Clopyralid –
WordPerfect Worksheets for Human Health and Ecological Risk Assessments

Worksheet Version 2.04d

Prepared for:

USDA, Forest Service
Forest Health Protection

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GENERAL NOTES

The worksheets included in this document are based on Worksheet Version 2.04d. See Documentation for Worksheets Version 2.04 - Human Health and Ecological Risk Assessments, SERA WSD 01-2.04, report dated . These worksheets are slightly modified from the original Version 2.04 by the additional of Worksheet F15, *Potential exposures of non-target plants through the use of contaminated irrigation water*, Worksheets F14a and F14b (*Consumption of contaminated insects by a small mammal and a small bird, acute exposure scenarios*), and F16a and F16b (*Consumption of contaminated small mammal by a carnivorous mammal and a carnivorous bird, acute exposure scenarios*). This specific version of the worksheets has been modified to included drift after aerial applications. Values from AgDrift are now included in Worksheet A06 and are used in Worksheet G05b.

These worksheets are arranged in the following order:

Most worksheets are designated by a simple alphanumeric code. For example, Worksheet D03 is the third worksheet in Series D. Some closely related worksheets as designated by an additional alphabetic sub-code. For example, Worksheets D01a and D01b are the direct spray scenarios for a child and a woman, respectively.

The worksheets in Series A and B also have short descriptive synonyms, as indicated in the table of contents. For example, Worksheet A03 contains the general assumptions used in exposure assessments for the general public and is designated as ***PUBL***.

The WordPerfect worksheets contain a much more detailed set of Series A and B worksheets than do the EXCEL worksheets. As noted in the documentation, the primary use of the EXCEL worksheets at this stage is to check rather than replace the WordPerfect worksheets. As the worksheets develop further, additional functionality will probably be added to the EXCEL worksheets to make them easier to manipulate and maintain.

It should be noted that all estimates of drift for chronic exposures for the off-site consumption of contaminated vegetation (Worksheets F04b, F11b, and F13b) all based on low-boom ground applications. These will need to be changed for high-boom or air-blast applications. For aerial applications, estimates specific to the program should be based on AGDRIFT.

CHEMICAL SPECIFIC NOTES

Information in these worksheets is taken from SERA TR 02-43-17-03a, Clopyralid - Human Health and Ecological Risk Assessment, Peer Review Draft, dated August 29, 2003. All section numbers cited in these worksheets refer to this report.

Note that the application rate is set at 0.35 lb/acre and no range is used. The consequences of varying application rates within the range of 0.1 to 0.5 lb/acre is considered in the risk characterization for human health (Section 3.4) and ecological effects (Section 4.4).

REVISION HISTORY

Modified in December 2004 based on peer review comments. No significant changes.

WORKSHEETS FOR
Clopyralid
WS Version 2.04d

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GENERAL ASSUMPTIONS, VALUES, and MODELS

Worksheet A01 [CONST]**:** Constants and conversion factors used in calculations

Conversion	ID	Value
mg/lb	mg_lb	453,600
mL/gallon	ml_gal	3,785
lb/gallon to mg/mL	lbg_mgml	119.8
lb/acre to μg/cm^2	lbac_ugcm	11.21
lb/acre to mg/cm^2	lbac_mgcm	0.01121
gallons to liters	gal_lit	3.785

Worksheet A02 [STD]**:** General Assumptions Used in Worker Exposure Assessments

Parameter	ID	Value	Units	Reference
Body Weight (General)	BW	70	kg	ICRP (1975), p. 13
Surface area of both hands	Hands	840	cm^2	U.S. EPA/ORD 1992, p. 8-11
Surface area of lower legs	LLegs	2070	cm^2	U.S. EPA/ORD 1992, p. 8-11
Weight of liquid adhering to surface of skin after a spill	Liq	0.008	mL/cm^2	Mason and Johnson 1987

Worksheet A03 [PUBL]**:** General Assumptions Used in Exposure Assessments for the General Public

Verbal Description: This table contains various values used in the exposure assessments for the general public. Three general groups of individuals are considered: adult male, adult female, and a 2 year old child. Values are specified for body weight, surface areas for various parts of the body, water intake, fish consumption, and the consumption of fruits or vegetables. Not all types of value are specified for each group. The only values specified are those used in the risk assessment.

Description	ID	Value	Units	Reference
		Body Weights		
Male, Adult	BWM	70	kg	ICRP (1975), p. 13.
Female, Adult	BWF	64	kg	See Note 1 below.
Child, 2-3 years old	BWC	13.3	kg	U.S. EPA/ORD 1996, p. 7-1, Table 7-2

[1]This is the average value (63.79 kg), rounded to the nearest kg for 3 different groups of women between 15-49 years old: control (62.07 kg), pregnant (65.90 kg), and lactating (63.48 kg). See Burnmaster 1998, Table III, p.218. This is identical to the body weight for females, 45-55 years old, 50th percentile from U.S. EPA, 1985, page 5, Table 2-2, rounded to nearest kilogram.

		Body Surface Areas		
Female, feet and lower legs	SAF1	2915	cm^2	U.S. EPA/ORD 1992, p. 8-11, Table 8-3, total for feet and lower legs
Female, exposed skin when wearing shorts and a T-shirt	SAF2	5300	cm^2	U.S. EPA/ORD 1992, p. 8-11, Table 8-3, total for arms, hands, lower legs, and feet.
Child, male, 2-3 years old, total body surface area	SAC	6030	cm^2	U.S. EPA/ORD 1996, p. 6-15, Table 6-6, 50th percentile.
		Water Intake		
Adult				
typical	WCAT	2	L/day	U.S. EPA/ORD 1996, p. 3-28, Table 3-30, midpoint of mean (1.4 L/day) and 90th percentile (2.4 L/day) rounded to one significant place.
lower range for exposure assessment	WCAL	1.4	L/day	U.S. EPA/ORD 1996, p. 3-28, Table 3-30, mean
upper range	WCAH	2.4	L/day	U.S. EPA/ORD 1996, p. 3-28, Table 3-30, 90th percentile
Child, < 3 years old				
typical	WCT	1	L/day	U.S. EPA/ORD 1996, p. 3-28, Table 3-30, midpoint of mean (0.61L/day) and 90th percentile (1.5 L/day) rounded to one significant place.
lower range for exposure assessment	WCL	0.61	L/day	U.S. EPA/ORD 1996, p. 3-28, Table 3-30, mean
upper range	WCH	1.50	L/day	U.S. EPA/ORD 1996, p. 3-28, Table 3-30, 90th percentile

Worksheet A03 [PUBL]***(continued)*:** General Assumptions Used in Exposure Assessments for the General Public

Description	ID	Value	Units	Reference
		Fish Consumption		
Freshwater anglers, typical intake per day over a prolonged period	FAT	0.010	kg/day	U.S. EPA/ORD 1996, p. 10-51, average of means from four studies rounded to one significant place.
Freshwater anglers, maximum consumption for a single day	FAU	0.158	kg/day	Ruffle et al. 1994
Native American subsistence populations, typical intake per day	FNT	0.081	kg/day	U.S. EPA/ORD 1996, p. 10-51, median value of 94 individuals
Native American subsistence populations, maximum for a single day	FNU	0.770	kg/day	U.S. EPA/ORD 1996, p. 10-51, highest value of 94 individuals
		Consumption of Fruits and Vegetables		
Consumption of fruit, total				
Central	FrTC	0.00168	kg fruit/kg bw/day	U.S. EPA/ORD 1996, Table 9-3, p. 9-11, Central and upper estimates are mean and 95th percentile, respectively. The 5th percentile is given as zero. For these worksheets, the central estimate is used for the lower bound.
Lower	FrTL	0.00168		
Upper	FrTU	0.01244		
Consumption of vegetables, total				
Central	VgTC	0.0036	kg veg/kg bw/day	U.S. EPA/ORD 1996, Table 9-12, p. 9-12, mean, 5th percentile and 95th percentile.
Lower	VgTL	0.00075		
Upper	VgTU	0.01		
Consumption of vegetables, homegrown				
Central	VgHC	0.000761	kg veg/kg bw/day	U.S. EPA/ORD 1996, Table 12-15, p. 9-14, mean, 5th percentile and 95th percentile for individuals between 20 and 39 years old..
Lower	VgHL	0.0000777		
Upper	VgHU	0.00492		
Worst-case scenario for consumption in a single day, acute exposure scenario only.	VAcute	0.454	kg food	1 lb. The approximate mid range of the above typical and upper limits based on the 64 kg body weight.
		Miscellaneous		
Estimate of dislodgeable residue as a proportion of application rate shortly after application.	DisL	0.1	none	Harris and Solomon 1992, data on 2,4-D

Worksheet A04 [HK]**:** Estimated pesticide residues on various types of vegetation shortly after an application of 1 lb/acre.

Type of Vegetation	Concentration (mg chemical/kg vegetation)			
	Typical		Upper Limit	
	ID	Value	ID	Value
The following values are from Hoerger and Kenaga (1972).				
Range grass	RGT	125	RGU	240
Grass	GST	92	GSU	110
Leaves and leafy crops	LVT	35	LVU	125
Forage crops	FCT	33	FCU	58
Pods containing seeds	PDT	3	PDU	12
Grain	GNT	3	GNU	10
Fruit	FRT	1.5	FRU	7
The following values are from Fletcher et al. (1994)				
Short grass	SGT	85	SGU	240
Tall grass	TGT	36	TGU	110
Broadleaf/forage plants and small insects	BLT	45	BLU	135
Fruits, pods, seeds, and large insects	FRT2	7	FRU2	15

Worksheet A05 [FRUIT]**:** Concentration of a chemical on spheres of various sizes at an application rate of 1 lb/acre.

Diameter (cm)	Planar Surface Area (cm^2)[a]	Amount deposited (mg)[b]	Weight of sphere (kg)[c]	Concentration (mg/kg)[d]
1	0.78540	0.00880	0.00052	16.8
5	19.63495	0.21991	0.06545	3.36
10	78.53982	0.87965	0.52360	1.68
	Application rate	1 lb/acre =	0.0112	mg/cm^2

a Planar surface area of a sphere = πr^2 where r is the radius in cm.

b Amount deposited is calculated as the application rate in mg/cm^2 multiplied by the planar surface area.

c Assumes a density of 1 g/cm^3 for the fruit. The volume of a sphere is$(1 \div 6) \times \pi \times d^3$ where d is the diameter in cm. Assuming a density of 1 g/cm^3, the weight of the sphere in kg is equal to:

$$kg = (1 \div 6) \times \pi \times d^3 \div 1000$$

d Amount of chemical in mg divided by the weight of the sphere in kg.

Worksheet A06 [OFFSITE**]:** Central estimates of off-site drift (expressed as fraction of application rate) associated with ground applications of pesticides [1] (from AgDRIFT Version 1.16, Teske et al. 2001)

Distance Down Wind (feet)	Low Boom [1]	High Boom [1]	Orchard Airblast [1] (Normal)	Aerial[2]
25	0.0187	0.1034	0.0057	0.1434
50	0.0101	0.0515	0.0029	0.0518
100	0.0058	0.0262	0.0007	0.0195
300	0.0024	0.0078	0.0001	0.0042
500	0.0015	0.0038	0.0000403	0.0022
900	0.0008	0.0015	0.000013	0.0009
990	0.0007	0.0013	< 0.0000108	0.0008

[1] Estimates based on very fine to fine spray. This will over-estimate drift for applications involving larger droplets.
[2] Estimated based on AgDrift defaults – Air Tractor AT-401, water, 8 ft. boom height, 4 mph wind speed. A large number of options are available in AgDrift for different weather conditions, pesticide mixtures, and aircraft.

Worksheet A07a [KAMODEL]: Estimate of first-order absorption rate (k_a in $hour^{-1}$) and 95% confidence intervals (from SERA 1997).

Model parameters	ID	Value	
Coefficient for $k_{o/w}$	C_KOW	0.233255	
Coefficient for MW	C_MW	0.005657	
Model Constant	C	1.49615	
Number of data points	DP	29	
Degrees of Freedom (d.f.)	DF	26	
Critical value of $t_{0.025}$ with 26 d.f.[1]	CRIT	2.056	
Standard error of the estimate	SEE	16.1125	
Mean square error or model variance	MDLV	0.619712	
Standard deviation of model (s)	MSD	0.787218	$MDLV^{0.5}$
X′X, cross products matrix	0.307537	-0.00103089	0.00822769
	-0.00103089	0.000004377	-0.0000944359
	0.0082	-0.0000944359	0.0085286

[1] Mendenhall and Scheaffer 1973, Appendix 3, 4, p. A31.

Central (maximum likelihood) estimate:

$$\log_{10} k_a = 0.233255 \log_{10}(k_{o/w}) - 0.005657\, MW - 1.49615$$

95% Confidence intervals for $\log_{10} k_a$

$$\log_{10} k_a \pm t_{0.025} \times s \times (a' X' X\, a)^{0.5}$$

where a is a column vector of {1, MW, $\log_{10}(k_{o/w})$}.

NB: Although the equation for the central estimate is presented with $k_{o/w}$ appearing before MW to be consistent with the way a similar equation is presented by EPA, MW must appear first in column vector a because of the way the statistical analysis was conducted to derive X′X .

See following page for details of calculating $a' X' X\, a$ without using matrix arithmetic.

Worksheet Worksheet A07a (continued)
Details of calculating a′X′X a

The term $\mathbf{a}'\cdot(\mathbf{X}'\mathbf{X})^{-1}\cdot\mathbf{a}$ requires matrix multiplication. While this is most easily accomplished using a program that does matrix arithmetic, the calculation can be done with a standard calculator.

Letting

$$\mathbf{a} = \{a\_1, a\_2, a\_3\}$$

and

$$(\mathbf{X}'\mathbf{X})^{-1} = \{ \{b\_1, b\_2, b\_3\}, \{c\_1, c\_2, c\_3\}, \{d\_1, d\_2, d\_3\} \},$$

$\mathbf{a}'\cdot(\mathbf{X}'\mathbf{X})^{-1}\cdot\mathbf{a}$ is equal to

Term 1: $\{a\_1 \times([a\_1\times b\_1] + [a\_2\times c\_1] + [a\_3\times d\_1])\} +$
Term 2: $\{a\_2 \times([a\_1\times b\_2] + [a\_2\times c\_2] + [a\_3\times d\_2])\} +$
Term 3: $\{a\_3 \times([a\_1\times b\_3] + [a\_2\times c\_3] + [a\_3\times d\_3])\}.$

Worksheet A07b [KPMODEL]: Estimate of dermal permeability (K_p in cm/hr) and 95% confidence intervals (data from U.S. EPA/ORD 1992).

Model parameters	ID	Value	
Coefficient for $k_{o/w}$	C_KOW	0.706648	
Coefficient for MW	C_MW	0.006151	
Model Constant	C	2.72576	
Number of data points	DP	90	
Degrees of Freedom (d.f.)	DF	87	
Critical value of $t_{0.025}$ with 87 d.f.[1]	CRIT	1.96	
Standard error of the estimate	SEE	45.9983	
Mean square error or model variance	MDLV	0.528716	
Standard deviation of model (s)	MSD	0.727129	$MDLV^{0.5}$
X′X, cross products matrix	0.0550931	-0.0000941546	-0.0103443
	-0.0000941546	0.0000005978	-0.0000222508
	-0.0103443	-0.0000222508	0.00740677

[1] Mendenhall and Scheaffer, 1973, Appendix 3, Table 4, p. A31.

NOTE: The data for this analysis is taken from U.S. EPA/ORD (1992), Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/011B, Table 5-4, pp. 5-15 through 5-19. The EPA report, however, does not provide sufficient information for the calculation of confidence intervals. The synopsis of the above analysis was conducted in STATGRAPHICS Plus for Windows, Version 3.1 (Manugistics, 1995) as well as Mathematica, Version 3.0.1.1 (Wolfram Research, 1997). Although not explicitly stated in the EPA report, 3 of the 93 data points are censored from the analysis because they are statistical outliers: [Hydrocortisone-21-yl]-hemipimelate, n-nonanol, and n-propanol. The model parameters reported above are consistent with those reported by U.S. EPA but are carried out to greater number of decimal places to reduce rounding errors when calculating the confidence intervals. See notes to Worksheet A07a for details of calculating maximum likelihood estimates and confidence intervals.

