Technical Letter Report
PNNL-21950

Recommended Parameter Values for GENII Modeling of Radionuclides in Routine Air and Water Releases

SF Snyder
CI Arimescu
BA Napier
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November 2013

Pacific Northwest
NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

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Pacific Northwest National Laboratory
Richland, Washington 99352

PR Reed, Project Manager
NRC Job Code V6237

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Acronyms and Abbreviations

Note: This acronym list does not include the numerous GENII code parameter names (i.e., abbreviations) included in this document.

ATO	atmospheric transport output
CFR	*Code of Federal Regulations*
CR	concentration ratio
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
Gv2	GENII version 2.10
IAEA	International Atomic Energy Agency
MEI	maximally exposed individual
NCDC	National Climatic Data Center
NRC	U.S. Nuclear Regulatory Commission
OBT	organically bound tritium
PNNL	Pacific Northwest National Laboratory
RH	relative humidity
SDD	Software Design Document
SLDN	soil density values
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture

Units of Measure

°C	temperature in degrees Celsius [T(°C) = T(K) – 273.15)]
ac	acre(s)
Ci	curie(s)
cm	centimeter(s)
d	day(s)
ft	foot/feet
g	gram(s)
hr	hour(s)
in.	inch(es)
L	liter(s)
lb	pound(s)
kg	kilogram(s)
m	meter(s)
mg	milligram(s)
mL	milliliter(s)
mm	millimeter(s)
mo	month(s)
yr	year(s)
µ	micro (prefix, 10^{-6})
µg	microgram(s)

Acknowledgments

Appendix E of this document contains daily rainfall rate values for numerous cities. While annual precipitation rates are readily available, the GENII version 2 code, RAIN parameter, requires daily rate values. The authors are grateful for JP Rishel for calculating the RAIN values tabulated in Appendix E.

Executive Summary

The GENII v2 code is used to estimate dose to individuals or populations from the release of radioactive materials into air or water. Numerous parameter values are required for input into this code. User-defined parameters cover the spectrum from chemical data, meteorological data, agricultural data, and behavioral data. This document is a summary of parameter values that reflect conditions in the United States. Reasonable regional and age-dependent data is summarized. Data availability and quality varies. The set of parameters described address scenarios for chronic air emissions or chronic releases to public waterways. Considerations for the special tritium and carbon-14 models are briefly addressed. GENIIv2.10.1 is the current software version that this document supports.

Executive Summary of Generic Parameters

Due to the volume of parameters the user may designate in the GENII v2 code, the initial task of designating appropriate values for the user's scenario at the location of interest can be somewhat daunting. Once this initial stage is passed, adjustments to a more limited number of parameters are generally required to establish scenario parameters. This summary of Generic Parameters was developed to serve as initial reference points for users to consider, then fine tune to their specific scenario of interest (e.g., fine tune for geography, climate, agriculture, exposure, and intake). The fine-tuning can be done upon consideration of details and references available in the cited document section or upon consideration of site-specific data.

Module input is presented in each table in the order in which it is requested. For age-specific parameters in the Receptor Intake section, a separate summary table of age-specific rates is provided.

ES1.0 Constituent Module

ES2.0 User-defined Modules – AFF, WFF – Initial Generic Parameters

ES3.0 Air Module, Surface Water Module – Initial Generic Parameters

ES4.0 Exposure Module

ES5.0 Receptor Intake Module – Initial Generic Parameters

ES6.0 Health Impacts Module

ES1.0 Constituent Module

Refer to Section 2.0 for details.

If a parameter is not listed, it is not implemented in current GENII models, nor of interest for record-keeping.

Table ES1.1. Constituent Module – Select Constituents of Concern

SELECT CONSTITUENTS OF CONCERN
<user selection of nuclides of interest>

Table ES1.2. Constituent Module – Edit Constituent Properties

EDIT CONSTITUENT PROPERTIES					
Description Section	**Symbol[(a)]**	**Parameter**	**Units**	**Suggested Value[(b)]**	**Comment[(c)]**
Partition Coefficients	CLKD	Dry soil-water partition coefficient	mL/g	<record-keeping only>	Value used is assigned in Exposure module SOILKD.
Exposure Factors	CLANDF	Inhalation volatilization factor	m^3/L	0	Value used is assigned in Exposure Module
Exposure Factors	CLWPF	Water purification factor	-	<see Table 2.1>	-
Radiation Dosimetry Factors	SOLUBIL	Lung solubility	-	<record-keeping only>	Value used is assigned in Health Impacts Module, may want to enter here for record-keeping.
Radiation Dosimetry Factors	CLDFA*x*	Inhalation dose factor	rem/pCi	<ICRP 66-72 value>	<enter for only one class; record-keeping only for Health Impacts module, ICRP 60 Method >
Radiation Dosimetry Factors	CLRDFG*x*	Ingestion dose factor	rem/pCi	<ICRP 66-72 value>	<enter for only one solubility; record-keeping only for Health Impacts module, ICRP 60 Method >
Radiation Dosimetry Factors	CLDEX	External dose factor, air immersion	mrem/hr per pCi/m^3	<FGR-12 value>	<review supplied value for concurrence>
Radiation Dosimetry Factors	CLDIMR	External dose factor, water immersion	mrem/hr per pCi/m^3	<FGR-12 value>	<review supplied value for concurrence>
Radiation Dosimetry Factors	CLDSH*x*	External dose factor, ... to 15 cm	mrem/hr per pCi/m^3	<FGR-12 value>	<review supplied value for concurrence>
Radiation Dosimetry Factors	CLDIAM	Inhalation dose factor, particle diameter	µm	<record-keeping only>	Value used is assigned in User-defined AFF Air Module.

Table ES1.2. (contd)

EDIT CONSTITUENT PROPERTIES					
Description Section	**Symbol[a]**	**Parameter**	**Units**	**Suggested Value[b]**	**Comment[c]**
Aquatic Food Transfer Factors	CLBF*x*	Bioaccumulation factors-freshwater animals	L/kg	<see Table 2.2, Table 2.3, Table 2.4>	<if applicable, review supplied value for concurrence>
Aquatic Food Transfer Factors	CLBFP	Bioaccumulation factor-freshwater plants	L/kg	<see Table 2.8>	<if applicable, review supplied value for concurrence>
Aquatic Food Transfer Factors	CLBM*x*	Bioaccumulation factor-saltwater animals	L/kg	<see Table 2.5, Table 2.6, Table 2.7>	<if applicable, review supplied value for concurrence>
Aquatic Food Transfer Factors	CLBMP	Bioaccumulation factors-saltwater plants	L/kg	<see Table 2.9>	<if applicable, review supplied value for concurrence>
Animal Transfer Factors	CLFMT	Animal transfer factors-feed to meat	d/kg	<see Table 2.10>	<review supplied value for concurrence>
Animal Transfer Factors	CLFMK	Animal transfer factors-milk	d/L	<see Table 2.11>	<review supplied value for concurrence>
Animal Transfer Factors	CLFPL	Animal transfer factors-poultry	d/kg	<see Table 2.12>	<review supplied value for concurrence>
Animal Transfer Factors	CLFEG	Animal transfer factors-egg	d/kg	<see Table 2.13>	<review supplied value for concurrence>
Plant Transfer Factors	CLBVx	Bioconcentration to edible crop from soil	kg/kg	<see Table 2.14, Table 2.15, Table 2.16, Table 2.17>	<review supplied value for concurrence>
Plant Transfer Factors	CLBVAx	Bioconcentration to feed or forage from soil	kg/kg	Not used in current model.	-
Plant Transfer Factors	CLBVAG	Bioconcentration to animal feed grain from soil	kg/kg	Not used in current model.	-
Plant Transfer Factors	CLBVOV	Bioconcentration in dry other vegetables from soil	kg/kg	Not used in current model.	-
Environmental Rates	CLVD	Atmospheric deposition velocity	m/sec	<record-keeping only>	-
Environmental Rates	CLCLASS	Atmospheric deposition class	-	<record-keeping only>	See help file for descriptions

(a) For symbols ending in an italic *x*, parameter subsets are available (e.g., aquatic food types or soil horizons). See main document section cited for details.
(b) <record-keeping only> = Good practice to document value assumed, but the value entered in here is not applied by the code for a chronic air or surface water scenario.
(c) <review supplied value for concurrence> = When initial case is created, review the supplied default value or the parameter to determine acceptability.

ES2.0 User-defined Modules – AFF, WFF – Initial Generic Parameters

Refer to Section 3.0 (AFF) and Section 5.0 (WFF) for details.

Table ES2.1. User-defined Module – Air

AFF – Air				
Symbol	**Parameter**	**Units**	**Suggested Value[a]**	**Comment**
media	Type of release	-	point	Typically a "point" source.
one	Exit area of source	m^2	<user input>	-
two	Exit height of source	m	<user input>	-
three	Height of adjacent structure	m	<user input>	-
four	Exit velocity of source	m/s	<user input>	-
five	Exit temperature of source	°C	<user input>	Enter same value as ambient temperature if effective height of source assigned as exit height.
six	Ambient air temperature	°C	<user input>	-
ctime	Release table- time	yr	0	first row entry
ctime	Release table- time	yr	1	second row entry
cval	Release table- Emission rate	pCi/yr	<user input>	same value for each release time for a routine chronic release

(a) <user input> indicates the value is very case-specific. No generic value is supplied.

Table ES2.2. User-defined Module – Water

WFF – Surface Water				
Symbol	**Parameter**	**Units**	**Suggested Value[a]**	**Comment[b]**
one	Width of flux plane	m	<user input>	<record-keeping only>
two	Height of flux plane	m	<user input>	<record-keeping only>
ctime	Table – time	yr	0	first row entry
ctime	Table – time	yr	1	second row entry
cval	Constituent= water	m^3/yr	<user input>	surface water source flow rate, same value for each time row for routine chronic release
cval	Constituent= <nuclide>; Adsorbed flux	pCi/yr	<user input>	-
cval	Constituent= <nuclide>; Dissolved flux	pCi/yr	<user input>	Enter all activity here

(a) <user input> indicates the value is very case-specific. No generic value is supplied.
(b) <record-keeping only> indicates that it is a good practice to document the value assumed here, but the entry is not applied by the code for a chronic air or surface water value.

ES3.0 Air Module, Surface Water Module – Initial Generic Parameters

Refer to Section 4.0 (Air) and Section 6.0 (Surface Water) for details.

Table ES3.1. Air Module – Chronic Plume

Air – Chronic Plume module					
Tab: Top-level/2nd level	**Symbol**	**Parameter**	**Units**	**Suggested Value[(a)]**	**Comment**
MODEL INFORMATION					
Radial Grid Definition	-	Distances	m	<user input>	16-sector radial grid more typical and will simplify detailed data reviews
Model Parameters	-	-	-	Briggs Open Country	-
Default Parameters	ARMINRISESPD	Minimum wind speed …	m/s	1.5	-
	ARMINSIGYSHIFT	Sigma to shift…	m	400	-
	ARTRANSRESIST	Transfer resistance for iodine	s/m	10	-
	ARTRANSRESIST	Transfer resistance for particles	s/m	100	-
	ARMINWIND	Maximum windspeed for “calm”	m/s	0.8	Minimum detected by anemometer.
(a) <user input> indicates the value is very case-specific. No generic value is supplied.					

Table ES3.2. Surface Water Module

Surface Water – Surface Water module					
Tab	**Symbol**	**Parameter**	**Units**	**Suggested Value[(a)]**	**Comment**
RIVER/LAKE	GNSWTREL	Duration of release to the surface water	yr	1	-
	<multiple>	<All other parameters on this tab>	<mult.>	<user input>	scenario specific
IMPOUNDMENT	-	<All selections/parameters on this tab>	<mult.>	<user input>	scenario specific
(a) <user input> indicates the value is very case-specific. No generic value is supplied.					

ES4.0 Exposure Module

Refer to Section 7.0 for most details. See last column of tables for specific sections.

Enter the Easting and Northing coordinates (km) in the GENERAL INFO option of this Exposure Module to indicate location of receptor (or field) relative to emission point.

NOTE: Environmental Conditions vary by location. Use suggested values at your own discretion.

Also, note that irrigation parameters are only necessary if irrigation with a contaminated water source is assumed in the scenario.

Table ES4.1. Exposure Module – Control Tab

Tab: Top-level/2nd level	Symbol	Parameter	Units	Suggested Value	Comment	Details
CONTROLS						
	NTKEND	Duration of exposure period	yr	1	Required for chronic exposure	-
	RELEND	End of release period	yr	1	-	-
	BEFORE	Time from start to exposure	yr	0	-	-
	ABSHUM	Absolute humidity	kg/m^3	<see Table 10.2>	Usually, that during growing season. Only used with tritium model.	Section 10.1.4
	RF1	Fraction of roots in surface soil	-	1	-	Section 7.1.1
	RAIN	Average rain rate, when raining	mm/d	<see Appendix E>	-	Section 7.1.2
	BEFAIR	Air deposition time prior to exposure	yr	0	-	

Table ES4.2. Exposure Module – Water Tab

Tab: Top-level/2nd level	Symbol	Parameter[(a)]	Units	Suggested Value	Comment	Details
WATER						
General	RIRRR	Irrigation rate for residential land	in./yr	35	Adjust by local climate.	Section 7.3.1
General	IRTIMR	Irrigation time for residential land	mo/yr	6	Adjust by local climate (see Figure 7.1) or crop irrigation times, below.	Section 7.3.1
General	BEFIRR	Irrigation water deposition time prior to exposure	yr	0	-	-
General	ANDKRN	Indoor volatilization factor for radon	L/m^3	0.1	-	Section 7.3.2
General	ANDKR	Indoor volatilization factor for radionuclides	L/m^3	0	-	Section 7.3.2
General	HOLDDW	Delay time in water distribution system	D	1	-	Section 7.3.3
General	SEDDN	Shoreline sediment density-option1	kg/m^2	200	silty, sandy sediment	Section 7.3.4
General	SEDDN	Shoreline sediment density-option2	kg/m^2	290	rocky shoreline	Section 7.3.4
Animal Water	DWFACA	contaminated fraction (all types of animal products)	-	1	-	Section 7.4.1
Animal Water	DWATER	Intake rate - meat animal	L/d	50	assume beef cow, near butcher date	Section 7.4.1
Animal Water	DWATER	Intake rate - poultry animal	L/d	0.26	assume chicken	Section 7.4.1
Animal Water	DWATER	Intake rate - milk animal	L/d	85	assume cow milk	Section 7.4.1
Animal Water	DWATER	Intake rate - egg animal	L/d	0.30	assume chicken	Section 7.4.1
Irrigation sources	-	N/A	-	-	-	-
Irrigation rates	RIRR	leafy vegetables, root vegetables-option1	in./yr	0	For Alaska	Section 7.5.1
Irrigation rates	RIRR	leafy vegetables, root vegetables-option2	in./yr	4	For Census Reporting Regions of Figure 7.2: 1, 2(North), 5(W of Cascade Mts)	Section 7.5.1
Irrigation rates	RIRR	leafy vegetables, root vegetables-option3	in./yr	10	For Census Reporting Regions of Figure 7.2: 4(North)	Section 7.5.1
Irrigation rates	RIRR	leafy vegetables, root vegetables-option4	in./yr	35	For Census Reporting Regions of Figure 7.2: 2(South), 3, 4(South), 5(E of the Cascade Mts), 6	Section 7.5.1
Irrigation rates	RIRR	leafy vegetables, root vegetables-option5	in./yr	44	For Hawaii	Section 7.5.1
Irrigation rates	RIRR	fruits-option1	in./yr	35	For west of the Mississippi River	Section 7.5.1

Table ES4.2. (contd)

Tab: Top-level/2nd level	Symbol	Parameter[a]	Units	Suggested Value	Comment	Details
Irrigation rates	RIRR	fruits-option2	in./yr	18	For east of the Mississippi River	Section 7.5.1
Irrigation rates	RIRR	grains	in./yr	0	When dryland farming assumed	Section 7.5.1
Irrigation rates	RIRRA	meat animal feed-option1	in./yr	6	For Census Reporting Regions of Figure 7.2: 1 excluding Nebraska, 2	Section 7.5.1
Irrigation rates	RIRRA	meat animal feed-option2	in./yr	11	For Census Reporting Regions of Figure 7.2: 3, 4, Nebraska	Section 7.5.1
Irrigation rates	RIRRA	meat animal feed-option3	in./yr	26	For Census Reporting Regions of Figure 7.2: 5	Section 7.5.1
Irrigation rates	RIRRA	meat animal feed-option4	in./yr	30	For Census Reporting Regions of Figure 7.2: 6	Section 7.5.1
Irrigation rates	RIRRA	poultry&egg animal feed	in./yr	0	When dryland farming of grain assumed	Section 7.5.1
Irrigation rates	RIRRA	milk animal feed-option1	in./yr	7.5	For Census Reporting Regions of Figure 7.2: 1	Section 7.5.1
Irrigation rates	RIRRA	milk animal feed-option2	in./yr	5	For Census Reporting Regions of Figure 7.2): 2	Section 7.5.1
Irrigation rates	RIRRA	milk animal feed-option3	in./yr	14.5	For Census Reporting Regions of Figure 7.2: 3	Section 7.5.1
Irrigation rates	RIRRA	milk animal feed-option4	in./yr	18	For Census Reporting Regions of Figure 7.2: 4	Section 7.5.1
Irrigation rates	RIRRA	milk animal feed-option5	in./yr	25	For Census Reporting Regions of Figure 7.2: 5	Section 7.5.1
Irrigation rates	RIRRA	milk animal feed-option6	in./yr	48	For Census Reporting Regions of Figure 7.2: 6	Section 7.5.1
Irrigation rates	RIRRA	meat animal forage	in./yr	see above	see milk animal feed options	Section 7.5.1
Irrigation rates	RIRRA	milk animal forage-option1	in./yr	7.5	For Census Reporting Regions of Figure 7.2: 1	Section 7.5.1
Irrigation rates	RIRRA	milk animal forage-option2	in./yr	5	For Census Reporting Regions of Figure 7.2: 2	Section 7.5.1
Irrigation rates	RIRRA	milk animal forage-option3	in./yr	10	For Census Reporting Regions of Figure 7.2: 3	Section 7.5.1
Irrigation rates	RIRRA	milk animal forage-option4	in./yr	18	For Census Reporting Regions of Figure 7.2: 4	Section 7.5.1

Table ES4.2. (contd)

Tab: Top-level/2nd level	Symbol	Parameter[a]	Units	Suggested Value	Comment	Details
Irrigation rates	RIRRA	milk animal forage-option5	in./yr	22	For Census Reporting Regions of Figure 7.2: 5, 7	Section 7.5.1
Irrigation rates	RIRRA	milk animal forage-option6	in./yr	30	For Census Reporting Regions of Figure 7.2: 6	Section 7.5.1
Irrigation times[b]	IRTIMT[b]	any crop	mo/yr	1	For Watershed Reporting Regions of Figure 7.3: 1, 2, 4, 9	Section 7.5.1
Irrigation times[b]	or	any crop	mo/yr	2	Section 7.5.1	Section 7.5.1
Irrigation times[b]	IRTIMA[b]	any crop	mo/yr	3	Watershed Reporting Regions of Figure 7.3: 7, 10, 16	Section 7.5.1
Irrigation times[b]	-	any crop	mo/yr	4	Watershed Reporting Regions of Figure 7.3: 17	Section 7.5.1
Irrigation times[b]	-	any crop	mo/yr	5	Watershed Reporting Regions of Figure 7.3: 8, 11, 18	Section 7.5.1
Irrigation times[b]	-	any crop	mo/yr	6	Watershed Reporting Regions of Figure 7.3: 3, 12, 13, 15	Section 7.5.1
Irrigation times[b]	-	any crop	mo/yr	8	Watershed Reporting Regions of Figure 7.3: 20	Section 7.5.1

(a) Several options are presented for some parameters, depending on the geographic location of interest as indicated in the Comment.
(b) Irrigation times have the symbol IRTIMT or IRTIMA. IRTIMT applies to crops ingested by people. IRTIMA applies to crops ingested by animals that produce animal products ingested by people.

Table ES4.3. Exposure Module – Soil Tab

Tab: Top-level/2nd level	Symbol	Parameter[(a)]	Units	Suggested Value	Comment	Details
SOIL						
Surface soil	SLDN	surface soil areal density-option1	kg/m^2	225	sandy soil - for crop growth	Section 7.7.1
Surface soil	SLDN	surface soil areal density-option2	kg/m^2	195	silty soil - for crop growth	Section 7.7.1
Surface soil	SLDN	surface soil areal density-option3	kg/m^2	155	clay soil - for crop growth	Section 7.7.1
Surface soil	SURCM	surface soil layer thickness used for density	cm	0.15	-	Section 7.7.1
Resuspension	XMLF	Mass loading factor for resuspension-option1	g/m^3	4.0E-05	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 1	Section 7.8.1
Resuspension	XMLF	Mass loading factor for resuspension-option2	g/m^3	5.0E-05	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 2–6, 8, 13, 17west, 19	Section 7.8.1
Resuspension	XMLF	Mass loading factor for resuspension-option3	g/m^3	5.7E-05	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 7, 10–12	Section 7.8.1
Resuspension	XMLF	Mass loading factor for resuspension-option4	g/m^3	6.7E-04	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 14–16, 17east, 18	Section 7.8.1
Leaching	LEACHOPTION	Selection: Leach rates calculated from user input	N/A	-	-	-
Leaching	THICK	Surface soil thickness	cm	0.15	Same value as entered in SOIL/Surface soil	Section 7.9.1
Leaching	MOISTC	Surface soil moisture content	mL/cm^3	0.12	Assumed loam soil value.	Section 7.9.2
Leaching	BULKD	Surface soil bulk density-option1	g/cm^3	1.5	Same value, but on a volume basis, as entered in SOIL/surface soil. Sandy soil	Section 7.9.3
Leaching	BULKD	Surface soil bulk density-option2	g/cm^3	1.3	Same value, but on a volume basis, as entered in SOIL/surface soil. Silty soil.	Section 7.9.3

Table ES4.3. (contd)

Tab: Top-level/2nd level	Symbol	Parameter[(a)]	Units	Suggested Value	Comment	Details
Leaching	BULKD	Surface soil bulk density-option3	g/cm^3	1.03	Same value, but on a volume basis, as entered in SOIL/surface soil. Clay soil.	Section 7.9.3
Leaching	VLEACH	Total Infiltration rate	cm/yr	3.5	Approximated by 10% of irrigation and precipitation rates. Adjust by climate.	Section 7.9.4
Leaching	SOILKD	Parent nuclide soil absorption coefficient	mL/g	<varies>	-	Section 7.9.5

(a) Several options are indicated for some parameters, depending on the soil type as indicated in the Comment.

Table ES4.4. Exposure Module – Agriculture Tab and Subtabs

Tab: Top-level/2nd level/3rd Level	Symbol	Parameter	Units	Suggested Value[(a)]	Comment[(b)]	Details
AGRICULTURE						
General	LEAFRS	Resuspension factor (soil-to-plant)	1/m	1.00E-10	-	Section 7.11.1
General	DPVRES	Deposition velocity (soil-to-plant)	m/s	0.001	-	Section 7.11.2
General	WTIM	Weathering rate constant from plants	d	14	-	Section 7.11.3
Animal Feed						
Biomass	BIOMA2	Biomass (wet) for animal feed and forage	kg/m^2	<see Table 7.17>	-	Section 7.13.1
Consumption	CONSUM	Consumption rate for feed and forage	kg/d	<see Table 7.18>	-	Section 7.14.1
Storage time	STORTM	Storage time for feed and forage	d	<see Table 7.19>	-	Section 7.14.1
Diet fraction	DIETFR	Diet fraction for feed and forage	-	<user input>	Could also be applied as fraction of feed or forage type from contaminant region.	Section 7.14.1
Growing period	GRWPA	Growing period for feed and forage	d	<see Table 7.17>	-	Section 7.13.1
Yield	YELDA	Yield for feed and forage	kg/m^2	<see Table 7.17>	-	Section 7.13.1
Dry/Wet ratio	DRYFA2	Dry/wet weight ratio for meat animal feed	-	0.5	See Table 7.20. Use in conjunction with Table 7.16 comments of food type.	Section 7.15.1
Dry/Wet ratio	DRYFA2	Dry/wet weight ratio for poultry feed	-	0.9	-	Section 7.15.1
Dry/Wet ratio	DRYFA2	Dry/wet weight ratio for milk animal feed	-	0.5	-	Section 7.15.1
Dry/Wet ratio	DRYFA2	Dry/wet weight ratio for egg animal feed	-	0.9	-	Section 7.15.1
Dry/Wet ratio	DRYFA2	Dry/wet weight ratio for meat animal forage	-	0.88	as fed value, hay+grain	Section 7.15.1
Dry/Wet ratio	DRYFA2	Dry/wet weight ratio for milk animal forage	-	0.4	-	Section 7.15.1
Translocation factor	TRANSA	Translocation factor for feed and forage	-	<see Table 7.17>	-	Section 7.13.1
Soil intake	SLCONA	Soil intake for meat animal	kg/d	0.5	-	Section 7.16.1
Soil intake	SLCONA	Soil intake for poultry animal	kg/d	0.01	assume chicken	Section 7.16.1
Soil intake	SLCONA	Soil intake for milk animal	kg/d	0.2	assume cow	Section 7.16.1
Soil intake	SLCONA	Soil intake for egg animal	kg/d	0.01	assume chicken	Section 7.16.1

Table ES4.4. (contd)

Tab: Top-level/2nd level/3rd Level	Symbol	Parameter	Units	Suggested Value[(a)]	Comment[(b)]	Details
Food Crop						
Biomass	BIOMAS	Biomass (wet) for human food crops	kg/m^2	<see Table 7.27>	-	Section 7.18.1
Growing period	GRWP	Growing period for human food crops	d	<see Table 7.27>	-	Section 7.18.1
Yield	YELD	Yield for human food crops	kg/m^2	<see Table 7.27>	-	Section 7.18.1
Dry/Wet ratio	DRYFAC	Dry/wet ratio for leafy vegetables	-	0.08	-	Section 7.19.1
Dry/Wet ratio	DRYFAC	Dry/wet ratio for other vegetables	-	0.20	-	Section 7.19.1
Dry/Wet ratio	DRYFAC	Dry/wet ratio for fruit	-	0.25	-	Section 7.19.1
Dry/Wet ratio	DRYFAC	Dry/wet ratio for grain	-	0.22	-	Section 7.19.1
Translocation factor	TRANS	Translocation factor for human food crops	-	<see Table 7.27>	-	Section 7.18.1
Intake delays	HLDUP	Intake delay (harvest - consumption) leafy vegetable	d	5	MEI[(b)]	Section 7.20.1
	HLDUP	Intake delay (harvest - consumption) other vegetable	d	5	MEI	Section 7.20.1
	HLDUP	Intake delay (harvest - consumption) fruit	d	5	MEI	Section 7.20.1
	HLDUP	Intake delay (harvest - consumption) grain	d	180	MEI	Section 7.20.1
	HLDUPA	Intake delay (harvest - consumption) meat	d	15	MEI	Section 7.20.1
	HLDUPA	Intake delay (harvest - consumption) poultry	d	15	MEI	Section 7.20.1
	HLDUPA	Intake delay (harvest - consumption) milk	d	3	MEI	Section 7.20.1
	HLDUPA	Intake delay (harvest - consumption) egg	d	5	MEI	Section 7.20.1
	HLDUP2	Intake delay (harvest - consumption) fish	d	2	MEI	Section 7.20.1
	HLDUP2	Intake delay (harvest - consumption) mollusca	d	2	MEI	Section 7.20.1
	HLDUP2	Intake delay (harvest - consumption) crustacea	d	2	MEI	Section 7.20.1
	HLDUP2	Intake delay (harvest - consumption) aquatic plants	d	0	MEI or population	Section 7.20.1

(a) <user input > indicates the value is very case-specific. No generic value is supplied.
(b) MEI = maximally exposed individual.

ES5.0 Receptor Intake Module – Initial Generic Parameters

Six age categories are suggested for age-dependent parameters: under1 year old, 1-3 yrs, 3-8 yrs, 8-13 yrs, 13-18 yrs, and greater than 18 yrs. In GENII version2, these categories are symbolized as age1, age2, age3, age4, age5, and age6. Refer to Section 8.0 for details.

Many parameters in this module do not vary by age category. Intake rates and exposure times may. A summary table with age-appropriate suggested values for the six age categories follows the main tables.

NOTE: Exposure time and intake rates can vary by location. Use suggested values at your own discretion. Suggested values are generally appropriate for the maximally-exposed individual.

Table ES5.1. Receptor Intake Module – Ages

Pathway Selection	Symbol	Parameter	Units	Suggested Value	Comment
N/A	LOWAGE	Lower age	yr	<see Table 8.1>	-
	UPAGE	Upper age	yr	<see Table 8.1>	-

Table ES5.2. Receptor Intake Module – External Exposure Pathways

Pathway Selection	Symbol	Parameter	Units	Suggested Value	Comment
External exposure to air	UEXAIR	Daily plume exposure time	hr	24	All ages, maximizing; see Table 8.3 for other options
	TEXAIR	Yearly plume exposure time	d	365	All ages, maximizing; see Table 8.3 for other options
External ground exposure	SHIN	Indoor shielding factor	-	1	-
	SHOUT	Outdoor shielding factor	-	1	-
	UEXGRD	Daily ground exposure time	hr	24	-
	TEXGRD	Yearly ground exposure time	d	365	-
	FTIN	Fraction of time spent indoors	-	0	-
	FTOUT	Fraction of time spent outdoors	-	1	-
External exposure while swimming	EVSWIM	Frequency of swimming event	event/d	1	-
	TESWIM	Duration of swimming event	hr	2	-
	TSWIM	Swimming days	d	5	-
	USWIM	Ingestion of water while swimming	L/hr	<see Table 8.5>	-
External exposure while boating	SFBOAT	Shielding factor	-	1	-
	EVBOAT	Frequency of boating event	event/d	1	-
	TEBOAT	Duration of boating event	hr	1	-
	TBOAT	Boating days	d	5	-
External exposure while on shoreline	EVSHOR	Frequency of shoreline use	event/d	1	-
	TESHOR	Duration of shoreline use event	hr	3.3	-
	TSHOR	Shoreline days	d	5	-
	SWFAC	Shoreline width factor	L/hr	0.2	-

Table ES5.3. Receptor Intake Module – Ingestion Pathways

Pathway Selection	Symbol	Parameter	Units	Suggested Value	Comment
Food crop ingestion	UCRP	All crop consumption rates	kg/d	<see Table 8.11>	-
	TCRP	All consumption periods	d/yr	365	-
Animal product ingestion	UANM	All animal product consumption rates	kg/d	<see Table 8.12>	-
	TANM	All consumption periods	d/yr	365	-
Aquatic food ingestion	UAQU	All aquatic consumption rates	kg/d	<see Table 8.13>	-
	TAQU	All consumption periods	d/yr	365	-
Drinking water ingestion	UDW	Drinking water ingestion rate	L/d	<see Table 8.14>	-
	TDW	Drinking water consumption period	d/yr	365	-
Water ingestion while swimming	EVSWIM	Frequency of swimming event	event/d	<see Table ES5.2>	User enters the same values as **External exposure while swimming.**
	TESWIM	Duration of swimming event	hr	<see Table ES5.2>	-
	TSWIM	Swimming days	d	<see Table ES5.2>	-
	USWIM	Ingestion of water while swimming	L/hr	<see Table ES5.2>	-
Water ingestion while showering	EVSHWR	Frequency of showering event	event/d	1	-
	TESHWR	Duration of showering event	hr	<see Table 8.15>	-
	TSHWR	Showering days	d	365	-
	USHIN	Ingestion of water while showering	L/hr	<see Table 8.16>	-
Inadvertent soil ingestion	TSOIL	Soil contact days	d	365	-
	USOIL	Inadvertent soil ingestion rate	mg/d	200	See Table 8.17 for other options.

Table ES5.4. Receptor Intake Module – Inhalation Pathways

Pathway Selection	Symbol	Parameter	Units	Suggested Value	Comment
Air Inhalation [outdoor air]	UINH	Air inhalation rate	m3/d	<see Table 8.18>	If FRINH (see below) is not 1, UINH=FRINH*<Table 8.18 value>.
	TINH	Air inhalation period	d/yr	365	-
	FRINH	Fraction of day for outdoor inhalation	-	1	Maximizing. See Table 8.4 for alternative fractions assumptions.
Resuspended soil inhalation	UINHR	Resuspended soil inhalation rate	m^3/d	< see Table 8.18>	Enter same values as UINH
	TINHR	Resuspended soil inhalation period	d/yr	365	-
	FRINHR	Fraction of day resuspended soil inhalation	-	<1>	Enter same values as FRINH
Indoor inhalation	UINDRH	Indoor inhalation rate	m^3/d	0	If FRINDR is not 0, UINDRH estimated by FRINDR*UINH.
	TINDRH	Indoor inhalation period	d/yr	365	-
	FRINDR	Fraction of day for indoor inhalation	-	0	If Outdoor inhalation rate is not 0, FRINDR=1-FRINH.

ES5.1 Receptor Intake Module – Summary of Age-dependent Values

Six age categories are suggested for age-dependent parameters, as indicated by the LOWAGE and UPAGE values of Table ES5.5. In GENII version2, these categories are symbolized as age1, age2, age3, age4, age5, and age6.

Refer to Section 8.0 for details.

Table ES5.5. Summary of Age-dependent Generic Values

Symbol (units)	Age1	Age2	Age3	Age4	Age5	Age6	Comment[(a)]
LOWAGE (yr)	0	1.5	2.5	7.5	12.5	17.5	Age group lower bound
UPAGE (yr)	1.5	2.5	7.5	12.5	17.5	17.5+	Age group upper bound
UEXAIR (hr)	24	24	16	17	16	15	Residential receptor MEI
FTIN	1	1	0.94	0.89	0.9	1	
FTOUT	0	0	0.06	0.11	0.1	0	
USWIM (L/hr)	0	0.12	0.12	0.12	0.12	0.071	
UCRP, leafy (kg/d)	0.0121	0.0388	0.0474	0.0628	0.0918	0.1872	
UCRP, root, other (kg/d)	0.1386	0.1765	0.2019	0.2679	0.2613	0.2928	
UCRP, fruit (kg/d)	0.2100	0.2950	0.2809	0.2926	0.2440	0.3360	
UCRP, grain (kg/d)	0.1058	0.1711	0.2065	0.2608	0.3210	0.3240	
UANM, meat (kg/d)	0.023	0.048	0.067	0.085	0.125	0.131	
UANM, poultry (kg/d)	0.023	0.046	0.055	0.067	0.092	0.086	
UANM, milk (kg/d)	0.300	1.083	1.311	0.949	0.975	0.888	
UANM, egg (kg/d)	0.022	0.022	0.024	0.031	0.034	0.036	
UAQU, fish (kg/d)	0.0068	0.0166	0.026	0.035	0.0449	0.088	per capita
UAQU, mollusk (kg/d)	0.0050	0.0119	0.0209	0.0241	0.0502	0.0730	per capita
UAQU, crustacean (kg/d)	<subtract from mollusk value, if applied>						
UAQU, aquatic plant (kg/d)	<apply site-specific values, if relevant>						

Table ES5.5. (contd)

Symbol (units)	**Age1**	**Age2**	**Age3**	**Age4**	**Age5**	**Age6**	**Comment[(a)]**
UDW (L/d)	0.97	0.865	0.928	1.36	1.841	2.73	
TESHWR (hr)	0	0.73	0.57	0.68	0.71	0.75	
USHIN (L/hr)	0	0.06	0.06	0.06	0.06	0.04	
UINH (m^3/d)	6.8	9.2	13.8	16.6	23.3	19.4	

(a) MEI = maximally exposed individual.

ES6.0 Health Impacts Module

Refer to Section 9.0 for details.

Table ES6.0. Health Impacts Module

Tab	Symbol	Parameter	Units	Suggested Value	Comment
METHOD SELECTION	FGR13	N/A	-	"...ICRP-60; FGR 12/13"	
METHOD PARAMETERS	SOILT	Thickness of contaminated soil/sediment	m	0.15	Enter same value as SURCM of the Exposure module.
	SLDN	Density of contaminated soil/sediment	kg/m^3	see options below	Enter same value as (SLDN of the Exposure module)*(1/0.15).
	SLDN	Density of contaminated soil/sediment-option1	kg/m^3	1466	sandy soil - for crop growth
	SLDN	Density of contaminated soil/sediment-option2	kg/m^3	1300	silty soil - for crop growth
	SLDN	Density of contaminated soil/sediment-option3	kg/m^3	1033	clay soil - for crop growth
	SLDN	Density of contaminated soil/sediment-option4	kg/m^3	1933	rocky shoreline
CONSTITUENT PARAMETERS	SOLUBIL	Lung transfer inhalation class	-	<see ICRP 68, 69, 71, 72>	-

1.0 Introduction

Guidance in Regulatory Guide 1.109 (NRC 1977), "Calculation of Annual Doses to Man from Routine Releases in Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," has been historically used as guidance to assess licensee compliance with public dose criteria. Public dose estimates calculated by nuclear power plant operators provide an extensive historical record of application of U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.109[1] information for the member of the public considered to be the maximally exposed individual (MEI). The NRC Office of New Reactors (NRO) has requested that a similar parameter document be developed for use in assessing compliance with both Title 10 *Code of Federal Regulations* (CFR) 50, Appendix I and 10 CFR Part 20 for use with the GENII version 2 (Gv2) computer code.

This document provides more detailed guidance for parameterization of the maximally exposed individual (MEI) and population doses for use with the GENII version 2 computer code (Gv2). Default parameter values are provided in the Users' Guide and Software Design Documentation. The Gv2 code requires a multitude of user-entered parameters, more than many environmental modeling codes. The numerous parameter entries are, in part, a result of the numerous linked modules that comprise a complete scenario definition from source to health impact. The numerous entries are also a consequence of the evolution of the code from a simpler, DOS-based code running on older computer systems to the advent of faster computer systems that allow more input to be processed in a practical amount of time.

The numerous user inputs make the code more flexible to user-specific conditions. Each user-defined parameter should have as strong a technical basis as possible. This document presents a compilation of U.S. generic and available regional parameter data and their technical bases. This document provides guidance for both MEI and population dose estimates. The user has the ultimate responsibility for ensuring the parameters entered are reasonable, technically strong, and coherent. Coherence means that the various parameters make sense; a simple example being that ingestion rates for youngsters would not result in a 150-lb six-year old. Although common for risk assessments to somewhat overestimate exposures or intakes to provide a reasonable upper bound, unreasonably overestimated impacts are unwarranted.

Typically, estimating dose to the MEI provides a prudently worst-case dose to a hypothetical individual. The MEI dose answers the question "What's the worst dose possible from annual radioactive emissions at my facility?" This individual is generally at an offsite location close to the emission source and harvests food, both animal products and crops, from this location. The public dose standards are based on an individual dose. The MEI intake and exposure assumptions are reasonable upper-bounds and would rarely be applicable to any actual person.

Population doses can be calculated by summing doses of more than one individual. Most of the U.S. population obtains the majority of their food from commercial sources from a wide variety of locations. Therefore, large numbers of individuals have smaller individual doses than the MEI. The population dose can be calculated for various population sets of interest and are generally limited to a greatest distance of 30–50 miles from the release point. The population dose has limited but informative

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[1]See U.S. NRC Radioactive Effluent and Environmental Reports, last accessed at http://www.nrc.gov/reactors/operating/ops-experience/tritium/plant-info.html.

applications, since there are no current population dose limits or guidelines. The population dose estimates and input parameters of the GENII code can be used to determine the several measures of interest.

- The dose to the average person can be calculated from average intake rates of regional food sources.[1] The population dose within a user-defined region can also be calculated and tracked for trending purposes.
- The dose to the average person from a large commercial agricultural operation for a single crop or livestock operation in a region can be calculated. This can be used as a comparative baseline for accident impact estimates.
- A small number of additional calculations can be performed for regional commercial agricultural operations to determine the number of individuals exposed to the crop or livestock products of a given region. This will provide an indication of the extent of public impact as well as an indication of impact to the domestic market for that particular agricultural product.

"Generic" parameter data and model selections for chronic air and for liquid effluent releases to public bodies of water are presented. Considering schedule, data availability and format, and other factors, regionally-specific parameter data are also presented in varying levels of detail. Additional resources are also provided to prompt the user regarding additional information sources about a specific parameter. The user must be aware that these generic values and the indicated minimum and maximums are not extreme, bounding minimum and maximum values, but rather "generic," "typical" minimum and maximum values in the majority of cases. No attempt was made to quantify the percentile level that the minimum and maximum values represent. The user will need to evaluate the applicability of the parameter values they assign and how comprehensively they desire to represent the full range, likely range, or typical range of receptors that they are modeling.

Information specific to tritium and carbon-14 modeling is in Section 10.0. As is the standard, the environmental modeling of these two nuclides implements specific-activity equivalence models.

If the sensitivity module of the GENII code is implemented, output uncertainties can be estimated. Appendix J provides information regarding the distribution type suggested for routine release scenarios.

Parameter data are presented in the order of its occurrence in a Gv2 module. Air emissions are more common, therefore no water modules would be implemented. Modules are represented as icons in the Gv2 window (see Figure 1.1).

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[1]This average individual dose can be compared to the regulatory dose limit, but has limited application because the MEI dose will always be larger.

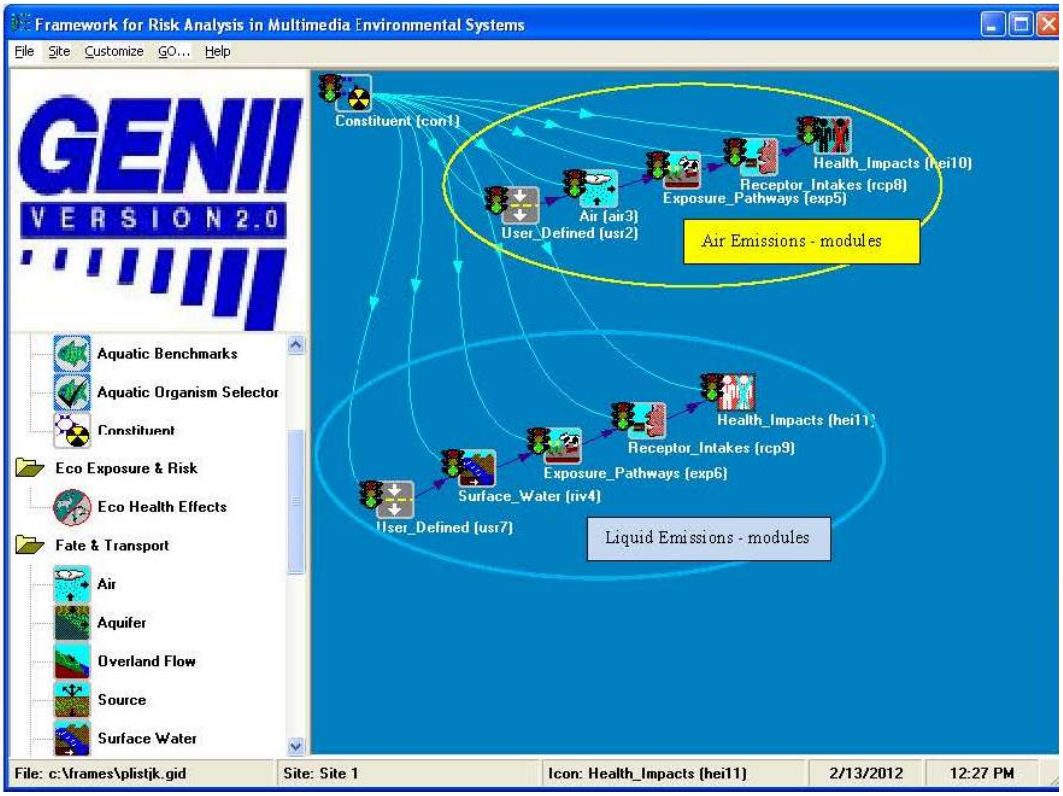

Figure 1.1. Example of GENIIv2 Chronic Air and Water Pathways Scenarios

One important concept to understand with use of the Gv2 code is the difference between a module and a model. Each icon represented in the blue field of Figure 1.1 represents a different module. Within each module, one or more models (i.e., algorithms) accept the user input and produce output. For example, the user can select a variety of models in the Air module (Acute 95th Percentile, Acute Plume, Acute Puff, Chronic Plume, among others). The models selected for use with the parameters presented in this document are indicated in Table 1.1. The model is selected before parameter values are entered. Some, but not all, parameters values may differ if a model other than that indicated is selected.

Table 1.1. Applicable Models to Select for Modules of Chronic Release Scenarios

Pathway	Module	Applicable Model to Select
Air and Water	Constituent	GENII Radionuclide database selection
Air	User-Defined	AFF Air Module
	Air	GENII V2 Air Module – Chronic Plume
	Exposure Pathways	GENII V2 Chronic Exposure Module
	Receptor Intakes	GENII V2 Receptor Intake Module
	Health Impacts	GENII V2 Health Impacts Module
Water	User-Defined	WFF Surface Water Module
	Surface Water	GENII V2 Surface Water Module
	Exposure Pathways	GENII V2 Chronic Exposure Module
	Receptor Intakes	GENII V2 Receptor Intake Module
	Health Impacts	GENII V2 Health Impacts Module

GENIIv2 modules define the models that are linked to represent the scenario of interest. Module details are available in GENII v2 documentation (Napier 2012, Napier et al. 2012). Modules are summarized as follows for airborne and liquid releases:

- Chronic Airborne Release Modules
  - Constituent: Chemical- or radionuclide-specific parameters entered
  - User-Defined (AIR): Radionuclide release rates entered
  - Air: Meteorological dispersion characterization
  - Exposure Pathways: Environmental media defined and characterized
  - Receptor Intakes: Intake rates and exposure times entered
  - Health Impacts: Dose is calculated from intake and exposure estimate
- Chronic Liquid Release Modules
  - Constituent: Chemical- or radionuclide-specific parameters entered
  - User-Defined (WATER): Radionuclide release rates entered
  - Surface Water: Mixing in surface water characterized
  - Exposure Pathways: Environmental media defined and characterized
  - Receptor Intakes: Intake rates and exposure times entered
  - Health Impacts: Dose is calculated from intake and exposure estimate.

Default parameter values are provided in most modules. Parameters such as emission rates and release point characteristics are user-specific, so default values are not provided. This parameter document provides information to allow the user to modify the default parameters to better represent their release, local conditions, and regional receptor characteristics to model the release and the impact estimate that best describes their facility and region.

1.1 References

10 CFR 20. 2013. "Standards for Protection Against Radiation." *Code of Federal Regulations*, U.S. Department of Energy, Washington, D.C.

10 CFR 50, Appendix I. 2007. "Domestic Licensing of Production and Utilization Facilities." Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as is Reasonably Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents." *Code of Federal Regulations*, U.S. Department of Energy, Washington, D.C.

Napier BA. 2012. *GENII Version 2 Users' Guide*. PNNL-14583, Rev. 4, Pacific Northwest National Laboratory, Richland, Washington.

Napier BA, DL Strenge, JV Ramsdell, Jr., PW Eslinger, and C Fosmire. 2012. *GENII Version 2 Software Design Document.* PNNL-14584, Rev. 4, Pacific Northwest National Laboratory, Richland, Washington.

NRC. 1977. *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I.* Regulatory Guide 1.109, Rev. 1, U.S. Nuclear Regulatory Commission, Washington, D.C.

2.0 Module: Constituent

The Constituent module will be the first module for all cases. The module model selected is "GENII Radionuclide Database Selection." The Constituent Module is where the user indicates the radionuclides of interest and assigns most element- or nuclide-specific parameter values. Two Tabs exist in this module: Select Constituents of Concern and Edit Constituent Properties. No user-defined parameters are entered in the Select Constituents of Concern Tab. Therefore, only the numerous parameters of the Edit Constituent Properties Tab are detailed in this section. Sub-tabs include Properties and Degradation Chain, but only the Properties sub-tab allows user-defined values.

2.1 Tab: Edit Constituent Properties/Properties

Numerous parameters are listed, but not all require input. Those that do not require input are not noted in this section, unless a particular editorial comment was deemed note-worthy. There are some parameters that a user would expect to require input, but are actually handled in other modules or not required. This particular set of parameters includes:

CLANDF	Inhalation Volatilization Factor for Indoors
SOLUBIL	Lung Solubility
CLDFAx	Inhalation Dose Factor, where x=D, W, or Y
CLDFGx	Ingestion Dose Factor, where x=S or I
CLBSAF	Bioaccumulation in Aquatic Biota from Sediment
CLBVOV	Bioconcentration in Other Feed Vegetables from Soil
CLVD	Atmospheric Deposition Velocity
CLSCLASS	Atmospheric Deposition Class

Inhalation and ingestion dose factors are not used from the entries in this module when the recommended Health Impact module selection [Method Selection of "Calculate Dose and/or Risk using ICRP-60 and EPA Risk Factors (Federal Guidance Reports 12/13)] is used (see Section 9.0), but are discussed briefly.

2.1.1 CLKD Dry Soil-Water Partition Coefficient

The default soil-water partition coefficients are listed here; for radionuclide modeling the value used by the code may also entered in a later module. If "Leach rates calculated from user input" is selected in the later Exposure Pathways-Chronic Exposure module (see Section 7.9), then the user may enter the values here that will be reflected as the defaults for SOILKD.

The units and range for this parameter in Gv2 are: mL/g (0–10 million).

See Chronic Exposure Module, Soil/Leaching tab (Section 7.9) for K_d value used for radionuclide modeling.

2.1.2 CLANDF Inhalation Volatilization Factor

CLANDF is intended to be used to calculate the indoor air contaminant concentrations that originate from shower water use, as the nuclide volatilizes from the heated, fine spray. The value applied for Gv2 modeling is assigned in the Chronic Exposure model, Water/General tab, parameter ANDKR (see Section 7.3.2).

The units and range for this parameter in Gv2 are: m^3/L (0 to 100).

It is suggested that all these values be set to zero, to remind the user that values are not applied at this point in water scenarios.

2.1.3 CLWPF Water Purification Factor

This value is used in modeling when the option for Treatment Plant Purification of Domestic Water is selected in the Chronic Exposure Module, Water/General tab (see Section 7.3). The parameter value indicates the ratio of the contaminant concentration after and before purification.

The units for this parameter in Gv2 are: fraction (0 to 1).

A conservative value would be 1.0.

Cleanup factors were developed for use in the original version of the GENII code used for U.S. Department of Energy (DOE) Hanford Site dose calculations (GENIIv1.485, Napier et al. 1988). The values indicated in the GENIIv1.485 BIOAC1.DAT file is shown in Table 2.1. These values reflect an alum-flocculation water treatment plant (Denham and Soldat 1974).

2.1.3.1 Additional Sources of Information

There are likely to be a number of additional sources of information available. None were identified at the time of publication.

2.1.3.2 CLWPF Water Purification Factor Tables

Table 2.1. Generic Water Treatment Cleanup Factors for Alum Flocculation Filtration

CLWPF (fraction)	Element
1	C, Cl, H
0.9	Bi, Cs, Mo, Na, Pb, Rb
0.8	F, I, Po, Sb, Se, Te
0.7	Ac, Ag, Am, As, Cm, Nb, Np, Pa, Pu, Ra, Si, Sn, Tc, Th, U, Zr
0.6	Cd
0.5	Mn, Pd, Rh, Ru
0.4	Ba, P, Zn
0.3	Sc
0.2	Be, Ca, Ce, Co, Er, Eu, Fe, Ho, La, Nd, Ni, Pm, Pr, Sm, Sr, Tb, Y
0.1	<none>
0	gases
N/A	Bk, Br, Cf, Cr, Cu, Dy, Ga, Gd, Hf, Hg, In, Ir, S, Ta, Tl, Tm, W, Yb

N/A = No value indicated in BIOAC1.DAT file of Napier et al. (1988).

2.1.4 SOLUBIL Lung Solubility

SOLUBIL is not implemented from this entry when the ICRP-30 internal dose factors are used (the code takes the largest available). When the recommended internal dose factors (see next section) are implemented these define the default types. See CLDFAx, additional information (Section 2.1.5.1) for a reference that contains generic solubility types. See the Health Impacts module, Constituent Parameters tab for parameterization of lung solubility (see Section 9.2).

The units for this parameter in Gv2 are: N/A.

2.1.5 CLDFAx Inhalation Dose Factor

There are three lines of potential input for this parameter; however, these would only be used for calculations when the later Health Impacts module, the *Method Selection* was indicated to be use of "… ICRP 30/48…" The recommended *Method Selection* is "ICRP 60," which is more recent, and implements age-dependent internal dose factors consistent with ICRP 66-72. Both use the same non-age-dependent external dose factors of Federal Guidance Report No. 12 (Eckerman and Ryman 1993).

If the user decides to use the ICRP 30/48 option in the later Health Impacts module, note the different data values for solubility class day (D) (CLDFAD), solubility class week (W) (CLDFAW), and solubility class year (Y) (CLDFAY). If more than one entry is provided, the code will use the greatest. If one particular class is desired for a nuclide, delete the others.

When the recommended later*, Health Impacts module selection* is made (Method Selection "…using ICRP 60…"), the dose factor implemented is implemented in code black-box processing and not defined explicitly by the user. Age-dependent inhalation dose factors are used, depending on the Receptor module age groups (see Section 8.0) and Health Impacts module inhalation class entered (see Section 9.2).

The units for this parameter in Gv2 are: rem/pCi (0–1).

The inhalation dose factors implemented are those of Federal Guidance Report 13 (Eckerman et al. 1998), which is consistent with those in ICRP 66-72.

2.1.5.1 Additional Sources of Information

ICRP 66 (ICRP 1994). The inhalation dose factors of ICRP 71 and 72 (and ICRP 68 for workers) are based on this human respiratory tract model.

ICRP 71 and 72 (ICRP 1995b, 1995c). These publications provide inhalation dose factors that are based on the ICRP 66 respiratory tract model. These values update those of ICRP 56 (ICRP 1990), which use an older respiratory tract model. ICRP 72 does not include organ-specific data.

ICRP 119 (ICRP 2012). Supplement 1 to ICRP 119 is a *Compendium of Dose Coefficients based on ICRP Publication 60*.

DOE Derived Concentration Technical Standard (DOE 2011). Table A-2 provides alternative effective dose coefficients from air inhalation ($Sv_{effective\_dose}/Bq_{inhaled}$). Table 4 indicates generic lung solubility type recommendations for each element in particulate form.

2.1.5.2 CLDFAx Inhalation Dose Factor Tables

Dose factors will not be tabulated here.

If the recommended "ICRP 60" method values of Federal Guidance Report 13 are implemented in the later *Health Impacts module*, the user can view the data implemented in the FRAMES/FGR13INH.HDB file, with different units indicated (Sv/Bq). The format of the file is discussed in the GENII documentation (Napier et al. 2012) Appendix B, Section B.4. The Federal Guidance Report No. 13 can be accessed separately per information available at http://www.epa.gov/radiation/federal/techdocs.html.

Although discouraged, if the "ICRP 30" method values of Federal Guidance Report 11 are implemented in the later *Health Impacts module*, the dose factors can be access per information available at the same site: http://www.epa.gov/radiation/federal/techdocs.html, but choose Report No. 11.

2.1.6 CLRDFGx Ingestion Dose Factor

This parameter is implemented in a manner similar to the Inhalation Dose Factor, above. There are two lines of potential input for this parameter, however only one will be used for calculations when later, *Health Impacts module, Method selection* of "… ICRP38/40…" is chosen. This "ICRP 38/40" choice is not recommended. The recommended option in the later, *Health Impacts module, Method selection* is ICRP 60. There are different data entry points for soluble (CLRDFGS) and insoluble (CLRDFGI). If more than one entry is provided, the code will use the greatest.

The units for this parameter in Gv2 are: rem/pCi.

2.1.6.1 Additional Sources of Information

ICRP 67 and 69 (ICRP 1992, 1995a). Age-dependent ingestion dose factors.

2.1.6.2 CLRDFGx Ingestion Dose Factor Tables

Age-dependent ingestion dose factors will not be tabulated here.

If the recommended "ICPR 60" method values of Federal Guidance Report 13 are implemented in the later *Health Impacts module,* the user can view the data implemented in the FRAMES/FGR13ING.GDB file with data presented in different units (Sv/Bq). The format of the file is discussed in the GENII documentation (Napier et al. 2012) Appendix B, Section B.3.

2.1.7 CLDEX External Dose Factor, Air Immersion

The external dose factor for air immersion is the dose rate received by an individual standing in a large cloud or plume of contaminated air having a radionuclide concentration of 1 pCi/m^3.

The units and range for this parameter in Gv2 are: mrem/hr per pCi/m^3 (0 to 1).

The values implemented in GENII are taken from Federal Guidance Report 12 (Eckerman and Ryman 1993).

2.1.7.1 Additional Sources of Information

None provided.

2.1.7.2 CLDEX External Dose Factor, Air Immersion Tables

Not tabulated here. See the air submersion dose factors in Table III.1 of Eckerman and Ryman (1993).

2.1.8 CLDIMR External Dose Factor, Water Immersion

The water immersion, external dose factor is the dose rate received by an individual immersed in water (e.g., swimming) having a radionuclide concentration of 1 pCi per L. For external exposure from boating, a 0.5 times the water immersion dose factor is applied for dose calculations.

The units and range for this parameter in Gv2 are: mrem/hr per pCi/m^3 (0 to 1).

Values applied are those in the U.S. Environmental Protection Agency (EPA) Federal Guidance Report No. 12 (Eckerman and Ryman 1993).

2.1.8.1 Additional Sources of Information

None provided.

2.1.8.2 CLDIMR External Dose Factor, Water Immersion Tables

Not tabulated here. See the water immersion dose factors in Table III.2 of Eckerman and Ryman (1993).

2.1.9 CLDSH*x* External Dose Factor, Ground Contaminated to 15 cm

There are three lines of potential input for this parameter; however, only one will be used. The entire set of parameters includes dose factors for surface contamination (CLDSH1), or contamination to a depth of 5 cm (CLDSH5), or contamination to a depth of 15 cm (CLDSH15).

- The units and range for CLDSH1 in Gv2 are: mrem/hr per pCi/m^2 ground surface (0–1).
- The units and range for CLDSH5 in Gv2 are: mrem/hr per pCi/m^3 for 5 cm depth (0–1).
- The units and range for CLDSH15 in Gv2 are: mrem/hr per pCi/m^3 for 15 cm depth (0–1).

Contamination to a depth of 15 cm is recommended. Values are applied from Federal Guidance Report No. 12 Table III.6 (Eckerman and Ryman 1993). No age-dependency is applied to these dose factors.

2.1.9.1 Additional Sources of Information

ICRP Report 74 (ICRP 1996) discusses age-dependency issues related to external dose coefficients in ICRP 74, Section 4.3.5.

2.1.9.2 CLDSHX External Dose Factor, Ground Contaminated to 15 cm Tables

Not tabulated here. See Table III.6 of Eckerman and Ryman (1993).

2.1.10 CLDIAM Inhalation Dose Factor, Particle Diameter

This parameter is not implemented in this module in GENII v2. The inhalation dose factors are defined for a specific particle size at the point of inhalation. For atmospheric transport modeling, the particle radius and density are parameterized in the next, User-Defined, AFF Air Module (select Flux Types button and enter values).

See User-Defined module, Section 3.0, for air pathway inputs

Bioconcentration and Transfer Factors

2.1.11 CLBF*x* and CLBM*x* Bioaccumulation Factor for Aquatic Animals (Freshwater and Saltwater)

These parameters describe the bioaccumulation factor for wet fish, wet mollusks, and wet Crustacea in freshwater (CLBFF, CLBFM, and CLBFI, respectively) and saltwater (CLBMF, CLBMM, and CLBMI, respectively). These parameters are the ratio of the chemical concentration in a freshwater or saltwater organism to the chemical concentration in the water to which the organism is exposed. The bioaccumulation factor generally accounts for uptake by the organism of the chemical from water, sediments passing across the gills, and from consumption of various foods.

The units and range for these parameters in Gv2 are: L/kg_{wet} which is a reduced from (Ci/kg_{wet}) per (Ci/L) (0 to 100,000 for all organisms).

To tabulate bioaccumulation factors for aquatic animals, sources considered to be the best available references were reviewed. Details on the references reviewed are available in Appendix A. The goal was to determine mean, median, geometric standard deviation, geometric mean, 5th percentile, and 95th percentile. Some of these values could be determined mathematically. In these cases, statistical calculations were performed, according to methods described in Strom and Stansbury (2000). (If, in assignment of statistical parameters, the assigned mean was greater than the 95th percentile, it is not shown in the tables.) The full set of data reviewed to determine the values tabulated in this section are provided in Appendix A. Selection priority was given to recent International Atomic Energy Agency (IAEA) documents (IAEA 2004, 2010) with a preference for lognormality in the data sets.

2.1.11.1 Additional Sources of Information

The references that were reviewed contain additional information regarding data completeness, data limitations, and application of values to environmental models.

There are numerous chemicals for which no aquatic animal bioaccumulation factors are available. The user can refer to Staven et al. (2003) for an approach to approximate values for non-tabulated chemicals. The user is encouraged to review additional research on transfer factors in the literature, as well.

2.1.11.2 CLBFx Tables – Freshwater Fish, Mollusks, and Crustaceans

For CLBFF Bioconcentration factors for freshwater Fish, see Table 2.2.

For CLBFM Bioconcentration factors for freshwater Mollusk, see Table 2.3. Because relatively few data were available, this table has been enhanced by including additional results from the freshwater Crustacea where other data are lacking.

For CLBFI Bioconcentration factors for freshwater Crustacea, see Table 2.4.

2.1.11.3 CLBMx Tables – Saltwater Fish, Mollusks, and Crustaceans

For CLBMF Bioconcentration factors for saltwater Fish, see Table 2.5

For CLBMM Bioconcentration factors for saltwater Mollusk, see Table 2.6

For CLBMI Bioconcentration factors for saltwater Crustacea, see Table 2.7

Table 2.2. CLBFF Bioaccumulation Factors – Freshwater Fish

Element	Mean	STD	Median	GSD	GM	5%	95%
Ac	N/A	N/A	2.50E+01	N/A	N/A	N/A	N/A
Ag	1.19E+02	5.05E+01	N/A	1.50E+00	1.10E+02	5.65E+01	2.14E+02
Al	1.29E+02	2.98E+02	N/A	3.90E+00	5.10E+01	5.44E+00	4.78E+02
Am	2.40E+02	N/A	N/A	N/A	N/A	N/A	N/A
As	4.35E+02	3.72E+02	N/A	2.10E+00	3.30E+02	9.74E+01	1.12E+03
Au	3.16E+02	2.71E+02	N/A	2.10E+00	2.40E+02	7.08E+01	8.13E+02
Ba	2.45E+00	4.35E+00	N/A	3.30E+00	1.20E+00	1.68E-01	8.55E+00
Be	N/A	N/A	2.00E+00	N/A	N/A	N/A	N/A
Bi	N/A	N/A	1.50E+01	N/A	N/A	N/A	N/A
Br	1.29E+02	1.29E+02	N/A	2.30E+00	9.10E+01	2.31E+01	3.58E+02
C	7.05E+05	1.02E+06	N/A	2.90E+00	4.00E+05	6.94E+04	2.31E+06
Ca	1.83E+01	2.09E+01	N/A	2.50E+00	1.20E+01	2.66E+00	5.42E+01
Cd	8.31E+02	4.86E+03	6.60E+00	1.40E+02	N/A	6.28E+00	3.12E+03
Ce	3.15E+02	3.96E+03	N/A	9.50E+00	2.50E+01	6.16E-01	1.01E+03
Cf	N/A	N/A	2.50E+01	N/A	N/A	N/A	N/A
Cl	5.46E+01	5.07E+01	N/A	2.20E+00	4.00E+01	1.09E+01	1.46E+02
Cm	N/A	N/A	2.50E+02	N/A	N/A	N/A	N/A
Co	1.11E+02	1.20E+02	N/A	2.40E+00	7.60E+01	1.80E+01	3.21E+02
Cr	5.09E+01	3.99E+01	N/A	2.00E+00	4.00E+01	1.28E+01	1.25E+02
Cs	3.67E+03	3.94E+03	N/A	2.40E+00	2.50E+03	5.92E+02	1.06E+04
Cu	2.65E+02	1.51E+02	N/A	1.70E+00	2.30E+02	9.61E+01	5.51E+02
Dy	6.50E+02	N/A	N/A	N/A	N/A	N/A	N/A
Eu	4.60E+02	1.56E+03	N/A	4.90E+00	1.30E+02	9.52E+00	1.78E+03
F	N/A	N/A	1.00E+01	N/A	N/A	N/A	N/A
Fe	1.10E+03	7.01E+03	N/A	6.90E+00	1.70E+02	7.09E+00	4.08E+03
Gd	N/A	N/A	2.50E+01	N/A	N/A	N/A	N/A
Ge	1.50E+00	N/A	N/A	N/A	N/A	N/A	N/A
Hf	1.35E+03	9.65E+02	N/A	1.90E+00	1.10E+03	3.83E+02	3.16E+03
Hg	7.50E+03	5.35E+03	N/A	1.90E+00	6.10E+03	2.12E+03	1.75E+04
Ho	N/A	N/A	2.50E+01	N/A	N/A	N/A	N/A
I	4.56E+01	5.24E+01	N/A	2.50E+00	3.00E+01	6.65E+00	1.35E+02
In	N/A	N/A	1.00E+05	N/A	N/A	N/A	N/A
Ir	N/A	N/A	1.00E+01	N/A	N/A	N/A	N/A
K	3.57E+03	1.78E+03	N/A	1.60E+00	3.20E+03	1.48E+03	6.93E+03
La	1.31E+02	4.44E+02	N/A	4.90E+00	3.70E+01	2.71E+00	5.05E+02
Mg	5.05E+01	4.69E+01	N/A	2.20E+00	3.70E+01	1.01E+01	1.35E+02
Mn	1.47E+03	8.82E+03	N/A	6.70E+00	2.40E+02	1.05E+01	5.48E+03

Table 2.2. (contd)

Element	Mean	STD	Median	GSD	GM	5%	95%
Mo	2.50E+00	2.14E+00	N/A	2.10E+00	1.90E+00	5.61E-01	6.44E+00
N	N/A	N/A	1.50E+05	N/A	N/A	N/A	N/A
Na	1.39E+02	2.13E+02	N/A	3.00E+00	7.60E+01	1.25E+01	4.63E+02
Nb	4.42E+01	5.73E+01	2.70E+00	2.70E+01	N/A	5.27E+00	1.38E+02
Nd	4.30E+01	3.91E+02	8.20E+00	4.70E+00	N/A	1.48E-01	1.50E+02
Ni	2.58E+01	1.84E+01	N/A	1.90E+00	2.10E+01	7.31E+00	6.04E+01
Os	N/A	N/A	1.00E+01	N/A	N/A	N/A	N/A
P	1.41E+05	1.34E+04	N/A	1.10E+00	1.40E+05	1.20E+05	1.64E+05
Pa	N/A	N/A	1.10E+01	N/A	N/A	N/A	N/A
Pb	4.41E+01	6.40E+01	N/A	2.90E+00	2.50E+01	4.34E+00	1.44E+02
Pd	7.13E+01	1.09E+02	3.00E+00	3.90E+01	N/A	6.40E+00	2.38E+02
Pm	N/A	N/A	2.50E+01	N/A	N/A	N/A	N/A
Po	1.04E+02	2.84E+02	N/A	4.30E+00	3.60E+01	3.27E+00	3.97E+02
Pr	N/A	N/A	2.50E+01	N/A	N/A	N/A	N/A
Pu	3.31E+04	4.05E+04	N/A	2.60E+00	2.10E+04	4.36E+03	1.01E+05
Ra	2.58E+01	1.65E+02	N/A	6.90E+00	4.00E+00	1.67E-01	9.59E+01
Rb	4.60E+03	2.63E+03	N/A	1.70E+00	4.00E+03	1.67E+03	9.58E+03
Re	N/A	N/A	1.20E+02	N/A	N/A	N/A	N/A
Rh	N/A	N/A	1.00E+01	N/A	N/A	N/A	N/A
Ru	N/A	N/A	1.00E+02	N/A	N/A	N/A	N/A
Ru	5.50E+01	N/A	N/A	N/A	N/A	N/A	N/A
S	3.50E+00	N/A	N/A	N/A	N/A	N/A	N/A
Sb	1.15E+02	3.36E+02	N/A	4.50E+00	3.70E+01	3.12E+00	4.39E+02
Sc	2.50E+02	2.14E+02	N/A	2.10E+00	1.90E+02	5.61E+01	6.44E+02
Se	6.21E+03	1.66E+03	N/A	1.30E+00	6.00E+03	3.90E+03	9.24E+03
Sm	N/A	N/A	2.50E+01	N/A	N/A	N/A	N/A
Sn	N/A	N/A	3.00E+03	N/A	N/A	N/A	N/A
Sr	7.32E+00	1.70E+01	N/A	3.90E+00	2.90E+00	3.09E-01	2.72E+01
Tb	5.04E+02	3.60E+02	N/A	1.90E+00	4.10E+02	1.43E+02	1.18E+03
Tc	N/A	N/A	1.50E+01	N/A	N/A	N/A	N/A
Te	1.63E+02	6.88E+01	N/A	1.50E+00	1.50E+02	7.70E+01	2.92E+02
Th	N/A	N/A	N/A	N/A	6.00E+00	N/A	N/A
Ti	2.01E+02	6.96E+01	N/A	1.40E+00	1.90E+02	1.09E+02	3.30E+02
Tl	1.42E+03	1.74E+03	N/A	2.60E+00	9.00E+02	1.87E+02	4.33E+03
U	9.76E-01	1.79E-01	N/A	1.20E+00	9.60E-01	7.11E-01	1.30E+00
V	1.19E+02	8.51E+01	N/A	1.90E+00	9.70E+01	3.37E+01	2.79E+02
W	N/A	N/A	1.20E+03	N/A	N/A	N/A	N/A
Y	6.09E+01	6.98E+01	N/A	2.50E+00	4.00E+01	8.86E+00	1.81E+02
Zn	5.99E+03	8.70E+03	N/A	2.90E+00	3.40E+03	5.90E+02	1.96E+04
Zr	3.23E+01	3.46E+01	N/A	2.40E+00	2.20E+01	5.21E+00	9.29E+01

GM = Geometric mean.
GSD = Geometric Standard Deviation.
N/A = Not available in the references reviewed.
STD = Standard Deviation.

Table 2.3. CLBFM Bioaccumulation Factors – Freshwater Mollusk

Element	Mean	STD	Median	GSD	GM	5%	95%
Ag	2.30E+02	1.40E+03	3.73E+01	6.74E+00	3.73E+01	1.62E+00	8.60E+02
Al	3.40E+03	4.00E+02	3.38E+03	1.12E+00	3.38E+03	2.78E+03	4.10E+03
Am	N/A	N/A	N/A	7.00E+00	2.40E+03	9.77E+01	5.89E+04
As	5.00E+01	N/A	N/A	N/A	N/A	N/A	N/A
As	1.50E+03	7.10E+02	1.36E+03	1.57E+00	1.36E+03	6.47E+02	2.84E+03
Au	1.40E+03	3.50E+02	1.36E+03	1.28E+00	1.36E+03	9.06E+02	2.04E+03
Ba	1.40E+02	3.50E+00	1.40E+02	1.03E+00	1.40E+02	1.34E+02	1.46E+02
Br	1.30E+03	7.60E+02	1.12E+03	1.72E+00	1.12E+03	4.60E+02	2.74E+03
C	5.17E+01	5.93E+01	N/A	2.50E+00	3.40E+01	7.53E+00	1.53E+02
Ca	N/A	N/A	N/A	3.90E+01	1.00E+02	2.41E-01	4.14E+04
Cd	N/A	N/A	N/A	3.90E+01	1.00E+02	2.41E-01	4.14E+04
Ce	2.30E+03	6.00E+02	2.23E+03	1.29E+00	2.23E+03	1.46E+03	3.39E+03
Cl	1.60E+02	3.50E+01	1.56E+02	1.24E+00	1.56E+02	1.10E+02	2.23E+02
Cm	9.50E+03	7.10E+02	9.47E+03	1.08E+00	9.47E+03	8.38E+03	1.07E+04
Co	2.50E+01	6.00E+00	2.43E+01	1.27E+00	2.43E+01	1.65E+01	3.59E+01
Cr	3.00E+01	8.00E+00	2.90E+01	1.30E+00	2.90E+01	1.88E+01	4.46E+01
Cr	3.00E+03	N/A	N/A	N/A	N/A	N/A	N/A
Cs	1.50E+01	4.00E+00	1.45E+01	1.30E+00	1.45E+01	9.42E+00	2.23E+01
Cu	6.00E+02	N/A	N/A	N/A	N/A	N/A	N/A
Eu	2.20E+02	2.10E+01	2.19E+02	1.10E+00	2.19E+02	1.87E+02	2.56E+02
Fe	7.30E+01	1.80E+01	7.09E+01	1.27E+00	7.09E+01	4.75E+01	1.06E+02
Hf	1.40E+03	1.40E+02	1.39E+03	1.10E+00	1.39E+03	1.18E+03	1.64E+03
Hg	1.23E+03	1.59E+03	N/A	2.70E+00	7.50E+02	1.46E+02	3.84E+03
I	7.00E+00	1.80E+00	6.78E+00	1.29E+00	6.78E+00	4.47E+00	1.03E+01
K	5.80E+02	5.00E+01	5.78E+02	1.09E+00	5.78E+02	5.02E+02	6.66E+02
La	3.50E+02	2.80E+01	3.49E+02	1.08E+00	3.49E+02	3.06E+02	3.98E+02
Lu	N/A	N/A	N/A	N/A	1.10E+03	N/A	N/A
Mg	3.20E+01	1.60E+00	3.20E+01	1.05E+00	3.20E+01	2.94E+01	3.47E+01
Mn	1.30E+03	3.00E+02	1.27E+03	1.26E+00	1.27E+03	8.71E+02	1.84E+03
Mo	1.21E+01	3.24E+02	N/A	1.30E+01	4.50E-01	6.62E-03	3.06E+01
Na	2.00E+02	N/A	N/A	N/A	N/A	N/A	N/A
Np	9.50E+03	1.10E+00	9.50E+03	1.00E+00	9.50E+03	9.50E+03	9.50E+03
P	2.00E+04	N/A	N/A	N/A	N/A	N/A	N/A
Pb	1.96E+03	1.74E+05	N/A	2.00E+01	2.20E+01	1.59E-01	3.04E+03
Po	7.20E+01	1.80E+01	6.99E+01	1.28E+00	6.99E+01	4.66E+01	1.05E+02
Pu	N/A	N/A	N/A	2.90E+01	7.40E+03	2.91E+01	1.88E+06
Ra	N/A	N/A	N/A	3.00E+01	1.00E+02	3.72E-01	2.69E+04
Rb	2.00E+03	2.80E+02	1.98E+03	1.15E+00	1.98E+03	1.58E+03	2.49E+03
Ru	1.20E+01	3.00E+00	1.16E+01	1.28E+00	1.16E+01	7.76E+00	1.75E+01
Sb	1.00E+01	3.00E+00	9.58E+00	1.34E+00	9.58E+00	5.91E+00	1.55E+01
Sc	3.50E+03	2.80E+02	3.49E+03	1.08E+00	3.49E+03	3.06E+03	3.98E+03
Se	2.23E+04	8.72E+05	N/A	1.50E+01	5.70E+02	6.63E+00	4.90E+04
Sm	1.60E+03	1.60E+03	1.13E+03	2.30E+00	1.13E+03	2.88E+02	4.45E+03
Sr	2.40E+03	6.00E+02	2.33E+03	1.28E+00	2.33E+03	1.55E+03	3.49E+03

Table 2.3. (contd)

Element	Mean	STD	Median	GSD	GM	5%	95%
Tc	3.60E+02	4.97E+03	N/A	9.90E+00	2.60E+01	5.99E-01	1.13E+03
Th	2.90E+03	1.40E+01	2.90E+03	1.00E+00	2.90E+03	2.88E+03	2.92E+03
U	1.30E+04	9.90E+05	N/A	1.90E+01	1.70E+02	1.34E+00	2.16E+04
V	3.80E+02	2.80E+01	3.79E+02	1.08E+00	3.79E+02	3.36E+02	4.28E+02
Zn	2.00E+03	N/A	N/A	N/A	N/A	N/A	N/A
Zr	1.50E+01	4.00E+00	1.45E+01	1.30E+00	1.45E+01	9.42E+00	2.23E+01

GM = Geometric mean.
GSD = Geometric Standard Deviation.
N/A = Not available in the references reviewed.
STD = Standard Deviation.

