF_{chick}	Biconcentration factor for TCDD-TEQ in thigh meat (unitless)	0.73	7
BCF_{egg}	Biconcentration factor for TCDD-TEQ in eggs (unitless)	1.68	7
BSAF	Fish biota to sediment accumulation factor (unitless)	4E-2	1
Other Parameters			
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)	6.0E-1	5
Health Benchmarks			
TEQ	Toxicity Equivalency Factor	0.1	1

[1] Pork biotransfer factor set equal to beef biotransfer factor.

Table E-1.11. Chemical-Specific Inputs for HxCDF 1,2,3,7,8,9

Parameter	Definition	Value	Ref
Chemical/Physical Properties			
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)	1.1E-1	1
Koc	Soil Adsorbtion Coefficient (ml/g)	1.2E+7	1
Kow	Octanol-water partition coefficient (unitless)	2.0E+7	1
VP	Vapor Pressure (atm)	3.7E-13	1
SOl	Water solubility (ml/g)	1.3E-5	1
MW	Molecular Weight (g/mol)	374.9	1
H	Henry's Law Constant (atm-m^3/mol)	1.0E-5	1
D_a	Diffusivity in air (cm^2/sec)	1.3-2	1
D_w	Diffusivity in water (cm^2/sec)	8.0E-6	2
Transfer Factors			
Bv	Air-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g air])	1.5E+5	24
RCF	Root concentration factor ([µg pollutant/g plant tissue FW]/[µg pollutant/g soil water])	1.3E+4	1
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	2.3E-3	3
Ba_{beef}/Ba_{pork}	Biotransfer factor for beef (day/kg)[1]	3.0E-2	23
Ba_{milk}	Biotransfer factor for milk (day/kg)	6.0E-3	5
BCF_{chick}	Biconcentration factor for TCDD-TEQ in thigh meat (unitless)	0.73	4
BCF_{egg}	Biconcentration factor for TCDD-TEQ in eggs (unitless)	1.68	4
BSAF	Fish biota to sediment accumulation factor (unitless)	4E-2	1
Other Parameters			
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)	6.0E-1	5
Health Benchmarks			
TEQ	Toxicity Equivalency Factor	0.1	1

[1] Pork biotransfer factor set equal to beef biotransfer factor.

Table E-1.12. Chemical-Specific Inputs for HxCDF 2,3,4,6,7,8-

Parameter	Definition	Value	Ref
Chemical/Physical Properties			
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)	7.0E-2	1
Koc	Soil Adsorbtion Coefficient (ml/g)	1.2E+7	1
Kow	Octanol-water partition coefficient (unitless)	2.0E+7	1
VP	Vapor Pressure (atm)	2.6E-13	1
SOl	Water solubility (ml/g)	1.3E-5	1
MW	Molecular Weight (g/mol)	374.9	1
H	Henry's Law Constant (atm-m^3/mol)	1.0E-5	1
D_a	Diffusivity in air (cm^2/sec)	4.4E-2	1
D_w	Diffusivity in water (cm^2/sec)	8.0E-6	2
Transfer Factors			
Bv	Air-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g air])	1.5E+5	24
RCF	Root concentration factor ([µg pollutant/g plant tissue FW]/[µg pollutant/g soil water])	1.3E4	1
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	2.3E-3	3
Ba_{beef}/Ba_{pork}	Biotransfer factor for beef (day/kg)[1]	3.0E-2	23
Ba_{milk}	Biotransfer factor for milk (day/kg)	5.0E-3	5
BCF_{chick}	Biconcentration factor for TCDD-TEQ in thigh meat (unitless)	0.39	7
BCF_{egg}	Biconcentration factor for TCDD-TEQ in eggs (unitless)	0.54	7
BSAF	Fish biota to sediment accumulation factor (unitless)	4E-2	1
Other Parameters			
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)	6.0E-1	5
Health Benchmarks			
TEQ	Toxicity Equivalency Factor	0.1	1

[1] Pork biotransfer factor set equal to beef biotransfer factor.

Table E-1.13. Chemical-Specific Inputs for HpCDD 1,2,3,4,6,7,8

Parameter	Definition	Value	Ref
Chemical/Physical Properties			
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)	2E-2	1
Koc	Soil Adsorbtion Coefficient (ml/g)	9.8E+7	1
Kow	Octanol-water partition coefficient (unitless)	1.6E+8	1
VP	Vapor Pressure (atm)	4.2E-14	1
SOl	Water solubility (ml/g)	2.4E-6	1
MW	Molecular Weight (g/mol)	425.3	1
H	Henry's Law Constant (atm-m^3/mol)	7.5E-6	1
D_a	Diffusivity in air (cm^2/sec)	4.1E-2	1
D_w	Diffusivity in water (cm^2/sec)	8.0E-6	2
Transfer Factors			
Bv	Air-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g air])	3.5E+5	24
RCF	Root concentration factor ([µg pollutant/g plant tissue FW]/[µg pollutant/g soil water])	6.2E+4	1
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	7.1E-4	3
Ba_{beef}/Ba_{pork}	Biotransfer factor for beef (day/kg)[1]	6E-3	23
Ba_{milk}	Biotransfer factor for milk (day/kg)	1E-3	5
BCF_{chick}	Biconcentration factor for TCDD-TEQ in thigh meat (unitless)	0.22	7
BCF_{egg}	Biconcentration factor for TCDD-TEQ in eggs (unitless)	0.98	7
BSAF	Fish biota to sediment accumulation factor (unitless)	5E-3	1
Other Parameters			
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)	6.0E-1	5
Health Benchmarks			
TEQ	Toxicity Equivalency Factor	0.01	1

[1] Pork biotransfer factor set equal to beef biotransfer factor.

Table E-1.14. Chemical-Specific Inputs for HpCDF 1,2,3,4,6,7,8-

Parameter	Definition	Value	Ref
Chemical/Physical Properties			
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)	4.0E-2	1
Koc	Soil Adsorbtion Coefficient (ml/g)	4.9E+7	1
Kow	Octanol-water partition coefficient (unitless)	7.9E+7	1
VP	Vapor Pressure (atm)	1.8E-13	1
SOl	Water solubility (ml/g)	1.4E-6	1
MW	Molecular Weight (g/mol)	409.3	1
H	Henry's Law Constant (atm-m^3/mol)	5.3E-5	1
D_a	Diffusivity in air (cm^2/sec)	4.2E-2	1
D_w	Diffusivity in water (cm^2/sec)	8.0E-6	2
Transfer Factors			
Bv	Air-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g air])	4.4E+5	24
RCF	Root concentration factor ([µg pollutant/g plant tissue FW]/[µg pollutant/g soil water])	3.7E+4	1
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	1.1E-3	3
Ba_{beef}/Ba_{pork}	Biotransfer factor for beef (day/kg)[1]	6.0E-3	23
Ba_{milk}	Biotransfer factor for milk (day/kg)	1.0E-3	5
BCF_{chick}	Biconcentration factor for TCDD-TEQ in thigh meat (unitless)	0.18	7
BCF_{egg}	Biconcentration factor for TCDD-TEQ in eggs (unitless)	0.68	7
BSAF	Fish biota to sediment accumulation factor (unitless)	5E-3	1
Other Parameters			
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)	6.0E-1	5
Health Benchmarks			
TEQ	Toxicity Equivalency Factor	0.01	1

[1] Pork biotransfer factor set equal to beef biotransfer factor.