Worksheet B01 [APPL]**:** Anticipated Application and Dilution Rates

Item		Code	Value	Units	Source
Application rate (***R***)					
	Central	Typ	0.35	lbs/acre	Section 2.4
	Lower	Low	0.35		Section 2.4
	Upper	Hi	0.35		Section 2.4
Dilution (***Dil***)					
	Central	CDil	10	gal./acre	Section 2.4
	Lower	LDil	2		
	Upper	HDil	40		
Concentration in field solutions[1]: $\mathbf{R_{(lb/acre)} \div Dil_{(gal/acre)} \times 119.8\ mg/mL \div lb/gal}$					
	Central	TypDr	4.2	mg/mL	
	Lower	LowDr	1		
	Upper	HI_Dr	21.0		

The typical concentration in applied solution is calculated as the typical application rate (lbs/acre) divided by the typical dilution (gal/acre), yielding units of lbs/gallon. This is converted to mg/mL using the relationship of lb/gal = 119.8 mg/mL from Worksheet A01. The lowest estimated concentration is calculated as the lowest application rate divided by the highest dilution. The highest estimated concentration is calculated as highest application rate divided by the lowest dilution.

NOTE ON UNITS FOR APPLICATION RATE: In all cases, lb/acre refers to lb a.e./acre.

Worksheet B02 [CHEM]**:** Summary of chemical specific values used in exposure assessment worksheets.

Parameter	ID	Value	Units	Source/Reference
Molecular weight, acid	MW	192	grams/mole	Table 2-1
Water Solubility, salt	WS	1000	mg/L	Table 2-1
$K_{o/w}$ (pH 7)	Kow	0.0023	unitless	Table 2-1, $Log_{10} K_{o/w} = -2.63$
Foliar half-time ($t_{½}$)				
central	FrT12C	28.3	days	Section 3.2.3.6
lower	FrT12L	21.2	days	
upper	FrT12U	42.8	days	
Dissipation coefficients on vegetation				
central	VgKC	0.0245	day^{-1}	ln(2)/half-time. The upper limit on half-time is used to calculate the lower limit on dissipation coefficient.
lower	VgKL	0.0162	day^{-1}	
upper	VgKU	0.0327	day^{-1}	
Bioconcentration factor, edible portion, acute exposure	BCFT	1	L/kg fish	See Section 3.2.3.5. The actual BCF for clopyralid is probably less than unity. This has no impact on this risk assessment.
Bioconcentration factor, edible portion, chronic exposure	BCFCh	1	L/kg fish	
Bioconcentration factor, whole fish, acute	BCFWA	1	L/kg fish	
Bioconcentration factor, whole fish, chronic	BCFWC	1	L/kg fish	
Chronic RfD[a]	RfDP	0.15	mg/kg bw/day	See Section 3.3
Acute RfD	RfDA	0.75	mg/kg bw/day	

Worksheet B03 [KA_CHEM]**:** Calculation of first-order dermal absorption rate (k_a)[1].

Parameters	Value	Units	Reference
Molecular weight	192	g/mole	
$K_{o/w}$ at pH 7	0.0023	unitless	
$\log_{10} K_{o/w}$	-2.64		

Column vector ***a*** for calculating confidence intervals

a_1	1
a_2	192
a_3	-2.64

Calculation of $\mathbf{a}' \cdot (\mathbf{X}'\mathbf{X})^{-1} \cdot \mathbf{a}$

Term 1	0.08795812
Term 2	0.011290517
Term 3	0.085587498
$\mathbf{a}' \cdot (\mathbf{X}'\mathbf{X})^{-1} \cdot \mathbf{a}$	0.1848

$\log_{10} k_a = 0.233255 \log_{10}(\boldsymbol{k_{o/w}}) - 0.005657\ \boldsymbol{MW} - 1.49615$

$\log_{10}$ of first order absorption rate (k_a)

Central estimate	-3.19768417361	±	$t_{0.025}$	×	s	×	$(\mathbf{a}'\cdot(\mathbf{X}'\mathbf{X})^{-1}\cdot\mathbf{a})^{0.5}$
Lower limit	-3.89345963757	-	2.0560	×	0.787218	×	0.4298837052
Upper limit	-2.50190870965	+	2.0560	×	0.787218	×	0.4298837052

First order absorption rates (i.e., antilog or 10^x of above values).

Central estimate	6.34e-04	$hour^{-1}$
Lower limit	1.28e-04	$hour^{-1}$
Upper limit	3.15e-03	$hour^{-1}$

[1] See Worksheet A07a for details of method.

Worksheet B04 [KP_CHEM]**:** Calculation of dermal permeability rate (K_p) in cm/hour [1].

Parameters	Value	Units	Reference
Molecular weight	192	g/mole	
$K_{o/w}$	0.0023	unitless	
$\log_{10} K_{o/w}$	-2.63827216398		

Column vector ***a*** for calculating confidence intervals

a_1	1
a_2	192
a_3	-2.63827216398

Calculation of $\mathbf{a}' \cdot (\mathbf{X}'\mathbf{X})^{-1} \cdot \mathbf{a}$

Term 1	0.0643064955
Term 2	0.0152307199
Term 3	0.0901168572
$\mathbf{a}' \cdot (\mathbf{X}'\mathbf{X})^{-1} \cdot \mathbf{a}$	0.1697

$\log_{10} K_p = 0.706648 \log_{10}(k_{o/w}) - 0.006151\ MW - 2.72576$

$\log_{10}$ of dermal permeability

Central estimate	-5.77108174813	$\pm$	$t_{0.025}$	$\times$	s	$\times$	$\mathbf{a}'\cdot(\mathbf{X}'\mathbf{X})^{-1}\cdot\mathbf{a}^{0.5}$
Lower limit	-6.35817685182	-	1.9600	$\times$	0.727129	$\times$	0.41194659848
Upper limit	-5.18398664445	+	1.9600	$\times$	0.727129	$\times$	0.41194659848

Dermal permeability

Central estimate	1.69e-06	cm/hour
Lower limit	4.38e-07	cm/hour
Upper limit	6.55e-06	cm/hour

[1] See Worksheet A07a for details of method.

Worksheet B05 [DERM]**:** Summary of chemical specific dermal absorption values.

Description	Code	Value	Units	Reference/Source
Zero-order absorption (K_p)				
Central estimate	KpC	**0.0000017**	cm/hour	Worksheet KPMODEL, values rounded to two significant figures
Lower limit	KpL	**0.00000044**	cm/hour	
Upper limit	KpU	**0.0000065**	cm/hour	
First-order absorption rates (k_a)				
Central estimate	AbsC	**0.00063**	$hour^{-1}$	Worksheet KAMODEL, values rounded to two significant figures
Lower limit	AbsL	**0.00013**	$hour^{-1}$	
Upper limit	AbsU	**0.0031**	$hour^{-1}$	

Worksheet B06 [AMBWAT]**:** Estimates of the concentrations in ambient water per pound applied per acre are used in the chronic contaminated water exposure assessments.

Scenario	Description	ID	***WCR*** (mg/L) ÷ (lb/acre)
	Short-term Peak Concentrations in Streams (See Section 3.2.3.4.1 for details)		
Central	Based on GLEAMS modeling supported by site-specific monitoring study by after characterized field applications the herbicide.	AWPT	0.02
Lower		AWPL	0.005
Upper		AWPU	0.07
	Longer-term Concentrations in Ponds (See Section 3.2.3.4.2 for details)		
Central	Base solely on GLEAMS modeling.	AWT	0.007
Lower		AWL	0.001
Upper		AWU	0.013

Worksheet C01a: Worker exposure estimates for directed foliar (backpack) applications [WkBkExp01]

Verbal Description: The absorbed dose for the worker is calculated from the amount handled per day and the generic absorbed dose rate from several field studies on worker applications of a number of herbicides. The amount handled per day is calculated from the application rates as well as estimates of the hours worked per day and acres treated per hour.

Parameter/Assumption		Value	Units	Source/Designation
Application rates (***R***)				
	Central	0.35	lb/acre	APPL.TYP
	Lower	0.35		APPL.LOW
	Upper	0.35		APPL.HI
Hours of application per day (***Hrs***)				
	Central	7	hours	USDA 1989a,b,c
	Lower	6		USDA 1989a,b,c
	Upper	8		USDA 1989a,b,c
Acres treated per hour (***Acres***)				
	Central	0.625	acres/hour	USDA 1989a,b,c
	Lower	0.25		USDA 1989a,b,c
	Upper	1		USDA 1989a,b,c
Acres treated per day (**ATD**): **Hrs × Acres**				
	Central	4.375	acres/day	
	Lower	1.5		
	Upper	8		
Amount handled per day (***AHD***): **R × ATD**				
	Central	1.53125	lb/day	
	Lower	0.525		
	Upper	2.8		
Absorbed dose rate (***ADR***):				
	Central	0.003	(mg agent/kg bw) ÷ (lbs agent handled per day)	SERA 2001
	Lower	0.0003		
	Upper	0.01		
Absorbed dose [D_{Abs}]: **AHD × ADR**				
	Central	4.59e-03	mg/kg bw/day	
	Lower	1.58e-04		
	Upper	2.80e-02		

Worksheet C01b: Worker exposure estimates for boom spray (hydraulic ground spray) applications [WkHyExp01]

Verbal Description: The absorbed dose for the worker is calculated from the amount handled per day and the generic absorbed dose rate from several field studies on worker applications of a number of herbicides. The amount handled per day is calculated from the application rates as well as estimates of the hours worked per day and acres treated per hour.

Parameter/Assumption		Value	Units	Source/Designation
Application rates (***R***)				
	Central	0.35	lb/acre	APPL.TYP
	Lower	0.35		APPL.LOW
	Upper	0.35		APPL.HI
Hours of application per day (***Hrs***)				
	Central	7	hours	USDA 1989a,b,c
	Lower	6		
	Upper	8		
Acres treated per hour (***Acres***)				
	Central	16	acres/hour	USDA 1989a,b,c.
	Lower	11		
	Upper	21		
Acres treated per day (***ATD***): **Hrs × Acres**				
	Central	112	acres/day	
	Lower	66		
	Upper	168		
Amount handled per day (***AHD***): **R × ATD**				
	Central	39.2	lb/day	
	Lower	23.1		
	Upper	58.8		
Absorbed dose rate (***ADR***)				
	Central	0.0002	(mg agent/kg bw) ÷ (lbs agent handled per day)	SERA 2001
	Lower	0.00001		
	Upper	0.0009		
Absorbed dose [D_{Abs}]: **AHD × ADR**				
	Central	7.84e-03	mg/kg bw/day	
	Lower	2.31e-04		
	Upper	5.29e-02		

Worksheet C01c: Worker exposure estimates for aerial applications [WKAREXP01]

Verbal Description: The absorbed dose for the worker is calculated from the amount handled per day and the generic absorbed dose rate from several field studies on worker applications of a number of herbicides (SERA 2001). The amount handled per day is calculated from the application rates as well as estimates of the hours worked per day and acres treated per hour.

Parameter/Assumption		Value	Units	Source/Designation
Application rates (***R***)				
	Central	0.35	lb/acre	Appl.Typ
	Lower	0.35		Appl.Low
	Upper	0.35		Appl.Hi
Hours of application per day (***Hrs***)				
	Central	7	hours	USDA 1989a,b,c
	Lower	6		
	Upper	8		
Acres treated per hour (***Acres***)				
	Central	70	acres/hour	USDA 1989a,b,c
	Lower	40		
	Upper	100		
Acres treated per day (***ATD***): **Hrs × Acres**				
	Central	490	acres/day	
	Lower	240		
	Upper	800		
Amount handled per day (***AHD***): **R × ATD**				
	Central	171.5	lb/day	
	Lower	84		
	Upper	280		
Absorbed dose rate (***ADR***)				
	Central	0.00003	(mg agent/kg bw) ÷ (lbs agent handled per day)	SERA 2001
	Lower	0.000001		
	Upper	0.0001		
Absorbed dose [D_{Abs}]: **AHD × ADR**				
	Central	5.15e-03	mg/kg bw	
	Lower	8.40e-05		
	Upper	2.80e-02		

Worksheet C02a: Workers: Accidental Dermal Exposure Assessments Using Zero-Order Absorption Wearing Contaminated Gloves for One Minute [WrkDrmZr01]

Verbal Description: Dermal absorption is calculated using the zero-order model from U.S. EPA/ORD (1992):

$$\text{Dose (mg/kg)} = Kp \times C \times \text{Time} \times S \div W$$

Each of the above terms are described below.

Parameter	Value	Units	Source
Body weight (***W***)	70	kg	STD.BW
Surface Area of hands (***S***)	840	cm^2	STD.Hands
Dermal permeability (K_p)			
Central	1.70e-06	cm/hour	DERM.KpC
Lower	4.40e-07	cm/hour	DERM.KpL
Upper	6.50e-06	cm/hour	DERM.KpU
Concentration in solution (***C***) [1]			
Central	4.2	mg/mL	APPL.TypDr
Lower	1	mg/mL	APPL.LowDr
Upper	21	mg/mL	APPL.HI_Dr
Duration of Exposure (***T***)	0.0167	hours	1÷60
Absorbed Dose (D_{Abs}): **Kp × C × T × S ÷ W**			
Central	1.43e-06	mg/kg	
Lower	8.80e-08	mg/kg	
Upper	2.73e-05	mg/kg	

[1] Note that 1 mL is equal to 1 cm^3 and thus mg/mL = mg/cm^3.

Worksheet C02b: Workers: Accidental Dermal Exposure Assessments Using Zero-Order Absorption Wearing Contaminated Gloves for One Hour [WrkDrmZr60]

Verbal Description: Dermal absorption is calculated using the zero-order model from U.S. EPA/ORD (1992):

$$\text{Dose (mg/kg)} = Kp \times C \times Time \times S \div W$$

Each of the above terms are described below.

Parameter	Value	Units	Source
Body weight (***W***)	70	kg	STD.BW
Surface Area of hands (***S***)	840	cm^2	STD.Hands
Dermal permeability (K_p)			
Central	1.70e-06	cm/hour	DERM.KpC
Lower	4.40e-07		DERM.KpL
Upper	6.50e-06		DERM.KpU
Concentration in solution (***C***)[1]			
Central	4.2	mg/mL	APPL.TypDr
Lower	1		APPL.LowDr
Upper	21		APPL.HI_Dr
Duration of Exposure (***T***)	1	hours	
Absorbed Dose (D_{Abs}): **Kp × C × T × S ÷ W**			
Central	8.57e-05	mg/kg bw	
Lower	5.28e-06		
Upper	1.64e-03		

[1] Note that 1 mL is equal to 1 cm^3 and thus mg/mL = mg/cm^3.

Worksheet C03a: Accidental Spill onto the Hands for 1 Hour Based on the Assumption of First-Order Absorption [WrkDrmFrHnd]

Verbal Description: A worker spills a solution of the compound at a specified concentration (***C***) on a defined area of the skin (***A***). Based on the amount of liquid adhering to the skin (***L***), the amount of chemical absorbed (***Dose***) over a given period is calculated from the first order dermal absorption coefficient (k_a), the amount of time that the chemical remains on the surface of the skin before it is effectively removed by washing (***T***) and the body weight (***W***) (Durkin et al. 1995).

Parameter	Value	Units	Source
Liquid adhering to skin after a spill (***L***)	0.008	mL/cm^2	STD.Liq
Body weight (***W***)	70	kg	STD.BW
Surface Areas (**A**)			
Hands	840	cm^2	STD.Hands
Duration of Exposure (***T***)	1	hours	
First-order dermal absorption rates (k_a)			
Central	0.00063	$hour^{-1}$	DERM.ABSC
Lower	0.000130		DERM.ABSL
Upper	0.00310		DERM.ABSU
Concentration in solution (***C***)			
Central	4.2	mg/mL	APPL.TypDr
Lower	1		APPL.LowDr
Upper	21		APPL.HI_Dr
Amount Deposited on Skin (***Amnt***): L × A × C			
Central	28.224	mg	
Lower	6.72		
Upper	141.12		
Proportion absorbed over period ***T*** (***Prop***): $1-e^{-k\,T}$			
Central	0.0006298	unitless	
Lower	0.0001300		
Upper	0.0030952		
Absorbed Dose (D_{Abs}): **Amnt × Prop ÷ W**			
Central	2.54e-04	mg/kg bw	
Lower	1.25e-05		

Upper	6.24e-03

Worksheet C03b: Accidental Spill onto the Lower Legs for 1 Hour Based on the Assumption of First-Order Absorption [WrkDrmFrLeg]

Verbal Description: A worker spills a solution of the compound at a specified concentration (***C***) on a defined area of the skin (***A***). Based on the amount of liquid adhering to the skin (***L***), the amount of chemical absorbed (***Dose***) over a given period is calculated from the first order dermal absorption coefficient (k_a), the amount of time that the chemical remains on the surface of the skin before it is effectively removed by washing (***T***) and the body weight (***W***) (Durkin et al. 1995).