Table 2.4. CLBFI Bioaccumulation Factor – Freshwater Crustacean

Element	Mean	STD	Median	GSD	GM	5%	95%
Ag	2.30E+02	1.40E+03	3.73E+01	6.74E+00	3.73E+01	1.62E+00	8.60E+02
Al	3.40E+03	4.00E+02	3.38E+03	1.12E+00	3.38E+03	2.78E+03	4.10E+03
Am	N/A	N/A	N/A	7.00E+00	2.40E+03	9.77E+01	5.89E+04
As	1.50E+03	7.10E+02	1.36E+03	1.57E+00	1.36E+03	6.47E+02	2.84E+03
Au	1.40E+03	3.50E+02	1.36E+03	1.28E+00	1.36E+03	9.06E+02	2.04E+03
Ba	1.40E+02	3.50E+00	1.40E+02	1.03E+00	1.40E+02	1.34E+02	1.46E+02
Br	1.30E+03	7.60E+02	1.12E+03	1.72E+00	1.12E+03	4.60E+02	2.74E+03
Ca	5.17E+01	5.93E+01	N/A	2.50E+00	3.40E+01	7.53E+00	1.53E+02
Cd	N/A	N/A	N/A	3.90E+01	1.00E+02	2.41E-01	4.14E+04
Ce	4.30E+02	1.90E+02	3.93E+02	1.53E+00	3.93E+02	1.96E+02	7.88E+02
Cl	1.60E+02	3.50E+01	1.56E+02	1.24E+00	1.56E+02	1.10E+02	2.23E+02
Cm	9.50E+03	7.10E+02	9.47E+03	1.08E+00	9.47E+03	8.38E+03	1.07E+04
Co	N/A	N/A	N/A	1.30E+02	2.20E+01	7.33E-03	6.60E+04
Cr	3.00E+02	1.20E+02	2.79E+02	1.47E+00	2.79E+02	1.48E+02	5.25E+02
Cs	N/A	N/A	N/A	7.50E+01	2.30E+01	1.89E-02	2.79E+04
Cu	7.44E+02	1.32E+04	N/A	1.10E+01	4.20E+01	8.13E-01	2.17E+03
Eu	2.20E+02	2.10E+01	2.19E+02	1.10E+00	2.19E+02	1.87E+02	2.56E+02
Fe	2.00E+03	2.10E+02	1.99E+03	1.11E+00	1.99E+03	1.67E+03	2.36E+03
Hf	1.40E+03	1.40E+02	1.39E+03	1.10E+00	1.39E+03	1.18E+03	1.64E+03
Hg	1.23E+03	1.59E+03	N/A	2.70E+00	7.50E+02	1.46E+02	3.84E+03
I	3.01E+02	5.33E+03	N/A	1.10E+01	1.70E+01	3.29E-01	8.78E+02
K	5.80E+02	5.00E+01	5.78E+02	1.09E+00	5.78E+02	5.02E+02	6.66E+02
La	3.50E+02	2.80E+01	3.49E+02	1.08E+00	3.49E+02	3.06E+02	3.98E+02
Lu	N/A	N/A	N/A	N/A	1.10E+03	N/A	N/A
Mg	3.20E+01	1.60E+00	3.20E+01	1.05E+00	3.20E+01	2.94E+01	3.47E+01
Mn	N/A	N/A	N/A	3.90E+02	2.10E+01	1.15E-03	3.84E+05
Mo	1.21E+01	3.24E+02	N/A	1.30E+01	4.50E-01	6.62E-03	3.06E+01
Na	N/A	N/A	N/A	3.60E+01	3.40E+00	9.36E-03	1.23E+03
Np	9.50E+03	1.10E+00	9.50E+03	1.00E+00	9.50E+03	9.50E+03	9.50E+03
P	1.30E+04	N/A	N/A	N/A	N/A	N/A	N/A
Pb	1.96E+03	1.74E+05	N/A	2.00E+01	2.20E+01	1.59E-01	3.04E+03
Po	9.90E+03	1.40E+03	9.80E+03	1.15E+00	9.80E+03	7.78E+03	1.24E+04

Table 2.4. (contd)

Element	Mean	STD	Median	GSD	GM	5%	95%
Pu	N/A	N/A	N/A	2.90E+01	7.40E+03	2.91E+01	1.88E+06
Ra	N/A	N/A	N/A	3.00E+01	1.00E+02	3.72E-01	2.69E+04
Rb	2.00E+03	2.80E+02	1.98E+03	1.15E+00	1.98E+03	1.58E+03	2.49E+03
Ru	4.02E+00	4.14E+02	N/A	2.10E+01	3.90E-02	2.61E-04	5.84E+00
S	2.00E+01	N/A	N/A	N/A	N/A	N/A	N/A
Sb	2.10E+02	1.90E+02	1.56E+02	2.17E+00	1.56E+02	4.36E+01	5.56E+02
Sc	3.50E+03	2.80E+02	3.49E+03	1.08E+00	3.49E+03	3.06E+03	3.98E+03
Se	2.23E+04	8.72E+05	N/A	1.50E+01	5.70E+02	6.63E+00	4.90E+04
Sm	1.60E+03	1.60E+03	1.13E+03	2.30E+00	1.13E+03	2.88E+02	4.45E+03
Sr	5.31E+02	8.99E+02	N/A	3.20E+00	2.70E+02	3.98E+01	1.83E+03
Tc	3.60E+02	4.97E+03	N/A	9.90E+00	2.60E+01	5.99E-01	1.13E+03
Th	2.90E+03	1.40E+01	2.90E+03	1.00E+00	2.90E+03	2.88E+03	2.92E+03
U	1.30E+04	9.90E+05	N/A	1.90E+01	1.70E+02	1.34E+00	2.16E+04
V	3.80E+02	2.80E+01	3.79E+02	1.08E+00	3.79E+02	3.36E+02	4.28E+02
Zn	2.67E+04	7.73E+06	N/A	2.90E+01	9.20E+01	3.62E-01	2.34E+04
Zr	2.60E+02	N/A	N/A	N/A	N/A	N/A	N/A

GM = Geometric mean.
GSD = Geometric Standard Deviation.
N/A = Not available in the references reviewed.
STD = Standard Deviation.

Table 2.5. CLBMF Bioaccumulation Factor – Marine Fish

Element	Mean	SDT	Median	GSD	GM	5%	95%
Ac	N/A	N/A	5.00E+01	N/A	N/A	N/A	N/A
Ag	4.20E+03	4.10E+03	3.01E+03	2.27E+00	3.01E+03	7.82E+02	1.15E+04
Am	5.80E+01	7.10E+01	3.67E+01	2.60E+00	3.67E+01	7.60E+00	1.77E+02
Am	N/A	N/A	1.00E+01	N/A	N/A	N/A	N/A
Ba	N/A	N/A	1.00E+01	N/A	N/A	N/A	N/A
Bk	N/A	N/A	1.00E+02	N/A	N/A	N/A	N/A
Br	N/A	N/A	1.00E+01	N/A	N/A	N/A	N/A
Ca	N/A	N/A	2.00E+00	N/A	N/A	N/A	N/A
Cd	9.60E+03	2.00E+04	4.15E+03	3.65E+00	4.15E+03	4.94E+02	3.49E+04
Ce	1.20E+02	2.40E+02	5.37E+01	3.56E+00	5.37E+01	6.66E+00	4.33E+02
Cf	N/A	N/A	1.00E+02	N/A	N/A	N/A	N/A
Cl	N/A	N/A	6.00E-02	N/A	N/A	N/A	N/A
Cm	N/A	N/A	1.00E+02	N/A	N/A	N/A	N/A
Co	5.30E+03	1.50E+04	1.77E+03	4.40E+00	1.77E+03	1.54E+02	2.02E+04
Cs	8.70E+01	1.20E+02	5.11E+01	2.81E+00	5.11E+01	9.35E+00	2.79E+02
Dy	N/A	N/A	3.00E+02	N/A	N/A	N/A	N/A
Eu	4.40E+02	3.00E+02	3.64E+02	1.85E+00	3.64E+02	1.32E+02	1.00E+03
Fe	N/A	N/A	3.00E+04	N/A	N/A	N/A	N/A
Gd	N/A	N/A	3.00E+02	N/A	N/A	N/A	N/A
Hf	N/A	N/A	5.00E+02	N/A	N/A	N/A	N/A
Hg	N/A	N/A	3.00E+04	N/A	N/A	N/A	N/A
I	N/A	N/A	9.00E+00	N/A	N/A	N/A	N/A

Table 2.5. (contd)

Element	Mean	SDT	Median	GSD	GM	5%	95%
In	N/A	N/A	5.00E+02	N/A	N/A	N/A	N/A
Ir	N/A	N/A	2.00E+01	N/A	N/A	N/A	N/A
Mn	2.40E+03	1.50E+04	3.79E+02	6.83E+00	3.79E+02	1.61E+01	8.94E+03
Na	N/A	N/A	1.00E+00	N/A	N/A	N/A	N/A
Nb	N/A	N/A	3.00E+01	N/A	N/A	N/A	N/A
Ni	1.70E+02	2.20E+02	1.04E+02	2.70E+00	1.04E+02	2.03E+01	5.31E+02
Np	N/A	N/A	1.00E+00	N/A	N/A	N/A	N/A
P	9.90E+04	3.00E+04	9.47E+04	1.35E+00	9.47E+04	5.82E+04	1.54E+05
Pa	N/A	N/A	5.00E+01	N/A	N/A	N/A	N/A
Pb	4.40E+03	1.40E+04	1.32E+03	4.72E+00	1.32E+03	1.03E+02	1.70E+04
Pd	N/A	N/A	3.00E+02	N/A	N/A	N/A	N/A
Pm	N/A	N/A	3.00E+02	N/A	N/A	N/A	N/A
Po	4.40E+04	1.20E+05	1.51E+04	4.31E+00	1.51E+04	1.37E+03	1.67E+05
Pu	1.60E+03	6.40E+03	3.88E+02	5.38E+00	3.88E+02	2.43E+01	6.19E+03
Ra	2.00E+02	3.80E+02	9.31E+01	3.44E+00	9.31E+01	1.22E+01	7.12E+02
Ru	3.00E+01	4.30E+01	1.72E+01	2.88E+00	1.72E+01	3.02E+00	9.76E+01
S	N/A	N/A	1.00E+00	N/A	N/A	N/A	N/A
Sb	2.20E+02	7.60E+02	6.12E+01	4.95E+00	6.12E+01	4.40E+00	8.50E+02
Sc	N/A	N/A	1.00E+03	N/A	N/A	N/A	N/A
Se	N/A	N/A	1.00E+04	N/A	N/A	N/A	N/A
Sm	N/A	N/A	3.00E+02	N/A	N/A	N/A	N/A
Sn	N/A	N/A	5.00E+05	N/A	N/A	N/A	N/A
Sr	2.30E+01	3.50E+01	1.26E+01	2.99E+00	1.26E+01	2.09E+00	7.65E+01
Ta	N/A	N/A	6.00E+01	N/A	N/A	N/A	N/A
Tb	N/A	N/A	6.00E+01	N/A	N/A	N/A	N/A
Tc	3.10E+01	5.60E+01	1.50E+01	3.33E+00	1.50E+01	2.07E+00	1.09E+02
Te	N/A	N/A	1.00E+03	N/A	N/A	N/A	N/A
Th	N/A	N/A	6.00E+02	N/A	N/A	N/A	N/A
Tl	N/A	N/A	5.00E+03	N/A	N/A	N/A	N/A
Tm	N/A	N/A	3.00E+02	N/A	N/A	N/A	N/A
U	1.40E+01	2.30E+01	7.28E+00	3.14E+00	7.28E+00	1.11E+00	4.78E+01
W	N/A	N/A	9.00E+01	N/A	N/A	N/A	N/A
Xe	N/A	N/A	1.00E+00	N/A	N/A	N/A	N/A
Y	N/A	N/A	2.00E+01	N/A	N/A	N/A	N/A
Yb	N/A	N/A	2.00E+02	N/A	N/A	N/A	N/A
Zn	N/A	N/A	1.00E+03	N/A	N/A	N/A	N/A
Zr	1.10E+02	1.50E+02	6.51E+01	2.79E+00	6.51E+01	1.20E+01	3.51E+02

GM = Geometric mean.
GSD = Geometric Standard Deviation.
N/A = Not available in the references reviewed.
STD = Standard Deviation.

Table 2.6. CLBMM Bioaccumulation Factor – Marine Mollusk

Element	Mean	STD	Median	GSD	GM	5%	95%
Ac	N/A	N/A	1.00E+03	N/A	N/A	N/A	N/A
Ag	N/A	N/A	6.00E+04	N/A	N/A	N/A	N/A
Am	3.00E+01	8.00E+00	N/A	1.30E+00	2.90E+01	1.88E+01	4.46E+01
Ba	N/A	N/A	1.00E+01	N/A	N/A	N/A	N/A
Bk	N/A	N/A	1.00E+03	N/A	N/A	N/A	N/A
Br	N/A	N/A	1.00E+01	N/A	N/A	N/A	N/A
Ca	N/A	N/A	3.00E+00	N/A	N/A	N/A	N/A
Cd	N/A	N/A	8.00E+04	N/A	N/A	N/A	N/A
Ce	N/A	N/A	2.00E+03	N/A	N/A	N/A	N/A
Cf	N/A	N/A	1.00E+03	N/A	N/A	N/A	N/A
Cl	N/A	N/A	5.00E-02	N/A	N/A	N/A	N/A
Cm	N/A	N/A	1.00E+03	N/A	N/A	N/A	N/A
Co	N/A	N/A	2.00E+04	N/A	N/A	N/A	N/A
Cs	N/A	N/A	2.00E+01	N/A	N/A	N/A	N/A
Cs	N/A	N/A	6.00E+01	N/A	N/A	N/A	N/A
Dy	N/A	N/A	7.00E+03	N/A	N/A	N/A	N/A
Eu	N/A	N/A	7.00E+03	N/A	N/A	N/A	N/A
Fe	N/A	N/A	5.00E+05	N/A	N/A	N/A	N/A
Gd	N/A	N/A	7.00E+03	N/A	N/A	N/A	N/A
Hf	N/A	N/A	7.00E+03	N/A	N/A	N/A	N/A
Hg	N/A	N/A	2.00E+03	N/A	N/A	N/A	N/A
I	N/A	N/A	1.00E+01	N/A	N/A	N/A	N/A
In	N/A	N/A	1.00E+04	N/A	N/A	N/A	N/A
Ir	N/A	N/A	1.00E+02	N/A	N/A	N/A	N/A
Kr	N/A	N/A	1.00E+00	N/A	N/A	N/A	N/A
Mn	N/A	N/A	5.00E+04	N/A	N/A	N/A	N/A
Na	N/A	N/A	3.00E-01	N/A	N/A	N/A	N/A
Nb	N/A	N/A	1.00E+03	N/A	N/A	N/A	N/A
Ni	N/A	N/A	2.00E+03	N/A	N/A	N/A	N/A
Np	N/A	N/A	4.00E+02	N/A	N/A	N/A	N/A
P	3.00E+04	N/A	N/A	N/A	N/A	N/A	N/A
Pa	N/A	N/A	5.00E+02	N/A	N/A	N/A	N/A
Pb	N/A	N/A	5.00E+04	N/A	N/A	N/A	N/A
Pd	N/A	N/A	3.00E+02	N/A	N/A	N/A	N/A
Pm	N/A	N/A	7.00E+03	N/A	N/A	N/A	N/A
Po	N/A	N/A	2.00E+04	N/A	N/A	N/A	N/A
Pu	N/A	N/A	3.00E+03	N/A	N/A	N/A	N/A
Ra	N/A	N/A	1.00E+02	N/A	N/A	N/A	N/A
Ru	N/A	N/A	5.00E+02	N/A	N/A	N/A	N/A
S	N/A	N/A	3.00E+00	N/A	N/A	N/A	N/A
Sb	N/A	N/A	3.00E+02	N/A	N/A	N/A	N/A
Sc	N/A	N/A	1.00E+05	N/A	N/A	N/A	N/A
Se	N/A	N/A	9.00E+03	N/A	N/A	N/A	N/A
Sm	N/A	N/A	7.00E+03	N/A	N/A	N/A	N/A
Sn	N/A	N/A	5.00E+05	N/A	N/A	N/A	N/A
Sr	N/A	N/A	1.00E+01	N/A	N/A	N/A	N/A

Table 2.6. (contd)

Element	Mean	STD	Median	GSD	GM	5%	95%
Ta	N/A	N/A	7.00E+03	N/A	N/A	N/A	N/A
Tb	N/A	N/A	3.00E+03	N/A	N/A	N/A	N/A
Tc	N/A	N/A	5.00E+02	N/A	N/A	N/A	N/A
Te	N/A	N/A	1.00E+03	N/A	N/A	N/A	N/A
Th	N/A	N/A	1.00E+03	N/A	N/A	N/A	N/A
Tl	N/A	N/A	6.00E+03	N/A	N/A	N/A	N/A
Tm	N/A	N/A	7.00E+03	N/A	N/A	N/A	N/A
U	N/A	N/A	3.00E+01	N/A	N/A	N/A	N/A
W	N/A	N/A	6.00E+02	N/A	N/A	N/A	N/A
Xe	N/A	N/A	1.00E+00	N/A	N/A	N/A	N/A
Y	N/A	N/A	1.00E+03	N/A	N/A	N/A	N/A
Yb	N/A	N/A	3.00E+03	N/A	N/A	N/A	N/A
Zn	N/A	N/A	8.00E+04	N/A	N/A	N/A	N/A
Zr	N/A	N/A	5.00E+03	N/A	N/A	N/A	N/A

GM = Geometric mean.
GSD = Geometric Standard Deviation.
N/A = Not available in the references reviewed.
STD = Standard Deviation.

Table 2.7. CLBMI Bioaccumulation Factor – Marine Crustacean

Element	Mean	STD	Median	GSD	GM	5%	95%
Ac	N/A	N/A	1.00E+03	N/A	N/A	N/A	N/A
Ag	N/A	N/A	2.00E+05	N/A	N/A	N/A	N/A
Am	1.30E+03	1.40E+03	8.85E+02	2.40E+00	8.85E+02	2.09E+02	3.75E+03
Ba	N/A	N/A	7.00E-01	N/A	N/A	N/A	N/A
Bk	N/A	N/A	4.00E+02	N/A	N/A	N/A	N/A
Br	N/A	N/A	1.00E+01	N/A	N/A	N/A	N/A
Ca	N/A	N/A	5.00E+00	N/A	N/A	N/A	N/A
Cd	2.60E+04	4.90E+04	1.22E+04	3.42E+00	1.22E+04	1.61E+03	9.23E+04
Ce	3.40E+03	5.70E+03	1.74E+03	3.18E+00	1.74E+03	2.60E+02	1.17E+04
Cf	N/A	N/A	4.00E+02	N/A	N/A	N/A	N/A
Cl	N/A	N/A	6.00E-02	N/A	N/A	N/A	N/A
Cm	N/A	N/A	4.00E+02	N/A	N/A	N/A	N/A
Co	1.80E+03	2.90E+03	9.49E+02	3.10E+00	9.49E+02	1.48E+02	6.10E+03
Cs	4.10E+01	8.30E+01	1.82E+01	3.58E+00	1.82E+01	2.22E+00	1.48E+02
Dy	N/A	N/A	4.00E+03	N/A	N/A	N/A	N/A
Eu	N/A	N/A	4.00E+03	N/A	N/A	N/A	N/A
Fe	N/A	N/A	5.00E+05	N/A	N/A	N/A	N/A
Gd	N/A	N/A	4.00E+03	N/A	N/A	N/A	N/A
Hf	N/A	N/A	4.00E+03	N/A	N/A	N/A	N/A
Hg	N/A	N/A	1.00E+04	N/A	N/A	N/A	N/A
I	N/A	N/A	3.00E+00	N/A	N/A	N/A	N/A
In	N/A	N/A	1.00E+04	N/A	N/A	N/A	N/A
Ir	N/A	N/A	1.00E+02	N/A	N/A	N/A	N/A
Kr	N/A	N/A	1.00E+00	N/A	N/A	N/A	N/A

Table 2.7. (contd)

Element	Mean	STD	Median	GSD	GM	5%	95%
Mn	2.30E+04	7.50E+04	6.74E+03	4.79E+00	6.74E+03	5.13E+02	8.87E+04
Na	N/A	N/A	7.00E-02	N/A	N/A	N/A	N/A
Nb	1.00E+02	1.20E+02	6.40E+01	2.57E+00	6.40E+01	1.35E+01	3.03E+02
Ni	5.50E+02	6.40E+02	3.58E+02	2.52E+00	3.58E+02	7.82E+01	1.64E+03
Ni	N/A	N/A	1.00E+03	N/A	N/A	N/A	N/A
Np	N/A	N/A	1.00E+02	N/A	N/A	N/A	N/A
P	2.70E+04	N/A	N/A	N/A	N/A	N/A	N/A
Pa	N/A	N/A	1.00E+01	N/A	N/A	N/A	N/A
Pb	7.50E+03	2.10E+04	2.52E+03	4.38E+00	2.52E+03	2.22E+02	2.86E+04
Pd	N/A	N/A	3.00E+02	N/A	N/A	N/A	N/A
Pm	N/A	N/A	4.00E+03	N/A	N/A	N/A	N/A
Po	5.60E+04	6.60E+04	3.62E+04	2.54E+00	3.62E+04	7.81E+03	1.68E+05
Pu	1.60E+02	1.40E+02	1.20E+02	2.13E+00	1.20E+02	3.48E+01	4.16E+02
Ra	1.10E+02	8.10E+01	8.86E+01	1.93E+00	8.86E+01	3.00E+01	2.62E+02
Ru	3.20E+02	4.40E+02	1.88E+02	2.80E+00	1.88E+02	3.46E+01	1.02E+03
Ru	1.00E+01	N/A	N/A	N/A	N/A	N/A	N/A
Ru	N/A	N/A	1.00E+02	N/A	N/A	N/A	N/A
S	N/A	N/A	1.00E+00	N/A	N/A	N/A	N/A
Sb	1.40E+03	2.60E+03	6.64E+02	3.39E+00	6.64E+02	8.90E+01	4.95E+03
Sc	N/A	N/A	3.00E+02	N/A	N/A	N/A	N/A
Se	7.10E+03	4.80E+03	5.88E+03	1.85E+00	5.88E+03	2.14E+03	1.61E+04
Sm	N/A	N/A	4.00E+03	N/A	N/A	N/A	N/A
Sn	N/A	N/A	5.00E+05	N/A	N/A	N/A	N/A
Sr	1.20E+01	1.20E+01	8.49E+00	2.30E+00	8.49E+00	2.16E+00	3.34E+01
Ta	N/A	N/A	2.00E+03	N/A	N/A	N/A	N/A
Tb	N/A	N/A	4.00E+03	N/A	N/A	N/A	N/A
Tc	1.70E+04	2.20E+04	1.04E+04	2.70E+00	1.04E+04	2.03E+03	5.31E+04
Te	N/A	N/A	1.00E+03	N/A	N/A	N/A	N/A
Th	N/A	N/A	1.00E+03	N/A	N/A	N/A	N/A
Tl	N/A	N/A	1.00E+03	N/A	N/A	N/A	N/A
Tm	N/A	N/A	4.00E+03	N/A	N/A	N/A	N/A
U	N/A	N/A	1.00E+01	N/A	N/A	N/A	N/A
W	N/A	N/A	1.00E+01	N/A	N/A	N/A	N/A
Xe	N/A	N/A	1.00E+00	N/A	N/A	N/A	N/A
Y	N/A	N/A	1.00E+03	N/A	N/A	N/A	N/A
Yb	N/A	N/A	4.00E+03	N/A	N/A	N/A	N/A
Zn	N/A	N/A	3.00E+05	N/A	N/A	N/A	N/A
Zr	2.20E+02	4.00E+02	1.06E+02	3.35E+00	1.06E+02	1.45E+01	7.74E+02

GM = Geometric mean.
GSD = Geometric Standard Deviation.
N/A = Not available in the references reviewed.
STD = Standard Deviation.

2.1.12 CLBFP and CLBMP Bioaccumulation Factor in Aquatic Plants (Freshwater and Saltwater)

This parameter is the ratio of the chemical concentration in freshwater aquatic plants to the chemical concentration in the water to which the plants are exposed.

The units and range for this parameter in Gv2 are: L/kg_{wet} which is a reduced from (Ci/kg_{wet}) per (Ci/L) (0 to 100,000).

To tabulate bioaccumulation factors for aquatic plants, sources considered to be the best available references were reviewed. The references reviewed are listed in the corresponding appendices. The goal was to determine mean, median, geometric standard deviation, geometric mean, 5^{th} percentile, and 95^{th} percentile. Some of these values could be determined mathematically. In these cases, statistical calculations were performed, according to methods described in Strom and Stansbury (2000). The full set of data reviewed to determine the values tabulated in this section are provided in Appendix A.

2.1.12.1 Additional Sources of Information

The references that were reviewed contain additional information regarding data completeness, data limitations, and application of values to environmental models.

There are numerous chemicals for which no aquatic plant bioaccumulation factors are available. The user can refer to Staven et al. (2003) for an approach to approximate values for non-tabulated chemicals. The user is encouraged to review additional research on transfer factors in the literature, as well.

2.1.12.2 CLBFP Bioaccumulation Factor in Aquatic Plants Tables

Table 2.8. CLBFP Bioaccumulation Factor – Freshwater Plants

Element	Mean	STD	Median	GSD	GM	5%	95%
Am	4.45E+04	5.33E+05	N/A	9.30E+00	3.70E+03	9.44E+01	1.45E+05
As	7.20E+03	1.10E+03	7.1E+03	1.16E+00	7.12E+03	5.54E+03	9.14E+03
Cd	1.23E+05	7.83E+05	N/A	6.90E+00	1.90E+04	7.92E+02	4.56E+05
Ce	3.50E+03	N/A	N/A	N/A	N/A	N/A	N/A
Cm	1.19E+05	7.40E+05	N/A	6.80E+00	1.90E+04	8.11E+02	4.45E+05
Co	2.68E+03	9.73E+03	N/A	5.10E+00	7.10E+02	4.87E+01	1.04E+04
Cs	4.53E+03	2.11E+05	N/A	1.60E+01	9.70E+01	1.01E+00	9.28E+03
Cu	5.04E+10	8.47E+17	N/A	3.20E+02	3.00E+03	2.27E-01	3.96E+07
Fe	1.12E+04	7.98E+03	N/A	1.90E+00	9.10E+03	3.17E+03	2.62E+04
I	3.06E+02	6.52E+02	N/A	3.70E+00	1.30E+02	1.51E+01	1.12E+03
Mn	3.01E+13	7.56E+22	N/A	7.20E+02	1.20E+04	2.39E-01	6.02E+08
Na	5.00E+02	N/A	N/A	N/A	N/A	N/A	N/A
Ni	1.07E+08	1.50E+13	N/A	1.30E+02	7.70E+02	2.56E-01	2.31E+06
Np	7.20E+03	N/A	N/A	N/A	N/A	N/A	N/A
P	3.00E+02	N/A	N/A	N/A	N/A	N/A	N/A
Pb	N/A	N/A	N/A	7.60E+01	1.90E+03	1.53E+00	2.36E+06
Pu	8.46E+05	2.75E+07	N/A	1.40E+01	2.60E+04	3.39E+02	2.00E+06

Table 2.8. (contd)

Element	Mean	STD	Median	GSD	GM	5%	95%
Ra	7.85E+03	1.97E+04	N/A	4.10E+00	2.90E+03	2.85E+02	2.95E+04
Ru	3.69E+02	2.90E+02	N/A	2.00E+00	2.90E+02	9.27E+01	9.07E+02
Se	5.80E+03	2.33E+04	N/A	5.40E+00	1.40E+03	8.74E+01	2.24E+04
Sr	8.36E+02	1.49E+03	N/A	3.30E+00	4.10E+02	5.75E+01	2.92E+03
Tc	1.94E+01	6.59E+01	N/A	4.90E+00	5.50E+00	4.03E-01	7.51E+01
U	2.58E+02	1.84E+02	N/A	1.90E+00	2.10E+02	7.31E+01	6.04E+02
Zn	5.63E+05	1.51E+07	N/A	1.30E+01	2.10E+04	3.09E+02	1.43E+06

GM = Geometric mean.
GSD = Geometric Standard Deviation.
N/A = Not available in the references reviewed.
STD = Standard Deviation.

Table 2.9. CLBMP Bioaccumulation Factor – Saltwater Plants

Element	Mean	Median	GSD	GM	5%	95%
Ac	N/A	1.00E+03	N/A	N/A	N/A	N/A
Ag	N/A	5.00E+03	N/A	N/A	N/A	N/A
Am	N/A	8.00E+03	N/A	N/A	N/A	N/A
Ba	N/A	7.00E+01	N/A	N/A	N/A	N/A
Be	N/A	2.00E+00	N/A	N/A	N/A	N/A
Bk	N/A	8.00E+03	N/A	N/A	N/A	N/A
Br	N/A	1.00E+01	N/A	N/A	N/A	N/A
Ca	N/A	6.00E+00	N/A	N/A	N/A	N/A
Cd	N/A	2.00E+04	N/A	N/A	N/A	N/A
Ce	N/A	5.00E+03	N/A	N/A	N/A	N/A
Cf	N/A	8.00E+03	N/A	N/A	N/A	N/A
Cl	N/A	5.00E-02	N/A	N/A	N/A	N/A
Cm	N/A	5.00E+03	N/A	N/A	N/A	N/A
Co	N/A	6.00E+03	N/A	N/A	N/A	N/A
Cs	N/A	5.00E+01	N/A	N/A	N/A	N/A
Dy	N/A	3.00E+03	N/A	N/A	N/A	N/A
Eu	N/A	3.00E+03	N/A	N/A	N/A	N/A
Fe	7.30E+02	N/A	N/A	N/A	N/A	N/A
Gd	N/A	3.00E+03	N/A	N/A	N/A	N/A
Hf	N/A	3.00E+03	N/A	N/A	N/A	N/A
Hg	N/A	2.00E+04	N/A	N/A	N/A	N/A
I	N/A	1.00E+04	N/A	N/A	N/A	N/A
In	N/A	5.00E+03	N/A	N/A	N/A	N/A
Ir	N/A	1.00E+03	N/A	N/A	N/A	N/A
Kr	N/A	1.00E+00	N/A	N/A	N/A	N/A
Mn	N/A	6.00E+03	N/A	N/A	N/A	N/A
Na	N/A	5.00E-01	N/A	N/A	N/A	N/A
Nb	N/A	3.00E+03	N/A	N/A	N/A	N/A
Ni	N/A	2.00E+03	N/A	N/A	N/A	N/A

Table 2.9. (contd)

Element	Mean	Median	GSD	GM	5%	95%
Np	N/A	5.00E+01	N/A	N/A	N/A	N/A
P	4.00E+03	N/A	N/A	N/A	N/A	N/A
Pa	N/A	1.00E+02	N/A	N/A	N/A	N/A
Pb	N/A	1.00E+03	N/A	N/A	N/A	N/A
Pd	N/A	1.00E+03	N/A	N/A	N/A	N/A
Pm	N/A	3.00E+03	N/A	N/A	N/A	N/A
Po	N/A	1.00E+03	N/A	N/A	N/A	N/A
Pu	N/A	4.00E+03	N/A	N/A	N/A	N/A
Ra	N/A	1.00E+02	N/A	N/A	N/A	N/A
Ru	N/A	2.00E+03	N/A	N/A	N/A	N/A
S	N/A	3.00E+00	N/A	N/A	N/A	N/A
Sb	N/A	2.00E+01	N/A	N/A	N/A	N/A
Sc	N/A	9.00E+04	N/A	N/A	N/A	N/A
Se	N/A	1.00E+03	N/A	N/A	N/A	N/A
Sm	N/A	3.00E+03	N/A	N/A	N/A	N/A
Sr	N/A	1.00E+01	N/A	N/A	N/A	N/A
Ta	N/A	3.00E+03	N/A	N/A	N/A	N/A
Tb	N/A	2.00E+03	N/A	N/A	N/A	N/A
Tc	N/A	3.00E+04	N/A	N/A	N/A	N/A
Te	N/A	1.00E+04	N/A	N/A	N/A	N/A
Th	N/A	2.00E+02	N/A	N/A	N/A	N/A
Tl	N/A	1.00E+03	N/A	N/A	N/A	N/A
Tm	N/A	3.00E+03	N/A	N/A	N/A	N/A
U	N/A	1.00E+02	N/A	N/A	N/A	N/A
W	N/A	6.00E+02	N/A	N/A	N/A	N/A
Xe	N/A	1.00E+00	N/A	N/A	N/A	N/A
Y	N/A	1.00E+03	N/A	N/A	N/A	N/A
Yb	N/A	8.00E+02	N/A	N/A	N/A	N/A
Zn	N/A	2.00E+03	N/A	N/A	N/A	N/A
Zr	N/A	3.00E+03	N/A	N/A	N/A	N/A

GM = Geometric mean.
GSD = Geometric Standard Deviation.
N/A = Not available in the references reviewed.

2.1.13 CLBSAF Bioaccumulation in Aquatic Biota from Sediment

This parameter is not implemented in human pathways for chronic water releases in Gv2.

The units and range for this parameter in Gv2 are: $kg_{wet\_biota}/kg_{wet\_sediment}$ (0 to 100,000).

2.1.14 CLFMT Feed to Meat Transfer Factor

The feed-to-meat transfer factor is the ratio of chemical concentration in fresh meat tissue to the daily intake of the radionuclide by the animal. This factor is generally based on beef as the meat animal.

The units and range for this parameter in Gv2 are: d/kg which is reduced from (Ci/kg_{wet}) per (Ci/d) (0 to 100,000).

To tabulate bioaccumulation factors for feed-to-meat, sources considered to be the best available references were reviewed. The goal was to determine mean, median, geometric standard deviation, geometric mean, 5th percentile, and 95th percentile. Selection priority was given to IAEA (2010), Howard et al. (2009), and Staven et al. (2003), with a preference for lognormality in the datasets. Some of these values could be determined mathematically. In these cases, statistical calculations were performed, according to methods described in Strom and Stansbury (2000). The full set of data reviewed to determine the values tabulated in this section are provided in Appendix B.

2.1.14.1 Additional Sources of Information

There are numerous chemicals for which no meat transfer factors are available. The user can refer to Staven et al. (2003) for an approach to approximate values for non-tabulated chemicals. The user is encouraged to review additional research on transfer factors in the literature, as well.

2.1.14.2 CLFMT Feed to Meat Transfer Factor Tables

Table 2.10. CLFMT Feed to Meat Transfer Factor

Element	Mean	STD	Median	GSD	GM	5%	95%
Ag	4.80E-04	N/A	3.00E-03	N/A	N/A	N/A	N/A
Am	5.00E-04	N/A	N/A	N/A	N/A	N/A	N/A
As	N/A	N/A	2.00E-03	N/A	N/A	N/A	N/A
Au	N/A	N/A	5.00E-03	N/A	N/A	N/A	N/A
Ba	N/A	N/A	N/A	5.00E-05	1.40E-04	N/A	N/A
Be	N/A	N/A	1.00E-03	N/A	N/A	N/A	N/A
Bi	N/A	N/A	4.00E-04	N/A	N/A	N/A	N/A
Br	N/A	N/A	2.50E-02	N/A	N/A	N/A	N/A
Ca	2.00E-01	3.50E-01	9.92E-02	3.27E+00	9.92E-02	1.42E-02	6.96E-01
Cd	N/A	N/A	N/A	7.80E+00	5.80E-03	N/A	N/A
Ce	2.50E-04	N/A	2.00E-05	N/A	N/A	N/A	N/A
Cf	N/A	N/A	4.00E-05	N/A	N/A	N/A	N/A
Cl	1.70E-02	N/A	N/A	N/A	N/A	N/A	N/A
Cm	N/A	N/A	4.00E-05	N/A	N/A	N/A	N/A
Co	N/A	N/A	N/A	2.30E+00	4.30E-04	N/A	N/A
Cr	N/A	N/A	9.00E-03	N/A	N/A	N/A	N/A
Cs	4.80E-01	5.30E-01	3.22E-01	2.44E+00	3.22E-01	7.42E-02	1.4
Cu	N/A	N/A	9.00E-03	N/A	N/A	N/A	N/A
Dy	N/A	N/A	2.00E-05	N/A	N/A	N/A	N/A
Er	N/A	N/A	2.00E-05	N/A	N/A	N/A	N/A
Eu	N/A	N/A	2.00E-05	N/A	N/A	N/A	N/A
F	N/A	N/A	1.50E-01	N/A	N/A	N/A	N/A
Fe	1.50E-02	6.70E-03	1.37E-02	1.53E+00	1.37E-02	6.79E-03	2.76E-02
Ga	N/A	N/A	5.00E-04	N/A	N/A	N/A	N/A
Gd	N/A	N/A	2.00E-05	N/A	N/A	N/A	N/A

Table 2.10. (contd)

Element	Mean	STD	Median	GSD	GM	5%	95%
Hf	N/A	N/A	1.00E-03	N/A	N/A	N/A	N/A
Hg	N/A	N/A	2.50E-01	N/A	N/A	N/A	N/A
Ho	N/A	N/A	2.00E-05	N/A	N/A	N/A	N/A
I	N/A	N/A	N/A	3.20E+00	6.70E-03	N/A	N/A
In	N/A	N/A	8.00E-03	N/A	N/A	N/A	N/A
Ir	N/A	N/A	1.50E-03	N/A	N/A	N/A	N/A
K	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
La	N/A	2.00E-05	N/A	1.20E+00	1.30E-04	N/A	N/A
Mg	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Mn	6.00E-04	N/A	N/A	N/A	N/A	N/A	N/A
Mo	1.00E-03	N/A	N/A	N/A	N/A	N/A	N/A
N	N/A	N/A	7.50E-02	N/A	N/A	N/A	N/A
Na	N/A	N/A	N/A	1.00E-02	1.50E-02	N/A	N/A
Nb	2.60E-07	N/A	N/A	N/A	N/A	N/A	N/A
Nd	N/A	N/A	3.00E-04	N/A	N/A	N/A	N/A
Ni	N/A	N/A	6.00E-03	N/A	N/A	N/A	N/A
Np	N/A	N/A	1.00E-03	N/A	N/A	N/A	N/A
Os	N/A	N/A	4.00E-01	N/A	N/A	N/A	N/A
P	5.50E-02	N/A	N/A	N/A	N/A	N/A	N/A
Pa	N/A	N/A	4.00E-05	N/A	N/A	N/A	N/A
Pb	N/A	N/A	N/A	2.50E+00	7.00E-04	N/A	N/A
Pd	N/A	N/A	4.00E-03	N/A	N/A	N/A	N/A
Pm	N/A	N/A	2.00E-05	N/A	N/A	N/A	N/A
Po	N/A	N/A	5.00E-03	N/A	N/A	N/A	N/A
Pr	N/A	N/A	3.00E-04	N/A	N/A	N/A	N/A
Pu	N/A	N/A	N/A	2.48E+01	1.10E-06	N/A	N/A
Ra	1.70E-03	N/A	N/A	N/A	N/A	N/A	N/A
Rb	N/A	N/A	1.00E-02	N/A	N/A	N/A	N/A
Re	N/A	N/A	8.00E-03	N/A	N/A	N/A	N/A
Rh	N/A	N/A	2.00E-03	N/A	N/A	N/A	N/A
Ru	N/A	N/A	N/A	1.80E+00	3.30E-03	N/A	N/A
S	1.70E+00	4.70E-01	1.64E+00	1.31E+00	1.64E+00	1.05E+00	2.56
Sb	N/A	N/A	N/A	1.10E-03	1.20E-03	N/A	N/A
Sc	N/A	N/A	1.50E-02	N/A	N/A	N/A	N/A
Se	N/A	N/A	1.50E-02	N/A	N/A	N/A	N/A
Si	N/A	N/A	4.00E-05	N/A	N/A	N/A	N/A
Sm	N/A	N/A	2.00E-05	N/A	N/A	N/A	N/A
Sn	N/A	N/A	8.00E-02	N/A	N/A	N/A	N/A
Sr	3.00E-03	5.10E-03	1.52E-03	3.21E+00	1.52E-03	2.24E-04	1.03E-02
Ta	N/A	N/A	3.00E-07	N/A	N/A	N/A	N/A
Tb	N/A	N/A	2.00E-05	N/A	N/A	N/A	N/A
Tc	N/A	N/A	1.00E-04	N/A	N/A	N/A	N/A
Te	7.00E-03	N/A	N/A	N/A	N/A	N/A	N/A
Th	N/A	N/A	N/A	2.90E+00	2.30E-04	N/A	N/A
Tl	N/A	N/A	4.00E-02	N/A	N/A	N/A	N/A
U	N/A	N/A	N/A	1.60E+00	3.90E-04	N/A	N/A
W	N/A	N/A	4.00E-02	N/A	N/A	N/A	N/A

Table 2.10. (contd)

Element	Mean	STD	Median	GSD	GM	5%	95%
Y	N/A	N/A	1.00E-03	N/A	N/A	N/A	N/A
Zn	N/A	N/A	N/A	3.20E+00	1.60E-01	N/A	N/A
Zr	1.20E-06	N/A	N/A	N/A	N/A	N/A	N/A

GM = Geometric mean.
GSD = Geometric Standard Deviation.
N/A = Not available in the references reviewed.
STD = Standard Deviation.

2.1.15 CLFMK Feed to Milk Transfer Factor

The feed-to-milk transfer factor is the ratio of chemical concentration in milk to the daily intake of the chemical by the milk animal.

Cow milk is the predominant milk consumed in the United States. The large majority of milk transfer factors are available for cow milk. If milk from another animal is assumed to be ingested, the user should perform a literature review to determine the applicability of cow milk transfer factor values.

The units and range for this parameter in Gv2 are: day/L (0 to 100,000).

To tabulate transfer factors for feed-to-milk, sources considered to be the best available references were reviewed. The goal was to determine mean, median, geometric standard deviation, geometric mean, 5^{th} percentile, and 95^{th} percentile. Selection priority was given to IAEA (2010), Howard et al. (2009), and Staven et al. (2003), with a preference for lognormality in the datasets. Some of these values could be determined mathematically. In these cases, statistical calculations were performed, according to methods described in Strom and Stansbury (2000). The full set of data reviewed to determine the values tabulated in this section are provided in Appendix B.

2.1.15.1 Additional Sources of Information

The references that were reviewed contain additional information regarding data completeness, data limitations, and application of values to environmental models.

There are numerous chemicals for which no milk transfer factors are available. The user can refer to Staven et al. (2003) for an approach to approximate values for non-tabulated chemicals. The user is encouraged to review additional research on transfer factors in the literature, as well.

2.1.15.2 CLFMK Feed to Milk Transfer Factor Tables

Table 2.11. CLFMK Feed to Milk Transfer Factor

Element	Mean	STD	Median	GSD	GM	5%	95%
Ac	N/A	N/A	2.00E-05	N/A	N/A	N/A	N/A
Ag	N/A	N/A	5.00E-05	N/A	N/A	N/A	N/A
Al	N/A	N/A	2.00E-04	N/A	N/A	N/A	N/A
Am	4.20E-07	N/A	N/A	N/A	N/A	N/A	N/A
As	N/A	N/A	6.00E-05	N/A	N/A	N/A	N/A
Au	N/A	N/A	5.50E-06	N/A	N/A	N/A	N/A
Ba	1.60E-04	N/A	N/A	2.70E+00	N/A	N/A	N/A
Be	8.30E-07	N/A	N/A	N/A	N/A	N/A	N/A
Bi	N/A	N/A	5.00E-04	N/A	N/A	N/A	N/A
Br	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Ca	1.00E-02	N/A	N/A	1.70E+00	N/A	N/A	N/A
Cd	N/A	N/A	1.00E-03	N/A	N/A	N/A	N/A
Cd	1.90E-04	N/A	N/A	1.50E+01	N/A	N/A	N/A
Ce	2.00E-05	N/A	N/A	5.80E+00	3.25E-05	7.94E-06	1.33E-04
Cf	N/A	N/A	7.50E-07	N/A	N/A	N/A	N/A
Cl	N/A	N/A	1.50E-02	N/A	N/A	N/A	N/A
Cm	N/A	N/A	9.60E-05	N/A	N/A	N/A	N/A
Co	1.30E-04	1.10E-04	9.92E-05	2.09E+00	9.92E-05	2.96E-05	3.32E-04
Cr	N/A	N/A	N/A	2.60E+01	4.30E-04	N/A	N/A
Cs	4.48E-03	3.05E-03	3.70E-03	1.85E+00	3.70E-03	1.34E-03	1.02E-02
Cu	N/A	N/A	2.00E-03	N/A	N/A	N/A	N/A
Dy	N/A	N/A	2.00E-05	N/A	N/A	N/A	N/A
Er	N/A	N/A	2.00E-05	N/A	N/A	N/A	N/A
Eu	N/A	N/A	3.00E-05	N/A	N/A	N/A	N/A
F	N/A	N/A	1.00E-03	N/A	N/A	N/A	N/A
Fe	N/A	N/A	N/A	2.00E+00	3.50E-04	N/A	N/A
Ga	N/A	N/A	5.00E-05	N/A	N/A	N/A	N/A
Gd	N/A	N/A	3.00E-05	N/A	N/A	N/A	N/A
Hf	N/A	N/A	5.50E-07	N/A	N/A	N/A	N/A
Hg	N/A	N/A	4.50E-04	N/A	N/A	N/A	N/A
Ho	N/A	N/A	3.00E-05	N/A	N/A	N/A	N/A
I	N/A	N/A	N/A	2.40E+00	5.40E-03	N/A	N/A
In	N/A	N/A	2.00E-04	N/A	N/A	N/A	N/A
Ir	N/A	N/A	2.00E-06	N/A	N/A	N/A	N/A
K	N/A	N/A	7.20E-03	N/A	N/A	N/A	N/A
La	N/A	N/A	2.00E-05	N/A	N/A	N/A	N/A
Mg	N/A	N/A	3.90E-03	N/A	N/A	N/A	N/A
Mn	N/A	N/A	N/A	4.90E+00	4.10E-05	N/A	N/A
Mo	N/A	N/A	N/A	2.30E+00	1.10E-03	N/A	N/A
N	N/A	N/A	2.50E-02	N/A	N/A	N/A	N/A
Na	1.60E-02	1.50E-02	1.17E-02	2.21E+00	1.17E-02	3.16E-03	4.31E-02
Nb	N/A	N/A	4.10E-07	N/A	N/A	N/A	N/A
Nd	N/A	N/A	3.00E-05	N/A	N/A	N/A	N/A

Table 2.11. (contd)

Element	Mean	STD	Median	GSD	GM	5%	95%
Ni	N/A	N/A	N/A	6.50E-04	9.50E-04	N/A	N/A
Np	N/A	N/A	5.00E-06	N/A	N/A	N/A	N/A
Os	N/A	N/A	5.00E-03	N/A	N/A	N/A	N/A
P	2.00E-02	N/A	N/A	N/A	N/A	N/A	N/A
Pa	N/A	N/A	5.00E-06	N/A	N/A	N/A	N/A
Pb	N/A	N/A	N/A	1.00E+00	1.90E-04	N/A	N/A
Pd	6.00E-03	N/A	N/A	N/A	N/A	N/A	N/A
Pm	N/A	N/A	3.00E-05	N/A	N/A	N/A	N/A
Po	2.30E-04	9.70E-05	2.12E-04	1.50E+00	2.12E-04	1.09E-04	4.12E-04
Pr	N/A	N/A	3.00E-05	N/A	N/A	N/A	N/A
Pu	1.00E-05	N/A	N/A	N/A	N/A	N/A	N/A
Ra	N/A	N/A	N/A	2.30E+00	3.80E-04	N/A	N/A
Rb	N/A	N/A	1.20E-02	N/A	N/A	N/A	N/A
Re	N/A	N/A	1.50E-03	N/A	N/A	N/A	N/A
Rh	N/A	N/A	1.00E-02	N/A	N/A	N/A	N/A
Ru	3.60E-05	5.30E-05	2.02E-05	2.93E+00	2.02E-05	3.46E-06	1.18E-04
S	4.30E-02	1.90E-02	3.93E-02	1.53E+00	3.93E-02	1.96E-02	7.88E-02
Sb	N/A	N/A	N/A	2.50E+00	3.80E-05	N/A	N/A
Sc	N/A	N/A	5.00E-06	N/A	N/A	N/A	N/A
Se	N/A	N/A	N/A	2.10E+00	4.00E-03	N/A	N/A
Si	N/A	N/A	2.00E-05	N/A	N/A	N/A	N/A
Sm	N/A	N/A	2.00E-05	N/A	N/A	N/A	N/A
Sm	N/A	N/A	3.00E-05	N/A	N/A	N/A	N/A
Sn	N/A	N/A	1.00E-03	N/A	N/A	N/A	N/A
Sr	N/A	N/A	N/A	1.70E+00	1.30E-03	N/A	N/A
Ta	N/A	N/A	4.10E-07	N/A	N/A	N/A	N/A
Tb	N/A	N/A	3.00E-05	N/A	N/A	N/A	N/A
Tc	N/A	N/A	1.40E-04	N/A	N/A	N/A	N/A
Te	3.40E-04	N/A	4.50E-04	2.40E+00	N/A	N/A	N/A
Th	N/A	N/A	5.00E-06	N/A	N/A	N/A	N/A
Ti	N/A	N/A	1.00E-02	N/A	N/A	N/A	N/A
Tl	N/A	N/A	2.00E-03	N/A	N/A	N/A	N/A
U	N/A	N/A	N/A	3.50E+00	1.80E-03	N/A	N/A
V	N/A	N/A	2.00E-05	N/A	N/A	N/A	N/A
W	N/A	N/A	N/A	3.10E+00	1.90E-04	N/A	N/A
Y	N/A	N/A	2.00E-05	N/A	N/A	N/A	N/A
Zn	N/A	N/A	N/A	3.90E+00	2.70E-03	N/A	N/A
Zr	N/A	N/A	N/A	4.30E+00	3.60E-06	N/A	N/A

GM = Geometric mean.
GSD = Geometric Standard Deviation.
N/A = Not available in the references reviewed.
STD = Standard Deviation.

2.1.16 CLFPL Feed to Poultry and CLFEG Egg Transfer Factor

These parameters characterize the ratio of constituent concentrations in poultry (CLFPL) and in eggs (CLFEG) to the concentration in the feed. The predominant type of egg consumed in the United States is that of a chicken. The majority of available transfer factor information for chicken poultry and eggs. If another type of poultry and egg is assumed to be ingested, the user should review the literature to determine if any transfer factors may need to be modified to reflect the different type of domesticated bird.

The units and range for these parameters in Gv2 are: day/kg (0 to 100,000).

To tabulate transfer factors for feed-to-poultry and egg, sources considered to be the best available references were reviewed. The goal was to determine mean, median, geometric standard deviation, geometric mean, 5th percentile, and 95th percentile. Selection priority was given to IAEA (2010), Howard et al. (2009), and Napier et al. (2012), with a preference for lognormality in the datasets. Some of these values could be determined mathematically. In these cases, statistical calculations were performed, according to methods described in Strom and Stansbury (2000). The full set of data reviewed to determine the values tabulated in this section are provided in Appendix B.

2.1.16.1 Additional Sources of Information

There are numerous chemicals for which no poultry or egg transfer factors are available. The user can refer to Staven et al. (2003) for an approach to approximate values for non-tabulated chemicals. The user is encouraged to review additional research on transfer factors in the literature, as well.

2.1.16.2 CLFPL Feed to Poultry and CLFEG Feed to Egg Transfer Factor Tables

Table 2.12. CLFPL Feed to Poultry Transfer Factor

Element	Mean	STD	Median	GSD	GM	5%	95%
Ac	N/A	N/A	6.00E-03	N/A	N/A	N/A	N/A
Ag	N/A	N/A	2.00E+00	N/A	N/A	N/A	N/A
Am	N/A	N/A	6.00E-03	N/A	N/A	N/A	N/A
As	N/A	N/A	8.30E-01	N/A	N/A	N/A	N/A
Au	N/A	N/A	N/A	N/A	1.00E+00	N/A	N/A
Ba	1.90E-02	N/A	N/A	N/A	N/A	N/A	N/A
Be	N/A	N/A	4.00E-01	N/A	N/A	N/A	N/A
Bi	N/A	N/A	N/A	N/A	9.00E-02	N/A	N/A
Br	N/A	N/A	4.00E-03	N/A	N/A	N/A	N/A
Ca	4.40E-02	N/A	N/A	N/A	N/A	N/A	N/A
Cd	1.70E+00	N/A	N/A	N/A	N/A	N/A	N/A
Ce	N/A	N/A	2.00E-03	N/A	N/A	N/A	N/A
Cf	N/A	N/A	4.00E-03	N/A	N/A	N/A	N/A
Cl	N/A	N/A	N/A	N/A	3.00E-02	N/A	N/A
Cm	N/A	N/A	4.00E-03	N/A	N/A	N/A	N/A
Co	9.70E-01	N/A	N/A	N/A	N/A	N/A	N/A

Table 2.12. (contd)

Element	Mean	STD	Median	GSD	GM	5%	95%
Cr	N/A	N/A	2.00E-01	N/A	N/A	N/A	N/A
Cs	3.00E+00	1.30E+00	2.75E+00	1.51E+00	2.75E+00	1.39E+00	5.45E+00
Cu	N/A	N/A	5.00E-01	N/A	N/A	N/A	N/A
Dy	N/A	N/A	2.00E-03	N/A	N/A	N/A	N/A
Er	N/A	N/A	2.00E-03	N/A	N/A	N/A	N/A
Eu	N/A	N/A	2.00E-03	N/A	N/A	N/A	N/A
F	N/A	N/A	N/A	N/A	1.40E-02	N/A	N/A
Fe	N/A	N/A	1.00E+00	N/A	N/A	N/A	N/A
Ga	N/A	N/A	8.00E-01	N/A	N/A	N/A	N/A
Gd	N/A	N/A	2.00E-03	N/A	N/A	N/A	N/A
Hf	N/A	N/A	6.00E-04	N/A	N/A	N/A	N/A
Hg	N/A	N/A	3.00E-02	N/A	N/A	N/A	N/A
Ho	N/A	N/A	2.00E-03	N/A	N/A	N/A	N/A
I	1.00E-02	5.60E-03	8.73E-03	1.69E+00	8.73E-03	3.70E-03	2.06E-02
In	N/A	N/A	8.00E-01	N/A	N/A	N/A	N/A
Ir	N/A	N/A	2.00E+00	N/A	N/A	N/A	N/A
K	N/A	N/A	4.00E-01	N/A	N/A	N/A	N/A
La	N/A	N/A	1.00E-01	N/A	N/A	N/A	N/A
Mg	N/A	N/A	3.00E-02	N/A	N/A	N/A	N/A
Mn	1.90E-03	N/A	N/A	N/A	N/A	N/A	N/A
Mo	N/A	N/A	1.80E-02	N/A	N/A	N/A	N/A
N	N/A	N/A	N/A	N/A	9.80E-02	N/A	N/A
Na	7.00E+00	N/A	N/A	N/A	N/A	N/A	N/A
Nb	N/A	N/A	3.10E-04	N/A	N/A	N/A	N/A
Nb	N/A	N/A	3.00E-04	N/A	N/A	N/A	N/A
Nb	3.00E-04	N/A	N/A	N/A	N/A	N/A	N/A
Nd	N/A	N/A	2.00E-03	N/A	N/A	N/A	N/A
Ni	N/A	N/A	1.00E-03	N/A	N/A	N/A	N/A
Np	N/A	N/A	6.00E-03	N/A	N/A	N/A	N/A
Os	N/A	N/A	N/A	N/A	8.40E-02	N/A	N/A
P	N/A	N/A	1.90E-01	N/A	N/A	N/A	N/A
Pa	N/A	N/A	6.00E-03	N/A	N/A	N/A	N/A
Pb	N/A	N/A	8.00E-01	N/A	N/A	N/A	N/A
Pd	N/A	N/A	3.00E-04	N/A	N/A	N/A	N/A
Pm	N/A	N/A	2.00E-03	N/A	N/A	N/A	N/A
Po	2.40E+00	N/A	N/A	N/A	N/A	N/A	N/A
Pr	N/A	N/A	2.00E-03	N/A	N/A	N/A	N/A
Pu	N/A	N/A	3.00E-03	N/A	N/A	N/A	N/A
Ra	N/A	N/A	3.00E-02	N/A	N/A	N/A	N/A
Rb	N/A	N/A	2.00E+00	N/A	N/A	N/A	N/A
Re	N/A	N/A	4.00E-02	N/A	N/A	N/A	N/A
Rh	N/A	N/A	2.00E+00	N/A	N/A	N/A	N/A
Ru	N/A	N/A	7.00E-03	N/A	N/A	N/A	N/A
S	N/A	N/A	N/A	N/A	2.30E+00	N/A	N/A
Sb	N/A	N/A	6.00E-03	N/A	N/A	N/A	N/A
Sc	N/A	N/A	4.00E-03	N/A	N/A	N/A	N/A
Se	1.26E+01	1.06E+01	9.64E+00	2.08E+00	9.64E+00	2.89E+00	3.21E+01

Table 2.12. (contd)

Element	Mean	STD	Median	GSD	GM	5%	95%
Si	N/A	N/A	8.00E-01	N/A	N/A	N/A	N/A
Sm	N/A	N/A	2.00E-03	N/A	N/A	N/A	N/A
Sn	N/A	N/A	8.00E-01	N/A	N/A	N/A	N/A
Sr	N/A	N/A	8.00E-02	N/A	N/A	N/A	N/A
Sr	2.30E-02	1.20E-02	2.04E-02	1.63E+00	2.04E-02	9.10E-03	4.57E-02
Ta	N/A	N/A	3.00E-04	N/A	N/A	N/A	N/A
Tb	N/A	N/A	2.00E-03	N/A	N/A	N/A	N/A
Tc	N/A	N/A	3.00E-02	N/A	N/A	N/A	N/A
Te	N/A	N/A	8.50E-02	N/A	N/A	N/A	N/A
Th	N/A	N/A	6.00E-03	N/A	N/A	N/A	N/A
Tl	N/A	N/A	8.00E-01	N/A	N/A	N/A	N/A
U	7.50E-01	N/A	N/A	3.00E-01	N/A	N/A	N/A
W	N/A	N/A	2.00E-01	N/A	N/A	N/A	N/A
Y	N/A	N/A	1.00E-02	N/A	N/A	N/A	N/A
Zn	4.70E-01	7.90E-02	4.63E-01	1.18E+00	4.63E-01	3.52E-01	6.10E-01
Zr	6.00E-05	N/A	N/A	N/A	N/A	N/A	N/A

GM = Geometric mean.
GSD = Geometric Standard Deviation.
N/A = Not available in the references reviewed.
STD = Standard Deviation.

Table 2.13. CLFEG Feed to Egg Transfer Factor

Element	Mean	STD	Median	GSD	GM	5%	95%
Ac	N/A	N/A	2.00E-03	N/A	N/A	N/A	N/A
Ag	N/A	N/A	5.00E-01	N/A	N/A	N/A	N/A
Am	3.00E-03	N/A	N/A	N/A	N/A	N/A	N/A
As	N/A	N/A	N/A	N/A	2.60E-01	N/A	N/A
Au	N/A	N/A	5.00E-01	N/A	N/A	N/A	N/A
Ba	8.70E-01	N/A	N/A	N/A	N/A	N/A	N/A
Be	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Bi	N/A	N/A	N/A	N/A	2.60E-01	N/A	N/A
Br	N/A	N/A	1.60E+00	N/A	N/A	N/A	N/A
Ca	4.40E-01	N/A	N/A	N/A	N/A	N/A	N/A
Cd	N/A	N/A	1.00E-01	N/A	N/A	N/A	N/A
Ce	3.10E-03	N/A	N/A	N/A	N/A	N/A	N/A
Cf	N/A	N/A	4.00E-03	N/A	N/A	N/A	N/A
Cl	N/A	N/A	N/A	N/A	2.70E+00	N/A	N/A
Cm	N/A	N/A	4.00E-03	N/A	N/A	N/A	N/A
Co	3.30E-02	N/A	N/A	N/A	N/A	N/A	N/A
Cr	N/A	N/A	9.00E-01	N/A	N/A	N/A	N/A
Cs	4.30E-01	1.60E-01	4.03E-01	1.43E+00	4.03E-01	2.23E-01	7.29E-01
Cu	N/A	N/A	5.00E-01	N/A	N/A	N/A	N/A
Dy	N/A	N/A	4.00E-05	N/A	N/A	N/A	N/A
Er	N/A	N/A	4.00E-05	N/A	N/A	N/A	N/A
Eu	N/A	N/A	4.00E-05	N/A	N/A	N/A	N/A

Table 2.13. (contd)

Element	Mean	STD	Median	GSD	GM	5%	95%
Fe	1.80E+00	N/A	N/A	8.50E-01	N/A	N/A	N/A
Ga	N/A	N/A	1.00E+00	N/A	N/A	N/A	N/A
Gd	N/A	N/A	4.00E-05	N/A	N/A	N/A	N/A
Hf	N/A	N/A	2.00E-04	N/A	N/A	N/A	N/A
Hg	N/A	N/A	N/A	N/A	5.00E-01	N/A	N/A
Ho	N/A	N/A	4.00E-05	N/A	N/A	N/A	N/A
I	2.40E+00	5.70E-01	2.34E+00	1.26E+00	2.34E+00	1.59E+00	3.43E+00
In	N/A	N/A	1.00E+00	N/A	N/A	N/A	N/A
Ir	N/A	N/A	1.00E-01	N/A	N/A	N/A	N/A
K	N/A	N/A	1.00E+00	N/A	N/A	N/A	N/A
La	N/A	N/A	9.00E-03	N/A	N/A	N/A	N/A
Mg	N/A	N/A	2.00E+00	N/A	N/A	N/A	N/A
Mn	4.40E-02	1.60E-02	4.14E-02	1.42E+00	4.14E-02	2.32E-02	7.38E-02
Mo	6.50E-01	1.90E-01	6.24E-01	1.33E+00	6.24E-01	3.90E-01	9.99E-01
N	N/A	N/A	N/A	N/A	2.60E-01	N/A	N/A
Na	N/A	N/A	N/A	1.90E+00	4.00E+00	N/A	N/A
Nb	1.00E-03	N/A	N/A	N/A	N/A	N/A	N/A
Nd	N/A	N/A	4.00E-05	N/A	N/A	N/A	N/A
Ni	N/A	N/A	1.00E-01	N/A	N/A	N/A	N/A
Np	N/A	N/A	4.00E-03	N/A	N/A	N/A	N/A
Os	N/A	N/A	N/A	N/A	7.10E-02	N/A	N/A
P	6.40E-01	N/A	N/A	N/A	N/A	N/A	N/A
Pa	N/A	N/A	4.00E-03	N/A	N/A	N/A	N/A
Pb	N/A	N/A	1.00E+00	N/A	N/A	N/A	N/A
Pd	N/A	N/A	4.00E-03	N/A	N/A	N/A	N/A
Pm	N/A	N/A	4.00E-05	N/A	N/A	N/A	N/A
Po	3.10E+00	N/A	N/A	N/A	N/A	N/A	N/A
Pr	N/A	N/A	4.00E-05	N/A	N/A	N/A	N/A
Pu	1.20E-03	N/A	N/A	N/A	N/A	N/A	N/A
Ra	N/A	N/A	N/A	N/A	3.10E-01	N/A	N/A
Rb	N/A	N/A	3.00E+00	N/A	N/A	N/A	N/A
Re	N/A	N/A	N/A	N/A	4.20E-01	N/A	N/A
Rh	N/A	N/A	1.00E-01	N/A	N/A	N/A	N/A
Ru	4.00E-03	N/A	N/A	N/A	N/A	N/A	N/A
S	N/A	N/A	N/A	N/A	7.00E+00	N/A	N/A
Sb	N/A	N/A	7.00E-02	N/A	N/A	N/A	N/A
Sc	N/A	N/A	N/A	N/A	4.20E-03	N/A	N/A
Se	N/A	N/A	N/A	1.90E+00	1.60E+01	N/A	N/A
Si	N/A	N/A	1.00E+00	N/A	N/A	N/A	N/A
Sm	N/A	N/A	4.00E-05	N/A	N/A	N/A	N/A
Sn	N/A	N/A	1.00E+00	N/A	N/A	N/A	N/A
Sr	N/A	N/A	N/A	1.40E+00	3.50E-01	N/A	N/A
Ta	N/A	N/A	1.00E-03	N/A	N/A	N/A	N/A
Tb	N/A	N/A	4.00E-05	N/A	N/A	N/A	N/A
Tc	N/A	N/A	3.00E+00	N/A	N/A	N/A	N/A
Te	5.10E+00	N/A	N/A	N/A	N/A	N/A	N/A
Th	N/A	N/A	4.00E-03	N/A	N/A	N/A	N/A

Table 2.13. (contd)

Element	Mean	STD	Median	GSD	GM	5%	95%
Tl	N/A	N/A	1.00E+00	N/A	N/A	N/A	N/A
U	1.10E+00	N/A	N/A	N/A	N/A	N/A	N/A
W	9.00E-01	N/A	N/A	N/A	N/A	N/A	N/A
Y	2.00E-03	N/A	N/A	N/A	N/A	N/A	N/A
Zn	1.40E+00	2.90E-01	1.37E+00	1.23E+00	1.37E+00	9.79E-01	1.92E+00
Zr	2.00E-04	N/A	N/A	N/A	N/A	N/A	N/A

GM = Geometric mean.
GSD = Geometric Standard Deviation.
N/A = Not available in the references reviewed.
STD = Standard Deviation.

2.1.17 CLBVx Bioconcentration to Edible Crop Portion from Soil

CLBVLV is the ratio of leafy vegetable plant concentration (dry weight) to the soil concentration (dry soil). The soil-to-plant concentration ratio (CR) accounts for the uptake from soil and transport through roots to the edible plant parts.

CLBVRV is the ratio of plant chemical concentration (dry weight) for root and other vegetables to the soil chemical concentration (dry soil). This parameter captures a wide range of food types, covering all categories beyond leafy vegetables, tree fruit, and grains. Although the range of crops encompassed by this bioconcentration factor covers a broad variety of plant and edible crop morphologies, it was determined to be the best approach to combine the paucity of data for crops beyond leafy vegetables, fruits, and grains. The soil-to-plant CR accounts for the uptake from soil and transport through roots to the edible plant parts. Especially with the CLBVRV category, if there is a particular crop that is predominantly consumed within this food crop type, the bioconcentration factors should reflect that particular food crop to the extent possible.

CLBVFR is the ratio of plant chemical concentration (dry weight) for the edible fruit portion to the soil chemical concentration (dry soil). The soil-to-plant CR accounts for the uptake from soil and transport through roots to the edible plant parts.

CLBVCL is the ratio of plant chemical concentration (dry weight) for cereal grain to the soil chemical concentration (dry soil). The soil-to-plant CR accounts for the uptake from soil and transport through roots to the edible plant parts. The Gv2 code currently applies the CLBVAG (see Section 2.1.19) value to grain. However, the user is encouraged to enter the same values in the CLBVCL and CLBVAG parameter entries. This action will capture any later changes to the Gv2 code if both parameters are applied separately for feed and food categories.

The units and range for CLBVx parameters in Gv2 are: $kg_{dry\_plant}/kg_{dry\_soil}$, which is reduced from (Ci/kg_{dry_soil}) per (Ci/kg_{dry_plant}) (0 to 5000).

For all food crop bioaccumulation factors, the goal was to determine mean, median, geometric standard deviation, geometric mean, 5th percentile, and 95th percentile. Some of these values could be determined mathematically. In these cases, statistical calculations were performed, according to methods described in Strom and Stansbury (2000).

CLBLV: To tabulate bioaccumulation factors for leafy vegetable, sources considered to be the best available references were reviewed. For leafy vegetable, the goal was to determine mean, median, geometric standard deviation, geometric mean, 5th percentile, and 95th percentile. Selection priority was given to IAEA (2010), Sheppard et al. (2010), and Staven et al. (2003), with a preference for lognormality in the datasets. Some of these values could be determined mathematically. In these cases, statistical calculations were performed, according to methods described in Strom and Stansbury (2000). The full set of data reviewed to determine the values tabulated in this section are provided in Appendix C.

CLBVRV: To tabulate bioaccumulation factors for root vegetables, sources considered to be the best available references were reviewed. For root vegetables, the goal was to determine mean, median, geometric standard deviation, geometric mean, 5th percentile, and 95th percentile. Selection priority was given to IAEA (2010), Sheppard et al. (2010), and Staven et al. (2003), with a preference for lognormality in the datasets. Some of these values could be determined mathematically. In these cases, statistical calculations were performed, according to methods described in Strom and Stansbury (2000). The full set of data reviewed to determine the values tabulated in this section are provided in Appendix C.

CLBVFR: To tabulate bioaccumulation factors for fruit, sources considered to be the best available references were reviewed. For fruit, the goal was to determine mean, median, geometric standard deviation, geometric mean, 5th percentile, and 95th percentile. Selection priority was given to IAEA (2010), Staven et al. (2003), and Napier et al. (2012) (when the distribution given there encompassed essentially all of the others), with a preference for lognormality in the datasets. Some of these values could be determined mathematically. In these cases, statistical calculations were performed, according to methods described in Strom and Stansbury (2000). The full set of data reviewed to determine the values tabulated in this section are provided in Appendix C.

CLBVCL: To tabulate bioaccumulation factors for cereal grain, sources considered to be the best available references were reviewed. For cereal grain, the goal was to determine mean, median, geometric standard deviation, geometric mean, 5th percentile, and 95th percentile. Selection priority was given to IAEA (2010), Sheppard et al. (2010), and Staven et al. (2003), with a preference for lognormality in the datasets. Some of these values could be determined mathematically. In these cases, statistical calculations were performed, according to methods described in Strom and Stansbury (2000). The full set of data reviewed to determine the values tabulated in this section are provided in Appendix C.

2.1.17.1 Additional Sources of Information

The references that were reviewed contain additional information regarding data completeness, data limitations, and application of values to environmental models.

There are numerous chemicals for which no food crop bioconcentration factors are available. The user can refer to Staven et al. (2003) for an approach to approximate values for non-tabulated chemicals. The user is encouraged to review additional research on bioconcentration factors in the literature, as well.

2.1.17.2 CLBVx Bioconcentration to Edible Crop Tables

For CLBVLV values, see Table 2.14.

For CLBVRV values see Table 2.15.

For CLBVFR values, see Table 2.16.

For CLBVCL values see Table 2.17.

Table 2.14. CLBVLV Concentration Ratio – Leafy Vegetable to Soil

Element	Mean	STD	Median	GSD	GM	5%	95%
Ac	N/A	N/A	4.70E-04	N/A	N/A	N/A	N/A
Ag	N/A	N/A	N/A	3.30E+00	1.80E-04	N/A	N/A
Am	N/A	N/A	N/A	3.30E+00	2.70E-04	N/A	N/A
As	N/A	N/A	4.00E-02	N/A	N/A	N/A	N/A
Au	N/A	N/A	1.00E-02	N/A	N/A	N/A	N/A
Ba	5.00E-03	N/A	N/A	N/A	N/A	N/A	N/A
Be	4.20E-01	N/A	N/A	N/A	N/A	N/A	N/A
Bi	N/A	N/A	5.00E-01	N/A	N/A	N/A	N/A
Br	N/A	N/A	1.50E+00	N/A	N/A	N/A	N/A
Ca	N/A	N/A	3.50E+00	N/A	N/A	N/A	N/A
Cd	N/A	N/A	5.50E-01	N/A	N/A	N/A	N/A
Ce	N/A	N/A	N/A	N/A	6.20E-03	N/A	N/A
Cf	N/A	N/A	4.70E-04	N/A	N/A	N/A	N/A
Cl	N/A	N/A	7.00E+00	N/A	N/A	N/A	N/A
Cm	N/A	N/A	N/A	4.50E+00	1.40E-03	N/A	N/A
Co	N/A	N/A	N/A	2.70E+00	1.70E-01	N/A	N/A
Cr	1.00E-03	N/A	N/A	N/A	N/A	N/A	N/A
Cs	N/A	N/A	N/A	6.00E+00	6.00E-02	N/A	N/A
Cu	N/A	N/A	4.00E-01	N/A	N/A	N/A	N/A
Dy	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Er	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Eu	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
F	N/A	N/A	6.00E-02	N/A	N/A	N/A	N/A
Fe	1.00E-03	N/A	N/A	N/A	N/A	N/A	N/A
Ga	N/A	N/A	4.00E-03	N/A	N/A	N/A	N/A
Gd	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Hf	N/A	N/A	1.00E-03	N/A	N/A	N/A	N/A
Hg	N/A	N/A	8.50E-01	N/A	N/A	N/A	N/A
Ho	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
I	N/A	N/A	4.00E-02	N/A	N/A	N/A	N/A
In	N/A	N/A	4.00E-03	N/A	N/A	N/A	N/A
Ir	N/A	N/A	5.50E-02	N/A	N/A	N/A	N/A
K	1.30E+00	N/A	N/A	N/A	N/A	N/A	N/A
La	N/A	N/A	N/A	2.70E+00	5.70E-03	N/A	N/A
Mg	N/A	N/A	1.00E+00	N/A	N/A	N/A	N/A

Table 2.14. (contd)

Element	Mean	STD	Median	GSD	GM	5%	95%
Mn	4.10E-01	N/A	N/A	2.40E+00	N/A	N/A	N/A
Mo	5.10E-01	N/A	N/A	N/A	N/A	N/A	N/A
N	N/A	N/A	5.50E-02	N/A	N/A	N/A	N/A
Na	3.00E-02	N/A	N/A	N/A	N/A	N/A	N/A
Nb	N/A	N/A	N/A	N/A	1.70E-02	N/A	N/A
Nd	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Ni	N/A	N/A	N/A	2.60E+00	1.70E-01	N/A	N/A
Np	N/A	N/A	N/A	3.00E+00	2.70E-02	N/A	N/A
Os	N/A	N/A	1.50E-02	N/A	N/A	N/A	N/A
P	1.00E+00	N/A	N/A	N/A	N/A	N/A	N/A
Pa	N/A	N/A	4.70E-04	N/A	N/A	N/A	N/A
Pb	N/A	N/A	N/A	1.30E+01	8.00E-02	N/A	N/A
Pd	N/A	N/A	1.50E-01	N/A	N/A	N/A	N/A
Pm	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Po	N/A	N/A	N/A	6.90E+00	7.40E-03	N/A	N/A
Pr	2.00E-02	N/A	N/A	N/A	N/A	N/A	N/A
Pu	N/A	N/A	N/A	2.70E+00	8.30E-05	N/A	N/A
Rb	N/A	N/A	N/A	N/A	6.20E-01	N/A	N/A
Re	N/A	N/A	1.50E+00	N/A	N/A	N/A	N/A
Rh	N/A	N/A	1.50E-01	N/A	N/A	N/A	N/A
Ru	N/A	N/A	N/A	3.70E+00	9.00E-02	N/A	N/A
S	N/A	N/A	1.50E+00	N/A	N/A	N/A	N/A
Sb	N/A	N/A	N/A	2.60E+00	9.40E-05	N/A	N/A
Sc	N/A	N/A	6.00E-03	N/A	N/A	N/A	N/A
Se	N/A	N/A	2.50E-01	N/A	N/A	N/A	N/A
Se	N/A	N/A	N/A	N/A	1.00E+00	N/A	N/A
Si	N/A	N/A	3.50E-01	N/A	N/A	N/A	N/A
Sm	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Sn	N/A	N/A	3.00E-02	N/A	N/A	N/A	N/A
Sr	N/A	N/A	N/A	6.00E+00	7.60E-01	N/A	N/A
Ta	N/A	N/A	2.50E-02	N/A	N/A	N/A	N/A
Tb	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Tc	N/A	N/A	2.10E+01	N/A	N/A	N/A	N/A
Te	3.00E-01	N/A	N/A	N/A	N/A	N/A	N/A
Th	N/A	N/A	6.60E-03	N/A	N/A	N/A	N/A
Tl	N/A	N/A	4.00E-03	N/A	N/A	N/A	N/A
U	N/A	N/A	N/A	7.30E+00	2.00E-02	N/A	N/A
V	N/A	N/A	N/A	N/A	8.80E-03	N/A	N/A
W	N/A	N/A	3.00E+00	N/A	N/A	N/A	N/A
Y	2.00E-03	N/A	N/A	N/A	N/A	N/A	N/A
Yb	N/A	N/A	N/A	N/A	8.00E-03	N/A	N/A
Zn	N/A	N/A	N/A	2.40E+00	2.40E+00	N/A	N/A
Zr	4.00E-02	N/A	N/A	N/A	N/A	N/A	N/A

GM = Geometric mean.
GSD = Geometric Standard Deviation.
N/A = Not available in the references reviewed.
STD = Standard Deviation.

Table 2.15. CLBVRV Concentration Ratio – Root (Other) Vegetable to Soil

Element	Mean	STD	Median	GSD	GM	5%	95%
Ac	N/A	N/A	3.50E-04	N/A	N/A	N/A	N/A
Ag	N/A	N/A	N/A	2.00E+00	1.30E-03	N/A	N/A
Am	N/A	N/A	N/A	2.40E+00	6.70E-04	N/A	N/A
As	N/A	N/A	6.00E-03	N/A	N/A	N/A	N/A
Au	N/A	N/A	1.80E-02	N/A	N/A	N/A	N/A
Ba	5.00E-03	N/A	N/A	N/A	N/A	N/A	N/A
Bi	N/A	N/A	1.00E-05	N/A	N/A	N/A	N/A
Br	N/A	N/A	1.50E+00	N/A	N/A	N/A	N/A
Ca	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cd	N/A	N/A	N/A	2.70E-01	2.70E-01	N/A	N/A
Ce	1.3E-02	N/A	N/A	N/A	N/A	N/A	N/A
Cf	N/A	N/A	3.50E-04	N/A	N/A	N/A	N/A
Cl	N/A	N/A	7.00E+00	N/A	N/A	N/A	N/A
Cm	N/A	N/A	N/A	3.00E+00	8.5E-04	N/A	N/A
Co	N/A	N/A	N/A	2.20E+00	1.10E-01	N/A	N/A
Cr	1.00E-03	N/A	N/A	1.00E-03	N/A	N/A	N/A
Cs	N/A	N/A	N/A	3.00E+00	4.20E-02	N/A	N/A
Cu	N/A	N/A	2.50E-01	N/A	N/A	N/A	N/A
Dy	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Er	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Eu	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
F	N/A	N/A	6.00E-03	N/A	N/A	N/A	N/A
Fe	1.00E-03	N/A	N/A	N/A	N/A	N/A	N/A
Ga	N/A	N/A	4.00E-04	N/A	N/A	N/A	N/A
Gd	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Hf	N/A	N/A	1.00E-03	N/A	N/A	N/A	N/A
Hg	N/A	N/A	2.00E-01	N/A	N/A	N/A	N/A
Ho	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
I	N/A	N/A	4.00E-02	N/A	N/A	N/A	N/A
In	N/A	N/A	4.00E-04	N/A	N/A	N/A	N/A
Ir	N/A	N/A	1.50E-02	N/A	N/A	N/A	N/A
K	N/A	N/A	5.50E-01	N/A	N/A	N/A	N/A
La	N/A	N/A	N/A	2.70E+00	1.60E-03	N/A	N/A
Mg	N/A	N/A	5.50E-01	N/A	N/A	N/A	N/A
Mn	N/A	N/A	N/A	4.10E+00	3.10E-01	N/A	N/A
Mo	3.20E-01	N/A	N/A	N/A	N/A	N/A	N/A
N	N/A	N/A	4.20E-02	N/A	N/A	N/A	N/A
Na	3.00E-02	N/A	N/A	N/A	N/A	N/A	N/A
Nb	8.00E-03	N/A	N/A	N/A	N/A	N/A	N/A
Nd	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Ni	N/A	N/A	N/A	2.50E+00	4.00E-01	N/A	N/A
Np	N/A	N/A	N/A	2.00E+00	2.20E-02	N/A	N/A
Os	N/A	N/A	3.50E-03	N/A	N/A	N/A	N/A
P	1	N/A	N/A	N/A	N/A	N/A	N/A
Pa	N/A	N/A	3.50E-04	N/A	N/A	N/A	N/A
Pb	N/A	N/A	3.20E-03	N/A	1.50E-02	N/A	N/A

Table 2.15. (contd)

Element	Mean	STD	Median	GSD	GM	5%	95%
Pd	N/A	N/A	4.00E-02	N/A	N/A	N/A	N/A
Pm	N/A	N/A	N/A	1.20E+00	4.20E-02	N/A	N/A
Po	N/A	N/A	N/A	4.30E+00	5.80E-03	N/A	N/A
Pr	2.00E-02	N/A	N/A	N/A	N/A	N/A	N/A
Pu	N/A	N/A	N/A	2.70E+00	6.50E-05	N/A	N/A
Ra	N/A	N/A	N/A	8.40E+00	1.70E-02	N/A	N/A
Rb	9.00E-01	N/A	N/A	N/A	N/A	N/A	N/A
Re	N/A	N/A	3.50E+00	N/A	N/A	N/A	N/A
Rh	N/A	N/A	4.00E-02	N/A	N/A	N/A	N/A
Ru	2.00E-02	N/A	N/A	N/A	N/A	N/A	N/A
S	N/A	N/A	1.50E+00	N/A	N/A	N/A	N/A
Sb	N/A	N/A	N/A	6.70E+00	1.30E-04	N/A	N/A
Sc	N/A	N/A	1.00E-03	N/A	N/A	N/A	N/A
Se	N/A	N/A	5.00E-02	N/A	N/A	N/A	N/A
Si	N/A	N/A	7.00E-02	N/A	N/A	N/A	N/A
Sm	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Sn	N/A	N/A	6.00E-03	N/A	N/A	N/A	N/A
Sr	N/A	N/A	N/A	4.10E+00	7.20E-01	N/A	N/A
Ta	N/A	N/A	2.50E-02	N/A	N/A	N/A	N/A
Tb	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Tc	N/A	N/A	2.40E-01	N/A	N/A	N/A	N/A
Te	3.00E-01	N/A	N/A	N/A	N/A	N/A	N/A
Th	7.80E-04		N/A	6.80E+00	N/A	N/A	N/A
Tl	N/A	N/A	4.00E-04	N/A	N/A	N/A	N/A
U	N/A	N/A	N/A	4.20E+00	1.50E-02	N/A	N/A
V	N/A	N/A	N/A	N/A	2.00E-03	N/A	N/A
W	N/A	N/A	3.00E+00	N/A	N/A	N/A	N/A
Y	2.00E-03	N/A	N/A	N/A	N/A	N/A	N/A
Yb	N/A	N/A	N/A	N/A	2.00E-03	N/A	N/A
Zn	N/A	N/A	N/A	1.80E+00	3.00E-01	N/A	N/A
Zr	4.00E-03	N/A	N/A	N/A	N/A	N/A	N/A

GM = Geometric mean.
GSD = Geometric Standard Deviation.
N/A = Not available in the references reviewed.
STD = Standard Deviation.