Table E-1.15. Chemical-Specific Inputs for HpCDF 1,2,3,4,7,8,9

Parameter	Definition	Value	Ref
Chemical/Physical Properties			
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)	3.0E-2	1
Koc	Soil Adsorbtion Coefficient (ml/g)	4.9E+7	1
Kow	Octanol-water partition coefficient (unitless)	7.9E+7	1
VP	Vapor Pressure (atm)	1.4E-13	1
SOl	Water solubility (ml/g)	1.4E-6	1
MW	Molecular Weight (g/mol)	409.3	1
H	Henry's Law Constant (atm-m^3/mol)	5.3E-5	1
D_a	Diffusivity in air (cm^2/sec)	4.2E-2	1
D_w	Diffusivity in water (cm^2/sec)	8.0E-6	2
Transfer Factors			
Bv	Air-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g air])	4.4E+5	24
RCF	Root concentration factor ([µg pollutant/g plant tissue FW]/[µg pollutant/g soil water])	3.7E+4	1
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	1.1E-3	3
Ba_{beef}/Ba_{pork}	Biotransfer factor for beef (day/kg)[1]	1.0E-2	23
Ba_{milk}	Biotransfer factor for milk (day/kg)	3.0E-3	5
BCF_{chick}	Biconcentration factor for TCDD-TEQ in thigh meat (unitless)	0.16	7
BCF_{egg}	Biconcentration factor for TCDD-TEQ in eggs (unitless)	0.49	7
BSAF	Fish biota to sediment accumulation factor (unitless)	5E-3	1
Other Parameters			
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)	6.0E-1	5
Health Benchmarks			
TEQ	Toxicity Equivalency Factor	0.01	1

[1] Pork biotransfer factor set equal to beef biotransfer factor.

Table E-1.16. Chemical-Specific Inputs for OCDD 1,2,3,4,5,7,8,9

Parameter	Definition	Value	Ref
Chemical/Physical Properties			
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)	2.0E-4	1
Koc	Soil Adsorbtion Coefficient (ml/g)	2.4E+7	1
Kow	Octanol-water partition coefficient (unitless)	3.9E+7	1
VP	Vapor Pressure (atm)	1.1E-15	1
SOl	Water solubility (ml/g)	7.4E-8	1
MW	Molecular Weight (g/mol)	460.8	1
H	Henry's Law Constant (atm-m^3/mol)	7.0E-9	1
D_a	Diffusivity in air (cm^2/sec)	3.9E-2	1
D_w	Diffusivity in water (cm^2/sec)	8.0E-6	2
Transfer Factors			
Bv	Air-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g air])	8.6E+6	24
RCF	Root concentration factor ([µg pollutant/g plant tissue FW]/[µg pollutant/g soil water])	2.1E+4	1
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	1.6E-3	3
Ba_{beef}/Ba_{pork}	Biotransfer factor for beef (day/kg)[1]	8.0E-3	23
Ba_{milk}	Biotransfer factor for milk (day/kg)	1.0E-3	5
BCF_{chick}	Biconcentration factor for TCDD-TEQ in thigh meat (unitless)	0.04	7
BCF_{egg}	Biconcentration factor for TCDD-TEQ in eggs (unitless)	0.47	7
BSAF	Fish biota to sediment accumulation factor (unitless)	$1x10^{-4}$	1
Other Parameters			
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)	6.0E-1	5
Health Benchmarks			
TEF	Toxicity Equivalency Factor	0.0001	1

[1] Pork biotransfer factor set equal to beef biotransfer factor.

Table E-1.17. Chemical-Specific Inputs for OCDF 1,2,3,4,6,7,8,9-

Parameter	Definition	Value	Ref
Chemical/Physical Properties			
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)	2E-3	1
Koc	Soil Adsorbtion Coefficient (ml/g)	3.9E+8	1
Kow	Octanol-water partition coefficient (unitless)	6.3E+8	1
VP	Vapor Pressure (atm)	4.9E-15	1
SOl	Water solubility (ml/g)	1.2E-6	1
MW	Molecular Weight (g/mol)	444.8	1
H	Henry's Law Constant (atm-m^3/mol)	1.9E-6	1
D_a	Diffusivity in air (cm^2/sec)	4.0E-2	1
D_w	Diffusivity in water (cm^2/sec)	8.0E-6	2
Transfer Factors			
Bv	Air-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g air])	1.3E+6	24
RCF	Root concentration factor ([µg pollutant/g plant tissue FW]/[µg pollutant/g soil water])	1.8E+5	1
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	3.2E-4	3
Ba_{beef}/Ba_{pork}	Biotransfer factor for beef (day/kg)[1]	5E-3	23
Ba_{milk}	Biotransfer factor for milk (day/kg)	1E-3	5
BCF_{chick}	Biconcentration factor for TCDD-TEQ in thigh meat (unitless)	0.07	7
BCF_{egg}	Biconcentration factor for TCDD-TEQ in eggs (unitless)	0.30	7
BSAF	Fish biota to sediment accumulation factor (unitless)	1E-4	1
Other Parameters			
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)	6.0E-1	5
Health Benchmarks			
TEQ	Toxicity Equivalency Factors	0.001	1

[1] Pork biotransfer factor set equal to beef biotransfer factor.

Table E-1.18. Chemical-Specific Inputs for Antimony

Parameter	Definition		Value	Ref
Chemical/Physical Properties				
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)		0	8
Kd_s	Soil-water partition coefficient (mL/g or L/kg)		2	9
Kd_{sw}	Suspended sediment-surface water partition coefficient (L/kg)		2	10
Kd_{bs}	Bottom sediment-sediment pore water partition coefficient (L/kg)		2	11
Transfer Factors				
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	root vegetables leafy vegetables forage / grain/ silage	0.03 0.2 0.2	12 12 12
Ba_{beef}	Biotransfer factor for beef (day/kg)		0.001	12
Ba_{milk}	Biotransfer factor for milk (day/kg)		0.0001	12
Ba_{pork}	Biotransfer factor for pork (day/kg)		0.001	13
BCF	Fish bioconcentration factor (L/kg)		0	14
BAF	Fish bioaccumulation factor (L/kg)		NA	
Other Parameters				
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)		0.2	15
Health Benchmarks				
CSF	Cancer Slope Factor (per mg/kg/day)		NA	
RfD	Reference Dose (mg/kg/day)		0.0004	16
URF	Unit Risk Factor (per µg/m^3)		NA	
RfC	Reference Concentration (mg/m^3)		NA	

Table E-1.19. Chemical-Specific Inputs for Arsenic

Parameter	Definition		Value	Ref
Chemical/Physical Properties				
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)		0	8
Kd_s	Soil-water partition coefficient (mL/g or L/kg)		29	17
Kd_{sw}	Suspended sediment-surface water partition coefficient (L/kg)		29	10
Kd_{bs}	Bottom sediment-sediment pore water partition coefficient (L/kg)		29	11
Transfer Factors				
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	root vegetables leafy vegetables forage / grain/ silage	0.008 0.036 0.06	18 18 18
Ba_{beef}	Biotransfer factor for beef (day/kg)		0.002	12
Ba_{milk}	Biotransfer factor for milk (day/kg)		0.006	12
Ba_{pork}	Biotransfer factor for pork (day/kg)		0.002	13
BCF	Fish bioconcentration factor (L/kg)		18	14
BAF	Fish bioaccumulation factor (L/kg)		NA	
Other Parameters				
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)		0.2	15
Health Benchmarks				
CSF	Cancer Slope Factor (per mg/kg/day)		1.75	16
RfD	Reference Dose (mg/kg/day)		0.0003	16
URF	Unit Risk Factor (per µg/m^3)		0.0043	16
RfC	Reference Concentration (mg/m^3)		NA	

Table E-1.20. Chemical-Specific Inputs for Barium

Parameter	Definition	Value	Ref
Chemical/Physical Properties			
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)	0	8
Kd_s	Soil-water partition coefficient (mL/g or L/kg)	8,265	25
Kd_{sw}	Suspended sediment-surface water partition coefficient (L/kg)	8,265	10
Kd_{bs}	Bottom sediment-sediment pore water partition coefficient (L/kg)	8,265	11
Transfer Factors			
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil]) — rootvegetables leafy vegetables forage / grain/ silage	0.015 0.15 0.15	12 12 12
Ba_{beef}	Biotransfer factor for beef (day/kg)	1.5e-4	12
Ba_{milk}	Biotransfer factor for milk (day/kg)	3.5e-4	12
Ba_{pork}	Biotransfer factor for milk (day/kg)	1.5e-4	13
BCF	Fish bioconcentration factor (L/kg)	NA	
BAF	Fish bioaccumulation factor (L/kg)	NA	9
Other Parameters			
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)	0.6	21
Health Benchmarks			
CSF	Cancer Slope Factor (per mg/kg/day)	NA	
RfD	Reference Dose (mg/kg/day)	0.07	16
URF	Unit Risk Factor (per µg/m^3)	NA	
RfC	Reference Concentration (mg/m^3)	0.0005	6