Parameter	Value	Units	Source
Liquid adhering to skin after a spill (***L***)	0.008	mL/cm^2	STD.Liq
Body weight (***W***)	70	kg	STD.BW
Surface Areas (**A**)			
Legs	2070	cm^2	STD.LLegs
Duration of Exposure (***T***)	1	hours	
First-order dermal absorption rates (k_a)			
Central	0.00063	$hour^{-1}$	DERM.ABSC
Lower	0.000130		DERM.ABSL
Upper	0.00310		DERM.ABSU
Concentration in solution (***C***)			
Central	4.2	mg/mL	APPL.TypDr
Lower	1		APPL.LowDr
Upper	21		APPL.HI_Dr
Amount Deposited on Skin (***Amnt***): L × A × C			
Central	69.552	mg	
Lower	16.56		
Upper	347.76		
Proportion absorbed over period ***T*** (***Prop***): $1-e^{-k\,T}$			
Central	0.0006298	unitless	
Lower	0.0001300		
Upper	0.0030952		
Absorbed Dose (D_{Abs}): **Amnt × Prop ÷ W**			
Central	6.26e-04	mg/kg bw	
Lower	3.08e-05		

Upper	1.54e-02

Worksheet D01a: Direct Spray of a Child, Assumption of First-Order Absorption [SpillFOACh01]

Verbal Description: A naked child is accidentally sprayed over the entire body surface (***A***) with a field dilution of a specified concentration (***C***). The child is effectively washed - i.e., all of the compound is removed - after a specified period of time (***T***). The absorbed dose (***D***) is calculated from the amount of liquid adhering to the skin (***L***), the first-order dermal absorption rate (k_a) and the body weight (***W***).

Parameter	Value	Units	Source
Liquid adhering to skin after a spill (***L***)	0.008	mL/cm^2	STD.Liq
Body weight (***W***)	13.3	kg	PUBL.BWC
Exposed surface area (***A***)			
Whole Body	6030	cm^2	PUBL.SAC
Duration of Exposure (***T***)	1	hours	
First-order dermal absorption rates (k_a)			
Central	0.00063	$hour^{-1}$	DERM.ABSC
Lower	0.00013		DERM.ABSL
Upper	0.0031		DERM.ABSU
Concentration in solution (***C***)			
Central	4.2	mg/mL	APPL.TypDr
Lower	1		APPL.LowDr
Upper	21		APPL.HI_Dr
Amount Deposited on Skin (***Amnt***): L × A × C			
Central	202.608	mg	
Lower	48.24		
Upper	1013.04		
Proportion absorbed over period ***T*** (***Prop***): $1-e^{-k\,T}$			
Central	0.0006298	unitless	
Lower	0.0001300		
Upper	0.0030952		
Absorbed Dose (D_{Abs}): **Amnt × Prop ÷ W**			
Central	9.59e-03	mg/kg bw	

Lower	4.71e-04
Upper	2.36e-01

Worksheet D01b: Direct Spray of a Woman, Assumption of First-Order Absorption [SpillFOAWm01]

Verbal Description: A woman is sprayed over the feet and lower legs (***A***) with a field dilution of a specified concentration (***C***). The woman effectively washes - i.e., all of the compound is removed - after a specified period of time (***T***). The absorbed dose (***D***) is calculated from the amount of liquid adhering to the skin (***L***), the first-order dermal absorption rate (k_a) and the body weight (***W***).

Parameter	Value	Units	Source
Liquid adhering to skin after a spill (***L***)	0.008	mL/cm^2	STD.Liq
Body weight (***W***)	64	kg	PUBL.BWF
Exposed surface area (***A***)			
Feet and lower legs	2915	cm^2	PUBL.SAF1
Duration of Exposure (***T***)	1	hours	
First-order dermal absorption rates (k_a)			
Central	0.00063	$hour^{-1}$	DERM.ABSC
Lower	0.000130		DERM.ABSL
Upper	0.00310		DERM.ABSU
Concentration in solution (***C***)			
Central	4.2	mg/mL	APPL.TypDr
Lower	1		APPL.LowDr
Upper	21		APPL.HI_Dr
Amount Deposited on Skin (***Amnt***): L × A × C			
Central	97.944	mg	
Lower	23.32		
Upper	489.72		
Proportion absorbed over period ***T*** (***Prop***): $1-e^{-k\,T}$			
Central	0.0006298	unitless	
Lower	0.0001300		
Upper	0.0030952		
Absorbed Dose (D_{Abs}): **Amnt × Prop ÷ W**			
Central	9.64e-04	mg/kg	
Lower	4.74e-05		

Upper	2.37e-02

Worksheet D02: Dermal contact with contaminated vegetation by a young woman [VegC_FOA01].

Verbal Description*: A woman wearing shorts and a short sleeved shirt is in contact with contaminated vegetation for 1 hour shortly after application of the compound - i.e. no dissipation or degradation is considered. The chemical is effectively removed from the surface of the skin - i.e., washing - after 24 hours.*

Parameter/Assumption		Value	Units	Source/Reference
Contact time (***Tc***)		1	hour	N/A
Exposure time (***Te***)		24	hours	N/A
Body weight (***W***)		64	kg	PUBL.BWF
Exposed surface area (***A***)		5300	cm^2	PUBL.SAF2
Application Rates in lb/acre (***Rlb***)				
	Central	0.35	lb/acre	APPL.TYP
	Lower	0.35		APPL.LOW
	Upper	0.35		APPL.HI
First-order dermal absorption rate (***k***)				
	Central	0.00063	$hour^{-1}$	DERM.AbsC
	Lower	0.000130		DERM.AbsL
	Upper	0.00310		DERM.AbsU
Application Rates in µg/cm^2 (***Rµg***): Rlb × Const.lbac_ugcm				
	Central	3.9235	µg/cm^2	
	Lower	3.9235		
	Upper	3.9235		
Proportion dislodgeable (***PropDr***)		0.1	none	PUBL.DisL
Dislodgeable residue (***Dr***): ***Rµg*** × ***PropDr***				
	Central	0.39235	µg/cm^2	
	Lower	0.39235		
	Upper	0.39235		
Transfer Rate (***Tr***): $Tr = 10^{(1.09 \times \log10(Dr) + 0.05)} \div 1000$ µg/mg				
	Central	4.05e-04	mg/(cm^2 hr)	The method of Durkin et al. (1995, p. 68, equation 4) is used to calculate the transfer rate (***Tr***) in units of µg/(cm^2·hr)) based on the dislodgeable residue ***(Dr***) in units of µg/cm^2. This is converted to units of mg/(cm^2·hr)) by dividing by 1000 µg/mg.
	Lower	4.05e-04		
	Upper	4.05e-04		
Amount Transferred to Skin Surface (***Amnt***): ***Tr*** × ***Tc*** × ***A***				
	Central	2.14477	mg	
	Lower	2.14477		
	Upper	2.14477		
Proportion Absorbed (***PropAbs***): $1 - e^{-ka \times Te}$				
	Central	1.50e-02	unitless	

	Lower	3.12e-03	
	Upper	7.17e-02	
Absorbed dose (D_{Abs}): **Amnt** × **PropAbs** ÷ **W**			
	Central	5.03e-04	mg/kg bw
	Lower	1.04e-04	
	Upper	2.40e-03	

Worksheet D03: Consumption of contaminated fruit, acute exposure scenario [VegAcHHRA01].

Verbal Description: Edible fruit is contaminated by drift (***Dr***). A drift of 1 (unity) indicates direct spray. The individual consumes contaminated fruit shortly after application of the chemical - i.e. no dissipation or degradation is considered. The concentration of the chemical in fruit (***C***) is estimated from empirical relationships relating residues on plants to application rate.

Parameters/Assumptions		Value	Units	Source/Reference
Amount of fruit consumed per Unit Body Weight (***A***):				
	Central	0.00168	kg fruit/kg bw/day	PUBL.FrTC
	Lower	0.00168		PUBL.FrTL
	Upper	0.01244		PUBL.FrTU
Application rates (***R***)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Residue rates (***rr***)				
	Central	7	mg/kg per lb/acre	HK.FRT2
	Lower	7		HK.FRT2
	Upper	15		HK.FRU2
Drift (***Drift***)				
	Central	1	unitless	Direct spray
	Lower	1		
	Upper	1		
Proportion Removed by Washing (***Wash***)				
	Central	0	unitless	No washing is assumed for this scenario.
	Lower	0		
	Upper	0		
Concentration on fruit (***C***): ***R*** × ***rr*** × ***Drift*** × (1-**Wash**)				
	Central	2.45	mg/kg fruit	
	Lower	2.45		
	Upper	5.25		
Dose estimates (***D***): ***C*** × ***A***				
	Central	4.12e-03	mg/kg bw	
	Lower	4.12e-03		
	Upper	6.53e-02		

Worksheet D04: Consumption of contaminated fruit, chronic exposure scenario [VegChHHRA01].

Verbal Description: An individual consumes contaminated fruit for a period of time (**t***) starting shortly after application of the chemical.* The concentration of the chemical in fruit at time zero (***C_0***) is estimated from the application rate (***A***), the proportion of drift (***Drift***), and empirical residues rates (***rr***) from Siltanen et al. (1981). The foliar halftime (***t_{50}***) is used to estimate the foliar decay coefficient (***k***): $\mathbf{k = ln(2) \div t_{50}}$. The concentration on the vegetation after time ***t*** (C_t) is calculated as $C_t = C_0 e^{-kt}$. The time-weighted average of the concentration on vegetation ($\mathbf{C_{TWA}}$) is calculated as the integral of the concentration after time ***t*** (C_t) divided by the duration (***t***).

Parameters/Assumptions		Value	Units	Source/Reference
Halftime on vegetation (***t_{50}***)	Central	28.3	days	CHEM.FrT12C
	Lower	21.2		CHEM.FrT12L
	Upper	42.8		CHEM.FrT12U
Duration of exposure (***T***)		90	days	N/A
Amount of fruit consumed per unit body weight(***A***): Central is also used for lower.				
	Central	0.00168	kg fruit/kg bw/day	PUBL.FrTC
	Lower	0.00168		PUBL.FrTL
	Upper	0.01244		PUBL.FrTU
Application rates (***R***)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Residue rates (***rr***):				
	Central	7	mg/kg per lb/acre	HK.FRT2
	Lower	7		HK.FRT2
	Upper	15		HK.FRU2
Drift (***Drift***)				
	Central	1	unitless	Assume direct spray
	Lower	1		
	Upper	1		
Decay coefficient (***k***): ln(2)/***t_{50}***				
	Central	0.024493	day^{-1}	Upper estimate of ***t_{50}*** used to calculate lower limit of ***k*** and lower estimate of ***t_{50}*** used to calculate upper limit of ***k***.
	Lower	0.016195		
	Upper	0.032696		

Worksheet D04 *(continued)*: Consumption of contaminated fruit, chronic exposure scenario [VegChHHRA01].

Initial Concentration on Vegetation (C_0): : $C_0 = A \times Drift \times rr$

Central	2.45	mg/kg veg.	
Lower	2.45		
Upper	5.25		

Concentration on Vegetation at time T (C_T): $C_T = C_0 \ e^{-kT}$

Central	2.70e-01	mg/kg veg.	The upper bound on the decay coefficient is used to calculate lower bound of residue rate and the lower bound on the decay coefficient is used to calculate the upper bound on residue rate.
Lower	1.29e-01		
Upper	1.22e+00		

Time-weighted Average Concentration on Raw Vegetation (C_{TWA}): $C_0 (1 - e^{-k T}) \div (k T)$

Central	0.9888207	mg/kg veg.	The upper bound on the decay coefficient is used to calculate lower bound of residue rate and the lower bound on the decay coefficient is used to calculate the upper bound on residue rate.
Lower	0.7886941		
Upper	2.7633803		

Proportion Removed by Washing (P_{wash}):

Central	0	unitless	Assume that washing is ineffective.
Lower	0		
Upper	0		

TWA Concentration on Consumed Vegetation (C_{Con}): $C_{TWA} \times 1\text{-}P_{Wash}$

Central	9.89e-01	mg/kg veg.
Lower	7.89e-01	
Upper	2.76e+00	

Dose estimates (D): $C_{Con} \times A$

Central	1.66e-03	mg/kg bw/day
Lower	1.33e-03	
Upper	3.44e-02	

Worksheet D05: Consumption of contaminated water following an accidental spill, acute exposure scenario [DWAcHHRA01].

Verbal Description: A young child (2-3 years old) consumes contaminated water shortly after an accidental spill of 200 gallons of a field solution into a pond that has an average depth of 1 m and a surface area of 1000 m^2 or about one-quarter acre . No dissipation or degradation is considered.

Parameters/Assumptions		Value	Units	Source/Reference
Surface area of pond (SA)		1000	m^2	N/A
Average depth (DPTH)		1	m	N/A
Volume of pond in cubic meters (VM)		1000	m^3	N/A
Volume of pond in Liters (VL)		1000000	L	1 m^3 = 1,000 L
Volume of spill (VS)		200	gallons	N/A
		757	liters	1 gallon = 3.785 Liters
Concentrations in field solution ($C_{Fld\ (mg/L)}$)				
	Central	4200	mg/L	APPL.TypDR × 1000
	Lower	1000		APPL.LowDR × 1000
	Upper	21000		APPL.Hi_DR × 1000
Concentrations in ambient water (C_{Wrt}): $C_{Fld} \times VS_{(Liters)} \div VL$)				
	Central	3.1794	mg/L	
	Lower	0.757		
	Upper	15.897		
Body weight (W)		13.3	kg	PUBL.BWC
Amount of water consumed (A)				
	Central	1	L/day	PUBL.WCT
	Lower	0.61		PUBL.WCL
	Upper	1.5		PUBL.WCH
Dose estimates (D): $C_{wrt} \times A \div W$				
	Central	2.39e-01	mg/kg bw	
	Lower	3.47e-02		
	Upper	1.79e+00		

Worksheet D06: Consumption of from a stream contaminated by runoff and/or percolation, acute exposure scenario [DWAcStrmHHRA01].

Verbal Description: A young child (2-3 years old) consumes contaminated ambient water from a stream that has been contaminated from run-off and/or percolation The levels in water are estimated from modeling or monitoring data and thus dissipation, degradation and other environmental processes are implicitly considered. The calculations involve multiplying the application rate (***R***) by the water contamination rate to get the concentration in ambient water. This product is in turn multiplied by the amount of water consumed per day and then divided by the body weight to get the estimate of the absorbed dose.

Parameters/Assumptions		Value	Units	Source/Reference
Application Rates (***R***)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Water Contamination Rate (***WCR***):				
	Central	0.02	mg/L per lb/acre applied	AMBWAT.AWPT
	Lower	0.005		AMBWAT.AWPL
	Upper	0.07		AMBWAT.AWPU
Body weight (***W***)		13.3	kg	PUBL.BWC
Amount of water consumed (***A***)				
	Central	1	L/day	PUBL.WCT
	Lower	0.61		PUBL.WCL
	Upper	1.5		PUBL.WCH
Concentration in Water (***C***): **R × WCR**				
	Central	0.007	mg/L	
	Lower	0.00175		
	Upper	0.0245		
Dose estimates (***D***): **C × A ÷ W**				
	Central	5.26e-04	mg/kg bw/day	
	Lower	8.03e-05		
	Upper	2.76e-03		

Worksheet D07: Consumption of contaminated water, chronic exposure scenario [DWChHHRA01].