Table 2.16. CLBVFR Concentration Ratio – Fruit to Soil

Element	Mean	STD	Median	GSD	GM	5%	95%
Ac	N/A	N/A	2.50E-04	N/A	N/A	N/A	N/A
Ag	N/A	N/A	8.00E-04	N/A	N/A	N/A	N/A
Al	1.00E-03	2.00E-03	2.81E-04	3.56E+00	4.47E-04	5.55E-05	3.60E-03
Am	N/A	N/A	6.20E-06	2.4	N/A	N/A	N/A
As	2.20E-01	2.50E-02	1.96E-01	1.12E+00	2.19E-01	1.81E-01	2.63E-01
Au	N/A	N/A	1.40E-02	N/A	N/A	N/A	N/A
Ba	3.00E-03	3.00E-03	1.30E-03	2.30E+00	2.12E-03	5.39E-04	8.34E-03

Table 2.16. (contd)

Element	Mean	STD	Median	GSD	GM	5%	95%
Be	N/A	N/A	1.50E-03	N/A	N/A	N/A	N/A
Bi	N/A	N/A	5.00E-01	N/A	N/A	N/A	N/A
Bk	N/A	N/A	2.50E-04	N/A	N/A	N/A	N/A
Br	1.81E-01	1.69E-01	8.20E-02	2.21E+00	1.32E-01	3.60E-02	4.87E-01
Ca	1.80E-01	1.34E-01	9.27E-02	1.94E+00	1.44E-01	4.84E-02	4.30E-01
Ce	1.06E-04	N/A	N/A	N/A	N/A	N/A	N/A
Cm	1.00E-04	2.60E-05	N/A	N/A	N/A	N/A	N/A
Co	N/A	N/A	7.00E-03	N/A	N/A	N/A	N/A
Cs	2.00E-03	1.00E-03	1.25E-03	1.60E+00	1.79E-03	8.22E-04	3.89E-03
Cu	N/A	N/A	2.50E-01	N/A	N/A	N/A	N/A
Dy	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Er	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Eu	1.00E-03	1.00E-03	4.35E-04	2.30E+00	7.07E-04	1.80E-04	2.78E-03
F	N/A	N/A	6.00E-03	N/A	N/A	N/A	N/A
Fe	2.00E-03	5.00E-04	1.56E-03	1.28E+00	1.94E-03	1.29E-03	2.91E-03
Ga	N/A	N/A	4.00E-04	N/A	N/A	N/A	N/A
Gd	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Hf	1.00E-03	1.00E-03	4.35E-04	2.30E+00	7.07E-04	1.80E-04	2.78E-03
Hg	N/A	N/A	3.70E-01	N/A	N/A	N/A	N/A
Ho	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
I	N/A	N/A	N/A	1.6	1.26E-03	N/A	N/A
In	N/A	N/A	4.00E-04	N/A	N/A	N/A	N/A
Ir	N/A	N/A	1.50E-02	N/A	N/A	N/A	N/A
K	5.57E-01	2.99E-01	3.37E-01	1.65E+00	4.91E-01	2.14E-01	1.12E+00
La	1.00E-03	2.00E-04	8.20E-04	1.22E+00	9.81E-04	7.08E-04	1.36E-03
La	N/A	N/A	4.00E-03	N/A	N/A	N/A	N/A
La	6.00E-03	N/A	N/A	N/A	N/A	N/A	N/A
La	4.00E-03	N/A	N/A	N/A	N/A	N/A	N/A
La	N/A	N/A	N/A	N/A	3.50E-04	N/A	N/A
Lu	2.00E-03	2.00E-03	8.70E-04	2.30E+00	1.41E-03	3.60E-04	5.56E-03
Mg	1.33E-01	1.77E-01	4.85E-02	2.74E+00	7.99E-02	1.52E-02	4.21E-01
Mn	2.30E-02	8.00E-03	1.64E-02	1.40E+00	2.17E-02	1.25E-02	3.79E-02
Mo	N/A	N/A	6.00E-02	N/A	N/A	N/A	N/A
N	N/A	N/A	3.00E-02	N/A	N/A	N/A	N/A
Na	1.70E-02	1.10E-02	9.41E-03	1.81E+00	1.43E-02	5.40E-03	3.78E-02
Nb	N/A	N/A	2.50E-02	N/A	N/A	N/A	N/A
Nd	9.00E-03	5.00E-03	5.36E-03	1.68E+00	7.87E-03	3.35E-03	1.85E-02
Ni	2.63E-01	8.90E-01	5.37E-02	4.89E+00	7.45E-02	5.47E-03	1.02E+00
Np	N/A	N/A	1.00E-02	N/A	N/A	N/A	N/A
Os	N/A	N/A	4.50E-02	N/A	N/A	N/A	N/A
P	N/A	N/A	3.50E+00	N/A	N/A	N/A	N/A
Pa	N/A	N/A	2.50E-04	N/A	N/A	N/A	N/A
Pb	N/A	N/A	1.00E-02	N/A	N/A	N/A	N/A
Pd	1.00E-02	5.96E-03	8.59E-03	1.74E+00	8.59E-03	3.47E-03	2.13E-02
Pm	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Po	N/A	N/A	1.20E-03	N/A	N/A	N/A	N/A
Pr	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A

Table 2.16. (contd)

Element	Mean	STD	Median	GSD	GM	5%	95%
Pu	N/A	N/A	4.50E-05	N/A	N/A	N/A	N/A
Ra	2.69E-02	4.61E-02	1.36E-02	3.22E+00	1.36E-02	1.98E-03	9.30E-02
Rb	1.45E-01	5.30E-02	1.02E-01	1.42E+00	1.36E-01	7.61E-02	2.44E-01
Re	N/A	N/A	3.50E-01	N/A	N/A	N/A	N/A
Rh	N/A	N/A	4.00E-02	N/A	N/A	N/A	N/A
Ru	N/A	N/A	4.00E-02	N/A	N/A	N/A	N/A
S	N/A	N/A	1.50E+00	N/A	N/A	N/A	N/A
Sb	9.60E-02	6.10E-02	5.36E-02	1.79E+00	8.10E-02	3.11E-02	2.11E-01
Sc	N/A	N/A	3.00E-03	N/A	N/A	N/A	N/A
Se	N/A	N/A	5.00E-02	N/A	N/A	N/A	N/A
Si	N/A	N/A	7.00E-02	N/A	N/A	N/A	N/A
Sm	1.00E-03	1.00E-03	4.35E-04	2.30E+00	7.07E-04	1.80E-04	2.78E-03
Sn	N/A	N/A	6.00E-03	N/A	N/A	N/A	N/A
Sr	6.80E-02	7.80E-02	2.72E-02	2.50E+00	4.47E-02	9.90E-03	2.02E-01
Ta	1.00E-03	1.00E-03	4.35E-04	2.30E+00	7.07E-04	1.80E-04	2.78E-03
Tb	2.00E-03	2.00E-03	8.70E-04	2.30E+00	1.41E-03	3.60E-04	5.56E-03
Tc	N/A	N/A	1.50E+00	N/A	N/A	N/A	N/A
Te	N/A	N/A	4.00E-03	N/A	N/A	N/A	N/A
Th	7.00E-04	4.00E-04	4.11E-04	1.70E+00	6.08E-04	2.53E-04	1.46E-03
Ti	5.40E-05	N/A	N/A	N/A	N/A	N/A	N/A
Tl	N/A	N/A	4.00E-04	N/A	N/A	N/A	N/A
U	5.72E-02	1.15E-01	2.55E-02	3.57E+00	2.55E-02	3.14E-03	2.06E-01
V	7.00E-03	1.00E-02	2.44E-03	2.87E+00	4.01E-03	7.08E-04	2.28E-02
W	N/A	N/A	3.00E+00	N/A	N/A	N/A	N/A
Y	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Yb	5.00E-03	5.00E-03	2.17E-03	2.30E+00	3.54E-03	8.99E-04	1.39E-02
Zn	1.37E-01	6.20E-02	8.90E-02	1.54E+00	1.25E-01	6.14E-02	2.54E-01
Zr	4.00E-03	8.00E-03	1.12E-03	3.56E+00	1.79E-03	2.22E-04	1.44E-02

GM = Geometric mean.
GSD = Geometric Standard Deviation.
N/A = Not available in the references reviewed.
STD = Standard Deviation.

Table 2.17. CLBVCL Concentration Ratio – Grain to Soil

Element	Mean	STD	Median	GSD	GM	5%	95%
Ac	N/A	N/A	2.20E-05	N/A	N/A	N/A	N/A
Ag	N/A	N/A	2.50E-01	N/A	N/A	N/A	N/A
Al	4.00E-03	2.00E-03	2.49E-03	1.60E+00	3.58E-03	1.64E-03	7.78E-03
Am		N/A	N/A	1.10E+01	2.20E-05	N/A	N/A
As	1.90E-02	6.00E-03	1.40E-02	1.36E+00	1.81E-02	1.09E-02	3.01E-02
Au	N/A	N/A	2.50E-01	N/A	N/A	N/A	N/A
Ba	5.00E-03	2.00E-03	3.40E-03	1.47E+00	4.64E-03	2.46E-03	8.75E-03
Be	N/A	N/A	3.00E-03	N/A	N/A	N/A	N/A
Bi	N/A	N/A	5.00E-01	N/A	N/A	N/A	N/A
Br	1.06E+00	3.01E-01	8.00E-01	1.32E+00	1.02E+00	6.43E-01	1.61E+00

Table 2.17. (contd)

Element	Mean	STD	Median	GSD	GM	5%	95%
Ca	1.08E-01	3.10E-02	8.15E-02	1.32E+00	1.04E-01	6.53E-02	1.65E-01
Ca	N/A	N/A	N/A	3.70E+00	8.70E+00	N/A	N/A
Cd	N/A	N/A	N/A	2.70E+00	8.80E-01	N/A	N/A
Ce	N/A	N/A	N/A	3.70E+00	3.10E-03	N/A	N/A
Cf	N/A	N/A	2.20E-05	N/A	N/A	N/A	N/A
Cl	1.16E+01	2.61E+03	4.30E-01	2.69E+01	5.12E-02	2.28E-04	1.15E+01
Cm	N/A	N/A	N/A	3.30E+00	2.30E-05	N/A	N/A
Co	N/A	N/A	N/A	5.50E+00	8.50E-03	N/A	N/A
Cr	2.00E-04	N/A	N/A	N/A	N/A	N/A	N/A
Cs	N/A	N/A	N/A	4.00E+00	2.90E-02	N/A	N/A
Cu	N/A	N/A	2.50E-01	N/A	N/A	N/A	N/A
Dy	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Er	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Eu	2.00E-03	1.00E-03	1.25E-03	1.60E+00	1.79E-03	8.22E-04	3.89E-03
F	N/A	N/A	6.00E-03	N/A	N/A	N/A	N/A
Fe	2.00E-04	N/A	N/A	N/A	N/A	N/A	N/A
Ga	N/A	N/A	4.00E-04	N/A	N/A	N/A	N/A
Gd	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Hf	2.00E-03	1.00E-03	1.25E-03	1.60E+00	1.79E-03	8.22E-04	3.89E-03
Hg	N/A	N/A	4.90E-01	N/A	N/A	N/A	N/A
Ho	N/A	N/A	4.00E-03	N/A	N/A	N/A	N/A
I	N/A	N/A	4.00E-02	N/A	N/A	N/A	N/A
In	N/A	N/A	4.00E-04	N/A	N/A	N/A	N/A
Ir	N/A	N/A	1.50E-02	N/A	N/A	N/A	N/A
K	2.78E-01	7.10E-02	2.16E-01	1.29E+00	2.69E-01	1.78E-01	4.07E-01
La	2.00E-05	N/A	N/A	N/A	N/A	N/A	N/A
Lu	4.00E-04	1.00E-03	9.79E-05	4.09E+00	1.49E-04	1.47E-05	1.50E-03
Mg	2.31E-01	1.13E-01	1.45E-01	1.59E+00	2.08E-01	9.69E-02	4.45E-01
Mn	N/A	N/A	N/A	3.30E+00	2.80E-01	N/A	N/A
Mo	8.00E-01	N/A	N/A	N/A	N/A	N/A	N/A
N	N/A	N/A	1.30E-01	N/A	N/A	N/A	N/A
Na	4.40E-02	1.00E-02	3.52E-02	1.25E+00	4.29E-02	2.97E-02	6.21E-02
Nb	1.40E-02	N/A	N/A	N/A	N/A	N/A	N/A
Nd	1.20E-02	3.00E-03	9.38E-03	1.28E+00	1.16E-02	7.76E-03	1.75E-02
Ni	3.09E-01	5.02E-01	9.92E-02	3.12E+00	1.62E-01	2.50E-02	1.05E+00
Np	N/A	N/A	N/A	5.00E+00	2.90E-03	N/A	N/A
O	N/A	N/A	6.00E-03	N/A	N/A	N/A	N/A
Os	N/A	N/A	3.50E-03	N/A	N/A	N/A	N/A
P	N/A	N/A	3.50E+00	N/A	N/A	N/A	N/A
Pa	N/A	N/A	2.20E-05	N/A	N/A	N/A	N/A
Pb	N/A	N/A	N/A	3.60E+00	1.10E-02	N/A	N/A
Pd	N/A	N/A	4.00E-02	N/A	N/A	N/A	N/A
Pm	N/A	N/A	N/A	6.00E+00	1.40E-02	N/A	N/A
Po	2.40E-04	N/A	N/A	N/A	N/A	N/A	N/A
Pr	2.00E-02	N/A	N/A	N/A	N/A	N/A	N/A
Pu	N/A	N/A	N/A	6.70E+00	9.50E-06	N/A	N/A
Ra	N/A	N/A	N/A	1.20E+01	1.70E-02	N/A	N/A

Table 2.17. (contd)

Element	Mean	STD	Median	GSD	GM	5%	95%
Rb	9.00E-01	N/A	N/A	N/A	N/A	N/A	N/A
Re	N/A	N/A	3.50E-01	N/A	N/A	N/A	N/A
Rh	N/A	N/A	4.00E-02	N/A	N/A	N/A	N/A
Ru	N/A	N/A	N/A	2.60E+00	3.00E-03	N/A	N/A
S	N/A	N/A	1.50E+00	N/A	N/A	N/A	N/A
Sb	N/A	N/A	N/A	2.70E+00	1.80E-03	N/A	N/A
Sc	1.00E-03	N/A	N/A	N/A	N/A	N/A	N/A
Se	N/A	N/A	2.50E-01	N/A	N/A	N/A	N/A
Si	N/A	N/A	7.00E-02	N/A	N/A	N/A	N/A
Sm	N/A	N/A	2.00E-02	N/A	N/A	N/A	N/A
Sn	N/A	N/A	6.00E-03	N/A	N/A	N/A	N/A
Sr	N/A	N/A	N/A	2.70E+00	1.10E-01	N/A	N/A
Ta	2.00E-03	1.00E-03	1.25E-03	1.60E+00	1.79E-03	8.22E-04	3.89E-03
Tb	3.00E-03	1.00E-03	2.17E-03	1.38E+00	2.85E-03	1.67E-03	4.85E-03
Tc	N/A	N/A	7.30E-01	N/A	N/A	N/A	N/A
Te	1.00E+01	N/A	N/A	N/A	N/A	N/A	N/A
Th	N/A	N/A	N/A	3.40E+00	2.10E-03	N/A	N/A
Ti	5.40E-05	N/A	N/A	N/A	N/A	N/A	N/A
Tl	N/A	N/A	4.00E-04	N/A	N/A	N/A	N/A
U	N/A	N/A	N/A	7.70E+00	6.20E-03	N/A	N/A
V	1.00E-02	5.00E-03	6.24E-03	1.60E+00	8.94E-03	4.11E-03	1.95E-02
W	N/A	N/A	3.00E+00	N/A	N/A	N/A	N/A
Y	5.00E-04	N/A	N/A	N/A	N/A	N/A	N/A
Yb	1.10E-02	4.00E-03	7.73E-03	1.42E+00	1.03E-02	5.79E-03	1.85E-02
Zn	N/A	N/A	N/A	2.70E+00	1.80E+00	N/A	N/A
Zr	5.00E-03	4.00E-03	2.47E-03	2.02E+00	3.90E-03	1.23E-03	1.24E-02

GM = Geometric mean.
GSD = Geometric Standard Deviation.
N/A = Not available in the references reviewed.
STD = Standard Deviation.

2.1.18 CLBVA*x* Bioconcentration in Animal Forage or Hay from Soil

These parameters represent the bioconcentration of a constituent in dry forage (CLBVAF) and in dry hay (CLBVAH) when the constituent is in the soil. Due to data availability, identical values are assigned to both of these values. Examples of dry forage are alfalfa hay and sun-cured timothy hay. These values are not currently used in GENII (although the inputs are listed in the GENII database). Additional data have been reviewed and compiled and are available from the authors; they are not included here at this time because they are not directly used by the code.

2.1.19 CLBVAG Bioconcentration in Animal Feed Grain from Soil

This parameter value should be assigned a value identical to that of CLBVCL, the bioconcentration of a constituent in soil to the grain consumed by humans. These two parameters were established to

differentiate between grain consumed by animals and by humans. However, these values are considered to be essentially identical. The user is responsible for entering the same values in CLBVAG and CLBVCL.

The units and range for CLBVAG in Gv2 are: $kg_{dry\_plant}/kg_{dry\_soil}$ (0 to 5000).

See CLBVCL in Section 2.1.17 for further information and parameter values.

2.1.20 CLBVOV Bioconcentration in Dry Other Vegetables from Soil

This is similar to the bioconcentration of a constituent in soil to the other vegetables consumed by humans, but is applied in this case to other vegetables consumed by meat and milk animals. This parameter is not implemented in the current models used for human ingestion of animal products.

The units and range for this parameter in Gv2 are: N/A.

2.1.21 CLVD Atmospheric Deposition Velocity

The deposition velocity is the rate of deposition of particulate matter from air to the ground. This parameter is not implemented via entries in this module, but is dealt with internally in the Air module (Section 4.0).

The units and range for this parameter in Gv2 are: m/sec (0 to 1).

2.1.22 CLSHALF Decay Half-Life in Soil

CLSHALF describes the loss by radiological transformation or chemical reaction in soil. This parameter is typically applicable to irrigated soil leaching and will be implemented in the Exposure Module. The provided default values are not implemented for Chronic Air or Chronic Water emission scenarios.

The units and minimum for this parameter in Gv2 are: day (no range defined).

2.1.23 CLCLASS Atmospheric Deposition Class

CLCLASS describes characteristics of the constituent for evaluation of loses during atmospheric transport. This parameter is not implemented in the Gv2 modules for chronic air transport.

For information purposes only, the CLCLASS values are as follows:

- Class Description
  - particles, radius = 7.5 micron
  - particles, radius = 3.0 micron
  - particles, radius = 0.3 micron (default for inorganic chemicals, radionuclides)
  - depositing gas, surface resistance of reactive gas

– non-depositing gas (e.g., volatile organic chemicals)

– gas behaving as a particle (same deposition rate as class 3), absorbed on particulate material.

2.2 References: Constituent Module

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ICRP. 1990. *Age-dependent Doses to Members of the Public from Intake of Radionuclides - Part 1*. ICRP (International Commission on Radiological Protection) Publication 56, Ann. ICRP 20 (2).

ICRP. 1992. *Age-dependent Doses to Members of the Public from Intake of Radionuclides - Part 2 Ingestion Dose Coefficients*. ICRP (International Commission on Radiological Protection) Publication 67, Ann. ICRP 22 (3–4).

ICRP. 1994. *Human Respiratory Tract Model for Radiological Protection*. ICRP (International Commission on Radiological Protection) Publication 66, Ann. ICRP 24 (1–3).

ICRP. 1995a. *Age-dependent Doses to Members of the Public from Intake of Radionuclides - Part 3 Ingestion Dose Coefficients*. ICRP (International Commission on Radiological Protection) Publication 69, Ann. ICRP 25 (1).

ICRP. 1995b. *Age-dependent Doses to Members of the Public from Intake of Radionuclides - Part 4 Inhalation Dose Coefficients*. ICRP (International Commission on Radiological Protection) Publication 71, Ann. ICRP 25 (3–4).

ICRP. 1995c. *Age-dependent Doses to the Members of the Public from Intake of Radionuclides - Part 5 Compilation of Ingestion and Inhalation Coefficients*. ICRP (International Commission on Radiological Protection) Publication 72, Ann. ICRP 26 (1).

ICRP. 1996. *Conversion Coefficients for use in Radiological Protection against External Radiation*. ICRP (International Commission on Radiological Protection) Publication 74, Ann. ICRP 26 (3–4).

ICRP. 2012. Compendium of Dose Coefficients based on ICRP Publication 60. ICRP (International Commission on Radiological Protection) Publication 119, Ann. ICRP 41(s). Available at: http://www.icrp.org/publication.asp?id=ICRP%20Publication%20119.

Napier BA, RA Peloquin, DL Strenge, and JV Ramsdell. 1988. *Hanford Environmental Dosimetry Upgrade Project, GENII – The Hanford Environmental Radiation Dosimetry Software System, Vol. 1: Conceptual Representation*. PNL-6584, Vol. 1, Pacific Northwest Laboratory, Richland, Washington.

Napier BA, DL Strenge, JV Ramsdell, Jr., PW Eslinger, and C Fosmire. 2012. *GENII Version 2, Software Design Document*. PNNL-14584, Rev. 4, Pacific Northwest National Laboratory, Richland, Washington.

Napier BA, RJ Fellows, and LD Minc. 2012. DRAFT. *Transfer Factors for Contaminant Uptake by Tree Fruits*. Pacific Northwest National Laboratory, Richland, Washington.

Sheppard SC, JM Long, and B Sanipelli. 2010a. "Measured Elemental Transfer Factors for Boreal Hunter/Gatherer Scenarios: Fish, Game and Berries." *Journal of Environmental Radioactivity* 101(11):902–909.

Staven LH, BA Napier, K Rhoads, and DL Strenge. 2003. *A Compendium of Transfer Factors for Agricultural and Animal Products*. PNNL-13421, Pacific Northwest National Laboratory, Richland, Washington.

Strom DJ and PS Stansbury. 2000. "Determining Parameters of Lognormal Distributions from Minimal Information." *American Industrial Hygiene Association Journal* 61(6):977–880.

3.0 Module: User-Defined Air

For scenarios with chronic atmospheric releases, the User-Defined module, AFF Air Module is selected. This module is downstream of the Constituent module and upstream of the Air Module. The user may wish to edit the User Label for this module to "Source term" or a more site-specific descriptive name for the facility creating the radioactive material release. The module model selected is "AFF Air Module." The user enters the annual activity released in this module.

The release information entered in this module is user-specific. The user enters the following facility-specific information (default units listed):

- Type of release: point or area
- Exit area of source (m^2)
- Exit height of source (point release only) (m)
- Height of adjacent structure (m)
- Exit velocity of source (m/s)
- Exit temperature of source (degrees C)
- Ambient air temperature (degrees C).

Consult the Gv2 Users Guide (Napier 2012) and Software Design Document (Napier et al. 2012, particularly, Section 5.3) for guidance on characterizing your facility specific emission point.

The radionuclide release information is entered at the bottom of the screen. The radionuclides and progeny selected in the Constituent module will self-populate. The user is then required to enter the annual release activity. Two rows of data should be entered. "Time" entries are 0 and 1. "Particle1" entries are identical and repeat the annual emission rate from the release point. For example if 10 microcuries of Cs-137 are released, enter 1E7 pCi/yr in both the Time 0 row and Time 1 row. This will model a constant emission rate.

3.1 References: User-Defined (AIR) Module

Napier BA. 2012. *GENII Version 2 Users' Guide*. PNNL-14583, Rev. 4, Pacific Northwest National Laboratory, Richland, Washington.

Napier BA, DL Strenge, JV Ramsdell, Jr., PW Eslinger, and C Fosmire. 2012. *GENII Version 2 Software Design Document.* PNNL-14584, Rev. 4, Pacific Northwest National Laboratory, Richland, Washington.

4.0 Module: Air

This module is downstream of the User-Defined AIR module and upstream of the Exposure Pathways Module. For scenarios with chronic atmospheric releases, the module model GENII V.2 Air module, Chronic Plume model,"[1] is selected. The user enters the characteristics of the atmosphere receiving the airborne effluent in this module.

Table 4.1. Tabs and Sub-Tabs in the Air Module Chronic Plume Model

Tab	Second-Level Tab
Model Information	Radial Grid Definition Model Parameters Default Parameters Meteorological Files
Source Information	None

4.1 Tab: Model Information/Radial Grid Definition

The user sets the output grid that results from the atmospheric dispersion modeling. Sixteen-sector radial grids with user-entered distances are common; thirty-six sectors may be used if the available meteorological data are supplied in 10-degree increments. Distances are typically based on distance to the receptor(s) of interest and additional uniformly-spaced distances. A first distance of less than 100 m should not be used.

4.2 Tab: Model Information/Model Parameters

The user selects the model used with the meteorological input to estimate atmospheric dispersion via radio buttons in the Model Parameters subtab. "Brigg's Open Country" is recommended for generic use. Details on the various model assumptions and differences are discussed in Napier et al. (2012) and Napier et al. (2011).

4.3 Tab: Model Information/Default Parameters

The user assigns specific parameters values.

4.3.1 ARMINRISESPD Minimum Speed during Plume Rise

The minimum speed during plume rise is required for model calculations. When wind is calm a surrogate value is used to prevent numerical instability in the equations. A minimum stack height wind speed is specified because very low wind speeds cause unrealistic values. The user should not apply a value of less than 0.5 m/s.

[1] If the user believes the Chronic Puff model is more appropriate for their scenario, consult the Napier (2012a) and Napier et al. (2012). Only the Chronic Plume model inputs are described here.

The units and range for this parameter in Gv2 are: m/s (0–99.99).

A value of 1.5 m/s is recommended.

4.3.1.1 Additional Sources of Information

No additional sources identified.

4.3.2 ARMINSIGYSHIFT Sigma Shift to SI Cloud Shine

When a semi-infinite cloud shine model is used, the width of the plume must be sufficient to model cloud-shine. A minimum Sigma shift of 400 m is required for appropriate modeling. This value, 400 m, is assigned for generic applications.

The units and range for this parameter in Gv2 are: m (0–10,000).

4.3.2.1 Additional Sources of Information

No additional sources are provided.

4.3.3 ARTRANSRESIST Transfer Resistance for Iodine and Particles

Dry deposition velocities consider aerodynamic resistance, surface resistance, and transfer resistance. Transfer resistance is generally a function of the depositing surface, for example, whether leaf stomatal openings are open or closed. Transfer resistance is used to establish an upper limit on the deposition velocity.

The units for this parameter in Gv2 are: s/m (0–1,000,000).

The Gv2 Software Design Document (SDD) (Napier et al. 2012) indicates appropriate values to apply. A value of 10 s/m is recommended for reactive gases (e.g., iodine) and 100 s/m for fine particulates. Use of these values will result in dry deposition results that are consistent with reported values.

4.3.3.1 Additional Sources of Information

The information provided in the SDD references Ramsdell et al. (1994).

The impact of various transfer resistance values on deposition velocity results is available in Napier (2012b, p. 6).

4.3.4 ARMINWIND Maximum Wind Speed for “Calm”

This value represents the lowest speed reliably indicated by the measuring anemometer. This value is user-determined when user-provided meteorological data files are used and would be available from consultation with the person who created the meteorological data.

The units for this parameter in Gv2 are: m/s (0–2).

A generic value of 0.8 m/s may be used.

4.4 References: Air Module

Napier BA. 2012a. *GENII Version 2 Users' Guide*. PNNL-14583, Rev. 4, Pacific Northwest National Laboratory, Richland, Washington.

Napier BA. 2012b. *Dry Deposition Velocity Estimation for the Savannah River Site: Part 1 – Parametric Analysis*. PNNL-21144, Pacific Northwest National Laboratory, Richland, Washington.

Napier BA, JP Rishel, and NE Bixler. 2011. *Final Review of Safety Assessment Issues at Savannah River Site, August 2011*. PNNL-20990, (especially Appendix A), Pacific Northwest National Laboratory, Richland, Washington.

Napier BA, DL Strenge, JV Ramsdell, Jr., PW Eslinger, and C Fosmire. 2012. *GENII Version 2 Software Design Document.* PNNL-14584, Rev. 4, Pacific Northwest National Laboratory, Richland, Washington.

Ramsdell Jr, JV, CA Simonen, and KW Burk. 1994. *Regional Atmospheric Transport Code for Hanford Emission Tracking (RATCHET)*. PNWD-2224 HEDR, Pacific Northwest National Laboratories, Richland, Washington.

5.0 Module: User-Defined Water

For scenarios with chronic releases to surface waters, the User-Defined module with a module model "WFF Surface Water Module" selected. This module is downstream of the Constituent module and upstream of the Surface Water Module. The user enters the annual activity released in the liquid effluent in this module. The user may wish to edit the User Label for this module to "Source term" or a more site-specific descriptive name for the facility creating the radioactive material release.

This module requires limited entries. The FRAMES system requires the facility-specific width and height of the liquid emission point; these are not used by the GENII models and unit vales may be entered. Consult the Gv2 Users Guide (Napier 2012) and Software Design Document (Napier et al. 2012) for guidance on characterizing your facility specific emission point.

The water volume and radionuclide release information is entered at the bottom of the screen. The "water" flux rate (m^3/s) is used to determine its effective dilution in the surface water source defined in some available versions of the next module (Surface Water module); it is not used with the GENII models and a unit value may be entered. If the radionuclide release rate for diffuse sources was determined by downstream water sampling (i.e., radionuclide water concentration times water flow rate), then the user is responsible for entering the same water volume in both modules when Chronic Flow Dilution is selected in the Surface Water module. As indicated for the radionuclide information entries, next, two rows of data are entered for this chronic emission scenario, "Time" is 0 and 1; "Flux rate" is the same in both "Time" rows.

Select the nuclides one at a time in the dropdown box that first presents with the "water" entry. Both "Adsorbed Flux" and "Dissolved Flux" columns will present. The radionuclides and progeny selected in the Constituent module will self-populate. The user is required to enter the annual release activity. When using the GENII models, the "Adsorbed Flux" and "Dissolved Flux" are treated identically and summed; for other models enter the activity as "Dissolved Flux" as an over-estimating assumption. Two rows of data should be entered. "Time" entries are 0 and 1. Entries in a single flux column are identical and repeat the annual emission rate. For example if 10 µCi of Cs-137 are released, enter 1E7 pCi/yr in both the Time 0 row and Time 1 row. This will model a constant emission rate.

5.1 References: User-Defined (Water) Module

Napier BA. 2012. *GENII Version 2 Users' Guide*. PNNL-14583, Rev. 4, Pacific Northwest National Laboratory, Richland, Washington.

Napier BA, DL Strenge, JV Ramsdell, Jr., PW Eslinger, and C Fosmire. 2012. *GENII Version 2 Software Design Document.* PNNL-14584, Rev. 4, Pacific Northwest National Laboratory, Richland, Washington.

6.0 Module: Surface Water

This module is used for scenarios with chronic releases to surface waters. This module is downstream of the User-Defined (water) module and upstream of the Exposure Pathways Module. The user enters the characteristics of the surface water receiving the liquid effluent in this module.

Tabs in this module include River/Lake and Impoundment. The user would enter information in the Impoundment tab, only if liquid emissions are impounded in a non-publicly accessible location prior to release to the surface water body.

The user-specific information is entered to describe the receiving water body of the facility liquid effluent. Inputs information varies according to the “Type of release and body of water” defined. Consult the Gv2 Users Guide (Napier 2012) and Software Design Document (Napier et al. 2012) for guidance on characterizing your site-specific body of water.

6.1 References: Surface Water Module

Napier BA. 2012. *GENII Version 2 Users' Guide*. PNNL-14583, Rev. 4, Pacific Northwest National Laboratory, Richland, Washington.

Napier BA, DL Strenge, JV Ramsdell, Jr., PW Eslinger, and C Fosmire. 2012. *GENII Version 2 Software Design Document.* PNNL-14584, Rev. 4, Pacific Northwest National Laboratory, Richland, Washington.

7.0 Module: Exposure Pathways – Chronic Exposure

This module is downstream of either the Surface Water module or Air (chronic plume) module. This module is upstream of the Receptor Intakes module. This module will receive the water or air radionuclide concentration data from the upstream module and use this information to estimate the concentration in various additional media.

The tabs and sub-tabs included in Gv2 Chronic Exposure Module are indicated in Table 7.1. This section is organized by tab and typical parameter input order. The parameters are presented with their code identification.

Table 7.1. Tabs and Sub-Tabs in the Chronic Exposure Module[(a)]

Tab	Second-Level Tab	Third-Level Tab
Controls	None	None
Water[(b)]	General Animal water *Irrigation sources* Irrigation rates Irrigation times	None
Soil	Leaching Resuspension Surface Soil	None
Agriculture	General	None
	Animal Feed	Biomass Consumption Storage Time Diet Fraction Growing Period Yield Dry/Wet Ratio Translocation Factor Soil Intake
	Food Crop	Biomass Growing Period Yield Dry/Wet Ratio Translocation Factor
	Intake delays	None
Pathways	None	None

(a) Italics indicate that the tab does not require user-defined numerical input and will not be discussed in detail.
(b) This tab will only appear for water pathway modeling.

Those interested in an overview of concepts for environmental models for radioactive material releases are directed to IAEA (2009). An overview of pathways, definitions, standardized nomenclature, and other topics are provided for terrestrial and freshwater environments. The Gv2 models track those identified in IAEA (2009).

A set of definitions provided in Table 1 of IAEA (2009) for CR, aggregate transfer factor, and feed transfer coefficient differs somewhat from that of Gv2. These terms describe the ratio of radioactive material concentrations in one compartment to that of another. The compartments considered include plant tissue-to-soil, aquatic food tissue-to-water, and animal tissue-to-feed. Gv2 uses the terms *bioaccumulation factors* for tissue-to-water ratios and tissue-to-sediment ratios (see Sections 2.1.11, 2.1.12, and 2.1.13) , *transfer factors* for animal product-to-feed ratios (see Sections 2.1.14, 2.1.15, and 2.1.16) and *bioconcentration factors* for feed-to-soil ratios (see Sections 2.1.17, 2.1.18, 2.1.19, and 2.1.20).

7.1 Tab: Controls

There are limited inputs in the Control tab. Chronic scenarios (1 yr stable exposure) indicate a 1-yr Duration of Release Period (NTKEND), 1-yr End of Release Period (RELEND), and a 0-yr Time From Start to Exposure (BEFORE). The final parameter on this tab, Air Deposition Time Prior to Exposure (BEFAIR) has a variable range from 0 to the user-entered BEFORE value. When tritium is included in the source term, absolute humidity information is used; this parameter is discussed in Section 10.1.4. Other parameter value recommendations are indicated, below.

7.1.1 RF1 Root Fraction

The Fraction of plant roots in surface soil is used in the food crop and animal feed analyses and represents the fraction of plant roots that are in the contaminated soil layer. The uptake by plants is assumed to be proportional to this fraction.

The units for this parameter in Gv2 are: fraction (0 to 1).

This value is set to 1, as a conservative assumption, and is consistent with the assumptions used in the development of plant transfer factors. A value of 1 will be representative for most food crop applications.

7.1.1.1 Additional sources of information

Section 5.1 of IAEA (2010) indicates factors that affect radionuclide uptake from the soil. It is indicated that models sometimes consider variable root depth by crop type, with grass root depth at 10 cm and all other crop root depth at 20 cm. These values may be considered with respect to the level of radionuclide mixing at various depths. Air deposition in dry climates would likely experience less radionuclide mixing than irrigation water depositions.

7.1.2 RAIN Rainfall Rate

Average daily rain rate is used to estimate the interception fraction from rain when wet deposition rates are provided in the atmospheric transport output file (ATO), and the user has selected the option to allow the code to calculate the wet deposition interception fraction. Note that the rainfall rates are not transferred with the ATO file, and a consistent value must be re-entered here. The value should reflect the rate "when it is raining," not the annual average.

The units for this parameter in Gv2 are: mm/d (0.01 to 500).

The user will enter the value determined from the meteorological data file used. Average the rainfall rate for the year for non-zero rainfall values. RAIN values for several cities are provided in Table 7.2, with a more comprehensive list in Appendix E. If precipitation data is not readily available the value can be approximated as follows.

The National Climatic Data Center (NCDC) provides access to climatological normals based on 30 years (1981–2010) of data for thousands of stations throughout the United States. Climatological values include normal annual precipitation amount and the normal number of days with precipitation greater than a trace (i.e., 0.01 inches or greater). The average daily rainfall rate can be estimated by dividing the normal precipitation amount by the normal number of precipitation days.
Estimation Procedure:

1. Go to http://www1.ncdc.noaa.gov/pub/data/normals/1981-2010/station-inventories/prcp-inventory.txt and view the available stations. The first column in the file contains the unique station id that is needed to identify the station when viewing the other files. Columns two, three, and six provide the station latitude, longitude, and name, respectively. A complete description of the file format is available at http://www1.ncdc.noaa.gov/pub/data/normals/1981-2010/readme.txt.
2. Go to http://www1.ncdc.noaa.gov/pub/data/normals/1981-2010/products/precipitatioN/Ann-prcp-normal.txt and find the unique station id from Step 1. The second column provides the normal annual precipitation in hundredths of inches (note: the letter that immediately follows the numeric value is a processing flag; a description of the flag can be found at http://www1.ncdc.noaa.gov/pub/data/normals/1981-2010/readme.txt).
3. Go to http://www1.ncdc.noaa.gov/pub/data/normals/1981-2010/products/precipitatioN/Ann-prcp-avgnds-ge001hi.txt and find the unique station id from Step 1. The second column provides the normal number of days with precipitation greater than a trace (i.e., 0.01 inches or greater) (note: the letter that immediately follows the numeric value is a processing flag; a description of the flag can be found at http://www1.ncdc.noaa.gov/pub/data/normals/1981-2010/readme.txt).
4. Convert the normal annual precipitation amount determined in Step 2 from inches (in.) to millimeters (mm) by multiplying by 25.4 (i.e., 1 in. = 25.4 mm). Divide the resulting value by the normal number of days with precipitation greater than a trace determined in Step 3—this is the average daily rainfall rate in mm/d.

In addition, a table of average daily rainfall rates for select cities is provided. It is recommended that the user acquire data using the above procedure, however, because precipitation is highly dependent on location and elevation.

7.1.2.1 Additional Sources of Information

The National Climatic Data Center allows queries of precipitation rates for a limited number of cities, all states, and an indication of whether a certain year's precipitation for a state was generally above, below, or about average. As an approximation, the annual rainfall can be divided by 365 to estimate the RAIN parameter. See the U.S. Climate at a Glance, web page, last accessed at http://www.ncdc.noaa.gov/oa/climate/research/cag3/cag3.html.

7.1.2.2 RAIN Rainfall Rate Table

Table 7.2. RAIN Daily Rainfall Rate

Station Name	Elevation (m)	Average Rainfall Rate (mm/d)
Boston, MA	3.7	8.8
Buffalo, NY	214.9	6.2
Pittsburgh, PA	366.7	6.4
Lexington, KY	298.7	8.8
Atlanta, GA	307.8	11.1
Tallahassee, FL	16.8	13.5
New Orleans, LA	1.2	13.9
Houston, TX	13.4	13.4
Oklahoma City, OK	391.7	11.0
Lincoln, NE	362.7	7.7
Bismarck, ND	503.2	4.6
Helena, MT	1166.8	3.1
Boulder, CO	1671.5	5.2
Albuquerque, NM	1618.5	3.9
Phoenix, AZ	337.4	5.6
Las Vegas, NV	649.5	4.0
Boise, ID	857.7	3.4
Seattle, WA	112.8	6.3
San Francisco, CA	45.7	8.2
San Diego, CA	4.6	6.3
Juneau, AK	4.9	6.9
Honolulu, HI	2.1	4.9

7.2 Tab: Water

The Water tab will be present only when a water pathway scenario is under evaluation. Inputs for this tab apply to

- ingestion of aquatic food types;
- animal water consumption rates and sources; and
- irrigation water rates, sources, and times.

7.3 Tab: Water/General

For Treatment Plant Purification Factors applied, see Constituent Module, CLWPF (see Section 2.1.3). For the first evaluation of an annual release, the Irrigation water deposition time prior to exposure (BEFIRR) is 0. Indoor volatilization factor for radon (ANDKRN) is implemented only in the radon model and is not discussed further since radons are not considered for release in the development of this publication.

7.3.1 RIRRR Residential Land Irrigation, IRTIMR Irrigation Time for Residential Land

The IRTIMR parameter indicates the time period over which the annual irrigation is applied to a location where a person works or resides and is used for external exposure to ground pathways. Irrigation of foods for the ingestion pathway is discussed in Section 7.5.1.

The units and range for RIRRR in Gv2 are: in/yr (0–200).

The units and range for IRTIMR in Gv2 are: mo/yr (0–12).

The U.S. Department of Agricultural conducts a Census of Agriculture every five years (USDA (2009). Part of the data collected is crop irrigation data. The data describing irrigation rates for pasture can be used to approximate irrigation rates for lawn irrigation. The irrigation rates in the Census are for a variety of crops and are reported by state or by region (see region map, Figure 7.3). See the pastureland irrigation rates indicate in Table 7.7 for rates that are most applicable to residential land irrigation. The rates indicated are those for the year 2007 or 2008. The user can go to the website to review data for other years. Data reported in units of annual ac-ft/ac are converted to the Gv2 units (in/yr) by multiplying ac-ft/ac by 12 in/ft.

State-specific irrigation information for pastureland (see Table 7.5) may provide an indication of how likely irrigation of residential lawns occurs. Irrigation application rates for residential land are highly variable. Therefore for areas where contaminated irrigation water is applied, it is suggested that population irrigation rates are assumed to be about 75 percent of the MEI value. The user may wish to subtract annual rainfall amounts from the irrigation rate if a non-location-specific irrigation rate is applied.

For the IRTIMR parameter, the user can maximize the time of irrigation water application to residential land by assuming irrigation from last frost to first frost day. Find your location in the map shown in Figure 7.1. (See NCDC (1981) [last accessed at http://www.ncdc.noaa.gov/oa/climate/freezefrost/frostfreemaps.html] for a high resolution map.) The National Climatic Data Center mapped the number of frost-free days (days with temperature above 32 degrees F) for the U.S. based on data from 1951 through 1980. The user can estimate the number of frost-free days for their location, divide by 30 d/mo, and round down to estimate a maximum IRTIMR value for their location.

7.3.1.1 Additional Sources of Information

http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Farm_and_Ranch_Irrigation_Survey/index.asp for Census of Agriculture 2007 results. There are links on this page to results for other Census years.

Annual rainfall can be obtained from numerous internet resources. A snapshot of United States, state-level annual rainfall for a user-entered year can be obtained from the National Climatic Data Center, U.S. Climate at a Glance webpage, last accessed at http://www.ncdc.noaa.gov/oa/climate/research/cag3/cag3.html. The user enters the “Precipitation”

element, year of interest, and "annual" period. The map will also indicate whether the annual precipitation is above, average, or below what is typical for the state.

7.3.1.2 RIRRR and IRTIMR Irrigation Time Values

See Section 7.5.1, Table 7.7 (pastureland) for RIRRR values.

Refer to Figure 7.1 for frost-free days to convert to mo/yr.

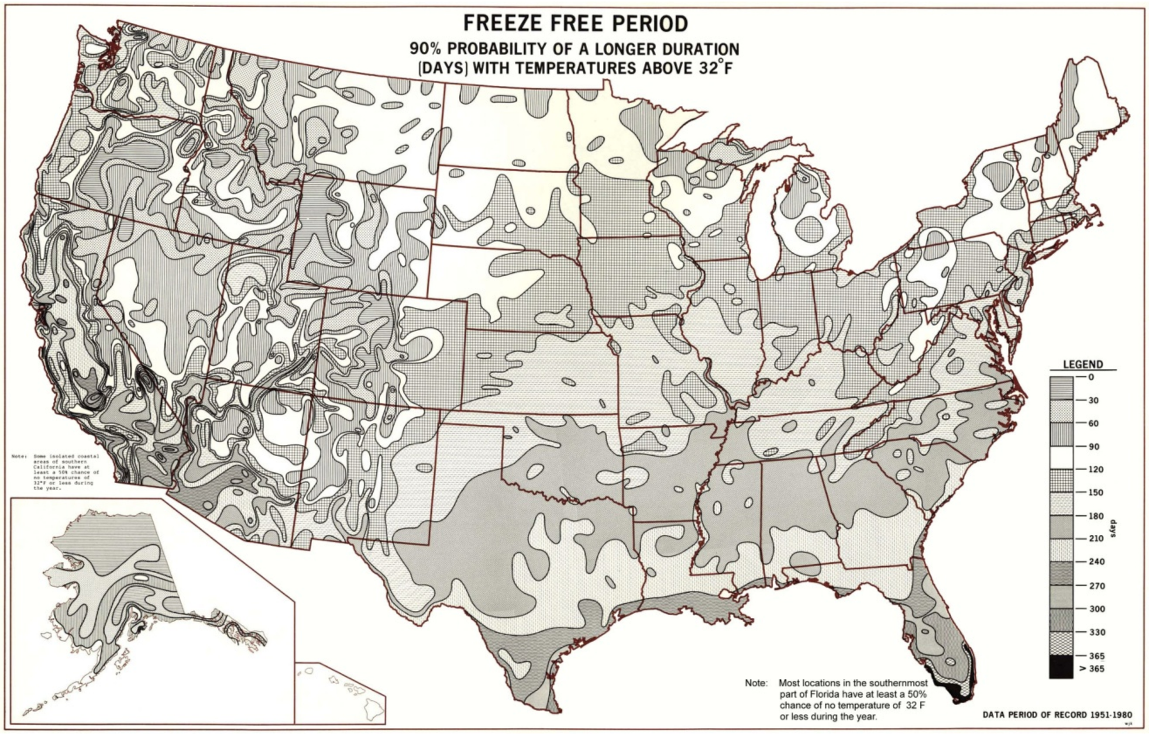

Figure 7.1. NCDC (1981) Frost-Free Days Map

7.3.2 ANDKR Indoor Volatilization Factor for Radionuclides

This value will be implemented if indoor air inhalation from water use is an exposure pathway of concern. The same value is applied to all radionuclide constituents, generally limited to noble gases and tritium. The value assigned is quite generic.

Note: The ANDKRN parameter (Radon indoor volatilization factor) is not discussed because radon modeling is not covered in this parameter document.

The units and range for this parameter in Gv2 are: L/m^3 (0–10).

Andelman (1990) proposes a rather simple model that tends to over-estimate this parameter value. A value of 0.5 L/m^3 is recommended; details on the value's derivation are found in EPA Risk Assessment Guidance (EPA 1991, p. 20).

7.3.2.1 Additional Sources of Information

No additional sources identified.

7.3.3 HOLDDW Delay Time for Water Distribution

The time from water withdrawal to tap allows for radiological decay to occur.

The units for this parameter in Gv2 are: d (0–365).

A 1-day value is conservatively applied. The value would vary depending on the average time of withdrawal from the surface water source to the time the water appeared at the receptor tap.

7.3.3.1 Additional Sources of Information

Providers of public water supplies may have estimates of this information.

7.3.4 SEDDN Shoreline Sediment Density

If recreational shoreline use of a surface water source with radiological contaminants is considered, this parameter will be used. The parameter converts radionuclide transfer per unit area to sediment concentration per unit mass. The density reported should apply to a soil depth of 15 cm because the dose factor implemented is for this depth.

Other soil density values are explicitly entered for other pathways. Soil density values (SLDN) used for the outdoor air inhalation pathway and crop uptake calculations are entered in the Soil/Surface Soil tab (see Section 7.7) of this Chronic Exposure module. Soil density values (SLDN) for the external dose pathway from air pathway emissions or direct soil contamination are entered separately in the Health Impacts module (see Section 9.1). It is up to the user to define the two SLDN entries in the Chronic Exposure module and the Health Impacts module, identically. The SEDDN value for shoreline sediment density may differ.

The units for this parameter in Gv2 are: kg/m^2 (0–5000).

The USDA *Soil Quality Indicators* worksheet (USDA 2008) contains generic information on soil bulk density. GENII-appropriate values were derived from the generic information by applying a 0.15 m (15 cm) depth factor. Solid rock, as a rule of thumb has a density of 398 kg/m^2. A fraction of bulk pore space can be applied to the solid rock value approximate densities for cobbles. The data presented in Section 7.3.4.2 provide information for generic soil textures and limited vegetation growth. Sediment bulk density can be approximated from the values listed with a maximum value at the cited generic rock value.

7.3.4.1 Additional Sources of Information

No additional sources recommended.

7.3.4.2 SEDDN Shoreline Sediment Density Table

Table 7.3. SEDDN Shoreline Sediment Density

Gv2 ID	Gv2 Description	Reference	Comment	Data Reported	Min Value	Max Value	Units
SEDDN	Soil bulk density – sediment	USDA (2008)	solid rock	datum	-	398	kg/m^2
SEDDN	Soil bulk density – sediment	USDA (2008)	sandy soil texture, restricted root growth	datum	270	-	kg/m^2
SEDDN	Soil bulk density – sediment	USDA (2008)	silty soil texture, restricted root growth	datum	248	-	kg/m^2
SEDDN	Soil bulk density – sediment	USDA (2008)	clayey soil texture, restricted root growth	datum	221	-	kg/m^2

7.4 Tab: Water/Animal Water

The Water/Animal Water tab allows for input of the fraction of contaminated water consumed by the food-source animal and intake rates. For dairy cows, lactation can last just over 300 days with milk production peaking about 7 weeks post-calving.

7.4.1 DWFACA and DWATER Contaminated Fraction and Animal Drinking Water Rate

The fraction contaminated parameter (DWFACA) will fraction out the contaminated portion consumed by each animal. The contaminated fractions are scenario-specific, but are typically conservatively set to 1.0. Total daily water intake rate, whether from contaminated source or not, is input in DWATER. Except for locations with invariable climatic conditions, daily water intake will vary over the year. The drinking water rate entered is the average annual rate to determine the average animal product radionuclide levels.

The units for this parameter in Gv2 are: L/d (0.001–200).

Animal water requirements vary by several factors, including rate of weight gain, pregnancy, lactation, activity level, type of diet, feed intake, and ambient temperature (Lardy and Stoltenow 1999). The intake rate should reflect the average intake over the entire year. Beef cattle generally consume less water than dairy cattle. Dairy cattle consume about 4–4.5 L/d per L of milk produced (derived from Lardy and Stoltenow 1999). The USDA provides summary information on milk production in major milk producing states (e.g., see http://www.nass.usda.gov/Charts_and_Maps/Milk_Production_and_Milk_Cows/mmlkpercow.asp). Other sources reviewed to determine animal water intake rates were Ensminger et al. (1990) and Ministry of the Environment (2001).

7.4.1.1 Additional Sources of Information

Regional variations for water intake for goat and cattle can be estimated by assuming goats consume 1.4–1.7 L of water per kg of dry matter consumed and cattle consume 2.1 L of water per kg of dry matter consumed (Ensminger et al. 1990, p. 934).

Lardy and Stoltenow (1999) provide a summary of water intake information for beef cattle, sheep, dairy cows, and swine in a North Dakota State University publication, AS-954. Last accessed at http://www.ag.ndsu.edu/pubs/h2oqual/watanim/as954.html.

A Canadian resource with a range of water intake rates for a variety of domestic or wild animals (e.g., goats, sheep, rabbit, pigeon, numerous waterfowl, bear, mule deer, opossum, raccoon, and walrus) is available (Last accessed at http://www.env.gov.bc.ca/wat/wq/reference/foodandwater.html). There are also formulae to calculate water intake based on the animal weight for a non-listed mammal or bird.

The Agricultural Extension offices in a number of states have online information related to feeding and water consumption of animals.

7.4.1.2 DWATER Animal Drinking Water Tables

Table 7.4. DWATER Total Daily Water Intake

Gv2_ ID	Gv2 Description	Food Type	Reference	Comment	Recom-mendation[(a)]	Min Value	Max Value	Units
DWATER	Intake rate of water	1.meat	Lardy and Stoltenow (1999)	Beef-600 lb finish wt	-	-	33	L/d
DWATER	Intake rate of water	1.meat	Lardy and Stoltenow (1999)	Beef-800 lb finish wt	-	-	40	L/d
DWATER	Intake rate of water	1.meat	Lardy and Stoltenow (1999); Ensminger et al. (1990)	Beef-1000 lb finish wt	**50**	25	47	L/d
DWATER	Intake rate of water	1.meat	Lardy and Stoltenow (1999); Ensminger et al. (1990)	Beef-1200 lb finish wt	-	25	53	L/d
DWATER	Intake rate of water	1.meat	Lardy and Stoltenow (1999); Ensminger et al. (1990)	Pig-200 lb	8.5	7.5	9.5	L/d
DWATER	Intake rate of water	1.meat	Lardy and Stoltenow (1999); Ensminger et al. (1990)	Sheep	5	2	7	L/d
DWATER	Intake rate of water	2.poultry	Ensminger et al. (1990); Ministry of the Environment (2001)	Chicken	**0.26**	0.2	0.32	L/d
DWATER	Intake rate of water	2.poultry	Ensminger et al. (1990); Ministry of the Environment (2001)	Turkey	0.55	0.5	0.6	L/d
DWATER	Intake rate of water	3.milk	Lardy and Stoltenow (1999); Ensminger et al. (1990); Ministry of the Environment (2011); Linn et al. 2002.	dairy cow (1200–1600 lb)	**85**	50	110	L/d
DWATER	Intake rate of water	4.egg	Ensminger et al. (1990); Ministry of the Environment (2001)	chicken, layers	**0.3**	0.19	0.34	L/d

(a) When multiple values are provided, the recommended value is in bold font.

7.5 Tabs: Water/Irrigation Rates and Water/Irrigation Times

Irrigation water rates and times are required for each human food crop (leafy vegetables, root vegetables, fruits, and grains) and each animal feed or forage type. Animal feed assumptions are: grain feed for meat, poultry, and egg; and hay for milk feed. Animal forage assumptions are hay for meat; and grass for milk. These values are only required if the contaminated water source is used for irrigation. No fractional fresh and contaminated water supplies are modeled, so the user enters only the rates and times when the contaminated water is used.

Table 7.5 provides information to indicate the prevalence of irrigation at a location. The prevalence of any farm to irrigate, irrigation prevalence for crop farms harvested in 2008, and irrigation prevalence for pastureland information is provided. This data provides the user with a general idea of how regionally common it is for farm, crop, and pasture irrigation.

Table 7.5. Percent of Crop Irrigated

2008 Data	Farms[(a)] (number)	Total Land in Farms[(a)] (acres)	Percent Irrigated[(a)] (%)	Crop Land Harvested[(b)] (acres)	Percent Irrigated[(b)] (%)	Crop Land Used Only for Pasture or Grazing[(b)] (acres)	Percent Irrigated[(b)] (%)
United States total	**206,834**	**198,160,896**	**27.7%**	**78,043,457**	**65.3%**	**21,826,263**	**11.8%**
Alabama	665	442,487	17%	310,127	24%	35,111	5%
Alaska	23	5,785	27%	2,225	N/A	N/A	N/A
Arizona	2,997	4,446,165	19%	803,563	100%	112,483	29%
Arkansas	4,119	6,162,119	73%	5,454,373	82%	54,887	3%
California	45,136	15,866,424	46%	7,407,931	94%	4,484,832	7%
Colorado	12,778	10,647,744	27%	3,132,687	77%	1,757,407	18%
Connecticut	147	10,403	22%	5,081	46%	402	0
Delaware	309	273,149	38%	247,025	42%	1,045	N/A
Florida	5,250	2,535,664	48%	1,252,339	91%	352,681	14%
Georgia	3,584	2,999,922	34%	1,661,353	59%	179,213	11%
Hawaii	1,077	213,387	47%	59,642	96%	4,239	8%
Idaho	13,834	6,421,820	52%	3,161,743	93%	778,565	35%
Illinois	1,091	1,309,942	35%	1,206,759	38%	9,188	N/A
Indiana	1,089	1,360,556	30%	1,261,582	32%	17,321	N/A
Iowa	527	590,047	28%	549,330	29%	5,990	N/A
Kansas	4,508	10,912,364	24%	6,887,476	37%	1,468,876	2%
Kentucky	822	329,198	10%	213,208	15%	34,032	2%
Louisiana	1,692	2,074,497	45%	1,518,997	61%	85,057	0%
Maine	196	118,107	15%	53,030	N/A	631	N/A
Maryland	597	278,277	31%	232,934	37%	4,038	6%
Massachusetts	677	52,718	33%	19,312	N/A	325	N/A
Michigan	2,121	1,503,006	35%	1,292,404	41%	9,677	28%
Minnesota	1,546	1,397,018	36%	1,204,250	42%	24,885	2%
Mississippi	1,277	2,512,434	58%	2,265,515	64%	9,566	0
Missouri	1,877	2,285,747	54%	2,063,897	60%	36,876	N/A
Montana	8,507	19,637,380	10%	2,463,577	63%	2,577,266	10%

Table 7.5. (contd)

2008 Data	Farms[a] (number)	Total Land in Farms[a] (acres)	Percent Irrigated[a] (%)	Crop Land Harvested[b] (acres)	Percent Irrigated[b] (%)	Crop Land Used Only for Pasture or Grazing[b] (acres)	Percent Irrigated[b] (%)
Nebraska	14,812	21,853,534	38%	11,682,565	71%	2,007,591	1%
Nevada	1,734	5,600,694	12%	538,941	98%	585,529	19%
New Hampshire	86	9,043	8%	3,366	21%	81	0
New Jersey	608	136,352	44%	93,910	63%	898	40%
New Mexico	8,878	12,816,722	7%	973,556	73%	758,042	10%
New York	596	144,640	14%	93,605	21%	6,588	0
North Carolina	1,975	990,106	15%	607,620	23%	37,303	30%
North Dakota	601	1,706,080	15%	1,103,232	22%	127,413	0%
Ohio	379	124,294	15%	100,738	18%	1,723	4%
Oklahoma	1,454	2,382,239	19%	1,119,486	37%	293,384	6%
Oregon	12,156	6,952,252	25%	1,767,412	80%	1,281,936	18%
Pennsylvania	1,090	149,947	12%	101,662	17%	8,111	N/A
Rhode Island	61	5,501	12%	1,515	45%	4	100%
South Carolina	712	443,293	23%	282,162	36%	24,054	11%
South Dakota	1,165	2,807,203	13%	1,379,726	26%	197,303	1%
Tennessee	582	424,980	17%	347,419	N/A	21,852	2%
Texas	12,673	16,634,484	32%	7,912,212	62%	1,864,920	14%
Utah	10,876	5,512,452	19%	899,493	90%	651,964	28%
Vermont	66	8,186	6%	1,637	30%	205	0
Virginia	657	323,778	14%	191,990	23%	15,960	2%
Washington	12,712	8,085,090	21%	1,925,767	80%	485,991	23%
West Virginia	90	13,493	7%	6,301	14%	N/A	N/A
Wisconsin	1,261	1,065,575	37%	776,071	50%	7,098	12%
Wyoming	5,164	15,584,598	10%	1,402,711	77%	1,401,854	19%

(a) Information from http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Farm_and_Ranch_Irrigation_Survey/index.asp, Table 2.

(b) Information from http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Farm_and_Ranch_Irrigation_Survey/index.asp, Table 3.

Table 7.5. Percent of Crop Irrigated (contd)

2008	Farms[(a)] (number)	Total Land in Farms[(a)] (acres)	Percent Irrigated[(a)] (%)	Crop Land Harvested[(b)] (acres)	Percent Irrigated[(a)] (%)	Crop Land Used Only for Pasture or Grazing[(b)] (acres)	Percent Irrigated[(a)] (%)
Water Resources Regions (see Figure 7.2)							
Region 01 New England	1,188	199,464	20%	82,570	N/A	1,475	11%
Region 02 Mid-Atlantic	3,200	1,052,547	29%	816,004	38%	25,300	4%
Region 03 South Atlantic-Gulf	12,428	7,495,555	34%	4,050,743	60%	629,405	14%
Region 04 Great Lakes	3,152	2,098,815	34%	1,810,691	40%	15,293	28%
Region 05 Ohio	2,056	1,461,874	21%	1,204,636	25%	57,505	2%
Region 06 Tennessee	527	283,315	15%	213,451	N/A	N/A	N/A
Region 07 Upper Mississippi	3,863	3,827,858	35%	3,289,626	40%	42,095	2%
Region 08 Lower Mississippi	7,341	11,412,924	64%	10,291,786	71%	129,345	0%
Region 09 Souris-Red-Rainy	400	714,430	22%	579,519	27%	21,124	1%
Region 10 Missouri	32,727	66,817,228	21%	22,116,957	59%	6,484,836	7%
Region 11 Arkansas-White-Red	10,336	24,462,413	22%	9,479,378	53%	3,207,945	8%
Region 12 Texas-Gulf	10,224	10,145,409	34%	5,341,739	60%	1,022,165	9%
Region 13 Rio Grande	8,031	8,037,090	13%	1,085,157	85%	401,947	24%
Region 14 Upper Colorado	10,771	5,822,461	23%	909,265	93%	1,132,804	32%
Region 15 Lower Colorado	3,551	4,727,545	20%	868,628	100%	125,876	34%
Region 16 Great Basin	10,157	9,893,297	16%	1,448,602	90%	1,083,623	20%
Region 17 Pacific Northwest	40,017	23,242,402	29%	6,920,803	86%	2,837,534	23%
Region 18 California	45,765	16,247,097	46%	7,472,035	94%	4,577,809	7%
Region 19 Alaska	23	5,785	27%	2,225	N/A	N/A	N/A
Region 20 Hawaii	1,077	213,387	47%	59,642	96%	4,239	8%

(a) Information from http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Farm_and_Ranch_Irrigation_Survey/index.asp, Table 2.

(b) Information from http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Farm_and_Ranch_Irrigation_Survey/index.asp, Table 3.

7.5.1 RIRR Crop Irrigation Rate, RIRRA Feed and Forage Irrigation Rate, IRTIMT Crop Irrigation Time, and IRTIMA Feed and Forage Irrigation Rate

The irrigation rates and times are used together for the code to determine the rate the contaminated water source is applied during the water application period. These rates and times are used for ingestion dose pathways. External exposure pathways use the residential land irrigation data (see Section 7.3.1).

The units and range for RIRR and RIRRA in Gv2 are: in/yr (0–200).

The units and range for IRTIMT and IRTIMA in Gv2 are: mo/yr (0–12).

RIRR and RIRRA

The U.S. Department of Agricultural conducts a Census of Agriculture every 5 years. Part of the data collected is crop irrigation data. The irrigation rates in the Census are for a variety of crops and are reported by state or by region (see region map, Figure 7.3). The rates indicated are those for the year 2007 or 2008. The user can go to the website to review data for other years. Data reported in units of annual ac-ft/ac are converted to the Gv2 units (in/yr) by multiplying ac-ft/ac by 12 in/ft.

IRTIMT and IRTIMA

The irrigation times are used to adjust the annual irrigation rate to the irrigation rate during the growing season. They are generally equal to the growing or fruiting period for the crop. However, the irrigation period for forage crops should be adjusted to account for continual browsing or multiple harvests, about 30 days. See Sections 7.13.1 and 7.18.1 for growing periods of animal feeds and food crops.

7.5.1.1 Additional Sources of Information

The USDA Census of Agriculture 2007 results are available. There are links on the indicated hyperlink to results for other Census years. Last accessed at http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Farm_and_Ranch_Irrigation_Survey/index.asp.

7.5.1.2 RIRR, RIRRA, IRTIMT, and IRTIMA Irrigation Rate Tables

State-specific human food crops RIRR Table – see Table 7.6

State- and region-specific animal feed crops RIRRA Table – see Table 7.7

Table 7.6. State- and Region-Specific Irrigation Rates for Human Food Crops

GENII Application Comment[(a)]	Human LV	Human RV	Human RV	Human F	Human F[(c)]	Human G	Human G	Human G	Human G
2008	Lettuce, Romaine[(b)] RIRR (in./yr)	Peanuts[(b)] RIRR (in./yr)	Potatoes[(b)] RIRR (in./yr)	All Berries[(b)] RIRR (in./yr)	Land in Orchard, Vineyard, Nut Trees[(b)] RIRR (in./yr)	Soybean for Beans[(b)] RIRR (in./yr)	Rice[(b)] RIRR (in./yr)	Other Small Grains[(b)] RIRR (in./yr)	Sweet Corn[(b)] RIRR (in./yr)
United States	34.8	12	21.6	26.4	28.8	8.4	27.6	16.8	18
Alabama	4.8	4.8	12	28.8	9.6	7.2	-	10.8	8.4
Alaska	(D)	-	(D)	3.6	3.6	-	-	-	-
Arizona	34.8	-	33.6	-	70.8	-	-	44.4	48
Arkansas	-	-	-	-	1.2	10.8	24	18	-
California	36	-	33.6	44.4	31.2	-	49.2	18	40.8
Colorado	16.8	-	21.6	-	9.6	14.4	-	14.4	36
Connecticut	4.8	-	6	9.6	3.6	-	-	-	3.6
Delaware	-	-	9.6	9.6	-	7.2	-	(D)	7.2

Table 7.6. (contd)

GENII Application Comment[(a)]	Human LV	Human RV	Human RV	Human F	Human F[(c)]	Human G	Human G	Human G	Human G
2008	Lettuce, Romaine[(b)] RIRR (in./yr)	Peanuts[(b)] RIRR (in./yr)	Potatoes[(b)] RIRR (in./yr)	All Berries[(b)] RIRR (in./yr)	Land in Orchard, Vineyard, Nut Trees[(b)] RIRR (in./yr)	Soybean for Beans[(b)] RIRR (in./yr)	Rice[(b)] RIRR (in./yr)	Other Small Grains[(b)] RIRR (in./yr)	Sweet Corn[(b)] RIRR (in./yr)
Florida	34.8	4.8	13.2	28.8	18	(D)	18	9.6	7.2
Georgia	-	8.4	10.8	18	14.4	7.2	-	4.8	10.8
Hawaii	44.4	(D)	1.2	1.2	28.8	-	-	-	19.2
Idaho	-	-	26.4	(D)	19.2	-	-	18	26.4
Illinois	2.4	-	(D)	2.4	4.8	6	(D)	4.8	3.6
Indiana	8.4	-	6	4.8	27.6	6	(D)	-	6
Iowa	2.4	-	14.4	19.2	1.2	4.8	-	6	6
Kansas	1.2	-	-	-	18	12	-	(D)	-
Kentucky	(D)	-	12	8.4	(D)	4.8	-	-	(D)
Louisiana	-	(D)	12	12	10.8	8.4	18	-	12
Maine	(D)	-	1.2	4.8	2.4	-	-	-	7.2
Maryland	(D)	-	8.4	13.2	7.2	7.2	-	-	9.6
Massachusetts	(D)	-	1.2	16.8	39.6	-	-	-	2.4
Michigan	2.4	-	10.8	8.4	6	6	-	2.4	6
Minnesota	1.2	-	9.6	10.8	4.8	7.2	-	7.2	7.2
Mississippi	-	-	-	9.6	8.4	9.6	22.8	(D)	15.6
Missouri	-	-	16.8	1.2	1.2	8.4	19.2	(D)	3.6
Montana	16.8	-	14.4	-	9.6	12	-	9.6	14.4
Nebraska	-	-	13.2	-	27.6	7.2	-	20.4	3.6
Nevada	-	-	(D)	-	57.6	-	-	31.2	-
New Hampshire	3.6	-	3.6	(D)	3.6	-	-	-	2.4
New Jersey	(D)	-	3.6	20.4	6	6	-	-	4.8
New Mexico	32.4	(D)	(D)	-	43.2	(D)	-	27.6	36
New York	2.4	-	4.8	7.2	7.2	-	-	-	7.2
North Carolina	34.8	4.8	30	14.4	4.8	30	-	7.2	6
North Dakota	-	-	12	12	24	8.4	-	10.8	-
Ohio	(D)	-	33.6	13.2	3.6	38.4	-	-	4.8
Oklahoma	3.6	13.2	7.2	19.2	20.4	9.6	-	7.2	4.8
Oregon	-	-	27.6	8.4	15.6	-	-	18	19.2
Pennsylvania	3.6	-	6	8.4	3.6	2.4	-	-	3.6
Rhode Island	1.2	-	(D)	(D)	9.6	-	-	(D)	10.8
South Carolina	-	8.4	12	27.6	9.6	7.2	-	9.6	7.2
South Dakota	2.4	-	7.2	-	(D)	6	-	9.6	(D)
Tennessee	10.8	-	3.6	6	4.8	7.2	27.6	(D)	2.4
Texas	-	15.6	24	19.2	33.6	12	30	12	12
Utah	-	-	(D)	20.4	22.8	-	-	13.2	(D)
Vermont	2.4	-	(D)	8.4	3.6	-	-	-	6
Virginia	3.6	3.6	3.6	8.4	8.4	6	-	-	8.4
Washington	3.6	-	27.6	(D)	30	22.8	-	19.2	30
West Virginia	8.4	-	8.4	6	10.8	(D)	-	-	3.6
Wisconsin	10.8	-	12	34.8	6	7.2	-	12	8.4
Wyoming	-	-	18	-	12	-	-	21.6	-

(a) LV=leafy vegetables; RV=root/other vegetables; F=fruit; G=grain.
(b) Data derived from http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Farm_and_Ranch_Irrigation_Survey/index.asp, Table 28.
(c) Includes grapes and nuts.
(D) = Data withheld to avoid disclosing data for individual farms.
\- = Represents zero.

Table 7.6. (contd)

GENII Application Comment[(a)]	Human LV	Human RV	Human RV	Human F	Human F[(c)]	Human G	Human G	Human G	Human G
2008	Lettuce, Romaine[(b)] RIRR (in./yr)	Peanuts[(b)] RIRR (in./yr)	Potatoes[(b)] RIRR (in./yr)	All Berries[(b)] RIRR (in./yr)	Land in Orchard, Vineyard, Nut Trees[(b)] RIRR (in./yr)	Soybeans for Beans[(b)] RIRR (in./yr)	Rice [(b)] RIRR (in./yr)	Other Small Grains [(b)] RIRR (in./yr)	Sweet Corn[(b)] RIRR (in./yr)
See Figure 7.2 for reference map of regions.									
Region 01 New England	2.4	-	1.2	12	13.2	-	-	(D)	3.6
Region 02 Mid-Atlantic	3.6	-	6	19.2	6	7.2	-	(D)	7.2
Region 03 South Atlantic-Gulf	34.8	8.4	14.4	19.2	16.8	10.8	18	6	8.4
Region 04 Great Lakes	3.6	-	10.8	8.4	4.8	6	-	8.4	6
Region 05 Ohio	4.8	-	7.2	8.4	12	7.2	(D)	(D)	7.2
Region 06 Tennessee	8.4	-	3.6	7.2	4.8	8.4	-	(D)	4.8
Region 07 Upper Mississippi	(D)	-	10.8	33.6	7.2	6	(D)	8.4	8.4
Region 08 Lower Mississippi	(D)	(D)	16.8	13.2	9.6	9.6	22.8	16.8	13.2
Region 09 Souris-Red-Rainy	-	-	9.6	-	18	7.2	-	10.8	-
Region 10 Missouri	4.8	-	13.2	12	22.8	7.2	-	15.6	6
Region 11 Arkansas-White-Red	2.4	(D)	(D)	19.2	14.4	10.8	22.8	8.4	(D)
Region 12 Texas-Gulf	-	15.6	21.6	19.2	25.2	12	30	19.2	12
Region 13 Rio Grande	19.2	(D)	21.6	-	46.8	-	-	24	36
Region 14 Upper Colorado	-	-	(D)	-	18	14.4	-	16.8	36
Region 15 Lower Colorado	34.8	-	33.6	-	70.8	-	-	44.4	48
Region 16 Great Basin	-	-	22.8	20.4	25.2	-	-	14.4	(D)
Region 17 Pacific Northwest	3.6	-	27.6	8.4	28.8	22.8	-	18	27.6
Region 18 California	36	-	33.6	44.4	31.2	-	49.2	18	40.8
Region 19 Alaska	(D)	-	(D)	3.6	3.6	-	-	-	-
Region 20 Hawaii	44.4	(D)	1.2	1.2	28.8	-	-	-	19.2

(a) LV=leafy vegetables; RV=root/other vegetables; F=fruit; G=grain.
(b) Data derived from http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Farm_and_Ranch_Irrigation_Survey/index.asp, Table 28.
(c) Includes grapes and nuts.
(D) = Data withheld to avoid disclosing data for individual farms.
\- = Represents zero.

Table 7.7. State- and Region-Specific Irrigation Rates for Animal Feed Crops

GENII Application Comment	FEED: Meat, Poultry, Egg	FEED: Meat, Poultry, Egg	FEED: Meat, Poultry, Egg	FEED:Milk; FORAGE: Meat	FEED:Milk; FORAGE: Meat	FEED:Milk; FORAGE: Meat	FORAGE: Milk
2008	Corn for Grain or Seed[a] RIRRA (in./yr)	Sorghum for Grain or Seed[a] RIRRA (in./yr)	Wheat for Grain or Seed[a] RIRRA (in./yr)	Corn for Silage or Greenchop[a] RIRRA (in./yr)	Alfalfa and Alfalfa Mixtures[a] RIRRA (in./yr)	All Other Hay[a] RIRRA (in./yr)	Pastureland, All Types[a] RIRRA (in./yr)
United States	12	10.8	16.8	25.2	28.8	21.6	19.2
Alabama	8.4	-	4.8	7.2	6	4.8	4.8
Alaska	-	-	-	-	-	3.6	(D)
Arizona	33.6	40.8	43.2	55.2	74.4	46.8	30
Arkansas	13.2	12	4.8	(D)	-	6	7.2
California	24	21.6	26.4	34.8	48	30	30
Colorado	19.2	7.2	16.8	18	20.4	18	18
Connecticut	-	-	-	-	-	-	-
Delaware	9.6	-	4.8	9.6	9.6	14.4	6
Florida	8.4	(D)	6	10.8	-	19.2	12
Georgia	13.2	14.4	4.8	15.6	7.2	10.8	8.4
Hawaii	(D)	(D)	-	-	-	-	21.6
Idaho	31.2	-	19.2	26.4	22.8	15.6	13.2
Illinois	6	4.8	4.8	2.4	3.6	8.4	(D)
Indiana	7.2	(D)	2.4	6	6	2.4	4.8
Iowa	6	-	(D)	4.8	8.4	(D)	(D)
Kansas	15.6	12	10.8	16.8	18	12	13.2
Kentucky	6	-	-	(D)	(D)	(D)	6
Louisiana	8.4	4.8	9.6	6	20.4	6	10.8
Maine	-	-	-	-	-	-	1.2
Maryland	9.6	-	4.8	4.8	4.8	3.6	3.6
Massachusetts	(D)	-	-	-	-	-	1.2
Michigan	7.2	-	3.6	4.8	4.8	-	3.6
Minnesota	7.2	-	6	7.2	7.2	8.4	7.2
Mississippi	10.8	10.8	2.4	-	-	1.2	-
Missouri	9.6	(D)	4.8	8.4	3.6	2.4	4.8
Montana	19.2	-	12	19.2	15.6	19.2	13.2
Nebraska	9.6	6	9.6	9.6	10.8	26.4	28.8
Nevada	-	-	33.6	38.4	37.2	20.4	31.2
New Hampshire	(D)	-	-	25.2	-	-	-
New Jersey	6	-	3.6	1.2	10.8	6	8.4
New Mexico	24	19.2	20.4	25.2	32.4	20.4	14.4
New York	4.8	-	(D)	25.2	1.2	-	-
North Carolina	18	(D)	2.4	4.8	3.6	4.8	3.6
North Dakota	9.6	-	10.8	13.2	13.2	6	9.6
Ohio	18	-	-	8.4	24	-	9.6
Oklahoma	16.8	9.6	10.8	15.6	15.6	12	8.4
Oregon	36	-	20.4	21.6	25.2	19.2	22.8
Pennsylvania	3.6	-	-	3.6	4.8	9.6	7.2
Rhode Island	-	-	-	-	-	-	21.6
South Carolina	9.6	(D)	6	7.2	9.6	4.8	12
South Dakota	9.6	19.2	6	15.6	12	10.8	18
Tennessee	7.2	(D)	6	2.4	1.2	3.6	20.4
Texas	20.4	9.6	12	20.4	19.2	13.2	12

Table 7.7. (contd)

GENII Application Comment	FEED: Meat, Poultry, Egg	FEED: Meat, Poultry, Egg	FEED: Meat, Poultry, Egg	FEED:Milk; FORAGE: Meat	FEED:Milk; FORAGE: Meat	FEED:Milk; FORAGE: Meat	FORAGE: Milk
2008	Corn for Grain or Seed[a] RIRRA (in./yr)	Sorghum for Grain or Seed[a] RIRRA (in./yr)	Wheat for Grain or Seed[a] RIRRA (in./yr)	Corn for Silage or Greenchop[a] RIRRA (in./yr)	Alfalfa and Alfalfa Mixtures[a] RIRRA (in./yr)	All Other Hay[a] RIRRA (in./yr)	Pastureland, All Types[a] RIRRA (in./yr)
Utah	33.6	15.6	22.8	28.8	30	26.4	24
Vermont	-	-	-	-	-	-	-
Virginia	6	-	3.6	3.6	3.6	2.4	3.6
Washington	28.8	-	22.8	30	28.8	28.8	24
West Virginia	(D)	-	-	(D)	(D)	-	2.4
Wisconsin	8.4	-	4.8	7.2	8.4	15.6	6
Wyoming	20.4	-	12	24	25.2	20.4	20.4

(a) Data derived from http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Farm_and_Ranch_Irrigation_Survey/index.asp, Table 28.