Table E-1.21. Chemical-Specific Inputs for Beryllium

Parameter	Definition		Value	Ref
Chemical/Physical Properties				
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)		0	8
Kd_s	Soil-water partition coefficient (mL/g or L/kg)		4,600	17
Kd_{sw}	Suspended sediment-surface water partition coefficient (L/kg)		4,600	10
Kd_{bs}	Bottom sediment-sediment pore water partition coefficient (L/kg)		4,600	11
Transfer Factors				
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	root vegetables leafy vegetables forage / silage/ grain	0.0015 0.01 0.01	12 12 12
Ba_{beef}	Biotransfer factor for beef (day/kg)		0.001	12
Ba_{milk}	Biotransfer factor for milk (day/kg)		9e-7	12
Ba_{pork}	Biotransfer factor for pork (day/kg)		0.001	13
BCF	Fish bioconcentration factor (L/kg)		95	14
BAF	Fish bioaccumulation factor (L/kg)		NA	
Other Parameters				
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)		0.6	21
Health Benchmarks				
CSF	Cancer Slope Factor (per mg/kg/day)		4.3	16
RfD	Reference Dose (mg/kg/day)		0.005	16
URF	Unit Risk Factor (per µg/m^3)		0.0024	16
RfC	Reference Concentration (mg/m^3)		NA	

Table E-1.22. Chemical-Specific Inputs for Cadmium

Parameter	Definition		Value	Ref
Chemical/Physical Properties				
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)		0	8
Kd_s	Soil-water partition coefficient (mL/g or L/kg)		120	17
Kd_{sw}	Suspended sediment-surface water partition coefficient (L/kg)		120	10
Kd_{bs}	Bottom sediment-sediment pore water partition coefficient (L/kg)		120	11
Transfer Factors				
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	root vegetables leafy vegetables forage / silage/ grain	0.064 0.36 0.14	18 18 18
Ba_{beef}	Biotransfer factor for beef (day/kg)		0.0004	5
Ba_{milk}	Biotransfer factor for milk (day/kg)		0.0001	5
Ba_{pork}	Biotransfer factor for pork (day/kg)		6e-4	5
BCF	Fish bioconcentration factor (L/kg)		32	14
BAF	Fish bioaccumulation factor (L/kg)		NA	
Other Parameters				
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)		0.6	21
Health Benchmarks				
CSF	Cancer Slope Factor (per mg/kg/day)		NA	
RfD	Reference Dose (mg/kg/day)		1e-3 soil 5e-4 water	16
URF	Unit Risk Factor (per µg/m^3)		0.0018	16
RfC	Reference Concentration (mg/m^3)		NA	

Table E-1.23. Chemical-Specific Inputs for Chromium III

Parameter	Definition		Value	Ref
Chemical/Physical Properties				
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)		0	8
Kd_s	Soil-water partition coefficient (mL/g or L/kg)		3.32E+6	26
Kd_{sw}	Suspended sediment-surface water partition coefficient (L/kg)		3.32E+6	10
Kd_{bs}	Bottom sediment-sediment pore water partition coefficient (L/kg)		3.32E+6	11
Transfer Factors				
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	root vegetables leafy vegetables forage / silage/ grain	0.0045 0.0075 0.0075	12 12 12
Ba_{beef}	Biotransfer factor for beef (day/kg)		5.5E-3	12
Ba_{milk}	Biotransfer factor for milk (day/kg)		0.0015	12
Ba_{pork}	Biotransfer factor for pork (day/kg)		5.5E-3	13
BCF	Fish bioconcentration factor (L/kg)		3	14
BAF	Fish bioaccumulation factor (L/kg)		NA	
Other Parameters				
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)		0.6	21
Health Benchmarks				
CSF	Cancer Slope Factor (per mg/kg/day)		NA	
RfD	Reference Dose (mg/kg/day)		1	16
URF	Unit Risk Factor (per µg/m^3)		NA	
RfC	Reference Concentration (mg/m^3)		NA	

Table E-1.24. Chemical-Specific Inputs for Chromium VI

Parameter	Definition		Value	Ref
Chemical/Physical Properties				
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)		0	8
Kd_s	Soil-water partition coefficient (mL/g or L/kg)		19	17
Kd_{sw}	Suspended sediment-surface water partition coefficient (L/kg)		19	10
Kd_{bs}	Bottom sediment-sediment pore water partition coefficient (L/kg)		19	11
Transfer Factors				
B_r	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	root vegetables leafy vegetables forage / silage /grain	0.0045 0.0075 0.0075	12 12 12
Ba_{beef}	Biotransfer factor for beef (day/kg)		0.0055	12
Ba_{milk}	Biotransfer factor for milk (day/kg)		0.0015	12
Ba_{pork}	Biotransfer factor for pork (day/kg)		0.0055	13
BCF	Fish bioconcentration factor (L/kg)		3	14
BAF	Fish bioaccumulation factor (L/kg)		NA	
Other Parameters				
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)		0.6	21
Health Benchmarks				
CSF	Cancer Slope Factor (per mg/kg/day)		NA	
RfD	Reference Dose (mg/kg/day)		0.005	16
URF	Unit Risk Factor (per µg/m^3)		0.012	16
RfC	Reference Concentration (mg/m^3)		NA	

Table E-1.25. Chemical-Specific Inputs for Lead

Parameter	Definition		Value	Ref
Chemical/Physical Properties				
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)		0	8
Kd_s	Soil-water partition coefficient (mL/g or L/kg)		2.8E+5	20
Kd_{sw}	Suspended sediment-surface water partition coefficient (L/kg)		2.8E+5	10
Kd_{bs}	Bottom sediment-sediment pore water partition coefficient (L/kg)		2.8E+5	11
Transfer Factors				
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	root vegetables leafy vegetables forage / silage/ grain	9.0E-3 1.3E-5 1.3E-5	12 12 12
Ba_{beef}	Biotransfer factor for beef (day/kg)		3E-4	12
Ba_{milk}	Biotransfer factor for milk (day/kg)		2.5E-4	12
Ba_{pork}	Biotransfer factor for pork (day/kg)		3e-4	13
BCF	Fish bioconcentration factor (L/kg)		NA	
BAF	Fish bioaccumulation factor (L/kg)		8	14
Other Parameters				
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)		0.6	21
Health Benchmarks				
CSF	Cancer Slope Factor (per mg/kg/day)		NA	
RfD	Reference Dose (mg/kg/day)		NA	
URF	Unit Risk Factor (per µg/m^3)		NA	
RfC	Reference Concentration (mg/m^3)		NA	

Table E-1.26. Chemical-Specific Inputs for Nickel

Parameter	Definition		Value	Ref
Chemical/Physical Properties				
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)		0	8
Kd_s	Soil-water partition coefficient (mL/g or L/kg)		21	17
Kd_{sw}	Suspended sediment-surface water partition coefficient (L/kg)		21	10
Kd_{bs}	Bottom sediment-sediment pore water partition coefficient (L/kg)		21	11
Transfer Factors				
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	root vegetables leafy vegetables forage / silage/ grain	0.008 0.032 0.11	18 18 18
Ba_{beef}	Biotransfer factor for beef (day/kg)		0.006	12
Ba_{milk}	Biotransfer factor for milk (day/kg)		0.001	12
Ba_{pork}	Biotransfer factor for pork (day/kg)		0.006	13
BCF	Fish bioconcentration factor (L/kg)		4	14
BAF	Fish bioaccumulation factor (L/kg)		NA	
Other Parameters				
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)		0.6	21
Health Benchmarks				
CSF	Cancer Slope Factor (per mg/kg/day)		NA	
RfD	Reference Dose (mg/kg/day)		0.02	16
URF	Unit Risk Factor (per µg/m^3)		2.4E-4	16
RfC	Reference Concentration (mg/m^3)		NA	