Verbal Description: An adult (70 kg male) consumes contaminated ambient water for a lifetime. The levels in water are estimated from modeling or monitoring data and thus dissipation, degradation and other environmental processes are implicitly considered. The calculations involve multiplying the application rate by the water contamination rate to get the concentration in ambient water. This product is in turn multiplied by the amount of water consumed per day and then divided by the body weight to get the estimate of the absorbed dose.

Parameters/Assumptions		Value	Units	Source/Reference
Application Rates (***R***)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Water Contamination Rate (***WCR***):				
	Central	0.007	mg/L per lb/acre applied	AMBWAT.AWT
	Lower	0.001		AMBWAT.AWL
	Upper	0.013		AMBWAT.AWU
Body weight (***W***)		70	kg	PUBL.BWM
Amount of water consumed (***A***)				
	Central	2	L/day	PUBL.WCAT
	Lower	1.4		PUBL.WCAL
	Upper	2.4		PUBL.WCAH
Concentration in Water (***C***): **R × WCR**				
	Central	0.00245	mg/L	
	Lower	0.0004		
	Upper	0.00455		
Dose estimates (***D***): **C × A ÷ W**				
	Central	7.00e-05	mg/kg bw/day	
	Lower	7.00e-06		
	Upper	1.56e-04		

Worksheet D08a: Consumption of contaminated fish, acute exposure scenarios for recreational fisherman following an accidental spill [FishAcHHRA01].

Verbal Description: An adult angler consumes fish taken from contaminated water shortly after an accidental spill of a fixed amount of a field solution into a pond of a specified depth and surface area. No dissipation or degradation is considered. As in the acute drinking water scenario, the concentration in the pond estimated from the concentration in the spilled solution, the volume spilled and the volume of the pond, assuming instantaneous mixing. The concentration in fish is estimated as the product of the concentration in water and the chronic BCF. The dose is calculated as the product of the concentration in the fish and the amount of fish consumed divided by the body weight.

Parameters/Assumptions		Value	Units	Source/Reference
Surface area of pond [SA]		1000	m^2	N/A
Average depth [DPTH]		1	m	N/A
Volume of pond in cubic meters [VM]		1000	m^3	N/A
Volume of pond in Liters [VL]		1000000	L	1 m^3 = 1,000 L
Volume of spill [VS]		200	gallons	N/A
		757	liters	1 gallon = 3.785 Liters
Concentrations in spilled solution (C_{Fld} (mg/L))				
	Central	4200	mg/L	APPL.TYPDR×1000
	Lower	1000		APPL.LOWDR×1000
	Upper	21000		APPL.HI_DR×1000
Concentrations in ambient water (C_{Wat}): $C_{Fld} \times VS_{(Liters)} \div$ VL				
	Central	3.1794	mg/L	
	Lower	0.757		
	Upper	15.897		
Bioconcentration factor ($BCF_{(L/kg\ fish)}$)		1	L/kg fish	CHEM.BCFT
Concentration in fish (C_{Fish}): C_{Wat} × BCF				
	Central	3.1794	mg/kg fish	
	Lower	0.757		
	Upper	15.897		
Body weight (W)		70	kg	PUBL.BWM
Amount of fish consumed (A)				
	Central	0.158	kg/day	PUBL.FAU
	Lower	0.158		PUBL.FAU
	Upper	0.158		PUBL.FAU
Dose estimates (D): $C_{Fish} \times A \div W$				
	Central	7.18e-03	mg/kg bw	
	Lower	1.71e-03		
	Upper	3.59e-02		

Worksheet D08b: Consumption of contaminated fish, acute exposure scenarios for subsistence populations following an accidental spill [FishAcHHRA02].

Verbal Description: An individual who relies on caught fish as a major source of protein consumes fish taken from contaminated water shortly after an accidental spill of a fixed amount of a field solution into a pond of a specified depth and surface area. As in the acute drinking water scenario, the concentration in the pond estimated from the concentration in the spilled solution, the volume spilled and the volume of the pond, assuming instantaneous mixing. The concentration in fish is estimated as the product of the concentration in water and the chronic BCF. The dose is calculated as the product of the concentration in the fish and the amount of fish consumed divided by the body weight.

Parameters/Assumptions		Value	Units	Source/Reference
Surface area of pond [SA]		1000	m^2	N/A
Average depth [DPTH]		1	m	N/A
Volume of pond in cubic meters [VM]		1000	m^3	N/A
Volume of pond in Liters [VL]		1000000	L	1 m^3 = 1,000 L
Volume of spill [VS]		200	gallons	N/A
		757	liters	1 gallon = 3.785 Liters
Concentrations in spilled solution (C_{Fld} (mg/L))				
	Central	4200	mg/L	APPL.TYPDR×1000
	Lower	1000		APPL.LOWDR×1000
	Upper	21000		APPL.HI_DR×1000
Concentrations in ambient water (C_{Wat}): $C_{Fld} \times VS_{(Liters)} \div VL$				
	Central	3.1794	mg/L	
	Lower	0.757		
	Upper	15.897		
Bioconcentration factor ($BCF_{(L/kg\ fish)}$)		1	L/kg fish	CHEM.BCFT
Concentration in fish (C_{Fish}): $C_{Wat} \times$ BCF				
	Central	3.1794	mg/kg fish	
	Lower	0.757		
	Upper	15.897		
Body weight (W)		70	kg	PUBL.BWM
Amount of fish consumed (A)				
	Central	0.77	kg/day	PUBL.FNU
	Lower	0.77		PUBL.FNU
	Upper	0.77		PUBL.FNU
Dose estimates (D): $C_{Fish} \times A \div W$				
	Central	3.50e-02	mg/kg bw	
	Lower	8.33e-03		
	Upper	1.75e-01		

Worksheet D09a: Consumption of contaminated fish, chronic exposure scenario for recreational fisherman [FishChHHRA01].

Verbal Description*:* An adult (70 kg male) consumes fish taken from contaminated ambient water for a lifetime. The levels in water are estimated from monitoring data and thus dissipation, degradation and other environmental processes are implicitly considered. As in the chronic drinking water scenario, the concentration in water is calculated as the application rate multiplied by the water contamination rate. The concentration in fish is estimated as the product of the concentration in water and the chronic BCF. The dose is calculated as the product of the concentration in the fish and the amount of fish consumed divided by the body weight.

Parameters/Assumptions		Value	Units	Source/Reference
Application Rates (***R***)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Water Contamination Rate (***WCR***)				
	Central	0.007	mg/L per lb/acre applied	AMBWAT.AWT
	Lower	0.001		AMBWAT.AWL
	Upper	0.013		AMBWAT.AWU
Concentration in Water (C_{Wat}): $R \times WCR$				
	Central	0.00245	mg/L	
	Lower	0.00035		
	Upper	0.00455		
Bioconcentration factor (***BCF***)		1	L/kg fish	CHEM.BCFCh
Concentration in fish (C_{Fish}): $C_{Wat} \times$ BCF)				
	Central	0.00245	mg/kg fish	
	Lower	0.00035		
	Upper	0.00455		
Body weight (***W***)		70	kg	PUBL.BWM
Amount of fish consumed (***A***)				
	Central	0.01	kg/day	PUBL.FAT
	Lower	0.01		PUBL.FAT
	Upper	0.01		PUBL.FAT
Dose estimates (***D***): $C_{Fish} \times A \div W$				
	Central	3.50e-07	mg/kg bw/day	
	Lower	5.00e-08		
	Upper	6.50e-07		

Worksheet D09b: Consumption of contaminated fish, chronic exposure scenario for subsistence populations [FishChHHRA02].

Verbal Description: An individual who relies on caught fish as a major source of protein consumes fish taken from contaminated ambient water for a lifetime. The levels in water are estimated from monitoring data and thus dissipation, degradation and other environmental processes are implicitly considered. As in the chronic drinking water scenario, the concentration in water is calculated as the application rate multiplied by the water contamination rate. The concentration in fish is estimated as the product of the concentration in water and the chronic BCF. The dose is calculated as the product of the concentration in the fish and the amount of fish consumed divided by the body weight.

Parameters/Assumptions		Value	Units	Source/Reference
Application Rates (***R***)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Water Contamination Rate (***WCR***) : **C** ÷ ***R***				
	Central	0.007	mg/L per lb/acre applied	AMBWAT.AWT
	Lower	0.001		AMBWAT.AWL
	Upper	0.013		AMBWAT.AWU
Concentration in Water (***C***): **R × WCR**				
	Central	0.00245	mg/L	
	Lower	0.00035		
	Upper	0.00455		
Bioconcentration factor (***BCF***)		1	L/kg fish	CHEM.BCFCh
Concentration in fish (C_{Fish}): C_{Wat} × **BCF**				
	Central	0.00245	mg/kg fish	
	Lower	0.00035		
	Upper	0.00455		
Body weight (***W***)		70	kg	PUBL.BWM
Amount of fish consumed (***A***)				
	Central	0.081	kg/day	PUBL.FNT
	Lower	0.081		PUBL.FNT
	Upper	0.081		PUBL.FNT
Dose estimates (***D***): C_{Fish} × ***A*** ÷ ***W***				
	Central	2.84e-06	mg/kg bw/day	
	Lower	4.05e-07		
	Upper	5.27e-06		

Worksheet E01: Summary of Worker Exposure Scenarios

Scenario	Dose (mg/kg/day or event)			Exposure Assessment Worksheet
	Central	Lower	Upper	
General Exposures (dose in mg/kg/day)				
Directed ground spray (Backpack)	4.59e-03	1.58e-04	2.80e-02	C01a
Broadcast ground spray (Boom spray)	7.84e-03	2.31e-04	5.29e-02	C01b
Aerial applications	5.15e-03	8.40e-05	2.80e-02	C01c
Accidental/Incidental Exposures (dose in mg/kg/event)				
Immersion of Hands, 1 minute	1.43e-06	8.80e-08	2.73e-05	C02a
Contaminated Gloves, 1 hour	8.57e-05	5.28e-06	1.64e-03	C02b
Spill on hands, 1 hour	2.54e-04	1.25e-05	6.24e-03	C03a
Spill on lower legs, 1 hour	6.26e-04	3.08e-05	1.54e-02	C03b

Worksheet E02: Summary of risk characterization (HQ's[1]) for workers.

Acute RfD	0.75	mg/kg/day	Sect. 3.3.3.	
Chronic RfD	0.15	mg/kg/day	Sect. 3.3.3.	

Scenario	Hazard Quotient Based on Chronic RfD			Exposure Assessment Worksheet
	Central	Lower	Upper	
General Exposures [using Chronic RfD]				
Directed ground spray (Backpack)	3e-02	1e-03	2e-01	C01a
Broadcast ground spray (Boom spray)	5e-02	2e-03	4e-01	C01b
Aerial applications	3e-02	6e-04	2e-01	C01c
Accidental/Incidental Exposures [using Acute RfD]				
Scenario	Hazard Quotient Based on Acute RfD			Exposure Assessment Worksheet
	Central	Lower	Upper	
Immersion of Hands, 1 minute	2e-06	1e-07	4e-05	C02a
Contaminated Gloves, 1 hour	1e-04	7e-06	2e-03	C02b
Spill on hands, 1 hour	3e-04	2e-05	8e-03	C03a
Spill on lower legs, 1 hour	8e-04	4e-05	2e-02	C03b

[1] Hazard quotient is the level of exposure divided by the RfD then rounded to one significant decimal place or digit. See Worksheet E01 for summary of exposure assessment.

Worksheet E03: Summary of Exposure Scenarios for the General Public

Scenario	Target	Dose (mg/kg/day)			Worksheet
		Central	Lower	Upper	
Acute/Accidental Exposures					
Direct spray, entire body	Child	9.59e-03	4.71e-04	2.36e-01	D01a
Direct spray, lower legs	Woman	9.64e-04	4.74e-05	2.37e-02	D01b
Dermal, contaminated vegetation	Woman	5.03e-04	1.04e-04	2.40e-03	D02
Contaminated fruit	Woman	4.12e-03	4.12e-03	6.53e-02	D03
Contaminated water, spill	Child	2.39e-01	3.47e-02	1.79e+00	D05
Contaminated water, stream	Child	5.26e-04	8.03e-05	2.76e-03	D06
Consumption of fish, general public	Man	7.18e-03	1.71e-03	3.59e-02	D08a
Consumption of fish, subsistence populations	Man	3.50e-02	8.33e-03	1.75e-01	D08b
Chronic/Longer Term Exposures					
Contaminated fruit	Woman	1.66e-03	1.33e-03	3.44e-02	D04
Consumption of water	Man	7.00e-05	7.00e-06	1.56e-04	D07
Consumption of fish, general public	Man	3.50e-07	5.00e-08	6.50e-07	D09a
Consumption of fish, subsistence populations	Man	2.84e-06	4.05e-07	5.27e-06	D09b

Worksheet E04: Summary of risk characterization (HQ's[1]) for the general public [1] .

Chronic RfD		0.15	mg/kg/day	Sect. 3.3.3.	
Acute RfD		0.75	mg/kg/day	Sect. 3.3.3.	

Scenario	Target	Hazard Quotient			Worksheet
		Central	Lower	Upper	
Acute/Accidental Exposures					
Direct spray, entire body	Child	1e-02	6e-04	3e-01	D01a
Direct spray, lower legs [2]	Woman	1e-03	6e-05	3e-02	D01b
Dermal, contaminated [2] vegetation	Woman	7e-04	1e-04	3e-03	D02
Contaminated fruit [2]	Woman	5e-03	5e-03	9e-02	D03
Contaminated water, spill	Child	3e-01	5e-02	**2**	D05
Contaminated water, stream	Child	7e-04	1e-04	4e-03	D06
Consumption of fish, general public	Man	1e-02	2e-03	5e-02	D08a
Consumption of fish, subsistence populations	Man	5e-02	1e-02	2e-01	D08b
Chronic/Longer Term Exposures					
Contaminated fruit	Woman	1e-02	9e-03	2e-01	D04
Consumption of water	Man	5e-04	5e-05	1e-03	D07
Consumption of fish, general public	Man	2e-06	3e-07	4e-06	D09a
Consumption of fish, subsistence populations	Man	2e-05	3e-06	4e-05	D09b

[1] The hazard quotients are the level of exposure divided by the RfD then rounded to one or two significant decimal places or digits. Hazard quotients >1 and ≤2 are shown to two significant digits. All others are rounded to one significant decimal place or integer. All hazard quotients that are below the level of concern – i.e., a hazard quotient below unity – are expressed in scientific notation. All hazard quotients greater than unity are expressed in fixed point decimal notation and highlighted with a shaded background.

Worksheet F01: Direct spray of small mammal assuming first order absorption kinetics [DDFOAEco01].

Verbal Description: A mammal of a specified body weight is directly sprayed over one half of the body surface as the chemical is being applied. An empirical relationship between body weight and surface area is used to estimate the surface area of the animal. The absorbed dose over the first day – i.e., a 24 hour period – is estimated using the assumption of first-order dermal absorption.

Parameter/Assumption		Value	Units	Source/Reference
Period of exposure (***T***)		24	hour	N/A
Body weight (***W***)		0.020	kg	Section 4.2.1.
Exposed surface area (***A***)		m^2=0.11 × BW(kg)$^{0.65}$		U.S. EPA/ORD 1993, eq. 3-22, p. 3-14
		0.0086509	m^2	
		86.51	cm^2	10,000 cm^2 /m^2
Application rate in lbs/acre (***R***$_{lbs}$)				
	Central	0.35	lb/acre	APPL.TYP
	Lower	0.35		APPL.LOW
	Upper	0.35		APPL.HI
Conversion Factor (***CF***) for lb/acre to mg/cm^2		0.01121		Const.LBAC_MGCM
Application rate in mg/cm^2 (***R***$_{mg}$): ***R***$_{lbs}$ × ***CF***				
	Central	0.003924	lb/acre	
	Lower	0.003924		
	Upper	0.003924		
First-order dermal absorption rate (***k***)				
	Central	0.00063	$hour^{-1}$	DERM.AbsC
	Lower	0.000130		DERM.AbsL
	Upper	0.00310		DERM.AbsU
Amount deposited on animal (***Amnt***): ***0.5*** × ***A*** × ***R***$_{mg}$				
	Central	0.16971	mg	
	Lower	0.169709		
	Upper	0.16971		
Proportion absorbed over period ***T*** (***Prop***): $1-e^{-k\,T}$				
	Central	0.01501	unitless	
	Lower	0.003115		
	Upper	0.07170		
Estimated Absorbed Doses (***D***): **Amnt × Prop ÷ W**				
	Central	1.27e-01	mg/kg	
	Lower	2.64e-02		
	Upper	6.08e-01		

Worksheet F02a: Direct spray of small mammal assuming 100% absorption over the first 24 hour period [DDEco01].