(D) = Data withheld to avoid disclosing data for individual farms.

\- = Represents zero.

Table 7.7. (contd)

GENII Application Comment	FEED: Meat, Poultry, Egg	FEED:Meat, Poultry, Egg	FEED:Meat, Poultry, Egg	FEED:Milk; FORAGE: Meat	FEED:Milk ; FORAGE: Meat	FEED:Milk; FORAGE: Meat	FORAGE: Milk
2008	Corn for Grain or Seed[a] RIRRA (in./yr)	Sorghum for Grain or Seed[a] RIRRA (in./yr)	Wheat for Grain or Seed[a] RIRRA (in./yr)	Corn for Silage or Greenchop [a] RIRRA (in./yr)	Alfalfa and Alfalfa Mixtures[a] RIRRA (in./yr)	All Other Hay[a] RIRRA (in./yr)	Pastureland, All Types[a] RIRRA (in./yr)
See Figure 7.2 for reference map of regions.							
Region 01 New England	1.2	-	-	25.2	-	-	1.2
Region 02 Mid-Atlantic	8.4	-	4.8	4.8	6	6	(D)
Region 03 South Atlantic-Gulf	13.2	(D)	4.8	12	6	10.8	10.8
Region 04 Great Lakes	7.2	-	3.6	6	6	14.4	4.8
Region 05 Ohio	7.2	-	3.6	8.4	10.8	4.8	6
Region 06 Tennessee	8.4	-	4.8	3.6	1.2	3.6	18
Region 07 Upper Mississippi	7.2	(D)	4.8	6	7.2	9.6	7.2
Region 08 Lower Mississippi	10.8	10.8	4.8	8.4	18	6	7.2
Region 09 Souris-Red-Rainy	8.4	-	7.2	9.6	8.4	8.4	4.8
Region 10 Missouri	10.8	7.2	10.8	15.6	18	19.2	18
Region 11 Arkansas-White-Red	18	12	12	19.2	18	13.2	13.2
Region 12 Texas-Gulf	19.2	9.6	12	20.4	24	12	9.6
Region 13 Rio Grande	(D)	21.6	27.6	28.8	26.4	20.4	19.2
Region 14 Upper Colorado	24	-	30	19.2	24	20.4	20.4
Region 15 Lower Colorado	32.4	40.8	43.2	55.2	72	46.8	28.8
Region 16 Great Basin	31.2	15.6	20.4	28.8	32.4	21.6	30

Table 7.7. (contd)

GENII Application Comment	FEED: Meat, Poultry, Egg	FEED:Meat, Poultry, Egg	FEED:Meat, Poultry, Egg	FEED:Milk; FORAGE: Meat	FEED:Milk; FORAGE: Meat	FEED:Milk; FORAGE: Meat	FORAGE: Milk
	Corn for Grain or Seed[(a)]	Sorghum for Grain or Seed[(a)]	Wheat for Grain or Seed[(a)]	Corn for Silage or Greenchop[(a)]	Alfalfa and Alfalfa Mixtures[(a)]	All Other Hay[(a)]	Pastureland, All Types[(a)]
2008	RIRRA (in./yr)	RIRRA (in./yr)	RIRRA (in./yr)	RIRRA (in./yr)	RIRRA (in./yr)	RIRRA (in./yr)	RIRRA (in./yr)
Region 17 Pacific Northwest	31.2	-	20.4	26.4	24	20.4	16.8
Region 18 California	24	21.6	26.4	34.8	45.6	30	27.6
Region 19 Alaska	-	-	-	-	-	3.6	(D)
Region 20 Hawaii	(D)	(D)	-	-	-	-	21.6

Data derived from http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Farm_and_Ranch_Irrigation_Survey/index.asp, Table 28.
(D) = Data withheld to avoid disclosing data for individual farms.
- = Represents zero.

7.6 Tab: Soil

The soil tab contains three secondary tabs: Surface Soil tab (input used for food ingestion pathways), Resuspension tab (input used for inhalation of resuspended soil pathway), and Leaching tab (input used to model the movement of radionuclides in soil for the multi-year evaluations).

7.7 Tab: Soil/Surface Soil

The Surface soil density parameter (SSLDN) will always be gray-fonted on this tab; the equivalent information is derived from the SLDN and SURCM parameters.

7.7.1 SLDN Surface Soil Areal Density and SURCM Surface Soil Thickness

These parameters are used to determine crop uptake from soil and to determine soil resuspension (see Section 7.8). For other inputs of soil density, see Section 7.3.4 for river-shore surface soil density (SEDDN) and the Health Impacts module, Method Parameters tab (Section 9.1). It is up to the user to define the SLDN of the Chronic Exposure module, Soil/Soil Surface tab, and the SLDN of the Health Impacts module, Method Parameters tab, consistently.[1]

The units and range for SLDN in Gv2 are: kg/m^2 (0.00001–3000).

The units and range for SURCM in Gv2 are: cm (0.00001–500).

The USDA *Soil Quality Indicators* worksheet (USDA 2008) contains generic information on soil bulk density. Values were derived from the generic information by applying a 0.15 m (15 cm) depth factor. As a comparative measure, solid rock, as a rule of thumb has a density of 398 kg/m^2 (equivalent to

[1]The (SLDN Health Impacts module) kg/m^3 = (SLDN Chronic Exposure module) kg/m^2 * (1/0.15m) because of units inconsistency issue in Gv2.10.

2.65 g/cm^3, as referenced in Burt 2011, p. 319). The data presented in Section 7.7.1.2 provide information for generic soil textures. The densities for restricted plant growth were about 15 percent greater than the densities reported for ideal plant growth. Therefore, the minimum values for ideal plant growth were generically calculated to be 15 percent less than the ideal value. The generic SURCM value is strongly recommended to be 15 cm for consistency with the soil-to-pant bioaccumulation and external dose rate conversion factors. If a different surface soil thickness is desired, the values can be adjusted. A generic value of 225 kg/m^3 is suggested.

7.7.1.1 Additional Sources of Information

Historic functions of the U.S. Soil Conservation Service have been delegated to the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) (see www.nrcs.usda.gov). Detailed soil information can be obtained via the website's Web Soil Survey (WSS) electronic database (http://websoilsurvey.nrcs.usda.gov).

Acquiring the soil density data value is not technically difficult or expensive. The user may want to acquire their own local data values for soil areal density.

7.7.1.2 SLDN Surface Soil Areal Density Table

Table 7.8. SLDN Surface Soil Areal Density

Gv2 ID	Gv2 Description	Reference	Comment	Data Reported	Min Value	Max Value	Units
SLDN	Soil bulk density – sediment	USDA (2008)	solid rock	datum	-	398	kg/m^2
SLDN	Soil bulk density – sediment	USDA (2008)	sandy soil texture, ideal for plant growth	range	204	240	kg/m^2
SLDN	Soil bulk density – sediment	USDA (2008)	silty soil texture, ideal for plant growth	range	179	210	kg/m^2
SLDN	Soil bulk density – sediment	USDA (2008)	clayey soil texture, ideal for plant growth	range	140	165	kg/m^2
SLDN	Soil bulk density – sediment	USDA (2008)	sandy soil texture, restricted root growth	datum	270	-	kg/m^2
SLDN	Soil bulk density – sediment	USDA (2008)	silty soil texture, restricted root growth	datum	248	-	kg/m^2
SLDN	Soil bulk density – sediment	USDA (2008)	clayey soil texture, restricted root growth	datum	221	-	kg/m^2

7.8 Tab: Soil/Resuspension

The recommended Type of Model to Run is: Use Mass Loading Model. If another model is desired, consult the Gv2 User's Guide (Napier 2012). This tab addresses resuspension of soil particulates into the outdoor air inhalation pathway and uses soil areal density information from the Soil/Surface Soil tab, see Section 7.7, above.

Resuspension of soil onto food and feed crop surfaces is considered in tab Agriculture/General (see Section 7.11). Along with dry and wet depositions, it is used to calculate radionuclide translocation from the plant surface to the edible portion of the feed or food crop.

7.8.1 XMLF Mass Loading Factor for Resuspension

The mass loading factor for resuspension is the airborne particulate concentration of resuspended soil particles at the exposure location.

The units and range for this parameter in Gv2 are: g/m^3 (0–5).

Generic values for arid regions range from 1.4E-05 to 3.5E-04 g/m^3 (Snyder et al. 1994). A value of 2E-04 g/m^3 is cited in the RESRAD code, as appropriate conservative value that takes into account short periods of high mass loading and sustained periods of normal activity on a typical farm (Yu et al. 2001). As a reference point, the U.S. primary 24-hour air quality standard for larger particulates (PM_{10} standard) in air is 1.5E-04 g/m^3. National trends in PM_{10} levels indicate a 2010 mean of 6.3E-05 g/m^3 with 10^{th} and 90^{th} percentile values of 3E-05 and 9E-05 g/m^3, respectively (EPA 2012). A value of 2E-4 is adequately generic and conservative for the region just above the soil surface.

7.8.1.1 Additional Sources of Information

Local particulate matter (PM_{10}) values can be found for numerous reporting locations at the EPA Air Trends website for particulate matter. A Google Earth file (KLM file) is available for the user to select their location of interest (last accessed at http://www.epa.gov/airtrends/pm.html). In addition, data trends for air quality constituents, including PM_{10} in units of microgram/cubic meter, are tabulated for U.S. counties or cities and can be found at the EPA Air Quality Monitoring Information website (last accessed at http://www.epa.gov/airtrends/factbook.html).

7.8.1.2 XMLF Mass Loading Factor Table

Table 7.9. XMLF Mass Loading Factor

Gv2 ID	Gv2 Description	Reference	Comment	Data Reported	Average	Mean Min Value	Mean Max Value	Units
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 1	1 city; annual 24-hr PM_{10}, 2nd maximum	4.0E-05	3.0E-05	5.0E-05	g/m^3
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 2	4 cities; annual 24-hr PM_{10}, 2nd maximum	6.0E-05	4.3E-05	7.7E-05	g/m^3
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 3	7 cities; annual 24-hr PM_{10}, 2nd maximum	4.6E-05	3.1E-05	6.1E-05	g/m^3
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 4	1 city; annual 24-hr PM_{10}, 2nd maximum	4.2E-05	2.8E-05	5.5E-05	g/m^3
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 5	3 cities; annual 24-hr PM_{10}, 2nd maximum	5.0E-05	4.0E-05	5.9E-05	g/m^3

Table 7.9. (contd)

Gv2 ID	Gv2 Description	Reference	Comment	Data Reported	Average	Mean Min Value	Mean Max Value	Units
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 6	1 city; annual 24-hr PM_{10}, 2nd maximum	4.8E-05	3.5E-05	6.0E-05	g/m^3
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 7	3 cities; annual 24-hr PM_{10}, 2nd maximum	5.6E-05	3.7E-05	7.5E-05	g/m^3
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 8	2 cities; annual 24-hr PM_{10}, 2nd maximum	5.9E-05	4.3E-05	7.5E-05	g/m^3
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 9	1 city; annual 24-hr PM_{10}, 2nd maximum	3.5E-05	2.8E-05	4.2E-05	g/m^3
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 10	4 cities; annual 24-hr PM_{10}, 2nd maximum	5.6E-05	3.7E-05	7.6E-05	g/m^3
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 11	2 cities; annual 24-hr PM_{10}, 2nd maximum	5.3E-05	4.0E-05	6.5E-05	g/m^3
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 12	2 cities; annual 24-hr PM_{10}, 2nd maximum	6.1E-05	4.0E-05	8.3E-05	g/m^3
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 13	2 cities; annual 24-hr PM_{10}, 2nd maximum	4.6E-05	2.4E-05	6.9E-05	g/m^3
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 14	2 cities; annual 24-hr PM_{10}, 2nd maximum	4.9E-05	3.3E-05	6.6E-05	g/m^3
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 15	2 cities; annual 24-hr PM_{10}, 2nd maximum	6.7E-05	4.9E-05	8.6E-05	g/m^3
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 16	2 cities; annual 24-hr PM_{10}, 2nd maximum	6.1E-05	4.5E-05	7.6E-05	g/m^3
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 17 east of Cascade Mts.	3 cities; annual 24-hr PM_{10}, 2nd maximum	7.6E-05	5.0E-05	1.0E-04	g/m^3
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 17 west of Cascade Mts.	2 cities; annual 24-hr PM_{10}, 2nd maximum	5.4E-05	3.9E-05	6.9E-05	g/m^3
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.33): 18	3 cities; annual 24-hr PM_{10}, 2nd maximum	8.1E-05	5.5E-05	1.1E-04	g/m^3
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 19	1 city; annual 24-hr PM_{10}, 2nd maximum	4.8E-05	3.6E-05	6.0E-05	g/m^3
XMLF	Mass loading factor for resuspension	(a)	Selection: Use mass loading model. Watershed Reporting Regions (Figure 7.3): 20	1 city; annual 24-hr PM_{10}, 2nd maximum	4.4E-05	2.8E-05	6.0E-05	g/m^3

(a) Estimation from representative cities in indicated region from EPA Air Trends PM10 data (Last accessed at: www.epa.gov/airtrends/pm.html)

7.9 Tab: Soil/Leaching

The recommended Type of Leach Rate Constant to select is: Leach rates calculated from user input. Do not select "GENII default leach rates" because this option is not functional (leach rates of zero are used). If the "User-provided leach rate constant" is selected, consult the Gv2 User's Guide (Napier 2012). For "Leach rates calculated from user input," four parameter entries plus radionuclide-specific soil absorption coefficients (K_d) are required. Parameters applied here are used for the calculation of soil concentrations for several soil exposure pathways (e.g., soil inhalation; external exposure – excluding shoreline exposure; and food and feed crops) modeling.

7.9.1 THICK Soil Thickness

The user is responsible for entering the same soil thickness (cm) value as entered in the Soil/Surface Soil tab (see Section 7.7.1). Coordinate with the value used for BULKD (see Section 7.9.3).

The units and range for THICK in Gv2 are: cm (0–10,000).

7.9.2 MOISTC Surface Soil Moisture Content

Surface soil moisture content is the volume fraction of the soil that is moisture.

The units and range for MOISTC in Gv2 are: ml/cm^3 (0–1.0).

For agricultural applications, this value is consistent with the field capacity of the soil, which is the water content of the soil after excess water has drained away. If values for available soil moisture are available, these may also be used. Available soil moisture is the amount of water usable by the plants. Chapter 2 of Brouwer et al. (1985) indicates generic values for available soil moisture: sand (0.025–0.100 ml/cm^3), loam (0.100–0.175 ml/cm^3), and clay 0.175–0.250 ml/cm^3).

7.9.2.1 Additional Sources of Information

The USDA Natural Resources Conservation Service, formerly the Soil Conservation Service, has a number of web applications with national soil data details. The Web Soil Survey (WSS) (last accessed at: http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm) provides access the information. The level of detail available varies by location. Once in the WSS application and an area of interest is identified, the user can obtain information on the Soil Data Explorer tab, "Available water supply, 0 to 25 cm" to approximate the MOISTC value for their location of interest.

The National Weather Service reports soil moisture (mm) under its Climate Prediction Center for drought surveillance. These data would be best applied to non-irrigated locations. Last accessed at: http://www.cpc.ncep.noaa.gov/cgi-bin/US_Soil-Moisture-Monthly.sh.

7.9.3 BULKD Surface Soil Bulk Density

The user is responsible for entering the same bulk density (kg/m^3) value as entered in the Soil/Surface Soil tab (see Section 7.7.1). Coordinate with the value used for THICK (see Section 7.9.1).

The units and range for BULKD in Gv2 are: g/cm^3 (0.5–3.0).

7.9.4 VLEACH Total Infiltration Rate

The total infiltration rate may be evaluated as the annual precipitation rate plus the irrigation rate minus the evapotranspiration rate. Unlike the rates applied in contaminated Surface Water scenarios, the irrigated water applications considered here may or may not be contaminated with radioactive materials. As a rough approximation for irrigated fields, assume 10 percent of the irrigation rate (see Section 7.3.1). Leaching rates are not crop-specific in Gv2, therefore, the user determines a representative rate to apply as VLEACH. Multiple modules could be used if variable leach rates are desired. Sandy soils generally have a greater infiltration rate, while consistently moist clay soils have lower rates.

The units and range for VLEACH in Gv2 are: cm/yr (0–500).

7.9.5 SOILKD Parent and Progeny Soil Absorption Coefficient

Soil absorption coefficients are commonly known as K_d values. The greater the number, the more tightly absorbed the nuclide is to the soil particle. The lower the number, the more likely the nuclide leaches out with the soil water. The user is responsible for entering the same value here and in the Constituent module (see CLKD, Section 2.1.1). If the values differ, the value entered in this Exposure module is the value applied for leaching calculations.

The units and range for SOILKD in Gv2 are: ml/g (0–1,000,000).

Values recommended for a number of potential contaminants are those of Serne (2007). Serne (2007) also provides references for additional sources of K_d values.

7.9.5.1 Additional Sources of Information

The EPA publication (EPA 1999) provides details regarding use and determinations of K_d values for environmental modeling. Available at: http://www.epa.gov/radiation/cleanup/402-r-99-004.html#vol1.

7.10 Tab: Agriculture

The agriculture tab has numerous sub-tabs to input data used for food ingestion pathways for human food crops and foods that livestock consume. U.S.-wide information is quite detailed for agricultural food commodities of interest, including but not limited to wheat, rice, corn, oats, barley, grain sorghums, mill feeds, butter, eggs, potatoes, peanuts, soybeans, soybean meal, livestock, livestock products, and frozen concentrated orange juice, but not onions.

Parameter documents similar to this one typically focus on a local view of agriculture practices as a consequence of the need for MEI impact determinations. This document attempts to provide a bigger view of agricultural production. This information provides an overview of the food production regions of commercially grown crops or animal products. Many distribution complexities (e.g., where a crop is processed, what parts of a crop are used in a final food product, what impact commercial processing

practices have on the final radionuclide content, variable delay times between harvest and consumption) versus the location of the consumers are highly simplified and largely ignored.

Whether a crop is irrigated or not will have an impact on biomass and yield. In addition, the annual variation on these parameters is much less when crops are irrigated. Data in Table 7.5 provides some indication of prevalence of irrigation in each state.

7.11 Tab: Agriculture/General

For a 1-year emission calculation, which is a typical assumption for chronic release scenarios, no Radionuclide Removal Due to Harvesting is considered (leave box blank). Activation of this model (checking the box) would model soil radionuclide removal at the end of each year based on plant uptake and leaching. Also, do not check (leave box blank) the user-defined dry- and wet-deposition fraction to plant options.

7.11.1 LEAFRS Soil-to-Plant Resuspension Factor

The resuspension factor from soil to plant surfaces parameter is used for ingestion pathways to evaluate the air concentration above the plants from resuspension of soil particulates. See Soil/Resuspension (Section 7.8) for resuspension factors used for the outdoor air inhalation pathway.

The units for this parameter in Gv2 are: m^{-1} (0–0.001).

A value of 1E-09 m^{-1} is used based on generic assumptions for atmospheric mass loading of 0.0002 g/m^3 soil in air and 225,000 g/m^2 areal soil density (to 15 cm), dividing mass loading by areal density (Napier et al. 1988, p. 4.64). The user would modify this value based on their assumption for mass loading (see Section 7.8.1) and surface soil density (see Section 7.7.1). A range of values derived from the generic soil textures cited for the surface soil density section (Section 7.7.1) and the range of mass loading values for arid regions (min 1.4E-05; max 3.5E-04; and central 2.0E-05 g/m^3) is provided, below.

7.11.1.1 Additional Sources of Information

See additional sources of information for mass loading (see Section 7.8.1) and surface soil density (see Section 7.7.1).

7.11.1.2 LEAFRS Soil-to-Plant Resuspension Factor Table

Table 7.10. LEAFRS Soil-to-Plant Resuspension Factor

Soil Texture	LEAFRS Min	LEAFRS Max	LEAFRS Central	Units
sandy soil texture, ideal for plant growth	7E-11	1E-09	1E-10	m^{-1}
silty soil texture, ideal for plant growth	8E-11	2E-09	1E-10	m^{-1}
clayey soil texture, ideal for plant growth	1E-10	2E-09	1E-10	m^{-1}

7.11.2 DPVRES Soil-to-Plant Deposition Velocity

This parameter describes the amount of resuspended activity that deposits onto plants. One value is applied to all crops; therefore, this value is very generalized.

The units and range for this parameter in Gv2 are: m/s (0–0.1).

Recommended value to assign is 0.001 m/s.

7.11.2.1 Additional Sources of Information

Although numerous publications have investigated deposition velocity, the single value is recommended for use in Gv2. This parameter in this application (contaminated soil resuspended at deposited on plant leaves) is not particularly sensitive within Gv2. Use of the default value is highly recommended.

7.11.3 WTIM Plant Weathering Rate Constant

This parameter indicates the weathering loss of a deposited radionuclide from a plant.

The units for this parameter in Gv2 are: d (0.1–100).

A weathering rate constant of 14 d has been historically used in GENII (Napier et al. 1988). The RESRAD code (Yu et al. 2001) applies a 20 yr^{-1} weathering removal constant, which converts to a 12.6-d removal rate for this lognormally distributed parameter. IAEA (2010) values relevant to Gv2 applications range from about 8–49 d. The professional opinion of the authors is that regional variability should not be considered for this parameter. The recommended value is 14 d.

7.11.3.1 Additional Sources of Information

Weathering is reviewed in Section 3.2 of IAEA (2010). Weathering halftimes are reported from a limited number of samples, a limited number of nuclides, and a range of crops (cereal, grass, rice, and fruit). Be aware that Gv2 applications use one weathering rate for all crops.

7.12 Tab: Agriculture/Animal Feed

The Agriculture/Animal Feed tab contains numerous sub-tabs because several feed and forage crops (grain, hay, and grass) require separate parameterization. Also, incidental soil intake by livestock is addressed in this tab. The GENII model assumes the feed and forage types shown in Table 7.11. Gv2 code labels and specific examples of the food types that can be assigned are indicated in Table 7.12. The user should survey the region of interest to determine the mix and type of grains, silage, and forage commonly fed to the animal. Except for locations with large commercial operations, there will likely be a range of feed mixes to consider. The user can perform separate biomass and yield comparisons on the various mixtures to determine the range of possible values to assign.

The creatures that provide animal products for human consumption which are modeled in Gv2 are assumed to be domesticated. Consider that wild or free-ranging counterparts will tend to consume more grass in their diet, which can increase intake rates of radionuclides.

Table 7.11. Feed and Forage Assumptions in GENII v2

		Feed or Forage Consumed[(a)]		
Type	Animal Product	Grain	Hay	Grass
FEED	Meat	X	-	-
	Poultry	X	-	-
	Milk	-	X	-
	Egg	X	-	-
FORAGE	Meat	-	X	-
	Milk	-	-	X

(a) These are the default assumptions for feed and forage in the distribution version of Gv2. Parameter values recommended in this document reflect a change in feed composition (hay, silage, fodder mixture) for the meat and milk animal.

Table 7.12. Gv2 Food Types and Feed and Forage Assumptions

FdFrLabel	Feed for Animals that are Later Consumed by People	Examples or Comment[(a)]
1	meat animal feed	grain (e.g., primarily corn), silage, and hay
2	poultry animal feed	grain (e.g., corn, wheat)
3	milk animal feed	hay
4	egg animal feed	grain (e.g., corn, wheat)
5	meat animal forage	leafy vegetable (e.g., alfalfa, grass)
6	milk animal forage	leafy vegetable (e.g., alfalfa, grass)
N/A	aquatic biota (all)	Aquatic biota use only water as their "contaminated food" source.

(a) These are the default assumptions for feed and forage in the distribution version of Gv2. Parameter values recommended in this document reflect a change in meat animal feed and milk animal feed composition (hay, silage, fodder mixture).

Meteorology, soil conditions, topography and other factors affect agricultural parameters. The U.S. Department of Agriculture conducts a census of agriculture every five years. The data is compiled by state, but Regions are also defined, as indicated in Figure 7.2 and Figure 7.3. State-specific data can be reviewed for a single census year or multiple census years, watershed specific data can be reviewed, and data from states with similar agriculture characteristics can be used to determine likely parameter ranges. For example, Figure 7.2 and Figure 7.3 indicate possible groupings of regions, which would permit regions from which ranges could be obtained.

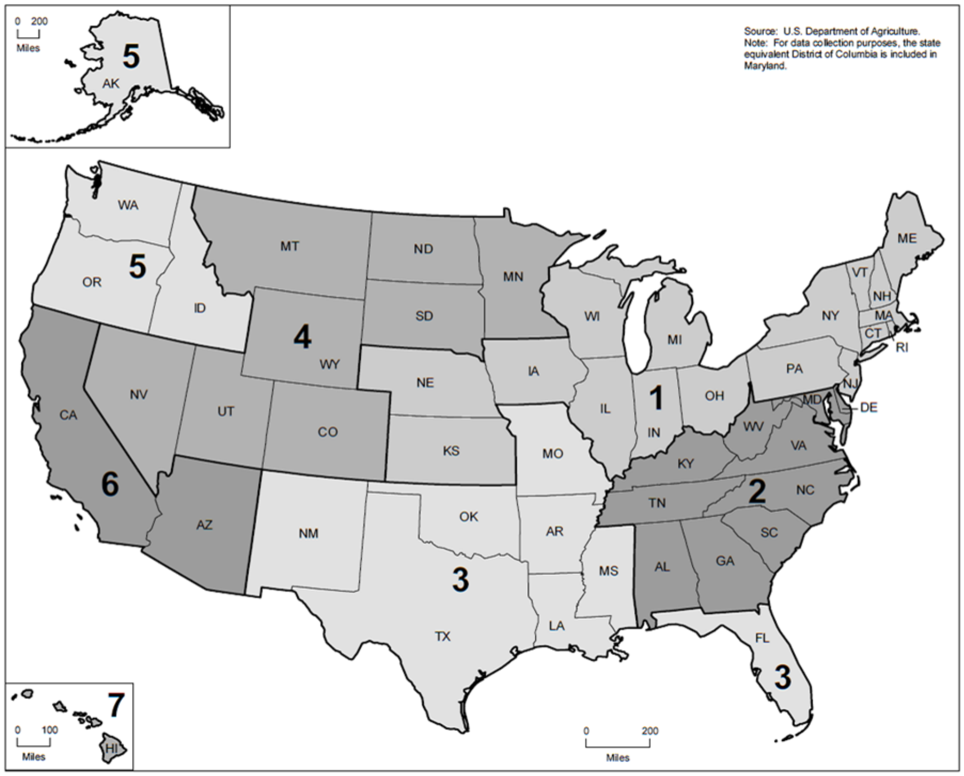

Figure 7.2. USDA Census of Agriculture Reporting Regions (USDA 2009)

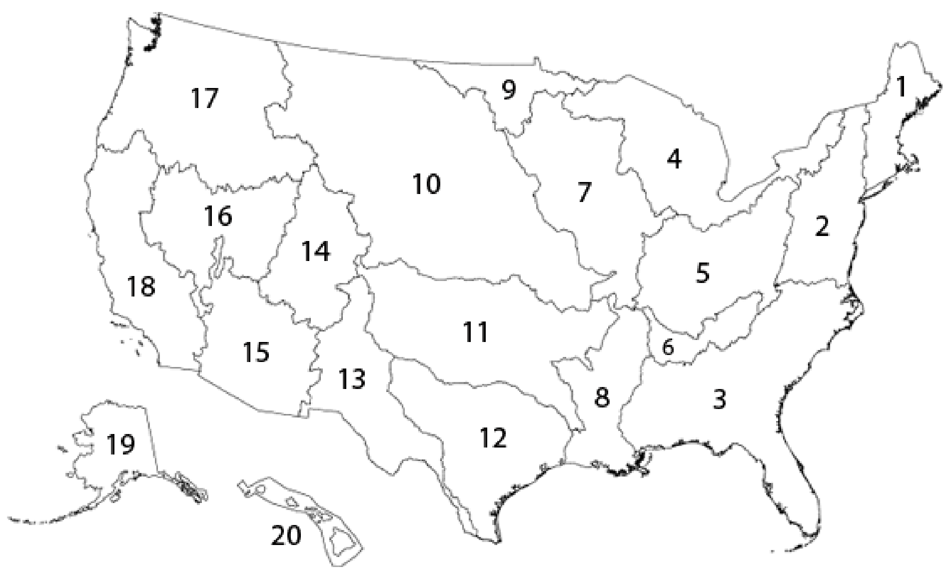

Figure 7.3. USDA Census of Agriculture Watershed Report Regions (USDA 2009)

7.13 Tabs: Agriculture/Animal Feed/Biomass; /Growing Period; /Yield; and /Translocation Factor

This section covers Animal Feed sub-tabs that pertain to the field characteristics of animal feed and forage. The input is entered in non-sequential tabs, but the data is presented together so that the field characteristic data can be compared among the various feed and forage crops. Crops considered are indicated in Table 7.11.

The biomass, growing period, yield and translocation factors for human food crops are covered in Section 7.18. The grain values for animal feed and human food should be comparable if not the same.

7.13.1 BIOMA2 Biomass; GRWPA Growing Period; YELDA Yield; and TRANSA Translocation Factor

The standing biomass for each animal feed type is the total above-ground plant mass (wet weight) used to estimate interception fractions for wet and dry deposition.

The growing period for each animal feed type defines the deposition period for irrigation and atmospheric deposition to plants. To the extent possible, the growing period should reflect the growing period of the edible portion of the crop. It may be approximated by 0.9 times the days between seed planting and harvesting. The entire plant-to-harvest period could also be used as a maximizing assumption.

The yield of each animal feed type gives the total annual production of edible feed crop mass (wet weight) per unit area of farmland. The yield is used to calculate the harvest removal losses from the soil. Radionuclide removal due to harvesting is modeled when opted on the Agriculture/General tab. This parameter only impacts scenarios that evaluate exposures which occur more than one-year after the release.

The translocation factor for each animal feed type is the fraction of activity reaching the plant surface that is transferred to the edible part of the plant. The significance of translocation depends on the radionuclide, kind of crop, time between harvest and consumption for fodder, and handling. This value differs from the animal feed or forage crop bioconcentration factors (CLBVAx and CLBVAG) assigned in the Constituent module (see Sections 2.1.17 through 2.1.19), which considers soil to plant transfer.

Similar parameters that are applicable to food crops ingested by people are found in Section 7.18.1.

The units and range for BIOMA2 in Gv2 are: kg_{wet}/m^2 (0.1–10).

The units and range for GRWPA in Gv2 are: d (0–365).

The units and range for YELDA in Gv2 are: kg_{wet}/m^2 (0.1–10).

The units and range for TRANSA in Gv2 are: fraction (0–1).

Biomass

Biomass values, in order of generally decreasing biomass are: fruit; root/other vegetables; leafy vegetables; human grain; feed for meat animal, poultry, and egg layer (grain); milk animal forage (grass); meat animal forage (hay); and milk animal feed (hay). A wide range of literature information is available to approximate biomass values. A limited set were reviewed and used for the evaluation (UC SAREP 2012; USDA 2009; Gallagher et al. 2003; Lalman and Sewell 1993).

Growing Period

USDA (2010) provided data on the planting and harvesting dates for a variety of crops and by state. Information on the area harvested was also provided, which provides an indication of the states that grow the most of a crop. Summary GRWPA data are provided in Table 7.14; state-specific details are provided in the Appendix F.

Yield

Yield information is collected in detail for commodity crops. Table 27 and Table 28 of the Census of Agriculture (USDA 2009) values were acquired and summarized for crops of interest. The values indicated are the wet-weight in the as-fed form of the crop (e.g., the wet weight of sun-cured hay is less than the wet-weight of the hay crop prior to sun-curing).

Translocation

Animal feed and forage translocation values (TRANSA) values are generally limited to 1.0 for leafy forages; a 0.9 "higher" value where 1.0 is not considered appropriate (e.g., corn silage or other non-grassy fodder); or a 0.1 "lower" value where a small fraction is appropriate to assign from translocation. The "lower" value would be appropriate to root feed crops (e.g., turnips) or grain feeds.

7.13.1.1 Additional Sources of Information

The USDA Agricultural Handbook Number 697 (USDA 1992) provides weights, measures, and conversion factors for agricultural commodities and their products. In particular, Table 6 provides commodity weights for a variety of crops and some crop products (e.g., bushels to kg). It is noted that fruits and vegetables can have considerable variation in weight per unit volume because of differences in size, condition, packing, and other factors. These data can be used when evaluating mass, volume, or other data for farm product information in the open literature.

Dry-to-wet conversion factors can be useful when reviewing the literature. The USDA National Agricultural Library (USDA 2011) has compiled nutrient information on a long list of foods. Part of this data is the water content of various raw and processed crops. Access the database at http://www.nal.usda.gov/fnic/foodcomp/search/. Select "*Start your search here*", select the food group of interest on the left side of the screen (e.g., *Vegetables and Vegetable Products*), select the food of interest. The water content in 100 g of the food is listed. If you select "Statistics Report," the minimum, maximum, and standard deviation of the water content may be listed.

Section 3.3 of IAEA (2010) reviews translocation factors. This reference also includes information regarding data availability and data quality.

The USDA Economics, Statistics, and Market Information System (e.g., http://usda.mannlib.cornell.edu/MannUsda/viewTaxonomy.do?taxonomyID=3) and the USDA Economic Research Service (e.g., http://www.ers.usda.gov/data-products/fruit-and-tree-nut-data.aspx) have summary information available on a variety of crops, including fruit, vegetables, nuts, berries, and field crops. In particular, biomass and yield information can be obtained from these resources. Some information is broken out by state, others are U.S. averages.

7.13.1.2 BIOMA2, GRWPA, YELDA, TRANSA Animal Feed Biomass, Growing Period, Crop Yield, and Translocation Tables

Table 7.13. BIOMA2 Standing Biomass – Animal Feed

Gv2_ID	Gv2 Description	Food Type	Reference	Comment	Low Value	High Value	Units
BIOMA2	Biomass for FEED, FORAGE	1.meat animal feed (grain)	UC SAREP (2012) and Gallagher et al. (2003)	barley, rapeseed, oats, ryegrass. Dry:wet assumption 0.3	0.01	0.5	kg_{wet}/m^2
BIOMA2	Biomass for FEED, FORAGE	1.meat animal feed (grain)	Derived from Gallagher et al. (2003) and USDA (2011)	winter and spring wheat, grain and crop residue	0.64	1.41	kg_{wet}/m^2
BIOMA2	Biomass for FEED, FORAGE	1.meat animal feed (grain)	Derived from Gallagher et al. (2003)	sorghum	1.5	1.8	kg_{wet}/m^2
BIOMA2	Biomass for FEED, FORAGE	1.meat animal feed (grain)	Derived from Gallagher et al. (2003) and USDA (2009, Tables 27 and 28)	corn	2.2	6	kg_{wet}/m^2
BIOMA2	Biomass for FEED, FORAGE	2.poultry feed (grain)	See meat animal feed, above	assumed 60% corn and 40 other (assumed oats-equivalent)	1.5	2.1	kg_{wet}/m^2
BIOMA2	Biomass for FEED, FORAGE	3. milk feed (corn silage)	Derived from Gallagher et al. (2003) and USDA (2009, Tables 27 and 28)	corn silage. Dry:wet assumption 0.5.	2.2	6	kg_{wet}/m^2
BIOMA2	Biomass for FEED, FORAGE	3. milk feed (hay)	Derived from Gallagher et al. (2003), USDA (2011), and USDA (2009, Tables 27 and 28)	hay. Dry:wet assumption 0.5.	0.2	1.3	kg_{wet}/m^2
BIOMA2	Biomass for FEED, FORAGE	4. egg feed (grain)	See poultry feed, above	assumed 60% corn and 40 other (assumed oats-equivalent)	1.5	2.1	kg_{wet}/m^2
BIOMA2	Biomass for FEED, FORAGE	5.meat animal forage (hay and corn silage)	See milk feed, hay and corn, above	50% corn silage, 50% hay	1.2	3.7	kg_{wet}/m^2
BIOMA2	Biomass for FEED, FORAGE	6.milk forage (grass)	Derived from Gallagher et al. (2003), USDA (2011), and USDA (2009, Tables 27 and 28)	hay. Dry:wet assumption 0.5.	0.2	1.3	kg_{wet}/m^2

Table 7.14. GRWPA Growing Period – Animal Feed

Gv2_ID	Gv2 Description	Food Type	Reference	Comment	Extremes (d)	Active Period or Average (d)	Units
GRWPA	Growing period	1.meat animal feed	Calculated from USDA (2010)	Corn for grain, planting to harvest	123–199	139–182	d
GRWPA	Growing period	1.meat animal feed	Calculated from USDA (2010)	Durum wheat, planting to harvest	105–237	110–215	d
GRWPA	Growing period	1.meat animal feed	Calculated from USDA (2010)	Spring wheat, planting to harvest	100–141	105–131	d
GRWPA	Growing period	1.meat animal feed	Calculated from USDA (2010)	Winter wheat, planting to harvest	151–350	174–337	d
GRWPA	Growing period	2.poultry feed	Calculated from USDA (2010)	Corn for grain, planting to harvest	123–199	139–182	d
GRWPA	Growing period	3. milk feed	Calculated from USDA (2010)	Corn for silage, planting to harvest	61–183	92–177	d
GRWPA	Growing period	3. milk feed	Calculated from USDA (2010)	Alfalfa hay[(a)], planting to harvest	6–74	26–38	d
GRWPA	Growing period	3. milk feed	Calculated from USDA (2010)	Other hay[(a)], planting to harvest	6–80	13–44	d
GRWPA	Growing period	4.egg layer feed	Calculated from USDA (2010)	Corn for grain, planting to harvest	123–199	139–182	d
GRWPA	Growing period	5.meat animal forage	Calculated from USDA (2010)	Corn for silage, planting to harvest	61–183	92–177	d
GRWPA	Growing period	5.meat animal forage	Calculated from USDA (2010)	Alfalfa hay[(a)], planting to harvest	6–74	26–38	d
GRWPA	Growing period	5.meat animal forage	Calculated from USDA (2010)	Other hay[(a)], planting to harvest	6–80	13–44	d
GRWPA	Growing period	6. milk forage	Calculated from USDA (2010)	Other hay[(a)], planting to harvest	6–80	13–44	d

(a) Assumed 2.5 harvests per growing season for most states. CA and AZ assumed 3.5 harvests.

Table 7.15. YELDA Crop Yield – Animal Feed

GENII ID	YELDA, YELD	YELDA	YELDA	YELDA	YELDA, YELD	YELDA	YELDA	YELDA	YELDA	YELDA, YELD	YELD
GENII application comment	FEED: meat, poultry, egg; human grain	FEED:milk; FORAGE: meat	FEED:milk; FORAGE: meat	FEED:milk; FORAGE: meat	FEED: meat, poultry, egg; human grain	FEED:milk; FORAGE: meat	FEED:milk; FORAGE: meat	FEED:milk; FORAGE: meat	FEED: meat, poultry, egg	FEED: meat, poultry, egg; human grain	human grain
	Corn for grain or seed	**Corn for silage or greenchop**	**Alfalfa and alfalfa mixtures***	**All other hay***	**Corn for grain or seed**	**Corn for silage or greenchop**	**Alfalfa and alfalfa mixtures***	**All other hay***	**Sorghum for grain or seed**	**Wheat for grain or seed**	**Rice**
	Average yield (irrigated)	Average yield (irrigated)	Average yield (irrigated)	Average yield (irrigated)	Average yield (nonIrrigated)	Average yield (nonIrrigated)	Average yield (nonIrrigated)	yield (nonIrrigated	yield (irrigated)	Average yield (irrigated)	yield (irrigated)
	kg_shelled/m2	kg_wet/m2	kg_dry/m2	kg_dry/m2	kg_shelled/m2	kg_wet/m2	kg_dry/m2	kg_dry/m2	kg/m2	kg/m2	kg/m2
United States average	1.1	5.6	1.0	0.6	0.8	3.6	0.5	0.4	0.5	0.5	0.8
Alabama	1.1	4.0	0.2	0.9	0.6	3.1	(D)	0.6	-	0.5	-
Alaska	-	-	-	0.6	-	-	-	(D)	-	-	-
Arizona	1.1	6.3	2.0	1.3	-	-	(D)	-	0.6	0.7	-
Arkansas	1.0	(D)	-	0.8	0.8	-	-	0.5	0.6	0.4	0.8
California	1.1	6.1	1.3	1.1	0.9	3.4	0.2	0.4	0.7	0.7	0.9
Colorado	1.1	5.2	0.7	0.4	0.4	1.8	0.2	0.2	0.3	0.5	-
Connecticut	-	-	-	-	(D)	(D)	(D)	1.3	-	-	-
Delaware	1.2	4.7	0.8	0.7	0.7	2.9	0.4	0.5	-	0.6	-
Florida	1.0	4.0	-	0.9	0.5	(D)	0.9	0.3	(D)	0.5	0.5
Georgia	1.1	4.9	1.8	1.1	0.4	2.9	0.4	1.0	0.3	0.5	-
Hawaii	(D)	-	-	-	-	-	-	-	(D)	-	-
Idaho	1.1	6.1	1.0	0.4	-	3.8	0.2	0.2	-	0.7	-
Illinois	1.2	3.1	0.5	0.7	1.1	3.1	0.5	(D)	0.7	0.4	0.7
Indiana	1.1	4.7	0.7	0.2	1.0	4.5	0.5	0.2	(D)	0.4	(D)
Iowa	1.1	5.4	1.2	(D)	1.0	2.9	0.8	0.4	-	(D)	-
Kansas	1.2	4.9	1.4	1.0	0.5	4.0	0.6	0.5	0.6	0.4	-
Kentucky	1.1	5.6	(D)	0.8	0.9	3.6	0.9	0.6	-	-	-
Louisiana	1.0	2.2	0.1	1.1	0.9	3.4	-	0.6	0.5	0.4	0.7
Maine	-	-	-	-	(D)	(D)	-	(D)	-	-	-
Maryland	1.2	6.1	1.5	1.1	0.7	3.6	1.1	0.7	-	0.5	-
Massachusetts	(D)	-	-	-	-	-	0.7	0.1	-	-	-
Michigan	1.1	4.9	1.2	-	0.8	3.4	0.9	0.6	-	0.5	-
Minnesota	1.1	4.5	1.0	0.5	0.9	3.8	0.6	0.3	-	0.4	-
Mississippi	1.1	-	-	1.4	0.9	(D)	-	0.9	0.5	0.4	0.8
Missouri	1.1	4.0	0.8	0.4	0.9	2.9	0.6	0.4	0.7	0.4	1.0
Montana	0.9	4.9	0.7	0.4	-	-	0.2	0.2	-	0.5	-
Nebraska	1.2	4.9	1.1	0.7	0.8	3.8	0.7	0.3	0.7	0.4	-
Nevada	-	6.1	0.9	0.4	-	-	0.7	0.2	-	0.5	-
New Hampshire	(D)	6.1	-	-	-	(D)	0.7	(D)	-	-	-
New Jersey	1.1	5.4	1.4	0.2	0.7	3.4	0.2	0.6	-	0.5	-
New Mexico	1.2	5.8	1.0	0.7	0.2	(D)	0.2	0.4	0.6	0.3	-
New York	1.2	5.6	1.7	-	1.0	3.1	1.1	0.7	-	(D)	-
North Carolina	0.8	6.1	0.2	0.7	0.4	3.6	0.8	0.6	(D)	0.3	-
North Dakota	1.0	4.3	0.9	0.4	0.8	2.0	0.4	0.2	-	0.4	-
Ohio	1.0	5.2	1.5	-	0.8	3.1	0.5	0.5	-	-	-
Oklahoma	1.2	3.8	1.2	0.6	0.5	-	0.9	0.6	0.4	0.3	-
Oregon	1.3	6.3	0.9	0.5	-	4.3	0.7	0.2	-	0.7	-
Pennsylvania	0.9	5.4	0.5	0.6	0.9	4.3	0.5	0.4	-	-	-
Rhode Island	-	-	-	-	-	-	(D)	0.7	-	-	-
South Carolina	1.0	3.4	0.7	1.0	0.3	2.5	-	0.7	(D)	0.5	-
South Dakota	1.1	4.0	0.8	0.4	0.8	3.1	0.4	0.4	0.6	0.4	-
Tennessee	1.2	4.7	1.0	(D)	0.8	4.0	1.2	0.6	(D)	0.5	(D)
Texas	1.2	5.6	1.0	0.7	0.3	2.9	0.9	0.4	0.4	0.3	0.8
Utah	1.0	4.9	0.9	0.5	-	2.7	0.4	0.5	0.7	0.6	-
Vermont	-	-	-	-	-	-	-	0.2	-	-	-
Virginia	1.1	5.6	1.0	0.3	0.7	3.4	0.2	0.4	-	0.5	-
Washington	1.2	6.5	1.1	1.0	(D)	5.8	0.5	0.2	-	0.7	-
West Virginia	(D)	(D)	(D)	-	0.9	2.9	0.8	0.5	-	-	-
Wisconsin	1.0	4.7	0.8	0.7	0.8	3.8	0.5	0.6	-	0.5	-
Wyoming	0.9	5.4	0.8	0.4	(D)	-	0.3	0.2	-	0.4	-

Table 7.15. (contd)

GENII ID	YELDA, YELD	YELDA	YELDA	YELDA	YELDA, YELD	YELDA	YELDA	YELDA	YELDA	YELDA, YELD	YELD
GENII application comment	FEED: meat, poultry, egg; human grain	FEED:milk; FORAGE: meat	FEED:milk; FORAGE: meat	FEED:milk; FORAGE: meat	FEED: meat, poultry, egg; human grain	FEED:milk; FORAGE: meat	FEED:milk; FORAGE: meat	FEED:milk; FORAGE: meat	FEED: meat, poultry, egg	FEED: meat, poultry, egg; human grain	human grain
	Corn for grain or seed	**Corn for silage or greenchop**	**Alfalfa and alfalfa mixtures***	**All other hay***	**Corn for grain or seed**	**Corn for silage or greenchop**	**Alfalfa and alfalfa mixtures***	**All other hay***	**Sorghum for grain or seed**	**Wheat for grain or seed**	**Rice**
	Average yield (irrigated)	Average yield (irrigated)	Average yield (irrigated)	Average yield (irrigated)	Average yield (nonIrrigated)	Average yield (nonIrrigated)	Average yield (nonIrrigated)	Average yield (nonIrrigated)	Average yield (irrigated)	Average yield (irrigated)	Average yield (irrigated)
	kg_shelled/m2	kg_wet/m2	kg_dry/m2	kg_dry/m2	kg_shelled/m2	kg_wet/m2	kg_dry/m2	kg_dry/m2	kg/m2	kg/m2	kg/m2
United States average	1.1	5.6	1.0	0.6	0.8	3.6	0.5	0.4	0.5	0.5	0.8
Watershed Region											
Region 01 New England	0.7	6.1	-	-	0.7	4.3	0.7	1.0	-	-	-
Region 02 Mid-Atlantic	1.2	5.6	1.1	0.8	0.7	3.8	0.5	0.5	-	0.5	-
Region 03 South Atlantic-Gulf	1.0	4.5	1.1	0.9	0.4	2.9	0.5	0.7	(D)	0.4	0.5
Region 04 Great Lakes	1.1	4.9	1.1	0.7	0.8	3.4	0.8	0.6	-	0.5	-
Region 05 Ohio	1.1	4.7	0.8	0.8	1.0	4.3	0.7	0.6	-	0.4	(D)
Region 06 Tennessee	1.2	4.7	0.9	0.5	0.7	4.0	1.3	0.6	-	0.6	-
Region 07 Upper Mississippi	1.1	4.5	0.8	0.5	1.0	3.6	0.6	0.4	(D)	0.5	(D)
Region 08 Lower Mississippi	1.1	4.0	0.2	1.1	0.9	3.1	0.8	0.6	0.6	0.4	0.8
Region 09 Souris-Red-Rainy	1.0	4.5	1.3	0.5	0.8	4.0	0.6	(D)	-	0.4	-
Region 10 Missouri	1.1	4.9	0.8	0.4	0.8	3.1	0.4	0.3	0.7	0.4	-
Region 11 Arkansas-White-Red	1.2	5.4	1.1	0.6	0.5	4.3	0.6	0.5	0.5	0.3	0.8
Region 12 Texas-Gulf	0.9	5.4	1.3	0.7	(D)	2.9	(D)	0.4	0.4	0.3	0.8
Region 13 Rio Grande	(D)	6.1	0.9	0.6	-	-	0.2	0.3	0.6	0.6	-
Region 14 Upper Colorado	1.2	5.2	0.6	0.4	-	2.7	0.2	0.3	-	0.6	-
Region 15 Lower Colorado	1.1	6.3	1.9	1.2	-	-	(D)	-	0.6	0.7	-
Region 16 Great Basin	0.9	5.2	0.9	0.4	-	3.1	0.4	0.4	0.7	0.6	-
Region 17 Pacific Northwest	1.2	6.3	0.9	0.5	(D)	5.4	0.4	0.2	-	0.7	-
Region 18 California	1.1	6.1	1.3	1.0	0.9	3.4	0.2	0.4	0.7	0.7	0.9
Region 19 Alaska	-	-	-	0.6	-	-	-	(D)	-	-	-
Region 20 Hawaii	(D)	-	-	-	-	-	-	-	(D)	-	-
Minimum yield	0.7	2.2	0.1	0.2	0.2	1.8	0.2	0.1	0.3	0.3	0.5
Maximum yield	1.3	6.5	2.0	1.4	1.1	5.8	1.3	1.3	0.7	0.7	1.0

See Figure 7.2 for Watershed Regions.
(D) = Witheld to avoid disclosing data for individual farms.
- = Represents zero.
* = Dry hay, green chop, and silage

Table 7.16. TRANSA Translocation Factor (Plant Surface to Edible Part) – Animal Feed

Gv2 _ID	Gv2_Description	Food Type	Reference	Comment	Min	Max	Units
TRANSA	Translocation Fraction for animal feed	1.meat_feed	Assumption based on feed/forage morphology	hay, silage, corn	0.9	1	fraction
TRANSA	Translocation Fraction for animal feed	2.poultry_feed	Assumption based on feed/forage morphology	grain	0.1	0.1	fraction
TRANSA	Translocation Fraction for animal feed	3.milk_feed	Assumption based on feed/forage morphology	hay, silage, fodder	0.9	1	fraction
TRANSA	Translocation Fraction for animal feed	4.egg_feed	Assumption based on feed/forage morphology	grain	0.1	0.1	fraction
TRANSA	Translocation Fraction for animal forage	5.meat_forage	Assumption based on feed/forage morphology	hay	1	1	fraction
TRANSA	Translocation Fraction for animal forage	6.milk_forage	Assumption based on feed/forage morphology	grass	1	1	fraction

To summarize generic values that may be used, the following table is provided. Varieties of feed and forage mixtures were considered in the development of this table.

Table 7.17. Summary for BIOMA2, GRWPA, YELDA, and TRANSA

Animal Feed and Forage	Biomass (kg/m^2)	Growing Period (d)	Yield (kg/m^2)	Translocation (fraction)
	BIOMA2[b]	GRWPA[c]	YELDA[d]	TRANSA[e]
1.meat animal feed	4.7	90	2.0	0.9
2.poultry feed	1.8	90	0.8	0.1
3. milk feed	2.0	90	1.1	0.9
4.egg layer feed	1.8	90	0.8	0.1
5.meat animal forage	2.0	30	3.3[a]	1
6.milk forage	1.3	30	1.5[a]	1

(a) The yield for hay and grass forage reflects the replacement growth that occurs over the year. Values indicated reflect three harvests over the year. Southern states may want to increase this value by a factor of 1.3 to reflect an additional growth cycle.
(b) Details regarding BIOMA2 values can be found in Table 7.13.
(c) Details regarding GRWPA values can be found in Table 7.14.
(d) Details regarding YELDA values can be found in Table 7.15.
(e) Details regarding TRANSA values can be found in Table 7.16.

7.14 Tabs: Agriculture/Animal Feed/Consumption; /Storage Time; and /Diet Fraction

The Animal Feed sub-tabs Consumption, Storage Time, and Diet Fraction are grouped together as feed and forage parameters related animal intake of the crops.

The consumption parameter for human food crops is covered in the Receptor module (see Section 8.2.1). The storage time parameter for human foods is covered in the Agriculture/Intake delays tab (see Section 7.20).

7.14.1 CONSUM Consumption, STORTM Storage Time, and DIETFR Diet Fraction

The feed and forage consumption rates for each animal feed is entered. The value for each feed type represents the total intake of this type of feed. The types of animal feed assigned by GENII to each category are listed in parentheses and in Table 7.11, above. These consumption rate values are multiplied by their respective contaminated fraction (DIETFR) to determine the contaminated portion of the intake of each feed type.

The storage time (STORTM) between harvest and feeding to the animal is used to evaluate radioactive decay during the storage period. Maximum storage periods are 1 year in Gv2.

The contaminated fraction of feed for each animal type is the fraction of the feed type eaten by the animal that is contaminated. This fraction is multiplied by the feed consumption rate (CONSUM) to determine the total contaminated intake of each feed type. A 1.0 contaminated fraction is assumed. The user can adjust this value for their situation. Above-ideal temperature and humidity and feed intake rates for poultry are inversely impacted, where ideal levels are 60–75 degrees F and 40–60 percent relative humidity (Ensminger et al. 1990).

The units and range for CONSUM in Gv2 are: kg/d (0.001–300).

The units and range for STORTM in Gv2 are: d (0–365).

The units and range for DIETFR in Gv2 are: fraction (0–1).

Consumption rates indicate consumption near the time of animal harvest for beef cattle and poultry. Milk cow consumption is related to the amount of milk they produce. Feed rates are indicated in as-fed weight. Beef cattle consume about 2–3 percent of their body weight in feed (dry weight) (Ensminger et al. 1990). Milk cows consume about 2.5–3.5 percent of their body weight (Ensminger et al. 1990). Beef cattle may be fed more grain than hay or silage near the time of animal harvest.

Storage time for animal feed and forages depend on the feed component. Storage minimum and maximums are indicated, with a single recommended value for each feed type. For specific cases, the harvest date of the animal relative to the harvest date of the feed crop may be given some consideration. The recommended value is an annual average.

7.14.1.1 Additional Sources of Information

Nutrient Requirements of Beef Cattle (NRC 1996). Available online from National Academy Press at http://www.nap.edu/catalog/9791.html. The year 2000 update may be available online.

Nutrient Requirements of Dairy Cattle (NRC 2001). National Research Council, National Academy Press, Washington, D.C. Last accessed at http://www.nap.edu/catalog.php?record_id=9825.

Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids, and New World Camelids (NRC 2007). Not currently available online.

7.14.1.2 CONSUM and STORTM Feed Consumption and Storage Time Tables

Table 7.18. CONSUM Consumption Rate – Animal Feed

Gv2_ID	Gv2 Description	Animal Feed/ Forage Type	Reference	Comment	Recom-mended[a]	Min	Max	Units[b]
CONSUM	Animal feed intake rate.	1.meat animal feed	Ensminger et al. (1990)	IF SOLELY ON FEED. Derived from half grain, half silage mixture. 2–3% (dry basis) of animal weight (800–1200 lb).	**18**	11	29	kg/d
CONSUM	Animal feed intake rate.	2.poultry	Ensminger et al. (1990)	grain. Chicken.	**0.12**	0.07	0.14	kg/d
CONSUM	Animal feed intake rate.	2.poultry	Ensminger et al. (1990)	grain. Turkey.	0.26	0.20	0.30	kg/d
CONSUM	Animal feed intake rate.	3.milk feed	Ensminger et al. (1990)	IF SOLELY ON FEED. Derived from half grain, half silage mixture. 2.5–3.5% (dry basis) of animal weight (900–1400 lb).	**25**	16	40	kg/d

Table 7.18. (contd)

Gv2_ID	Gv2 Description	Animal Feed/ Forage Type	Reference	Comment	Recom-mended[(a)]	Min	Max	Units[(b)]
CONSUM	Animal feed intake rate.	4.egg layer feed	Ensminger et al. (1990)	grain	**0.12**	0.07	0.14	kg/d
CONSUM	Animal feed intake rate.	5.meat animal forage	Ensminger et al. (1990)	IF SOLELY ON DRY FORAGE. Derived from hay-grain mixture (90/10).	13	8.4	19	kg/d
CONSUM	Animal feed intake rate.	5.meat animal forage	Ensminger et al. (1990)	IF SOLELY ON FRESH FORAGE. Derived from fresh pasture forage.	50	18	60	kg/d
CONSUM	Animal feed intake rate.	6.milk forage	Ensminger et al. (1990)	IF SOLELY ON FORAGE. Derived from fresh pasture forage.	**40**	25	65	kg/d

(a) Recommended single value in **bold**.
(b) As-fed mass.

Table 7.19. STORTM Storage Time – Animal Feed

Gv2_ID	Gv2_Description	Food Type	Reference	Comment	Estimate for a Mixture	Min	Max	Units
STORTM	Storage Time for animal feed	1.meat animal feed	Estimate. Single annual harvests.	corn grain	140	45	365	d
STORTM	Storage Time for animal feed	1.meat animal feed	Estimate. Approximate with end of spring wheat harvest (about Sept) and beginning of winter wheat harvest (about June).	wheat	-	45	280	d
STORTM	Storage Time for animal feed	1.meat animal feed	Estimate. One month minimum to cure.	corn silage	-	30	180	d
STORTM	Storage Time for animal feed	1.meat animal feed	Estimate.	stored hay	-	30	180	d
STORTM	Storage Time for animal feed	2.poultry feed	Estimate. See above, meat animal feed, corn.	corn grain	180	45	365	d
STORTM	Storage Time for animal feed	3. milk feed	Estimate. See above, meat animal feed, corn silage	corn silage	140	30	180	d
STORTM	Storage Time for animal feed	3. milk feed	Estimate. See above, meat animal feed, stored hay.	stored hay	-	30	180	d
STORTM	Storage Time for animal feed	4.egg layer feed	Estimate. See above, meat animal feed, corn.	corn grain	180	45	365	d
STORTM	Storage Time for animal feed	5.meat animal forage	Estimate. Max value based on a chronic, once-a-month air emission.	pasture grass	0	0	15	d
STORTM	Storage Time for animal feed	6.milk forage	Estimate. Max value based on a chronic, once-a-month air emission.	pasture grass	0	0	15	d

7.15 Tab: Agriculture/Animal Feed/Dry/Wet Ratio

The dry/wet ratio for each animal feed type is used to convert between dry and wet weight bases. These data are also helpful when information found in open literature must be converted to the appropriate dry- or wet-bases for model input.

7.15.1 DRYFA2 Dry-to-Wet Ratio

The dry/wet ratio for each feed crop is used to convert between dry and wet weight bases. The most appropriate dry-to-wet ratio applied should be that of the edible portion; if edible portion data is not available, use data available (e.g., entire plant data). Oven-dry data, rather than ash weight data, are typically applied. One focus of animal nutrition is on the dry mass of the feed. Eliminating the water content, the dry matter contains all the other necessary nutrients required by the animals. As a result there is a large amount of information on the internet. Local animal producers, especially larger commercial operations, should also be able to provide regional information, as well.

Separate dry/wet ratio parameters for human food crops are covered in Section 7.19. The grain values for animal feed and human food should be comparable, if not the same.

The units and range for this parameter in Gv2 are: fraction (0.05–0.95).

Data has not changed over time for these data. However, consideration of feed mixtures may be required. Generalized values are provided in this section; minimum and maximum values are also generalized. Values for a number of specific feed and forage types are indicated in the Appendix H. Care should be exercised in the application of some values. For example, when considering hay, the user should determine whether the dry-to-wet ratio applies to the as-grown or as-fed dry-wet ratio.

7.15.1.1 Additional Sources of Information

IAEA (2010) Appendix I, Table 82 through 85, provides a list of dry matter content (percentage basis) for a variety of feed and crop types.

Ensminger et al. (1990), Section V, provides tables of dry-to-wet ratios for numerous energy feeds, protein feeds, dry forages, silages and haylages, and pasture and range plants.

Feed operations typically provide feed to livestock based on feed mass. One method of gauging sufficient animal nutrition is to determine the dry matter content of the feed. As a result, dry matter information is available at a variety of internet sites.

7.15.1.2 DRYFA2 Animal Feed Dry-to-wet Ratio Table

Table 7.20. DRYFA2 Dry-to-Wet Ratio – Animal Feed

Gv2_ID	Gv2_Description	Food Type	Reference	Comment	Recom-mendation(a)	Min	Max	Units
DRYFA2	Dry-to-wet ratio for animal feed	1.meat animal feed	Ensminger et al. (1990)	silage	0.5	0.27	0.78	kg_{dry}/kg_{wet}
DRYFA2	Dry-to-wet ratio for animal feed	1.meat animal feed	Ensminger et al. (1990)	grain plus silage mixture	**0.5**	-	-	kg_{dry}/kg_{wet}
DRYFA2	Dry-to-wet ratio for animal feed	2.poultry feed	Ensminger et al. (1990)	corn	**0.9**	0.85	0.95	kg_{dry}/kg_{wet}
DRYFA2	Dry-to-wet ratio for animal feed	3. milk feed	Ensminger et al. (1990)	grain plus silage mixture	**0.5**	-	-	kg_{dry}/kg_{wet}
DRYFA2	Dry-to-wet ratio for animal feed	4.egg layer feed	Ensminger et al. (1990)	corn	**0.9**	0.85	0.95	kg_{dry}/kg_{wet}
DRYFA2	Dry-to-wet ratio for animal feed	5.meat animal forage	Ensminger et al. (1990)	grain	0.9	-	-	kg_{dry}/kg_{wet}
DRYFA2	Dry-to-wet ratio for animal feed	5.meat animal forage	Ensminger et al. (1990)	sun-cured hay	0.85	0.82	0.93	kg_{dry}/kg_{wet} (as fed)
DRYFA2	Dry-to-wet ratio for animal feed	5.meat animal forage	Ensminger et al. (1990)	hay+grain mixture	**0.88**	-	-	kg_{dry}/kg_{wet} (as fed)
DRYFA2	Dry-to-wet ratio for animal feed	5.meat animal forage	Ensminger et al. (1990)	sun-cured hay	0.15	0.2	0.5	kg_{dry}/kg_{wet} (as grown)
DRYFA2	Dry-to-wet ratio for animal feed	6.milk forage	Ensminger et al. (1990)	fresh pasture grass	**0.4**	0.2	0.5	kg_{dry}/kg_{wet}

(a) Recommended discrete values in **bold**.

7.16 Tab: Agriculture/Animal Feed/Soil Intake

7.16.1 SLCONA Animal Soil Intake

The soil intake for each animal type is the mass of soil ingested daily by the animal. For incidental soil ingestion of humans, see Receptor module, Section 8.4.1.

The units and range for this parameter in Gv2 are: kg/d (0–5).

Zach and Mayoh (1984) indicate that the soil intake rate, as a percent of dry-matter intake is greater for beef cattle (4–8 percent) than dairy cows (0.6–3.8 percent). Given that dry-matter intake rates are about 2–3 percent of the bovine mass (Ensminger et al. 1990), soil intake estimated for bovine categories: meat cattle, outdoor dairy cows, and housed dairy cows. The lower range values may be assigned for wet highly vegetated locations and higher values for dry or muddier locations. Free-range chickens were assigned a soil intake rate of 10 percent of their food intake rate (Schoeters and Hoogenboom 2006). Chickens cooped in commercial operations would not be assigned soil intakes.

7.16.1.1 Additional Sources of Information

Zach and Mayoh (1984) provide information regarding animal incidental food ingestion. Animals included are domestic dairy and beef cattle (lactating and non-lactating), sheep, and mule deer. They also note how grazing land quality can impact soil ingestion. Ingestion rates are provided either by mass per day or by percent of food ingestion.

7.16.1.2 SLCONA Animal Soil Intake Tables

Table 7.21. SLCONA Soil Intake – Animal Feed

Gv2_ID	Gv2 Description	Food Type (ANFlabel)	Reference	Comment	Recom-mendation[a]	Min/ Max	Units
SLCONA	Soil intake by animal	1.meat animal	Ensminger et al. (1990); Zach and Mayoh (1984)	Cattle. Derived from animal mass (800–1200 lb), dry matter intake (2–3% of animal mass), soil intake (4–8% of dry matter intake).	**0.5**	0.3/0.9	kg/d
SLCONA	Soil intake by animal	2.poultry animal	Schoeters and Hoogenboom (2006)	Free range chicken. 10% of dry matter intake.	**0.01**	0.007/ 0.015	kg/d
SLCONA	Soil intake by animal	3.milk animal	Ensminger et al. (1990); Zach and Mayoh (1984)	Outdoor bovine. Derived from animal mass (900–1400 lb), dry matter intake (2–3% of animal mass), soil intake (1.5–3.8% of dry matter intake).	**0.2**	0.1/0.5	kg/d
SLCONA	Soil intake by animal	3.milk animal	Ensminger et al. (1990); Zach and Mayoh (1984)	Housed bovine. Derived from animal mass (900–1400 lb), dry matter intake (2–3% of animal mass), soil intake (0.6% of dry matter intake).	0.08	0.06/ 0.13	kg/d
SLCONA	Soil intake by animal	4.egg animal	Schoeters and Hoogenboom (2006)	Free range chicken. 10% of dry matter intake.	**0.01**	0.007/ 0.15	kg/d

(a) Recommended discrete value in **bold**.

7.17 Tab: Agriculture/Food Crop

The human Food Crop tab parameters pertaining to field characteristics (biomass, growing period, yield, and translocation factor) are grouped in one section. The dry-to-wet ratio for food crops is covered in the next section.

7.18 Tabs: Agriculture/Food Crop/Biomass; /Growing Period; /Yield; and /Translocation Factor

This section covers human food crop categories: leafy vegetables, root vegetables,[1] fruit, and grain. The biomass, growing period, yield, and translocation factor parameters for animal feeds are covered in Section 7.13. The grain values should be comparable, if not the same, for both human food and animal feed. Grains are an important crop to consider as the per capita daily amount ingested (mass basis) is greatest for this category.

The most difficult food category to parameterize is the root vegetables because this category is essentially a catch-all for non-leafy and non-tree crops. As such it includes such wide-ranging crops as tomatoes, melons, strawberries, potatoes, carrots, and berries. The user should reasonably approximate the predominant human food crops grown in their region of interest, consider the volume of each food crop consumed, and then determine which crops are to be represented by the root vegetable category for their region.

Table 7.22 indicates a guideline for which crops fall into the four fixed Gv2 food categories. Some crops could be in two different categories, but the following guidance is suggested. A more detailed list of crops and Gv2 crop assignments is provided in Appendix D. Leafy vegetables are generally characterized as having a larger surface area to volume ratio. Difficult crops to model generically in Gv2 are tree nuts, fruit consumed as juice or wine, hops, and vegetable oils. If these foods are important to a scenario, they are best considered with a special Gv2 case supplemented with hand calculations.

Table 7.22. Suggested Categories for Food Crop Parameter Assignment

Leafy Vegetables	Root/Other Vegetables	Fruit	Grain
Head lettuce	Potatoes	Apples	Wheat
Romaine lettuce	Tomatoes	Citrus fruits	Corn
Leafy lettuce	Snap beans	Bananas	Lentils
Spinach	Green beans	Pears	
Cabbage	Carrots	Peaches	
Endive	Onions	Apricots	
Broccoli[(a)]	Cauliflower	Plums	
Brussels Sprouts	Celery	Cherries	
Asparagus[(a)]	Cucumber	Grapes	
	Zucchini		
	Melons		
	Onions		
	Peas		
	Peppers		
	Sweet potatoes		
	Sweet corn[(b)]		
	Pumpkin		
	Beans		
	Strawberries		

[1] The term “root vegetables” is also indicated as “other vegetables” in Gv2. The terms are used interchangeably.

Table 7.22. (contd)

Leafy Vegetables	Root/Other Vegetables	Fruit	Grain
	Raspberries		
	Blueberries		
	Mulberries[c]		
	Cranberries		
	Peanuts		

(a) Also could be considered root/other vegetable
(b) Also could be considered grain.
(c) Also could be considered fruit.

7.18.1 BIOMAS Biomass, GRWP Growing Period, YELD Yield, and TRANS Translocation Factor

The standing biomass for each human food crop type is the total above-ground plant mass (wet weight) used to estimate interception fractions for wet and dry deposition. Non-tree crop biomass values in the literature generally range from 0.1–3.0 kg/m2. Gv2 biomass values may be greater or less than yield values. For example, fruit biomass values are generally greater than fruit yield values, but biomass values for other food types may be approximately the same or less than yield values.

The growing period for each human food crop type defines the deposition period for irrigation and atmospheric deposition to plants. Water availability, crop nutrient availability, soil conditions, weather conditions, and other factors impact this value. For a given location, the user should review available data sources relevant to their region. To the extent possible, the growing period should reflect the growing period of the edible portion of the crop. Values for each crop type may be determined from a number of available data sources (e.g., frost-free days, days to maturity, planting-to-harvest dates).

The yield of each human food crop type gives the total annual production of edible feed crop mass (wet weight) per unit area of farmland. The yield is used to calculate the harvest removal losses from the soil. Radionuclide removal due to harvesting is modeled when opted on the Agriculture/General tab. This parameter only impacts scenarios that evaluate exposures which occur more than one-year after the release. Parameter assignment should consider whether the vegetative, non-edible portion of the crop is harvested with the crop. Parameter estimation should also consider the relative consumption rates of the various crops within the four fixed food types (leafy vegetables, other vegetables, fruit, and grain).

The translocation factor for each human food crop type is the fraction of activity depositing on the plant surface that is translocated to the edible part of the plant. This value differs from the bioconcentration factor (CLBVx) assigned in the Constituent module (see Section 2.1.17), which considers soil to plant transfer.

The root vegetables BIOMAS, GRWP, and YELD values are the most challenging food category parameters to assign. The root vegetable category encompasses a number of crops. It is recommended that the user determine the predominantly consumed (mass basis) non-leafy, non-fruit crops grown in their region, then determine growing periods, biomass, and yields for those particular crops to determine the best user-specific value to apply.

The units and range for BIOMAS in Gv2 are: kg_{wet}/m^2 (0.1–10).

The units and range for GRWP in Gv2 are: d (0–365).

The units and range for YELD in Gv2 are: kg_{wet}/m^2 (0.001–10).

The units and range for TRANS in Gv2 are: fraction (0–1).

The biomass was determined from USDA Census of Agriculture data in a manner similar to the animal feed (BIOMA2) data in Section 7.13.1. Specific crop and tree data (i.e., no crops grown; but native vegetation is modeled) are provided in Appendix G. Summary BIOMAS values are indicated in Table 7.27.

The Growing period reported in this document is based on planting and harvesting dates. USDA (2010) provided data on the planting and harvesting dates for a number of crops and by state. The data reflect 2008 or 2009 data. Grains are consumed by most people. Wheat is the predominant grain consumed per capita, and the types more commonly consumed are Spring and Winter wheat rather than durum wheat. Winter wheat has a long growing season, but is dormant for much of that time. GRWP data are summarized in Table 7.24; state-specific details are provided in the Appendix F. In reviewing the Appendix information, be cognizant of whether the crop is harvested multiple times over the growing season (e.g., melons, tomatoes, and berries) or harvested at the end of its growth cycle (e.g., wheat, potatoes, corn). For those harvested multiple times, a best estimate growing period closer to the minimum Appendix value would be more appropriate, whereas end-of-season crops would be approximated by average values.

The YELD values were determined from USDA Census of Agriculture data. Values for corn, wheat, and rice are presented with animal feed data in Table 7.15. Typically, total crop yields were divided by harvested acreage values. User-calculated values need to consider whether the vegetative, non-consumed, portion of the crop is harvested/removed annually; then consider whether the mass of the non-consumed plant mass is significant compared to the uncertainty in the crop yield value. If the non-consumed mass is harvested, approximate and document the additional fraction of the edible yield mass of the non-consumed mass, so that nuclide harvest removal can be better accounted. Summary YELD values are indicated in Table 7.27; crop-specific details are provided in the Appendix G. State-specific online data from the USDA should be pursued for scenarios. YELD and BIOMAS values should be coherent. The YELD and BIOMAS values are likely biased high since the values represent commercial agriculture and would not be harvested if harvest costs were not recoverable in the market.

Translocation values (TRANS) are generally assigned as 1 for leafy plants; a 0.9 "higher" value where 1.0 is not considered appropriate; or a 0.1 "lower" value where a small fraction is appropriate to assign from translocation. The "lower" value would be applied to root crops (e.g., potatoes), crops where the edible portion is covered by a surface that is removed prior to consumption (e.g., orange, watermelon), or the edible portion is sizable in comparison to the surface area available for deposition (e.g., medium to large tomatoes).

A determination was made for the BIOMAS and YELD values for the root/other vegetables category. Assumptions are indicated in the footnotes of Table 7.27. Strictly root and tuber vegetable values are somewhat distinct from non-underground crops in this category. Therefore, generic values for

underground and above-ground crops for the root/other vegetable category are provided and the user can determine which crops are more representative for their scenario, or alternatively to average the values.

7.18.1.1 Additional Sources of Information

The USDA Economics, Statistics, and Market Information System (e.g., http://usda.mannlib.cornell.edu/MannUsda/viewTaxonomy.do?taxonomyID=3) and the USDA Economic Research Service (e.g., http://www.ers.usda.gov/data-products/fruit-and-tree-nut-data.aspx) have summary information available on a variety of crops, including fruit, vegetables, nuts, berries, and field crops. In particular, biomass and yield information can be obtained from these resources. Some information is broken out by state, others are U.S. averages. The USDA Economics, Statistics, and Market Information System also provides summary information on U.S. per capita use of various crops, which can be used to estimate the mix of broad vegetative categories, such as "other vegetables."

USDA Agricultural Handbook 628 (USDA 2010). Provides planting and harvesting dates for a number of grain, feed, forage, and other crops. Agriculture Handbooks can be accessed at http://www.nal.usda.gov/ref/USDApubs/aghandbk.htm.

USDA Agricultural Handbook 507 (USDA 2007). Provides planting and harvesting dates for Vegetable crops. Data cover years 2004–2006. It can be accessed from the National Agricultural Library Digital Collections, last accessed at http://usda01.library.cornell.edu/usda/current/UsuPlant/UsuPlant-05-31-2007.pdf.

Growing Degree Days (GDD) can provide growing season information. GDD is a measure of the amount of time a crop is exposed to temperatures amenable to plant growth. More data is available for certain crop and plant species and for specific locations than others. Growing degree days calculators are available at several websites (e.g., http://www.weather.com/outdoors/agriculture/forecast/99352:4).

Another growing period source is information on *days to maturity* for various crops which can be found from various sources on the internet. Some sources provide regional information. No one source is recommended in particular.

7.18.1.2 BIOMAS, GRWP, YELD, TRANS Biomass, Growing Period, Yield, and Translocation Tables

Table 7.23. BIOMAS Standing Biomass – Human Food Crop Categories

Gv2_ID	Description	Food Type	Comment	Reported	Recom-mended[(a)]	Min/ Max	Units
BIOMAS	Biomass-food crop	1. Leafy vegetables	Assume biomass equals yield	Summarized data from Appendix	**2.6**	1.3/4.2	kg_wet/m^2
BIOMAS	Biomass-food crop	2. Other/Root vegetables	Above-ground crops. BIOMAS assumed to be 0.5 YELD for melon, tomatoes, peppers; equal to YELD for beans.	Assumed mix: 30% melon, 25% tomatoes, 25% beans, 20% peppers	1.3	1.2/1.5	kg_wet/m^2
BIOMAS	Biomass-food crop	2. Other/Root vegetables	Below-ground crops. BIOMAS assumed to be 0.5 YELD.	Assumed mix: 55% potatoes, 30% onions, 15% carrots	**2.2**	1.9/2.4	kg_wet/m^2
BIOMAS	Biomass-food crop	3. Fruit	Tree fruit. Assumed to be 0.25 YELD with foliage added (average 32 ft tree footprint)[(b)].	Assumed mix: 80% apples, 20% peaches	**3.7**	2.6/4.5	kg_wet/m^2
BIOMAS	Biomass-food crop	4. Grain	Assumed silage yield for corn BIOMAS.	Assumed mix: wheat 80%, silage 20%.	**1.1**	0.6/1.7	kg_wet/m^2

(a) **Bold** values are recommended for discrete input
(b) Jenkins et al. (2004).