Table E-1.27. Chemical-Specific Inputs for Selenium

Parameter	Definition		Value	Ref
Chemical/Physical Properties				
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)		0	8
Kd_s	Soil-water partition coefficient (mL/g or L/kg)		5	17
Kd_{sw}	Suspended sediment-surface water partition coefficient (L/kg)		5	10
Kd_{bs}	Bottom sediment-sediment pore water partition coefficient (L/kg)		5	11
Transfer Factors				
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	root vegetables leafy vegetables forage/ silage/ grain	0.022 0.016 0.006	18
Ba_{beef}	Biotransfer factor for beef (day/kg)		0.0076	5
Ba_{milk}	Biotransfer factor for milk (day/kg)		0.0451	5
Ba_{pork}	Biotransfer factor for pork (day/kg)		0.63	5
BCF	Fish bioconcentration factor (L/kg)		88	14
BAF	Fish bioaccumulation factor (L/kg)		NA	
Other Parameters				
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)		0.2	15
Health Benchmarks				
CSF	Cancer Slope Factor (per mg/kg/day)		NA	
RfD	Reference Dose (mg/kg/day)		0.005	16
URF	Unit Risk Factor (per µg/m^3)		NA	
RfC	Reference Concentration (mg/m^3)		NA	

Table E-1.28. Chemical-Specific Inputs for Silver

Parameter	Definition		Value	Ref
Chemical/Physical Properties				
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)		0	8
Kd_s	Soil-water partition coefficient (mL/g or L/kg)		0.4	9
Kd_{sw}	Suspended sediment-surface water partition coefficient (L/kg)		0.4	10
Kd_{bs}	Bottom sediment-sediment pore water partition coefficient (L/kg)		0.4	11
Transfer Factors				
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	root vegetables leafy vegetables forage/ silage/ grain	0.1 0.4 0.4	12 12 12
Ba_{beef}	Biotransfer factor for beef (day/kg)		0.003	12
Ba_{milk}	Biotransfer factor for milk (day/kg)		0.02	12
Ba_{pork}	Biotransfer factor for pork (day/kg)		0.003	13
BCF	Fish bioconcentration factor (L/kg)		0	14
BAF	Fish bioaccumulation factor (L/kg)		NA	
Other Parameters				
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)		0.6	21
Health Benchmarks				
CSF	Cancer Slope Factor (per mg/kg/day)		NA	
RfD	Reference Dose (mg/kg/day)		0.005	16
URF	Unit Risk Factor (per µg/m^3)		NA	
RfC	Reference Concentration (mg/m^3)		NA	

Table E-1.29. Chemical-Specific Inputs for Thallium (I)

Parameter	Definition		Value	Ref
Chemical/Physical Properties				
Fv	Fraction of pollutant air concentration present in the vapor phase (dimensionless)		0	8
Kd_s	Soil-water partition coefficient (mL/g or L/kg)		71	17
Kd_{sw}	Suspended sediment-surface water partition coefficient (L/kg)		71	10
Kd_{bs}	Bottom sediment-sediment pore water partition coefficient (L/kg)		71	11
Transfer Factors				
Br	Soil-to-plant biotransfer factor ([µg pollutant/g plant tissue DW]/[µg pollutant/g soil])	root vegetables leafy vegetables forag/ silage/ grain	0.0004 0.004 0.004	12 12 12
Ba_{beef}	Biotransfer factor for beef (day/kg)		0.04	12
Ba_{milk}	Biotransfer factor for milk (day/kg)		0.002	12
Ba_{pork}	Biotransfer factor for pork (day/kg)		0.04	13
BCF	Fish bioconcentration factor (L/kg)		67	14
BAF	Fish bioaccumulation factor (L/kg)		NA	
Other Parameters				
Fw	Fraction of wet deposition that adheres to plant surfaces (dimensionless)		0.6	21
Health Benchmarks				
CSF	Cancer Slope Factor (per mg/kg/day)		NA	
RfD	Reference Dose (mg/kg/day)		8E-5	19
URF	Unit Risk Factor (per µg/m^3)		NA	
RfC	Reference Concentration (mg/m^3)		NA	

Table E-1.30. Data Sources for Chemical-Specific Parameters

Reference numbers refer to references shown in chemical specific input tables (E-1.1 through E-1.30)

1. U.S. EPA. 1994. *Estimating Exposure to Dioxin-like Compounds. Volume II. Properties, Sources, Occurrences, and Background Exposures - Draft.* EPA/600/6-88/005Cb Office of Research and Development, Washington, DC. and U.S. EPA. 1994. *Estimating Exposure to Dioxin-like Compounds. Volumes III. Site-Specific Assessment Procedures - Draft.* EPA/600/6-88/005Cc. Office of Research and Development, Washington, DC.

2. Default value. U.S. EPA. 1994. *User's Guide for Wastewater Treatment Compound Property Processor and Air Emissions Estimator (WATER8).* EPA-453/C-94-080c. Office of Air Quality Planning and Standards, RTP, NC.

3. Calculated from an equation in Travis, C.C. and A.D. Arms. 1988. Bioconcentration of organics in beef, milk, and vegetation. *Environmental Science and Technology*, 22:271-274.

$$\log(Br) = 1.588 - 0.578 \log K_{ow}$$

where
Br = soil to plant biotransfer factor ([µg/g DW plant]/[µg/g soil])
K_{ow} = octanol water partition coefficient (unitless) - (see table A1-27)

4. No BCFs for these chemical are presented in Stephens, et. al. (1992) due to low concentration of these isomers. Values for these chemicals are taken from the most structurally similar isomer listed in the reference.

5. U.S. EPA. 1995. *Further Issues for Modeling the Indirect Exposure Impacts for Combustor Emissions.* Memorandum form M. Lorber and G. Rice, Office of Research and Development, Washington, DC. January 20, 1995.

6. U.S. EPA. 1993. *Health Effects Assessment Summary Tables. Annual Update.* Office of Emergency and Remedial Response. Washington, D.C. March.

7. Stephens, R.D., Petras, M.X., and Hayward, D.G. 1992. Biotransfer and bioaccumulation of dioxins and dibenzofurans from soil. *12 th International Symposium on Dioxins and Related Compounds.* University of Tampere, Tampere, Finland.

8. Constituent is a nonvolatile metal, therefore, it is assumed to be 100% in the particulate phase and 0% in the vapor phase.

9. Strenge, D.L., and S.R. Peterson. 1989. *Chemical Data Bases for the Multimedia Environmental Pollutant Assessment System (MEPAS): Version I.* Prepared by Pacific Northwest Laboratory for the U.S. Department of Energy.

10. Set equal to Kd_s. For organics, the Kd values for soil and suspended sediments differs due to differing level of organic carbon in soil versus suspended sediments. However, metals are not thought to be affected by organic carbon; therefore, the Kd values are the same.

11. Set equal to Kd_s. For organics, the Kd values for soil and bottom sediments differs due to differing level of organic carbon in soil versus bottom sediments. However, metals are not thought to be affected by organic carbon; therefore, the Kd values are the same.

12. Baes, C.F., R.D. Sharp, A.L. Sjoreen, and R.W. Shor. 1984. *Review and Analysis of Parameters and Assessing Transport of Environmentally Released Radionuclides Through Agriculture.* Oak Ridge National Laboratory, Oak Ridge, Tennessee.

13. The pork biotransfer factor was assumed to equal the biotransfer factor for beef because no biotransfer factor for pork was available for this chemical.

14. U.S. EPA Region IV. 1992. *TSC1292 Criteria Chart.* Water Management Division, 304(a) Criteria and Related Information for Toxic Pollutants. December.

15. Derived from data in Hoffman, F.O., K.M. Thiessen, M.L. Frank, and B.G. Blaylock. 1992. Quantification of the interception and initial retention of radioactive contaminants deposited on pasture grass by simulated rain. *Atmospheric Environment* 26A(18):3313-3321. Hoffman et al. present experimental values of what they term "interception fraction" which corresponds in the methodology used here to the product of Rp and Fw. Fw values were estimated from the Hoffmann et al. values by dividing by an Rp of 0.47 for forage. The values used here apply to anions and correspond to moderate rainfall.