Verbal Description*: A 20 g mammal is directly sprayed over one half of the body surface as the chemical is being applied. The deposited dose is assumed to be completely absorbed during the first day. An empirical relationship between body weight and surface area is used to estimate the surface area of the animal.*

Parameter/Assumption		Value	Units	Source/Reference
Period of exposure (***T***)		24	hour	N/A
Body weight (***W***)		0.020	kg	Section 4.2.1.
Exposed surface area		m^2=0.011 × BW(g)$^{0.65}$		U.S. EPA/ORD 1993, eq. 3-22, p. 3-14
		0.0086509	m^2	
	(***SA***)	86.51	cm^2	m^2 = 10,000 cm^2
Application rate in lbs/acre (R_{lbs})				
	Central	0.35	lb/acre	APPL.TYP
	Lower	0.35		APPL.LOW
	Upper	0.35		APPL.HI
Conversion Factor (***CF***) for lb/acre to mg/cm^2		0.01121		Const.LBAC_MGCM
Application rate in mg/cm^2 (R_{mg}): R_{lbs} × ***CF***				
	Central	0.003924	mg/cm^2	
	Lower	0.003924		
	Upper	0.003924		
Amount deposited on animal (***Amnt***): ***0.5*** × ***SA*** × R_{mg}				
	Central	0.16971	mg	
	Lower	0.169709		
	Upper	0.16971		
Estimated Absorbed Doses (D_{Abs}): **Amnt ÷ W**				
	Central	8.49e+00	mg/kg	
	Lower	8.49e+00		
	Upper	8.49e+00		

Worksheet F02b: Direct spray of bee assuming 100% absorption over the first 24 hour period [DDEco02].

Verbal Description*: A honeybee is directly sprayed over one half of the body surface as the chemical is being applied. The deposited dose is assumed to be completely absorbed during the first day. An empirical relationship between body weight and surface area is used to estimate the surface area of the animal.*

Parameter/Assumption		Value	Units	Source/Reference
Period of exposure (***T***)		24	hour	N/A
Body weight (***W***)		0.000093	kg	Section 4.2.1.
Exposed surface area (***SA***)		$cm^2=1110\times BW(kg)^{0.65}$		Boxenbaum and D'Souza 1990
		2.6597260	cm^2	
Application rate ($\boldsymbol{R_{lbs}}$)				
	Central	0.35	lb/acre	APPL.TYP
	Lower	0.35		APPL.LOW
	Upper	0.35		APPL.HI
Conversion Factor (***CF***) for lb/acre to mg/cm^2		0.01121		Const.LBAC_MGCM
Application rate in mg/cm^2 ($\boldsymbol{R_{mg}}$): $\boldsymbol{R_{lbs} \times CF}$				
	Central	0.003924	mg/cm^2	
	Lower	0.003924		
	Upper	0.003924		
Amount deposited on animal (***Amnt***): $\boldsymbol{0.5 \times SA \times R_{mg}}$				
	Central	0.00522	mg	
	Lower	0.005218		
	Upper	0.00522		
Estimated Absorbed Doses ($\boldsymbol{D}_{\text{Abs}}$): $\boldsymbol{Amnt \div W}$				
	Central	5.61e+01	mg/kg	
	Lower	5.61e+01		
	Upper	5.61e+01		

Worksheet F03: Consumption of contaminated fruit by a small mammal, acute exposure scenario [VegAcERA01].

Verbal Description*: A 20 g mammal consumes fruit shortly after application of the chemical - i.e. no dissipation or degradation is considered. The contaminated vegetation accounts for 100% of the diet. Residue estimates based on relationships for fruit from* Siltanen et al. (1981).

Parameters/Assumptions		Value	Units	Source/Reference
Body weight (***W***)		0.020	kg	Section 4.2.1
Allometric coefficients for food consumption in g based on body weight in g				
	a	0.621		Rodents U.S. EPA/ORD 1993, p. 3-6
	b	0.584		
Food consumed per day (***A***): $\mathbf{a \times (W \times 1000)^{b} \div 1000}$				
		0.003572	kg	
Application rates (***R***)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Residue rates (***rr***)				
	Central	7	mg/kg per lb/acre	HK.FRT2
	Lower	7		HK.FRT2
	Upper	15		HK.FRU2
Concentration in food(***C***): **R × rr**				
	Central	2.45	mg/kg food	
	Lower	2.45		
	Upper	5.25		
Dose estimates (***D***): **A × C ÷ W**				
	Central	4.38e-01	mg/kg bw	
	Lower	4.38e-01		
	Upper	9.38e-01		

Worksheet F04a: Consumption of contaminated fruit by a small mammal, chronic exposure scenario at application site [VegChSmMam01].

Verbal Description: A 20 g mammal consumes contaminated fruit for a 90 day period starting shortly after application of the chemical. Food consumption is estimated from allometric relationships. The concentration of the chemical in fruit at time zero (C_0) is estimated from the application rate (A), the proportion of drift (***Drift***), and empirical residues rates (***rr***) from Siltanen et al. (1981). Because the animal is assumed to inhabit the application site, drift is taken as unity - i.e., direct spray. The foliar halftime (t_{50}) is used to estimate the foliar decay coefficient (k): $\mathbf{k = \ln(2) \div t_{50}}$. The concentration on the vegetation after time t (C_t) is calculated as $C_t = C_0 e^{-kt}$. The time-weighted average of the concentration on vegetation ($\mathbf{C_{TWA}}$) is calculated as the integral of the concentration after time t (C_t) divided by the duration (t). The daily dose is calculated as the product of food consumption and the proportion of the diet that is contaminated divided by the body weight.

Parameters/Assumptions		Value	Units	Source/Reference
Duration of exposure (T)		90	days	N/A
Body weight (W)		0.02	kg	N/A
Allometric coefficients for food consumption in g based on body weight in g				
	a	0.621		U.S. EPA/ORD 1993, p. 3-6
	b	0.584		
Food consumed per day (A): $\mathbf{a \times (W \times 1000)^{b} \div 1000}$				
		0.0035718	kg	
Foliar halftimes ($t_{½}$)	Central	28.3	days	CHEM.FrT12C
	Lower	21.2		CHEM.FrT12L
	Upper	42.8		CHEM.FrT12U
Application rates (R)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Residue rates (rr):				
	Central	7	mg/kg per lb/acre	HK.FRT2
	Lower	7		HK.FRT2
	Upper	15		HK.FRU2
Drift (***Drift***):				
	Central	1	unitless	Assume direct spray
	Lower	1		
	Upper	1		
Decay coefficient (k): $\ln(2)/t_{50}$				
	Central	0.0244928	day^{-1}	Upper estimate of t_{50} used to calculate lower limit of k and lower estimate of t_{50} used to calculate upper limit of k.
	Lower	0.0161950		
	Upper	0.0326956		

Worksheet F04a *(continued)*: Consumption of contaminated vegetation by a small mammal, chronic exposure scenario .

Initial Concentration on Vegetation ($\mathbf{C_0}$): : $\mathbf{C_0 = R \times rr \times Drift}$

Central	2.45	mg/kg veg.	
Lower	2.45		
Upper	5.25		

Concentration on Vegetation at time T (C_T): $\mathbf{C_T = C_0\ e^{-kT}}$

Central	2.70e-01	mg/kg veg.	These values are not used directly in calculating the dose.
Lower	1.29e-01		
Upper	1.22e+00		

Time-weighted Average Concentration on Vegetation (C_{TWA}): $\mathbf{C_0\ (1 - e^{-k\,T})\ \div\ (k\ T)}$

Central	9.89e-01	mg/kg veg.	
Lower	7.89e-01		
Upper	2.76e+00		

Proportion of Diet Contaminated (*Prop*)[1]:

Central	0.1	unitless	See footnote.
Lower	0.05		
Upper	0.2		

Dose estimates (D_{Abs}): $\mathbf{C_{TWA} \times A \times Prop \div W}$

Central	1.77e-02	mg/kg/day
Lower	7.04e-03	
Upper	9.87e-02	

[1] Based on data on the shrew (U.S. EPA/ORD 1996, p. 2-214,), the vegetation accounts for about 5% of the diet. This is used as the lower limit. The typical and upper values are judgmentally set to account for incidental contamination of other food items such as insects as well as different feeding preferences among other small mammals.

Worksheet F04b: Consumption of contaminated fruit by a small mammal, chronic exposure scenario off-site [VegChSmMam02].

Verbal Description: A 20 g mammal consumes contaminated fruit for a 90 day period starting shortly after application of the chemical. Food consumption is estimated from allometric relationships. The concentration of the chemical in fruit at time zero (C_0) is estimated from the application rate (***A***), the proportion of drift (***Drift***), and empirical residues rates (***rr***) from Siltanen et al. (1981). Drift is estimated for distances of 25 to 100 feet from the application site. The foliar halftime (t_{50}) is used to estimate the foliar decay coefficient (***k***): $\mathbf{k = \ln(2) \div t_{50}}$. The concentration on the vegetation after time ***t*** (C_t) is calculated as $C_t = C_0 e^{-kt}$. The time-weighted average of the concentration on vegetation ($\mathbf{C_{TWA}}$) is calculated as the integral of the concentration after time ***t*** (C_t) divided by the duration (***t***). The daily dose is calculated as the product of food consumption and the proportion of the diet that is contaminated divided by the body weight.

Parameters/Assumptions		Value	Units	Source/Reference
Duration of exposure (***T***)		90	days	N/A
Body weight (***W***)		0.02	kg	Section 4.2.1
Allometric coefficients for food consumption in g based on body weight in g				
	a	0.621		U.S. EPA/ORD 1993, p. 3-6
	b	0.584		
Food consumed per day (***A***): $\mathbf{a \times (W \times 1000)^{b} \div 1000}$				
		0.0035718	kg	
Foliar halftimes ($t_{½}$)	Central	28.3	days	CHEM.FrT12C
	Lower	21.2		CHEM.FrT12L
	Upper	42.8		CHEM.FrT12U
Application rates (***R***)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Residue rates (***rr***):				
	Central	7	mg/kg per lb/acre	HK.FRT2
	Lower	7		HK.FRT2
	Upper	15		HK.FRU2
Drift (***Drift***):				
	50 feet	0.0101	unitless	Estimated from AgDRIFT for low-boom applications. See Worksheet A06.
	100 feet	0.0058		
	25 feet	0.0187		
Decay coefficient (***k***): $\ln(2)/t_{50}$				
	Central	0.0244928	day^{-1}	Upper estimate of t_{50} used to calculate lower limit of ***k*** and lower estimate of t_{50} used to calculate upper limit of ***k***.
	Lower	0.0161950		
	Upper	0.0326956		

Worksheet F04b *(continued)*: Consumption of contaminated vegetation by a small mammal, chronic off-site exposure scenario .

Initial Concentration on Vegetation ($\mathbf{C_0}$): $\mathbf{C_0 = R \times rr \times Drift}$

Central	0.024745	mg/kg veg.
Lower	0.01421	
Upper	0.098175	

Concentration on Vegetation at time T (C_T): $\mathbf{C_T = C_0\ e^{-kT}}$

Central	2.73e-03	mg/kg veg.
Lower	7.49e-04	
Upper	2.29e-02	

Time-weighted Average Concentration on Vegetation (C_{TWA}): $\mathbf{C_0\ (1 - e^{-k\,T}) \div (k\ T)}$

Central	9.99e-03	mg/kg veg.
Lower	4.57e-03	
Upper	5.17e-02	

Proportion of Diet Contaminated (*Prop*)[1]:

Central	0.1	unitless	See footnote.
Lower	0.05		
Upper	0.2		

Dose estimates (D): $\mathbf{C_{TWA} \times A \times Prop \div W}$

Central	1.78e-04	mg/kg bw/day
Lower	4.08e-05	
Upper	1.85e-03	

[1] Based on data on the shrew (U.S. EPA/ORD 1996, p. 2-214,), the vegetation accounts for about 5% of the diet. This is used as the lower limit. The typical and upper values are judgementally set to account for incidental contamination of other food items such as insects as well as different feeding preferences among other small mammals.

Worksheet F05: Consumption of contaminated water by a small mammal, acute exposure scenario for an accidental spill. [DWAcERA01].

Verbal Description*: An animal of a specified weight consumes contaminated water shortly after an accidental spill into a small pond. No dissipation or degradation is considered.* The amount of water consumed is estimated from allometric relationships. The calculations involve multiplying the concentration in the field solution by the amount of solution spilled to get the amount of chemical released. This is divided by the volume of water in the pond to get the concentration in ambient water. The resulting concentration is multiplied by the amount of water consumed per day and then divided by the body weight to get the estimate of the absorbed dose.

Parameters/Assumptions		Value	Units	Source/Reference
Surface area of pond [SA]		1000	m^2	N/A
Average depth [DPTH]		1	m	N/A
Volume of pond in cubic meters [VM]		1000	m^3	N/A
Volume of pond in Liters [VL]		1000000	L	1 m^3 = 1,000 L
Volume of spill [VS]		200	gallons	N/A
		757	liters	1 gallon = 3.785 Liters
Concentrations in field solution ($C_{Fld\ (mg/L)}$)				
	Central	4200	mg/L	APPL.TypDR × 1000
	Lower	1000		APPL.LowDR × 1000
	Upper	21000		APPL.Hi_DR × 1000
Concentrations in ambient water (C_{Wrt}): $C_{Fld} \times VS_{(Liters)} \div VL$)				
	Central	3.1794	mg/L	
	Lower	0.757		
	Upper	15.897		
Body weight (W)		0.02	kg	Section 4.2.1
Allometric coefficients for water consumption in L based on body weight in kg				
	a	0.099		All mammals. U.S. EPA/ORD 1993, Eq. 3-17, p. 3-10.
	b	0.9		
Water consumed per day (A): $\mathbf{a \times W^{b}}$				
		0.002928	L	
Dose estimates (D): $C_{wrt} \times A \div W$				
	Central	4.65e-01	mg/kg bw	
	Lower	1.11e-01		
	Upper	2.33e+00		

Worksheet F06: Consumption of contaminated water by a small mammal, acute exposure scenario for runoff or percolation into a stream. [DWAcStrmERA01].

Verbal Description: An small mammal consumes stream water contaminated by runoff and/or percolation. The peak levels in water are estimated from modeling or monitoring data and thus dissipation, degradation and other environmental processes are implicitly considered. The calculations involve multiplying the application rate by the water contamination rate to get the concentration in ambient water. This product is in turn multiplied by the amount of water consumed per day and then divided by the body weight to get the estimate of the absorbed dose.

Parameters/Assumptions		Value	Units	Source/Reference
Application Rates (***R***)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Peak Water Contamination Rate (***rr***):				
	Central	0.02	mg/L per lb/acre applied	AMBWAT.AWPT
	Lower	0.005		AMBWAT.AWPL
	Upper	0.07		AMBWAT.AWPU
Body weight (***W***)		0.02	kg	
Allometric coefficients for water consumption in L based on body weight in kg				
	a	0.099		All mammals. U.S. EPA/ORD 1993, Eq. 3-17, p. 3-10.
	b	0.9		
Water consumed per day (***A***): $\mathbf{a \times W^{b}}$				
		0.002928	L	
Concentration in Water (***C***): **R** × **rr**				
	Central	0.007	mg/L	These values are used in Worksheet G03 for characterizing acute risks to aquatic species.
	Lower	0.00175		
	Upper	0.0245		
Dose estimates (***D***): **C** × **A** ÷ **W**				
	Central	1.02e-03	mg/kg bw/day	
	Lower	2.56e-04		
	Upper	3.59e-03		

Worksheet F07: Consumption of contaminated water by a small mammal, chronic exposure scenario [DWChERA01].