Table 7.24. GRWP Growing Period – Human Food Crop Categories

Gv2 ID	Gv2 Description	Food Type	Reference	Comment	Extremes (d)	Active Period or Average (d)	Units
GRWP	Growing period	1.leafy	Calculated from USDA (2010)	-	56–137	75–103	d
GRWP	Growing period	2. root	Calculated from USDA (2010)	full range of crops included in category	36–365	110–152	d
GRWP	Growing period	2. root	Calculated from USDA (2010)	potatoes	98–139	127	d
GRWP	Growing period	2. root	Calculated from USDA (2010)	tomatoes	50–152	97	d
GRWP	Growing period	2. root	Calculated from USDA (2010)	generic potato/tomato	75–145	112	d
GRWP	Growing period	3.fruit	internet review	fruit set to harvest estimate; primarily apples		55–90	d
GRWP	Growing period	4.grain	Calculated from USDA (2010)	Spring wheat	100–141	105–131	d
GRWP	Growing period	4.grain	Calculated from USDA (2010)	Winter wheat	151–350	174–337	d
GRWP	Growing period	4.grain	Calculated from USDA (2010)	generic wheat, average of spring and winter wheat	125–245	140–234	d

Table 7.25. YELD Crop Yield – Human Food Crop Categories

Gv2_ ID	Description	Food Type	Comment	Reported	Recom-mended(a)	Min/Max	Units
YELD	Yield- food crop	1. Leafy vegetables	-	"All lettuce", see Appendix data.	**2.6**	1.3/4.2	kg_wet/m^2
YELD	Yield- food crop	2. Other/ Root vegetables	Above-ground crops	Assumed mix: 30% melon, 25% tomatoes, 25% beans, 20% peppers	2.5	2.1/2.7	kg_wet/m^2
YELD	Yield- food crop	2. Other/ Root vegetables	Below-ground crops	Assumed mix: 55% potatoes, 30% onions, 15% carrots	**4.3**	3.9/4.7	kg_wet/m^2
YELD	Yield- food crop	3. Fruit	Tree fruit	Assumed mix: 80% apples, 20% peaches. Foliage assumed to remain in orchard.	**2.6**	2.2/2.9	kg_wet/m^2
YELD	Yield- food crop	4. Grain	-	Assumed mix: wheat 80%, sweet corn 20%.	**0.92**	0.72/1.1	kg_wet/m^2

(a) Bold values are recommended for discrete input.

Table 7.26. TRANS Translocation (Surface to Edible Portion) – Human Food Crops

Gv2 ID	Gv2_Description	Food Type	Reference	Comment	Min	Max	Units
TRANS	Translocation fraction for human food crop	1.leafy	Assumption based on crop morphology	Surface area to volume ratio is "high"	1	1	fraction
TRANS	Translocation fraction for human food crop	2. root	Assumption based on crop morphology	Wide variation in of non-leafy and non-fruit crops. Edible portion below-ground or protected; or surface area to volume ratio of edible portion is "low"	0.1	0.25	fraction
TRANS	Translocation fraction for human food crop	3.fruit	Assumption based on crop morphology	Edible portion protected; surface area to volume ratio of edible portion is "low"; or leafy tree growing the edible crop	0.1	0.1	fraction
TRANS	Translocation fraction for human food crop	4.grain	Assumption based on crop morphology	grain	0.1	0.1	fraction

Table 7.27. Summary Table of BIOMAS, GRWP, YELD, TRANS

	Biomass (kg/m^2)	Growing Period (day)	Yield (kg/m^2)	Translocation (fraction)
Human Food Crop	BIOMAS	GRWP	YELD	TRANS
1.leafy	2.6[a,b]	56	2.6[a]	1.0
2.other (non-root)	1.3[b]	75	2.5[c]	0.8
2. other (root only)	2.2[b]	110	4.3[d]	0.1
3.fruit	3.7[e]	60	2.6[f]	0.1
4.grain	1.1[b,g]	120	0.92[g]	0.1

(a) "All lettuce" (lettuce, cabbage, broccoli, spinach).
(b) Assumed to be half the YELD value for melon, tomato, peppers, potatoes, onions, and carrots; and same as YELD for leafy, beans, wheat, and silage.
(c) Mass fractions assumed: 30% melon; 25% tomato; 25% snap beans; 20% peppers.
(d) Mass fractions assumed: 55% potatoes, 30% onions, 15% carrots.
(e) Tree foliage of 32 ft footprint tree plus 25% of YELD value.
(f) Mass fractions assumed: 80% apples; 20% peaches.
(g) Mass fractions assumed: 80% wheat and 20% silage for BIOMAS; 80% wheat and 20% sweet corn for YELD.

7.19 Tab: Agriculture/Food Crop/Dry-to-Wet Ratio

This section covers human food crop categories: leafy vegetables, root vegetables, fruit, and grain. Section 7.15 covers the dry-to-wet ratios for animal feed types. The grain values should be comparable, if not the same, for both animal feed and human food.

7.19.1 DRYFAC Dry-to-Wet Ratio

The dry-to-wet ratio for each food crop is used to convert between dry and wet weight bases. These data are also helpful when information found in open literature must be converted to the appropriate dry- or wet-bases for model input. Aquatic plant concentrations are modeled solely from bioconcentration from water with no sediment-to-plant uptake, as with terrestrial crop models. Therefore, no dry-to-wet ratios for aquatic foods are provided.

The units and range for this parameter in Gv2 are: fraction (i.e., kg_{dry}/kg_{wet}) (0.05–0.95).

Values were derived from two large data sets, USDA (2011) and Gebhardt and Thomas (2002). Extracts of some data are provided in Appendix H.

7.19.1.1 Additional Sources of Information

The USDA Agricultural Research Service publishes the National Nutrient Database for Standard Reference information providing nutrition information for numerous foods. The current Standard Reference is Release 24 (September 2011). Reports by single nutrient, one of which is water, are located at the link provided. Examples of relevant values derived at this link are 0.05 for head lettuce to 0.98 for dry nuts. Data was accessed Jan 2012 at http://www.ars.usda.gov/Services/docs.htm?docid=22114 Another more comprehensive link for the data is http://ndb.nal.usda.gov/; select "Start your search here",

and then choose a food group or scroll through the list. Once the food is selected, the variability in the data can be acquired by selecting "Statistics Report" near the top of the screen.

IAEA (2010) Appendix I, Table 82 through 85, provides a list of dry matter content (percentage basis) for a variety of feed and crop types.

7.19.1.2 DRYFAC Food Crop/Dry-to-Wet Ratio Tables

Table 7.28. DRYFAC Dry-to-Wet Ratio – Human Food Categories

Gv2_ID	Description	Food Type	Reference	Comment	Recom-mendation[(a)]	Min Value	Max Value	Units
DRYFAC	Dry/Wet ratio	1. Leafy vegetable	USDA (2011); Gebhardt and Thomas (2002)	lettuces, edible greens, spinach, cabbage, broccoli	**0.08**	0.05	0.12	dry/wet
DRYFAC	Dry/Wet ratio	2. Other vegetables	USDA (2011); Gebhardt and Thomas (2002)	Root vegetables	**0.20**	0.09	0.33	dry/wet
DRYFAC	Dry/Wet ratio	2. Other vegetables	USDA (2011); Gebhardt and Thomas (2002)	Non-root vegetables, ground-growing fruits, sweet corn	0.25	0.06	0.31	dry/wet
DRYFAC	Dry/Wet ratio	3. Fruit	USDA (2011); Gebhardt and Thomas (2002)	Tree fruit, Tree nuts, fruit on supported vines	**0.25**	0.11	0.95	dry/wet
DRYFAC	Dry/Wet ratio	4. Grain	USDA (2011); Gebhardt and Thomas (2002)	predominantly wheat, some corn prior to drying	**0.22**	0.18	0.30	dry/wet_as grown

(a) Recommended generic value in **bold**. Most commonly consumed foods from the food category considered in recommended estimate.
(b) Appropriate values to use for dry/wet_as eaten would be recommended (min/max) of 0.90 (0.88–0.91). These values would NOT be applied in Gv2, but could be used for conversion from literature values.

7.20 Tab: Agriculture/Intake Delays

The intake delay for the ingestion pathway for human foods is assigned in the Agriculture/Intake Delays tab. Intake delays for food crops, terrestrial animal products, and aquatic foods are covered in this section. See Section 7.14 for delay times between harvest and animal consumption for animal feed crops (STORTM).

7.20.1 HLDUP, HLDUPA, and HLDUP2 Intake Delays for Crops, Animal Products, and Aquatic Foods

The HLDUP parameter assigns intake delays for food crops (leafy vegetables, root vegetables, fruit, and grain). The HLDUPA parameter assigns intake delays for animal products consumed by people (meat, poultry, milk, and eggs). The HLDUP2 parameter assigns intake delays for aquatic foods (fish, mollusca, crustacea, and aquatic plants), when surface water scenarios are evaluated.

Although a number of feeds and dried, frozen, or processed foods can be stored longer than a year, the maximum storage time is limited in the Gv2 code to 365 d. The user can run a separate evaluation to determine emissions in year 1 and consumption in year 2, if this scenario detail is important.

The units for HLDUP, HLDUPA, and HLDUP2 in Gv2 are: d (0–365).

Assignment of intake delay values depends on the type of scenario being evaluated – whether MEI or population average. MEI scenarios assume more local food consumption and therefore, shorter intake delays. Population scenarios assume more consumption of commercially-purchased food and longer hold-up times are more likely. The shelf-life of various foods will provide a measure of upper-bound values for hold-up times. Storage times for a variety of food categories are provided in Appendix I. The appendix tables are more applicable to retail food purchases, rather than backyard sources. To support the determinations of population scenario intake delay times, Table 8.9 indicates per capita food consumption and provides an indication of the fractions and types of crops consumed fresh, frozen, and canned.

The U.S. Department of Agriculture, Food Safety Inspection Service, provides information regarding food storage. It is worth noting that foods frozen at 0 degrees F or lower remain safe indefinitely, but food quality will degrade after a certain amount of time (USDA 2012). However, code limits provide an upper bound assumption of 365 d.

7.20.1.1 Additional Sources of Information

There are numerous internet resources regarding food shelf-life.

The United Nations Food and Agriculture Organization and World Health Organization publish the Codex Alimentarius which are international food standards, guidelines, and codes of practice (website: http://www.codexalimentarius.org/codex-home/en/). The Codex Alimentarius ("food code") is a global reference point for consumers, food producers and processors, and national food control agencies. Official food standards were created for a number of foods and are available on the internet (last accessed at http://www.codexalimentarius.org/standards/list-of-standards/). Recommended practices for General Principals of Food Hygiene are also available at the same location. This hygiene information is generalized, but provides an overview of issues related to maintaining edible foods. FAO information is not specific to the hold-up parameter, but provides comprehensive information for various foods.

7.20.1.2 HLDUP, HLDUPA, and HLDUP2 Human Consumption Intake Delays for Crops, Animal Products, and Aquatic Foods Tables

Table 7.29. HLDUP, HLDUPA, HLDUP2 Hold-Up Time by Food Category

Gv2 ID	Gv2_Description	Food Type	Comment	MEI Scenario Recommended	POP Scenario Recommended	Units
HLDUP	Intake delay between harvest and consumption.	1.leafy vegetable	POP Assumed predominantly fresh, but some canned or frozen.	5	14	d
HLDUP	Intake delay between harvest and consumption.	2.other vegetable	POP Assumed 50% fresh/ 25% canned/25% frozen.	5	80	d
HLDUP	Intake delay between harvest and consumption.	3.fruit	POP Assumed half fresh and half juice.	5	80	d
HLDUP	Intake delay between harvest and consumption.	4.grain	Predominantly wheat.	180	270	d
HLDUPA	Intake delay between harvest and consumption.	1.meat	Predominantly beef and pork.	15	30	d
HLDUPA	Intake delay between harvest and consumption.	2.poultry	Assumed all chicken.	15	30	d
HLDUPA	Intake delay between harvest and consumption.	3.dairy	POP Assumed 75% milk, 25% other dairy.	3	10	d
HLDUPA	Intake delay between harvest and consumption.	4.egg	Chicken egg.	5	15	d
HLDUP2	Intake delay between harvest and consumption.	1.fish		2	15	d
HLDUP2	Intake delay between harvest and consumption.	2.mollusk		2	15	d
HLDUP2	Intake delay between harvest and consumption.	3.crustacean		2	15	d
HLDUP2	Intake delay between harvest and consumption.	4.aquatic plant	No intake assumed. Special case application.	0	0	d

7.21 References: Chronic Exposure Module

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8.0 Module: Receptor Intake

The Receptor Intake module is downstream of the Exposure Pathways module and upstream of the Health Impacts module. Receptor intakes describe behavioral factors for the receptor of interest. This receptor may be the maximally exposed individual (MEI) or the average member of the population. The user will need to determine the receptor required to address the purpose of the assessment. MEI parameters are prudent overestimates of exposure and intake rates, and address the question "what's the reasonably worst case impact?" Population estimates use average exposure and intake rate and indicate the average impact to the average person in the evaluated location or region.

The impact measure of importance to radioactive material exposure is radiation dose. Dose can come from internal radionuclide exposures from inhalation, ingestion, or less frequently from dermal uptake. Additional dose can result from external exposure to radioactive material external to the body. Internal dose varies by age at which the inhalation or ingestion intake occurs. Age-dependent inhalation and ingestion dose factors were published in ICRP Reports 68, 69, 71, and 72 (ICRP 1994b, 1995a, 1995b, 1995c). To apply the internal dose factor data most effectively, the intake data will be presented in the age categories considered for the age-dependent dose factors (Table 8.1). External dose factors have not been calculated on an age-dependent basis. Therefore, any air, ground, or water external exposure routes will apply the same pathway-appropriate dose factor to all ages.

Table 8.1. Age Ranges of Six Age Categories

Age Category	Minimum (yr)	Maximum (yr)
1	0	1.49
2	1.5	2.49
3	2.5	7.49
4	7.5	12.49
5	12.5	17.49
6	17.5	100

Note: If age category reported as 0, assume the value is applicable to all age categories.

MEI characteristics for sites that routinely calculate dose estimates have stronger technical roots than population dose characteristics. MEI intake and exposure rates reported from historical sources can be used as a comparison set when establishing MEI values for a new site or considering comparative values for average or representative individual values or population values.

EPA published an updated Exposure Factors Handbook in 2011 (EPA 2011). The Exposure Factors Handbook is a resource used to provide guidance for risk assessment data applications. The data compilation and summaries is considered the best available for current model input. It also includes input data that allows the user to adjust the input value to their specific assessment purpose. Values for GENIIv2 input were derived from this reference. Recommended values are presented by age category and receptor type (i.e., MEI and population), with some indication of variability when possible. The user can refer to EPA (2011) for details on variability, data quality, and other information.

The screen tab format is not used in this module. As in the Receptor Intake module screen, parameters listed below are grouped by exposure/intake pathway. If a source pathway (e.g., surface water) is not relevant the pathway parameter values need not be zeroed out. They simply will not be used in any calculation.

8.1 Pathway Selection: External Exposure (multiple)

Several external exposure pathways require parameterization to define the exposure scenario. Table 8.2 indicates the sources of contamination for external exposure pathways.

Table 8.2. Receptor Intake Module External Exposure Parameters

Source of Contamination	Pathway Selection	Media Causing Exposure
Air	External exposure to air	Plume
Air and Water	External exposure to ground	Ground – from plume deposition, soil contamination, and irrigation application
Water	External exposure while swimming	Surface water
	External exposure while boating	Surface water
	External Exposure to shoreline	Shoreline – from surface water

8.1.1 External Exposure: Air and Ground

Plume exposure from radioactive material in the air is estimated with exposure parameters for hr/d (UEXAIR) and d/yr (TEXAIR). Ground exposure, from air and irrigation deposition, is calculated in a similar manner with UEXGRD and TEXGRD parameters, but allows for separate definition of indoor vs. outdoor shielding factors (SHIN and SHOUT) and specification of time spent indoors and out (FTIN and FTOUT).

Shielding factors are characteristic of the material between the surface deposition and the individual and are those appropriate for shielding of gamma radiation. They typically represent building materials. Applying appropriate shielding factors are generally more important for accident scenarios or chronic scenarios involving soil contamination exposure, rather than scenarios of low levels of chronic airborne emissions. A shielding factor of 1.0 is equivalent to no shielding.

When considering the fraction of time spent indoors and out, it is unnecessary for the indoor and outdoor fractions to add up to one if the individual is assumed to be "off location" for a fraction of the time. The user is responsible for making sure that the indoor and outdoor fractions add to the total fraction that the individual remains at a single grid location and for making sure that FTIN and FTOUT add to 1.

Ground exposure to shoreline soil from surface water contamination is addressed separately in the next section (Section 8.1.2).

- Air (plume) Exposure
  - The units and range for UEXAIR in Gv2 are: hr (0–24)
  - The units and range for TEXAIR in Gv2 are: d (0–365)
- Ground Exposure
  - The units and range for UEXGRD in Gv2 are: hr (0–24)
  - The units and range for TEXGRD in Gv2 are: d (0–365)
  - The units and range for FTIN and FTOUT in Gv2 are: fraction (0–1)
  - The units and range for SHIN and SHOUT in Gv2 are: fraction (0–1).

Air Exposure

Daily and annual exposure time to the plume should reflect occupancy at the location of interest. Constant occupancy is indicative of conservative residential exposure scenarios. Worksite occupancy for stationary jobs would be indicated by 9 hr/d, 250 d/yr for a typical 8 hr/d work schedule. School exposure times could assume 7 hr/d, 180 d/yr. Assignment of school occupancy would depend on whether the school is located in the area of interest or outside the area of interest.

Ground Exposure

Shielding factors can be conservatively set to 1.0. Smaller shielding factors should be applied when ground contamination is a significant dose contributor to external dose. Jacob and Meckback (1987) indicate issues important to shielding factor determinations: more wet deposition and less vegetation results in less source strength; tree depositions will result in higher source strengths than lawn depositions; indoor deposition in openly ventilated homes is comparable to dry lawn depositions. They also looked at age-dependent doses and proposed factors of up to an 80 percent dose increase to youth since all their tissues are in closer proximity to the contaminated modeled plane. Shielding factors generally range from 0.2 to 0.8. Structures with dense, thick materials have shielding factors in the lower end of this range, or even lower if gamma energies of 500 keV or less are considered (LeGrand et al. 1987).

The user is responsible for aligning the fraction of time spent indoors and outdoors (FTIN and FTOUT) for external exposures with the indoor and outdoor fractions for inhalation exposure (see Section 8.5.1). The FTIN and FTOUT values tabulated in Section 8.1.1.3 apply to the residential MEI and population individuals. The values reflect the mostly indoor lifestyles of most of the United States. See the MEI table footnote for important information. Maximizing FTOUT values would be 1.0. Occupational times would apply to age group 6, only.

8.1.1.1 Additional Sources of Information

See Chapter 16 of EPA (2011) for extensive details regarding activity factors.

The U.S. Census conducts an American Housing survey that includes information regarding the primary exterior wall materials used for single-family homes, by year and region. The year of construction of the houses in a region is also available. This information can be helpful when determining regionally specific material to assume for generic residential shielding factors. See http://www.census.gov/housing/ahs/data/national.html.

An NRC poster presentation (Barr et al. 2010) provides an excellent overview of shielding factors and summarizes SHIN options. Available at: http://pbadupws.nrc.gov/docs/ML1006/ML100610262.pdf.

Due to the high inherent uncertainty of shielding factors, radionuclide-specific values are rarely considered. However, Leung (1992) provides a glimpse of how shielding factors vary by nuclide.

8.1.1.2 UEXAIR, TEXAIR Air and Ground External Exposure Time Tables

Table 8.3. UEXAIR and TEXAIR Plume Exposure Time

Gv2_Description	Age[a]	Qualifier	Reference	Comment	UEXAIR (hr/d)	TEXAIR (d/yr)
External exposure, Plume Air	0	MEI	generic assumption	residential	24	365
External exposure, Plume Air	1–4	MEI	generic assumption	location of interest is workplace	0	0
External exposure, Plume Air	5	MEI	generic assumption	location of interest is workplace	4	130
External exposure, Plume Air	6	MEI	generic assumption	location of interest is workplace	9	250
External exposure, Plume Air	1	MEI	generic assumption	location of interest is school/daycare	8	125
External exposure, Plume Air	2	MEI	generic assumption	location of interest is school/daycare	8	125
External exposure, Plume Air	3	MEI	generic assumption	location of interest is school/daycare	7	180
External exposure, Plume Air	4	MEI	generic assumption	location of interest is school/daycare	7	180
External exposure, Plume Air	5	MEI	generic assumption	location of interest is school/daycare	8	200
External exposure, Plume Air	6	MEI	generic assumption	location of interest is school/daycare	0	0

(a) See Table 8.1 for age groups.

Gv2_Description	Age[a]	Qualifier	Reference	Comment	UEXAIR (hr/d)	TEXAIR (d/yr)
External exposure, Plume Air	0	POP	generic assumption	residential	22	360
External exposure, Plume Air	1-4	POP	generic assumption	location of interest is workplace	0	0
External exposure, Plume Air	5	POP	generic assumption	location of interest is workplace	3	80
External exposure, Plume Air	6	POP	generic assumption	location of interest is workplace, some off-location travel assumed	9	200

Table 8.3. (contd)

Gv2_Description	Age[a]	Qualifier	Reference	Comment	UEXAIR (hr/d)	TEXAIR (d/yr)
External exposure, Plume Air	1	POP	generic assumption	location of interest is school/childcare	1	365
External exposure, Plume Air	2	POP	generic assumption	location of interest is school/childcare	1	365
External exposure, Plume Air	3	POP	generic assumption	location of interest is school/daycare	4	180
External exposure, Plume Air	4	POP	generic assumption	location of interest is school/daycare	7	180
External exposure, Plume Air	5	POP	generic assumption	location of interest is school/daycare	7	180
External exposure, Plume Air	6	POP	generic assumption	location of interest is school/daycare	0	0

(a) See Table 8.1 for age groups.

8.1.1.3 FTIN, FTOUT Air and Ground Exposure Fraction Tables

Table 8.4. FTIN and FTOUT Fraction of Time Indoors and Outdoors

Gv2_ID	Gv2_Description	Age[a]	Qualifier	Reference	Comment	FTIN	FTOUT[b]	Units
FTIN, FTOUT	Fraction of time indoors, outdoors	1	MEI	EPA (2011)	FTOUT based on (1-FTIN)	1	0	fraction
FTIN, FTOUT	Fraction of time indoors, outdoors	2	MEI	EPA (2011)	FTOUT based on (1-FTIN)	1	0	fraction
FTIN, FTOUT	Fraction of time indoors, outdoors	3	MEI	EPA (2011)	FTOUT based on (1-FTIN)	0.94	0.06	fraction
FTIN, FTOUT	Fraction of time indoors, outdoors	4	MEI	EPA (2011)	FTOUT based on (1-FTIN)	0.89	0.11	fraction
FTIN, FTOUT	Fraction of time indoors, outdoors	5	MEI	EPA (2011)	FTOUT based on (1-FTIN)	0.9	0.1	fraction
FTIN, FTOUT	Fraction of time indoors, outdoors	6	MEI	EPA (2011)	FTOUT based on (1-FTIN)	1	0	fraction

(a) See Table 8.1 for age groups.
(b) Maximizing the MEI would assign FTIN and FTOUT values of 0 and 1.0, respectively. Reported values indicate fraction of time spent indoors for scenarios where indoor contamination was of primary concern. If shielding fractions are set to 1.0, then apply values as reported. If shielding values are not zero, assign indicated FTIN to the FTOUT parameter entry and indicate FTOUT to the FTIN entry for conservatism.

Gv2 ID	Gv2_Description	Age[a]	Qual-ifier	Reference	Comment	FTIN Range	FTIN	FTOUT	Units
FTIN, FTOUT	Fraction of time indoors, outdoors	1	POP	EPA (2011)	FTOUT based on (1-FTIN)	0.77–1	1	0	fraction
FTIN, FTOUT	Fraction of time indoors, outdoors	2	POP	EPA (2011)	FTOUT based on (1-FTIN)	0.68–0.94	0.81[b]	0.19	fraction
FTIN, FTOUT	Fraction of time indoors, outdoors	3	POP	EPA (2011)	FTOUT based on (1-FTIN)	0.66–0.89	0.77[b]	0.23	fraction
FTIN, FTOUT	Fraction of time indoors, outdoors	4	POP	EPA (2011)	FTOUT based on (1-FTIN)	0.62–0.86	0.74[b]	0.26	fraction
FTIN, FTOUT	Fraction of time indoors, outdoors	5	POP	EPA (2011)	FTOUT based on (1-FTIN)	0.58–0.88	0.73[b]	0.27	fraction
FTIN, FTOUT	Fraction of time indoors, outdoors	6	POP	EPA (2011)	FTOUT based on (1-FTIN)	0.66–0.82	0.74[b]	0.26	fraction

(a) See Table 8.1 for age groups.
(b) FTIN datum values were calculated as simple averages of the reported range.

8.1.2 External Exposure: Surface Water from Swimming, Boating, and Shoreline

The surface water pathway has three routes of external exposure: water immersion during swimming; water while in a boat; and shoreline contamination from water exposure. These parameters reflect exposure to the contaminated water source. Any water activity at non-contaminated sources is not included in the parameterization. The ground exposure from air deposition and irrigation water application is addressed in Section 8.1.1.

Swimming exposure uses three parameters to calculate external exposure from swimming: number of swimming events per day (EVSWIM), duration of a "swimming event" (TESWIM), number of days that swimming occurs in a year (TSWIM). The product of these three parameters indicates the hours of swimming time in a year. The "External exposure while swimming" pathway selection also prompts for the hourly water ingestion rate while swimming. The user is responsible for entering the same values in the Pathway Selections: External Exposure While Swimming and Water Ingestion while Swimming (see Section 8.3.3) parameters.

Boating external exposure uses four parameters to characterize: shielding factor (SFBOAT), frequency of boating events (EVBOAT), duration of a "boating event" (TEBOAT), and the number of days that boating is done in a year (TBOAT). The product of EVBOAT, TEBOAT, and TBOAT indicate the total boating hours in a year. Assuming most scenarios will not assume an individual is boating on highly contaminated waterways, a shielding factor of 1 should be assigned in virtually all routine emissions calculations. Other shielding factors, for building materials, are discussed in Section 8.1.1.

Shoreline exposure uses four parameters for characterization: daily frequency of shoreline events (EVSHOR), duration of a "shoreline event" (TESHOR), number of days that an individual partakes in shoreline activities in a year (TSHOR), and a shoreline width factor (SWFAC). The product of EVSHOR, TESHOR, and TSHOR indicate the hours of shoreline activity in a year. The shoreline width factor corrects for the fact that a person does not remain at, roughly, the average high water mark the entire time of their shoreline event.

- Swimming
  - The units and range for EVSWIM in Gv2 are: events/d (0–10)
  - The units and range for TESWIM in Gv2 are: hr (0–24)
  - The units and range for TSWIM in Gv2 are: d (0–365)
  - The units and range for USWIM in Gv2 are: L/hr (0–10)
- Boating
  - The units and range for SFBOAT in Gv2 are: fraction (0–1)
  - The units and range for EVBOAT in Gv2 are: events/d (0–10)
  - The units and range for TEBOAT in Gv2 are: hr (0–24)
  - The units and range for TBOAT in Gv2 are: d (0–365)

- Shoreline
  - The units and range for EVSHOR in Gv2 are: events/d (0–10)
  - The units and range for TESHOR in Gv2 are: hr (0–24)
  - The units and range for TSHOR in Gv2 are: d (0–365)
  - The units and range for SWFAC in Gv2 are: fraction (0–1).

Swimming

The number of daily swim events, time per event, and swimming days per year is arbitrarily assigned as 1 event/d, 2 hr/event, and 5 d/yr for all age groups. The user must determine if these values are appropriate to their location. The incidental swimming ingestion rates (USWIM) are derived from EPA (2011) with the adult rate assigned to age group 6 and the children rate assigned to all other age groups. No incidental swimming ingestion is assigned for age category 1 (i.e., 1 year-old). The MEI is assumed to ingest the 97th or 95th percentile value reported, while the population is assigned the average value.

Boating

A shielding factor of 1.0 is recommended as a conservative assumption, meaning no shielding. Shielding value determinations would consider the height of the individual above the water surface and the construction material of the boat. Other boating parameter recommendations are somewhat arbitrary. The number of daily boating events, duration of the boating event, and boating days per year is assigned as 1 event/d, 1 hr/event, and 5 d/yr for all age groups. The user must determine if these values are appropriate to their location.

Shoreline

As with the other water recreation assumptions, the participation rate in shoreline activities is assigned somewhat arbitrarily. The number of daily shoreline events, duration of event, and number of annual shoreline days is assigned as 1 event/d, 3.3 hr/event, and 5 shoreline d/yr for all age groups. The user must determine if these values are appropriate to their location. No strong age-dependent information for water recreation times was identified. The shoreline width factors of NRC (1977, aka, Reg Guide 1.109), Table A-2, are still valid. The shoreline width factor can be approximated by the ratio of the (horizontal distance from the average high water mark to the average water level location) to the (total horizontal shore distance, i.e., total shore depth). A default shoreline width factor of 0.2 is assumed, considering a typical mixed fission source term is involved.

8.1.2.1 Additional Sources of Information

See Chapter 16, Table 16-1, of EPA (2011) for recommendations for mean and 95th percentile minutes per month for swimming, by age.

See Chapter 16, Table 16-77 in the Moderately Active Activities row, of EPA (2011) for estimates of minutes per 2-d-period spent, in part, boating; values listed for children, by sex and age.

See Chapter 3, Table 3-93, of EPA (2011) for details regarding swimming water ingestion during boating, canoeing, fishing, kayaking, rowing, and wading.

8.1.2.2 Swimming Tables (EVSWIM, TESWIM, TSWIM, USWIM)

For EVSWIM, TESWIM, and TSWIM, see text above.

Table 8.5. USWIM Incidental Ingestion Rate of Swimming Water

Gv2 ID	Gv2 Description	Age[(a)]	Qualifier	Reference	Comment	Data Reported	Value	Units
USWIM	Ingestion rate of water while swimming	2	MEI	EPA (2011)	Chap 3, 97th percentile	97th percentile child	0.12	L/hr
USWIM	Ingestion rate of water while swimming	3	MEI	EPA (2011)	Chap 3, 97th percentile	97th percentile child	0.12	L/hr
USWIM	Ingestion rate of water while swimming	4	MEI	EPA (2011)	Chap 3, 97th percentile	97th percentile child	0.12	L/hr
USWIM	Ingestion rate of water while swimming	5	MEI	EPA (2011)	Chap 3, 97th percentile	97th percentile child	0.12	L/hr
USWIM	Ingestion rate of water while swimming	6	MEI	EPA (2011)	Chap 3, 95th percentile	95th percentile adult	0.071	L/hr

(a) See Table 8.1 for age groups.

Gv2 ID	Gv2 Description	Age[(a)]	Qualifier	Reference	Comment	Data Reported	Value	Units
USWIM	Ingestion rate of water while swimming	2	POP	EPA (2011)	Chap 3, average	average child	0.049	L/hr
USWIM	Ingestion rate of water while swimming	3	POP	EPA (2011)	Chap 3, average	average child	0.049	L/hr
USWIM	Ingestion rate of water while swimming	4	POP	EPA (2011)	Chap 3, average	average child	0.049	L/hr
USWIM	Ingestion rate of water while swimming	5	POP	EPA (2011)	Chap 3, average	average child	0.049	L/hr
USWIM	Ingestion rate of water while swimming	6	POP	EPA (2011)	Chap 3, average	average adult	0.021	L/hr

(a) See Table 8.1 for age groups.

8.1.2.3 Boating Tables (SFBOAT, EVBOAT, TEBOAT, TBOAT)

See text, above. No tabulation necessary.

8.1.2.4 Shoreline Sediments Tables (EVSHOR, TESHOR, TSHOR, SWFAC)

See text above. No tabulation necessary.

8.2 Pathway Selection: Food Ingestion (multiple)

Food ingestion pathways require assignment of intake rates and consumption periods. The Pathway Selections are broken out by food crops, animal products, and aquatic food. All consumption periods for food crops (TCRP), animal products (TANM), and aquatic foods (TAQU) should be assigned as 365 d/yr. Table 8.6, Table 8.7, and Table 8.8 indicate the food types consumed by humans and examples of each. For use in reading Gv2 GID files, the ANFLabel, TFDLabel, and AQDLabel coding is indicated. Parameters related to the animal feed and forage crops of Table 8.6 were completed in the Exposure module, above. They are listed here as an indication of how crops are modeled to travel through the food chain to humans.

Note: There is no modeling of loses during food preparation in Gv2. If the assumption of nuclide loss during food preparation is desired, as indicated in IAEA (2010), external calculations could be performed on the scenario RIF or HIF files.

Table 8.6. Gv2 Animal Product Food Types and Examples

ANFLabel	Human Exposure and Receptor Modules – Food Types	Examples or Comment	Feed	Forage
1	meat animal	beef, pork	Silage+ Grain	Hay+ grain
2	poultry animal	chicken, turkey	Grain	N/A
3	milk animal	milk from cow or goat	Silage+ Grain	Grass
4	egg animal	egg from chicken	Grain	N/A

Table 8.7. Gv2 Crop Food Types and Examples

TFDLabel	Human Exposure and Receptor Modules – Food Types	Examples or Comment
1	leafy vegetables	lettuce, spinach
2	root vegetables	carrot, potato
3	fruits	apple, plum
4	grains	Primarily wheat. Others, barley, oats

Table 8.8. Gv2 Aquatic Foods Food Types and Examples

AQFLabel	Human Exposure and Receptor Modules – Food Types[(a)]	Examples or Comment
1	fish (fw)	pelagic fish - bass, trout
2	mollusks (fw)	freshwater mussels, snails
3	crustacea (fw)	crayfish, freshwater shrimp
4	aquatic plants (fw)	watercress, water chestnut
1	fish (marine)	pelagic fish - tuna, salmon
2	mollusks (marine)	squid, oyster, clam, scallop
3	crustacea (marine)	crab, lobster, shrimp
4	aquatic plants (marine)	seaweed

(a) fw = Freshwater biota.

Table 8.9 indicates the per capita consumption of major food commodities (mass per year) by retail mass. More important than its consumption rate information which would require correction for preparation losses is the information it provides regarding the fresh and processed fractions of food types consumed. When the relevant detailed information is available, this data can be used to apply appropriate bioconcentration factors in the Constituents module and intake delay times in the exposure module. It can also be used to appropriately distribute relative consumption rates of various food types (e.g., chicken intakes are about 65 percent of red meat intakes).

Table 8.9. Distribution of Per Capita Food Consumption (lb/yr) from 2000 to 2009

	2000–2009 Average[(a)]	2000–2009 Min[(a)]	2000–2009 Max[(a)]	2009[(a)]	2009 Percent of Category Total
Red meats total[(b)]	**110.6**	105.7	114.1	**105.7**	-
Beef	62.2	58.1	64.5	58.1	55%
Veal	0.4	0.3	0.5	0.3	0.3%
Lamb and mutton	0.8	0.7	0.9	0.7	0.7%
Pork	47.2	45.9	48.5	46.6	44%
Poultry total[(b)]	**71.4**	67.8	74.2	**69.4**	-
Chicken	57.8	54.0	60.9	56.0	81%
Turkey	13.6	13.2	14.0	13.3	19%
Fish and shellfish[(b)]	15.9	14.7	16.5	15.8	-
Eggs (number)	**253**	246	258	**246**	-
Listed Dairy Products total	**596.5**	585.2	607.1	**607.1**	-
Cheese total (excluding cottage cheese)	**31.5**	29.4	33.7	**32.8**	-
American	12.9	12.5	13.4	13.4	41%
Italian	13.2	12.1	14.3	13.9	42%
Other	5.4	4.8	6.0	5.5	17%
Cottage cheese	2.6	2.3	2.7	2.4	-
Beverage milks (gallons)	21.3	20.6	22.5	20.6	-
Fluid cream products (1/2 pints)[(c)]	22.4	18.3	24.7	23.6	-
Yogurt (excluding frozen) (1/2 pints)	17.7	12.0	23.1	23.1	-
Ice cream	15.1	13.4	16.7	13.4	-

Table 8.9. (contd)

	2000–2009 Average[(a)]	2000–2009 Min[(a)]	2000–2009 Max[(a)]	2009[(a)]	2009 Percent of Category Total
Low-fat ice cream	7.0	6.5	7.5	6.8	-
Sherbet	1.2	1.1	1.3	1.1	-
Frozen yogurt	1.4	1.1	2.0	1.1	-
Fats and oils[(d)]	**84.3**	78.6	87.3	**78.6**	-
Butter (product weight)	4.6	4.4	5.0	4.9	7%
Margarine (product weight)	5.3	3.7	8.2	3.7	5%
Lard (direct use)	1.3	0.8	1.7	1.5	2%
Edible beef tallow (direct use)	3.2	0.7	4.0	0.7	1%
Shortening	27.0	15.9	32.8	15.9	21%
Salad and cooking oils	43.3	33.7	54.2	51.9	69%
Other edible fats and oils	1.6	1.3	2.1	1.7	2%
Flour and cereal products[(e)]	**194.3**	191.3	199.2	**194.5**	-
Wheat flour	137.5	134.3	146.3	134.6	69%
Rice, milled	20.1	18.9	21.2	21.2	11%
Corn products	31.0	28.4	33.0	33.0	17%
Caloric sweeteners, total[(f)]	**140.9**	130.7	148.9	**130.7**	-
Sugar, refined cane and beet	63.2	60.9	65.5	63.5	49%
Corn sweeteners[(g)]	76.3	65.7	81.8	65.7	50%
Fruits and vegetables[(h)]					
Fruit total	**271.2**	256.6	286.0	**257.0**	-
Fresh fruits	126.7	123.5	128.5	127.5	50%
Canned fruit	16.5	15.4	17.6	15.5	6%
Dried fruit	9.9	9.2	10.5	9.2	4%
Frozen fruit	4.8	4.1	5.3	4.9	2%
Selected fruit juices	112.8	99.0	124.6	99.2	39%
Vegetables total	**410.8**	390.9	424.6	**390.9**	-
Fresh	196.0	184.8	204.5	184.8	47%
Canning	99.4	94.4	104.8	100.4	26%
Freezing	76.4	71.3	79.4	71.3	18%
Dehydrated and chips	31.7	27.4	34.5	27.4	7%
Legumes	7.3	6.7	8.5	6.9	2%
Other/Miscellaneous					
Cocoa beans	5.8	4.8	6.5	5.5	-
Coffee (green beans)	9.5	9.1	10.3	9.1	-
Peanuts (shelled)	6.3	5.8	6.6	6.5	-
Tree nuts (shelled)	3.2	2.6	3.7	3.7	-

Table derived from **Food Supply and Use; Table 39--Per Capita Consumption of Major Food Commodities**. Found at http://www.ers.usda.gov/Publications/AgOutlook/AOTables/.
(a) Pounds retail weight unless otherwise indicated.
(b) Boneless trimmed weight.
(c) Includes heavy cream, light cream, half-and-half, and eggnog.
(d) Fat content mass, only.
(e) Includes rye, corn, oats, and barley products.
(f) Dry weight. Includes edible syrups (e.g., maple, molasses, honey)
(g) Includes high fructose corn syrup, glucose, and dextrose.
(h) Farm weight.

8.2.1 Ingestion Exposure: Food Crops

Four food crop groups considered: leafy vegetables, root vegetables, fruit, and grain.

Set all consumption periods (TCRP) for all food groups and age groups to 365.

The units and range for UCRP in Gv2 are: kg/d (0–10).

The units and range for TCRP in Gv2 are: d/yr (0–365).

Information at www.census.gov/compendia/statab/cats/health_nutrition/food_consumption_and_nutrition.html provides United States per capita consumption rates (mass based) for a variety of food categories over time.

Values are derived from EPA (2011), which are presented in units of kg/kg-d based on the body weight of the consumer. Assumed age-specific body weights used for units conversions are indicated in Table 8.10, from EPA (2011, Chapter 8). Then, intakes are averaged to determine Gv2 age-specific values, as indicate in the table.

Table 8.10. Age-Specific Body Weights.

Age Group	kg	Gv2 Age Category[(a)]
Birth to 1 year	6.825	1
1 to <2 years	11.4	1
2 to <3 years	13.8	2
3 to <6 years	18.6	3
6 to <11 years	31.8	4
11 to <16 years	56.8	5
16 to <21 years	71.6	5
21 to <50 years	80	6
≥50 years	80	6

(a) See Table 8.1 for age ranges in each age category.

8.2.1.1 Additional Sources of Information

http://www.ars.usda.gov/Services/docs.htm?docid=22112. The USDA Agricultural Research Service publishes the National Nutrient Database for Standard Reference information providing nutrition information for numerous foods. Among the groups of foods reported are dairy and egg, finfish and shellfish, beef and other specific meat groups, fruits and juices, legumes, and vegetables. Useful information includes water content, mineral content, percent of refuse for specific foods, and mass of cooked meat from raw meat. The data were derived from Gebhardt and Thomas (2002), which also provides a table of particular foods high in evaluated minerals (Gebhardt and Thomas 2002, Table 5).

The USDA Agricultural Handbook Number 697 (USDA 1992) provides weights, measures, and conversion factors for agricultural commodities and their products. Conversions from farm weights are provided. Table 27 indicates corn fractions for various foods containing corn. Wheat, soybeans, and oils are covered in other tables. Table 38 indicates the mass of canned product from average masses of

farm-weight fresh product. Table 40 indicates farm-weight per final volume of various juices. Tables 41 and 42 indicate farm-weight to processed weight conversions for several fruits. Tables 45 and 46 indicate farm-weight to canned weight for vegetables. Nut information is found in Table 51. Honey and maple syrup volume-to-mass conversions are found in Table 57.

8.2.1.2 UCRP Ingestion Rate of Food Crops Tables

Table 8.11. UCRP Ingestion Rate – Human Intake of Food Crop Categories

Gv2 ID	Age	Food Type	Qualifier	Reference	Comment	Data Reported	Value	Units
UCRP	1	1.leafy	MEI	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers 95th, Root/Leafy breakout	0.0121	kg/day
UCRP	1	2.root	MEI	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers 95th, Root/Leafy breakout	0.1386	kg/day
UCRP	1	3.fruit	MEI	EPA (2011)	Ch 9, consumers only Fruit	derivation, consumers 95th percentile	0.21	kg/day
UCRP	1	4.grain	MEI	EPA (2011)	Table 12-1, consumers only 95th, grain	derivation, consumers only 95th, grain	0.1058	kg/day
UCRP	2	1.leafy	MEI	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers 95th, Root/Leafy breakout	0.0388	kg/day
UCRP	2	2.root	MEI	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers 95th, Root/Leafy breakout	0.1765	kg/day
UCRP	2	3.fruit	MEI	EPA (2011)	Ch 9, consumers only Fruit	derivation, consumers 95th percentile	0.295	kg/day
UCRP	2	4.grain	MEI	EPA (2011)	Table 12-1, consumers only 95th, grain	derivation, consumers only 95th, grain	0.1711	kg/day
UCRP	3	1.leafy	MEI	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers 95th, Root/Leafy breakout	0.0474	kg/day
UCRP	3	2.root	MEI	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers 95th, Root/Leafy breakout	0.2019	kg/day
UCRP	3	3.fruit	MEI	EPA (2011)	Ch 9, consumers only Fruit	derivation, consumers 95th percentile	0.2809	kg/day
UCRP	3	4.grain	MEI	EPA (2011)	Table 12-1, consumers only 95th, grain	derivation, consumers only 95th, grain	0.2065	kg/day
UCRP	4	1.leafy	MEI	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers 95th, Root/Leafy breakout	0.0628	kg/day
UCRP	4	2.root	MEI	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers 95th, Root/Leafy breakout	0.2679	kg/day
UCRP	4	3.fruit	MEI	EPA (2011)	Ch 9, consumers only Fruit	derivation, consumers 95th percentile	0.2926	kg/day
UCRP	4	4.grain	MEI	EPA (2011)	Table 12-1, consumers only 95th, grain	derivation, consumers only 95th, grain	0.2608	kg/day
UCRP	5	1.leafy	MEI	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers 95th, Root/Leafy breakout	0.0918	kg/day
UCRP	5	2.root	MEI	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers 95th, Root/Leafy breakout	0.2613	kg/day
UCRP	5	3.fruit	MEI	EPA (2011)	Ch 9, consumers only Fruit	derivation, consumers 95th percentile	0.244	kg/day
UCRP	5	4.grain	MEI	EPA (2011)	Table 12-1, consumers only 95th, grain	derivation, consumers only 95th, grain	0.3210	kg/day
UCRP	6	1.leafy	MEI	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers 95th, Root/Leafy breakout	0.1872	kg/day
UCRP	6	2.root	MEI	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers 95th, Root/Leafy breakout	0.2928	kg/day
UCRP	6	3.fruit	MEI	EPA (2011)	Ch 9, consumers only Fruit	derivation, consumers 95th percentile	0.336	kg/day
UCRP	6	4.grain	MEI	EPA (2011)	Table 12-1, consumers only 95th, grain	derivation, consumers only 95th, grain	0.3240	kg/day

Table 8.11. (contd)

Gv2 ID	Age	Food Type	Qualifier	Reference	Comment	Data Reported	Value	Units
UCRP	1	1.leafy	POP	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers mean, Root/Leafy breakout	0.0049	kg/day
UCRP	1	2.root	POP	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers mean, Root/Leafy breakout	0.0565	kg/day
UCRP	1	3.fruit	POP	EPA (2011)	Ch 9, consumers only Fruit	derivation, consumers mean	0.0806	kg/day
UCRP	1	4.grain	POP	EPA (2011)	Table 12-1, consumers only mean, grain	derivation, consumers only mean, grain	0.0505	kg/day
UCRP	2	1.leafy	POP	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers mean, Root/Leafy breakout	0.0166	kg/day
UCRP	2	2.root	POP	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers mean, Root/Leafy breakout	0.0758	kg/day
UCRP	2	3.fruit	POP	EPA (2011)	Ch 9, consumers only Fruit	derivation, consumers mean	0.1118	kg/day
UCRP	2	4.grain	POP	EPA (2011)	Table 12-1, consumers only mean, grain	derivation, consumers only mean, grain	0.0883	kg/day
UCRP	3	1.leafy	POP	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers mean, Root/Leafy breakout	0.0191	kg/day
UCRP	3	2.root	POP	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers mean, Root/Leafy breakout	0.0814	kg/day
UCRP	3	3.fruit	POP	EPA (2011)	Ch 9, consumers only Fruit	derivation, consumers mean	0.0874	kg/day
UCRP	3	4.grain	POP	EPA (2011)	Table 12-1, consumers only mean, grain	derivation, consumers only mean, grain	0.1153	kg/day
UCRP	4	1.leafy	POP	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers mean, Root/Leafy breakout	0.0224	kg/day
UCRP	4	2.root	POP	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers mean, Root/Leafy breakout	0.0953	kg/day
UCRP	4	3.fruit	POP	EPA (2011)	Ch 9, consumers only Fruit	derivation, consumers mean	0.0795	kg/day
UCRP	4	4.grain	POP	EPA (2011)	Table 12-1, consumers only mean, grain	derivation, consumers only mean, grain	0.1399	kg/day
UCRP	5	1.leafy	POP	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers mean, Root/Leafy breakout	0.0384	kg/day
UCRP	5	2.root	POP	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers mean, Root/Leafy breakout	0.1093	kg/day
UCRP	5	3.fruit	POP	EPA (2011)	Ch 9, consumers only Fruit	derivation, consumers mean	0.0706	kg/day
UCRP	5	4.grain	POP	EPA (2011)	Table 12-1, consumers only mean, grain	derivation, consumers only mean, grain	0.1541	kg/day
UCRP	6	1.leafy	POP	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers mean, Root/Leafy breakout	0.0796	kg/day
UCRP	6	2.root	POP	EPA (2011)	Ch 9, consumers only Veg	derivation, consumers mean, Root/Leafy breakout	0.1244	kg/day
UCRP	6	3.fruit	POP	EPA (2011)	Ch 9, consumers only Fruit	derivation, consumers mean	0.104	kg/day
UCRP	6	4.grain	POP	EPA (2011)	Table 12-1, consumers only mean, grain	derivation, consumers only mean, grain	0.1560	kg/day

8.2.2 Ingestion Exposure: Terrestrial Animal Products

Four land-based animal product groups are considered: meat, poultry, milk, and eggs. Assessed individuals are not assumed to be vegetarians. Consumption of the full range of animal products should be assumed in most cases. Set all consumption periods (TANM) for all food groups and age groups to 365.

The units and range for UANM in Gv2 are: kg/d (0–10).

The units and range for TANM in Gv2 are: d/yr (0–365).

The MEI intake rates were approximated from U.S. Census Bureau (USCB) summaries (USCB 2012, Table 217) of U.S. per capita meat consumption[1] data, which indicates that 2009 meat consumption (0.131 kg/d) was predominantly beef (55 percent) and pork (44 percent). Poultry consumption, 0.087 kg/d in 2009, was predominantly chicken (81 percent) with turkey (19 percent) accounting for the remainder. Per capita beverage milk consumption was 0.213 L/d. Per capita egg consumption was 173 eggs/yr (0.474 kg/d) with an additional 73 eggs/yr (0.201 kg/d) consumed in various processed foods. These values were assumed to be adult intake rates. Age-dependency was assigned from the population data, described next. The rates for the MEI of each age were the product of the adult intake rate and the ratio of the age group X to age group 6 rate of the population values. The age ratios indicated that meat and egg consumption increased with age; poultry consumption increased with age with a slightly higher intake for age group 5 than for age group 6; and milk consumption decreased with age. Sebastian et al. (2010) noted a statistically significant decrease in milk consumption between the late 1970s and the early 2000s in the United States. The largest decrease was in the 12–19 year old age group. In addition, the percentage reporting any milk consumption decreased in every age group.

Age-dependent population data were derived from EPA (2011), Table 11-5 for meat and poultry, Table 11-4 for total dairy products which are interpreted for modeling as fluid milk consumption, and Table 11-12 for eggs. The body masses used to convert units from kg/kg-d to kg/d are found in Table 8.10, above. The indicated infant milk consumption rates are likely very conservative, since nursing or formula-fed infants would warrant adjusted values. Siega-Riz et al (2010) indicates that direct cow milk consumption (i.e., the not highly processed cow milk found in infant formulas) only becomes a significant part of infant diets after they are one year old.

8.2.2.1 Additional Sources of Information

The USDA Agricultural Handbook Number 697 (USDA 1992) provides weights, measures, and conversion factors for agricultural commodities and their products. In particular, Tables 7 and 11 provide factors to use in converting carcass weight to boneless, raw meat weights for beef, pork, veal, and lamb. Table 8 provides live weights and carcass weights for cattle, sheep, calves, and hogs. Milk and egg information is also provided in the reference.

The U.S. Census Bureau provides per capita consumption information for a variety of animal products and food commodities online. Last accessed at: www.census.gov/compendia/statab/cats/health_nutrition/food_consumption_and_nutrition.html.

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[1]Information last accessed at: www.census.gov/compendia/statab/cats/health_nutrition/food_consumption_and_nutrition.html.

8.2.2.2 UANM Ingestion Rate of Meat, Poultry, Milk, and Eggs Tables

Table 8.12. UANM Ingestion Rates – Human Intake of Animal Product Categories

Gv2 ID	Gv2 Description	Age[(a)]	Food Type	Qualifier	Reference	Comment	Value	Units
UANM	Animal product consumption	age.1	1.meat	MEI	USCB (2012) with age-dependency from EPA (2011)	Intake is relatively unsustainable. Assume all protein is from this one category and consider no other animal product categories.	0.023	kg/d
UANM	Animal product consumption	age.2	1.meat	MEI	USCB (2012) with age-dependency from EPA (2011)	Intake is relatively unsustainable. Assume all protein is from this one category and consider no other animal product categories.	0.048	kg/d
UANM	Animal product consumption	age.3	1.meat	MEI	USCB (2012) with age-dependency from EPA (2011)	Intake is relatively unsustainable. Assume all protein is from this one category and consider no other animal product categories.	0.067	kg/d
UANM	Animal product consumption	age.4	1.meat	MEI	USCB (2012) with age-dependency from EPA (2011)	Intake is relatively unsustainable. Assume all protein is from this one category and consider no other animal product categories.	0.085	kg/d
UANM	Animal product consumption	age.5	1.meat	MEI	USCB (2012) with age-dependency from EPA (2011)	Intake is relatively unsustainable. Assume all protein is from this one category and consider no other animal product categories.	0.125	kg/d
UANM	Animal product consumption	age.6	1.meat	MEI	USCB (2012)	Reference indicates beef (55%), veal, lamb (1%), pork (44%)	0.131	kg/d
UANM	Animal product consumption	age.1	2.poultry	MEI	USCB (2012), EPA (2011)	Age-dependency derived from EPA (2011)	0.023	kg/d
UANM	Animal product consumption	age.2	2.poultry	MEI	USCB (2012), EPA (2011)	Age-dependency derived from EPA (2011)	0.046	kg/d
UANM	Animal product consumption	age.3	2.poultry	MEI	USCB (2012), EPA (2011)	Age-dependency derived from EPA (2011)	0.055	kg/d
UANM	Animal product consumption	age.4	2.poultry	MEI	USCB (2012), EPA (2011)	Age-dependency derived from EPA (2011)	0.067	kg/d
UANM	Animal product consumption	age.5	2.poultry	MEI	USCB (2012), EPA (2011)	Age-dependency derived from EPA (2011)	0.092	kg/d
UANM	Animal product consumption	age.6	2.poultry	MEI	USCB (2012)	Reference indicates chicken (81%), turkey (19%)	0.086	kg/d

Table 8.12. (contd)

Gv2 ID	Gv2 Description	Age[(a)]	Food Type	Qualifier	Reference	Comment	Value	Units
UANM	Animal product consumption	age.1	3.milk	MEI	USCB (2012), EPA (2011)	Age-dependency derived EPA (2011),Table 11-4, 95th percentile	0.300	kg/d
UANM	Animal product consumption	age.2	3.milk	MEI	USCB (2012), EPA (2011)	Age-dependency derived EPA (2011),Table 11-4, 95th percentile	1.083	kg/d
UANM	Animal product consumption	age.3	3.milk	MEI	USCB (2012), EPA (2011)	Age-dependency derived EPA (2011),Table 11-4, 95th percentile	1.311	kg/d
UANM	Animal product consumption	age.4	3.milk	MEI	USCB (2012), EPA (2011)	Age-dependency derived EPA (2011),Table 11-4, 95th percentile	0.949	kg/d
UANM	Animal product consumption	age.5	3.milk	MEI	USCB (2012), EPA (2011)	Age-dependency derived EPA (2011),Table 11-4, 95th percentile	0.975	kg/d
UANM	Animal product consumption	age.6	3.milk	MEI	USCB (2012), EPA(2011)	Age-dependency derived EPA (2011),Table 11-4, 95th percentile	0.888	kg/d
UANM	Animal product consumption	age.1	4.egg	MEI	USCB (2012), EPA (2011)	Age-dependency derived from EPA (2011)	0.022	kg/d
UANM	Animal product consumption	age.2	4.egg	MEI	USCB (2012), EPA (2011)	Age-dependency derived from EPA (2011)	0.022	kg/d
UANM	Animal product consumption	age.3	4.egg	MEI	USCB (2012), EPA (2011)	Age-dependency derived from EPA (2011)	0.024	kg/d
UANM	Animal product consumption	age.4	4.egg	MEI	USCB (2012), EPA (2011)	Age-dependency derived from EPA (2011)	0.031	kg/d
UANM	Animal product consumption	age.5	4.egg	MEI	USCB (2012), EPA (2011)	Age-dependency derived from EPA (2011)	0.034	kg/d
UANM	Animal product consumption	age.6	4.egg	MEI	USCB (2012)	53 g/egg (21 g yolk, 32 g white)	0.036	kg/d

(a) See Table 8.1 for the ages of each age category.

Gv2_ID	Gv2_Description	Age[(a)]	Food Type	Qualifier	Reference	Comment	Value	Units
UANM	Animal product consumption	age.1	1.meat	POP	EPA (2011)	Derived from Table 11-5, beef+pork	0.014	kg/d
UANM	Animal product consumption	age.2	1.meat	POP	EPA (2011)	Derived from Table 11-5, beef+pork	0.029	kg/d
UANM	Animal product consumption	age.3	1.meat	POP	EPA (2011)	Derived from Table 11-5, beef+pork	0.041	kg/d
UANM	Animal product consumption	age.4	1.meat	POP	EPA (2011)	Derived from Table 11-5, beef+pork	0.052	kg/d
UANM	Animal product consumption	age.5	1.meat	POP	EPA (2011)	Derived from Table 11-5, beef+pork	0.076	kg/d
UANM	Animal product consumption	age.6	1.meat	POP	EPA (2011)	Derived from Table 11-5, beef+pork	0.080	kg/d

Table 8.12. (contd)

Gv2_ID	Gv2_Description	Age[(a)]	Food Type	Qualifier	Reference	Comment	Value	Units
UANM	Animal product consumption	age.1	2.poultry	POP	EPA (2011)	Derived from Table 11-5, poultry	0.013	kg/d
UANM	Animal product consumption	age.2	2.poultry	POP	EPA (2011)	Derived from Table 11-5, poultry	0.026	kg/d
UANM	Animal product consumption	age.3	2.poultry	POP	EPA (2011)	Derived from Table 11-5, poultry	0.031	kg/d
UANM	Animal product consumption	age.4	2.poultry	POP	EPA (2011)	Derived from Table 11-5, poultry	0.038	kg/d
UANM	Animal product consumption	age.5	2.poultry	POP	EPA (2011)	Derived from Table 11-5, poultry	0.051	kg/d
UANM	Animal product consumption	age.6	2.poultry	POP	EPA (2011)	Derived from Table 11-5, poultry	0.048	kg/d
UANM	Animal product consumption	age.1	3.milk	POP	EPA (2011)	Derived from EPA (2011),Table 11-4, mean	0.080	kg/d
UANM	Animal product consumption	age.2	3.milk	POP	EPA (2011)	Derived from EPA (2011),Table 11-4, mean	0.493	kg/d
UANM	Animal product consumption	age.3	3.milk	POP	EPA (2011)	Derived from EPA (2011),Table 11-4, mean	0.596	kg/d
UANM	Animal product consumption	age.4	3.milk	POP	EPA (2011)	Derived from EPA (2011),Table 11-4, mean	0.446	kg/d
UANM	Animal product consumption	age.5	3.milk	POP	EPA (2011)	Derived from EPA (2011),Table 11-4, mean	0.361	kg/d
UANM	Animal product consumption	age.6	3.milk	POP	EPA (2011)	Derived from EPA (2011),Table 11-4, mean	0.301	kg/d
UANM	Animal product consumption	age.1	4.egg	POP	EPA (2011)	Derived from Table 11-12, per capita	0.013	kg/d
UANM	Animal product consumption	age.2	4.egg	POP	EPA (2011)	Derived from Table 11-12, per capita	0.013	kg/d
UANM	Animal product consumption	age.3	4.egg	POP	EPA (2011)	Derived from Table 11-12, per capita	0.014	kg/d
UANM	Animal product consumption	age.4	4.egg	POP	EPA (2011)	Derived from Table 11-12, per capita	0.018	kg/d
UANM	Animal product consumption	age.5	4.egg	POP	EPA (2011)	Derived from Table 11-12, per capita	0.020	kg/d
UANM	Animal product consumption	age.6	4.egg	POP	EPA (2011)	Derived from Table 11-12, per capita	0.021	kg/d

(a) See Table 8.1 for the ages of each age category.

8.2.3 Ingestion Exposure: Aquatic Foods

Aquatic food ingestion somewhat differs from crop and animal product ingestion in that more people do not consume this category of food. Application of intake rates should be done with care. Few resources indicate freshwater vs. saltwater fish consumption. MEI rates are presented for consumers-only.

The daily intake rate (UAQU) and number of intake days per year (TAQU) require definition for each aquatic food type (fish, mollusk, crustacean, and aquatic plant). Set the consumption period for each aquatic food type to 365 d/yr.

The units and range for UAQU in Gv2 are: kg/d (0–10).

The units and range for TAQU in Gv2 are: d/yr (0–365).

Values are derived from EPA 2011, which are presented in units of g/kg-d base on the body weight of the consumer. Assumed body weights are indicated in Table 8.10 and then age-specific intake rates are averaged according to the Gv2 age categories shown in the same table. Population UAQU values tabulated below indicates both the per capita mean and a more conservative per capita 95th percentile rates. MEI UAQU values tabulated below indicate both the consumers-only mean and the consumers-only 95th percentile rates. It is suggested that the user assume the MEI 95th percentile value if their state/region has a large aquaculture industry. It is suggested that the user assume the POP mean per capita rates for population estimates.

Aquatic plant consumption is not a major food source, currently, and should be set to 0. U.S. states with larger contributions to mollusk (abalone, clam, mussel, oyster, snail) aquaculture industry in 2007 are Virginia, Massachusetts, Florida, Maine, New York, Washington, and Connecticut (USDA 2009, Table 23 Aquaculture Sold). U.S. states with larger contributions to crustacean (crawfish, lobster, prawn, shrimp, softshell crabs) aquaculture industry in 2007 are Texas and Florida. Fish aquaculture is dominant in Mississippi (catfish) and Pennsylvania and Colorado (trout). Pennsylvania, Washington, and Alaska are dominant sportfish/gamefish states. Higher aquatic food consumption rates may be applied to these states.

8.2.3.1 Additional Sources of Information

The USDA Agricultural Handbook Number 697 (USDA 1992) provides weights, measures, and conversion factors for agricultural commodities and their products. In particular, Table 24 provides conversion factors for whole fish and shellfish masses, to the edible mass. Table 26 indicates the mass of various aquatic foods in a standard case of canned product.

The U.S. 2007 Census of Agriculture (USDA 2009) reports information on aquaculture. It can be accessed at http://www.agcensus.usda.gov/Publications/2007/Full_Report/index.asp.

8.2.3.2 UAQU Ingestion Rate of Aquatic Foods Tables

Table 8.13. UAQU Ingestion Rates – Human Intake of Aquatic Food Categories

Gv2_ID	Age[(a)]	Food Type	Qualifier	Reference	Comment	Data Reported	Value	Units
UAQU	1	1.fish	MEI	EPA (2011)	Ch 10, consumers only mean, fw or sw	derivation, consumers only mean, Finfish	0.0136	kg/day
UAQU	1	1.fish	MEI	EPA (2011)	Ch 10, consumers only 95th, fw or sw	derivation, consumers only 95th, Finfish	0.0378	kg/day
UAQU	1	2.mollusk	MEI	EPA (2011)	Ch 10, consumers only 95th, mollusk or crustacea	derivation, consumers only 95th, Shellfish	0.0278	kg/day
UAQU	2	1.fish	MEI	EPA (2011)	Ch 10, consumers only mean, fw or sw	derivation, consumers only mean, Finfish	0.0221	kg/day
UAQU	2	1.fish	MEI	EPA (2011)	Ch 10, consumers only 95th, fw or sw	derivation, consumers only 95th, Finfish	0.0676	kg/day
UAQU	2	2.mollusk	MEI	EPA (2011)	Ch 10, consumers only 95th, mollusk or crustacea	derivation, consumers only 95th, Shellfish	0.0483	kg/day
UAQU	3	1.fish	MEI	EPA (2011)	Ch 10, consumers only mean, fw or sw	derivation, consumers only mean, Finfish	0.0242	kg/day
UAQU	3	1.fish	MEI	EPA (2011)	Ch 10, consumers only 95th, fw or sw	derivation, consumers only 95th, Finfish	0.067	kg/day
UAQU	3	2.mollusk	MEI	EPA (2011)	Ch 10, consumers only 95th, mollusk or crustacea	derivation, consumers only 95th, Shellfish	0.0539	kg/day
UAQU	4	1.fish	MEI	EPA (2011)	Ch 10, consumers only mean, fw or sw	derivation, consumers only mean, Finfish	0.035	kg/day
UAQU	4	1.fish	MEI	EPA (2011)	Ch 10, consumers only 95th, fw or sw	derivation, consumers only 95th, Finfish	0.0922	kg/day
UAQU	4	2.mollusk	MEI	EPA (2011)	Ch 10, consumers only 95th, mollusk or crustacea	derivation, consumers only 95th, Shellfish	0.0636	kg/day
UAQU	5	1.fish	MEI	EPA (2011)	Ch 10, consumers only mean, fw or sw	derivation, consumers only mean, Finfish	0.0424	kg/day
UAQU	5	1.fish	MEI	EPA (2011)	Ch 10, consumers only 95th, fw or sw	derivation, consumers only 95th, Finfish	0.1091	kg/day
UAQU	5	2.mollusk	MEI	EPA (2011)	Ch 10, consumers only 95th, mollusk or crustacea	derivation, consumers only 95th, Shellfish	0.122	kg/day
UAQU	6	1.fish	MEI	EPA (2011)	Ch 10, consumers only mean, fw or sw	derivation, consumers only mean, Finfish	0.0532	kg/day
UAQU	6	1.fish	MEI	EPA (2011)	Ch 10, consumers only 95th, fw or sw	derivation, consumers only 95th, Finfish	0.164	kg/day
UAQU	6	2.mollusk	MEI	EPA (2011)	Ch 10, consumers only 95th, mollusk or crustacea	derivation, consumers only 95th, Shellfish	0.136	kg/day

(a) See Table 8.1 for the ages of each age category.

Table 8.13. (contd)

Gv2 ID	Age[(a)]	Food Type	Qualifier	Reference	Comment	Data Reported	Value	Units
UAQU	1	1.fish	POP	EPA (2011)	Ch 10, per capita mean fw or sw	derivation, per capita mean, Finfish	0.0014	kg/day
UAQU	1	1.fish	POP	EPA (2011)	Ch 10, per capita 95th fw or sw	derivation, per capita 95th, Finfish	0.0068	kg/day
UAQU	1	2.mollusk	POP	EPA (2011)	Ch 10, consumers only mean, mollusk or crustacea	derivation, consumers only mean, Shellfish	0.0068	kg/day
UAQU	2	1.fish	POP	EPA (2011)	Ch 10, per capita mean fw or sw	derivation, per capita mean, Finfish	0.003	kg/day
UAQU	2	1.fish	POP	EPA (2011)	Ch 10, per capita 95th fw or sw	derivation, per capita 95th, Finfish	0.0166	kg/day
UAQU	2	2.mollusk	POP	EPA (2011)	Ch 10, consumers only mean, mollusk or crustacea	derivation, consumers only mean, Shellfish	0.013	kg/day
UAQU	3	1.fish	POP	EPA (2011)	Ch 10, per capita mean fw or sw	derivation, per capita mean, Finfish	0.0035	kg/day
UAQU	3	1.fish	POP	EPA (2011)	Ch 10, per capita 95th fw or sw	derivation, per capita 95th, Finfish	0.026	kg/day
UAQU	3	2.mollusk	POP	EPA (2011)	Ch 10, consumers only mean, mollusk or crustacea	derivation, consumers only mean, Shellfish	0.0186	kg/day
UAQU	4	1.fish	POP	EPA (2011)	Ch 10, per capita mean fw or sw	derivation, per capita mean, Finfish	0.0051	kg/day
UAQU	4	1.fish	POP	EPA (2011)	Ch 10, per capita 95th fw or sw	derivation, per capita 95th, Finfish	0.035	kg/day
UAQU	4	2.mollusk	POP	EPA (2011)	Ch 10, consumers only mean, mollusk or crustacea	derivation, consumers only mean, Shellfish	0.0229	kg/day
UAQU	5	1.fish	POP	EPA (2011)	Ch 10, per capita mean fw or sw	derivation, per capita mean, Finfish	0.0064	kg/day
UAQU	5	1.fish	POP	EPA (2011)	Ch 10, per capita 95th fw or sw	derivation, per capita 95th, Finfish	0.0449	kg/day
UAQU	5	2.mollusk	POP	EPA (2011)	Ch 10, consumers only mean, mollusk or crustacea	derivation, consumers only mean, Shellfish	0.0392	kg/day
UAQU	6	1.fish	POP	EPA (2011)	Ch 10, per capita mean fw or sw	derivation, per capita mean, Finfish	0.014	kg/day
UAQU	6	1.fish	POP	EPA (2011)	Ch 10, per capita 95th fw or sw	derivation, per capita 95th, Finfish	0.088	kg/day
UAQU	6	2.mollusk	POP	EPA (2011)	Ch 10, consumers only mean, mollusk or crustacea	derivation, consumers only mean, Shellfish	0.0416	kg/day

(a) See Table 8.1 for the ages of each age category.

8.3 Pathway Selection: Water Ingestion (multiple)

Water ingestion pathways include intakes from direct ingestion, incidental swimming-water ingestion, and incidental shower-water ingestion. These routes consider only ingestion exposure to the contaminated water. If a non-contaminated source is assumed for either drinking water, shower water, or swimming water, zero out the intake for that route.

Drinking water ingestion requires assignment of intake rate and consumption period. The swimming and showering exposures determine intakes based on hourly exposure rather than daily exposure, therefore more parameterization is required.

8.3.1 Water Ingestion Exposure: Drinking Water

Annual drinking water ingestion is described by the daily intake rate (UDW) and the number of days drinking water is acquired from the contaminated source (TDW).

The units for UDW in Gv2 are: L/d (0–10).

The units for TDW in Gv2 are: d/yr (0–365).

The values provided assume that only water from the contaminated source is consumed. Therefore, TDW is set to 365 d/yr. EPA (2011) age-specific ranges of drinking water rates are assigned. The average of the range can be assigned as a discrete value. Pregnant and lactating female intake rates are also provided in the tables presented here.

Note: Compliance-specific calculations sometimes require the use of a 2 L/d water ingestion rate. The values tabulated, below, indicate actual ingestion rates of water in the United States and should be applied when a certain water ingestion rate is not prescribed.

8.3.1.1 Additional Sources of Information

EPA (2004) provides additional information on U.S. water ingestion rates. Last accessed at: http://water.epa.gov/actioN/Advisories/drinking/percapita_index.cfm.

8.3.1.2 UDW Drinking Water Ingestion Rate Table

Table 8.14. UDW Drinking Water Ingestion Rate

Gv2 ID	Gv2 Description	Age[(a)]	Qualifier	Reference	Comment	Data Reported	Min	Max	Units
UDW	Drinking water ingestion rate	1	MEI	EPA (2011)	Chap 3, 95th percentile	95th percentile range	0.839	1.101	L/day
UDW	Drinking water ingestion rate	2	MEI	EPA (2011)	Chap 3, 95th percentile	95th percentile range	0.837	0.893	L/day
UDW	Drinking water ingestion rate	3	MEI	EPA (2011)	Chap 3, 95th percentile	95th percentile range	0.877	0.979	L/day
UDW	Drinking water ingestion rate	4	MEI	EPA (2011)	Chap 3, 95th percentile	95th percentile range	1.316	1.404	L/day
UDW	Drinking water ingestion rate	5	MEI	EPA (2011)	Chap 3, 95th percentile	95th percentile range	1.783	1.899	L/day
UDW	Drinking water ingestion rate	6	MEI	EPA (2011)	Chap 3, 95th percentile	95th percentile range	2.368	3.092	L/day
UDW	Drinking water ingestion rate	6	Pregnant MEI	EPA (2011)	Chap 3, 95th percentile	95th percentile range	2.503	2.589	L/day
UDW	Drinking water ingestion rate	6	Lactating MEI	EPA (2011)	Chap 3, 95th percentile	95th percentile range	3.434	3.588	L/day

(a) See Table 8.1 for the ages of each age category.

Gv2 ID	Gv2 Description	Age[(a)]	Qualifier	Reference	Comment	Data Reported	Min	Max	Units
UDW	Drinking water ingestion rate	1	POP	EPA (2011)	Chap 3, average	average range	0.184	0.467	L/day
UDW	Drinking water ingestion rate	2	POP	EPA (2011)	Chap 3, average	average range	0.271	0.308	L/day
UDW	Drinking water ingestion rate	3	POP	EPA (2011)	Chap 3, average	average range	0.317	0.382	L/day
UDW	Drinking water ingestion rate	4	POP	EPA (2011)	Chap 3, average	average range	0.414	0.511	L/day
UDW	Drinking water ingestion rate	5	POP	EPA (2011)	Chap 3, average	average range	0.52	0.702	L/day
UDW	Drinking water ingestion rate	6	POP	EPA (2011)	Chap 3, average	average range	0.681	1.288	L/day
UDW	Drinking water ingestion rate	6	Pregnant POP	EPA (2011)	Chap 3, average	average range	0.819	0.872	L/day
UDW	Drinking water ingestion rate	6	Lactating POP	EPA (2011)	Chap 3, average	average range	1.379	1.665	L/day

(a) See Table 8.1 for the ages of each age category.

8.3.2 Water Ingestion Exposure: Incidental Shower Water

Incidental shower water ingestion requires the assignment of four parameters: the number of showers per day (EVSHWR), the duration of the shower event (TESHWR), the number of days the individual showers (TSHWR), and the ingestion rate of water while showering (USHIN).

The units and range for EVSHWR in Gv2 are: number (0–10).

The units and range for TESHWR in Gv2 are: hr (0–24).

The units and range for TSHWR in Gv2 are: d (0–365).

The units and range for USHIN in Gv2 are: L/hr (0–10).

Assume that both the MEI and population take 1 shower/d and that they take a shower every day. Chapter 16 of EPA (2011) indicates the shower minutes per day by age, for those who shower. Mean values are assigned to the population and 95th percentile values assigned to the MEI, as adjusted for the age groups of interest. For the shower water ingestion rate, a reasonable assumption would be to assume half the swimming water ingestion rates presented in Section 8.1.2.2.

8.3.2.1 Additional Sources of Information

No additional sources that provide greater detail than EPA (2011) were identified.

8.3.2.2 TESHWR, USHIN Incidental Shower Water Intake Tables

Table 8.15. TESHWR Shower Duration

Gv2 ID	Gv2 Description	Age[(a)]	Qualifier	Reference	Comment	Value	Units
TESHWR	Shower duration	1	MEI	EPA (2011)	Table 16-1, 95th percentile	0	hr
TESHWR	Shower duration	2	MEI	EPA (2011)	Table 16-1, 95th percentile	0.73	hr
TESHWR	Shower duration	3	MEI	EPA (2011)	Table 16-1, 95th percentile	0.57	hr
TESHWR	Shower duration	4	MEI	EPA (2011)	Table 16-1, 95th percentile	0.68	hr
TESHWR	Shower duration	5	MEI	EPA (2011)	Table 16-1, 95th percentile	0.71	hr
TESHWR	Shower duration	6	MEI	EPA (2011)	Table 16-1, 95th percentile	0.75	hr

(a) See Table 8.1 for age groups.

Gv2 ID	Gv2 Description	Age[(a)]	Qualifier	Reference	Comment	Value	Units
TESHWR	Shower duration	1	POP	EPA (2011)	Table 16-1 mean	0.29	hr
TESHWR	Shower duration	2	POP	EPA (2011)	Table 16-1 mean	0.37	hr
TESHWR	Shower duration	3	POP	EPA (2011)	Table 16-1 mean	0.28	hr
TESHWR	Shower duration	4	POP	EPA (2011)	Table 16-1 mean	0.30	hr
TESHWR	Shower duration	5	POP	EPA (2011)	Table 16-1 mean	0.32	hr
TESHWR	Shower duration	6	POP	EPA (2011)	Table 16-1 mean	0.33	hr

(a) See Table 8.1 for age groups.

Table 8.16. USHIN Incidental Ingestion of Shower Water

Gv2 ID	Gv2_Description	Age[(a)]	Qualifier	Reference	Value	Units
USHIN	Ingestion rate of water while showering	2	MEI	Half of USWIM	0.06	L/hr
USHIN	Ingestion rate of water while showering	3	MEI	Half of USWIM	0.06	L/hr
USHIN	Ingestion rate of water while showering	4	MEI	Half of USWIM	0.06	L/hr
USHIN	Ingestion rate of water while showering	5	MEI	Half of USWIM	0.06	L/hr
USHIN	Ingestion rate of water while showering	6	MEI	Half of USWIM	0.04	L/hr

(a) See Table 8.1 for age groups.

Gv2_ID	Gv2_Description	Age[(a)]	qualifier	Reference	Value	Units
USHIN	Ingestion rate of water while showering	1	POP	Half of USWIM, age 2	0.02	L/hr
USHIN	Ingestion rate of water while showering	2	POP	Half of USWIM	0.02	L/hr
USHIN	Ingestion rate of water while showering	3	POP	Half of USWIM	0.02	L/hr
USHIN	Ingestion rate of water while showering	4	POP	Half of USWIM	0.02	L/hr
USHIN	Ingestion rate of water while showering	5	POP	Half of USWIM	0.02	L/hr
USHIN	Ingestion rate of water while showering	6	POP	Half of USWIM	0.01	L/hr

(a) See Table 8.1 for age groups.

8.3.3 Water Ingestion Exposure: Incidental Swimming Water

The user is responsible for entering the same values in the Pathway Selections: Water Ingestion while Swimming and External Exposure while Swimming (see Section 8.1.2) parameters.

The units and ranges for swimming water ingestion parameters are found in Section 8.1.2.

Additional information sources and tables of values are found in Section 8.1.2.2

8.4 Pathway Selection: Inadvertent Soil Ingestion

8.4.1 USOIL Human Soil Ingestion Rate and TSOIL Soil Contact Days

Annual incidental soil ingestion is determined by multiplying the USOIL and TSOIL parameters. Soil may be considered either outdoor soil or indoor dust accumulation. If the radiological characteristics of the outdoor and indoor soils are understood to be sufficiently different, the user may want to evaluate each in separate cases. Set the soil consumption period (TSOIL) for each age group to 365 d.

Incidental ingestion of soil by animals is discussed in Section 7.16.

The USOIL units and range in Gv2 are: mg/d (0–15,000).

The TSOIL units and range in Gv2 are: d (0–365).

Values were obtained from Chapter 5 of EPA (2011). The range of MEI intakes are the central or upper values, at the low end, to the pica values at the high end. The MEI age 1 and MEI age 6 values can use the closest age category value listed. The range of Population values are the central to upper incidental soil and dust intakes. Single value assignments should use the minimum values listed for the population and the MEI. The TSOIL value assigned assumes fulltime occupancy at the location of interest and therefore, would be 365 d/yr.

8.4.1.1 Additional Sources of Information

No additional sources that provide greater detail than EPA (2011) were identified.