16. U.S. EPA. 1995. *Integrated Risk Information System.* Duluth, MN.

17. U.S. EPA. 1994. *Technical Background Document for Soil Screening Guidance. Review Draft.* EPA/540/R-94/102. Office of Solid Waste and Emergency Response, Washington, DC.

18. U.S. EPA. 1992. *Technical Support Document for Land Application of Sewage Sludge, Volume I and II.* Office of Water, Washington, DC. EPA 822/R-93-001a.

19. U.S. EPA. 1995. *Integrated Risk Information System.* Based on values for thallium salts; 3 salts have RfDs of 8e-5, while 3 others have RfDs of 9e-5. The more conservative (lower) value was chosen to represent thallium.

20. Calculated for neutral pH conditions from an equation from U.S. EPA. 1991. *Background Document for Finite Source Methodology for Wastes Containing Metals.* HWEP-S0040. Office of Solid Waste, Washington, DC.

$$\log Kd = 0.11 pH + 1.102$$

where
Kd = soil-water partition coefficient (mL/g)
pH = soil pH, assumed to be 7 (neutral conditions)

21. Derived from data in Hoffman, F.O., K.M. Thiessen, M.L. Frank, and B.G. Blaylock. 1992. Quantification of the interception and initial retention of radioactive contaminants deposited on pasture grass by simulated rain. *Atmospheric Environment* 26A(18):3313-3321. Hoffman et al. present experimental values of what they term "interception fraction" which corresponds in the methodology used here to the product of Rp and Fw. Fw values were estimated from the Hoffman et al. values by dividing by an Rp of 0.47 for forage. The values used here apply to cations and correspond to moderate rainfall.

22. U.S. EPA. 1992. *Technical Support Document for Land Application of Sewage Sludge. Volume I.* Office of Water. Washington, DC.

23. The Ba_{beef} for dioxin congeners was calculated from the Ba_{milk} and the ratio of percent beef fat to percent milk fat. Therefore, the biotransfer factor for beef is 5.4 times higher than for milk.
U.S. EPA. 1995. *Further Issues for Modeling the Indirect Exposure Impacts for Combustor Emissions.* Memorandum from M. Lorber and G. Rice, Office of Research and Development, Washington, DC.

January 20, 1995. The Ba_{pork} was assumed to be the same as the Ba_{beef}.

24. Lorber, M. 1995. Development of air-to-leaf vapor phase transfer factor for dioxins and furans. *Organohalogen Compounds*. 24: 179-186.

25. The value for K_{ds} for barium was taken from the average of the range of K_{ds} from literature (530 to 16,000 l/kg for a pH range of 5 to 9) as given in U.S. EPA. 1994. *Technical Background Document for Soil Screening Guidance*. *Review Draft*. EPA/540/R-94/102. Office of Solid Waste and Emergency Response, Washington, DC. This value differs from the predicted value given in Table 5-15 of that document.

26. RTI (Research Triangle Institute). 1994. *Chemical Properties for Soil Screening Levels*. Research Triangle Park, NC.

Table E-2.1. Data Sources for Fate and Transport Equations

Parameter	Definition	Value	Derivation
	Soil Concentration		
Z	Soil mixing depth for soil ingestion (cm)	1	Reflects untilled soil. *Addendum* (U.S. EPA, 1993)
BD	Soil bulk density (g/cm^3)	1.5	Based on mean for loam soil from Carsel et al. (1988). Also recommended as center of range of values in *Addendum* (U.S. EPA, 1993).
f_{oc}	Fraction of organic carbon in soil (unitless)	0.01	*Addendum* (U.S. EPA, 1993)
Vdv	Dry deposition velocity of vapors (cm/sec)	0.2	The value for dioxins were taken from Koester and Hites, 1992. Dry deposition velocity was not used for the metals because they were considered to be nonvolatile.
θ_s	Soil volumetric water content (mL/cm^3)	0.2	*Addendum* (U.S. EPA, 1993)
R	Universal Gas Constant (atm-m^3/mol-K)	8.205e-5	Standard value
μ_a	Viscosity of air (g/cm-sec)	1.81e-4	*CRC Handbook* (Weast, 1979). Taken at standard conditions (temperature = 20 °C, pressure = 1 atm or 760 mm Hg).
ρ_a	Density of air (g/cm^3)	0.0012	*CRC Handbook* (Weast, 1979). Taken at standard conditions (temperature = 20 °C, pressure = 1 atm or 760 mm Hg).

Table E-2.1. Data Sources for Fate and Transport Equations

Parameter	Definition	Value	Derivation
Terrestrial Food Chain			
Z	Soil mixing depth (cm)	20 tilled 1 untilled	Reflects tilled soil. *Addendum* (U.S. EPA, 1993); Used in calculating concentrations in root vegetables and aboveground produce consumed by humans and in silage and grain consumed by livestock. Reflects untilled soil. *Addendum* (U.S. EPA, 1993); Used in calculating concentrations in forage and soil which is then consumed by livestock
kp	Plant surface loss coefficient (yr^{-1})	18	Corresponds to a half-life of 14 days, and reflects physical processes only, no chemical degradation. *Addendum* (U.S. EPA, 1993)
Tp	Length of the plant's exposure to deposition per harvest (yrs)	0.12 forage 0.16 other	*Indirect Exposure Document* (U.S. EPA, 1990b). 45 days; based on the average of average period between successive hay harvests (60 days) and average period between successive grazing (30 days) in Belcher and Travis (1989). Used in calculating concentration in forage feed to cattle. *Indirect Exposure Document* (U.S. EPA, 1990b). 60 days; based on average period between successive hay harvests in Belcher and Travis (1989). Used in calculating concentration in aboveground produce and root vegetables consumed by humans and silage consumed by animals

Table E-2.1. Data Sources for Fate and Transport Equations

Parameter	Definition	Value	Derivation
Yp	Yield or standing crop biomass aboveground fruits and vegetables (kg DW/m^2)	1.6	The value for Yp was calculated from data in Rice (1994a). Yp may be estimated from dry harvest yield (Yh) and area harvested (Ah): $$Yp \approx \frac{Yh}{Ah}$$ Here, Yp was estimated for fruits, fruiting vegetables, legumes, and leafy vegetables using U.S. average Yh and Ah values for a variety of fruits and vegetables for 1993; Yh values were converted to dry weight using average conversion factors for fruits, fruiting vegetables, legumes, and leafy vegetables. The following fruits and vegetables were included in each category: Fruits: apple, apricot, berry, cherry, cranberry, grape, peach, pear, plum/prune, strawberry Fr. veg: asparagus, cucumber, eggplant, sweet pepper, tomato Legumes: snap beans Leafy: broccoli, brussels sprout, cabbage, cauliflower, celery, lettuce, and spinach The calculated Yp values for fruits, fruiting vegetables, legumes, and leafy vegetables were then weighted by relative ingestion of each group to determine the weighted average Yp given here. Unweighted Yp (kg DW/m^2) and the ingestion rates (kg DW/day) used for weighing were as follows: Yp Intake Fruits 2.5e-6 13.2 Fr. veg. 10.5 4.2 Leafy 0.34 2.0 Legume 0.075 8.8 The ingestion rate for fruits was based on a whole weight intake of 88 g/day from the *Dioxin Document* (U.S. EPA, 1994b) and an average whole-weight to dry-weight conversion factor for fruits (excluding plums/prunes, which had an extreme value) of 0.15 from Rice (1994a).