Verbal Description: A small mammal consumes contaminated ambient water for an extended period of time. The levels in water are estimated from modeling or monitoring data and thus dissipation, degradation and other environmental processes are implicitly considered. The calculations involve multiplying the application rate by the water contamination rate to get the concentration in ambient water. This product is in turn multiplied by the amount of water consumed per day and then divided by the body weight to get the estimate of the absorbed dose.

Parameters/Assumptions		Value	Units	Source/Reference
Application Rates (***R***)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Water Contamination Rate (***rr***):				
	Central	0.007	mg/L per lb/acre applied	AMBWAT.AWT
	Lower	0.001		AMBWAT.AWL
	Upper	0.013		AMBWAT.AWU
Body weight (***W***)		0.02	kg	
Allometric coefficients for water consumption in L based on body weight in kg				
	a	0.099		All mammals. U.S. EPA/ORD 1993, Eq. 3-17, p. 3-10.
	b	0.9		
Water consumed per day (***A***): $\mathbf{a \times W^{b}}$				
		0.002928	L	
Concentration in Water (***C***): **R** × **rr**				
	Central	0.00245	mg/L	
	Lower	3.50e-04		
	Upper	0.00455		
Dose estimates (***D***): **C** × **A** ÷ **W**				
	Central	3.59e-04	mg/kg/day	
	Lower	5.12e-05		
	Upper	6.66e-04		

Worksheet F08: Consumption of contaminated fish by predatory bird, acute exposure scenario after accidental spill. *[FishBirdAcute]*

Verbal Description: A predatory bird consumes fish taken from contaminated water after an accidental spill of 200 gallons of a field solution into a pond that has an average depth of 1 m and a surface area of 1000 m^2 or about one-quarter acre . No dissipation or degradation is considered. The assumption is made that bioconcentration will reach equilibrium. This probably will overestimate exposure and subsequent risk.

Parameters/Assumptions		Value	Units	Source/Reference
Surface area of pond (SA)		1000	m^2	N/A
Average depth (DPTH)		1	m	N/A
Volume of pond in cubic meters (VM)		1000	m^3	N/A
Volume of pond in Liters (VL)		1000000	L	1 m^3 = 1,000 L
Volume of spill (VS)		200	gallons	N/A
	$\mathbf{VS_L}$	757	liters	1 gallon = 3.785 liters
Concentrations in field solution (***FC***)				
	Central	4200	mg/L	APPL.TypDR×1000
	Lower	1000		APPL.LowDR×1000
	Upper	21000		APPL.Hi_DR×1000
Concentrations in ambient water (***WC***): $\mathbf{FC \times VS_L / VL}$				
	Central	3.1794	mg/L	
	Lower	0.757		
	Upper	15.897		
Bioconcentration factor (***BCF***)		1	L/kg fish	CHEM.BCFWA
Concentrations in whole fish ($\boldsymbol{C_{Fish}}$): **WC × BCF**				
	Central	3.1794	mg/kg fish	
	Lower	0.757		
	Upper	15.897		
Fish consumed as a proportion of body weight ($\mathbf{P_F}$)				
	Central	0.1	g fish/g bw	Various species based on values from U.S. EPA/ORD (1993).
	Lower	0.05		
	Upper	0.15		
Dose estimates (D) ($\mathbf{C_{Fish} \times P_F}$)				
	Central	3.18e-01	mg/kg bw/day	
	Lower	3.79e-02		
	Upper	2.38e+00		

Worksheet F09: Consumption of contaminated fish by predatory bird, chronic exposure scenario. *[FishBirdChronic]*

Verbal Description*: An predatory bird consumes fish taken from contaminated ambient water for a lifetime. The levels in water are estimated from monitoring and modeling data and dissipation, degradation and other environmental processes are considered.*

Parameters/Assumptions		Value	Units	Source/Reference
Application Rates (***R***)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Water Contamination Rate (***WCR***)				
	Central	0.007	mg/L per lb/acre applied	AMBWAT.AWT
	Lower	0.001		AMBWAT.AWL
	Upper	0.013		AMBWAT.AWU
Concentration in Water (***C***): **WCR × R**				
	Central	0.00245	mg/L	These values are used in G03 for chronic assessment of aquatic species.
	Lower	0.00035		
	Upper	0.00455		
Bioconcentration factor (***BCF***)		1	L/kg fish	CHEM.BCFWhl
Concentrations in whole fish (***FC***): **C × BCF**				
	Central	0.00245	mg/kg fish	
	Lower	0.00035		
	Upper	0.00455		
Fish consumed as a proportion of body weight (P_F)				
	Central	0.1	g fish/g bw	Various species based on values from U.S. EPA/ORD (1993).
	Lower	0.05		
	Upper	0.15		
Dose estimates (***D***): **FC × P_F**				
	Central	2.45e-04	mg/kg bw/day	
	Lower	1.75e-05		
	Upper	6.83e-04		

Worksheet F10: Consumption of contaminated vegetation by a large mammal, acute exposure scenario on-site. *[VGCLMA]*

***Verbal Description**:* A 70 kg herbivore, such as a deer, consumes short grass shortly after application of the chemical - i.e. no dissipation or degradation is considered. Caloric requirements are used to estimate food consumption.

Parameters/Assumptions		Value	Units	Source/Reference
Body weight (***W***)		70	kg	N/A
Caloric requirement (***KR***)		5226.288	kcal/day	U.S. EPA/ORD (1993, p. 3-6)
above based on following equation: $kcal/day = 1.518 \times W(g)^{0.73}$				
Caloric content of vegetation (dry weight, ***KCD***)		2.46	kcal/g	U.S. EPA (1993, p. 3-5)
Water content of vegetation (proportion, ***PW***)		0.85	unitless	U.S. EPA/ORD (1993, p. 4-14)
Caloric content of vegetation (wet weight, ***KCW***)		0.37	kcal/g	***KCD*** × (1-***PW***)
Food consumed per day (wet weight, ***A***)		14.16338	kg	(***KR*** ÷ ***KCW***)/1000 g/kg
Duration of exposure (***T***)		1	day	N/A
Application rates (***R***)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Residue rates (***rr***)				
	Central	85	mg/kg veg. per lb/acre applied	HK.SGT
	Lower	85		HK.SGT
	Upper	240		HK.SGU
Conc. in Vegetation (***C***): ***R*** × ***rr***				
	Central	29.75	mg/kg	Note: lower value based on typical ***rr*** and lower ***R***.
	Lower	29.75		
	Upper	84		
Drift (***Drift***)				
	Central	1	unitless	Direct spray on-site
	Lower	1		
	Upper	1		
Proportion of Diet Contaminated (***Prop***)				
	Central	1	unitless	Assume grazing exclusively on-site.
	Lower	1		
	Upper	1		
Dose estimates (***D***): **Drift × Prop × C × A ÷W**				
	Central	6.02e+00	mg/kg bw	
	Lower	6.02e+00		
	Upper	1.70e+01		

Worksheet F11a: Consumption of contaminated vegetation by a large mammal, chronic exposure scenario on-site [VegChLrgMam01].

***Verbal Description**:* A 70 kg herbivore, such as a deer, consumes short grass for a 90 day period after application of the chemical. The contaminated vegetation accounts for 10 to 100% of the diet assuming that the animal would spend 10 to 100% of the grazing time at the application site. Because the animal is assumed to be on-site, drift is set to unity - i.e., direct spray. Residue estimates based on relationships for range grass. Caloric requirements are used to estimate food consumption. Dissipation is considered using the foliar halftime and taking time-weighted average concentration over the exposure period.

Parameters/Assumptions		Value	Units	Source/Reference
Duration of exposure (***T***)		90	days	N/A
Body Weight (***W***)		70	kg	
Caloric requirement (***KR***)		5226.28803	kcal/day	U.S. EPA/ORD (1993, p. 3-6)
above based on following equation: $kcal/day = 1.518 \times W(g)^{0.73}$				
Caloric content of vegetation (dry weight, ***KCD***)		2.46	kcal/g	U.S. EPA/ORD (1993, p. 3-5)
Water content of vegetation (proportion, ***PW***)		0.85	unitless	U.S. EPA/ORD (1993, p. 4-14)
Caloric content of vegetation (wet weight, ***KCW***)		0.369	kcal/g	***KCD*** × (1-***PW***)
Food consumed per day (wet weight, ***A***)		14.1633822	kg	(***KR*** ÷ ***KCW***)/1000 g/kg
Foliar halftimes ($t_{½}$)	Central	28.3	days	Worksheet B03
	Lower	21.2		
	Upper	42.8		
Application rates (***R***)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Residue rates (***rr***):				
	Central	85	mg/kg veg per lb/acre	HK.SGT
	Lower	85		HK.SGU
	Upper	240		HK.SGU
Drift (***Drift***)				
	Central	1	unitless	On-site scenario assumes a function drift of 1 - i.e., direct spray
	Lower	1		
	Upper	1		
Decay coefficient (***k***): $\ln(2)/t_{50}$				
	Central	0.0244928	day^{-1}	Upper estimate of t_{50} used to calculate lower limit of ***k*** and lower estimate of t_{50} used to calculate upper limit of ***k***.
	Lower	0.0161950		
	Upper	0.0326956		

Worksheet F11a *(continued)*: Consumption of contaminated vegetation by a large mammal, chronic exposure scenario on-site.

Initial Concentration on Vegetation ($\mathbf{C_0}$): **R × rr × Drift**

Central	29.75	mg/kg veg.
Lower	29.75	
Upper	84	

Concentration on Vegetation at time ***T*** (C_T): $\mathbf{C_0\ e^{-kT}}$

Central	3.28e+00	mg/kg veg.
Lower	1.57e+00	
Upper	1.96e+01	

Time-weighted Average Concentration on Vegetation (C_{TWA}): $C_0\ (1 - e^{-k\,T}) \div (k\ T)$

Central	12.007109	mg/kg veg.
Lower	9.57700018	
Upper	44.2140845	

Proportion of Diet Contaminated (***Prop***)

Central	0.3	unitless
Lower	0.1	
Upper	1.0	

Dose estimates (***D***): $C_{TWA} \times A \times$ **Prop** $\div W$

Central	7.29e-01	mg/kg bw/day
Lower	1.94e-01	
Upper	8.95e+00	

Worksheet F11b: Consumption of contaminated vegetation by a large mammal, chronic exposure scenario off-site [VegChLrgMam02].

***Verbal Description**:* A 70 kg herbivore, such as a deer, consumes range grass for a 90 day period after application of the chemical. The contaminated vegetation accounts for 100% of the diet assuming that the animal would spends all of the grazing time near the application site. Drift is estimated at distances of 25 to 100 feet from the application site. Residue estimates based on relationships for range grass. Caloric requirements are used to estimate food consumption. Dissipation is considered using the foliar halftime and taking time-weighted average concentration over the exposure period.

Parameters/Assumptions		Value	Units	Source/Reference
Duration of exposure (***D***)		90	days	N/A
Body Weight (***W***)		70	kg	
Caloric requirement (***KR***)		5226.28803	kcal/day	U.S. EPA/ORD (1993, p. 3-6)
above based on following equation: $kcal/day = 1.518 \times W(g)^{0.73}$				
Caloric content of vegetation (dry weight, ***KCD***)		2.46	kcal/g	U.S. EPA/ORD (1993, p. 3-5)
Water content of vegetation (proportion, ***PW***)		0.85	unitless	U.S. EPA/ORD (1993, p. 4-14)
Caloric content of vegetation (wet weight, ***KCW***)		0.37	kcal/g	***KCD*** × (1-***PW***)
Food consumed per day (wet weight, ***A***)		14.16	kg	(***KR*** ÷ ***KCW***)/1000 g/kg
Foliar halftimes ($t_{½}$)	Central	28.3	days	Worksheet B03
	Lower	21.2		
	Upper	42.8		
Application rates (***R***)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Residue rates (***rr***):				
	Central	85	mg/kg veg per lb/acre	HK.SGT
	Lower	85		HK.SGU
	Upper	240		HK.SGU
Drift (***Drift***)				
	50 feet	0.0101	unitless	Estimated from AgDRIFT for low-boom applications. See Worksheet A06.
	100 feet	0.0058		
	25 feet	0.0187		
Decay coefficient (***k***): $\ln(2)/t_{50}$				
	Central	0.0244928	day^{-1}	Upper estimate of t_{50} used to calculate lower limit of ***k*** and lower estimate of t_{50} used to calculate upper limit of ***k***.
	Lower	0.0161950		
	Upper	0.0326956		

Worksheet F11b *(continued)*: Consumption of contaminated vegetation by a large mammal, chronic exposure scenario off-site.

Initial Concentration on Vegetation ($\mathbf{C_0}$): **R × rr × Drift**

Central	0.300475	mg/kg veg.
Lower	0.17255	
Upper	1.5708	

Concentration on Vegetation at time ***T*** (C_T): $\mathbf{C_0\ e^{-kT}}$

Central	3.31e-02	mg/kg veg.
Lower	9.10e-03	
Upper	3.66e-01	

Time-weighted Average Concentration on Vegetation (C_{TWA}): $C_0\ (1 - e^{-kT}) \div (k\ T)$

Central	0.1212718	mg/kg veg.
Lower	0.0555466	
Upper	0.82680338	

Proportion of Diet Contaminated (***Prop***)

Central	1	unitless
Lower	1	
Upper	1	

Dose estimates (***D***): $C_{TWA} \times A \times$ **Prop** $\div W$

Central	2.45e-02	mg/kg bw/day
Lower	1.12e-02	
Upper	1.67e-01	

Worksheet F12: Consumption of contaminated vegetation by a large bird, acute exposure scenario. *[VGCLBA]*

Verbal Description: A 4 kg herbivorous bird, such as a Canada Goose, consumes grass shortly after application of the chemical - i.e. no dissipation or degradation is considered. The contaminated vegetation accounts for 100% of the diet. Residue estimates based on relationships for short grass summarized in Worksheet A05.

Parameters/Assumptions		Value	Units	Source/Reference
Body weight (***W***)		4	kg	N/A
Caloric requirement (***KR***)		467.5185	kcal/day	U.S. EPA/ORD (1993, Eq. 3-35, p. 3-22)
above based on following equation: $kcal/day = 3.12 \times W(g)^{0.604}$				
Caloric content of vegetation (dry weight, ***KCD***)		2.46	kcal/g	U.S. EPA/ORD (1993, p. 3-5)
Water content of vegetation (proportion, ***PW***)		0.85	unitless	U.S. EPA/ORD (1993, p. 4-14)
Caloric content of vegetation (wet weight, ***KCW***)		0.369	kcal/g	***KCD*** × (1-***PW***)
Food consumed per day (wet weight, ***A***)		1.266988	kg	(***KR*** ÷ ***KCW***)/1000 g/kg
Duration of exposure (***T***)		1	day	N/A
Application rates (***R***)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Residue rates (***rr***)				
	Central	85	mg/kg vegetation per lb/acre applied	HK.SGT
	Lower	85		HK.SGT
	Upper	240		HK.SGU
Conc. in Vegetation (***C***): [**R**×**rr**]				
	Central	29.75	mg/kg	Note: lower value based on typical ***rr*** and lower ***R***.
	Lower	29.75		
	Upper	84		
Drift (***Drift***)				
	Central	1	unitless	Direct spray on-site
	Lower	1		
	Upper	1		
Proportion of Diet Contaminated (***Prop***)				
	Central	1	unitless	Assume feeding exclusively on-site.
	Lower	1		
	Upper	1		
Dose estimates (***D***): **Drift** × **Prop** × **C** × **A** ÷ **W**				
	Central	9.42e+00	mg/kg bw	
	Lower	9.42e+00		
	Upper	2.66e+01		

Worksheet F13a: Consumption of contaminated vegetation by a large bird, chronic on-site exposure scenario. *[VegChLBrd01]*

Verbal Description: A 4 kg herbivorous bird, such as a Canada Goose, consumes grass for a 90 day period after application of the chemical. The contaminated vegetation accounts for 10 to 100% of the diet assuming that the animal spends 10% to 100% of the time feeding at the site. Because the location is the application site, drift is set to unity - i.e., direct spray. Residue estimates based on short grass. Caloric requirements are used to estimate food consumption from U.S. EPA/ORD (1993). Dissipation is considered using the foliar halftime and taking the geometric mean of the initial and day-90 residues as the measure of dose.