8.4.1.2 USOIL Human Incidental Soil Ingestion Rate Table

Table 8.17. USOIL Incidental Ingestion of Soil

Gv2 ID	Gv2 Description	Age[(a)]	Qualifier	Reference	Comment	Min	Max	Units
USOIL	Inadvertent soil ingestion rate	2	MEI	EPA (2011)	Table 5-1, soil+dust upper to pica	**200**	1000	mg/day
USOIL	Inadvertent soil ingestion rate	3	MEI	EPA (2011)	Table 5-1, soil+dust upper to pica	**200**	1000	mg/day
USOIL	Inadvertent soil ingestion rate	4	MEI	EPA (2011)	Table 5-1, soil+dust central to pica	**200**	1000	mg/day
USOIL	Inadvertent soil ingestion rate	5	MEI	EPA (2011)	Table 5-1, soil+dust central to pica	**200**	1000	mg/day

(a) See Table 8.1 for age groups.
Values in **bold** are recommended for discrete values.

Gv2 ID	Gv2 Description	Age[(a)]	Qualifier	Reference	Comment	Min	Max	Units
USOIL	Inadvertent soil ingestion rate	1	POP	EPA (2011)	Table 5-1, soil+dust; central to upper	**60**	200	mg/day
USOIL	Inadvertent soil ingestion rate	2	POP	EPA (2011)	Table 5-1, soil+dust; central to upper	**100**	200	mg/day
USOIL	Inadvertent soil ingestion rate	3	POP	EPA (2011)	Table 5-1, soil+dust; central to upper	**100**	200	mg/day
USOIL	Inadvertent soil ingestion rate	4	POP	EPA (2011)	Table 5-1, soil+dust; central to upper	**100**	200	mg/day
USOIL	Inadvertent soil ingestion rate	5	POP	EPA (2011)	Table 5-1, soil+dust; central to upper	**100**	200	mg/day
USOIL	Inadvertent soil ingestion rate	6	POP	EPA (2011)	Table 5-1, soil+dust; central to upper	**50**	200	mg/day

(a) See Table 8.1 for age groups.
Values in **bold** are recommended for discrete values.

8.5 Pathway Selection: Inhalation (multiple)

Three inhalation pathways require parameterization. The boxes checked on the Pathways tab of the Exposure module will indicate which three inhalation pathways are calculated. The pathway selection "Air inhalation" will describe inhalation of plume contaminants (i.e., outdoor air). The pathway selection "Resuspended soil inhalation" describes suspended or resuspended soil particulate inhalation. The pathway selection "Indoor inhalation", of course, describes inhalation of indoor air. Indoor air inhalation will add in shower water contributions to the outdoor air levels. The user is responsible for making sure the fraction of the day that indoor and outdoor inhalation occurs is 1 or less.

8.5.1 Ux, Tx, FRx Inhalation

Each inhalation pathway selection requires three parameters: inhalation rate (U*x*), inhalation period (T*x*), and fraction of the day that inhalation of the indicated air type occurs (FR*x*). The product of these three within each air type will indicate the volume of each air type inhaled. The time periods (TINH, TINHR, TINDHR) for each age group should be assigned as 356 d. The user is responsible for making the FRINH and FRINDR parameters add to one.

The user is responsible for making judgments on the reasonableness of the external ground exposure FTOUT value (see Section 8.1.1) and the FRINH and FRINHR values of outdoor and resuspended soil inhalation pathways parameters. One option for inhalation assignments is for the user to assign the same inhalation rate to all categories (i.e., outdoor air, resuspended soil air, and indoor air) and only vary the fractional exposure time to each route.

- Air inhalation (outdoor air)
  - The units and range for UINH in Gv2 are: m^3/d (0–50)
  - The units and range for TINH in Gv2 are: d/yr (0–365)
  - The units and range for FRINH in Gv2 are: fraction (0–1)
- Resuspended soil inhalation
  - The units and range for UINHR in Gv2 are: m^3/d (0–50)
  - The units and range for TINHR in Gv2 are: d/yr (0–365)
  - The units and range for FRINHR in Gv2 are: fraction (0–1)
- Indoor Air inhalation
  - The units and range for UINDRH in Gv2 are: m^3/d (0–50)
  - The units and range for TINDRH in Gv2 are: d/yr (0–365)
  - The units and range for FRINDR in Gv2 are: fraction (0–1).

EPA 2011 provides detailed intake rates for a variety of ages and activities (Chapter 6) and fractions of time spent indoors and outdoors (Chapter 16). UINH values (outdoor air inhalation) rates are shown in Table 8.18 and assume the individual is outside 100 percent of the time. The UINDRH (indoor air inhalation) values use the recommended outdoor rate (UINH) value and multiply it by the age-dependent fraction of time that an individual remains indoors, according to the data in Table 16-1 of EPA (2011). If

the individual is not assumed to be outdoors full time, the difference between the fulltime outdoors UINH value of Table 8.18 and the UINDRH value of Table 8.19 would provide an adjusted UINH value.

People generally remain indoors. See Section 8.1.1, FTIN and FTOUT values and associated notes. The values assigned here for FRINHR and FRINDR should be consistent. Some scenarios may consider that the individual is always outdoors.

8.5.1.1 Additional Sources of Information

ICRP Publications 66 and 71 (ICRP 1994a, 1995b). The ICRP publications indicate age-specific inhalation rates. ICRP information includes inhalation rates (m3/hr) for various activity levels. Hours of activity levels can then be assigned to determine daily inhalation volumes.

Table 3 of DOE (2011) provides age-dependent inhalation volumes for males and females.

8.5.1.2 UINH, UINHR, UINDRH Inhalation Rate Tables

Table 8.18. UINH Outdoor Air Inhalation Rate

Gv2 ID	Gv2 Description	Age[(a)]	Qualifier	Reference	Comment	Recom-mended	Min	Max	Units
UINH	Air inhalation rate	1	MEI	EPA (2011)	Ch 6, assumes 100% outdoor	6.8	6.8	6.8	m^3/day
UINH	Air inhalation rate	2	MEI	EPA (2011)	Ch 6, assumes 100% outdoor	9.2	9.2	9.2	m^3/day
UINH	Air inhalation rate	3	MEI	EPA (2011)	Ch 6, assumes 100% outdoor	13.8	13.8	13.8	m^3/day
UINH	Air inhalation rate	4	MEI	EPA (2011)	Ch 6, assumes 100% outdoor	16.6	16.6	16.6	m^3/day
UINH	Air inhalation rate	5	MEI	EPA (2011)	Ch 6, assumes 100% outdoor	23.3	23.3	23.3	m^3/day
UINH	Air inhalation rate	6	MEI	EPA (2011)	Ch 6, assumes 100% outdoor	19.4	19.4	19.4	m^3/day
UINH	Air inhalation rate	1	POP	EPA (2011)	Ch 6, assumes 100% outdoor	4.5	3.6	5.4	m^3/day
UINH	Air inhalation rate	2	POP	EPA (2011)	Ch 6, assumes 100% outdoor	7.2	5.4	8.9	m^3/day
UINH	Air inhalation rate	3	POP	EPA (2011)	Ch 6, assumes 100% outdoor	10.1	10.1	10.1	m^3/day
UINH	Air inhalation rate	4	POP	EPA (2011)	Ch 6, assumes 100% outdoor	12	12	12	m^3/day
UINH	Air inhalation rate	5	POP	EPA (2011)	Ch 6, assumes 100% outdoor	15.8	15.2	16.3	m^3/day
UINH	Air inhalation rate	6	POP	EPA (2011)	Ch 6, assumes 100% outdoor	14.1	12.2	16	m^3/day

(a) See Table 8.1 for the ages of each age category.

Table 8.19. UINDRH Indoor Air Inhalation Rate

Gv2 ID	Gv2 Description	Age[(a)]	Qualifier	Reference	Comment/Age-Dependent Assumptions	Recom-mended	Min	Max	Units
UINDRH	Indoor air inhalation rate	1	MEI	EPA (2011)	UINH*Ch16frac. indoors_age (1.0)	6.8	N/A	N/A	m^3/d
UINDRH	Indoor air inhalation rate	2	MEI	EPA (2011)	UNIH*Ch16frac. indoors (1.0)	9.2	N/A	N/A	m^3/d
UINDRH	Indoor air inhalation rate	3	MEI	EPA (2011)	UINH*Ch16frac. indoors (0.94)	13	N/A	N/A	m^3/d
UINDRH	Indoor air inhalation rate	4	MEI	EPA (2011)	UINH*Ch16frac. indoors (0.89)	14.7	N/A	N/A	m^3/d
UINDRH	Indoor air inhalation rate	5	MEI	EPA (2011)	UINH*Ch16frac. indoors (0.90)	21.0	N/A	N/A	m^3/d
UINDRH	Indoor air inhalation rate	6	MEI	EPA (2011)	UINH*Ch16frac. indoors (1.0)	19.4	N/A	N/A	m^3/d
UINDRH	Indoor air inhalation rate	1	POP	EPA (2011)	UINH_age*Ch16frac. indoors_age (0.77–1.0)	4.1	2.8	5.4	m^3/d
UINDRH	Indoor air inhalation rate	2	POP	EPA (2011)	UINH*Ch16frac. indoors (0.68–0.94)	6.05	3.7	8.4	m^3/d
UINDRH	Indoor air inhalation rate	3	POP	EPA (2011)	UINH*Ch16frac. indoors (0.66–0.89)	7.85	6.7	9	m^3/d
UINDRH	Indoor air inhalation rate	4	POP	EPA (2011)	UINH*Ch16frac. indoors (0.62–0.86)	8.9	7.4	10.4	m^3/d
UINDRH	Indoor air inhalation rate	5	POP	EPA (2011)	UINH*Ch16frac. indoors (0.58–0.88)	11.55	8.8	14.3	m^3/d
UINDRH	Indoor air inhalation rate	6	POP	EPA (2011)	UINH*Ch16frac. indoors (0.66–0.82)	10.55	8	13.1	m^3/d

(a) See Table 8.1 for the ages of each age category.

8.6 References: Receptor Intake Module

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9.0 Module: Health Impacts

This module is downstream of the Receptor Intake module and may be upstream of a Report Generator module, if the user selects the module. The Health Impacts module establishes the radiation dose factors applied. The intake estimates of the Receptor Intake module are translated into radiation doses in this module. Three tabs are in this module: Method Selection, Method Parameters, and Constituent Parameters. The user will select the "Calculate Dose and/or risk using ICRP-60 and EPA risk factors (Federal Guidance Reports 12/13)" in the Method Selection tab. The remaining tabs are discussed, below.

9.1 Tab: Method Parameters

The user will opt for "Calculate radiation effective dose equivalent (CEDE)" The soil thickness (SOILT) and soil density (SLDN) are to be entered as indicated in the Chronic Exposure module, see Section 7.7, assigning the SOILT parameter the value indicated for SURCM, with units conversion to meters.

The units and range for SOILT in Gv2 are: m (0–5).

The units and range for SLDN in Gv2 are: kg/m^3 (500–3000).

There is currently (Gv2.10) an inconsistency in the SLDN units assignment in the Health Impacts module and the Chronic Exposure module. This becomes evident only when the user reviews the GID file. Although the parameters will have the same ID (i.e., SLDN) enter the value appropriate to the units indicated in the user entry screen. SLDN of the Chronic Exposure module has the units kg/m^2 and the SLDN of the health impacts module has the units kg/m^3. The SLDN values indicated for each module will differ by a factor of 1/0.15.

9.2 Tab: Constituent Parameters

The constituent parameters tab is important when inhalation pathways are considered. The user will scroll through the constituents and assign the appropriate lung transfer inhalation class solubility: gas, vapor, fast, medium, and slow. See ICRP Publications 68, 69, 71, and 72 (ICRP 1994, 1995a, 1995b, 1995c) for details regarding solubility class assumptions for inhalation dose factor calculations. Table 2 of ICRP Publication 72 (1995c) summarizes the solubility classes available for each chemical and provides reference to the ICRP publication that contains biokinetic model details.

Generic guidance for inhalation class designation is provided in the Help file. Help file values were based on two primary factors: the predominant solubility typically encountered and, when such information is unavailable or variable, the solubility class that would maximize the dose. Although the Help file lists suggestions by radionuclide, the user could reasonably assign inhalation classes by chemical rather than specific nuclide.

9.2.1 Additional Sources of Information

DOE Derived Concentration Technical Standard (DOE 2011). Table 4 indicates generic lung solubility type recommendations for each element in particulate form.

9.3 References: Health Impact Module

ICRP. 1994. *Dose Coefficients for Intakes of Radionuclides by Workers*. ICRP (International Commission on Radiological Protection) Publication 68, Ann. ICRP 24 (4).

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10.0 Considerations for Tritium and Carbon-14

Gv2 includes special models for tritium (^3H or T) and carbon-14 (^{14}C). The special considerations required for these two ubiquitous nuclides for chronic air or water emission cases are reviewed in this section. The model assumptions generally assume instantaneous equilibrium for the chronic emission cases, which is more reasonable for food and feed modeling but may overestimate inhalation, external exposure, and water ingestion pathway exposures. The magnitudes of the over-estimates are typically not excessive in most cases.

10.1 Tritium Model Considerations

Tritium can be released as a gas (H^3H or $^3H^3H$), vapor (H^3HO or $^3H^3HO$), where H indicates stable, non-tritium hydrogen. Organically bound tritium (OBT) is automatically included in the source term when tritium gas or tritiated water is selected. Tritium gas conversion into vapor; and biological conversion of gas and vapor into OBT is modeled. OBT describes tritium that is incorporated into food or feed. Any direct emission of OBT from a facility would be better handled by hand calculations or sampling. Chronic models for tritium are described in Section 9.6 of the Gv2 SDD (Napier et al. 2012).

The tritium model generally assumes specific activity equilibrium with some differences in modeling depending on the chemical form. As an example, a constant Bq H^3HO/m^3 emitted in air effluent is divided by the absolute humidity entered in the Chronic Exposure Module to determine the Bq/L in air moisture.

To model food or feed crop tritiated water concentrations, the calculated equilibrium level of tritiated water (Bq/L) in air moisture is used with a 0.9 factor applied for leafy vegetable and pasture categories and a 0.8 factor applied for other crop categories (fruit, root, other vegetables, grain).

To model food or feed crop OBT concentrations, the calculated Bq/L in air moisture is used with a 0.9 factor for all food and feed crops, as well as a 0.9 form discrimination factor, and factors to account for the relative moisture content of various crops (see Section 9.6.1 of Napier et al. 2012 for details). There is no defined root uptake pathway; all pathways related to root uptake (food or feed crop) are set equal to zero.

Modules itemized below require commentary for tritium modeling. Modules not itemized do not require additional considerations, if tritium is a contaminant of concern.

10.1.1 Module: Constituent

Constituent of concern choices are indicated in Table 10.1. When tritiated water or tritium gas is selected as a constituent of concern, OBT (organically-bound tritium) is automatically added. If OBT is deleted as a constituent of concern, the H3 or H3EL will be deleted as well. However, if H3 or H3EL is deleted, the OBT will remain. The OBT is indicated only for subsequent use by the code. The Gv2.10 tritium models only reflect environmental modeling of tritium gas and tritiated water.

Table 10.1. Tritium Nuclide Source Term Selection

Effluent Path	Constituent Module – Constituent of Concern	Comment
Air Effluent		
Tritiated Water	H3 or HTO	-
Tritium gas	H3EL or HT	Although soil conversion of tritium gas to tritiated water is modeled, tritiated soil water is assumed to be an insignificant dose contributor and is ignored for soil exposure impacts.
Organically Bound Tritium	OBT[(a)]	Environmental modeling of facility OBT emissions in air is best performed by hand calculations or environmental sampling.
Liquid Effluent		
Tritiated Water	H3 or HTO	Enter release as dissolved flux in User-Defined Water Module.
Tritium gas	H3EL or HT	Tritium gas in water not modeled in Gv2.10. Enter release rate as zero.
Organically Bound Tritium	OBT[(a)]	Environmental modeling of facility OBT emissions in liquid is best performed by hand calculations or environmental sampling.

(a) Automatically added when any other tritium constituent of concern is selected. Concentrations calculated by the code, downstream, in the Chronic Exposure Module.

Water purification-, aquatic food, animal product, and food crop transfer factors all default to 1 for H3, H3EL, and OBT. H3EL deposition will be zero because gases are not modeled to deposit on the ground or plant surfaces.

10.1.2 Module: User-Defined AIR and User-Defined WATER

For the User-Defined AIR module, the user is requested to enter release rates for the selected tritium form and OBT, as with other nuclides. The user is responsible for entering a zero for OBT because the Gv2 algorithms reflect only tritium gas and water vapor models. Any special entries of particle size, using the "Flux Types" button, will have no impact for H3 or OBT.

The required zero Ci OBT releases in the source term results in OBT media concentrations of zero in the output AFF file of the User-Defined module and in the ATO file of the AIR module; but concentrations are non-zero in the EPF file of the Exposure and subsequent modules for food and soil pathways.

10.1.3 Module: Surface Water

Water concentrations are modeled identically for tritiated water and OBT. As indicated earlier, the user is discouraged from entering an OBT source term because models reflect tritiated water environmental movement.

10.1.4 Module: Chronic Exposure

The chronic exposure module requires the absolute humidity to be entered. Humidity values that reflect that of the growing season are preferred.

Controls Tab: ABSHUM Absolute Humidity

Relative humidity (RH) information can be found at the NCDC website http://lwf.ncdc.noaa.gov/oa/climate/online/ccd/avgrh.html (NCDC 2008). Data were summarized into the USDA watershed regions (see Figure 7.3) in Table 10.2 for the months of May through September, which are common growing season months in the US. Gv2 requires absolute, rather than relative, humidity values. The RH information can be converted into an approximate absolute humidity with the information provided in Table 10.3; the temperature assumed should at least correspond with that entered in the User-Defined module for ambient temperature (see Section 3.0) but is best assumed to be the average temperature during the growing season. Data in Table 10.3 were derived from TIS-GRD (2012); more precise calculations can be used to convert from relative to absolute humidity from calculations found in other resources. Specific humidity values could be used for absolute humidity values.

Chronic exposure module calculations for environmental media concentrations are modeled identically for tritiated water and OBT source terms in the EPF for aquatic foods, direct exposure to water pathways (i.e., boating, swimming, shower, and water ingestion), and shoreline exposure. Liquid effluent tritiated water source terms impact food and feed concentrations when irrigation is assumed.

Table 10.2. Relative Humidity (RH) by Watershed Region

Watershed Region[(a)]	Average of Morning RH	Average of Afternoon RH	Average RH
1	80.2	59.7	69.9
2	80.6	55.9	68.3
3	87.4	59.9	73.7
4	84.7	58.7	71.7
5	85.2	58.8	72.0
6	88.2	58.5	73.4
7	83.7	60.2	72.0
8	90.3	63.1	76.7
9	81.3	54.8	68.0
10	75.5	42.4	58.9
11	82.3	56.9	69.6
12	82.5	57.4	69.9
13	65.5	31.7	48.6
14	66.1	31.3	48.7
15	51.8	23.4	37.6
16	52.8	20.6	36.7
17	77.3	42.6	60.0
18	72.6	44.6	58.6
19	78.9	67.2	73.1
20	81.2	71.2	76.2

(a) USDA (2009); see also Figure 7.3.
RH = Relative humidity.

Table 10.3. Approximation of Absolute Humidity from RH

Relative Humidity:		10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Temp (°C)	Temp (°F)	Approximate Absolute Humidity (g/m^3)									
50	122	8.3	16.6	24.9	33.2	41.5	49.8	58.1	66.4	74.7	83.0
45	113	6.5	13.1	19.6	26.2	32.7	39.3	45.8	52.4	58.9	65.4
40	104	5.1	10.2	15.3	20.5	25.6	30.7	35.8	40.9	46.0	51.1
35	95	4.0	7.9	11.9	15.8	19.8	23.8	27.7	31.7	35.6	39.6
30	86	3.0	6.1	9.1	12.1	15.2	18.2	21.3	24.3	27.3	30.4
25	77	2.3	4.6	6.9	9.2	11.5	13.8	16.1	18.4	20.7	23.0
20	68	1.7	3.5	5.2	6.9	8.7	10.4	12.1	13.8	15.6	17.3
15	59	1.3	2.6	3.9	5.1	6.4	7.7	9.0	10.3	11.5	12.8
10	50	0.9	1.9	2.8	3.8	4.7	5.6	6.6	7.5	8.5	9.4
5	41	0.7	1.4	2.0	2.7	3.4	4.1	4.8	5.4	6.1	6.8
0	32	0.5	1.0	1.5	1.9	2.4	2.9	3.4	3.9	4.4	4.8
-5	23	0.3	0.7	1.0	1.4	1.7	2.1	2.4	2.7	3.1	3.4

The shaded area reflects most absolute humidity values for typical U.S. growing season (May–September).

10.1.5 Module: Health Impacts

The sub-tab Constituent Parameters requires entry of Lung transfer inhalation class (SOLUBIL) assignments. The assignments will impact results. Be sure H^3 and HTO are assigned as “Vapor;” H3EL and HT are assigned as “Gas;” and OBT is assigned “Vapor.”

10.2 Carbon-14 Model Considerations

Carbon options in Gv2 are C14 and C11. Both are modeled using special models, however, the 20-minute half-life of ^{11}C results in essentially zero concentrations in media other than air. The topic of ^{14}C dose estimation has been brought to the forefront in recent years.[1] Carbon-14 has become a more significant radioactive nuclide emission at nuclear power plants due to improved controls on other radioactive emissions and has been more intensely studied as a part of greenhouse gas emission research. The increase in CO_2 levels in the atmosphere is largely the result of fossil fuel combustion; fossil fuel contains a lower ^{14}C to ^{13}C ratio, resulting in a net decrease in background $^{14}CO_2$ concentrations over time. As a result of the recent evolution of ^{14}C work, the ^{14}C models for air emissions as currently implemented in Gv2 are currently under review; estimates of dose from the current models should be considered to be minor overestimates.

Liquid effluent releases of ^{14}C are generally much less important than airborne releases. Liquid effluent releases of ^{14}C and subsequent irrigation water deposition are described in Section 9.6.2 of Napier

[1]For example, see the Electric Power Research Institute presentation at http://hps.ne.uiuc.edu/rets-remp/PastWorkshops/2011/presentations/4B-C-14%20Dose%20Calculation%20Methods%20at%20Nuclear.pdf (last accessed June 2012).

et al. (2012). However, current coding of this model is simplistic and probably results in significant overestimates of dose. The short half-life of carbon-11 results in essentially zero concentrations in media other than surface water.

10.3 References

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Appendix A

Aquatic Biota

Appendix A

Aquatic Biota

A.1 Introduction

This appendix contains tables of bioaccumulation factors for aquatic animals and plants, including both freshwater and saltwater values. References are indicated for each value.

FRESHWATER

Table A.1. Bioaccumulation in Wet Fish from Freshwater, L/kgwet (CLBFF)

Table A.2. Bioaccumulation in Wet Mollusk from Freshwater, L/kgwet (CLBFM)

Table A.3. Bioaccumulation in Wet Crustacea from Freshwater, L/kgwet (CLBFI)

Table A.4. Bioaccumulation in Wet Plants from Freshwater, L/kgwet (CLBFP)

SALTWATER

Table A.5. Bioaccumulation in Wet Fish from Saltwater, L/kgwet (CLBMF)

Table A.6. Bioaccumulation in Wet Mollusk from Saltwater, L/kgwet (CLBMM)

Table A.7. Bioaccumulation in Wet Crustacea from Saltwater, L/kgwet (CLBMI)

Table A.8. Bioaccumulation in Wet Plants from Saltwater, L/kgwet (CLBMP)

In all tables if an element is listed once and there is no data for that element, no bioaccumulation factor information was currently identified, preferred, or available.

Table A.1. Bioaccumulation in Wet Fish from Freshwater, L/kg$_{wet}$ (CLBFF)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Ac	89											2.50E+01		NUREG/CR-5512		Strenge et al. (1986)
Ag	47											2.30E+00		NUREG/CR-5512		Strenge et al. (1986)
Ag	47	23	5.70E+01	1.80E+02					1.30E+00	1.10E+02				TRS_364	4	
Ag	47	27	4.00E+01	2.10E+02					1.50E+00	1.10E+02				TRS_472		
Al	13	93	4.50E+00	5.20E+03					7.10E+00	6.60E+01				TRS_364	3	
Al	13	31	5.90E+00	3.00E+02					3.90E+00	5.10E+01				TRS_472		
Am	95											2.50E+02		NUREG/CR-5512		Poston and Klopfer (1988)
Am	95					1.30E+03										Fesenko et al. (2011)
Am	95	2	7.20E+01	4.00E+02		2.40E+02								TRS_472		
Ar	18															
As	33											1.00E+02		NUREG/CR-5512		Strenge et al. (1986)
As	33				9.10E+01									Thompson et al. (1972)	2723	Davis et al. (1958)
As	33	33	8.10E+01	1.00E+03					2.30E+00	3.80E+02				TRS_364	4	
As	33								5.20E+00	1.40E+01						Sheppard et al. (2010a)
As	33	15	5.00E+01	9.50E+02					2.10E+00	3.30E+02				TRS_472		
At	85															
Au	79											3.30E+01		NUREG/CR-5512		Strenge et al. (1986)
Au	79	13	5.00E+01	1.00E+03					2.30E+00	2.90E+02				TRS_364	4	
Au	79	17	5.00E+01	9.00E+02					2.10E+00	2.40E+02				TRS_472		
Ba	56											2.00E+02		NUREG/CR-5512		Poston and Klopfer (1988)
Ba	56	92	5.00E+00	2.20E+02					1.70E+00	4.70E+01				TRS_364	4	
Ba	56	111	5.30E-02	3.20E+01					3.30E+00	1.20E+00				TRS_472		
Be	4											2.00E+00		NUREG/CR-5512		Strenge et al. (1986)
Bi	83											1.50E+01		NUREG/CR-5512		Strenge et al. (1986)
Bk	97															
Br	35											4.20E+02		NUREG/CR-5512		Strenge et al. (1986)
Br	35	37	1.50E+01	7.90E+02					2.30E+00	1.60E+03				TRS_364	4	
Br	35	15	1.90E+01	3.00E+02					2.30E+00	9.10E+01				TRS_472		
C	6											4.60E+03		NUREG/CR-5512		Strenge et al. (1986)
C	6					6.30E+03		4.40E+03								Fesenko et al. (2011)
C	6	6	1.90E+05	3.20E+06					2.90E+00	4.00E+05				TRS_472		
Ca	20											4.00E+01		NUREG/CR-5512		Strenge et al. (1986)
Ca	20	118	8.40E+01	5.60E+03					3.40E+00	1.00E+03				TRS_364	5	
Ca	20					8.80E+00										Fesenko et al. (2011)
Ca	20								4.30E+00	9.00E+01						Sheppard et al. (2010a)
Ca	20	104	2.00E+00	9.70E+01					2.50E+00	1.20E+01				TRS_472		
Cd	48											2.00E+02		NUREG/CR-5512		Strenge et al. (1986)
Cd	48								6.60E+00	1.40E+02						Sheppard et al. (2010a)
Ce	58											5.00E+02		NUREG/CR-5512		Strenge et al. (1986)
Ce	58				1.00E+00									Thompson et al. (1972)	6012	Polikarpov (1966)
Ce	58	90	3.00E+00	1.10E+02					2.70E+00	1.20E+01				TRS_364	5	
Ce	58					3.50E+02										Fesenko et al. (2011)
Ce	58								9.00E+00	4.80E+00						Sheppard et al. (2010a)
Ce	58					2.20E+02										Fesenko et al. (2011)
Ce	58	71	9.00E+01	1.20E+03					9.50E+00	2.50E+01				TRS_472		
Cf	98											2.50E+01		NUREG/CR-5512		Strenge et al. (1986)
Cl	17											5.00E+01		NUREG/CR-5512		Strenge et al. (1986)
Cl	17	37	2.50E+01	2.30E+02					1.60E+00	8.50E+01				TRS_364	4	
Cl	17								1.30E+00	1.10E+02						Sheppard et al. (2010a)
Cl	17	16	9.90E+00	1.20E+02					2.20E+00	4.00E+01				TRS_472		

Table A.1. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Cm	96											2.50E+02		NUREG/CR-5512		Poston and Klopfer (1988)
Co	27											3.30E+02		NUREG/CR-5512		Poston and Klopfer (1988)
Co	27		3.00E+00	4.50E+01										Thompson et al. (1972)	5731	Perkins et al. (1967)
Co	27	118	2.30E+02	2.40E+03					1.60E+00	4.00E+02				TRS_364	14	
Co	27					2.10E+02										Fesenko et al. (2011)
Co	27					1.50E+01										Fesenko et al. (2011)
Co	27					7.60E+01		2.20E+01								Fesenko et al. (2011)
Co	27					6.70E+01		3.10E+01								Fesenko et al. (2011)
Co	27					5.30E+01		7.00E+00								Fesenko et al. (2011)
Co	27								6.10E+00	9.60E+01						Sheppard et al. (2010a)
Co	27	65	9.00E+00	5.60E+02					2.40E+00	7.60E+01				TRS_472		
Cr	24											2.00E+02		NUREG/CR-5512		Strenge et al. (1986)
Cr	24				4.00E+03									Thompson et al. (1972)	2723	Davis et al. (1958)
Cr	24	51	3.50E+01	7.60E+02					2.00E+00	2.10E+02				TRS_364	5	
Cr	24								7.90E+00	4.00E-01						Sheppard et al. (2010a)
Cr	24	57	1.30E+01	1.20E+02					2.00E+00	4.00E+01				TRS_472		
Cs	55											2.00E+03		NUREG/CR-5512		Strenge et al. (1986)
Cs	55				2.40E+03									Thompson et al. (1972)	5731	Perkins et al. (1967)
Cs	55				2.40E+03									Thompson et al. (1972)	5731	Perkins et al. (1967)
Cs	55		3.30E+03	4.50E+03	3.90E+03									Thompson et al. (1972)	6335	Preston et.al. (1967)
Cs	55		4.60E+02	1.10E+03										Thompson et al. (1972)	8625	Kolehmainen et al. (1969)
Cs	55		1.60E+03	1.70E+03										Thompson et al. (1972)	9957	Seelye (1970)
Cs	55		3.90E+02	4.70E+03										Thompson et al. (1972)	10052	Bigliocca et al. (1969)
Cs	55	145	7.50E+01	2.40E+04					2.60E+00	3.00E+03				TRS_364	52	
Cs	55					8.50E+01		1.20E+02								Fesenko et al. (2011)
Cs	55					1.00E+01										Fesenko et al. (2011)
Cs	55					6.00E+02		9.50E+02								Fesenko et al. (2011)
Cs	55					5.80E+02		9.50E+02								Fesenko et al. (2011)
Cs	55								6.00E+00	6.90E+03						Sheppard et al. (2010a)
Cs	55	106	1.40E+02	1.50E+04					2.40E+00	2.50E+03				TRS_472		
Cu	29											5.00E+01		NUREG/CR-5512		Strenge et al. (1986)
Cu	29				5.00E+01									Thompson et al. (1972)	1679	Krumholz et al. (1957)
Cu	29		3.00E+00	1.00E+01										Thompson et al. (1972)	2723	Davis et al. (1958)
Cu	29	102	8.60E+01	1.20E+03					1.50E+00	2.70E+02				TRS_364	5	
Cu	29					1.40E+03		3.00E+02								Fesenko et al. (2011)
Cu	29								2.50E+00	1.24E+02						Sheppard et al. (2010a)
Cu	29	96	9.90E+01	7.20E+02					1.70E+00	2.30E+02				TRS_472		
Dy	66	1								3.00E+02				TRS_364	3	
Dy	66	2	2.20E+02	1.10E+03		6.50E+02								TRS_472		
Er	68															
Es	99															
Eu	63											2.50E+01		NUREG/CR-5512		Strenge et al. (1986)
Eu	63	53	7.60E+00	2.20E+03					3.20E+00	1.50E+02				TRS_364	4	
Eu	63	24	1.10E+01	7.20E+02					4.90E+00	1.30E+02				TRS_472		
F	9											1.00E+01		NUREG/CR-5512		Strenge et al. (1986)
Fe	26											2.00E+03		NUREG/CR-5512		Poston and Klopfer (1988)
Fe	26	114	1.60E+01	5.30E+03					5.70E+00	1.40E+02				TRS_364	6	
Fe	26					1.00E+04										Fesenko et al. (2011)
Fe	26								6.80E+00	3.60E+01						Sheppard et al. (2010a)
Fe	26	96	6.60E+00	2.00E+03					6.90E+00	1.70E+02				TRS_472		
Fm	100															
Fr	87															

Table A.1. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Ga	31															
Gd	64											2.50E+01		NUREG/CR-5512		Strenge et al. (1986)
Ge	32															
Ge	32					1.50E+00										Fesenko et al. (2011)
H	1											1.00E+00		NUREG/CR-5512		Poston and Klopfer (1988)
Hf	72	20	3.00E+02	2.80E+04					3.20E+00	2.10E+03				TRS_364	3	
Hf	72	10	3.30E+02	2.00E+03					1.90E+00	1.10E+03				TRS_472		
Hg	80											1.00E+03		NUREG/CR-5512		Strenge et al. (1986)
Hg	80	20	1.10E+03	2.20E+04					2.20E+00	4.50E+03				TRS_364	3	
Hg	80	14	1.90E+03	1.70E+04					1.90E+00	6.10E+03				TRS_472		
Ho	67											2.50E+01		NUREG/CR-5512		Strenge et al. (1986)
I	53											5.00E+02		NUREG/CR-5512		Poston and Klopfer (1988)
I	53	84	1.00E+02	4.50E+04					2.10E+00	6.50E+02				TRS_364	8	
I	53					1.70E+01		1.50E+01								Fesenko et al. (2011)
I	53					2.50E+00										Fesenko et al. (2011)
I	53								2.70E+00	3.40E+01						Sheppard et al. (2010a)
I	53	50	1.10E+01	4.00E+02					2.50E+00	3.00E+01				TRS_472		
In	49											1.00E+05		NUREG/CR-5512		Strenge et al. (1986)
Ir	77											1.00E+01		NUREG/CR-5512		Strenge et al. (1986)
K	19											1.00E+03		NUREG/CR-5512		Strenge et al. (1986)
K	19	120	5.70E+02	1.50E+04					2.00E+00	4.00E+03				TRS_364	5	
K	19								2.10E+00	1.40E+04						Sheppard et al. (2010a)
K	19	97	1.20E+03	9.00E+03					1.60E+00	3.20E+03				TRS_472		
Kr	36															
La	57											2.50E+01		NUREG/CR-5512		Strenge et al. (1986)
La	57	102	3.60E+00	3.40E+02					3.20E+00	1.60E+01				TRS_364	4	
La	57								7.60E+00	5.40E+00						Sheppard et al. (2010a)
La	57	74	1.10E+00	6.60E+02					4.90E+00	3.70E+01				TRS_472		
Lu	71															
Md	101															
Mg	12	111	1.40E+01	4.30E+02					3.00E+00	1.10E+02				TRS_364	4	
Mg	12								2.20E+00	1.40E+02						Sheppard et al. (2010a)
Mg	12	96	7.90E+00	1.90E+02					2.20E+00	3.70E+01				TRS_472		
Mn	25											4.00E+02		NUREG/CR-5512		Poston and Klopfer (1988)
Mn	25		6.00E-01	2.00E+00										Thompson et al. (1972)	5731	Perkins et al. (1967)
Mn	25		1.50E+02	6.60E+02										Thompson et al. (1972)	8687	Bortoli et al. (1969)
Mn	25				2.60E+01									Thompson et al. (1972)	2723	Davis et al. (1958)
Mn	25	110	4.80E+01	7.00E+03					4.00E+00	4.50E+02				TRS_364	6	
Mn	25					6.30E+01		2.10E+01								Fesenko et al. (2011)
Mn	25					2.20E+02										Fesenko et al. (2011)
Mn	25								8.10E+00	1.60E+02						Sheppard et al. (2010a)
Mn	25	97	1.30E+01	1.40E+05					6.70E+00	2.40E+02				TRS_472		
Mo	42											1.00E+01		NUREG/CR-5512		Poston and Klopfer (1988)
Mo	42	81	2.10E+00	1.90E+02					1.90E+00	2.70E+01				TRS_364	5	
Mo	42								3.80E+00	9.00E+00						Sheppard et al. (2010a)
Mo	42	64	4.00E-03	2.00E+01					2.10E+00	1.90E+00				TRS_472		
N	7											1.50E+05		NUREG/CR-5512		Strenge et al. (1986)
Na	11											1.00E+02		NUREG/CR-5512		Poston and Klopfer (1988)
Na	11		3.00E+01	1.30E+02										Thompson et al. (1972)	2723	Davis et al. (1958)
Na	11		4.20E+01	4.20E+02										Thompson et al. (1972)	5731	Perkins et al. (1967)
Na	11	42	3.40E+01	6.00E+02					2.10E+00	1.40E+02				TRS_364	5	
Na	11								2.30E+00	6.20E+01						Sheppard et al. (2010a)

Table A.1. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Na	11	97	1.70E+01	6.10E+02					3.00E+00	7.60E+01				TRS_472		
Nb	41											2.00E+02		NUREG/CR-5512		Poston and Klopfer (1988)
Nb	41								2.70E+00	2.70E+01						Sheppard et al. (2010a)
Nd	60											2.50E+01		NUREG/CR-5512		Strenge et al. (1986)
Nd	60								8.20E+00	4.70E+00						Sheppard et al. (2010a)
Ne	10															
Ni	28											1.00E+02		NUREG/CR-5512		Poston and Klopfer (1988)
Ni	28	24	1.90E+01	6.60E+02					2.10E+00	7.10E+01				TRS_364	1	
Ni	28								3.70E+00	9.60E+01						Sheppard et al. (2010a)
Ni	28	5	1.10E+01	4.40E+01					1.90E+00	2.10E+01				TRS_472		
Np	93															
O	8															
OBT																
Os	76											1.00E+01		NUREG/CR-5512		Strenge et al. (1986)
P	15											7.00E+04		NUREG/CR-5512		Poston and Klopfer (1988)
P	15		3.00E+04	1.00E+05										Thompson et al. (1972)	1679	Krumholz et al. (1957)
P	15		1.20E+04	1.00E+05										Thompson et al. (1972)	2723	Davis et al. (1958)
P	15				1.50E+05									Thompson et al. (1972)	4081	Ewool et al. (1963)
P	15		5.00E+02	5.50E+04										Thompson et al. (1972)	9576	<unknown>
P	15															Smith et al. (2011)
P	15	39	1.20E+05	1.70E+05					1.10E+00	1.40E+05				TRS_472		
Pa	91											1.10E+01		NUREG/CR-5512		Strenge et al. (1986)
Pb	82											1.00E+02		NUREG/CR-5512		Strenge et al. (1986)
Pb	82		5.00E-01	1.50E+02										Thompson et al. (1972)	8956	Wong_etal_1970
Pb	82	82	5.80E+01	5.70E+03					3.00E+00	3.70E+02				TRS_364	1	
Pb	82					2.30E+01		8.00E+00								Fesenko et al. (2011)
Pb	82					1.90E+01		6.00E+00								Fesenko et al. (2011)
Pb	82	39	1.00E-01	2.70E+02					2.90E+00	2.50E+01				TRS_472		
Pd	46											1.00E+01		NUREG/CR-5512		Strenge et al. (1986)
Pd	46								3.00E+00	3.90E+01						Sheppard et al. (2010a)
Pm	61											2.50E+01		NUREG/CR-5512		Strenge et al. (1986)
Po	84											5.00E+02		NUREG/CR-5512		Strenge et al. (1986)
Po	84		6.70E+01	4.50E+03	3.00E+02									Thompson et al. (1972)		Wong et al. (1970)
Po	84	5	6.00E+00	1.70E+02					4.30E+00	3.60E+01				TRS_472		
Pr	59											2.50E+01		NUREG/CR-5512		Strenge et al. (1986)
Pt	78															
Pu	94											2.50E+02		NUREG/CR-5512		Poston and Klopfer (1988)
Pu	94					7.60E+01										Fesenko et al. (2011)
Pu	94					3.10E+01										Fesenko et al. (2011)
Pu	94					3.00E+00										Fesenko et al. (2011)
Pu	94	3	7.70E+03	5.00E+04					2.60E+00	2.10E+04				TRS_472		
Ra	88											7.00E+01		NUREG/CR-5512		Poston and Klopfer (1988)
Ra	88	2	1.60E+02	2.50E+02		2.10E+02		6.00E+01						TRS_364	3	
Ra	88					1.60E+00		6.30E+00								Fesenko et al. (2011)
Ra	88					4.00E+01										Pyle and Clulow (1998)
Ra	88	21	6.00E-02	1.50E+02					6.90E+00	4.00E+00				TRS_472		
Rb	37											2.00E+03		NUREG/CR-5512		Strenge et al. (1986)
Rb	37	113	1.20E+03	1.60E+03					1.60E+00	6.10E+03				TRS_364	4	
Rb	37					3.40E+01										Fesenko et al. (2011)
Rb	37								3.90E+00	5.10E+04						Sheppard et al. (2010a)
Rb	37	92	1.00E+03	1.40E+04					1.70E+00	4.00E+03				TRS_472		
Re	75											1.20E+02		NUREG/CR-5512		Strenge et al. (1986)

Table A.1. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Rh	45											1.00E+01		NUREG/CR-5512		Strenge et al. (1986)
Rn	86															
Ru	44											1.00E+02		NUREG/CR-5512		Poston and Klopfer (1988)
Ru	44					9.00E+01										Fesenko et al. (2011)
Ru	44					2.00E+01										Fesenko et al. (2011)
Ru	44	2	1.00E+01	1.00E+02		5.50E+01								TRS_472		
S	16											7.50E+02		NUREG/CR-5512		Strenge et al. (1986)
S	16					3.50E+00										Fesenko et al. (2011)
Sb	51											2.00E+02		NUREG/CR-5512		Poston and Klopfer (1988)
Sb	51	37	4.70E+00	9.30E+06					8.80E+00	7.10E+01				TRS_364	4	
Sb	51								3.70E+00	9.10E+00						Sheppard et al. (2010a)
Sb	51	14	1.90E+00	3.60E+02					4.50E+00	3.70E+01				TRS_472		
Sc	21											1.00E+02		NUREG/CR-5512		Poston and Klopfer (1988)
Sc	21		6.00E-01	3.30E+00										Thompson et al. (1972)	5731	Perkins et al. (1967)
Sc	21	30	6.70E+01	3.70E+04					3.60E+00	9.30E+02				TRS_364	3	
Sc	21	20	3.30E+01	7.30E+02					2.10E+00	1.90E+02				TRS_472		
Se	34											1.70E+02		NUREG/CR-5512		Strenge et al. (1986)
Se	34	28	3.60E+03	1.20E+04					1.30E+00	6.80E+03				TRS_364	6	
Se	34								3.70E+00	1.10E+01						
Se	34	14	3.50E+03	9.40E+03					1.30E+00	6.00E+03				TRS_472		
Si	14															
Sm	62											2.50E+01		NUREG/CR-5512		Strenge et al. (1986)
Sn	50											3.00E+03		NUREG/CR-5512		Strenge et al. (1986)
Sr	38											5.00E+01		NUREG/CR-5512		Poston and Klopfer (1988)
Sr	38				3.00E+00									Thompson et al. (1972)	9533	Feldt (1971)
Sr	38		5.80E+01	1.70E+02	1.60E+01									Thompson et al. (1972)	10067	Friend et al. (1965)
Sr	38	116	2.20E+01	7.10E+02					2.20E+00	1.90E+02				TRS_364	26	
Sr	38					3.80E+02		7.50E+02								Fesenko et al. (2011)
Sr	38					8.30E+01		1.50E+02								Fesenko et al. (2011)
Sr	38					1.10E+02		2.50E+02								Fesenko et al. (2011)
Sr	38					1.00E+03		2.20E+03								Fesenko et al. (2011)
Sr	38					5.00E+01		1.20E+02								Fesenko et al. (2011)
Sr	38					2.20E+02		9.80E+02								Fesenko et al. (2011)
Sr	38					2.70E+01		8.00E+00								Fesenko et al. (2011)
Sr	38								5.40E+00	1.20E+01						Sheppard et al. (2010a)
Sr	38					1.16E+03		6.70E+02								Outola et al. (2009)
Sr	38					1.60E+01		7.00E+00								Outola et al. (2009)
Sr	38					3.50E+02		1.00E+02								Outola et al. (2009)
Sr	38	99	1.40E-01	6.90E+01					3.90E+00	2.90E+00				TRS_472		
Ta	73															
Tb	65											2.50E+01		NUREG/CR-5512		Strenge et al. (1986)
Tb	65	18	8.00E+01	2.40E+03					2.60E+00	7.50E+02				TRS_364	3	
Tb	65	11	2.00E+02	1.70E+03					1.90E+00	4.10E+02				TRS_472		
Tc	43											1.50E+01		NUREG/CR-5512		Poston and Klopfer (1988)
Te	52											4.00E+02		NUREG/CR-5512		Strenge et al. (1986)
Te	52	9	2.20E+02	8.90E+02					1.50E+00	4.20E+02				TRS_364	1	
Te	52	3	9.60E+01	2.10E+02					1.50E+00	1.50E+02				TRS_472		
Th	90											1.00E+02		NUREG/CR-5512		Poston and Klopfer (1988)
Th	90	2	3.80E+01	3.80E+03		1.90E+02		2.60E+02						TRS_364	5	
Th	90								3.50E+00	1.30E+02						Sheppard et al. (2010a)
Th	90	3	6.00E+00	6.00E+00						6.00E+00				TRS_472		
Ti	22	30	1.20E+02	1.30E+03					1.90E+00	3.70E+02				TRS_364	3	

Table A.1. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Ti	22	13	1.10E+02	3.50E+02					1.40E+00	1.90E+02				TRS_472		
Tl	81	81	6.40E+01	3.10E+03					1.90E+00	5.80E+02				TRS_364	3	
Tl	81								1.90E+00	2.90E+03						Sheppard et al. (2010a)
Tl	81	59	6.60E+01	1.00E+04					2.60E+00	9.00E+02				TRS_472		
Tm	69															
U	92											5.00E+01		NUREG/CR-5512		Poston and Klopfer (1988)
U	92				2.00E+00									Thompson et al. (1972)	10058	Ouchi et al. (1970)
U	92	2	1.50E+00	3.30E+00		1.30E+00		2.40E+00						TRS_364	3	
U	92								2.10E+00	2.30E+01						Sheppard et al. (2010a)
U	92	9	2.00E-02	2.00E+01					1.20E+00	9.60E-01				TRS_472		
V	23	103	3.00E+01	1.10E+03					2.00E+00	2.80E+02				TRS_364	4	
V	23								7.10E+00	2.50E+00						Sheppard et al. (2010a)
V	23	91	1.00E+01	2.40E+02					1.90E+00	9.70E+01				TRS_472		
W	74											1.20E+03		NUREG/CR-5512		Strenge et al. (1986)
Xe	54															
Y	39											2.50E+01		NUREG/CR-5512		Strenge et al. (1986)
Y	39	12	1.10E+01	6.20E+01					1.60E+00	3.10E+00				TRS_364	1	
Y	39	19	4.50E+00	1.20E+02					2.50E+00	4.00E+01				TRS_472		
Yb	70															
Zn	30											2.50E+03		NUREG/CR-5512		Poston and Klopfer (1988)
Zn	30		3.20E+02	8.50E+03	1.70E+03									Thompson et al. (1972)	2723	Davis et al. (1958)
Zn	30	114	1.20E+03	1.80E+04					1.80E+00	4.70E+03				TRS_364	5	
Zn	30					1.80E+01		8.00E+00								Fesenko et al. (2011)
Zn	30					1.00E+03										Fesenko et al. (2011)
Zn	30					1.10E+03										Fesenko et al. (2011)
Zn	30								3.40E+00	2.50E+02						Sheppard et al. (2010a)
Zn	30	96	3.30E+02	1.60E+04					2.90E+00	3.40E+03				TRS_472		
Zr	40											2.00E+02		NUREG/CR-5512		Poston and Klopfer (1988)
Zr	40					1.00E+02										Fesenko et al. (2011)
Zr	40					1.50E+01										Fesenko et al. (2011)
Zr	40	10	9.20E+00	1.20E+02					2.40E+00	2.20E+01				TRS_472		

Table A.2. Bioaccumulation in Wet Mollusk from Freshwater, L/kg$_{wet}$ (CLBFM)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Ac	89															
Ag	47	2	1.30E+02	3.30E+02		2.30E+02								TRS_472		
Al	13	2	3.10E+03	3.70E+03		3.40E+03								TRS_472		
Am	95	17	5.90E+01	9.00E+04					7.00E+00	2.40E+03				TRS_472		
Ar	18															
As	33				5.00E+01									Thompson et al. (1972)	2723	Davis et al. (1958)
As	33	2	1.00E+03	2.00E+03		1.50E+03								TRS_472		
At	85															
Au	79	2	1.00E+03	1.50E+03		1.40E+03								TRS_472		
B	5															
Ba	56	2	1.10E+02	1.60E+02		1.40E+02								TRS_472		
Be	4															
Bi	83															
Bk	97															
Br	35	2	7.20E+02	1.90E+03		1.30E+03								TRS_472		
C	6	24	1.30E+04	5.70E+05					2.60E+00	6.50E+04				TRS_472		
Ca	20	3	1.20E+01	6.60E+01					2.50E+00	3.40E+01				TRS_472		
Cd	48	149	1.40E-02	3.10E+04					3.90E+01	1.00E+02				TRS_472		
Ce	58					2.30E+03		6.00E+02								Fesenko et al. (2011)
Ce	58	2	2.90E+02	5.60E+02		4.30E+02								TRS_472		
Cf	98															
Cl	17	2	1.30E+02	1.90E+02		1.60E+02								TRS_472		
Cm	96	29	9.00E+03	1.00E+04		9.50E+03								TRS_472		
Co	27					2.50E+01		6.00E+00								Fesenko et al. (2011)
Co	27	2	1.90E-02	4.10E+04					1.30E+02	2.20E+01				TRS_472		
Cr	24				3.00E+03									Thompson et al. (1972)	2723	Davis et al. (1958)
Cr	24					3.00E+01		8.00E+00								Fesenko et al. (2011)
Cr	24	29	2.10E+02	3.90E+02		3.00E+02								TRS_472		
Cs	55					1.50E+01		4.00E+00								Fesenko et al. (2011)
Cs	55	92	5.40E-03	6.10E+03					7.50E+01	2.30E+01				TRS_472		
Cu	29				6.00E+02									Thompson et al. (1972)	2723	Davis et al. (1958)
Cu	29	2	5.60E+01	1.40E+03					1.10E+01	4.20E+01				TRS_472		
Dy	66															
Er	68															
Es	99															
Eu	63	2	2.00E+02	2.30E+02		2.20E+02								TRS_472		
F	9															
Fe	26					7.30E+01		1.80E+01								Fesenko et al. (2011)
Fe	26	2	1.90E+03	2.10E+03		2.00E+03								TRS_472		
Fm	100															
Fr	87															
Ga	31															
Gd	64															
Ge	32															
H	1															
Hf	72	2	1.30E+03	1.50E+03		1.40E+03								TRS_472		
Hg	80	31	2.00E+02	5.20E+03					2.70E+00	7.50E+02				TRS_472		
Ho	67															
I	53					7.00E+00		1.80E+00								Fesenko et al. (2011)
I	53	99	4.00E-01	1.30E+03					1.10E+01	1.70E+01				TRS_472		

Table A.2. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
In	49															
Ir	77															
K	19	2	5.40E+02	6.10E+02		5.90E+02								TRS_472		
Kr	36															
La	57	2	3.30E+02	3.70E+02		3.50E+02								TRS_472		
Li	3															
Lu	71	1								1.10E+03				TRS_472		
Md	101															
Mg	12	2	2.10E+01	4.30E+01		3.20E+01								TRS_472		
Mn	25				9.30E+03									Thompson et al. (1972)		Gaglione et al. (1964)
Mn	25					1.30E+03		3.00E+02								Fesenko et al. (2011)
Mn	25	4	1.10E-01	3.70E+03					3.90E+02	2.10E+01				TRS_472		
Mo	42	33	2.90E-02	3.00E+03					1.30E+01	4.50E-01				TRS_472		
N	7															
Na	11				2.00E+02									Thompson et al. (1972)	2723	Davis et al. (1958)
Na	11	4	1.40E-01	1.10E+02					3.60E+01	3.40E+00				TRS_472		
Nb	41															
Nd	60															
Ne	10															
Ni	28															
Np	93	2	9.00E+03	1.00E+04		9.50E+03								TRS_472		
O	8															
Os	76															
P	15				2.00E+04									Thompson et al. (1972)	2723	Davis et al. (1958)
Pa	91															
Pb	82	79	4.50E-02	7.00E+02					2.00E+01	2.20E+01				TRS_472		
Pd	46															
Pm	61															
Po	84					7.20E+01		1.80E+01								Fesenko et al. (2011)
Pr	59															
Pt	78															
Pu	94	100	3.60E-01	5.50E+06					2.90E+01	7.40E+03				TRS_472		
Ra	88	5	1.90E+00	1.90E+03					3.00E+01	1.00E+02				TRS_472		
Rb	37	2	1.90E+03	2.20E+03		2.00E+03								TRS_472		
Re	75															
Rh	45															
Rn	86															
Ru	44					1.20E+01		3.00E+00								Fesenko et al. (2011)
Ru	44	9	1.90E-03	9.30E+01					2.10E+01	3.90E-02				TRS_472		
S	16															
Sb	51					1.00E+01		3.00E+00								Fesenko et al. (2011)
Sb	51	2	7.40E+01	3.50E+02		2.10E+02								TRS_472		
Sc	21	2	3.30E+03	3.70E+03		3.50E+03								TRS_472		
Se	34	16	1.20E+01	6.90E+04					1.50E+01	5.70E+02				TRS_472		
Si	14															
Sm	62	2	5.00E+02	2.70E+03		1.60E+03								TRS_472		
Sn	50															
Sr	38					2.40E+03		6.00E+02								Fesenko et al. (2011)
Sr	38	5	7.70E+01	1.30E+03					3.20E+00	2.70E+02				TRS_472		
Ta	73															
Tb	65															
Tc	43	10	1.90E+00	4.00E+02					9.90E+00	2.60E+01				TRS_472		

Table A.2. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Te	52															
Th	90	2	2.90E+03	2.90E+03		2.90E+03								TRS_472		
Ti	22															
Tl	81															
Tm	69															
U	92	9	3.60E+00	6.00E+04					1.90E+01	1.70E+02				TRS_472		
V	23	2	3.60E+02	4.00E+02		3.90E+02								TRS_472		
W	74															
Xe	54															
Y	39															
Yb	70															
Zn	30				2.00E+03									Thompson et al. (1972)	2723	Davis et al. (1958)
Zn	30	92	6.30E-02	1.50E+03					2.90E+01	9.20E+01				TRS_472		
Zr	40					1.50E+01		4.00E+00								Fesenko et al. (2011)

Table A.3. Bioaccumulation in Wet Crustacea from Freshwater, L/kg_{wet} (CLBFI)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Ac	89															
Ag	47	2	1.30E+02	3.30E+02		2.30E+02		1.40E+03						TRS_364	2	
Ag	47	2	1.30E+02	3.30E+02		2.30E+02								TRS_472		
Al	13	2	3.10E+03	3.70E+03		3.40E+03		4.00E+02						TRS_364	2	
Al	13	2	3.10E+03	3.70E+03		3.40E+03								TRS_472		
Am	95	17	5.90E+01	8.00E+04					7.00E+00	2.40E+03				TRS_364	7	
Am	95	17	5.90E+01	9.00E+04					7.00E+00	2.40E+03				TRS_472		
Am	95					9.70E+01		1.50E+01								Hosseini et al. (2008)
Ar	18															
As	33				3.00E+01									Thompson et al. (1972)	2723	Davis et al. (1958)
As	33	2	1.00E+03	2.00E+03		1.50E+03		7.10E+02						TRS_364	2	
As	33	2	1.00E+03	2.00E+03		1.50E+03								TRS_472		
At	85															
Au	79	2	1.00E+03	1.50E+03		1.40E+03		3.50E+02						TRS_364	2	
Au	79	2	1.00E+03	1.50E+03		1.40E+03								TRS_472		
Ba	56	2	1.10E+02	1.60E+02		1.40E+02		3.50E+00						TRS_364	2	
Ba	56	2	1.10E+02	1.60E+02		1.40E+02								TRS_472		
Be	4															
Bi	83															
Bk	97															
Br	35	2	7.20E+02	1.80E+03		1.30E+03		7.60E+02						TRS_364	2	
Br	35	2	7.20E+02	1.90E+03		1.30E+03								TRS_472		
C	6	24	1.30E+03	5.70E+05					2.60E+00	6.50E+04				TRS_364	3	
C	6	24	1.30E+04	5.70E+05					2.60E+00	6.50E+04				TRS_472		
Ca	20	3	1.20E+01	6.60E+01					2.50E+00	3.40E+01				TRS_364	2	
Ca	20	3	1.20E+01	6.60E+01					2.50E+00	3.40E+01				TRS_472		
Cd	48	149	1.40E-02	3.10E+04					3.90E+01	1.00E+02				TRS_364	8	
Cd	48	149	1.40E-02	3.10E+04					3.90E+01	1.00E+02				TRS_472		
Cd	48					5.00E+03										Hosseini et al. (2008)
Ce	58	2	2.90E+02	5.60E+02		4.30E+02		1.90E+02						TRS_364	2	
Ce	58	2	2.90E+02	5.60E+02		4.30E+02								TRS_472		
Ce	58					1.00E+03										Hosseini et al. (2008)
Cf	98															
Cl	17	2	1.30E+02	1.80E+02		1.60E+02		3.50E+01						TRS_364	2	
Cl	17	2	1.30E+02	1.90E+02		1.60E+02								TRS_472		
Cl	17					5.00E+01										Hosseini et al. (2008)
Cm	96	2	9.00E+03	1.00E+04		9.50E+03		7.10E+02						TRS_364	1	
Cm	96	29	9.00E+03	1.00E+04		9.50E+03								TRS_472		
Co	27	28	1.80E-03	4.10E+04					1.30E+02	2.20E+01				TRS_364	9	
Co	27	2	1.90E-02	4.10E+04					1.30E+02	2.20E+01				TRS_472		
Co	27					1.50E+03		5.00E+02								Hosseini et al. (2008)
Cr	24				2.00E+02									Thompson et al. (1972)	2723	Davis et al. (1958)
Cr	24	2	2.10E+02	3.80E+02		3.00E+02		1.20E+02						TRS_364	2	
Cr	24	29	2.10E+02	3.90E+02		3.00E+02								TRS_472		
Cs	55	29	5.40E-03	6.10E+03					7.50E+01	2.30E+01				TRS_364	11	
Cs	55	92	5.40E-03	6.10E+03					7.50E+01	2.30E+01				TRS_472		
Cs	55					7.60E+03		8.90E+03								Hosseini et al. (2008)
Cu	29				3.00E+01									Thompson et al. (1972)	2723	Davis et al. (1958)
Cu	29	82	5.60E+01	1.40E+03					1.10E+01	4.20E+01				TRS_364	4	
Cu	29	2	5.60E+01	1.40E+03					1.10E+01	4.20E+01				TRS_472		

Table A.3. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Dy	66															
Er	68															
Es	99															
Eu	63	2	2.00E+02	2.30E+02		2.20E+02		2.10E+01						TRS_364	2	
Eu	63	2	2.00E+02	2.30E+02		2.20E+02								TRS_472		
F	9															
Fe	26	2	1.80E+03	2.10E+03		2.00E+03		2.10E+02						TRS_364	2	
Fe	26	2	1.90E+03	2.10E+03		2.00E+03								TRS_472		
Fm	100															
Fr	87															
Ga	31															
Gd	64															
Ge	32															
H	1															
Hf	72	2	1.30E+03	1.50E+03		1.40E+03		1.40E+02						TRS_364	2	
Hf	72	2	1.30E+03	1.50E+03		1.40E+03								TRS_472		
Hg	80	31	2.00E+02	5.20E+03					2.70E+00	7.50E+02				TRS_364	3	
Hg	80	31	2.00E+02	5.20E+03					2.70E+00	7.50E+02				TRS_472		
Ho	67															
I	53	99	4.00E-01	1.30E+03					1.10E+01	1.70E+01				TRS_364	5	
I	53	99	4.00E-01	1.30E+03					1.10E+01	1.70E+01				TRS_472		
I	53					4.00E+02		2.30E+02								Hosseini et al. (2008)
In	49															
Ir	77															
K	19	2	5.40E+02	6.10E+02		5.80E+02		5.00E+01						TRS_364	2	
K	19	2	5.40E+02	6.10E+02		5.90E+02								TRS_472		
Kr	36															
La	57	2	3.30E+02	3.70E+02		3.50E+02		2.80E+01						TRS_364	2	
La	57	2	3.30E+02	3.70E+02		3.50E+02								TRS_472		
Lu	71	1								1.10E+03				TRS_364	2	
Lu	71	1								1.10E+03				TRS_472		
Md	101															
Mg	12	2	2.10E+01	4.30E+01		3.20E+01		1.60E+00						TRS_364	2	
Mg	12	2	2.10E+01	4.30E+01		3.20E+01								TRS_472		
Mn	25	4	1.10E-01	3.70E+03					3.90E+02	2.10E+01				TRS_364	3	
Mn	25	4	1.10E-01	3.70E+03					3.90E+02	2.10E+01				TRS_472		
Mn	25					1.00E+04										Hosseini et al. (2008)
Mo	42	33	2.90E-02	3.00E+03					1.30E+01	4.50E-01				TRS_364	3	
Mo	42	33	2.90E-02	3.00E+03					1.30E+01	4.50E-01				TRS_472		
N	7															
Na	11				2.00E+02									Thompson et al. (1972)	2723	Davis et al. (1958)
Na	11	4	1.40E-01	1.10E+02					3.60E+01	3.40E+00				TRS_364	3	
Na	11	4	1.40E-01	1.10E+02					3.60E+01	3.40E+00				TRS_472		
Nb	41															
Nd	60															
Ne	10															
Ni	28															
Np	93	2	9.00E+03	1.00E+04		9.50E+03		1.10E+00						TRS_364	1	
Np	93	2	9.00E+03	1.00E+04		9.50E+03								TRS_472		
O	8															
OBT																
Os	76															

Table A.3. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
P	15				1.00E+04									Thompson et al. (1972)	2723	Davis et al. (1958)
P	15					1.30E+04										Hosseini et al. (2008)
Pa	91															
Pb	82	79	4.50E-02	7.00E+02					2.00E+01	2.20E+01				TRS_364	3	
Pb	82	79	4.50E-02	7.00E+02					2.00E+01	2.20E+01				TRS_472		
Pd	46															
Pm	61															
Po	84					9.90E+03		1.40E+03								Hosseini et al. (2008)
Pr	59															
Pt	78															
Pu	94	100	3.60E-01	5.50E+06					2.90E+01	7.40E+03				TRS_364	13	
Pu	94	100	3.60E-01	5.50E+06					2.90E+01	7.40E+03				TRS_472		
Pu	94					1.10E+03		4.30E+02								Hosseini et al. (2008)
Ra	88	5	1.80E+00	1.80E+03					3.00E+01	1.00E+02				TRS_364	1	
Ra	88	5	1.90E+00	1.90E+03					3.00E+01	1.00E+02				TRS_472		
Ra	88					1.50E+03		1.30E+03								Hosseini et al. (2008)
Rb	37	2	1.80E+03	2.20E+03		2.00E+03		2.80E+02						TRS_364	2	
Rb	37	2	1.90E+03	2.20E+03		2.00E+03								TRS_472		
Re	75															
Rh	45															
Rn	86															
Ru	44	9	1.80E-03	8.30E+01					2.10E+01	3.80E-02				TRS_364	2	
Ru	44	9	1.90E-03	9.30E+01					2.10E+01	3.90E-02				TRS_472		
S	16					2.00E+01										Hosseini et al. (2008)
Sb	51	2	7.40E+01	3.50E+02		2.10E+02		1.90E+02						TRS_364	2	
Sb	51	2	7.40E+01	3.50E+02		2.10E+02								TRS_472		
Sc	21	2	3.30E+03	3.70E+03		3.50E+03		2.80E+02						TRS_364	2	
Sc	21	2	3.30E+03	3.70E+03		3.50E+03								TRS_472		
Se	34	16	1.20E+01	6.90E+04					1.50E+01	5.70E+02				TRS_364	5	
Se	34	16	1.20E+01	6.90E+04					1.50E+01	5.70E+02				TRS_472		
Si	14															
Sm	62	2	5.00E+02	2.70E+03		1.60E+03		1.60E+03						TRS_364	2	
Sm	62	2	5.00E+02	2.70E+03		1.60E+03								TRS_472		
Sn	50															
Sr	38	5	7.70E+01	1.30E+03					3.20E+00	2.70E+03				TRS_364	5	
Sr	38	5	7.70E+01	1.30E+03					3.20E+00	2.70E+02				TRS_472		
Sr	38					2.00E+02		1.80E+02								Hosseini et al. (2008)
Ta	73															
Tb	65															
Tc	43	10	1.80E+00	4.00E+02					9.80E+00	2.60E+01				TRS_364	1	
Tc	43	10	1.90E+00	4.00E+02					9.90E+00	2.60E+01				TRS_472		
Te	52															
Th	90	2	2.90E+03	2.92E+03		2.90E+03		1.40E+01						TRS_364	2	
Th	90	2	2.90E+03	2.90E+03		2.90E+03								TRS_472		
Ti	22															
Tl	81															
Tm	69															
U	92				6.00E+01									Thompson et al. (1972)	10058	Ouchi et al. (1970)
U	92	8	3.60E+00	6.00E+04					1.90E+01	1.70E+02				TRS_364	1	
U	92	9	3.60E+00	6.00E+04					1.90E+01	1.70E+02				TRS_472		
U	92					5.00E+02		7.00E+02								Hosseini et al. (2008)
V	23	2	3.60E+02	4.00E+02		3.80E+02		2.80E+01						TRS_364	2	

Table A.3. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
V	23	2	3.60E+02	4.00E+02		3.90E+02								TRS_472		
W	74															
Xe	54															
Y	39															
Yb	70															
Zn	30				4.00E+03									Thompson et al. (1972)	2723	Davis et al. (1958)
Zn	30	82	6.30E-02	1.50E+03					2.90E+01	9.20E+01				TRS_364	4	
Zn	30	92	6.30E-02	1.50E+03					2.90E+01	9.20E+01				TRS_472		
Zr	40					2.60E+02										Hosseini et al. (2008)

Table A.4. Bioaccumulation in Wet Plants from Freshwater, L/kg$_{wet}$ (CLBFP)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	Document	Reference#	Reference
Ac	89														
Ag	47														
Al	13														
Am	95	16	7.50E+00	3.80E+04					8.30E+00	3.70E+00			TRS_364	6	
Am	95	16	7.50E+00	3.90E+04					9.30E+00	3.70E+03			TRS_472		
Ar	18														
As	33				3.50E+03								Thompson et al. (1972)	2723	Davis et al. (1958)
As	33														
At	85														
Au	79														
B	5														
Ba	56														
Be	4														
Bi	83														
Bk	97														
Br	35														
C	6	10	4.40E+01	8.90E+04					1.50E+01	1.60E+04			TRS_364	1	
C	6	10	4.40E+01	9.90E+04					1.50E+01	1.60E+04			TRS_472		
Ca	20														
Cd	48	5	1.10E+04	2.30E+04					6.80E+00	1.90E+04			TRS_364	2	
Cd	48	5	1.10E+04	2.30E+04					6.90E+00	1.90E+04			TRS_472		
Ce	58		2.00E+03	1.00E+04									Thompson et al. (1972)	5335	Bryan et al. (1966)
Cf	98														
Cl	17														
Cm	96	1								8.00E+03			TRS_364	1	
Cm	96	1				9.00E+03							TRS_472		
Co	27	18	5.00E+01	2.00E+04					5.10E+00	7.10E+02			TRS_364	11	
Co	27	19	5.00E+01	2.00E+04					5.10E+00	7.10E+02			TRS_472		
Cr	24				4.00E+03								Thompson et al. (1972)	2723	Davis et al. (1958)
Cs	55		7.00E+01	1.20E+03									Thompson et al. (1972)	2722	Pendleton et al. (1958)
Cs	55		4.70E+02	8.70E+02									Thompson et al. (1972)	5811	Ravera (1966)
Cs	55	26	1.80E+00	3.30E+03					1.60E+01	8.70E+01			TRS_364	2	
Cs	55	26	1.90E+00	3.30E+03					1.60E+01	9.70E+01			TRS_472		
Cu	29		5.00E+02	2.00E+03									Thompson et al. (1972)	1679	Krumholz et al. (1957)
Cu	29				6.00E+03								Thompson et al. (1972)	2723	Davis et al. (1958)
Cu	29	5	2.40E+03	3.60E+03					3.19E+02	3.00E+03			TRS_364	3	
Cu	29	5	2.00E+03	3.60E+03					3.20E+02	3.00E+03			TRS_472		
Dy	66														
Er	68														
Es	99														
Eu	63														
F	9														
Fe	26	5	5.20E+03	1.50E+04					1.80E+00	9.10E+03			TRS_364	1	
Fe	26	5	5.20E+03	1.50E+04					1.90E+00	9.10E+03			TRS_472		
Fm	100														
Fr	87														
Ga	31														
Gd	64														
Ge	32														
H	1														

Table A.4. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	Document	Reference#	Reference
He	2														
Hf	72														
Hg	80														
Ho	67														
I	53	3	7.80E+01	2.70E+02					3.70E+00	1.30E+02			TRS_364	1	
I	53	3	7.90E+01	2.70E+02					3.70E+00	1.30E+02			TRS_472		
In	49														
Ir	77														
K	19														
Kr	36														
La	57														
Li	3														
Lu	71														
Md	101														
Mg	12														
Mn	25				1.20E+04								Thompson et al. (1972)	5811	Ravera (1966)
Mn	25	6	3.10E-01	1.50E+05					7.22E+02	1.20E+04			TRS_364	4	
Mn	25	6	3.10E-01	1.50E+05					7.20E+02	1.20E+04			TRS_472		
Mo	42														
N	7														
Na	11				5.00E+02								Thompson et al. (1972)	1307	Fontaine (1962)
Na	11				5.00E+02								Thompson et al. (1972)	1679	Krumholz et al. (1957)
Na	11				6.60E+02								Thompson et al. (1972)	2723	Davis et al. (1958)
Nb	41														
Nd	60														
Ne	10														
Ni	28	5	2.50E+02	1.10E+03					1.29E+02	7.70E+02			TRS_364	3	
Ni	28	5	2.50E+02	1.10E+03					1.30E+02	7.70E+02			TRS_472		
Np	93				3.00E+02								Thompson et al. (1972)	2723	Davis et al. (1958)
Np	93	2	6.50E+03	8.00E+03		7.20E+03		1.10E+03					TRS_364	3	
Np	93	2	6.50E+03	9.00E+03		7.20E+03							TRS_472		
O	8														
Os	76														
P	15		1.00E+05	8.50E+05									Thompson et al. (1972)	1679	Krumholz et al. (1957)
P	15				2.70E+05								Thompson et al. (1972)	2723	Davis et al. (1958)
Pa	91														
Pb	82	5	1.30E+03	2.20E+03					7.60E+01	1.90E+03			TRS_364	1	
Pb	82	5	1.30E+03	2.20E+03					7.60E+01	1.90E+03			TRS_472		
Pd	46														
Pm	61														
Po	84														
Pr	59														
Pt	78														
Pu	94	40	1.20E+02	4.90E+07					1.40E+01	2.60E+04			TRS_364	4	
Pu	94	40	1.20E+02	4.90E+07					1.40E+01	2.60E+04			TRS_472		
Ra	88	8	6.40E+02	1.10E+04					4.10E+00	2.80E+03			TRS_364	2	
Ra	88		1.10E+01	4.40E+02											Jha et al. (2010)
Ra	88	9	6.40E+02	1.10E+04					4.10E+00	2.90E+03			TRS_472		
Rb	37														
Re	75														
Rh	45														
Rn	86														

Table A.4. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	Document	Reference#	Reference
Ru	44		2.50E+02	2.50E+03									Thompson et al. (1972)	5335	Bryan et al. (1966)
Ru	44		1.80E+03	1.20E+04									Thompson et al. (1972)	5811	Ravera (1966)
Ru	44	8	7.40E+01	6.70E+02					2.00E+00	2.90E+02			TRS_364	1	
Ru	44	9	7.40E+01	6.70E+02					2.00E+00	2.90E+02			TRS_472		
S	16														
Sb	51														
Sc	21														
Se	34	31	9.00E+00	8.20E+03					5.40E+00	1.40E+03			TRS_364	1	
Se	34	31	9.40E+00	9.20E+03					5.40E+00	1.40E+03			TRS_472		
Si	14														
Sm	62														
Sn	50														
Sr	38				6.00E+02								Thompson et al. (1972)	1784	Harvey (1964)
Sr	38		3.30E+02	6.90E+02									Thompson et al. (1972)	3133	Berg et al. (1961)
Sr	38		2.40E+01	2.80E+02									Thompson et al. (1972)	10050	Kalnina et al. (1969)
Sr	38	17	3.90E+01	1.90E+03					3.30E+00	4.10E+02			TRS_364	16	
Sr	38	17	3.90E+01	1.90E+03					3.30E+00	4.10E+02			TRS_472		
Ta	73														
Tb	65														
Tc	43	8	2.80E-01	8.80E+01					4.90E+00	5.50E+00			TRS_364	1	
Tc	43	9	2.90E-01	9.90E+01					4.00E+00	5.50E+00			TRS_472		
Te	52														
Th	90														
Ti	22														
Tl	81														
Tm	69														
U	92		4.00E-01	7.00E-01	5.50E-01								Thompson et al. (1972)	10058	Ouchi et al. (1970)
U	92	4	8.10E+01	5.20E+02					1.90E+00	2.10E+02			TRS_364	1	
U	92	4	9.10E+01	5.20E+02					1.90E+00	2.10E+02			TRS_472		
V	23														
W	74														
Xe	54														
Y	39														
Yb	70														
Zn	30				6.00E+03								Thompson et al. (1972)	1784	Harvey (1964)
Zn	30				1.30E+05								Thompson et al. (1972)	2723	Davis et al. (1958)
Zn	30	5	1.40E+04	2.70E+04					1.30E+01	2.10E+04			TRS_364	1	
Zn	30	5	1.40E+04	2.70E+04					1.30E+01	2.10E+04			TRS_472		
Zr	40														

Table A.5. Bioaccumulation in Wet Fish from Saltwater, L/kg_{wet} (CLBMF)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Ac	89											5.0E+01		TRS 422		
Ag	47					4.20E+03		4.10E+03								Hosseini et al. (2008)
Ag	47											1.0E+04		TRS 422		
Al	13															
Am	95		7.00E+00	2.30E+04								1.6E+02				
Am	95					5.80E+01		7.10E+01								Hosseini et al. (2008)
Am	95											1.0E+02		TRS 422		
Ar	18															
As	33															
At	85															
Au	79															
Ba	56															
Ba	56											1.0E+01		TRS 422		
Be	4															
Bi	83															
Bk	97															
Bk	97											1.0E+02		TRS 422		
Br	35											1.0E+01		Coughtrey et al. (1985)	S4.2	
Br	35															
C	6											2.0E+04		TRS 422		
Ca	20					1.20E+04										Hosseini et al. (2008)
Ca	20											2.0E+00		TRS 422		
Cd	48		1.00E-01	1.00E+02								2.00E+03		Coughtrey et al. (1985)	S4.2.4, T4.13	
Cd	48					9.60E+03		2.00E+04								Hosseini et al. (2008)
Cd	48											5.0E+03		TRS 422		
Ce	58											5.00E+01		Coughtrey et al. (1985)	S4.2.3, T4.5	
Ce	58				1.00E+00									Thompson et al. (1972)	1682	Mauchline et al. (1964)
Ce	58					1.20E+02		2.40E+02								Hosseini et al. (2008)
Ce	58											5.0E+01		TRS 422		
Cf	98											1.0E+02		TRS 422		
Cl	17					5.60E+02										Hosseini et al. (2008)
Cl	17											6.0E-03		TRS 422		
Cm	96											1.0E+02		TRS 422		
Co	27					5.30E+03		1.50E+04								Hosseini et al. (2008)
Co	27											7.0E+02		TRS 422		
Cr	24											2.0E+02		TRS 422		
Cs			5.00E-01	1.00E+04								7.00E+01		Coughtrey et al. (1985)	S4.2.4	
Cs	55		3.00E+01	4.50E+02										Thompson et al. (1972)	1799	Agnedal (1965)
Cs	55				1.00E+02									Thompson et al. (1972)	8845	Folsom et al. (1965)
Cs	55		2.00E+00	1.30E+02										Thompson et al. (1972)	9532	Kamath et al. (1971)
Cs	55				4.00E+00									Thompson et al. (1972)	9533	Feldt (1971)
Cs						8.70E+01		1.20E+02								Hosseini et al. (2008)
Cs	55											1.0E+02		TRS 422		
Cu	29															
Dy	66											3.0E+02		TRS 422		
Er	68															
Es	99															
Eu	63					4.40E+02		3.00E+02								Hosseini et al. (2008)
Eu	63											3.0E+02		TRS 422		
F	9															
Fe	26											3.0E+04		TRS 422		