Table E-2.1. Data Sources for Fate and Transport Equations

Parameter	Definition	Value	Derivation
Terrestrial Food Chain			
Yp	Yield or standing crop biomass (kg DW/m^2)	0.24 forage 0.8 silage	Weighted average of crop yields for pasture grass (forage) and hay. Weights were based on the fraction of a year cattle could be pastured; the weights used here were 0.75 for pasture grass and 0.25 for hay, based on 9 months/year in pasture and 3 months per year not in pasture (and fed hay). Unweighted Yp values were 0.15 kg DW/m^2 for pasture grass (*Dioxin Document*, U.S. EPA, 1994b) and 0.5 for hay. The Yp for hay was estimated from dry harvest yield (Yh) and area harvested (Ah) (Rice, 1994a): $$Yp \approx \frac{Yh}{Ah}$$ Yh = 1.22e+11 kg DW: U.S. average Yh for hay for 1993 is 1.35e+11 kg (Rice, G., 1994a); this is converted to dry weight using a conversion factor of 0.9 (Rice, 1994a). Ah = 2.45e+11 m^2: U.S. average Ah for hay for 1993 (Rice, 1994a) Production weighted U.S. average for silage (Rice, 1994a). Crop yield for grains was not used because it was considered a protected species.

Table E-2.1. Data Sources for Fate and Transport Equations

Parameter	Definition	Value	Derivation
Rp	Interception fraction for aboveground fruits and vegetables (dimensionless)	0.05	Calculated (Rice, 1994a): $$Rp = 1 - e^{-\gamma \cdot Yp}$$ γ = empirical constant; 0.0846 for leafy vegetables; 0.0324 for fruits, fruiting vegetables, and legumes. Yp = estimated as shown above for fruits, fruiting vegetables, legumes, and leafy vegetables. The following fruits and vegetables were included in each category: Fruits: apple, apricot, berry, cherry, cranberry, grape, peach, pear, plum/prune, strawberry Fr. veg: asparagus, cucumber, eggplant, sweet pepper, tomato Legumes: snap beans Leafy: broccoli, brussels sprout, cabbage, cauliflower, celery, lettuce, and spinach The calculated Rp values for fruits, fruiting vegetables, legumes, and leafy vegetables were then weighted by relative ingestion of each group to determine the weighted average Rp given here. Unweighted Rp and the ingestion rates (kg DW/day) used for weighing were as follows: Rp / Intake Fruits 7.9e-8 / 13.2 Fr. veg. 0.29 / 4.2 Leafy 0.028 / 2.0 Legume 0.0024 / 8.8 The ingestion rate for fruits was based on a whole weight intake of 88 g/day from the *Dioxin document* (U.S. EPA, 1994b) and an average whole-weight to dry-weight conversion factor for fruits (excluding plums/prunes, which had an extreme value) of 0.15 from Rice, (1994a). The rest of the ingestion rates were presented as dry weight in U.S. EPA, 1992a.

Table E-2.1. Data Sources for Fate and Transport Equations

Parameter	Definition	Value	Derivation
Terrestrial Food Chain			
Rp	Interception fraction (dimensionless)	0.5 forage 0.46 silage	Calculated (Chamberlain, 1970): $$Rp = 1 - e^{-\gamma \cdot Yp}$$ γ = empirical constant; Chamberlain (1970) gives range as 2.3-3.33; the midpoint of the range, 2.88 is used (Baes et al., 1984) Yp = 0.24 kg DW/m^2 (see above) Calculated from Yp of 0.8 for silage Interception fractions were not used for grains because it was considered a protected species.
VG_{ag}	Empirical correction factor that reduces produce concentration because Bv was developed for azalea leaves	varies	For dioxins, the VG_{ag} was assumed to be 0.01 for fruits and fruiting vegetables. For leafy vegetables and forage, VG_{ag} was assumed to equal 1. *Dioxin document* (U.S. EPA, 1994b). The VG_{ag} was assumed to be 0.5 for silage. The VG_{ag} was not used for grains because it was considered a protected species.
VG_{bg}	Empirical correction factor that reduces produce concentration	0.01 dioxins 1.0 metals	For dioxins, the VG_{bg} was assumed to be 0.01 for root vegetables. *Dioxin document* (U.S. EPA, 1994b). For metals, the VG_{bg} was assumed to be 1.0. *Addendum* (U.S. EPA, 1993)

Table E-2.1. Data Sources for Fate and Transport Equations

Parameter	Definition	Value	Derivation
Terrestrial Food Chain			
Qp	Quantity of plant matter eaten by cattle (kg plant tissue DW/day		
	Subsistence Beef Farmer	8.8 forage 0.47 grain 2.5 silage	Forage intake = 75% of total dry matter intake (DMI) for beef cattle on subsistence farms (i.e., unsupplemented) (Rice, 1994b) Grain intake = 3.9% of total dry matter intake (DMI) for beef cattle on subsistence farms (i.e., unsupplemented) Silage intake = 21% of total dry matter intake (DMI) for beef cattle on subsistence farms (i.e., unsupplemented) DMI = 2% of body weight for beef cattle (Rice, 1994b) Average body weight for beef cattle = 590 kg (Rice, 1994b)
	Typical Beef Farmer	3.8 forage 3.8 grain 1.0 silage	(Rice, 1994b). Values here include grain supplement during growing phase for beef cattle.
	Subsistence Dairy Farmer	13.2 forage 3.0 grain 4.1 silage	Forage intake = 65% of total dry matter intake (DMI) for dairy cattle on subsistence farms (Rice, 1994b) Grain intake = 15% of total dry matter intake (DMI) for dairy cattle on subsistence farms Silage intake = 20% of total dry matter intake (DMI) for dairy cattle on subsistence farms DMI = 3.2% of body weight for dairy cattle (Rice, 1994b) Average body weight for dairy cattle = 630 kg (Rice, 1994b)
	Typical Dairy Farmer	6.2 forage 12.2 grain 1.9 silage	Taken from Rice, (1994b)

Table E-2.1. Data Sources for Fate and Transport Equations

Parameter	Definition	Value	Derivation
Terrestrial Food Chain			
Qs	Quantity of soil eaten by cattle (kg soil/day)		
	Subsistence Beef Farmer	0.5	Soil intake = 4% of DMI for beef cattle on subsistence farms (Rice, 1994b) DMI = 2% of body weight (Rice, 1994b) Average body weight for beef cattle = 590 kg (Rice, 1994b)
	Typical Beef Farmer	0.25	(Rice, 1994b)
	Subsistence Dairy Farmer	0.4	Soil intake = 2% of DMI for dairy cattle on subsistence farms (Rice, 1994b) DMI = 3.2% of body weight (Rice, 1994b) Average body weight for dairy cattle = 630 kg (Rice, 1994b)
	Typical Dairy Farmer	0.2	(Rice, 1994b)

Table E-2.1. Data Sources for Fate and Transport Equations

Parameter	Definition	Value	Derivation
Terrestrial Food Chain			
Qp	Quantity of plant matter eaten by hog (kg plant tissue DW/day)	3.0 grain 1.3 silage	Grain intake = 70% of average daily intake *Indirect Exposure Document* (U.S. EPA, 1990b). Silage intake = 30% of average daily intake *Indirect Exposure Document* (U.S. EPA, 1990b). Hogs are not grazing animals and are not assumed to eat forage.
Qs	Quantity of soil eaten by hogs (kg soil /day)	0.37	Soil intake = 8% of DMI for hogs - *Addendum* (U.S. EPA, 1993)
F_d	Fraction of chicken diet that is soil (unitless)	0.1	Biotransfer factors for poultry were calculated for chickens consuming 10% of their diet as contaminated soil. (Stephens et al. 1992). Only chickens raised by subsistence poultry farmers were assumed to eat soil. These chickens consumed no contaminated grain. Chickens raised by the typical farmer were assumed to consume no contaminated soil. However, all the grain consumed by these chickens was assumed to be contaminated. No consumption rate of soil or grain is used in the calculation of dioxin concentration in poultry because the bioconcentration factor for poultry is unitless.