Parameters/Assumptions		Value	Units	Source/Reference
Body weight (***W***)		4	kg	N/A
Caloric requirement (***KR***)		467.5185	kcal/day	U.S. EPA/ORD (1993, p. 3-6)
above based on following equation: $kcal/day = 3.12 \times W(g)^{0.604}$				
Caloric content of vegetation (dry weight, ***KCD***)		2.46	kcal/g	U.S. EPA/ORD (1993, p. 3-5)
Water content of vegetation (proportion, ***PW***)		0.85	unitless	U.S. EPA/ORD (1993, p. 4-14)
Caloric content of vegetation (wet weight, ***KCW***)		0.369	kcal/g	***KCD*** × (1-***PW***)
Food consumed per day (wet weight, ***A***)		1.266988	kg	(***KR*** ÷ ***KCW***)/1000 g/kg
Duration of exposure (***T***)		90	days	N/A
Application rates (***R***)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Residue rates (***rr***)				
	Central	85	mg/kg veg per lb/acre	HG.SGT
	Lower	85		HG.SGT
	Upper	240		HG.SGU
Drift (***Drift***):				
	Central	1	unitless	Set to unity for on-site assessment.
	Lower	1		
	Upper	1		
Day 0 Conc. in Vegetation (C_0): **R** × **rr** × **Drift**				
	Central	29.75	mg/kg	
	Lower	29.75		
	Upper	84		
Foliar dissipation coefficient (***k***)				
	Central	0.02449	day^{-1}	Worksheet B02
	Lower	0.0162		
	Upper	0.0327		
Conc. in Vegetation at time T (C_T) [$C_0 \times e^{-k \times T}$]				
	Central	3.28e+00	mg/kg	
	Lower	1.57e+00		
	Upper	1.96e+01		

Worksheet F13a *(continued)*: Consumption of contaminated vegetation by a large bird, chronic on-site exposure scenario.

Time-weighted Average Concentration on Vegetation (C_{TWA}): $C_0 (1 - e^{-k T}) \div (k T)$

Central	12.00711	mg/kg	
Lower	9.577		
Upper	44.21408		

Proportion of diet contaminated (P_D)

Central	0.3	unitless	See section 4.2.2.3.
Lower	0.1		
Upper	1.0		

Dose estimates (D): $P_D \times C_{TWA} \times A \div W$

Central	1.14e+00	mg/kg bw
Lower	3.03e-01	
Upper	1.40e+01	

Worksheet F13b: Consumption of contaminated vegetation by a large bird, chronic off-site exposure scenario. *[VegChLBrd02]*

Verbal Description: A 4 kg herbivorous bird, such as a Canada Goose, consumes grass for a 90 day period after application of the chemical. The contaminated vegetation accounts for 100% of the diet assuming that the animal spends all of the feeding time near the site. Drift is estimated at 25 to 100 feet from the application site. Residue estimates are based on short grass. Caloric requirements are used to estimate food consumption. Dissipation is considered using the foliar halftime and taking the geometric mean of the initial and day-90 residues as the measure of dose.

Parameters/Assumptions		Value	Units	Source/Reference
Body weight (***W***)		4	kg	N/A
Caloric requirement (***KR***)		467.5185	kcal/day	U.S. EPA/ORD (1993, p. 3-6)
above based on following equation: $kcal/day = 3.12 \times W(g)^{0.604}$				
Caloric content of vegetation (dry weight, ***KCD***)		2.46	kcal/g	U.S. EPA/ORD (1993, p. 3-5)
Water content of vegetation (proportion, ***PW***)		0.85	unitless	U.S. EPA/ORD (1993, p. 4-14)
Caloric content of vegetation (wet weight, ***KCW***)		0.369	kcal/g	***KCD*** × (1-***PW***)
Food consumed per day (wet weight, ***A***)		1.266988	kg	(***KR*** ÷ ***KCW***)/1000 g/kg
Duration of exposure (***T***)		90	days	N/A
Application rates (***R***)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Residue rates (***rr***)				
	Central	85	mg/kg veg per lb/acre	HG.SGT
	Lower	85		HG.SGT
	Upper	240		HG.SGU
Drift (***Drift***):				
	50 feet	0.0101	unitless	Estimated from AgDRIFT for low-boom applications. See Worksheet A06.
	100 feet	0.0058		
	25 feet	0.0187		
Day 0 Conc. in Vegetation (C_0): **R** × **rr** × **Drift**				
	Central	0.300475	mg/kg	Note: lower value based on typical ***rr*** and lower ***R***.
	Lower	0.17255		
	Upper	1.5708		
Foliar dissipation coefficient (***k***)				
	Central	0.02449	day^{-1}	Worksheet B02
	Lower	0.0162		
	Upper	0.0327		
Conc. in Vegetation at time T (C_T): $C_0 \times e^{-k \times T}$]				
	Central	3.31e-02	mg/kg	
	Lower	9.10e-03		
	Upper	3.66e-01		

Worksheet F13b *(continued)*: Consumption of contaminated vegetation by a large bird, chronic off-site exposure scenario.

Time-weighted Average Concentration on Vegetation (C_{TWA}): $C_0 (1 - e^{-k T}) \div (k T)$

Central	0.121272	mg/kg	
Lower	0.05555		
Upper	0.826803		

Proportion of diet contaminated (P_D)

Central	1.0	unitless	100% of time spent feeding near site
Lower	1.0		
Upper	1.0		

Dose estimates (D): $P_D \times C_{TWA} \times A \div W$

Central	3.84e-02	mg/kg bw
Lower	1.76e-02	
Upper	2.62e-01	

Worksheet F14a: Consumption of contaminated insects by a small mammal, acute exposure scenario. *[InsCSMA]*

***Verbal Description**: A small insectivorous mammal (20g) consumes insects shortly after application of the chemical - i.e. no dissipation or degradation is considered. The contaminated food accounts for 100% of the diet. Residue estimates in insects are based on relationships from Fletcher et al. (1994) summarized in Worksheet A04.*

Parameters/Assumptions		Value	Units	Source/Reference
Body weight (***W***)		0.02	kg	N/A
Caloric requirement (KR): = **a** × W^{b}				
a coefficient		1.894		U.S. EPA (1993, p. 3-6), equation 3-11
b coefficient		0.7		
Calculated caloric requirement (***KR***)		15.42059	kcal/day	
Caloric content of prey (wet weight, ***KCW***)		1.5	kcal/g	U.S. EPA (1993), Table 4-1, p. 4-13. Value for beetles.
Food consumed per day (wet weight, ***A***)		0.01028	kg	(***KR*** ÷ ***KCW***)/1000 g/kg
Duration of exposure (***T***)		1	day	N/A
Application rates (***R***)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Residue rates (***rr***)				
	Central	45	mg/kg per lb/acre applied	@@HK.BLT
	Lower	45		HK.BLT
	Upper	135		HK.BLU
Conc. in Vegetation (***C***): **R** × **rr**				
	Central	15.75	mg/kg	
	Lower	15.75		
	Upper	47.25		
Drift (***Drift***)				
	Central	1	unitless	Direct spray on-site
	Lower	1		
	Upper	1		
Proportion of Diet Contaminated (***Prop***)				
	Central	1	unitless	Assume feeding exclusively on-site.
	Lower	1		
	Upper	1		
Dose estimates (***D***): **Drift** × **Prop** × **C** × **A** ÷ **W**				
	Central	8.10e+00	mg/kg bw	
	Lower	8.10e+00		
	Upper	2.43e+01		

Worksheet F14b: Consumption of contaminated insects by a small bird, acute exposure scenario. *[InsCSBA]*

***Verbal Description**: A small insectivorous bird (10g) consumes insects shortly after application of the chemical - i.e. no dissipation or degradation is considered. The contaminated food accounts for 100% of the diet. Residue estimates in insects are based on relationships for seed containing pods and forage crops from Fletcher et al. (1994) summarized in Worksheet A04.*

Parameters/Assumptions		Value	Units	Source/Reference
Body weight (***W***)		0.01	kg	N/A
Caloric requirement (KR): = **a** × W^{b}				
a coefficient		3.12		U.S. EPA (1993, Eq.3-35, p.3-6)
b coefficient		0.604		
Calculated caloric requirement (***KR***)		12.53587	kcal/day	
Caloric content of prey (wet weight, ***KCW***)		1.5	kcal/g	U.S. EPA (1993), Table 4-1, p. 4-13. Value for beetles.
Food consumed per day (wet weight, ***A***)		0.0084	kg	(***KR*** ÷ ***KCW***)/1000 g/kg
Duration of exposure (***T***)		1	day	N/A
Application rates (***R***)				
	Central	0.35	lb/acre	APPL.Typ
	Lower	0.35		APPL.Low
	Upper	0.35		APPL.Hi
Residue rates (***rr***)				
	Central	45	mg/kg per lb/acre applied	@@HK.BLT
	Lower	45		HK.BLT
	Upper	135		HK.BLU
Conc. in Vegetation (***C***): **R** × **rr**				
	Central	15.75	mg/kg	
	Lower	15.75		
	Upper	47.25		
Drift (***Drift***)				
	Central	1	unitless	Direct spray on-site
	Lower	1		
	Upper	1		
Proportion of Diet Contaminated (***Prop***)				
	Central	1	unitless	Assume feeding exclusively on-site.
	Lower	1		
	Upper	1		
Dose estimates (***D***): **Drift** × **Prop** × **C** × **A** ÷ **W**				
	Central	1.32e+01	mg/kg bw	
	Lower	1.32e+01		
	Upper	3.95e+01		

Worksheet F15: Potential exposures of non-target plants through the use of contaminated irrigation water.

Verbal Description*: Non-target plants/crops are irrigated with 1 inch of contaminated ambient water. The levels in water are estimated from modeling and/or monitoring data thus dissipation, degradation and other environmental processes are considered.*

Parameters/Assumptions		Value	Units	Source/Reference
Application Rates ($R_{(lb\ a.e./acre)}$)				
	Central	0.35	lb a.e./acre	WSB01.Typ
	Low	0.35		WSB01.Low
	High	0.35		WSB01.Hi
Water Contamination Rate (WCR)($C_{(mg/L)} \div R_{(lb\ a.e./arce)}$)				
	Central	0.02	mg/L/lb a.e./acre	WSB07.AWT
	Low	0.005		WSB07.AWL
	High	0.07		WSB07.AWU
Concentrations in irrigation water ($C_{(mg/L)}$) ($A \times WRC$)				
	Central	7.00e-03	mg/L	
	Low	1.75e-03	mg/L	
	High	2.45e-02	mg/L	
Irrigation rate		1	inch	U.S. EPA 1989a
Liters of water applied per acre (L)		10,279	L	see below
Functional Application Rate($A_{lb/acre}$) ($C \times L \times 0.0000022$ lbs/mg $\div$ 1 acre)				
	Central	1.58e-04	lb/acre	
	Low	3.96e-05	lb/acre	
	High	5.54e-04	lb/acre	

Calculations of constants:

Litters of water applied per acre per inch irrigation water:

1 m^2 = 100 cm × 100 cm = 10,000 cm^2

1 acre = 4047 m^2 = 4047 m^2×10,000 cm^2/m^2 = 4,047,000 cm^2

1 inch = 2.54 cm

2.54 cm × 4,047,000 cm^2 = 10,279,380 cm^3 = 10,279,380 mL = 10,279 L

Number of lbs/mg:

1 kg = 2.2 lbs

1 g = 0.0022 lbs

1 mg = 0.0000022 lbs

Worksheet F16a: Consumption of contaminated small mammal by a carnivorous mammal, acute exposure scenario. *[SmMCCMA]*

Verbal Description*: A carnivorous mammal consumes small mammals shortly after the direct spray of the small mammal at the specified application rate - i.e. no dissipation or degradation is considered. The amount consumed is sufficient to satisfy the caloric requirements for one day. Residue estimates for the small mammal are taken from Worksheet F02a, Direct Spray of a Small Mammal assuming 100% absorption.*

Parameters/Assumptions	Value	Units	Source/Reference
Body weight (***W***)	5	kg	Red Fox, U.S. EPA (1993, p. 2-221). Range of 3 to 7 kg.
Caloric requirement (KR): = **a** × W^{b}			
a coefficient	1.894		U.S. EPA (1993, p. 3-6), equation 3-11
b coefficient	0.7		
Calculated caloric requirement (***KR***)	735.629	kcal/day	
Caloric content of prey (wet weight, ***KCW***)	1.7	kcal/g	U.S. EPA (1993), Table 4-1, p. 4-13
Food consumed per day (wet weight, ***A***)	0.43272	kg	(***KR*** ÷ ***KCW***)/1000 g/kg
Concentration on Small Mammal After Direct Spray (***CSM***)			
Central	8.49e+00	mg/kg	Worksheet F02a
Lower	8.49e+00		
Upper	8.49e+00		
Total Amount to Predator (TA): A × CSM			
Central	3.67e+00	mg/kg bw	
Lower	3.67e+00		
Upper	3.67e+00		
Dose to Predator: TA/BW			
Central	7.34e-01	mg/kg bw	
Lower	7.34e-01		
Upper	7.34e-01		

Worksheet F16b: Consumption of contaminated small mammal by a carnivorous bird, acute exposure scenario. *[SmMCCBA]*

Verbal Description*: A carnivorous bird consumes small mammals shortly after the direct spray of the small mammal at the specified application rate - i.e. no dissipation or degradation is considered. The amount consumed is sufficient to satisfy the caloric requirements for one day. Residue estimates for the small mammal are taken from Worksheet F02a, Direct Spray of a Small Mammal assuming 100% absorption.*

Parameters/Assumptions	Value	Units	Source/Reference
Body weight (***W***)	0.637	kg	Female Spotted Owl (*Strix occidentalis*), Dunning 1993, p. 97. Range of 548 to 760 g.
Caloric requirement (KR): = **a** × W^{b}			
a coefficient	1.146		U.S. EPA (1993, p. 3-23), equation 3-37
b coefficient	0.749		
Calculated caloric requirement (***KR***)	144.3727	kcal/day	
Caloric content of prey (wet weight, ***KCW***)	1.7	kcal/g	U.S. EPA (1993), Table 4-1, p. 4-13
Food consumed per day (wet weight, ***A***)	0.08493	kg	(***KR*** ÷ ***KCW***)/1000 g/kg
Concentration on Small Mammal After Direct Spray (***CSM***)			
Central	8.49e+00	mg/kg	Worksheet F02a
Lower	8.49e+00		
Upper	8.49e+00		
Total Amount to Predator (TA): A × CSM			
Central	7.21e-01	mg/kg bw	
Lower	7.21e-01		
Upper	7.21e-01		
Dose to Predator: TA/BW			
Central	1.13e+00	mg/kg bw	
Lower	1.13e+00		
Upper	1.13e+00		

Worksheet G01: Summary of Exposure Scenarios for Terrestrial Animals.