Table A.5. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Fm	100															
Fr	87															
Ga	31															
Gd	64											3.0E+02		TRS 422		
Ge	32															
H	1											1.0		TRS 422		
Hf	72											5.0E+02		TRS 422		
Hg	80											3.0E+04		TRS 422		
Ho	67															
I	53					3.50E+00										Hosseini et al. (2008)
I	53											9.0E+00		TRS 422		
In	49											5.0E+02		TRS 422		
Ir	77											2.0E+01		TRS 422		
K	19															
Kr	36											1.0		TRS 422		
La	57															
Lu	71															
Md	101															
Mg	12															
Mn	25				5.50E+02									Thompson et al. (1972)	1405	Folsom et al. (1963)
Mn	25					2.40E+03		1.50E+04								Hosseini et al. (2008)
Mn	25											1.0E+03		TRS 422		
Mo	42															
N	7															
Na	11											1.0E+00		TRS 422		
Nb	41											3.0E+02		TRS 422		
Nd	60															
Ne	10															
Ni	28					1.70E+02		2.20E+02								Hosseini et al. (2008)
Ni	28											1.0E+03		TRS 422		
Np	93											1.0E+00		TRS 422		
O	8															
OBT																
Os	76															
P	15					9.90E+04		3.00E+04								Hosseini et al. (2008)
Pa	91											5.0E+01		TRS 422		
Pb	82					4.40E+03		1.40E+04								Hosseini et al. (2008)
Pb	82											2.0E+02		TRS 422		
Pd	46											3.0E+02		TRS 422		
Pm	61											3.0E+02		TRS 422		
Po	84		3.00E+02	4.50E+03										Thompson et al. (1972)	5832	Folsom (1966)
Po	84					4.40E+04		1.20E+05								Hosseini et al. (2008)
Po	84											2.0E+03		TRS 422		
Pr	59															
Pt	78															
Pu	94				3.00E+00									Thompson et al. (1972)	1299	Pillai et al. (1964)
Pu	94				5.00E+00									Thompson et al. (1972)	8956	Wong et al. (1970)
Pu	94		1.00E+00	5.00E+00										Thompson et al. (1972)	9995	Wong et al. (1971)
Pu	94				1.30E+01									Thompson et al. (1972)	10010	Noshkin (1971)
Pu	94					1.60E+03		6.40E+03								Hosseini et al. (2008)
Pu	94															
Pu	94											1.0E+02		TRS 422		

Table A.5. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Ra	88					2.00E+02		3.80E+02								Hosseini et al. (2008)
Ra	88											1.0E+02		TRS 422		
Rb	37															
Re	75															
Rh	45															
Rn	86															
Ru	44				1.00E+00									Thompson et al. (1972)	1682	Mauchline et al. (1964)
Ru	44		1.00E+00	1.00E+01										Thompson et al. (1972)	8915	Preston et al. (1965)
Ru	44					3.00E+01		4.30E+01								Hosseini et al. (2008)
Ru	44											2.0E+00		TRS 422		
S	16					9.40E+01										Hosseini et al. (2008)
S	16											1.0E+00		TRS 422		
Sb	51		1.50E-01	1.00E+03								1-100		Coughtrey et al. (1985)	S4.2.4,T4.11	
Sb	51					2.20E+02		7.60E+02								Hosseini et al. (2008)
Sb	51											6.0E+02		TRS 422		
Sc	21											1.0E+03		TRS 422		
Se	34					9.30E+03		4.60E+03								Hosseini et al. (2008)
Se	34											1.0E+04		TRS 422		
Si	14															
Sm	62											3.0E+02		TRS 422		
Sn	50											5.0E+05		TRS 422		
Sr	38				6.00E-01									Thompson et al. (1972)	1682	Mauchline et al. (1964)
Sr	38				3.00E-01									Thompson et al. (1972)	5335	Bryan et al. (1966)
Sr	38		3.00E+00	4.00E+00										Thompson et al. (1972)	9533	Feldt (1971)
Sr	38				3.00E+00									Thompson et al. (1972)	10059	Agnedal et al. (1958)
Sr	38					2.30E+01		3.50E+01								Hosseini et al. (2008)
Sr	38											3.0E+00		TRS 422		
Ta	73											6.0E+01		TRS 422		
Tb	65											6.0E+01		TRS 422		
Tc	43					3..1e1		5.60E+01								Hosseini et al. (2008)
Tc	43											8.0E+01		TRS 422		
Te	52											1.0E+03		TRS 422		
Th	90					1.30E+03										Hosseini et al. (2008)
Th	90											6.0E+02		TRS 422		
Ti	22															
Tl	81											5.0E+03		TRS 422		
Tm	69											3.0E+02		TRS 422		
U	92					1.40E+01		2.30E+01								Hosseini et al. (2008)
U	92											1.0E+00		TRS 422		
V	23															
W	74											9.0E+01		TRS 422		
Xe	54											1.0E+00		TRS 422		
Y	39											2.0E+01		TRS 422		
Yb	70											2.0E+02		TRS 422		
Zn	30											1.0E+03		TRS 422		
Zr	40					1.10E+02		1.50E+02								Hosseini et al. (2008)

Table A.6. Bioaccumulation in Wet Mollusk from Saltwater, L/kg$_{wet}$ (CLBMM)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Ac	89											1.00E+3		TRS 422		
Ag	47											6.00E+04		TRS 422		
Al	13															
Am	95		2.00E+00	4.00E+04								2.90E+02		Coughtrey et al. (1985)		
Am	95					3.00E+01		8.00E+00								Metian et al. (2011)
Am	95											1.00E+03		TRS 422		
Ar	18															
As	33															
At	85															
Au	79															
Ba	56											1.00E+01		TRS 422		
Be	4															
Bi	83															
Bk	97											1.00E+03		TRS 422		
Br	35											1.00E+01		Coughtrey et al. (1985)	S4.2	
C	6											2.00E+04		TRS 422		
Ca	20											3.00E+00		TRS 422		
Cd	48		2.00E+00	1.00E+04								1.00E+04		Coughtrey et al. (1985)	S4.2.3, T4.10	
Cd	48											8.00E+04		TRS 422		
Ce	58											5.00E+02		Coughtrey et al. (1985)	S4.2.2, T4.5	
Ce	58				2.00E+03									Thompson et al. (1972)	506	Mauchline (1963)
Ce	58		2.00E+02	2.00E+03										Thompson et al. (1972)	5335	Bryan et al. (1966)
Ce	58											2.00E+03		TRS 422		
Cf	98											1.00E+03		TRS 422		
Cl	17											5.00E-02		TRS 422		
Cm	96											1.00E+03		TRS 422		
Co	27											2.00E+04		TRS 422		
Cr	24											2.00E+03		TRS 422		
Cs	55		1.00E-01	1.00E+03								2.00E+01		Coughtrey et al. (1985)	S4.2.3	
Cs	55		6.00E+01	1.50E+02										Thompson et al. (1972)	1799	Agnedal (1965)
Cs	55		9.00E+00	7.20E+01	3.70E+01									Thompson et al. (1972)	5335	Bryan et al. (1966)
Cs	55		2.00E+01	6.00E+01										Thompson et al. (1972)	9532	Kamath et al. (1971)
Cs	55				1.20E+01									Thompson et al. (1972)	9533	Feldt (1971)
Cs	55					3.00E+00		1.00E+00								Metian et al. (2011)
Cs	55											6.00E+01		TRS 422		
Cu	29															
Dy	66											7.00E+03		TRS 422		
Er	68															
Es	99															
Eu	63											7.00E+03		TRS 422		
F	9															
Fe	26											5.00+E05		TRS 422		
Fm	100															
Fr	87															
Ga	31															
Gd	64											7.00E+03		TRS 422		
Ge	32															
H	1											1.00E+00		TRS 422		

Table A.6. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Hf	72											7.00E+03		TRS 422		
Hg	80											2.00E+03		TRS 422		
Ho	67															
I	53											1.00E+01		TRS 422		
In	49											1.00E+04		TRS 422		
Ir	77											1.00E+02		TRS 422		
K	19															
Kr	36											1.00E+00		TRS 422		
La	57															
Lu	71															
Md	101															
Mg	12															
Mn	25		8.00E+02	8.30E+02										Thompson et al. (1972)	1405	Folsom et al. (1963)
Mn	25				8.30E+02									Thompson et al. (1972)	5583	Polikarpov et al. (1957)
Mn	25											5.00E+04		TRS 422		
Mo	42															
N	7															
Na	11											3.00E-01		TRS 422		
Nb	41											1.00E+03		TRS 422		
Nd	60															
Ne	10															
Ni	28											2.00E+03		TRS 422		
Np	93											4.00E+02		TRS 422		
O	8															
OBT																
Os	76															
P	15		2.40E+03	4.10E+04	3.00E+04									Thompson et al. (1972)	8761	Seymour (1969)
P	15															
Pa	91											5.00E+02		TRS 422		
Pb	82											5.00E+04		TRS 422		
Pd	46											3.00E+02		TRS 422		
Pm	61											7.00E+03		TRS 422		
Po	84				5.00E+03									Thompson et al. (1972)	5832	Folsom (1966)
Po	84											2.00E+04		TRS 422		
Pr	59															
Pt	78															
Pu	94		2.30E+02	2.90E+02	2.60E+02									Thompson et al. (1972)	1299	Pillai et al. (1964)
Pu	94				2.90E+02									Thompson et al. (1972)	8956	Wong et al. (1970)
Pu	94		1.60E+02	3.80E+02										Thompson et al. (1972)	9995	Wong et al. (1971)
Pu	94		1.00E+02	3.50E+02										Thompson et al. (1972)	10010	Noshkin (1971)
Pu	94											3.00E+03		TRS 422		
Ra	88											1.00E+02		TRS 422		
Rb	37															
Re	75															
Rh	45															
Rn	86															
Ru	44				2.90E+02									Thompson et al. (1972)	6048	Iwashima et al. (1966)
Ru	44				3.20E+03									Thompson et al. (1972)	6048	Iwashima et al. (1966)
Ru	44		1.20E+03	2.00E+03										Thompson et al. (1972)	8915	Preston et al. (1965)
Ru	44											5.00E+02		TRS 422		

Table A.6. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
S	16											3.00E+00		TRS 422		
Sb	51		1.00E+00	1.00E+01								5-100		Coughtrey et al. (1985)	S4.2.3,T4.9	
Sb	51											3.00E+02		TRS 422		
Sc	21											1.00E+05		TRS 422		
Se	34											9.00E+03		TRS 422		
Si	14															
Sm	62											7.00E+03		TRS 422		
Sn	50											5.00E+05		TRS 422		
Sr	38		5.00E+00	1.70E+01										Thompson et al. (1972)	5335	Bryan et al. (1966)
Sr	38				3.00E+00									Thompson et al. (1972)	9533	Feldt (1971)
Sr	38															
Sr	38															
Sr	38											1.00E+01		TRS 422		
Ta	73											7.00E+03		TRS 422		
Tb	65											3.00E+03		TRS 422		
Tc	43											5.00E+02		TRS 422		
Te	52											1.00E+03		TRS 422		
Th	90											1.00E+03		TRS 422		
Ti	22															
Tl	81											6.0E+03		TRS 422		
Tm	69											7.00E+03		TRS 422		
U	92											3.00E+01		TRS 422		
V	23															
W	74											6.00E+02		TRS 422		
Xe	54											1.00E+00		TRS 422		
Y	39											1.00E+03		TRS 422		
Yb	70											3.00E+03		TRS 422		
Zn	30		8.40E+03	1.80E+04										Thompson et al. (1972)	2971	Seymour et al. (1964)
Zn	30				1.00E+05									Thompson et al. (1972)	9903	Preston (1968)
Zn	30											8.00E+04		TRS 422		
Zr	40		2.00E+01	2.70E+02										Thompson et al. (1972)	140	Cigna et al. (1963)
Zr	40											5.00E+03		TRS 422		

Table A.7. Bioaccumulation in Wet Crustacea from Saltwater, L/kg$_{wet}$ (CLBMI)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Ac	89											1.00E+03		TRS 422		
Ag	47					1.60E+04										Hosseini et al. (2008)
Ag	47											2.00E+05		TRS 422		
Al	13															
Am	95		8.40E+01	1.30E+03								3.60E+02		Coughtrey et al. (1985)		
Am	95					1.30E+03		1.40E+03								Hosseini et al. (2008)
Am	95											4.00E+02		TRS 422		
Ar	18															
As	33															
At	85															
Au	79															
Ba	56											7.00E-01		TRS 422		
Be	4															
Bi	83															
Bk	97											4.00E+02		TRS 422		
Br	35											1.00E+01		Coughtrey et al. (1985)	S4.2	
Br	35															
C	6					1.00E+04										Hosseini et al. (2008)
C	6											2.00E+04		TRS 422		
Ca	20											5.00E+00		TRS 422		
Cd	48		3.80E+01	3.00E+03								5.00E+03		Coughtrey et al. (1985)	S4.2.2, T4.8	
Cd	48					2.60E+04		4.90E+04								Hosseini et al. (2008)
Cd	48											8.00E+04		TRS 422		
Ce	58											5.00E+02		Coughtrey et al. (1985)	S4.2.2, T4.5	
Ce	58				1.00E+02									Thompson et al. (1972)	5335	Bryan et al. (1966)
Ce	58					3.40E+03		5.70E+03								Hosseini et al. (2008)
Ce	58											1.00E+03		TRS 422		
Cf	98											4.00E+02		TRS 422		
Cl	17					5.60E-02										Hosseini et al. (2008)
Cl	17											6.00E-02		TRS 422		
Cm	96											4.00E+02		TRS 422		
Co	27					1.80E+03		2.90E+03								Hosseini et al. (2008)
Co	27											7.00E+03		TRS 422		
Cr	24											1.00E+02		TRS 422		
Cs	55		3.00E-01	1.10E+04								2.00E+01		Coughtrey et al. (1985)	S4.2.2	
Cs	55		2.90E+01	3.00E+01										Thompson et al. (1972)	5335	Bryan et al. (1966)
Cs	55				3.50E+01									Thompson et al. (1972)	9532	Kamath et al. (1971)
Cs	55				2.30E+01									Thompson et al. (1972)	9533	Feldt (1971)
Cs	55				4.00E+01									Thompson et al. (1972)	10061	Templeton (1964)
Cs	55					4.10E+01		8.30E+01								Hosseini et al. (2008)
Cs	55											5.00E+01		TRS 422		
Cu	29															
Dy	66											4.00E+03		TRS 422		
Er	68															
Es	99															
Eu	63											4.00E+03		TRS 422		
F	9															
Fe	26											5.0E+05		TRS 422		
Fm	100															
Fr	87															

Table A.7. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Ga	31															
Gd	64											4.00E+03		TRS 422		
Ge	32															
H	1											1.00E+00		TRS 422		
Hf	72											4.00E+03		TRS 422		
Hg	80											1.00E+04		TRS 422		
Ho	67															
I	53					3.50E+00										Hosseini et al. (2008)
I	53											3.00E+00		TRS 422		
In	49											1.00E+04		TRS 422		
Ir	77											1.00E+02		TRS 422		
K	19															
Kr	36											1.00E+00		TRS 422		
La	57															
Lu	71															
Md	101															
Mg	12															
Mn	25				1.50E-01									Thompson et al. (1972)	10023	Bryan et al. (1966)
Mn	25					2.30E+04		7.50E+04								Hosseini et al. (2008)
Mn	25											5.00E+03		TRS 422		
Mo	42															
N	7															
Na	11											7.00E-02		TRS 422		
Nb	41					1.00E+02		1.20E+02								Hosseini et al. (2008)
Nb	41											2.00E+02		TRS 422		
Nd	60															
Ne	10															
Ni	28					5.50E+02		6.40E+02								Hosseini et al. (2008)
Ni	28											1.00E+03		TRS 422		
Np	93											1.00E+02		TRS 422		
O	8															
OBT																
Os	76															
P	15					2.70E+04										Hosseini et al. (2008)
Pa	91											1.00E+01		TRS 422		
Pb	82					7.50E+03		2.10E+04								Hosseini et al. (2008)
Pb	82											9.00E+04		TRS 422		
Pd	46											3.00E+02		TRS 422		
Pm	61											4.00E+03		TRS 422		
Po	84					5.60E+04		6.60E+04								Hosseini et al. (2008)
Po	84											2.00E+04		TRS 422		
Pr	59															
Pt	78															
Pu	94					1.60E+02		1.40E+02								Hosseini et al. (2008)
Pu	94											2.00E+02		TRS 422		
Ra	88					1.10E+02		8.10E+01								Hosseini et al. (2008)
Ra	88											1.00E+02		TRS 422		
Rb	37															
Re	75															
Rh	45															
Rn	86															
Ru	44				1.00E+01									Thompson et al. (1972)	5335	Bryan et al. (1966)

Table A.7. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Ru	44		2.50E+01	6.00E+02										Thompson et al. (1972)	8915	Preston et al. (1965)
Ru	44					3.20E+02		4.40E+02								Hosseini et al. (2008)
Ru	44											1.00E+02		TRS 422		
S	16					1.20E+00										Hosseini et al. (2008)
S	16											1.00E+00		TRS 422		
Sb	51		1.00E+00	3.00E+02								“10-200”		Coughtrey et al. (1985)	S4.2.2,T4.7	
Sb	51					1.40E+03		2.60E+03								Hosseini et al. (2008)
Sb	51											3.00E+02		TRS 422		
Sc	21											3.00E+02		TRS 422		
Se	34					7.10E+03		4.80E+03								Hosseini et al. (2008)
Se	34											1.00E+04		TRS 422		
Si	14															
Sm	62											4.00E+03		TRS 422		
Sn	50											5.00E+05		TRS 422		
Sr	38				3.00E+01									Thompson et al. (1972)	9533	Feldt (1971)
Sr	38					1.20E+01		1.20E+01								Hosseini et al. (2008)
Sr	38											5.00E+00		TRS 422		
Ta	73											2.00E+03		TRS 422		
Tb	65											4.00E+03		TRS 422		
Tc	43					1.70E+04		2.20E+04								Hosseini et al. (2008)
Tc	43											1.00E+03		TRS 422		
Te	52											1.00E+03		TRS 422		
Th	90											1.00E+03		TRS 422		
Ti	22															
Tl	81											1.00E+03		TRS 422		
Tm	69											4.00E+03		TRS 422		
U	92											1.00E+01		TRS 422		
V	23															
W	74											1.00E+01		TRS 422		
Xe	54											1.00E+00		TRS 422		
Y	39											1.00E+03		TRS 422		
Yb	70											4.00E+03		TRS 422		
Zn	30											3.00E+05		TRS 422		
Zr	40				1.00E+02									Thompson et al. (1972)	5335	Bryan et al. (1966)
Zr	40					2.20E+02		4.00E+02								Hosseini et al. (2008)
Zr	40											2.00E+02		TRS 422		

Table A.8. Bioaccumulation in Wet Plants from Saltwater, L/kg_{wet} (CLBMP)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Ac	89											1.00E+03		TRS-422		
Ag	47											5.00E+03		TRS-422		
Al	13															
Am	95											8.00E+03		TRS-422		
Am	95		2.00E+03	9.00E+03								2.90E+02		Coughtrey et al. (1985)		
Ar	18															
As	33															
At	85															
Au	79															
B	5															
Ba	56											7.00E+01		TRS-422		
Be	4											2.00E+00		TRS-422		
Bi	83															
Bk	97											8.00E+03		TRS-422		
Br	35											1.00E+01		Coughtrey et al. (1985)	S4.2	
C	6															
Ca	20											6.00E+00		TRS-422		
Cd	48											2.00E+04		TRS-422		
Cd	48		1.00E+01	1.00E+04								1.00E+03		Coughtrey et al. (1985)	S4.2.1, T4.6	
Ce	58		1.00E+02	7.00E+04								5.00E+03		Coughtrey et al. (1985)	T4.2, T4.5	
Ce	58				7.00E+02									Thompson et al. (1972)	506	Mauchline (1963)
Ce	58		3.00E+02	9.00E+02										Thompson et al. (1972)	5335	Bryan et al. (1966)
Ce	58											5.00E+03		TRS-422		
Cf	98											8.00E+03		TRS-422		
Cl	17											5.00E-02		TRS-422		
Cm	96											5.00E+03		TRS-422		
Co	27											6.00E+03		TRS-422		
Cr	24															
Cs	55		1.00E+00	1.20E+04								7.00E+02		Coughtrey et al. (1985)	S4.2.1	
Cs	55		1.00E+01	1.70E+02										Thompson et al. (1972)	1799	Agnedal (1965)
Cs	55		1.80E+01	7.40E+01	4.10E+01									Thompson et al. (1972)	5335	Bryan et al. (1966)
Cs	55				7.00E+01									Thompson et al. (1972)	10061	Templeton (1964)
Cs	55				7.00E+01									Thompson et al. (1972)	506	Mauchline (1963)
Cs	55											5.00E+01		TRS-422		
Cu	29															
Dy	66											3.00E+03		TRS-422		
Er	68															
Es	99															
Eu	63											3.00E+03		TRS-422		
F	9															
Fe	26				7.30E+02									Thompson et al. (1972)	5583	Polikarpov et al. (1957)
Fm	100															
Fr	87															
Ga	31															
Gd	64											3.00E+03		TRS-422		
Ge	32															
H	1															
He	2															
Hf	72											3.00E+03		TRS-422		
Hg	80											2.00E+04		TRS-422		

Table A.8. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Ho	67															
I	53				1.00E+03									Thompson et al. (1972)	9532	Kamath et al. (1971)
I	53											1.00E+04		TRS-422		
In	49											5.00E+03		TRS-422		
Ir	77											1.00E+03		TRS-422		
K	19															
Kr	36											1.00E+00		TRS-422		
La	57															
Li	3															
Lu	71															
Md	101															
Mg	12															
Mn	25		5.50E+03	2.50E+04										Thompson et al. (1972)	1848	Black et al. (1952)
Mn	25		6.80E+02	5.50E+03										Thompson et al. (1972)	1405	Folsom et al. (1963)
Mn												6.00E+03		TRS-422		
Mo	42															
N	7															
Na	11											5.00E-01		TRS-422		
Nb	41		3.70E+01	5.20E+02										Thompson et al. (1972)	5813	Hampson (1967)
Nb	41		4.50E+02	1.00E+03										Thompson et al. (1972)	5335	Bryan et al. (1966)
Nb	41											3.00E+03		TRS-422		
Nd	60															
Ne	10															
Ni	28											2.00E+03		TRS-422		
Np	93											5.00E+01		TRS-422		
O	8															
Os	76															
P	15		2.10E+02	2.20E+02										Thompson et al. (1972)	2971	Seymour et al. (1964)
P	15				4.00E+03									Thompson et al. (1972)	9136	Shannon et al. (1970)
Pa	91											1.00E+02		TRS-422		
Pb	82				8.70E+02									Thompson et al. (1972)	9136	Shannon et al. (1970)
Pb	82				1.00E+04									Thompson et al. (1972)	9863	Kauranen et al. (1971)
Pb	82											1.00E+03		TRS-422		
Pd	46											1.00E+03		TRS-422		
Pm	61											3.00E+03		TRS-422		
Po	84				2.30E+03									Thompson et al. (1972)	5832	Folsom (1966)
Po	84											1.00E+03		TRS-422		
Pr	59															
Pt	78															
Pu	94				3.00E+03									Thompson et al. (1972)	9538	Aarkrog (1971)
Pu	94		2.60E+02	3.50E+03	8.90E+02									Thompson et al. (1972)	10010	Noshkin (1971)
Pu	94		7.70E+02	1.60E+03										Thompson et al. (1972)	1299	Pillai et al. (1964)
Pu	94											4.00E+03		TRS-422		
Ra	88											1.00E+02		TRS-422		
Rb	37															
Re	75															
Rh	45															
Rn	86															
Ru	44				2.50E+02									Thompson et al. (1972)	506	Mauchline (1963)
Ru	44		1.50E+01	2.00E+03										Thompson et al. (1972)	5335	Bryan et al. (1966)
Ru	44				1.20E+03									Thompson et al. (1972)	6048	Iwashima et al. (1966)
Ru	44				7.60E+02									Thompson et al. (1972)	6048	Iwashima et al. (1966)

Table A.8. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Ru	44											2.00E+03		TRS-422		
S	16											3.00E+00		TRS-422		
Sb	51		1.00E+01	1.00E+03								“50-100”		Coughtrey et al. (1985)	S4.2.3,T4.9	
Sb	51											2.00E+01		TRS-422		
Sc	21											9.00E+04		TRS-422		
Se	34											1.00E+03		TRS-422		
Si	14															
Sm	62											3.00E+03		TRS-422		
Sn	50											2.00E+05		TRS-422		
Sr	38				4.00E+01									Thompson et al. (1972)	506	Mauchline (1963)
Sr	38				2.50E+01									Thompson et al. (1972)	1799	Agnedal (1965)
Sr	38		9.00E+01	2.00E+01										Thompson et al. (1972)	5335	Bryan et al. (1966)
Sr	38				4.00E+01									Thompson et al. (1972)	10061	Templeton (1964)
Sr	38											1.00E+01		TRS-422		
Ta	73											3.00E+03		TRS-422		
Tb	65											2.00E+03		TRS-422		
Tc	43											3.00E+04		TRS-422		
Te	52											1.00E+04		TRS-422		
Th	90											2.00E+02		TRS-422		
Ti	22															
Tl	81											1.00E+03		TRS-422		
Tm	69											3.00E+03		TRS-422		
U	92											1.00E+02		TRS-422		
V	23															
W	74											6.00E+02		TRS-422		
Xe	54											1.00E+00		TRS-422		
Y	39											1.00E+03		TRS-422		
Yb	70											8.00E+02		TRS-422		
Zn	30											2.00E+03		TRS-422		
Zr	40				1.00E+03									Thompson et al. (1972)	506	Mauchline (1963)
Zr	40		3.50E+02	1.00E+03										Thompson et al. (1972)	5335	Bryan et al. (1966)
Zr	40											3.00E+03		TRS-422		

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Appendix B

Terrestrial Animal

Appendix B

Terrestrial Animal

This appendix contains tables of feed to animal product transfer factors. References are indicated for each value.

Table B.1. Feed to Meat Transfer Factor, d/$kg_{wet\_as\_fed}$ (CLFMT)

Table B.2. Feed to Milk Transfer Factor, d/L (CLFMK)

Table B.3. Feed to Poultry Transfer Factor, d/$kg_{wet\_as\_fed}$ (CLFPL)

Table B.4. Feed to Egg Transfer Factor, d/$kg_{wet\_as\_fed}$ (CLFEG)

In all tables if an element is listed once and there is no data for that element, no transfer factor information was currently identified, preferred, or available.

Table B.1. Feed to Meat Transfer Factor, d/kg$_{wet_as_fed}$ (CLFMT)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	Document	Reference#	Reference
Ac	89											4.00E-04	PNNL-13421	LS85	
Ac	89											2.50E-05	NUREG/CR-5512		
Ag	47											3.00E-03	PNNL-13421	CEC87	
Ag	47					4.80E-04									Howard et al. (2009)
Al	13														
Am	95											4.00E-05	PNNL-13421	Co90	
Am	95											3.50E-06	NUREG/CR-5512		
Am	95					5.00E-04									Howard et al. (2009)
Am	95					1.10E-04									Howard et al. (2009)
Am	95	1				5.00E-04							TRS_472		
Ar	18														
As	33											2.00E-03	PNNL-13421	Ng68	
At	85														
Au	79											5.00E-03	PNNL-13421	NCRP86	
Au	79											8.00E-03	NUREG/CR-5512		
Ba	56											2.00E-04	PNNL-13421	Jo88	
Ba	56											1.50E-04	NUREG/CR-5512		
Ba	56					1.40E-04									Howard et al. (2009)
Ba	56					1.30E-05									Howard et al. (2009)
Ba	56	2	5.00E-05	2.30E-04		1.40E-04							TRS_472		
Be	4											1.00E-03	PNNL-13421	Ng68	
Bi	83											4.00E-04	PNNL-13421	Ng68	
Bk	97														
Br	35											2.50E-02	PNNL-13421	Ng68	
C	6		3.00E-01	6.00E-01											Galeriu et al. (2007)
Ca	20											2.00E-03	PNNL-13421	Ng82a	
Ca	20											7.00E-04	NUREG/CR-5512		
Ca	20					2.00E-01		3.50E-01							Howard et al. (2009)
Ca	20	3	1.00E-03	6.10E-01					3.00E+01	1.30E-02			TRS_472		
Cd	48											4.00E-04	PNNL-13421	Ng82a	
Cd	48											5.50E-04	NUREG/CR-5512		
Cd	48					1.90E-02		2.40E-02							Howard et al. (2009)
Cd	48					1.20E-03									Howard et al. (2009)
Cd	48	8	1.50E-04	6.00E-02					7.80E+00	5.80E-03			TRS_472		
Ce	58											2.00E-05	PNNL-13421	CEC87	
Ce	58											7.50E-04	NUREG/CR-5512		
Ce	58					2.50E-04									Howard et al. (2009)
Cf	98											4.00E-05	PNNL-13421	Co90	
Cf	98											5.00E-03	NUREG/CR-5512		
Cl	17											2.00E-02	PNNL-13421	Bi89	
Cl	17											8.00E-02	NUREG/CR-5512		
Cl	17					1.70E-02									Howard et al. (2009)
Cl	17	1				1.70E-02							TRS_472		
Cm	96											4.00E-05	PNNL-13421	Co90	
Cm	96											3.50E-06	NUREG/CR-5512		
Co	27											1.00E-02	PNNL-13421	Ng82a	
Co	27											2.00E-02	NUREG/CR-5512		
Co	27			4.60E-04											Beresford et al. (2007)
Co	27					5.20E-04		3.00E-04							Howard et al. (2009)
Co	27					1.20E-02									Howard et al. (2009)

Table B.1. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	Document	Reference#	Reference
Co	27	4	1.30E-04	8.40E-04					2.30E+00	4.30E-04			TRS_472		
Cr	24											9.00E-03	PNNL-13421	Ng82a	
Cr	24											5.50E-03	NUREG/CR-5512		
Cs	55											5.00E-02	PNNL-13421	Co90	
Cs	55											2.00E-02	NUREG/CR-5512		
Cs	55					9.30E-03		1.97E-03							Beresford et al. (2007)
Cs	55					8.30E-03		1.57E-03							Beresford et al. (2007)
Cs	55					3.00E-02		2.30E-02							Howard et al. (2009)
Cs	55					4.80E-01		5.30E-01							Howard et al. (2009)
Cs	55					2.70E-01		2.60E-01							Howard et al. (2009)
Cs	55	58	4.70E-03	9.60E-02					2.40E+00	2.20E-02			TRS_472		
Cu	29											9.00E-03	PNNL-13421	Ng82a	
Cu	29											1.00E-02	NUREG/CR-5512		
Dy	66											2.00E-05	PNNL-13421	CEC87	
Dy	66											5.50E-03	NUREG/CR-5512		
Er	68											2.00E-05	PNNL-13421	CEC87	
Er	68											4.00E-03	NUREG/CR-5512		
Es	99														
Eu	63											2.00E-05	PNNL-13421	CEC87	
Eu	63											5.00E-03	NUREG/CR-5512		
F	9											1.50E-01	PNNL-13421	Ng68	
Fe	26											2.00E-02	PNNL-13421	Ng82a	
Fe	26					1.50E-02		6.70E-03							Howard et al. (2009)
Fe	26	4	9.00E-03	2.50E-02					1.50E+00	1.40E-02			TRS_472		
Fm	100														
Fr	87														
Ga	31											5.00E-04	PNNL-13421	Ba84	
Gd	64											2.00E-05	PNNL-13421	CEC87	
Gd	64											3.50E-03	NUREG/CR-5512		
Ge	32														
H	1		6.40E-01	8.20E-01											Galeriu et al. (2007)
Hf	72											1.00E-03	PNNL-13421	Ng68	
Hg	80											2.50E-01	PNNL-13421	Ng68	
Ho	67											2.00E-05	PNNL-13421	CEC87	
Ho	67											4.50E-03	NUREG/CR-5512		
I	53											4.00E-02	PNNL-13421	Bi89	
I	53											7.00E-03	NUREG/CR-5512		
I	53		8.00E-04	2.00E-02											
I	53		8.00E-03	2.00E-01											Thorne (2003)
I	53					1.20E-03		1.50E-02							Howard et al. (2009)
I	53					3.00E-02									Howard et al. (2009)
I	53	5	2.00E-03	3.80E-02					3.20E+00	6.70E-03			TRS_472		
In	49											8.00E-03	PNNL-13421	Ng68	
Ir	77											1.50E-03	PNNL-13421	Ng68	
K	19											2.00E-02	PNNL-13421	Ng82a	
Kr	36														
La	57											2.00E-03	PNNL-13421	NCRP96	
La	57											3.00E-04	NUREG/CR-5512		
La	57					1.30E-04		2.00E-05							Howard et al. (2009)
La	57	3	1.10E-04	1.50E-04					1.20E+00	1.30E-04			TRS_472		
Lu	71														
Md	101														

Table B.1. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	Document	Reference#	Reference
Mg	12											2.00E-02	PNNL-13421	Ng82a	
Mg	12											5.00E-03	NUREG/CR-5512		
Mn	25											5.00E-04	PNNL-13421	Ng82a	
Mn	25											4.00E-04	NUREG/CR-5512		
Mn	25					6.00E-04									Howard et al. (2009)
Mn	25					9.00E-03									Howard et al. (2009)
Mn	25	2	6.00E-04	6.00E-04		6.00E-04							TRS_472		
Mo	42											1.00E-03	PNNL-13421	Jo88	
Mo	42											6.00E-03	NUREG/CR-5512		
Mo	42					1.00E-03									Howard et al. (2009)
Mo	42	1				1.00E-03							TRS_472		
N	7											7.50E-02	PNNL-13421	Ng68	
Na	11											8.00E-02	PNNL-13421	Ng82a	
Na	11											5.50E-02	NUREG/CR-5512		
Na	11					1.50E-02									Howard et al. (2009)
Na	11					1.10E-01									Howard et al. (2009)
Na	11	2	1.00E-02	2.00E-02		1.50E-02							TRS_472		
Nb	41											3.00E-07	PNNL-13421	Jo88	
Nb	41											2.50E-01	NUREG/CR-5512		
Nb	41			2.40E-03											Beresford et al. (2007)
Nb	41					2.60E-07									Howard et al. (2009)
Nb	41					6.00E-05									Howard et al. (2009)
Nb	41	1				2.60E-07							TRS_472		
Nd	60											2.00E-05	PNNL-13421	CEC87	
Nd	60											3.00E-04	NUREG/CR-5512		
Ne	10														
Ni	28											5.00E-03	PNNL-13421	Cr90	
Ni	28											6.00E-03	NUREG/CR-5512		
Np	93											1.00E-03	PNNL-13421	Br79	
Np	93											5.50E-05	NUREG/CR-5512		
O	8														
OBT															
Os	76											4.00E-01	PNNL-13421	Ng68	
P	15											5.00E-02	PNNL-13421	Ng82a	
P	15											5.50E-02	NUREG/CR-5512		
P	15					5.50E-02									Howard et al. (2009)
P	15	1				5.50E-02							TRS_472		
Pa	91											4.00E-05	PNNL-13421	Co90	
Pa	91											1.00E-05	NUREG/CR-5512		
Pb	82											4.00E-04	PNNL-13421	Ng82a	
Pb	82											3.00E-04	NUREG/CR-5512		
Pb	82					9.30E-04		6.40E-04							Howard et al. (2009)
Pb	82					7.10E-03									Howard et al. (2009)
Pb	82	5	2.00E-04	1.60E-03					2.50E+00	7.00E-04			TRS_472		
Pd	46											4.00E-03	PNNL-13421	Ng68	
Pm	61											2.00E-05	PNNL-13421	CEC87	
Pm	61											5.00E-03	NUREG/CR-5512		
Po	84											5.00E-03	PNNL-13421	Ng82a	
Po	84											3.00E-04	NUREG/CR-5512		
Pr	59											2.00E-05	PNNL-13421	CEC87	
Pr	59											3.00E-04	NUREG/CR-5512		
Pt	78														

Table B.1. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	Document	Reference#	Reference
Pu	94											1.00E-05	PNNL-13421	Co90	
Pu	94											5.00E-07	NUREG/CR-5512		
Pu	94					4.40E-05		1.37E-05							Beresford et al. (2007)
Pu	94					3.90E-05		1.12E-05							Beresford et al. (2007)
Pu	94					6.00E-05		1.30E-04							Howard et al. (2009)
Pu	94					5.30E-05									Howard et al. (2009)
Pu	94	5	8.80E-08	3.00E-04					2.48E+01	1.10E-06			TRS_472		
Ra	88											9.00E-04	PNNL-13421	MB90	
Ra	88											2.50E-04	NUREG/CR-5512		
Ra	88					1.70E-03									Howard et al. (2009)
Ra	88	1				1.70E-03							TRS_472		
Rb	37											1.00E-02	PNNL-13421	Ng82a	
Rb	37											1.50E-02	NUREG/CR-5512		
Re	75											8.00E-03	PNNL-13421	Ng68	
Rh	45											2.00E-03	PNNL-13421	Ng79	
Rn	86														
Ru	44											5.00E-02	PNNL-13421	Co90	
Ru	44											2.00E-03	NUREG/CR-5512		
Ru	44			1.70E-04											Beresford et al. (2007)
Ru	44					3.70E-03		2.30E-03							Howard et al. (2009)
Ru	44					2.10E-03									Howard et al. (2009)
Ru	44	3	2.20E-03	6.40E-03					1.80E+00	3.30E-03			TRS_472		
S	16											2.00E-01	PNNL-13421	IAEA87	
S	16											1.00E-01	NUREG/CR-5512		
S	16					1.70E+00		4.70E-01							Howard et al. (2009)
Sb	51											1.00E-03	PNNL-13421	IAEA87	
Sb	51					1.20E-03									Howard et al. (2009)
Sb	51	2	1.10E-03	1.30E-03		1.20E-03							TRS_472		
Sc	21											1.50E-02	PNNL-13421	Ng68	
Se	34											1.50E-02	PNNL-13421	Ng68	
Si	14											4.00E-05	PNNL-13421	Ng68	
Sm	62											2.00E-05	PNNL-13421	CEC87	
Sm	62											5.00E-03	NUREG/CR-5512		
Sn	50											8.00E-02	PNNL-13421	Ng68	
Sr	38											8.00E-03	PNNL-13421	Co90	
Sr	38											3.00E-04	NUREG/CR-5512		
Sr	38					2.10E-03		2.20E-03							Howard et al. (2009)
Sr	38					3.00E-03		5.10E-03							Howard et al. (2009)
Sr	38					1.70E-03		7.50E-04							Howard et al. (2009)
Sr	38	35	2.00E-04	9.20E-03					2.90E+00	1.30E-03			TRS_472		
Ta	73											3.00E-07	PNNL-13421	Jo88	
Ta	73											6.00E-04	NUREG/CR-5512		
Tb	65											2.00E-05	PNNL-13421	CEC87	
Tb	65											4.50E-03	NUREG/CR-5512		
Tc	43											1.00E-04	PNNL-13421	Bi89	
Tc	43											8.50E-03	NUREG/CR-5512		
Tc	43		7.50E-05	7.50E-03											Thorne (2003)
Tc	43		7.50E-04	7.50E-03											Thorne (2003)
Te	52											7.00E-03	PNNL-13421	Jo88	
Te	52											1.50E-02	NUREG/CR-5512		
Te	52					7.00E-03									Howard et al. (2009)
Te	52					2.40E-03									Howard et al. (2009)

Table B.1. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	Document	Reference#	Reference
Te	52	1				7.00E-03							TRS_472		
Th	90											4.00E-05	PNNL-13421	Co90	
Th	90											6.00E-06	NUREG/CR-5512		
Th	90					3.50E-04		3.30E-04							Howard et al. (2009)
Th	90	6	4.00E-05	9.60E-04					2.90E+00	2.30E-04			TRS_472		
Ti	22														
Tl	81											4.00E-02	PNNL-13421	Ng68	
Tm	69														
U	92											3.00E-04	PNNL-13421	Cr90	
U	92											2.00E-04	NUREG/CR-5512		
U	92		8.00E-01	2.00E+00											Thorne (2003)
U	92		9.00E-01	2.20E+00											Thorne (2003)
U	92					4.20E-04		2.00E-04							Howard et al. (2009)
U	92	3	2.50E-04	6.30E-04					1.60E+00	3.90E-04			TRS_472		
V	23														
W	74											4.00E-02	PNNL-13421	Ng82a	
W	74											4.50E-02	NUREG/CR-5512		
Xe	54														Thorne (2003)
Y	39											1.00E-03	PNNL-13421	Ng82a	
Y	39											3.00E-04	NUREG/CR-5512		
Y	39					5.40E-02									Howard et al. (2009)
Yb	70														
Zn	30											1.00E-01	PNNL-13421	Ng82a	
Zn	30					2.60E-01		2.40E-01							Howard et al. (2009)
Zn	30					5.90E-02		4.70E-02							Howard et al. (2009)
Zn	30	6	4.00E-02	6.30E+00					3.20E+00	1.60E-01			TRS_472		
Zr	40											1.00E-06	PNNL-13421	Jo88	
Zr	40											5.50E-03	NUREG/CR-5512		
Zr	40					1.20E-06									Howard et al. (2009)
Zr	40					2.00E-05									Howard et al. (2009)
Zr	40	1				1.20E-06							TRS_472		

Table B.2. Feed to Milk Transfer Factor, d/L (CLFMK)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	MED	95%ile	Document	Reference#	Reference
Ac	89										2.00E-05		PNNL-13421	Ng77	
Ag	47										5.00E-05		PNNL-13421	CEC87	
Ag	47										2.00E-02		NUREG/CR-5512		
Ag	47										1.90E-02				Ng et al. (1979)
Al	13										2.00E-04				Ng et al. (1979)
Am	95										1.50E-06		PNNL-13421	Co90	
Am	95	1				4.20E-07							TRS_472		
Am	95										4.00E-07		NUREG/CR-5512		
Am	95										4.00E-07				Ng et al. (1979)
Am	95					4.20E-07									Howard et al. (2009)
Am	95					6.90E-06									Howard et al. (2009)
Ar	18														
As	33										6.00E-05		PNNL-13421	Ng77	
As	33										6.20E-05				Ng et al. (1979)
At	85														
Au	79										5.50E-06		PNNL-13421	Ng77	
Au	79										5.30E-06				Ng et al. (1979)
Ba	56										4.00E-04		PNNL-13421	Jo88	
Ba	56	15	3.80E-05	7.30E-04					2.70E+00	1.60E-04			TRS_472		
Ba	56										3.50E-04		NUREG/CR-5512		
Ba	56										3.50E-04				Ng et al. (1979)
Ba	56		3.80E-05	7.30E-04		2.50E-04		2.40E-04	2.70E+00	1.60E-04					Howard et al. (2009)
Ba	56		2.10E-03	1.50E-01		5.40E-02		8.70E-02	9.90E+00	1.10E-02					Howard et al. (2009)
Ba	56					4.10E-02									Howard et al. (2009)
Be	4										9.00E-07		PNNL-13421	Ng77	
Be	4	1				8.30E-07							TRS_472		
Be	4										9.00E-07				Ng et al. (1979)
Be	4					8.30E-07									Howard et al. (2009)
Bi	83										5.00E-04		PNNL-13421	Ng77	
Bk	97														
Br	35										2.00E-02		PNNL-13421	Ng77	
Br	35										2.00E-02				Ng et al. (1979)
C	6										1.50E-02				Ng et al. (1979)
C	6		1.30E-01	2.10E-01											Galeriu et al. (2007)
Ca	20										3.00E-03		PNNL-13421	CT83	
Ca	20	15	4.00E-03	2.50E-02					1.70E+00	1.00E-02			TRS_472		
Ca	20										1.00E-02		NUREG/CR-5512		
Ca	20										1.10E-02				Ng et al. (1979)
Ca	20		4.00E-03	2.50E-03		1.20E-02		5.90E-03							Howard et al. (2009)
Ca	20		1.20E-02	1.40E-01		8.30E-02		3.40E-02							Howard et al. (2009)
Cd	48										1.00E-03		PNNL-13421	Ng77	
Cd	48	8	1.80E-06	8.40E-03					1.50E+01	1.90E-04			TRS_472		
Cd	48										1.00E-03				Ng et al. (1979)
Cd	48		1.80E-06	8.40E-03		1.90E-03		3.40E-03							Howard et al. (2009)
Cd	48					1.60E-02									Howard et al. (2009)
Cd	48					4.90E-02									Howard et al. (2009)
Ce	58										3.00E-05		PNNL-13421	CEC87	
Ce	58	6	2.00E-06	1.30E-04					5.80E+00	2.00E-05			TRS_472		

Table B.2. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	MED	95%ile	Document	Reference#	Reference
Ce	58										2.00E-05		NUREG/CR-5512		
Ce	58										2.00E-05				Ng et al. (1979)
Ce	58		2.00E-06	1.30E-04		4.70E-05		4.90E-05							Howard et al. (2009)
Ce	58					4.00E-05									Howard et al. (2009)
Cf	98										1.50E-06		PNNL-13421	Co90	
Cf	98										7.50E-07		NUREG/CR-5512		
Cl	17										1.70E-02		PNNL-13421	Bi89	
Cl	17										1.50E-02		NUREG/CR-5512		
Cl	17										1.70E-02				Ng et al. (1979)
Cm	96										9.60E-05		PNNL-13421	Ng77	
Cm	96										2.00E-05		NUREG/CR-5512		
Co	27										3.00E-04		PNNL-13421	Ba84	
Co	27	4	6.00E-05	3.00E-04					2.00E+00	1.10E-04			TRS_472		
Co	27										2.00E-03		NUREG/CR-5512		
Co	27										1.80E-03				Ng et al. (1979)
Co	27		6.00E-05	3.00E-04		1.30E-04		1.10E-04							Howard et al. (2009)
Co	27					5.00E-03									Howard et al. (2009)
Co	27					2.70E-03									Howard et al. (2009)
Cr	24										1.00E-05		PNNL-13421	Va84	
Cr	24	3	1.00E-05	4.30E-03					2.60E+01	4.30E-04			TRS_472		
Cr	24										1.50E-03		NUREG/CR-5512		
Cr	24										1.60E-03				Ng et al. (1979)
Cr	24		2.90E-03	2.80E-02		1.50E-02									Howard et al. (2009)
Cr	24		1.00E-05	4.30E-03		2.00E-03		2.10E-03							Howard et al. (2009)
Cr	24					2.00E-02									Howard et al. (2009)
Cs	55										7.90E-03		PNNL-13421	Co90	
Cs	55	288	6.00E-04	6.80E-02					2.00E+00	4.60E-03			TRS_472		
Cs	55										7.00E-03		NUREG/CR-5512		
Cs	55									2.70E-03					Tsukada et al. (2003)
Cs	55										7.10E-03				Ng et al. (1979)
Cs	55		6.00E-04	6.80E-02		6.10E-03		6.30E-03							Howard et al. (2009)
Cs	55		7.00E-03	3.30E-01		1.30E-01		8.00E-02							Howard et al. (2009)
Cs	55					7.70E-02									Howard et al. (2009)
Cs	55		9.00E-04	4.50E-03											Gastbergera et al. (2001)
Cs	55					4.48E-03		3.05E-03							Panchal et al. (2011)
Cu	29										2.00E-03		PNNL-13421	IAEA87	
Cu	29										1.50E-03		NUREG/CR-5512		
Cu	29										1.70E-03				Ng et al. (1979)
Dy	66										3.00E-05		PNNL-13421	CEC87	
Dy	66										2.00E-05		NUREG/CR-5512		
Er	68										2.00E-05		NUREG/CR-5512		
Es	99														
Eu	63										3.00E-05		PNNL-13421	CEC87	
Eu	63										2.00E-05		NUREG/CR-5512		
F	9										1.00E-03		PNNL-13421	Ng77	
F	9										1.10E-03				Ng et al. (1979)
Fe	26										3.00E-05		PNNL-13421	Va84	
Fe	26	7	1.00E-05	9.70E-05					2.00E+00	3.50E-04			TRS_472		
Fe	26										2.50E-04		NUREG/CR-5512		
Fe	26										2.70E-04				Ng et al. (1979)
Fe	26		1.00E-05	9.70E-05		4.20E-05		2.70E-05							Howard et al. (2009)
Fm	100														

Table B.2. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	MED	95%ile	Document	Reference#	Reference
Fr	87														
Ga	31										5.00E-05		PNNL-13421	Ng77	
Gd	64										3.00E-05		PNNL-13421	CEC87	
Gd	64										2.00E-05		NUREG/CR-5512		
Ge	32														
H	1										1.50E-02		PNNL-13421	Va83	
H	1										1.40E-02				Ng et al. (1979)
H	1		7.60E-01	9.20E-01											Galeriu et al. (2007)
Hf	72										5.50E-07		PNNL-13421	Jo88	
Hf	72										5.00E-06		NUREG/CR-5512		
Hg	80										4.70E-04		PNNL-13421	Ng82a	
Hg	80										4.50E-04		NUREG/CR-5512		
Hg	80										4.70E-04				Ng et al. (1979)
Ho	67										3.00E-05		PNNL-13421	CEC87	
Ho	67										2.00E-05		NUREG/CR-5512		
I	53										9.00E-03		PNNL-13421	Sn94	
I	53	104	4.00E-04	2.50E-02					2.40E+00	5.40E-03			TRS_472		
I	53										1.00E-02		NUREG/CR-5512		
I	53		2.00E-03	5.00E-02											Thorne (2003)
I	53										9.90E-03				Ng et al. (1979)
I	53		2.00E-02	1.00E+00											Thorne (2003)
I	53		4.00E-04	2.50E-02		9.10E-03		7.00E-03							Howard et al. (2009)
I	53		2.70E-02	7.70E-01		3.30E-01		2.30E-01							Howard et al. (2009)
I	53					3.50E-01									Howard et al. (2009)
In	49										2.00E-04		PNNL-13421	NCRP86	
In	49										1.00E-04		NUREG/CR-5512		
Ir	77										2.00E-06		PNNL-13421	Ng77	
Ir	77										2.00E-06				Ng et al. (1979)
K	19										7.20E-02		PNNL-13421	Ng82a	
K	19										7.00E-03		NUREG/CR-5512		
K	19										7.20E-03				Ng et al. (1979)
K	19					5.30E-03		3.08E-03							Panchal et al. (2011)
Kr	36														
La	57										2.00E-05		PNNL-13421	Ng77	
Lu	71														
Md	101														
Mg	12										3.90E-03		PNNL-13421	Ng82a	
Mg	12										4.00E-03		NUREG/CR-5512		
Mg	12										3.90E-03				Ng et al. (1979)
Mn	25										5.00E-05		PNNL-13421	Va84	
Mn	25	4	7.00E-06	3.30E-04					4.90E+00	4.10E-05			TRS_472		
Mn	25										3.50E-04		NUREG/CR-5512		
Mn	25										3.30E-04				Ng et al. (1979)
Mn	25		3.30E-04	7.00E-06		1.00E-04		1.50E-04							Howard et al. (2009)
Mn	25					2.40E-03									Howard et al. (2009)
Mo	42										1.70E-03		PNNL-13421	Jo88	
Mo	42	7	4.30E-04	5.20E-03					2.30E+00	1.10E-03			TRS_472		
Mo	42										1.50E-03		NUREG/CR-5512		
Mo	42										1.40E-03				Ng et al. (1979)
Mo	42		4.30E-06	5.20E-03		1.50E-03		1.70E-03							Howard et al. (2009)
Mo	42		5.00E-03	1.10E-02		8.50E-03		2.50E-03							Howard et al. (2009)

Table B.2. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	MED	95%ile	Document	Reference#	Reference
N	7										2.50E-02		PNNL-13421	Ng77	
N	7										2.30E-02				Ng et al. (1979)
Na	11										1.60E-02		PNNL-13421	IAEA94	
Na	11	7	5.00E-03	5.00E-03					2.00E+00	1.30E-02			TRS_472		
Na	11										3.50E-02		NUREG/CR-5512		
Na	11										3.50E-02				Ng et al. (1979)
Na	11		5.00E-03	5.00E-02		1.60E-02		1.50E-02							Howard et al. (2009)
Na	11					1.00E-01									Howard et al. (2009)
Nb	41										4.10E-07		PNNL-13421	Jo88	
Nb	41	1				4.10E-07							TRS_472		
Nb	41										2.00E-02		NUREG/CR-5512		
Nb	41					4.10E-07									Howard et al. (2009)
Nb	41					6.40E-06									Howard et al. (2009)
Nd	60										3.00E-05		PNNL-13421	CEC87	
Nd	60										2.00E-05		NUREG/CR-5512		
Nd	60										2.00E-05				Ng et al. (1979)
Ne	10														
Ni	28										1.60E-02		PNNL-13421	Cr90	
Ni	28	2	1.30E-03			9.50E-04			6.50E-04				TRS_472		
Ni	28										1.00E-03		NUREG/CR-5512		
Ni	28										1.00E-03				Ng et al. (1979)
Ni	28		6.50E-04	1.30E-03		9.50E-04									Howard et al. (2009)
Ni	28		3.20E-03	1.60E-01		8.30E-02									Howard et al. (2009)
Ni	28					1.00E-01									Howard et al. (2009)
Np	93										5.00E-06		PNNL-13421	Ng82a	
O	8														
OBT															
Os	76										5.00E-03		PNNL-13421	Ng77	
P	15										1.60E-02		PNNL-13421	Ng82a	
P	15	n/a				2.00E-02							TRS_472		
P	15										1.50E-02		NUREG/CR-5512		
P	15										1.60E-02				Ng et al. (1979)
Pa	91										5.00E-06		PNNL-13421	Ng77	
Pb	82										2.60E-04		PNNL-13421	Ng77	
Pb	82	15	7.30E-06	1.20E-03					1.00E+00	1.90E-04			TRS_472		
Pb	82										2.50E-04		NUREG/CR-5512		
Pb	82										2.60E-04				Ng et al. (1979)
Pb	82		7.30E-06	1.20E-03		3.30E-04		3.50E-04							Howard et al. (2009)
Pd	46										1.00E-02		PNNL-13421	Ng77	
Pd	46					6.00E-03									Howard et al. (2009)
Pm	61										3.00E-05		PNNL-13421	CEC87	
Pm	61										2.00E-05		NUREG/CR-5512		
Pm	61					2.70E-05									Howard et al. (2009)
Po	84										3.40E-04		PNNL-13421	Ng82a	
Po	84	4	8.90E-05	3.00E-04					1.80E+00	2.10E-04			TRS_472		
Po	84										3.50E-04		NUREG/CR-5512		
Po	84		8.90E-05	3.00E-04		2.30E-04		9.70E-05							Howard et al. (2009)
Po	84					2.30E-03									Howard et al. (2009)
Po	84										3.40E-04				Ng et al. (1979)
Pr	59										3.00E-05		PNNL-13421	CEC87	
Pr	59										2.00E-05		NUREG/CR-5512		
Pt	78														

Table B.2. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	MED	95%ile	Document	Reference#	Reference
Pu	94										1.10E-06		PNNL-13421	Co90	
Pu	94	n/a				1.00E-05							TRS_472		
Pu	94										1.00E-07		NUREG/CR-5512		
Pu	94										1.00E-07				Ng et al. (1979)
Pu	94					1.00E-05									Howard et al. (2009)
Pu	94					1.00E-04									Howard et al. (2009)
Pu	94					5.80E-05		6.90E-05							Howard et al. (2007)
Ra	88										1.30E-03		PNNL-13421	MB90	
Ra	88	11	9.00E-04	1.40E-03					2.30E+00	3.80E-04			TRS_472		
Ra	88										4.50E-04		NUREG/CR-5512		
Ra	88										4.50E-04				Ng et al. (1979)
Ra	88		9.00E-05	1.40E-03		5.10E-05		3.80E-04							Howard et al. (2009)
Rb	37										1.20E-02		PNNL-13421	Ng82a	
Rb	37										1.00E-02		NUREG/CR-5512		
Rb	37										1.20E-02				Ng et al. (1979)
Re	75										1.50E-03		PNNL-13421	Ng77	
Re	75										1.30E-03				Ng et al. (1979)
Rh	45										1.00E-02		PNNL-13421	Ng77	
Rn	86														
Ru	44										3.30E-06		PNNL-13421	Co90	
Ru	44	6	6.70E-07	1.40E-04					8.50E+00	9.40E-06			TRS_472		
Ru	44										6.00E-07		NUREG/CR-5512		
Ru	44										6.00E-07				Ng et al. (1979)
Ru	44		6.70E-07	1.40E-04		3.60E-05		5.30E-05							Howard et al. (2009)
S	16										1.60E-02		PNNL-13421	Ng82a	
S	16	1				7.90E-03							TRS_472		
S	16										1.50E-02		NUREG/CR-5512		
S	16										1.60E-02				Ng et al. (1979)
S	16					7.90E-03									
S	16		6.80E-02	1.60E-02		4.30E-02		1.90E-02							
Sb	51										2.50E-05		PNNL-13421	Va82	
Sb	51	3	2.00E-05	1.10E-04					2.50E+00	3.80E-05			TRS_472		
Sb	51										1.00E-04		NUREG/CR-5512		
Sb	51										1.10E-04				Ng et al. (1979)
Sb	51		2.00E-05	1.10E-04		5.20E-05	5.10E-02								Howard et al. (2009)
Sc	21										5.00E-06		PNNL-13421	Ng77	
Se	34										4.00E-03		PNNL-13421	Ng77	
Se	34	12	1.50E-03	1.60E-02					2.10E+00	4.00E-03			TRS_472		
Se	34										4.00E-03				Ng et al. (1979)
Se	34		1.50E-03	1.60E-02		5.20E-03		4.50E-03							Howard et al. (2009)
Se	34		5.90E-02	7.90E-02		6.90E-02									Howard et al. (2009)
Si	14										2.00E-05		PNNL-13421	Ng77	
Si	14										2.00E-05				Ng et al. (1979)
Sm	62										3.00E-05		PNNL-13421	CEC87	
Sm	62										2.00E-05		NUREG/CR-5512		
Sn	50										1.00E-03		PNNL-13421	NCRP86	
Sn	50										1.20E-03				Ng et al. (1979)
Sr	38										2.80E-03		PNNL-13421	Co90	
Sr	38	154	3.40E-04	4.30E-03					1.70E+00	1.30E-03			TRS_472		
Sr	38										1.50E-03		NUREG/CR-5512		
Sr	38										1.40E-03				Ng et al. (1979)
Sr	38		3.40E-04	4.30E-03		1.50E-03		8.10E-04							Howard et al. (2009)

Table B.2. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	MED	95%ile	Document	Reference#	Reference
Sr	38		5.80E-03	8.10E-02		2.10E-02		2.00E-02							Howard et al. (2009)
Sr	38					3.00E-02									Howard et al. (2009)
Sr	38		5.00E-04	1.20E-03											Gastbergera et al. (2001)
Ta	73										4.10E-07		PNNL-13421	Jo88	
Ta	73										3.00E-06		NUREG/CR-5512		
Ta	73										2.80E-06				Ng et al. (1979)
Tb	65										3.00E-05		PNNL-13421	CEC87	
Tb	65										2.00E-05		NUREG/CR-5512		
Tc	43										1.40E-04		PNNL-13421	Jo88	
Tc	43										1.50E-02		NUREG/CR-5512		
Tc	43		7.50E-05	7.50E-03											Thorne (2003)
Tc	43		7.50E-04	7.50E-02											Thorne (2003)
Te	52	11	7.80E-05	1.00E-03					2.40E+00	3.40E-04	4.50E-04		PNNL-13421	Jo88	
Te	52										2.00E-04		NUREG/CR-5512		
Te	52										2.00E-04				Ng et al. (1979)
Te	52		7.80E-05	1.00E-03		4.50E-04		2.90E-04							Howard et al. (2009)
Te	52					4.40E-03									Howard et al. (2009)
Te	52					2.90E-03									Howard et al. (2009)
Th	90										5.00E-06		PNNL-13421	Ng77	
Ti	22										1.00E-02				Ng et al. (1979)
Tl	81										2.00E-03		PNNL-13421	Na88	
Tm	69														
U	92										4.00E-04		PNNL-13421	MB90	
U	92	3	5.00E-04	6.10E-03					3.50E+00	1.80E-03			TRS_472		
U	92										6.00E-04		NUREG/CR-5512		
U	92		4.00E-03	5.00E-02											Thorne (2003)
U	92		1.00E-02	1.50E-01											Thorne (2003)
U	92										6.10E-04				Ng et al. (1979)
U	92		5.00E-04	6.10E-03		2.90E-03		2.90E-03							Howard et al. (2009)
U	92					1.40E-03									Howard et al. (2009)
V	23										2.00E-05				Ng et al. (1979)
W	74										3.00E-04		PNNL-13421	Ng77	
W	74	7	3.40E-05	6.80E-04					3.10E+00	1.90E-04			TRS_472		
W	74										2.90E-04				Ng et al. (1979)
W	74		3.40E-05	6.80E-04		2.90E-04		2.40E-04							Howard et al. (2009)
Xe	54														
Y	39										2.00E-05		PNNL-13421	Ng77	
Yb	70														
Zn	30										1.00E-02		PNNL-13421	Ng77	
Zn	30	8	1.30E-04	9.00E-03					3.90E+00	2.70E-03			TRS_472		
Zn	30										1.00E-02				Ng et al. (1979)
Zn	30		1.30E-04	9.00E-03		4.30E-03		3.00E-03							Howard et al. (2009)
Zr	40										5.50E-07		PNNL-13421	Jo88	
Zr	40	6	5.50E-07	1.70E-05					4.30E+00	3.60E-06			TRS_472		
Zr	40										3.00E-05		NUREG/CR-5512		
Zr	40										3.00E-05				Ng et al. (1979)
Zr	40		5.50E-07	1.70E-05		7.10E-06		6.90E-06							Howard et al. (2009)
Zr	40					5.50E-06									Howard et al. (2009)

Table B.3. Feed to Poultry Transfer Factor, d/kg$_{wet_as_fed}$ (CLFPL)

Element	Atomic#	N	Min	Max	AVG	Mean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Ac	89										6.00E-03		PNNL-13421	Co90	
Ac	89										4.00E-03		NUREG/CR-5512		
Ag	47										2.00E+00		PNNL-13421	CEC87	
Al	13														
Am	95										6.00E-03		PNNL-13421	Co90	
Am	95										2.00E-04		NUREG/CR-5512		
Ar	18														
As	33										8.30E-01		PNNL-13421	Na88	
At	85														
Au	79								1.00E+00				PNNL-13421	g.m.	
Ba	56										9.00E-03		PNNL-13421	En88a	
Ba	56										8.10E-04		NUREG/CR-5512		
Ba	56					1.90E-02									Howard et al. (2009)
Ba	56	2	9.20E-03	2.90E-02		1.90E-02							TRS_472		
Be	4										4.00E-01		PNNL-13421	Na88	
Bi	83								9.00E-02				PNNL-13421	g.m.	
Bk	97														
Br	35										4.00E-03		PNNL-13421	Na88	
C	6		3.30E-01	4.30E-01											Galeriu et al. (2007)
Ca	20										4.00E-02		PNNL-13421	Ng82a	
Ca	20										4.40E-02		NUREG/CR-5512		
Ca	20					4.40E-02									Howard et al. (2009)
Ca	20	2	4.40E-02	4.40E-02		4.40E-02							TRS_472		
Cd	48										8.00E-01		PNNL-13421	Ng82a	
Cd	48										8.40E-01		NUREG/CR-5512		
Cd	48					1.70E+00									Howard et al. (2009)
Cd	48	2	1.70E+00	1.80E+00		1.70E+00							TRS_472		
Ce	58										2.00E-03		PNNL-13421	Ng82a	
Ce	58										1.00E-02		NUREG/CR-5512		
Cf	98										4.00E-03		NUREG/CR-5512		
Cl	17								3.00E-02				PNNL-13421	Na88	
Cl	17										3.00E-02		NUREG/CR-5512		
Cm	96										4.00E-03		NUREG/CR-5512		
Co	27										2.00E+00		PNNL-13421	Ng82a	
Co	27										5.00E-01		NUREG/CR-5512		
Co	27					9.70E-01									Howard et al. (2009)
Co	27	2	3.00E-02	1.90E+00		9.70E-01							TRS_472		
Cr	24										2.00E-01		PNNL-13421	KS92	
Cs	55										3.00E+00		PNNL-13421	Vo93	
Cs	55										4.40E+00		NUREG/CR-5512		
Cs	55					3.00E+00	1.30E+00								Howard et al. (2009)
Cs	55	13	1.20E+00	5.6E+00				1.60E+00	2.70E+00				TRS_472		
Cu	29										5.00E-01		PNNL-13421	Ng82a	
Cu	29										5.10E-01		NUREG/CR-5512		
Dy	66										2.00E-03		PNNL-13421	Ng82a	
Er	68										2.00E-03		PNNL-13421	Ng82a	
Es	99														
Eu	63										2.00E-03		PNNL-13421	Ng82a	
Eu	63										4.00E-03		NUREG/CR-5512		
F	9								1.40E-02				PNNL-13421	g.m.	

Table B.3. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Fe	26										1.00E+00		PNNL-13421	Ng82a	
Fe	26										1.50E+00		NUREG/CR-5512		
Fm	100														
Fr	87														
Ga	31										8.00E-01		PNNL-13421	Na88	
Gd	64										2.00E-03		PNNL-13421	Ng82a	
Ge	32														
H	1		7.00E-01	9.00E-01											Galeriu et al. (2007)
Hf	72										6.00E-04		PNNL-13421	En88a	
Hg	80										3.00E-02		PNNL-13421	Ng82a	
Hg	80										1.10E-02		NUREG/CR-5512		
Ho	67										2.00E-03		PNNL-13421	Ng82a	
Ho	67										4.00E-03		NUREG/CR-5512		
I	53										5.00E-02		PNNL-13421	Sn94	
I	53										1.80E-02		NUREG/CR-5512		
I	53		2.00E-02	5.00E-01											Thorne (2003)
I	53					1.00E-02	5.60E-03								Howard et al. (2009)
I	53	3	4.00E-03	1.50E-02				2.00E+00	8.70E-03				TRS_472		
In	49										8.00E-01		PNNL-13421	Na88	
Ir	77										2.00E+00		PNNL-13421	Ng82a	
K	19										4.00E-01		PNNL-13421	KS92	
K	19														
La	57										1.00E-01		PNNL-13421	Ng82a	
Lu	71														
Md	101														
Mg	12										3.00E-02		PNNL-13421	KS92	
Mn	25										5.00E-02		PNNL-13421	Ng82a	
Mn	25					1.90E-03									Howard et al. (2009)
Mn	25	2	1.00E-03	2.80E-03		1.90E-03							TRS_472		
Mo	42										1.80E-02		PNNL-13421	En88a	
Mo	42										1.90E-01		NUREG/CR-5512		
Mo	42					1.80E-01									Howard et al. (2009)
Mo	42	1				1.80E-01							TRS_472		
N	7								9.80E-02				PNNL-13421	g.m.	
Na	11										1.00E-02		PNNL-13421	Na88	
Na	11					7.00E+00									Howard et al. (2009)
Na	11	1				7.00E+00							TRS_472		
Nb	41										3.00E-04		PNNL-13421	En88a	
Nb	41										3.10E-04		NUREG/CR-5512		
Nb	41					3.00E-04									Howard et al. (2009)
Nb	41	1				3.00E-04							TRS_472		
Nd	60										2.00E-03		PNNL-13421	Ng82a	
Nd	60										4.00E-03		NUREG/CR-5512		
Ne	10														
Ni	28										1.00E-03		PNNL-13421	Na88	
Np	93										6.00E-03		PNNL-13421	Co90	
Np	93										4.00E-03		NUREG/CR-5512		
O	8														
OBT															
Os	76								8.40E-02				PNNL-13421	g.m.	

Table B.3. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
P	15										1.90E-01		PNNL-13421	Na88	
Pa	91										6.00E-03		PNNL-13421	Co90	
Pa	91										4.00E-03		NUREG/CR-5512		
Pb	82										8.00E-01		PNNL-13421	Na88	
Pd	46										3.00E-04		PNNL-13421	Na88	
Pm	61										2.00E-03		PNNL-13421	Ng82a	
Po	84								2.30E+00				PNNL-13421	g.m.	
Po	84					2.40E+00									Howard et al. (2009)
Po	84	1				2.40E+00							TRS_472		
Pr	59										2.00E-03		PNNL-13421	Ng82a	
Pr	59										3.00E-02		NUREG/CR-5512		
Pt	78														
Pu	94										3.00E-03		PNNL-13421	Co90	
Pu	94										1.50E-04		NUREG/CR-5512		
Ra	88										3.00E-02		PNNL-13421	KS92	
Rb	37										2.00E+00		PNNL-13421	Na88	
Re	75										4.00E-02		PNNL-13421	Ba84	
Rh	45										2.00E+00		PNNL-13421	Ng82a	
Rn	86														
Ru	44										7.00E-03		PNNL-13421	Ng82a	
S	16								2.30E+00				PNNL-13421	g.m.	
Sb	51										6.00E-03		PNNL-13421	Na88	
Sc	21										4.00E-03		PNNL-13421	Na88	
Se	34										9.00E+00		PNNL-13421	Ng82a	
Se	34										8.50E+00		NUREG/CR-5512		
Se	34					1.26E+01	1.06E+01								Howard et al. (2009)
Se	34	4	4.10E+00	2.80E+01				2.30E+00	9.70E+00				TRS_472		
Si	14										8.00E-01		PNNL-13421	Na88	
Sm	62										2.00E-03		PNNL-13421	Ng82a	
Sm	62										4.00E-03		NUREG/CR-5512		
Sn	50										8.00E-01		PNNL-13421	Na88	
Sr	38										8.00E-02		PNNL-13421	Co90	
Sr	38										3.50E-02		NUREG/CR-5512		
Sr	38					2.30E-02	1.20E-02								Howard et al. (2009)
Sr	38	7	7.00E-03	4.10E-02				1.80E+00	2.00E-02				TRS_472		
Ta	73										3.00E-04		PNNL-13421	En88a	
Tb	65										2.00E-03		PNNL-13421	Ng82a	
Tb	65										4.00E-03		NUREG/CR-5512		
Tc	43										3.00E-02		PNNL-13421	En88a	
Tc	43		1.30E-02	1.30E+00											Thorne (2003)
Te	52										6.00E-01		PNNL-13421	En88a	
Te	52										8.50E-02		NUREG/CR-5512		
Te	52					6.00E-01									Howard et al. (2009)
Te	52	1				6.00E-01							TRS_472		
Th	90										6.00E-03		PNNL-13421	Co90	
Th	90										4.00E-03		NUREG/CR-5512		
Th	90		8.00E-04	2.80E-03											Jeambrun et al. (2012)
Ti	22														
Tl	81										8.00E-01		PNNL-13421	Na88	
Tm	69														
U	92										1.00E+00		PNNL-13421	Ng82a	
U	92										1.20E+00		NUREG/CR-5512		

Table B.3. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
U	92		1.50E+00	7.50E+00											Thorne (2003)
U	92		1.80E-03	7.30E-03											Howard et al. (2009)
U	92	2	3.00E-01	1.20E+00		7.50E-01							TRS_472		
V	23														
W	74										2.00E-01		PNNL-13421	IAEA94	
Xe	54														
Y	39										1.00E-02		PNNL-13421	Ng82a	
Yb	70														
Zn	30										7.00E+00		PNNL-13421	Ng82a	
Zn	30										6.50E+00		NUREG/CR-5512		
Zn	30					4.70E-01	7.90E-02								Howard et al. (2009)
Zn	30	3	3.80E-01	5.30E-01				1.20E+00	4.70E-01				TRS_472		
Zr	40										5.00E-05		PNNL-13421	En88a	
Zr	40										6.40E-05		NUREG/CR-5512		
Zr	40					6.00E-05									Howard et al. (2009)
Zr	40	1				6.00E-05							TRS_472		

Table B.4. Feed to Egg Transfer Factor, $d/kg_{wet\_as\_fed}$ (CLFEG)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	Document	Reference#	Reference
Ac	89											4.00E-03	PNNL-13421	Ng82a	
Ac	89											2.00E-03	NUREG/CR-5512		
Ag	47											5.00E-01	PNNL-13421	Ng82a	
Al	13														
Am	95											4.00E-03	PNNL-13421	Ng82a	
Am	95											9.00E-05	NUREG/CR-5512		
Am	95					3.00E-03									Howard et al. (2009)
Am	95	1				3.00E-03							TRS_472		
Ar	18														
As	33									2.60E-01			PNNL-13421	g.m.	
At	85														
Au	79											5.00E-01	PNNL-13421	Ng82a	
Ba	56											9.00E-01	PNNL-13421	En88a	
Ba	56											1.50E+00	NUREG/CR-5512		
Ba	56					8.70E-01									Howard et al. (2009)
Ba	56	1				8.70E-01							TRS_472		
Be	4											2.00E-02	PNNL-13421	Na88	
Bi	83									2.60E-01			PNNL-13421	g.m.	
Bk	97														
Br	35											1.60E+00	PNNL-13421	Na88	
C	6		3.10E-01	4.00E-01											Galeriu et al. (2007)
Ca	20											4.00E-01	PNNL-13421	Ng82a	
Ca	20											4.40E+01	NUREG/CR-5512		
Ca	20					4.40E-01									Howard et al. (2009)
Ca	20	1				4.40E-01							TRS_472		
Cd	48											1.00E-01	PNNL-13421	Ng82a	
Ce	58											4.00E-05	PNNL-13421	CEC87	
Ce	58											5.00E-03	NUREG/CR-5512		
Ce	58					3.10E-03									Howard et al. (2009)
Ce	58	1				3.10E-03							TRS_472		
Cf	98											4.00E-03	PNNL-13421	Ng82a	
Cf	98											2.00E-03	NUREG/CR-5512		
Cl	17									2.70E+00			PNNL-13421	g.m.	
Cm	96											4.00E-03	PNNL-13421	Ng82a	
Cm	96											2.00E-03	NUREG/CR-5512		
Co	27											1.00E-01	PNNL-13421	Ng82a	
Co	27					3.30E-02									Howard et al. (2009)
Cr	24											9.00E-01	PNNL-13421	En88a	
Cs	55											4.00E-01	PNNL-13421	Co90	
Cs	55											4.90E-01	NUREG/CR-5512		
Cs	55					4.30E-01		1.60E-01							Howard et al. (2009)
Cu	29											5.00E-01	PNNL-13421	Ng82a	
Cu	29											4.90E-01	NUREG/CR-5512		
Dy	66											4.00E-05	PNNL-13421	CEC87	
Er	68											4.00E-05	PNNL-13421	CEC87	
Es	99														
Eu	63											4.00E-05	PNNL-13421	CEC87	
Eu	63											7.00E-03	NUREG/CR-5512		
F	9														
Fe	26											1.00E+00	PNNL-13421	Ng82a	
Fe	26											1.30E+00	NUREG/CR-5512		

Table B.4. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	Document	Reference#	Reference
Fe	26					1.80E+00									Howard et al. (2009)
Fe	26	2	8.50 E-01	2.80E+00		1.80E+00							TRS_472		
Fm	100														
Fr	87														
Ga	31											1.00E+00	PNNL-13421	Na88	
Gd	64											4.00E-05	PNNL-13421	CEC87	
Ge	32														
H	1		6.30E-01	8.1E-01											Galeriu et al. (2007)
Hf	72											2.00E-04	PNNL-13421	Jo88	
Hg	80									5.00E-01				g.m.	
Ho	67											4.00E-05	PNNL-13421	CEC87	
Ho	67											7.00E-03	NUREG/CR-5512		
I	53											4.40E+00	PNNL-13421	Sn94	
I	53											2.80E+00	NUREG/CR-5512		
I	53		6.00E+01	1.50E+01											Thorne (2003)
I	53					2.40E+00		5.70E-01							Howard et al. (2009)
I	53	4	1.90E+00	3.20E+00					1.30E+00	2.4E+00			TRS_472		
In	49											1.00E+00	PNNL-13421	Na88	
Ir	77											1.00E-01	PNNL-13421	Ng82a	
K	19											1.00E+00	PNNL-13421	Ng82a	
Kr	36														
La	57											9.00E-03	PNNL-13421	Ng82a	
Lu	71														
Md	101														
Mg	12											2.00E+00	PNNL-13421	Ng82a	
Mg	12											1.60E+00	NUREG/CR-5512		
Mg	12														
Mn	25											6.00E-02	PNNL-13421	Ng82a	
Mn	25											6.50E-02	NUREG/CR-5512		
Mn	25					4.40E-02		1.60E-02							Howard et al. (2009)
Mn	25	3	3.20E-02	6.20E-02					1.40E+00	4.20E-02			TRS_472		
Mo	42											9.00E-01	PNNL-13421	En88a	
Mo	42											7.80E-01	NUREG/CR-5512		
Mo	42					6.50E-01		1.90E-01							Howard et al. (2009)
Mo	42	3	5.20E-02	8.70E-01					1.30E+00	6.40E-01			TRS_472		
N	7									2.60E-01			PNNL-13421	g.m.	
Na	11											6.00E+00	PNNL-13421	Ng82a	
Na	11											2.00E-01	NUREG/CR-5512		
Na	11					4.00E+00									Howard et al. (2009)
Nb	41											1.00E-03	PNNL-13421	En88a	
Nb	41											1.30E-03	NUREG/CR-5512		
Nb	41					1.00E-03									Howard et al. (2009)
Nb	41	1				1.00E-03							TRS_472		
Nd	60											4.00E-05	PNNL-13421	CEC87	
Nd	60											2.00E-04	NUREG/CR-5512		
Nd	60														
Ne	10														
Ni	28											1.00E-01	PNNL-13421	Na88	
Np	93											4.00E-03	PNNL-13421	Ng82a	
Np	93											2.00E-03	NUREG/CR-5512		
O	8														
OBT															

Table B.4. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	Document	Reference#	Reference
Os	76									7.10E-02				g.m.	
P	15											1.00E+00	PNNL-13421	Na88	
P	15											1.00E+01	NUREG/CR-5512		
P	15					6.40E-01									Howard et al. (2009)
P	15	1				6.40E-01							TRS_472		
Pa	91											4.00E-03	PNNL-13421	Ng82a	
Pa	91											2.00E-03	NUREG/CR-5512		
Pb	82											1.00E+00	PNNL-13421	Na88	
Pd	46											4.00E-03	PNNL-13421	Na88	
Pd	46														
Pm	61											4.00E-05	PNNL-13421	CEC87	
Pm	61											2.00E-02	NUREG/CR-5512		
Po	84									7.00E+00			PNNL-13421	g.m.	
Po	84					3.10E+00									Howard et al. (2009)
Po	84					3.10E+00							TRS_472		
Pr	59											4.00E-05	PNNL-13421	CEC87	
Pr	59											5.00E-03	NUREG/CR-5512		
Pt	78														
Pu	94											5.00E-04	PNNL-13421	Ng82a	
Pu	94											8.00E-03	NUREG/CR-5512		
Pu	94					1.20E-03									Howard et al. (2009)
Pu	94	2	9.90E-06	2.30E-03		1.20E-03							TRS_472		
Ra	88									3.10E-01			PNNL-13421	g.m.	
Ra	88											2.00E-05	NUREG/CR-5512		
Ra	88		1.50E-02	1.10E-01											Jeambrun et al. (2012)
Rb	37											3.00E+00	PNNL-13421	Na88	
Re	75									4.20E-01				g.m.	
Rh	45											1.00E-01	PNNL-13421	Ng82a	
Rn	86														
Ru	44											5.00E-03	PNNL-13421	Co90	
Ru	44											6.00E-03	NUREG/CR-5512		
Ru	44					4.00E-03									Howard et al. (2009)
Ru	44	1				4.00E-03							TRS_472		
S	16									7.00E+00			PNNL-13421	g.m.	
Sb	51											7.00E+00	PNNL-13421	Na88	
Sc	21									4.20E-03			PNNL-13421	g.m.	
Se	34											9.00E+00	PNNL-13421	Ng82a	
Se	34											9.30E+00	NUREG/CR-5512		
Se	34					1.82E+01		1.04E+01							Howard et al. (2009)
Se	34	4	8.80E+00	2.80E+01					1.90E+00	1.60E+01			TRS_472		
Si	14											1.00E+00	PNNL-13421	Na88	
Sm	62											4.00E-05	PNNL-13421	CEC87	
Sm	62											7.00E-03	NUREG/CR-5512		
Sn	50											1.00E+00	PNNL-13421	Na88	
Sr	38											2.00E-01	PNNL-13421	Co90	
Sr	38											3.00E-01	NUREG/CR-5512		
Sr	38					8.80E-01		1.50E+00							Howard et al. (2009)
Ta	73											1.00E-03	PNNL-13421	En88a	
Tb	65											4.00E-05	PNNL-13421	CEC87	
Tb	65											7.00E-03	NUREG/CR-5512		
Tc	43											3.00E+00	PNNL-13421	En88a	
Tc	43		1.00E-01	3.00E+00											Thorne (2003)

Table B.4. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	Document	Reference#	Reference
Te	52											5.00E+00	PNNL-13421	En88a	
Te	52											5.20E+00	NUREG/CR-5512		
Te	52					5.10E+00									Howard et al. (2009)
Te	52	1				5.10E+00							TRS_472		
Th	90											4.00E-03	PNNL-13421	Ng82a	
Th	90											2.00E-03	NUREG/CR-5512		
Th	90					6.00E-04		4.00E-04							Jeambrun et al. (2012)
Ti	22														
Tl	81											1.00E+00	PNNL-13421	Na88	
Tm	69														
U	92											1.00E+00	PNNL-13421	Ng82a	
U	92											9.90E-01	NUREG/CR-5512		
U	92		1.50E+00	7.50E+00											Thorne (2003)
U	92					1.10E+00									Howard et al. (2009)
U	92		1.80E-04	1.80E-03											Jeambrun et al. (2012)
U	92	2	9.20E-01	1.20E+00		1.10E+00							TRS_472		
V	23														
W	74											9.00E-01	PNNL-13421	En88a	
Xe	54														
Y	39											2.00E-03	PNNL-13421	Ng82a	
Yb	70														
Zn	30											3.00E+00	PNNL-13421	Ng82a	
Zn	30											2.60E+00	NUREG/CR-5512		
Zn	30					1.40E+00		2.90E-01							Howard et al. (2009)
Zn	30	4	1.20E+00	1.90E+00					1.20E+00	1.40E+00			TRS_472		
Zr	40											2.00E-04	PNNL-13421	En88a	
Zr	40											1.90E-04	NUREG/CR-5512		
Zr	40					2.00E-04									Howard et al. (2009)

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Appendix C

Terrestrial Plant

Appendix C

Terrestrial Plant

This appendix contains tables of soil to feed or food-crop bioconcentration factors. References are indicated for each value. For elements with no data compiled, a blank row for that element is shown.