Table E-2.1. Data Sources for Fate and Transport Equations

Parameter	Definition	Value	Derivation
Aquatic Food Chain			
Z	Soil mixing depth for watershed (cm)	1	Reflects untilled soil. *Addendum* (U.S. EPA, 1993)
ER	Soil enrichment ratio (unitless)	3	Applies to organics only; value should be 1 for metals. *Addendum* (U.S. EPA, 1993).
T_w (also T_k)	Waterbody temperature (K)	298	Assumption; equals 25 °C.
K	USLE erodability factor (ton/acre)	0.36	Based on 1% organic matter. Droppo et al. (1989). Value was chosen to be representative of a whole watershed, not just an agricultural field.
LS	USLE length-slope factor (unitless)	1.5	Reflects a variety of possible distance and slope conditions. *Superfund Exposure Assessment Manual* (U.S. EPA, 1988a) Value was chosen to be representative of a whole watershed, not just an agricultural field.
C	USLE cover management factor (unitless)	0.1	Values up to 0.1 reflect dense vegetative cover, as pasture grass; values from 0.1 to 0.7 reflect agricultural row crops; a value of 1 reflects bare soil. Value of 0.1 selected to cover both grass or agricultural crops. *Addendum* (U.S. EPA, 1993) Value was chosen to be representative of a whole watershed, not just an agricultural field.
P	USLE supporting practice factor (unitless)	1	Represents no erosion/runoff control measures. *Addendum* (U.S. EPA, 1993)
b	Empirical slope coefficient for sediment delivery ratio calculation	0.125	*Addendum* (U.S. EPA, 1993)

Table E-2.1. Data Sources for Fate and Transport Equations

Parameter	Definition	Value	Derivation
Aquatic Food Chain			
a	Empirical intercept coefficient for sediment delivery ratio calculation	0.6-2.1	Depends on watershed area; values are as follows *Addendum* (U.S. EPA, 1993): (Note 1 sq. mile = 2.59x10^6 m^2) Watershed Area (sq. miles) — a ≤ 0.1 — 2.1 1 — 1.9 10 — 1.4 100 — 1.2 1,000 — 0.6
d_b	Depth of the upper benthic layer (m)	0.03	Based on center of range given in *Addendum* (U.S. EPA, 1993)
TSS	Total suspended solids (mg/L)	10	*Addendum* (U.S. EPA, 1993)
BS	Bed sediment concentration (g/cm^3)	1	*Addendum* (U.S. EPA, 1993)
θ_{bs}	Bed sediment porosity (L_{water}/L)	0.6	Calculated from bed sediment concentration (BS = 1, see above) and solids density (ρ_s = 2.65 g/cm^3) as follows *Addendum* (U.S. EPA, 1993): $\theta_{bs} = 1 - \frac{BS}{\rho_s}$
θ	Temperature correction factor (unitless)	1.026	*Addendum* (U.S. EPA, 1993).
C_d	Drag coefficient (unitless)	0.0011	*Addendum* (U.S. EPA, 1993).

Table E-2.1. Data Sources for Fate and Transport Equations

Parameter	Definition	Value	Derivation
Aquatic Food Chain			
ρ_w	Density of water (g/cm^3)	1	*CRC Handbook* (Weast, 1979).
k	von Karman's constant	0.4	*Addendum* (U.S. EPA, 1993).
μ_w	Viscosity of water (g/cm-sec)	1.69e-2	*CRC Handbook* (Weast, 1979).
λ_2	Dimensionless viscous sublayer thickness (unitless)	4	*Addendum* (U.S. EPA, 1993).
f_{lipid}	Fish lipid content (fraction)	0.07	Cook et al. (1991); value used in *Dioxin document* (U.S. EPA, 1994b)
OC_{ss}	Fraction of organic carbon in suspended solids (unitless)	0.075	Corresponds roughly to a surface soil fraction organic carbon of 0.01. Midpoint of range given in *Addendum* (U.S. EPA, 1993).
OC_{sed}	Fraction organic carbon in bottom sediment (unitless)	0.04	Corresponds roughly to a surface soil fraction organic carbon of 0.01. Midpoint of range given in *Addendum* (U.S. EPA, 1993).

Table E-2.1. Data Sources for Fate and Transport Equations

Parameter	Definition	Value	Derivation
Breast Milk Exposure for Dioxins			
h	Half-life of dioxin in adults (days)	2555	*Dioxin document* (U.S. EPA, 1994a)
f_1	Proportion of ingested dioxin that is stored in fat (unitless)	0.9	*Dioxin document* (U.S. EPA, 1994a)
f_2	Proportion of mother's weight that is fat (unitless)	0.3	*Dioxin document* (U.S. EPA, 1994a)
f_3	Fraction of fat in breastmilk (unitless)	0.04	*Dioxin document* (U.S. EPA, 1994a)
f_4	Fraction ingested contaminant which is adsorbed (unitless)	0.9	*Dioxin document* (U.S. EPA, 1994a)

Table E-3.1. Intake Rates and Other Exposure Factors Applicable for All Cases

Parameter	Exposure Factor		Reference
Inhalation of Air			
Intake rate of air (m^3/d)	adult child	20 12	U.S. EPA, 1990a
Ingestion of Drinking Water			
Intake of drinking water (L/d)	adult child	1.4 0.5	U.S. EPA, 1990a
Ingestion of Soil			
Intake of soil (g/d)	adult child	0.1 0.2	U.S. EPA, 1990a
Ingestion of Produce			
Intake of root vegetables (g whole weight/d)	adult child	28 40	Adult: U.S. EPA, 1990a and U.S. EPA, 1994b Child: U.S. EPA, 1994c
Intake aboveground produce (g DW/d)	adult child	19.7 14	Adult: U.S. EPA, 1990a and U.S. EPA, 1994b Child: U.S. EPA, 1994c

Table E-3.1. Intake Rates and Other Exposure Factors Applicable for All Cases

Parameter	Exposure Factor		Reference
Ingestion of Animal Products			
Intake of beef (g FW/d)[1]	adult child	57 32	U.S.D.A., 1993
Intake of milk (g FW/d)[1]	adult child	181 353	U.S.D.A., 1993
Intake of pork (g FW/d)[1]	adult child	17 9	U.S.D.A., 1993
Intake of chicken (g FW/d)	adult child	34 17	U.S.D.A., 1993
Intake of eggs (g FW/d)	adult child	23 11	U.S.D.A., 1993
Ingestion of Fish			
Intake of fish (g/d)	Subsistence fisher Recreational fisher Other adults Child	60 30 1.64 0.35	Columbia River, 1994 Murray and Burmaster, 1994 and FIMS, 1993 U.S.D.A., 1978 Calculated from adult consumption based on bodyweight
Ingestion of Breastmilk by the Infant			
Ingestion rate of breastmilk (kg/d)	0.8		U.S. EPA, 1994a

1 For cadmium and selenium, these consumption rates have to be multiplied by dry weight conversion factors before being used to calculate individual hazard quotients. The conversion factors are 0.4 and 0.1 for beef and milk, respectively (U.S. EPA,1995a). The conversion factor for pork is assumed to equal that for beef.

Table E-3.1. Intake Rates and Other Exposure Factors Applicable for All Cases

Parameter	Exposure Factor			Reference
Miscellaneous				
Average body weight (kg)	adult child infant	70 15 10		U.S. EPA, 1990a U.S. EPA, 1990a U.S. EPA, 1994a
Lifetime/averaging time for carcinogens (yr)	70			Standard Value
Exposure frequency (d/yr)	350			U.S. EPA, 1991b
Exposure duration (yr)		Central Tendency	High End	
	farmers others child infant	20 9 6 1	40 30 6 1	Assumption U.S., EPA 1990a U.S. EPA, 1990a U.S. EPA, 1994b

Table E-3.2. Contaminated Fraction Based on Economic Analysis of Regional Capacity

Descriptions		Central Tendency	High End Contaminated Fraction
CASE A - LOUISIANA			
fraction beef contaminated	Subsistence beef farmer Other scenarios	1 0.01	1 0.01
fraction dairy contaminated	Subsistence dairy farmer **Typical farmer** Other scenarios	1 **0.60** 0.34	1 **0.84** 0.34
fraction produce contaminated	Subsistence scenarios Typical farmer and home gardener Other scenarios	1 0.27 0.03	1 0.42 0.03
fraction fish contaminated	Subsistence & Recreational Fisher Other scenarios	1 0.01	1 0.01
fraction of pork contaminated	Subsistence pork farmer Other scenarios	1 0.01	1 0.01
fraction of poultry and eggs contaminated	Subsistence poultry farmer Other scenarios	1 0.01	1 0.01
CASE B - SOUTH CAROLINA			
fraction beef contaminated	Subsistence beef farmer Other scenarios	1 0.01	1 0.01
fraction dairy contaminated	Subsistence dairy farmer Other scenarios	1 0.20	1 0.20
fraction produce contaminated	Subsistence scenarios Typical farmer and home gardener Other scenarios	1 0.43 0.24	1 0.54 0.24
fraction fish contaminated	Subsistence & recreational fisher Other scenarios	1 0.01	1 0.01
fraction of pork contaminated	Subsistence pork farmer **Typical farmer** Other scenarios	1 **0.47** 0.06	1 **0.77** 0.06
fraction of poultry and eggs contaminated	Subsistence poultry farmer Other scenarios	1 0.01	1 0.01