Scenario	Dose (mg/kg/day)			Worksheet
	Central	Lower	Upper	
Acute/Accidental Exposures				
Direct spray				
small mammal, first-order absorption	1.27e-01	2.64e-02	6.08e-01	F01
small animal, 100% absorption	8.49e+00	8.49e+00	8.49e+00	F02a
bee, 100% absorption	5.61e+01	5.61e+01	5.61e+01	F02b
Contaminated vegetation				
small mammal	4.38e-01	4.38e-01	9.38e-01	F03
large mammal	6.02e+00	6.02e+00	1.70e+01	F10
large bird	9.42e+00	9.42e+00	2.66e+01	F12
Contaminated water				
small mammal, spill	4.65e-01	1.11e-01	2.33e+00	F05
stream	1.02e-03	2.56e-04	3.59e-03	F06
Contaminated insects				
small mammal	8.10e+00	8.10e+00	2.43e+01	F14a
small bird	1.32e+01	1.32e+01	3.95e+01	F14b
Contaminated fish				
predatory bird, spill	3.18e-01	3.79e-02	2.38e+00	F08
Contaminated small mammal				
carnivorous mammal	7.34e-01	7.34e-01	7.34e-01	F16a
carnivorous bird	1.13e+00	1.13e+00	1.13e+00	F16b
Longer-term Exposures				
Contaminated vegetation				
small mammal, on site	1.77e-02	7.04e-03	9.87e-02	F04a
off-site	1.78e-04	4.08e-05	1.85e-03	F04b
large mammal, on site	7.29e-01	1.94e-01	8.95e+00	F11a
off-site	2.45e-02	1.12e-02	1.67e-01	F11b
large bird, on site	1.14e+00	3.03e-01	1.40e+01	F13a
off-site	3.84e-02	1.76e-02	2.62e-01	F13b
Contaminated water				
small mammal	3.59e-04	5.12e-05	6.66e-04	F07
Contaminated fish				
predatory bird	2.45e-04	1.75e-05	6.83e-04	F09

Worksheet G02: Summary of quantitative risk characterization for terrestrial animals [1]

Scenario	Hazard Quotient[2] Central	Lower	Upper
Acute/Accidental Exposures			
Direct spray			
small mammal, first-order absorption	2e-03	4e-04	8e-03
small animal, 100% absorption	1e-01	1e-01	1e-01
bee, 100% absorption	6e-02	6e-02	6e-02
Contaminated vegetation			
small mammal	6e-03	6e-03	1e-02
large mammal	8e-02	8e-02	2e-01
large bird	1e-02	1e-02	4e-02
Contaminated water			
small mammal, spill	6e-03	1e-03	3e-02
small mammal, stream	1e-05	3e-06	5e-05
Contaminated insects			
small mammal	1e-01	1e-01	3e-01
small bird	2e-02	2e-02	6e-02
Contaminated fish			
predatory bird, spill	5e-04	6e-05	4e-03
Contaminated small mammal			
carnivorous mammal	1e-02	1e-02	1e-02
carnivorous bird	2e-03	2e-03	2e-03
Longer-term Exposures			
Contaminated vegetation			
small mammal, on site	1e-03	5e-04	7e-03
off-site	1e-05	3e-06	1e-04
large mammal, on site	5e-02	1e-02	6e-01
off-site	2e-03	7e-04	1e-02
large bird, on site	8e-02	2e-02	9e-01
off-site	3e-03	1e-03	2e-02
Contaminated water			
small mammal	2e-05	3e-06	4e-05
Contaminated fish			
predatory bird	2e-05	1e-06	5e-05

Toxicity Indices [3]		
Acute toxicity value for mammal - NOAEL	75	mg/kg
Chronic toxicity value for mammal - NOAEL	15	mg/kg/day
Acute toxicity value for bird - NOAEL	670	mg/kg
Chronic toxicity value for birds- NOAEL not available, use NOAEL from mammals	15	mg/kg/day
Toxicity value for bee - no mortality	909	mg/kg

[1] See Worksheet G01 for summary of exposure assessment.
[2] Estimated dose ÷ toxicity index
[3] See Section 4.3 of the risk assessment for a discussion of the dose-response assessments for each group: Section 4.3.2.1 for mammals, Section 4.3.2.2 for birds, and Section 4.3.2.3 for insects.

Worksheet G03: Quantitative Risk Characterization for Aquatic Species.

Hazard Quotients [1]	**Central**	**Lower**	**Upper**	**Toxicity Value (mg/L)**	**End-point**
Fish, Acute Exposures					
Tolerant species (bluegill)	4e-06	1e-06	1e-05	1645	LC_{50}
Sensitive species (rainbow trout)	7e-05	2e-05	2e-04	103	LC_{50}
Fish, Chronic Exposures					
Tolerant species (estimated from daphnid data)	1e-04	2e-05	2e-04	23.1	NOEC
Sensitive species (estimated from daphnid data)	2e-04	4e-05	5e-04	10	NOEC
Aquatic Invertebrates, Acute Exposures	3e-05	8e-06	1e-04	214	LC_{50}
Aquatic Invertebrates, Chronic Exposures	2e-04	3e-05	4e-04	11.8	NOEC
Aquatic Plants					
Tolerant Species	2e-05	4e-06	5e-05	449	LC_{50}
Sensitive Species	1e-03	3e-04	4e-03	6.9	LC_{50}

Exposures (mg/L)	Central	Lower	Upper	Worksheets	
Acute	7.0e-03	1.8e-03	2.5e-02	F06	Stream
Longer-term	2.5e-03	3.5e-04	4.6e-03	F09	Stream

See Sections 4.3.3.2 and 4.3.3.3 for a discussion and derivation of the toxicity values for fish, invertebrates, and aquatic plants. See Worksheets F06 and F09 for the derivation of the concentrations in streams and ponds, respectively.

Worksheet G04: Summary of Exposure Assessment and Risk Characterization for Terrestrial Plants from Runoff [TerrPlntRU].

	lb a.e./acre	Note
Application rate	0.35	Typical FS rate, Section 2.4.
Sensitive Species	0.025	Section 4.3.2.4.
Tolerant Species	0.5	Section 4.3.2.4.

Annual Rainfall	Clay	Loam	Sand
		Proportion lost	
5	0.00e+00	0.00e+00	0.00e+00
10	0.00e+00	0.00e+00	0.00e+00
15	7.09e-03	0.00e+00	0.00e+00
20	1.04e-02	0.00e+00	0.00e+00
25	1.26e-02	0.00e+00	0.00e+00
50	1.70e-02	9.08e-07	0.00e+00
100	2.16e-02	4.61e-07	0.00e+00
150	2.60e-02	2.23e-08	0.00e+00
200	3.06e-02	2.20e-09	0.00e+00
250	3.52e-02	0.00e+00	0.00e+00
		Functional Off-site Application Rate[1]	
5	0.00e+00	0.00e+00	0.00e+00
10	0.00e+00	0.00e+00	0.00e+00
15	2.48e-03	0.00e+00	0.00e+00
20	3.66e-03	0.00e+00	0.00e+00
25	4.40e-03	0.00e+00	0.00e+00
50	5.94e-03	3.18e-07	0.00e+00
100	7.55e-03	1.61e-07	0.00e+00
150	9.11e-03	7.81e-09	0.00e+00
200	1.07e-02	7.70e-10	0.00e+00
250	1.23e-02	0.00e+00	0.00e+00
		Sensitive Species -Hazard Quotient[2]	
5	0	0	0
10	0	0	0
15	0.10	0	0
20	0.1	0	0
25	0.2	0	0
50	0.2	1e-05	0
100	0.3	6e-06	0
150	0.4	3e-07	0
200	0.4	3e-08	0
250	0.5	0e+00	0
		Tolerant Species - Hazard Quotient[2]	
5	0	0	0
10	0	0	0
15	5e-03	0	0
20	7e-03	0	0
25	9e-03	0	0
50	1e-02	6e-07	0
100	2e-02	3e-07	0
150	2e-02	2e-08	0
200	2e-02	2e-09	0
250	2e-02	0e+00	0

[1] The functional off-site application rate is calculated as the nominal application rate (specified above after the worksheet title) multiplied by the proportion lost in runoff.

[2] The hazard quotient is calculated as the functional off-site application rate divided by the NOEC value. The NOEC's are specified above on the lines following the application rate.

Worksheet G05a: Summary of Exposure Assessment and Risk Characterization for Terrestrial Plants from Drift After Low-Boom Ground Applications and Wind Erosion [TerrPlntWind].

	Most Sensitive Plant (lb a.e./acre)	Note
Most sensitive species	0.0005	NOEC for most sensitive species in vegetative vigor assay. Section 4.3.2.5.
Most tolerant species	0.5	NOEC for most tolerant species in vegetative vigor assay. Section 4.3.2.5.
Application Rate, lb a.e./acre	0.35	See chemical specific notes

Estimates of the proportion of offsite drift

Distance (feet)	Drift	
25	0.0187	Terrestrial Drift based on AGDRIFT using a low boom ground sprayer. See Worksheet A06 for details and drift estimates based on other methods of application.
50	0.0101	
100	0.0058	
300	0.0024	
500	0.0015	
900	0.0008	

Estimates of functional offsite application rate

Distance (feet)	Rate (lb/acre)	
25	0.006545	Calculated as the product of the application rate and the estimated proportion of offsite drift.
50	0.003535	
100	0.00203	
300	0.00084	
500	0.000525	
900	0.00028	

Hazard Quotient - Sensitive Species

25	13	Calculated as the offsite application rate divided by the NOEC for the most sensitive species.
50	7	
100	4	
300	2	
500	1	
900	0.6	

Hazard Quotient - Tolerant Species

Distance (feet)		
25	1e-02	Calculated as the offsite application rate divided by the NOEC for the most tolerant species.
50	7e-03	
100	4e-03	
300	2e-03	
500	1e-03	
900	6e-04	

Worksheet G05b: Summary of Exposure Assessment and Risk Characterization for Terrestrial Plants from Drift After Aerial Applications [TerrPlntAirDrift].

	Most Sensitive Plant	
Most sensitive species	0.00056	NOEC for most sensitive species in vegetative vigor assay. Section 4.3.2.5.
Most tolerant species	0.56	NOEC for most tolerant species in vegetative vigor assay. Section 4.3.2.5.
Application Rate, lb/acre	0.35	See chemical specific notes

Estimates of the proportion of offsite drift

Distance (feet)	Drift	
25	0.1434	Estimated based on AgDrift defaults – Air Tractor AT-401, water, 8 ft. boom height, 4 mph wind speed. A large number of options are available in AgDrift for different weather conditions, pesticide mixtures, and aircraft.
50	0.0518	
100	0.0195	
300	0.0042	
500	0.0022	
900	0.0009	

Estimates of functional offsite application rate

Distance (feet)	Rate (lb/acre)	
25	0.05019	Calculated as the product of the application rate and the estimated proportion of offsite drift.
50	0.01813	
100	0.006825	
300	0.00147	
500	0.00077	
900	0.0003150	

Hazard Quotient - Sensitive Species

25	90	Calculated as the offsite application rate divided by the NOEC for the most sensitive species.
50	32	
100	12	
300	3	
500	1	
900	0.6	

Hazard Quotient - Tolerant Species

Distance (feet)		
25	9e-02	Calculated as the offsite application rate divided by the NOEC for the most tolerant species.
50	3e-02	
100	1e-02	
300	3e-03	
500	1e-03	
900	6e-04	

STANDARD REFERENCES FOR WORKSHEETS

{Boxenbaum and D'Souza. 1990} Boxenbaum J; D'Souza R. 1990. Interspecies pharmacokinetic scaling, biological design and neoteny. Adv. Drug Res. 19: 139-195.

{Burnmaster. 1998} Burnmaster DE. 1998. Lognormal distribution for total water intake and tap water intake by pregnant and lactating women in the United States. Risk Analysis. 18(5): 215-219

{Dunning. 1993} Dunning JB. 1993. CRC Handbook of Avian Body Masses. CRC Press, Boca Raton FL, 371 pp.

{Durkin et al. 1995} Durkin PR; Rubin L; Withey J; Meylan W. 1995. Methods of assessing dermal absorption with emphasis on uptake from contaminated vegetation. Toxicol. Indust. Health. 11(1): 63-79.

{Harris and Solomon. 1992} Harris SA; Solomon KR. 1992. Human exposure to 2,4-D following controlled activities on recently sprayed turf. J. Environ. Sci. Health. B27(1): 9-22.

{Hoerger and Kenaga. 1972} Hoerger F; Kenaga EE. 1972. Pesticide residues on plants: Correlation of representative data as a basis for estimation of their magnitude in the environment. In: Environmental Quality and Safety, Volume I: Global Aspects of Toxicology and Technology as Applied to the Environment. F. Coulston and F. Kerte (eds.). Academic Press, New York, NY. pp. 9-28.

{ICRP. 1975} ICRP (International Commission on Radiologic Protection). 1975. Report of the Task Group on Reference Man. Recommendations of the International Commission on Radiological Protection (ICRP) Publ. No. 23. Pergamon Press, New York, NY.

{Knisel et al. 1992} Knisel WG; Davis FM; Leonard RA. 1992. GLEAMS Version 2.0 User Manual. U.S. Department of Agriculture, Agricultural Research Service, Southeast Watershed Research Laboratory, Tifton, GA. 202pp. {}

{Manugistics. 1995} Manugistics. 1995. Statgraphics Plus for Windows. Version 3. Available from Manugistics, Inc. Rockville, Maryland.

{Mason and Johnson. 1987} Mason RW; Johnson BL. 1987. Ergonomic factors in chemical hazard control. In: Handbook of Human Factors. Salveny, G; ed. John Wiley and Sons, New York, NY. pp. 772-741.

{Mendenhall and Scheaffer. 1973} Mendenhall W; Scheaffer RF. 1973. Mathematical Statistics with Applications. Duxbury Press, North Scituate, Massachusetts. 461 pp. plus appendices.

{Ruffle et al. 1994} Ruffle B; Burmaster DE; Anderson PD; Gordon HD. 1994. Lognormal distributions for fish consumption by the general U.S. population. Risk Analy. 14(4): 395-404.

{SERA. 1997} SERA (Syracuse Environmental Research Associates, Inc.). 1997. Reevaluation of Methods for Assessing Worker Exposure to Pesticides, SERA TR 96-21-08-01, draft dated December 31, 1997. Prepared under USDA/FS Contract 53-3187-5-12. Syracuse Environmental Research Associates, Inc., Fayetteville, NY.

{SERA. 2001} SERA (Syracuse Environmental Research Associates, Inc.). 2001. Preparation of Environmental Documentation and Risk Assessments, SERA MD 2001-01a, draft dated July 2001. Syracuse Environmental Research Associates, Inc., Fayetteville, NY. Available at www.sera-inc.com{}

{Teske et al. 2001} Teske ME; Bird SL; Esterly DM; Ray SL; Perry SG. 2001. A User's Guide for AgDRIFT 2.0: A Tiered Approach for the Assesment of Spray Drift. Continuum Dynamics, Inc. Public Use Version. C.D.I. Report No. 01-01. Available, with executable model at: http://www.agdrift.com/ {}

{USDA. 1989a} USDA (U.S. Department of Agriculture/Forest Service). 1989a. Final Environmental Impact Statement: Vegetation Management in the Coastal Plain/Piedmont, Management Bulletin R8-MB-23, dated January, 1989. 1213 pp.

{USDA. 1989b} USDA (U.S. Department of Agriculture/Forest Service). 1989b. Draft Environmental Impact Statement: Vegetation Management in the Ozark/Ouachita Mountains, Management Bulletin R8-MB-23, dated June, 1989. 499 pp.

{USDA. 1989c} USDA (U.S. Department of Agriculture/Forest Service). 1989c. Final Environmental Impact Statement: Vegetation Management in the Appalachian Mountains, Management Bulletin R8-MB-38, dated July, 1989. 1104 pp.

{U.S. EPA/OPP. 1999} U.S. EPA/OPP ((U.S. Environmental Protection Agency/Office of Pesticide Programs). 1999. ECOFRAM: Terrestrial ECOFRAM Terrestrial Draft Report. Ecological Committee on FIFRA Risk Assessment Methods(ECOFRAM). Report dated May 10, 1999. Available at: http://www.epa.gov/oppefed1/ecorisk/terrreport.pdf.

{U.S. EPA/ORD. 1992} U.S. EPA/ORD (U.S. Environmental Protection Agency/Office of Research and Development). 1992. Dermal Exposure Assessment: Principles and Applications. EPA/600/8-91/011B. Interim Report. Exposure Assessment Group, Office of Health and Environmental Assessment, Washington, DC.

{U.S. EPA/ORD. 1993} U.S. EPA/ORD (U.S. Environmental Protection Agency/Office of Research and Development). 1993. Wildlife Exposure Factors Handbook. Volumes 1 and 2. EPA/600/R-93/187a,b. Pagination not continuous. Available NTIS: PB94-174778 and PB94-174779.

{U.S. EPA/ORD. 1996} U.S. EPA (U.S. Environmental Protection Agency/Office of Research and Development). 1996. Exposure Factors Handbook. National Center for Environmental Assessment, U.S. EPA, Washington, DC. EPA/600/P-95/002Ba-c. Avail. NTIS: PB97-117683, 97-117691, PB97-117709.

{Wolfram Research. 1997} Wolfram Research. 1997. Mathematica Version 3.0.1. Available from Wolfram Research, Inc. Champaign, IL.