Table E-3.2. Contaminated Fraction Based on Economic Analysis of Regional Capacity

Descriptions		Central Tendency	High End Contaminated Fraction
CASE C - INDIANA			
fraction beef contaminated	Subsistence beef farmer Other scenarios	1 0.01	1 0.01
fraction dairy contaminated	Subsistence dairy farmer Other scenarios	1 0.14	1 0.14
fraction produce contaminated	Subsistence scenarios Typical farmer and home gardener Other scenarios	1 0.27 0.02	1 0.41 0.02
fraction fish contaminated	Subsistence & recreational fisher Other scenarios	1 0.01	1 0.01
fraction of pork contaminated	Subsistence pork farmer **Typical farmer** Other scenarios	1 **1** 1	1 **1** 1
fraction of poultry and eggs contaminated	Subsistence poultry farmer Other scenarios	1 0.01	1 0.01
CASE D - KANSAS			
fraction beef contaminated	Subsistence beef farmer **Typical farmer** Other scenarios	1 **0.45** 0.01	1 **0.75** 0.01
fraction dairy contaminated	Subsistence dairy farmer Other scenarios	1 0.01	1 0.01
fraction produce contaminated	Subsistence scenarios Typical farmer and home gardener Other scenarios	1 0.26 0.01	1 0.41 0.01
fraction fish contaminated	Subsistence & recreational fisher Other scenarios	1 0.01	1 0.01
fraction of pork contaminated	Subsistence pork farmer Other scenarios	1 0.01	1 0.01
fraction of poultry and eggs contaminated	Subsistence poultry farmer Other scenarios	1 0.01	1 0.01

Table E-3.2. Contaminated Fraction Based on Economic Analysis of Regional Capacity

Descriptions		Central Tendency	High End Contaminated Fraction
CASE E - MINNESOTA			
fraction beef contaminated	Subsistence beef farmer Other scenarios	1 0.24	1 0.24
fraction dairy contaminated	Subsistence dairy farmer	1	1
	Typical farmer	**1**	**1**
	Other scenarios	1	1
fraction produce contaminated	Subsistence scenarios Typical farmer and home gardener Other scenarios	1 0.34 0.12	1 0.472 0.12
fraction fish contaminated	Subsistence & recreational fisher Other scenarios	1 0.01	1 0.01
fraction of pork contaminated	Subsistence pork farmer Other scenarios	1 0.01	1 0.01
fraction of poultry and eggs contaminated	Subsistence poultry farmer Other scenarios	1 0.01	1 0.01
CASE F - MICHIGAN			
fraction beef contaminated	Subsistence beef farmer Other scenarios	1 0.01	1 0.01
fraction dairy contaminated	Subsistence dairy farmer	1	1
	Typical farmer	**0.41**	**0.75**
	Other scenarios	0.01	0.01
fraction produce contaminated	Subsistence scenarios Typical farmer and home gardener Other scenarios	1 0.26 0.01	1 0.41 0.1
fraction fish contaminated	Subsistence & recreational fisher Other scenarios	1 0.01	1 0.01
fraction of pork contaminated	Subsistence pork farmer Other scenarios	1 0.01	1 0.12
fraction of poultry and eggs contaminated	Subsistence poultry farmer Other scenarios	1 0.01	1 0.01

Table E-3.2. Contaminated Fraction Based on Economic Analysis of Regional Capacity

Descriptions		Central Tendency	High End Contaminated Fraction
CASE G - TEXAS			
fraction beef contaminated	Subsistence beef farmer Other scenarios	1 0.01	1 0.01
fraction dairy contaminated	Subsistence dairy farmer Other scenarios	1 0.05	1 0.05
fraction produce contaminated	Subsistence scenario Typical farmer and home gardener Other scenarios	1 0.27 0.02	1 0.41 0.02
fraction fish contaminated	Subsistence & recreational fisher Other scenarios	1 0.01	1 0.01
fraction of pork contaminated	Subsistence pork farmer Other scenarios	1 0.01	1 0.01
fraction of poultry and eggs contaminated	Subsistence poultry farmer Other scenarios	1 0.01	1 0.01
CASE H - PENNSYLVANIA			
fraction beef contaminated	Subsistence beef farmer Other scenarios	1 0.08	1 0.08
fraction dairy contaminated	Subsistence dairy farmer **Typical farmer** Other scenarios	1 **0.83** 0.71	1 **0.93** 0.71
fraction produce contaminated	Subsistence scenarios Typical farmer and home gardener Other scenarios	1 0.42 0.23	1 0.54 0.23
fraction fish contaminated	Subsistence & recreational fisher Other scenarios	1 0.01	1 0.01
fraction of pork contaminated	Subsistence pork farmer Other scenarios	1 0.2	1 0.2
fraction of poultry and eggs contaminated	Subsistence poultry farmer Other scenarios	1 0.01	1 0.1

Table E-3.2. Contaminated Fraction Based on Economic Analysis of Regional Capacity

Descriptions		Central Tendency	High End Contaminated Fraction
CASE I -CALIFORNIA			
fraction beef contaminated	Subsistence beef farmer Other scenarios	1 0.01	1 0.01
fraction dairy contaminated	Subsistence dairy farmer Other scenarios	1 0.31	1 0.31
fraction produce contaminated	Subsistence scenarios	1	1
	Typical farmer and home gardener	**1**	**1**
	Other scenarios	1	1
fraction fish contaminated	Subsistence & recreational fisher Other scenarios	1 0.01	1 0.01
fraction of pork contaminated	Subsistence pork farmer Other scenarios	1 0.01	1 0.01
fraction of poultry contaminated	Subsistence poultry farmer Other scenarios	1 0.01	1 0.01
fraction of eggs contaminated	Subsistence poultry farmer Other scenarios	1 0.2	1 0.2
Case J - New York			
fraction beef contaminated	Subsistence beef farmer Other scenarios	1 0.03	1 0.03
fraction dairy contaminated	Subsistence dairy farmer	1	1
	Typical farmer	**1**	**1**
	Other scenarios	1	1
fraction produce contaminated	Scenario scenarios Typical farmer and home gardener Other scenarios	1 0.36 0.14	1 0.48 0.14

Table E-3.2. Contaminated Fraction Based on Economic Analysis of Regional Capacity

Descriptions		Central Tendency	High End Contaminated Fraction
fraction fish contaminated	Subsistence & recreational fisher Other scenarios	1 0.01	1 0.01
fraction of pork contaminated	Subsistence pork farmer Other scenarios	1 0.29	1 0.29
fraction of poultry and eggs contaminated	Subsistence poultry farmer Other scenarios	1 0.01	1 0.01
Case K -Virginia			
fraction beef contaminated	Subsistence beef farmer Other scenarios	1 0.03	1 0.03
fraction dairy contaminated	Subsistence dairy farmer Other scenarios	1 0.01	1 0.01
fraction produce contaminated	Subsistence scenarios Typical farmer and home gardener Other scenarios	1 0.26 0.01	1 0.41 0.01
fraction fish contaminated	Subsistence & recreational fisher Other scenarios	1 0.01	1 0.01
fraction of pork contaminated	Subsistence pork farmer **Typical farmer** Other scenarios	1 **0.47** 0.05	1 **0.76** 0.05
fraction of poultry and eggs contaminated	Subsistence poultry farmer Other scenarios	1 0.01	1 0.01

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