Table C.1. Bioconcentration in Leafy Vegetables from Soil, $kg_{dry\_plant}/kg_{dry\_soil}$ (CLBVLV)

Table C.2. Bioconcentration in Root Vegetables from Soil, $kg_{dry\_plant}/kg_{dry\_soil}$ (CLBVRV)

The GENII code uses the CLBVRV parameter information to indicate the bioconcentration factors for both root vegetables and other vegetables (i.e., an “other vegetable” meaning a non-leafy, non-grain, non-fruit crop). In some cases, a reference includes bioconcentration factors for a particular root vegetable and for an “other vegetable.” As a result, there may be more than one bioconcentration value listed in the table from a single reference.

Table C.3. Bioconcentration in Fruit from Soil, $kg_{dry\_plant}/kg_{dry\_soil}$ (CLBVFR)

Table C.4. Bioaccumulation in Grain from Soil, $kg_{dry\_plant}/kg_{dry\_soil}$ (CLBVCL)

In all tables if an element is listed once and there is no data for that element, no bioconcentration factor information was currently identified, preferred, or available.

Table C.1. Bioconcentration in Dry Leafy Vegetables from Soil, $kg_{dry\_plant}/kg_{dry\_soil}$ (CLBVLV)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Ac	89											3.50E-03		NUREG/CR-5512		
Ac	89											4.70E-04		PNNL-13421	Fr82	
Ag	47											2.70E-04		PNNL-13421	Fr82	
Ag	47	5	5.90E-05	1.30E-02					3.30E+00	1.80E-04				TRS_472		
Ag	47									1.20E-01						Sheppard et al. (2010b)
Al	13															
Am	95											5.80E-04		NUREG/CR-5512		
Am	95											4.70E-04		PNNL-13421	Fr82	
Am	95	10	4.00E-05	1.50E-03					3.30E+00	2.70E-04				TRS_472		
Ar	18															
As	33											4.00E-02		PNNL-13421	Ba84	
As	33									7.00E-03						Sheppard et al. (2010b)
At	85															
Au	79											4.00E-01		NUREG/CR-5512		
Au	79											1.00E-02		PNNL-13421	g.m	
Ba	56											1.50E-01		PNNL-13421	Ba84	
Ba	56	1				5.00E-03								TRS_472		
Ba	56									2.80E-02						Sheppard et al. (2010b)
Be	4											1.00E-02		PNNL-13421	Ba84	
Be	4					4.20E-01								TRS_472		
Bi	83											3.50E-02		NUREG/CR-5512		
Bi	83											5.00E-01		PNNL-13421	IAEA82	
Bk	97															
Br	35											1.50E+00		PNNL-13421	Fu78	
C	6											7.00E-01		PNNL-13421		
Ca	20											3.50E+00		PNNL-13421	Ba84	
Ca	20		2.30E+00	3.80E+01					3.70E+00	8.70E+00				TRS_472		
Ca	20									7.90E-02						Sheppard et al. (2010b)
Ca	48											5.50E-01		PNNL-13421	Ba84	
Cd	48		1.90E-01	5.40E+00					2.20E+00	2.10E+00				TRS_472		
Cd	48									7.80E-01						Sheppard et al. (2010b)
Ce	58											1.00E-02		NUREG/CR-5512		
Ce	58											2.00E-02		PNNL-13421	Ng82b	
Ce	58	1				6.00E-03								TRS_472		
Ce	58									6.20E-03						Sheppard et al. (2010b)
Cf	98											1.00E-02		NUREG/CR-5512		
Cf	98											4.70E-04		PNNL-13421	Fr82	
Cf	98											2.50E-04		PNNL-13421	Ba84	
Cl	17											7.00E+00		PNNL-13421	Ba84	
Cl	17									2.50E+01						Sheppard et al. (2010b)
Cm	96											3.00E-04		NUREG/CR-5512		
Cm	96											7.70E-04		PNNL-13421	Fr82	
Cm	96	7	2.00E-04	8.10E-03					4.50E+00	1.40E-03				TRS_472		
Co	26											8.10E-02		NUREG/CR-5512		
Co	27											2.70E-01		PNNL-13421	Fr89	
Co	27	185	1.30E-02	1.00E+00					2.70E+00	1.70E-01				TRS_472		
Co	27									1.20E-02						Sheppard et al. (2010b)
Cr	24											7.00E-03		PNNL-13421	Ba84	
Cr	24	1				1.00E-03								TRS_472		
Cr	24									1.30E-02						Sheppard et al. (2010b)

Table C.1. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Cs	55											1.30E-01		NUREG/CR-5512		
Cs	55											4.60E-01		PNNL-13421	Fr82	
Cs	55	290	3.00E-04	9.80E-01					6.00E+00	6.00E-02				TRS_472		
Cs	55									2.20E-02						Sheppard et al. (2010b)
Cs	55											2.30E-01				Mollah et al. (1998)
Cs	55											9.10E-01				Mollah et al. (1998)
Cu	29											4.00E-01		PNNL-13421	Ba84	
Cu	29									2.70E-01						Sheppard et al. (2010b)
Dy	66											1.00E-02		NUREG/CR-5512		
Dy	66											2.00E-02		PNNL-13421	Ng82b	
Er	68											1.00E-02		NUREG/CR-5512		
Er	68											2.00E-02		PNNL-13421	Ng82b	
Es	99															
Eu	63											1.00E-02		NUREG/CR-5512		
Eu	63											2.00E-02		PNNL-13421	Ng82b	
F	9											6.00E-02		PNNL-13421	Ba84	
Fe	26											4.00E-03		NUREG/CR-5512		
Fe	26											5.00E-02		PNNL-13421	CT83	
Fe	26	1				1.00E-03								TRS_472		
Fm	100															
Fr	87															
Ga	31											4.00E-03		PNNL-13421	Ba84	
Gd	64											1.00E-02		NUREG/CR-5512		
Gd	64											2.00E-02		PNNL-13421	Ng82b	
Ge	32															
H	1															
Hf	72											3.50E-03		NUREG/CR-5512		
Hf	72											1.00E-03		PNNL-13421	Ng82b	
Hg	80											9.00E-01		NUREG/CR-5512		
Hg	80											8.50E-01		PNNL-13421		
Ho	67											1.00E-02		NUREG/CR-5512		
Ho	67											2.00E-02		PNNL-13421	Ng82b	
I	53											3.40E-03		NUREG/CR-5512		
I	53											4.00E-02		PNNL-13421	Sn94	
I	53									1.40E-02						Uchida and Tagami (2011)
In	49											4.00E-03		PNNL-13421	Fu78	
Ir	77											5.50E-02		PNNL-13421	Ba84	
K	19											1.00E+00		PNNL-13421	Ba84	
K	19	2	1.20E+00	1.30E+00		1.30E+00								TRS_472		
K	19		1.00E+00	5.00E+00												Al-Masri et al. (2008)
K	19									1.00E-01						Sheppard et al. (2010b)
Kr	36															
La	57											5.70E-04		NUREG/CR-5512		
La	57											5.20E-03		PNNL-13421	Fr89	
La	57	7	1.10E-03	1.50E-02					2.70E+00	5.70E-03				TRS_472		
La	57									6.80E-03						Sheppard et al. (2010b)
Lu	71															
Md	101															
Mg	12											1.00E+00		PNNL-13421	Ba84	
Mg	12									7.30E-01						Sheppard et al. (2010b)
Mn	25											5.60E-01		NUREG-5512		
Mn	25											7.00E-01		PNNL-13421	Fr89	

Table C.1. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Mn	25	103	5.20E-02	3.00E+00					2.40E+00	4.10E-01				TRS_472		
Mn	25									1.00E-01						Sheppard et al. (2010b)
Mo	42											2.50E-01		NUREG/CR-5512		
Mo	42											8.00E-01		PNNL-13421	Ng82b	
Mo	42	1	2.10E-01	8.00E+01		5.10E-01								TRS_472		
Mo	42									3.80E+00						Sheppard et al. (2010b)
N	7											3.00E+01		NUREG-5512		
N	7											5.50E-02		PNNL-13421	Ba84	
Na	11											7.50E-02		NUREG-5512		
Na	11											3.00E-01		PNNL-13421	Ng82b	
Na	11	1				3.00E-02								TRS_472		
Na	11									3.20E+00						Sheppard et al. (2010b)
Nb	41											2.00E-02		NUREG/CR-5512		
Nb	41											2.50E-02		PNNL-13421	CT83	
Nb	41	2	8.00E-03	2.50E-02		1.70E-02								TRS_472		
Nb	41									1.70E-02						Sheppard et al. (2010b)
Nd	60											1.00E-02		NUREG/CR-5512		
Nd	60											2.00E-02		PNNL-13421	Ng82b	
Nd	60									4.30E-03						Sheppard et al. (2010b)
Ne	10															
Ni	28											2.80E-01		PNNL-13421	IUR89	
Ni	28		1.80E-02	5.80E-01					2.60E+00	1.70E-01				TRS_472		
Ni	28									1.80E-02						Sheppard et al. (2010b)
Np	93											1.30E-02		NUREG/CR-5512		
Np	93											3.20E-02		PNNL-13421	Fr82	
Np	93	5	5.00E-03	8.00E-02					3.00E+00	2.70E-02				TRS_472		
O	8															
OBT																
Os	76											1.50E-02		PNNL-13421	Ba84	
P	15											3.50E+00		PNNL-13421	Ba84	
P	15	1				1.00E+00								TRS_472		
Pa	91											2.50E-03		NUREG/CR-5512		
Pa	91											4.70E-04		PNNL-13421	Fr82	
Pb	82											5.80E-03		NUREG/CR-5512		
Pb	82											1.00E-02		PNNL-13421	Fr89	
Pb	82	31	3.20E-03	2.50E+01					1.30E+01	8.00E-02				TRS_472		
Pb	82		2.40E-01	1.43E+00												Al-Masri et al. (2008)
Pb	82									4.90E-03						Sheppard et al. (2010b)
Pb	82		3.21E-03	2.46E+01		2.11E+00		6.12E+00								Vandenhove et al. (2009b)
Pd	46											1.50E-01		PNNL-13421	Ba84	
Pm	61											1.00E-02		NUREG/CR-5512		
Pm	61											2.00E-02		PNNL-13421	Ng82b	
Pm	61		2.20E-02	1.40E+00					4.10E+00	2.30E-01				TRS_472		
Po	84											1.20E-03		PNNL-13421	Ho91	
Po	84	12	2.50E-04	5.00E-02					6.90E+00	7.40E-03				TRS_472		
Po	84		2.80E-02	2.10E-01												Al-Masri et al. (2008)
Po	84					1.90E-02	1.72E-02									Vandenhove et al. (2009b)
Pr	59											1.00E-02		NUREG/CR-5512		
Pr	59											2.00E-02		PNNL-13421	Ng82b	
Pr	59	1				2.00E-02								TRS_472		
Pr	59									5.40E-03						Sheppard et al. (2010b)
Pt	78															

Table C.1. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Pu	94											3.90E-04		NUREG/CR-5512		
Pu	94											5.00E-05		PNNL-13421	Fr82	
Pu	94	13	1.00E-05	2.90E-04					2.70E+00	8.30E-05				TRS_472		
Ra	88											7.50E-02		NUREG/CR-5512		
Ra	88											4.90E-02		PNNL-13421	Fr89	
Ra	88	77	1.80E-03	1.30E+02					6.70E+00	9.10E-02				TRS_472		
Ra	88		2.60E-02	3.80E-02												Lauria et al. (2009)
Ra	88		1.76E-03	1.25E+02		2.58E+00		1.49E+01								Vandenhove et al. (2009b)
Rb	37											1.50E-01		NUREG/CR-5512		
Rb	37											9.00E-01		PNNL-13421	Ng82b	
Rb	37	2	3.40E-01	9.00E-01		6.20E-01								TRS_472		
Rb	37									6.20E-01						Sheppard et al. (2010b)
Re	75											1.50E+00		PNNL-13421	Ba84	
Rh	45											1.50E-01		PNNL-13421	Ba84	
Rn	86															
Ru	44											5.20E-01		NUREG/CR-5512		
Ru	44											4.00E-02		PNNL-13421	Ng82b	
Ru	44	3	2.00E-02	2.30E-01					3.70E+00	9.00E-02				TRS_472		
S	16											1.50E+00		PNNL-13421	Ba84	
Sb	51											1.30E-04		PNNL-13421	IUR89	
Sb	51	5	2.20E-05	2.30E-04					2.60E+00	9.40E-05				TRS_472		
Sb	51									1.70E-02						Sheppard et al. (2010b)
Sc	21											6.00E-03		PNNL-13421	Ba84	
Se	34											2.50E-01		PNNL-13421	CT83	
Se	34									1.00E+00						Sheppard et al. (2010b)
Si	14											3.50E-01		PNNL-13421	Ba84	
Sm	62											1.00E-02		NUREG/CR-5512		
Sm	62											2.00E-02		PNNL-13421	Ng82b	
Sm	62									4.50E-03						Sheppard et al. (2010b)
Sn	50											3.00E-02		PNNL-13421	Fu78	
Sn	50									1.20E-01						Sheppard et al. (2010b)
Sr	38											1.60E+00		NUREG/CR-5512		
Sr	38											3.00E+00		PNNL-13421	Fr82	
Sr	38	217	3.90E-03	7.80E+00					6.00E+00	7.60E-01				TRS_472		
Sr	38									1.10E+00						Sheppard et al. (2010b)
Sr	38											6.90E-01				Mollah et al. (1998)
Sr	38											5.90E-01				Mollah et al. (1998)
Ta	73											1.00E-02		NUREG/CR-5512		
Ta	73											2.50E-02		PNNL-13421	CT83	
Tb	65											1.00E-02		NUREG/CR-5512		
Tb	65											2.00E-02		PNNL-13421	Ng82b	
Tb	65									7.20E-03						Sheppard et al. (2010b)
Tc	43											4.40E+01		NUREG/CR-5512		
Tc	43											2.10E+01		PNNL-13421	Fr82	
Te	52											2.50E-02		NUREG/CR-5512		
Te	52											2.00E-02		PNNL-13421	Ba84	
Te	52	1				3.00E-01								TRS_472		
Th	90											6.60E-03		NUREG/CR-5512		
Th	90											1.80E-03		PNNL-13421	Fr89	
Th	90	24	9.40E-05	2.10E-01					6.00E+00	1.20E-03				TRS_472		
Th	90									1.36E-02						Sheppard et al. (2010b)
Th	90		9.38E-05	2.11E-01		1.18E-02		4.29E-02								Vandenhove et al. (2009b)

Table C.1. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Ti	22															
Tl	81											4.00E-03		PNNL-13421	Fu78	
Tl	81									1.16E-01						Sheppard et al. (2010b)
Tm	69															
U	92											1.70E-02		NUREG/CR-5512		
U	92											8.30E-03		PNNL-13421	Fr89	
U	92	108	7.80E-05	8.80E+00					7.30E+00	2.00E-02				TRS_472		
U	92		3.00E-03	5.70E-02												Al-Masri et al. (2008)
U	92									5.20E-03						Sheppard et al. (2010b)
U	92		1.10E-02	1.40E-02												Lauria et al. (2009)
U	92		7.84E-05	8.82E+00		2.21E-01		1.14E+00								Vandenhove et al. (2009b)
V	23									8.80E-03						Sheppard et al. (2010b)
W	74											4.50E-02		NUREG/CR-5512		
W	74											3.00E+00		PNNL-13421	NCRP86	
Xe	54															
Y	39											1.50E-02		NUREG/CR-5512		
Y	39											1.00E-02		PNNL-13421	Ng82b	
Y	39	1				2.00E-03								TRS_472		
Y	39									5.50E-03						Sheppard et al. (2010b)
Yb	70									8.00E-03						Sheppard et al. (2010b)
Zn	30											1.40E+00		NUREG/CR-5512		
Zn	30											1.30E+00		PNNL-13421	Fr89	
Zn	30	112	1.00E-01	1.70E+01					2.40E+00	2.40E+00				TRS_472		
Zn	30									2.80E-01						Sheppard et al. (2010b)
Zr	40											2.00E-03		NUREG/CR-5512		
Zr	40											1.00E-03		PNNL-13421	Ng82b	
Zr	40	1				4.00E-02								TRS_472		
Zr	40									8.70E-02						Sheppard et al. (2010b)

Table C.2. Bioconcentration in Dry Root Vegetables from Soil, $kg_{dry\_plant}/kg_{dry\_soil}$ (CLBVRV&CLBVOV combined)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	MED	95%ile	Document	Reference#	Reference
Ac	89										3.50E-04		PNNL-13421	Fr82	
Ag	47										1.30E-03		PNNL-13421	Fr82	
Ag	47									3.70E-02					Sheppard et al. (2010b)
Ag	47	5	2.50E-04	2.00E-03					2.30E+00	6.40E-04			TRS_472 (OV)		
Ag	47	6	5.70E-04	3.90E-03					2.00E+00	1.30E-03			TRS_472 (RV)		
Al	13														
Am	95										3.50E-04		PNNL-13421	Fr82	
Am	95										4.10E-04		NUREG/CR-5512		
Am	95		3.00E-06	1.00E-03							1.00E-05		Coughtrey et al. (1985)	S2.2, T2.1	
Am	95	9	2.30E-05	1.90E-03					5.00E+00	3.60E-04			TRS_472 (OV)		
Am	95	4	2.00E-04	1.70E-03					2.40E+00	6.70E-04			TRS_472 (RV)		
Ar	18														
As	33										6.00E-03		PNNL-13421	Ba84	
As	33										5.00E-03		NUREG/CR-5512		
As	33									4.00E-03					Sheppard et al. (2010b)
At	85														
Au	79										1.80E-02		PNNL-13421	g.m.	
Au	79										1.00E-01		NUREG/CR-5512		
Ba	56										1.50E-02		PNNL-13421	Ba84	
Ba	56									7.50E-02					Sheppard et al. (2010b)
Ba	56	1				5.00E-03							TRS_472 (OV)		
Be	4														
Bi	83										1.00E-05		PNNL-13421	IAEA82	
Bi	83										5.00E-03		NUREG/CR-5512		
Bk	97														
Br	35										1.50E+00		PNNL-13421	Fu78	
Br	35		1.00E-02	1.57E+01									Coughtrey et al. (1985)	S2.1	
C	6										7.00E-01		PNNL-13421	Na88	
Ca	20										3.50E-01		PNNL-13421	Ba84	
Ca	20									7.10E-02					Sheppard et al. (2010b)
Ca	20	6	53	75						2.00E+01			TRS_472 (legume)		
Cd	48										1.50E-01		PNNL-13421	Ba84	
Cd	48									2.60E-01					Sheppard et al. (2010b)
Cd	48		7.00E-02	4.00E+00						8.00E-01			Coughtrey et al. (1985)	S2.1, T2.3	
Cd	48	1	8.00E-02	4.60E-01		2.70E-01			2.70E-01				TRS_472 (legume)		
Cd	48	1				1.50E+00							TRS_472 (tuber)		
Ce	58										2.00E-02		PNNL-13421	Ng82b	
Ce	58										4.00E-03		NUREG/CR-5512		
Ce	58									6.70E-04					Sheppard et al. (2010b)
Ce	58	2	6.00E-03	2.00E-02		1.30E-02							TRS_472 (legume)		
Ce	58	1				6.00E-03							TRS_472 (RV)		
Cf	98										3.50E-04		PNNL-13421	Fr82	
Cf	98										1.00E-02		NUREG/CR-5512		
Cl	17										7.00E+00		PNNL-13421	Ba84	
Cl	17									7.80E+00					Sheppard et al. (2010b)
Cm	96										4.30E-04		PNNL-13421	Fr82	
Cm	96										2.40E-04		NUREG/CR-5512		
Cm	96	8	3.60E-05	1.40E-03					4.50E+00	3.20E-04			TRS_472 (OV)		
Cm	96	6	2.00E-04	3.90E-03					3.00E+00	8.50E-04			TRS_472 (RV)		
Co	27										6.70E-02		PNNL-13421	Fr89	
Co	27										4.00E-02		NUREG/CR-5512		

Table C.2. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	MED	95%ile	Document	Reference#	Reference
Co	27									4.50E-03					Sheppard et al. (2010b)
Co	27	7	5.70E-02	2.30E-01					1.60E+00	1.40E-01			TRS_472(OV)		
Co	27	14	4.70E-02	7.20E-01					2.20E+00	1.10E-01			TRS_472 (RV)		
Cr	24										4.50E-03		PNNL-13421	Ba84	
Cr	24									3.00E-03					Sheppard et al. (2010b)
Cr	24	1				1.00E-03							TRS_472 (OV, RV)		
Cs	55										1.00E-01		PNNL-13421	Fr82	
Cs	55										4.90E-02		NUREG/CR-5512		
Cs	55									5.00E-03					Sheppard et al. (2010b)
Cs	55		5.00E-03	1.20E+01							2.50E-01		Coughtrey et al. (1985)	S2.1	
Cs	55	38	7.00E-04	7.30E-01					4.10E+00	2.10E-02			TRS_472(OV)		
Cs	55	81	1.00E-03	8.80E-01					3.00E+00	4.20E-02			TRS_472 (RV)		
Cu	29										2.50E-01		PNNL-13421	Ba84	
Cu	29									2.00E-01					Sheppard et al. (2010b)
Dy	66										2.00E-02		PNNL-13421	Ng82b	
Dy	66										4.00E-03		NUREG/CR-5512		
Er	68										2.00E-02		PNNL-13421	Ng82b	
Er	68										4.00E-03		NUREG/CR-5512		
Es	99														
Eu	63										2.00E-02		PNNL-13421	Ng82b	
Eu	63										4.00E-03		NUREG/CR-5512		
F	9										6.00E-03		PNNL-13421	Ba84	
Fe	26										5.00E-02		PNNL-13421	CT83	
Fe	26										1.00E-03		NUREG/CR-5512		
Fe	26	3								1.00E-03			TRS_472 (OV,RV)		
Fm	100														
Fr	87														
Ga	31										4.00E-04		PNNL-13421	Ba84	
Gd	64										2.00E-02		PNNL-13421	Ng82b	
Gd	64										4.00E-03		NUREG/CR-5512		
Ge	32														
H	1										1.50E-03		PNNL-13421	Ba84	
Hf	72										1.00E-03		PNNL-13421	Ng82b	
Hf	72										8.50E-04		NUREG/CR-5512		
Hg	80										2.00E-01		PNNL-13421	Ba84	
Ho	67										2.00E-02		PNNL-13421	Ng82b	
Ho	67										4.00E-03		NUREG/CR-5512		
Ho	67														
I	53										4.00E-02		PNNL-13421	Sn94	
I	53										5.00E-02		NUREG/CR-5512		
I	53									7.70E-03					Uchida and Tagami (2011)
I	53									1.40E-02					Uchida and Tagami (2011)
In	49										4.00E-04		PNNL-13421	Fu78	
In	49														
Ir	77										1.50E-02		PNNL-13421	Ba84	
Ir	77														
K	19										5.50E-01		PNNL-13421	Ba84	
K	19									1.40E+00					Sheppard et al. (2010b)
Kr	36														
La	57										3.50E-04		PNNL-13421	Fr89	
La	57										6.40E-04		NUREG/CR-5512		

Table C.2. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	MED	95%ile	Document	Reference#	Reference
La	57									7.50E-04					Sheppard et al. (2010b)
La	57	2	5.90E-03	6.00E-03		6.00E-03							TRS_472 (OV)		
La	57	9	4.50E-04	6.00E-03					2.70E+00	1.60E-03			TRS_472 (RV)		
Lu	71														
Md	101														
Mg	12										5.50E-01		PNNL-13421	Ba84	
Mg	12									1.40E-01					Sheppard et al. (2010b)
Mn	25										2.00E-01		PNNL-13421	Fr89	
Mn	25										1.50E-01		NUREG/CR-5512		
Mn	25	3	1.00E-01	1.50E+00					4.10E+00	3.10E-01			TRS_472 (OV)		
Mn	25	13	1.50E-02	3.90E+00					5.50E+00	4.20E-01			TRS_472 (RV)		
Mn	25									1.70E-02					Sheppard et al. (2010b)
Mo	42										8.00E-01		PNNL-13421	Ng82b	
Mo	42										6.00E-02		NUREG/CR-5512		
Mo	42									7.00E-01					Sheppard et al. (2010b)
Mo	42	1				5.40E+00							TRS_472 (legume)		
Mo	42	3	2.30E-02	4.20E-01						3.20E-01			TRS_472 (RV)		
N	7										4.20E-02		PNNL-13421	Ba84	
N	7										3.00E+01		NUREG/CR-5512		
Na	11										3.00E-01		PNNL-13421	Ng82b	
Na	11										5.50E-02		NUREG/CR-5512		
Na	11									5.60E-01					Sheppard et al. (2010b)
Na	11	1				3.00E-02							TRS_472 (OV)		
Nb	41										2.50E-02		PNNL-13421	CT83	
Nb	41										5.00E-03		NUREG/CR-5512		
Nb	41									2.50E-03					Sheppard et al. (2010b)
Nb	41	1				8.00E-03							TRS_472 (OV)		
Nb	41	2	8.00E-03	2.50E-02		1.70E-02							TRS_472 (RV)		
Nd	60										2.00E-02		PNNL-13421	Ng82b	
Nd	60										4.00E-03		NUREG/CR-5512		
Nd	60									5.40E-04					Sheppard et al. (2010b)
Ne	10														
Ni	28										6.00E-02		PNNL-13421	Ba84	
Ni	28										4.00E-02		NUREG/CR-5512		
Ni	28									1.70E-02					Sheppard et al. (2010b)
Ni	28		2.34E-02	2.90E-01		1.18E-01			2.76E+00	8.08E-02					Vandenhove et al. (2009a)
Ni	28		2.79E-02	1.28E-01		5.38E-02			1.73E+00	4.65E-02					Vandenhove et al. (2009a)
Ni	28	27	7.30E-02	2.60E+00					2.50E+00	4.00E-01			TRS_472 (legume)		
Np	93										1.30E-02		PNNL-13421	Fr82	
Np	93										9.40E-03		NUREG/CR-5512		
Np	93	9	4.00E-03	5.70E-02					2.40E+00	1.80E-02			TRS_472 (OV)		
Np	93	7	5.00E-03	3.60E-02					2.00E+00	2.20E-02			TRS_472 (RV)		
O	8														
OBT															
Os	76										3.50E-03		PNNL-13421	Ba84	
P	15										3.50E+00		PNNL-13421	Ba84	
P	15	1				1.00E+00							TRS_472 (OV, RV)		
Pa	91										3.50E-04		PNNL-13421	Fr82	
Pa	91										2.50E-04		NUREG/CR-5512		
Pb	82										6.00E-03		PNNL-13421	Fr89	
Pb	82										3.20E-03		NUREG/CR-5512		
Pb	82									2.00E-03					Sheppard et al. (2010b)

Table C.2. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	MED	95%ile	Document	Reference#	Reference
Pb	82		2.40E-04	3.30E+00		4.14E-01		9.77E-01							Vandenhove et al. (2009b)
Pb	82		1.47E-03	3.86E+00		7.77E-01		1.72E+00							Vandenhove et al. (2009b)
Pb	82	5	1.50E-03	3.90E+00					2.60E+01	1.50E-02			TRS_472 (OV)		
Pb	82	27	2.40E-04	3.30E+00					1.60E+01	1.50E-02			TRS_472 (RV)		
Pd	46										4.00E-02		PNNL-13421	Ba84	
Pm	61										2.00E-02		PNNL-13421	Ng82b	
Pm	61										4.00E-03		NUREG/CR-5512		
Pm	61	4	2.00E-02	1.20E+00					7.40E+00	1.70E-01			TRS_472 (OV)		
Pm	61	5	3.60E-02	6.00E-02					1.20E+00	4.20E-02			TRS_472 (RV)		
Po	84										7.00E-03		PNNL-13421	HW91	
Po	84										9.00E-03		NUREG/CR-5512		
Po	84		2.40E-04	4.92E-02		1.20E-02		1.65E-02							Vandenhove et al. (2009b)
Po	84		1.60E-05	3.70E-04		1.93E-04		2.50E-04							Vandenhove et al. (2009b)
Po	84	2	1.60E-05	3.70E-04		1.90E-04							TRS_472 (OV)		
Po	84	10	2.40E-04	4.90E-02					4.30E+00	5.80E-03			TRS_472 (RV)		
Pr	59										2.00E-02		PNNL-13421	Ng82b	
Pr	59										4.00E-03		NUREG/CR-5512		
Pr	59									7.50E-04					Sheppard et al. (2010b)
Pr	59	1				2.00E-02							TRS_472 (RV)		
Pt	78														
Pu	94										1.10E-03		PNNL-13421	Fr82	
Pu	94										2.00E-04		NUREG/CR-5512		
Pu	94	9	6.00E-06	2.00E-04					2.70E+00	6.50E-05			TRS_472 (OV)		
Pu	94	5	7.00E-05	5.80E-03					1.00E+01	3.90E-04			TRS_472 (RV)		
Ra	88										2.00E-03		PNNL-13421	Fr89	
Ra	88										3.20E-03		NUREG/CR-5512		
Ra	88		2.04E-03	5.56E+01		1.93E+00		7.81E+00							Vandenhove et al. (2009b)
Ra	88		2.41E-04	6.25E+00		2.62E-01		1.01E+00							Vandenhove et al. (2009b)
Ra	88	44	2.40E-04	6.30E+00					8.40E+00	1.70E-02			TRS_472 (OV)		
Ra	88	60	2.00E-03	5.60E+01					9.20E+00	7.00E-02			TRS_472 (RV)		
Rb	37										9.00E-01		PNNL-13421	Ng82b	
Rb	37										7.00E-02		NUREG/CR-5512		
Rb	37									2.50E-01					Sheppard et al. (2010b)
Rb	37	1				9.00E-01							TRS_472 (RV)		
Re	75										3.50E+00		PNNL-13421	Ba84	
Re	75										3.50E-01		NUREG/CR-5512		
Rh	45										4.00E-02		PNNL-13421	Ba84	
Rn	86														
Ru	44										4.00E-02		PNNL-13421	Ng82b	
Ru	44										2.00E-02		NUREG/CR-5512		
Ru	37	1				2.00E-02							TRS_472 (OV)		
Ru	44	1				1.00E-02							TRS_472 (RV)		
S	16										1.50E+00		PNNL-13421	Ba84	
Sb	51										5.60E-04		PNNL-13421	Fr82	
Sb	51									4.90E-03					Sheppard et al. (2010b)
Sb	51		7.00E-03	5.00E-02							5.00E-02		Coughtrey et al. (1985)	S2.1	
Sb	51	5	1.50E-05	1.60E-03					6.70E+00	1.30E-04			TRS_472 (OV)		
Sb	51	5	4.00E-04	1.10E-03					1.50E+00	6.20E-04			TRS_472 (RV)		
Sc	21										1.00E-03		PNNL-13421	Ba84	
Se	34										5.00E-02		PNNL-13421	CT83	
Se	34										2.50E-02		NUREG/CR-5512		
Se	34									6.60E-01					Sheppard et al. (2010b)

Table C.2. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	MED	95%ile	Document	Reference#	Reference
Si	14										7.00E-02		PNNL-13421	Ba84	
Sm	62										2.00E-02		PNNL-13421	Ng82b	
Sm	62										4.00E-03		NUREG/CR-5512		
Sm	62									6.40E-04					Sheppard et al. (2010b)
Sn	50										6.00E-03		PNNL-13421	Fu78	
Sn	50									1.20E+00					Sheppard et al. (2010b)
Sr	38										5.00E-01		PNNL-13421	Fr82	
Sr	38										8.10E-01		NUREG/CR-5512		
Sr	38									1.10E-01					Sheppard et al. (2010b)
Sr	38	19	7.10E-03	7.90E+00					5.50E+00	3.60E-01			TRS_472 (OV)		
Sr	38	56	3.00E+02	4.80E+00					4.10E+00	7.20E-01			TRS_472 (RV)		
Ta	73										2.50E-02		PNNL-13421	CT83	
Ta	73										2.50E-03		NUREG/CR-5512		
Tb	65										2.00E-02		PNNL-13421	Ng82b	
Tb	65										4.00E-03		NUREG/CR-5512		
Tb	65									1.30E-03					Sheppard et al. (2010b)
Tc	43										2.40E-01		PNNL-13421	Fr82	
Tc	43										1.10E+00		NUREG/CR-5512		
Te	52										4.00E-03		PNNL-13421	Ba84	
Te	52	1				3.00E-01							TRS_472 (OV, RV)		
Th	90										3.30E-04		PNNL-13421	Fr89	
Th	90										1.20E-04		NUREG/CR-5512		
Th	90									4.20E-03					Sheppard et al. (2010b)
Th	90		8.21E-06	9.50E-02		9.33E-03		2.00E-02							Vandenhove et al. (2009b)
Th	90		6.21E-05	1.62E-02		3.43E-03		5.36E-03							Vandenhove et al. (2009b)
Th	90	17	6.20E-05	1.60E-02		7.80E-04			6.80E+00				TRS_472 (OV)		
Th	90	33	8.20E-06	9.50E-02		8.00E-04			1.30E+01				TRS_472 (RV)		
Ti	22														
Tl	81										4.00E-04		PNNL-13421	Fu78	
Tl	81									1.60E-02					Sheppard et al. (2010b)
Tm	69														
U	92										1.20E-02		PNNL-13421	Fr89	
U	92										1.40E-02		NUREG/CR-5512		
U	92									3.20E-03					Sheppard et al. (2010b)
U	92		4.91E-04	2.63E-01		3.61E-02		6.50E-02							Vandenhove et al. (2009b)
U	92		5.23E-04	2.03E-01		3.57E-02		5.27E-02							Vandenhove et al. (2009b)
U	92	38	5.20E-04	2.00E-01		1.50E-02			4.20E+00				TRS_472 (OV)		
U	92	46	4.90E-04	2.60E-01		8.40E-03			6.20E+00				TRS_472 (RV)		
V	23									2.00E-03					Sheppard et al. (2010b)
W	74										3.00E+00		PNNL-13421	NCRP86	
W	74										1.00E-02		NUREG/CR-5512		
Xe	54														
Y	39										1.00E-02		PNNL-13421	Ng82b	
Y	39										6.00E-02		NUREG/CR-5512		
Y	39									8.00E-04					Sheppard et al. (2010b)
Y	39	1				2.00E-03							TRS_472 (OV, RV)		
Yb	70									2.00E-03					Sheppard et al. (2010b)
Zn	30										3.50E-01		PNNL-13421	Fr89	
Zn	30										5.90E-01		NUREG/CR-5512		
Zn	30									1.70E-01					Sheppard et al. (2010b)

Table C.2. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	MED	95%ile	Document	Reference#	Reference
Zn	30	3	1.00E-01	9.50E-01					3.70E+00	4.20E-01			TRS_472 (OV)		
Zn	30	20	5.00E-02	6.30E-01					1.80E+00	3.00E-01			TRS_472 (RV)		
Zr	40										1.00E-04		PNNL-13421	Ng82b	
Zr	40										5.00E-04		NUREG/CR-5512		
Zr	40									1.40E-02					Sheppard et al. (2010b)
Zr	40	1				4.00E-03							TRS_472 (OV, RV)		

Table C.3. Bioconcentration in Fruit from Soil, $kg_{dry\_plant}/kg_{dry\_soil}$ (CLBVFR)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Ac	89											2.50E-04		PNNL-13421	Ba84	
Ac												3.53E-03		NUREG/CR-5512		
Ac	89															
Ag	47											8.00E-04		PNNL-13421	Fr82	
Ag	47									7.00E-02						Sheppard et al. (2010b)
Al	13					1.80E-04								Napier et al. (2012)		TRS_364
Al	13					1.00E-03		2.00E-03						Napier et al. (2012)		
Am	95											2.50E-04		PNNL-13421	Ba84	
Ar	18															
As	33					6.00E-03								Napier et al. (2012)		TRS_364
As	33					2.20E-01		2.50E-02						Napier et al. (2012)		
As	33											6.00E-03		PNNL-13421	Ba84	
As	33									4.00E-03						Sheppard et al. (2010b)
At	85															
Au	79											1.40E-02		PNNL-13421	g.m.	
Au	79											1.00E-01		NUREG/CR-5512		
Ba	56					5.00E-03								Napier et al. (2012)		TRS_472
Ba	56					1.50E-02								Napier et al. (2012)		TRS_364
Ba	56					3.00E-03		3.00E-03						Napier et al. (2012)		
Ba	56											1.50E-02		PNNL-13421	Ba84	
Ba	56									2.80E-02						Sheppard et al. (2010b)
Be	4											1.50E-03		PNNL-13421	Ba84	
Bi	83											5.00E-01		PNNL-13421	IAEA94	
Bk	97											2.50E-04		PNNL-13421	Ba84	
Br	35					1.50E+00								Napier et al. (2012)		TRS_364
Br	35					1.81E-01		1.69E-01						Napier et al. (2012)		
Br	35											1.50E+00		PNNL-13421	Fu78	
C	6											7.00E-01		PNNL-13421	Na88	
Ca	20					3.50E-01								Napier et al. (2012)		TRS_364
Ca	20					1.80E-01		1.34E-01						Napier et al. (2012)		
Ca	20											3.50E-01		PNNL-13421	Ba84	
Ca	20									1.30E-01						Sheppard et al. (2010b)
Cd	48											1.50E-01		PNNL-13421	Ba84	
Cd	48									2.10E-01						Sheppard et al. (2010b)
Ce	58					2.00E-02								Napier et al. (2012)		TRS_364
Ce	58					1.00E-03		1.00E-03						Napier et al. (2012)		
Ce	58											2.00E-02		PNNL-13421	Ng82b	
Ce	58											4.00E-03		NUREG/CR-5512		
Ce	58									2.10E-04						Sheppard et al. (2010b)
Cf	98											1.00E-02		NUREG/CR-5512		
Cl	17					7.00E+01								Napier et al. (2012)		TRS_364
Cl	17					3.94E+00		2.49E+00						Napier et al. (2012)		
Cl	17											7.00E+00		PNNL-13421	Ba84	
Cl	17									1.20E+01						Sheppard et al. (2010b)
Cm	96											1.50E-05		PNNL-13421	Ba84	
Co	27					1.40E-01								Napier et al. (2012)		TRS_472
Co	27					7.00E-03								Napier et al. (2012)		TRS_364
Co	27					6.00E-04		2.00E-03						Napier et al. (2012)		
Co	27					1.40E-01								Napier et al. (2012)		TRS_472
Co	27											7.00E-03		PNNL-13421	Ba84	

Table C.3. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Co	27									7.70E-03						Sheppard et al. (2010b)
Cr	24					1.00E-03								Napier et al. (2012)		TRS_472
Cr	24					4.50E-03								Napier et al. (2012)		TRS_364
Cr	24					1.10E-02		8.00E-03						Napier et al. (2012)		
Cr	24											4.30E-03		PNNL-13421	Ba84	
Cr	24									2.00E-03						Sheppard et al. (2010b)
Cs	55					2.10E-02								Napier et al. (2012)		TRS_472
Cs	55					2.20E-01								Napier et al. (2012)		TRS_364
Cs	55					2.00E-03		1.00E-03						Napier et al. (2012)		
Cs	55											2.20E-01		PNNL-13421	Fr89	
Cs	55		2.30E-03	9.50E-02												Al-Oudat et al. (2006)
Cs	55									5.40E-03						Sheppard et al. (2010b)
Cs	55		2.00E-02	6.00E-02												Velasco et al. (2012)
Cu	29											2.50E-01		PNNL-13421	Ba84	
Cu	29									2.70E-01						Sheppard et al. (2010b)
Dy	66											2.00E-02		PNNL-13421	Ng82b	
Dy	66											4.00E-03		NUREG/CR-5512		
Er	68											2.00E-02		PNNL-13421	Ng82b	
Er	68											4.00E-03		NUREG/CR-5512		
Es	99															
Eu	63					1.00E-03		1.00E-03						Napier et al. (2012)		
Eu	63					2.00E-02								Napier et al. (2012)		TRS_364
Eu	63											2.00E-02		PNNL-13421	Ng82b	
Eu	63											4.00E-03		NUREG/CR-5512		
F	9											6.00E-03			Ba84	
Fe	26					1.00E-03								Napier et al. (2012)		TRS_472
Fe	26					5.00E-02								Napier et al. (2012)		TRS_364
Fe	26					2.00E-03		5.00E-04						Napier et al. (2012)		
Fe	26											5.00E-02		PNNL-13421	CT83	
Fe	26											1.00E-03		NUREG/CR-5512		
Fm	100															
Fr	87															
Ga	31											4.00E-04		PNNL-13421	Ba84	
Gd	64											2.00E-02		PNNL-13421	Ng82b	
Gd	64											4.00E-03		NUREG/CR-5512		
Ge	32															
H	1															
Hf	72					1.00E-03								Napier et al. (2012)		TRS_364
Hf	72					1.00E-03		1.00E-03						Napier et al. (2012)		
Hf	72											1.00E-03		PNNL-13421	Ng82b	
Hf	72											8.50E-04		NUREG/CR-5512		
Hg	80											3.70E-01		PNNL-13421	g.m.	
Hg	80											2.00E-01		NUREG/CR-5512		
Ho	67											2.00E-02		PNNL-13421	Ng82b	
Ho	67											4.00E-03		NUREG/CR-5512		
I	53											2.00E-02		PNNL-13421	Sn94	
I	53											5.00E-02		NUREG/CR-5512		
In	49											4.00E-04		PNNL-13421	Fu78	

Table C.3. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Ir	77											1.50E-02		PNNL-13421	Ba84	
K	19					5.50E-01								Napier et al. (2012)		TRS_364
K	19					5.57E-01		2.99E-01						Napier et al. (2012)		
K	19											5.50E-01		PNNL-13421	Ba84	
K	19									1.20E-01						Sheppard et al. (2010b)
K	19		5.40E-01	1.02E+00												Velasco et al. (2012)
Kr	36															
La	57					6.00E-03								Napier et al. (2012)		TRS_472
La	57					4.00E-03								Napier et al. (2012)		TRS_364
La	57					1.00E-03		2.00E-04						Napier et al. (2012)		
La	57											4.00E-03		PNNL-13421	Ba84	
La	57									3.50E-04						Sheppard et al. (2010b)
Lu	71					2.00E-02								Napier et al. (2012)		TRS_364
Lu	71					2.00E-03		2.00E-03						Napier et al. (2012)		
Md	101															
Mg	12					5.50E-01								Napier et al. (2012)		TRS_364
Mg	12					1.33E-01		1.77E-01						Napier et al. (2012)		
Mg	12											5.50E-01		PNNL-13421	Ba84	
Mg	12									2.70E-01						Sheppard et al. (2010b)
Mn	25					3.10E-01								Napier et al. (2012)		TRS_472
Mn	25					5.00E-02								Napier et al. (2012)		TRS_364
Mn	25					2.30E-02		8.00E-03						Napier et al. (2012)		
Mn	25											5.00E-02		PNNL-13421	Ba84	
Mn	25									2.70E-02						Sheppard et al. (2010b)
Mn	25					3.90E+00								TRS_472		
Mo	42											5.00E-02		PNNL-13421	CT83	
Mo	42											6.00E-02		NUREG/CR-5512		
Mo	42									1.50E+00						Sheppard et al. (2010b)
N	7											3.00E-02		PNNL-13421	g.m	
Na	11					3.00E-02								Napier et al. (2012)		TRS_472
Na	11					3.00E-01								Napier et al. (2012)		TRS_364
Na	11					1.70E-02		1.10E-02						Napier et al. (2012)		
Na	11											3.00E-01		PNNL-13421	Ng82b	
Na	11											5.50E-02		NUREG/CR-5512		
Na	11									2.20E-01						Sheppard et al. (2010b)
Nb	41											2.50E-02		PNNL-13421	CT83	
Nb	41											5.30E-03		NUREG/CR-5512		
Nb	41									1.50E-03						Sheppard et al. (2010b)
Nd	60					9.00E-03		5.00E-03						Napier et al. (2012)		
Nd	60					2.00E-02								Napier et al. (2012)		TRS_364
Nd	60											2.00E-02		PNNL-13421	Ng82b	
Nd	60											4.00E-03		NUREG/CR-5512		
Nd	60									2.10E-04						Sheppard et al. (2010b)
Ne	10															
Ni	28					2.63E-01		8.90E-01						Napier et al. (2012)		
Ni	28					6.00E-02								Napier et al. (2012)		TRS_364
Ni	28											6.00E-02		PNNL-13421	Ba84	
Ni	28									2.90E-02						Sheppard et al. (2010b)
Np	93											1.00E-02		PNNL-13421	Ba84	
Np	93															

Table C.3. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
O	8															
OBT																
Os	76											4.50E-02		PNNL-13421	g.m.	
Os	76											3.50E-03		NUREG/CR-5512		
P	15											3.50E+00		PNNL-13421	Ba84	
Pa	91											2.50E-04		PNNL-13421	Ba84	
Pb	82											1.00E-02		PNNL-13421	Fr89	
Pb	82											9.00E-03		NUREG/CR-5512		
Pb	82									1.00E-03						Sheppard et al. (2010b)
Pd	46											4.00E-02		PNNL-13421	Ba84	
Pd	46		1.11E-01	1.00E+00		1.00E-02		5.96E-03								Vandenhove et al. (2009b)
Pm	61											2.00E-02		PNNL-13421	Ng82b	
Pm	61											4.00E-03		NUREG/CR-5512		
Po	84											1.20E-03		PNNL-13421	Ho91	
Po	84											4.00E-04		NUREG/CR-5512		
Pr	59											2.00E-02		PNNL-13421	Ng82b	
Pr	59											4.00E-03		NUREG/CR-5512		
Pr	59									3.20E-04						Sheppard et al. (2010b)
Pt	78															
Pu	94											4.50E-05		PNNL-13421	Ba84	
Ra	88											6.10E-03		PNNL-13421	Fr89	
Ra	88		1.39E-03	1.68E-01		2.69E-02		4.61E-02								Vandenhove et al. (2009b)
Rb	37					9.00E-01								Napier et al. (2012)		TRS_364
Rb	37					1.45E-01		5.30E-02						Napier et al. (2012)		
Rb	37											9.00E-01		PNNL-13421	Ng82b	
Rb	37											7.00E-02		NUREG/CR-5512		
Rb	37									3.60E-01						Sheppard et al. (2010b)
Re	75											3.50E-01		PNNL-13421	Ba84	
Rh	45											4.00E-02		PNNL-13421	Ba84	
Rn	86															
Ru	44											4.00E-02		PNNL-13421	Ng82b	
Ru	44											2.20E-02		NUREG/CR-5512		
S	16											1.50E+00		PNNL-13421	Ba84	
Sb	51					1.30E-04								Napier et al. (2012)		TRS_472
Sb	51					8.00E-05								Napier et al. (2012)		TRS_364
Sb	51					9.60E-02		6.10E-02						Napier et al. (2012)		
Sb	51											8.00E-05		PNNL-13421	IUR89	
Sb	51									5.50E-03						Sheppard et al. (2010b)
Sc	21					1.00E-03								Napier et al. (2012)		TRS_364
Sc	21					1.00E-03		0.00E+00						Napier et al. (2012)		
Sc	21											3.00E-03		PNNL-13421	Ba84	
Se	34											5.00E-02		PNNL-13421	CT83	
Se	34											2.50E-02		NUREG/CR-5512		
Se	34									3.80E-01						Sheppard et al. (2010b)
Si	14											7.00E-02		PNNL-13421	Ba84	
Sm	62					2.00E-02								Napier et al. (2012)		TRS_364
Sm	62					1.00E-03		1.00E-03						Napier et al. (2012)		
Sm	62											2.00E-02		PNNL-13421	Ng82b	
Sm	62											4.00E-03		NUREG/CR-5512		
Sm	62									2.00E-04						Sheppard et al. (2010b)

Table C.3. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Sn	50											6.00E-03		PNNL-13421	Fu78	
Sn	50									9.70E-01						Sheppard et al. (2010b)
Sr	38					3.60E-01								Napier et al. (2012)		TRS_472
Sr	38					2.00E-01								Napier et al. (2012)		TRS_364
Sr	38					6.80E-02		7.80E-02						Napier et al. (2012)		
Sr	38											2.00E-01		PNNL-13421	Fr82	
Sr	38											1.70E-01		NUREG/CR-5512		
Sr	38		8.00E-02	1.30E-01												Al-Oudat et al. (2006)
Sr	38									1.80E-01						Sheppard et al. (2010b)
Ta	73					2.50E-02								Napier et al. (2012)		TRS_364
Ta	73					1.00E-03		1.00E-03						Napier et al. (2012)		
Ta	73											2.50E-02		PNNL-13421	CT83	
Tb	65					2.00E-02								Napier et al. (2012)		TRS_364
Tb	65					2.00E-03		2.00E-03						Napier et al. (2012)		
Tb	65											2.00E-02		PNNL-13421	Ng82b	
Tb	65											4.00E-03		NUREG/CR-5512		
Tb	65									5.00E-04						Sheppard et al. (2010b)
Tc	43											1.50E+00		PNNL-13421	Ba84	
Te	52											4.00E-03		PNNL-13421	Ba84	
Th	90					7.80E-04								Napier et al. (2012)		TRS_472
Th	90					2.50E-04								Napier et al. (2012)		TRS_364
Th	90					7.00E-04		4.00E-04						Napier et al. (2012)		
Th	90											2.50E-04		PNNL-13421	Ba84	
Th	90											8.50E-05		NUREG/CR-5512		
Th	90									3.60E-03						Sheppard et al. (2010b)
Th	90		2.50E-03	1.00E-02		6.25E-03		5.30E-03								Vandenhove et al. (2009b)
Ti	22					5.40E-05								Napier et al. (2012)		TRS_364
Ti	22															
Tl	81											4.00E-04		PNNL-13421	Ba84	
Tl	81									1.20E-02						Sheppard et al. (2010b)
Tm	69															
U	92					1.50E-02								Napier et al. (2012)		TRS_472
U	92					4.00E-03								Napier et al. (2012)		TRS_364
U	92					5.00E-03		6.00E-03						Napier et al. (2012)		
U	92											4.00E-03		PNNL-13421	Ba84	
U	92									7.00E-04						Sheppard et al. (2010b)
U	92		1.29E-03	3.73E-01		5.72E-02		1.15E-01								Vandenhove et al. (2009b)
V	23					1.30E-03								Napier et al. (2012)		TRS_364
V	23					7.00E-03		1.00E-02						Napier et al. (2012)		
V	23															
V	23									4.00E-04						Sheppard et al. (2010b)
W	74											3.00E+00		PNNL-13421	NCRP96	
W	74											1.00E-02		NUREG/CR-5512		
Xe	54															
Y	39											2.00E-02		PNNL-13421	Ng82b	
Y	39											6.00E-03		NUREG/CR-5512		
Y	39									3.60E-04						Sheppard et al. (2010b)
Yb	70					2.00E-02								Napier et al. (2012)		TRS_364
Yb	70					5.00E-03		5.00E-03						Napier et al. (2012)		
Yb	70									1.00E-03						Sheppard et al. (2010b)

Table C.3. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	95%ile	Document	Reference#	Reference
Zn	30					4.20E-01								Napier et al. (2012)		TRS_472
Zn	30					9.00E-01								Napier et al. (2012)		TRS_364
Zn	30					1.37E-01		6.20E-02						Napier et al. (2012)		
Zn	30											9.00E-01		PNNL-13421	Ba84	
Zn	30									2.30E-01						Sheppard et al. (2010b)
Zr	40					4.00E-03		8.00E-03						Napier et al. (2012)		
Zr	40					4.00E-03								Napier et al. (2012)		TRS_472
Zr	40					1.00E-03								Napier et al. (2012)		TRS_364
Zr	40											1.00E-03		PNNL-13421	Ng82b	
Zr	40											5.00E-04		NUREG/CR-5512		
Zr	40									1.20E-02						Sheppard et al. (2010b)

Table C.4. Bioaccumulation in Dry Grain (Feed or Food Crop) from Soil, $kg_{dry\_plant}/kg_{dry\_soil}$

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	Document	Reference#	Reference
Ac	89											3.40E-04	NUREG/CR-5512		
Ac	89											2.20E-05	PNNL-13421	Fr82	
Ag	47											1.00E-01	NUREG/CR-5512		
Ag	47											2.50E-01	PNNL-13421	Ba84	
Ag	47									3.90E-02					Sheppard et al. (2010b)
Al	13					1.80E-04							Napier et al. (2012)		TRS_364
Al	13					4.00E-03		2.00E-03					Napier et al. (2012)		
Am	95		3.00E-07	1.00E-03								1.00E-05	Coughtrey et al. (1985)	S2.1, T2.1	
Am	95											2.20E-05	PNNL-13421	Fr82	
Am	95									2.30E-03					Uchida et al. (2009)
Am	95	83	7.40E+07	3.40E-02					1.10E+01	2.20E-05			TRS_472		
As	33					6.00E-03							Napier et al. (2012)		TRS_364
As	33					1.90E-02		6.00E-03					Napier et al. (2012)		
As	33											6.00E-03	PNNL-13421	Ba84	
As	33									2.70E-02					Sheppard et al. (2010b)
As	33									7.10E-03					Uchida et al. (2009)
As	33									9.20E-03					Uchida et al. (2009)
Au	79											1.00E-01	NUREG/CR-5512		
Au	79											2.50E-01	PNNL-13421	Ba84	
Ba	56					1.50E-02							Napier et al. (2012)		TRS_364
Ba	56					1.00E-03							Napier et al. (2012)		TRS_472
Ba	56					5.00E-03		2.00E-03					Napier et al. (2012)		
Ba	56											1.50E-02	PNNL-13421	Ba84	
Ba	56									2.60E-02					Sheppard et al. (2010b)
Ba	56									3.90E-04					Uchida et al. (2009)
Ba	56	1				1.00E-03							TRS_472		
Be	4											1.50E-03	NUREG/CR-5512		
Be	4											3.00E-03	PNNL-13421	g.m.	
Be	4									1.80E-03					Uchida et al. (2009)
Bi	83											5.00E-01	PNNL-13421	IAEA82	
Br	35					1.50E+00							Napier et al. (2012)		TRS_364
Br	35					1.06E+00		3.01E-01					Napier et al. (2012)		
Br	35		1.00E-02	1.57E+01									Coughtrey et al. (1985)	S2.1	
Br	35											1.50E+00	PNNL-13421	Fu78	
C	6											7.00E-01	PNNL-13421	Na88	
Ca	20					3.50E-01							Napier et al. (2012)		TRS_364
Ca	20					2.00E+01							Napier et al. (2012)		TRS_472
Ca	20					1.08E-01		3.10E-02					Napier et al. (2012)		
Ca	20											3.50E-01	PNNL-13421	Ba84	
Ca	20									4.80E-02					Sheppard et al. (2010b)
Ca	20									4.10E-03					Uchida et al. (2009)
Ca	20									8.80E-03					Uchida et al. (2009)
Ca	20	6	2.30E+00	3.80E+01					3.70E+00	8.70E+00			TRS_472		
Cd	48											1.50E-01	PNNL-13421	Ba84	
Cd	48									1.20E-01					Sheppard et al. (2010b)
Cd	48									9.10E-02					Uchida et al. (2009)
Cd	48									9.40E-02					Uchida et al. (2009)
Cd	48	11	1.40E-01	2.9					2.70E+00	8.80E-01			TRS_472		
Ce	58					2.00E-02							Napier et al. (2012)		TRS_364
Ce	58					3.00E-03							Napier et al. (2012)		TRS_472

Table C.4. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	Document	Reference#	Reference
Ce	58					2.00E-03							Napier et al. (2012)		
Ce	58											4.00E-03	NUREG/CR-5512		
Ce	58											2.00E-02	PNNL-13421	Ng82b	
Ce	58									1.60E-04					Sheppard et al. (2010b)
Ce	58									3.30E-05					Uchida et al. (2009)
Ce	58	20	2.40E-04	2.00E-02					3.70E+00	3.10E-03			TRS_472		
Cf	98											1.00E-02	NUREG/CR-5512		
Cf	98											2.20E-05	PNNL-13421	Fr82	
Cl	17					7.00E+01							Napier et al. (2012)		TRS_364
Cl	17					1.16E+01		2.61E+03					Napier et al. (2012)		
Cl	17											7.00E+00	PNNL-13421	Ba84	
Cl	17									3.20E+00					Sheppard et al. (2010b)
Cm	96											2.10E-05	PNNL-13421	Fr82	
Cm	96	67	1.40E-06	2.00E-04					3.30E+00	2.30E-05			TRS_472		
Co	27					3.70E-03							Napier et al. (2012)		TRS_364
Co	27					8.50E-03							Napier et al. (2012)		TRS_472
Co	27					2.20E-02		2.00E-03					Napier et al. (2012)		
Co	27											3.70E-03	PNNL-13421	Fr89	
Co	27									1.60E-03					Sheppard et al. (2010b)
Co	27									4.60E-04					Uchida et al. (2009)
Co	27									9.30E-04					Uchida et al. (2009)
Co	27	61	4.00E-04	7.20E-01					5.50E+00	8.50E-03			TRS_472		
Cr	24					4.50E-03							Napier et al. (2012)		TRS_364
Cr	24					2.00E-04							Napier et al. (2012)		TRS_472
Cr	24					2.50E-02		6.00E-03					Napier et al. (2012)		
Cr	24											4.50E-03	PNNL-13421	Ba84	
Cr	24									4.00E-03					Sheppard et al. (2010b)
Cr	24									1.50E-03					Uchida et al. (2009)
Cr	24									2.00E-03					Uchida et al. (2009)
Cr	24	1				2.00E-04							TRS_472		
Cs	55					2.60E-01							Napier et al. (2012)		TRS_364
Cs	55					2.90E-02							Napier et al. (2012)		TRS_472
Cs	55					3.00E-03		1.00E-03					Napier et al. (2012)		
Cs	55		3.00E-03	1.00E+00								5.00E-02	Coughtrey et al. (1985)	S2.1	
Cs	55											2.60E-01	PNNL-13421	Fr82	
Cs	55											0.28			Mollah et al. (1998)
Cs	55									2.80E-03					Sheppard et al. (2010b)
Cs	55									6.00E-04					Uchida et al. (2009)
Cs	55									9.40E-04					Uchida et al. (2009)
Cs	55	470	2.00E-04	9.00E-01					4.00E+00	2.90E-02			TRS_472		
Cu	29											2.50E-01	PNNL-13421	Ba84	
Cu	29									2.00E-01					Sheppard et al. (2010b)
Cu	29									8.80E-02					Uchida et al. (2009)
Cu	29									1.00E-01					Uchida et al. (2009)
Dy	66											4.00E-03	NUREG/CR-5512		
Dy	66											2.00E-02	PNNL-13421	Ng82b	
Er	68											4.00E-03	NUREG/CR-5512		
Er	68											2.00E-02	PNNL-13421	Ng82b	
Eu	63					2.00E-02							Napier et al. (2012)		TRS_364
Eu	63					2.00E-03		1.00E-03					Napier et al. (2012)		

Table C.4. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	Document	Reference#	Reference
Eu	63											4.00E-03	NUREG/CR-5512		
Eu	63											2.00E-02	PNNL-13421	Ng82b	
Eu	63									3.10E-04					Uchida et al. (2009)
Eu	63									2.60E-04					Uchida et al. (2009)
F	9											6.00E-03	NUREG/CR-5512		
Fe	26					5.00E-02							Napier et al. (2012)		TRS_364
Fe	26					2.00E-04							Napier et al. (2012)		TRS_472
Fe	26					4.00E-03							Napier et al. (2012)		
Fe	26											1.00E-03	NUREG/CR-5512		
Fe	26											5.00E-02	PNNL-13421	CT83	
Fe	26									9.80E-05					Uchida et al. (2009)
Fe	26									2.90E-04					Uchida et al. (2009)
Fe	26	1				2.20E-04							TRS_472		
Ga	31											4.00E-04	PNNL-13421	Ba84	
Gd	64											4.00E-03	NUREG/CR-5512		
Gd	64											2.00E-02	PNNL-13421	Ng82b	
Hf	72					1.00E-03							Napier et al. (2012)		TRS_364
Hf	72					2.00E-03		1.00E-03					Napier et al. (2012)		
Hf	72											8.50E-04	NUREG/CR-5512		
Hf	72											3.00E-03	PNNL-13421	Ng82b	
Hg	80											2.00E-01	NUREG/CR-5512		
Hg	80											4.90E-01	PNNL-13421	g.m.	
Ho	67											4.00E-03	NUREG/CR-5512		
Ho	67											2.00E-02	PNNL-13421	Ng82b	
Ho	67									4.00E-04					Uchida et al. (2009)
Ho	67									1.80E-04					Uchida et al. (2009)
I	53											5.00E-02	NUREG/CR-5512		
I	53											4.00E-02	PNNL-13421	Sn94	
I	53									2.00E-03					Uchida et al. (2009)
I	53									5.00E-03					Uchida et al. (2009)
I	53									4.90E-03					Uchida and Tagami (2011)
In	49											4.00E-04	PNNL-13421	Fu78	
Ir	77											1.50E-02	PNNL-13421	Ba84	
K	19					5.50E-01							Napier et al. (2012)		TRS_364
K	19					7.40E-01							Napier et al. (2012)		TRS_472
K	19					2.78E-01		7.10E-02					Napier et al. (2012)		
K	19											5.50E+00	PNNL-13421	Ba84	
K	19									1.80E+00					Sheppard et al. (2010b)
K	19									6.20E-02					Uchida et al. (2009)
K	19									2.20E-01					Uchida et al. (2009)
K	19	2	7.30E-01	7.40E-01		7.40E-01							TRS_472		
La	57					4.00E-03							Napier et al. (2012)		TRS_364
La	57					2.00E-05							Napier et al. (2012)		TRS_472
La	57					2.00E-03							Napier et al. (2012)		
La	57											4.00E-03	PNNL-13421	Ba84	
La	57									2.10E-04					Sheppard et al. (2010b)
La	57									3.50E-05					Uchida et al. (2009)
La	57									4.90E-05					Uchida et al. (2009)
La	57	1				2.00E-05							TRS_472		
Lu	71					2.00E-02							Napier et al. (2012)		TRS_364
Lu	71					4.00E-04		1.00E-03					Napier et al. (2012)		

Table C.4. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	Document	Reference#	Reference
Mg	12					5.50E-01							Napier et al. (2012)		TRS_364
Mg	12					2.31E-01		1.13E-01					Napier et al. (2012)		
Mg	12											5.50E-01	PNNL-13421	Ba84	
Mg	12									1.90E-01					Sheppard et al. (2010b)
Mn	25					3.00E-01							Napier et al. (2012)		TRS_364
Mn	25					2.80E-01							Napier et al. (2012)		TRS_472
Mn	25					1.49E-01		1.90E-02					Napier et al. (2012)		
Mn	25											2.90E-01	NUREG/CR-5512		
Mn	25											3.00E-01	PNNL-13421	IAEA94	
Mn	25									4.50E-02					Sheppard et al. (2010b)
Mn	25									1.50E-02					Uchida et al. (2009)
Mn	25									4.60E-02					Uchida et al. (2009)
Mn	25	78	1.40E-02	2.70E+00					3.30E+00	2.80E-01			TRS_472		
Mo	42											6.00E-02	NUREG/CR-5512		
Mo	42											8.00E-01	PNNL-13421	Ng82b	
Mo	42									1.00E+00					Sheppard et al. (2010b)
Mo	42									7.40E-01					Uchida et al. (2009)
Mo	42									7.50E-01					Uchida et al. (2009)
Mo	42	1				8.00E-01							TRS_472		
N	7											3.00E+01	NUREG/CR-5512		
N	7											1.30E-01	PNNL-13421	g.m.	
Na	11					3.00E-01							Napier et al. (2012)		TRS_364
Na	11					1.00E-02							Napier et al. (2012)		TRS_472
Na	11					4.40E-02		1.00E-02					Napier et al. (2012)		
Na	11											5.50E-02	NUREG/CR-5512		
Na	11											3.00E-01	PNNL-13421	Ng82b	
Na	11									4.00E-02					Sheppard et al. (2010b)
Na	11									6.90E-04					Uchida et al. (2009)
Na	11									9.80E-04					Uchida et al. (2009)
Na	11	1				1.00E-02							TRS_472		
Nb	41											2.50E-02	PNNL-13421	CT83	
Nb	41									1.50E-03					Sheppard et al. (2010b)
Nb	41	2	2.00E-03	2.50E-02		1.40E-02							TRS_472		
Nd	60					2.00E-02							Napier et al. (2012)		TRS_364
Nd	60					1.20E-02		3.00E-03					Napier et al. (2012)		
Nd	60											4.00E-03	NUREG/CR-5512		
Nd	60											2.00E-02	PNNL-13421	Ng82b	
Nd	60									1.00E-04					Sheppard et al. (2010b)
Nd	60									3.00E-05					Uchida et al. (2009)
Nd	60									5.00E-05					Uchida et al. (2009)
Ni	28					3.00E-02							Napier et al. (2012)		TRS_364
Ni	28					2.70E-02							Napier et al. (2012)		TRS_472
Ni	28					3.09E-01		5.02E-01					Napier et al. (2012)		
Ni	28											3.00E-02	PNNL-13421	Fr89	
Ni	28									1.70E-02					Sheppard et al. (2010b)
Ni	28		0.0031	0.75		0.0881			3.49	4.12E-02					Vandenhove et al. (2009a)
Ni	28									1.40E-02					Uchida et al. (2009)
Ni	28									1.30E-02					Uchida et al. (2009)
Ni	28	44	3.10E-03	1.70E-01					2.70E+00	2.70E-02			TRS_472		
Np	93											2.70E-03	PNNL-13421	Fr82	
Np	93	85	2.30E-05	7.10E-02					5.00E+00	2.90E-03			TRS_472		

Table C.4. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	Document	Reference#	Reference
O	8											6.00E-03	PNNL-13421	Ba84	
Os	76											3.50E-03	PNNL-13421	Ba84	
P	15											3.50E+00	PNNL-13421	Ba84	
P	15	1				2.00E-01							TRS_472		
Pa	91											2.50E-04	NUREG/CR-5512		
Pa	91											2.20E-05	PNNL-13421	Fr82	
Pb	82											4.70E-03	PNNL-13421	Fr89	
Pb	82									2.50E-04					Uchida et al. (2009)
Pb	82									3.30E-05					Uchida et al. (2009)
Pb	82		5.2 E-04	4.80E-02		1.13E-02		1.41E-02							Vandenhove et al. (2009b)
Pb	82	9	1.90E-03	4.80E-02					3.60E+00	1.10E-02			TRS_472		
Pd	46											4.00E-02	PNNL-13421	Ba84	
Pd	46									2.20E-03					Sheppard et al. (2010b)
Pm	61											4.00E-03	NUREG/CR-5512		
Pm	61											2.00E-02	PNNL-13421	Ng82b	
Pm	61	17	1.70E-03	2.40E-01					6.00E+00	1.40E-02			TRS_472		
Po	84											4.00E-04	NUREG/CR-5512		
Po	84											2.30E-03	PNNL-13421	Ho91	
Po	84		0.000018	0.0168		0.00356		0.00743							Vandenhove et al. (2009b)
Po	84	2	2.20E-04	2.60E-04		2.40E-04							TRS_472		
Pr	59											2.00E-02	PNNL-13421	Ng82b	
Pr	59									2.30E-04					Sheppard et al. (2010b)
Pr	59									1.10E-04					Uchida et al. (2009)
Pr	59									6.40E-05					Uchida et al. (2009)
Pr	59	1				2.00E-02							TRS_472		
Pu	94											2.60E-05	NUREG/CR-5512		
Pu	94											8.60E-05	PNNL-13421	Fr82	
Pu	94									1.30E-03					Uchida et al. (2009)
Pu	94	105	2.00E-07	1.10E-03					6.70E+00	9.50E-06			TRS_472		
Ra	88											1.20E-03	PNNL-13421	Fr89	
Ra	88									4.70E-04					Uchida et al. (2009)
Ra	88									9.10E-04					Uchida et al. (2009)
Ra	88		0.00008	0.666		0.0641		0.131							Vandenhove et al. (2009b)
Ra	88	24	8.00E-05	6.70E-01					1.20E+01	1.70E-02			TRS_472		
Rb	37					9.00E-01							Napier et al. (2012)		TRS_364
Rb	37					9.00E-01							Napier et al. (2012)		TRS_472
Rb	37					5.20E-02		9.00E-03					Napier et al. (2012)		
Rb	37											7.00E-02	NUREG/CR-5512		
Rb	37											9.00E-01	PNNL-13421	Ng82b	
Rb	37									1.60E-01					Sheppard et al. (2010b)
Rb	37									5.60E-02					Uchida et al. (2009)
Rb	37									1.20E-01					Uchida et al. (2009)
Rb	37	1				9.00E-01							TRS_472		
Re	75											3.50E-01	PNNL-13421	Ba84	
Rh	45											4.00E-02	PNNL-13421	Ba84	
Ru	44											5.00E-03	PNNL-13421	Fr89	
Ru	44	12	6.00E-04	1.00E+02					2.60E+00	3.00E-03			TRS_472		
S	16											1.50E+00	PNNL-13421	Ba84	
Sb	51					3.00E-02							Napier et al. (2012)		TRS_364
Sb	51					1.80E-03							Napier et al. (2012)		TRS_472
Sb	51					4.30E-02		1.40E-02					Napier et al. (2012)		
Sb	51											3.00E-02	NUREG/CR-5512		

Table C.4. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	Document	Reference#	Reference
Sb	51		7.00E-03	1.10E-01								5.00E-02	Coughtrey et al. (1985)	S2.1	
Sb	51											3.00E-02	PNNL-13421	Fu78	
Sb	51									3.30E-03					Sheppard et al. (2010b)
Sb	51	24	3.00E-04	9.00E-03					2.70E+00	1.80E-03			TRS_472		
Sc	21					1.00E-03							Napier et al. (2012)		TRS_364
Sc	21					3.00E-03							Napier et al. (2012)		
Sc	21											1.00E-03	PNNL-13421	Ba84	
Se	34											2.50E-02	NUREG/CR-5512		
Se	34											2.50E-01	PNNL-13421	CT83	
Se	34									1.60E+00					Sheppard et al. (2010b)
Se	34									5.40E-02					Uchida et al. (2009)
Se	34									6.70E-02					Uchida et al. (2009)
Si	14											7.00E-02	PNNL-13421	Ba84	
Sm	62					2.00E-02							Napier et al. (2012)		TRS_364
Sm	62					2.00E-03							Napier et al. (2012)		
Sm	62											4.00E-03	NUREG/CR-5512		
Sm	62											2.00E-02	PNNL-13421	Ng82b	
Sm	62									1.10E-04					Sheppard et al. (2010b)
Sn	50											6.00E-03	PNNL-13421	Fu78	
Sn	50									1.40E-01					Sheppard et al. (2010b)
Sn	50									5.60E-03					Uchida et al. (2009)
Sn	50									6.40E-03					Uchida et al. (2009)
Sr	38					2.10E-01							Napier et al. (2012)		TRS_364
Sr	38					1.10E-01							Napier et al. (2012)		TRS_472
Sr	38					4.90E-02		2.10E-02					Napier et al. (2012)		
Sr	38											1.30E-01	NUREG/CR-5512		
Sr	38											2.10E-01	PNNL-13421	Fr82	
Sr	38									7.00E-02					Sheppard et al. (2010b)
Sr	38											0.82			Mollah et al. (1998)
Sr	38									1.00E-03					Uchida et al. (2009)
Sr	38									3.00E-03					Uchida et al. (2009)
Sr	38	282	3.60E-03	1.00E+00					2.70E+00	1.10E-01			TRS_472		
Ta	73					2.50E-02							Napier et al. (2012)		TRS_364
Ta	65					2.00E-02							Napier et al. (2012)		TRS_364
Ta	73					2.00E-03		1.00E-03					Napier et al. (2012)		
Ta	73											2.50E-03	NUREG/CR-5512		
Ta	73											2.50E-02	PNNL-13421	CT83	
Tb	65					3.00E-03		1.00E-03					Napier et al. (2012)		
Tb	65											4.00E-03	NUREG/CR-5512		
Tb	65											2.00E-02	PNNL-13421	Ng82b	
Tb	65									4.00E-04					Sheppard et al. (2010b)
Tc	43											7.30E-01	PNNL-13421	Fr89	
Tc	43									2.00E-04					Uchida et al. (2009)
Te	52											4.00E-03	PNNL-13421	Ba84	
Te	52	1				1.00E+01							TRS_472		
Th	90					3.40E-05							Napier et al. (2012)		TRS_364
Th	90					2.10E-03							Napier et al. (2012)		TRS_472
Th	90					2.00E-03							Napier et al. (2012)		
Th	90											3.40E-05	PNNL-13421	IUR89	
Th	90									9.00E-03					Sheppard et al. (2010b)
Th	90									1.70E-04					Uchida et al. (2009)
Th	90									1.40E-04					Uchida et al. (2009)

Table C.4. (contd)

Element	Atomic#	N	Min	Max	AVG	Mean	Wmean	STD	GSD	GM	WGM	MED	Document	Reference#	Reference
Th	90		1.24E-06	2.24E-02		2.81E-03		4.20E-03							Vandenhove et al. (2009b)
Th	90	36	1.60E-04	2.20E-02					3.40E+00	2.10E-03			TRS_472		
Ti	22					5.40E-05							Napier et al. (2012)		TRS_364
Ti	22					0.00E+00							Napier et al. (2012)		
Tl	81											4.00E-04	PNNL-13421	Ba84	
Tl	81									5.50E-02					Sheppard et al. (2010b)
U	92					1.30E-03							Napier et al. (2012)		TRS_364
U	92					6.20E-03							Napier et al. (2012)		TRS_472
U	92					1.00E-02		5.00E-03					Napier et al. (2012)		
U	92											1.30E-03	PNNL-13421	Bi91	
U	92									1.10E-03					Sheppard et al. (2010b)
U	92									1.90E-04					Uchida et al. (2009)
U	92									2.80E-04					Uchida et al. (2009)
U	92		1.60E-04	9.64E-01		5.37E-02		1.67E-01							Vandenhove et al. (2009b)
U	92	59	1.60E-04	8.20E-01					7.70E+00	6.20E-03			TRS_472		
V	23					1.30E-03							Napier et al. (2012)		TRS_364
V	23					1.00E-02		5.00E-03					Napier et al. (2012)		
V	23									1.30E-03					Sheppard et al. (2010b)
W	74											1.00E-02	NUREG/CR-5512		
W	74											3.00E+00	PNNL-13421	NCRP96	
Y	39											1.00E-02	PNNL-13421	Ng82b	
Y	39									2.10E-04					Sheppard et al. (2010b)
Y	39	5								5.00E-04			TRS_472		
Yb	70					2.00E-02							Napier et al. (2012)		TRS_364
Yb	70					1.10E-02		4.00E-03					Napier et al. (2012)		
Yb	70									8.00E-04					Sheppard et al. (2010b)
Zn	30					1.60E+00							Napier et al. (2012)		TRS_364
Zn	30					1.80E+00							Napier et al. (2012)		TRS_472
Zn	30					2.11E-01		3.80E-02					Napier et al. (2012)		
Zn	30											1.30E+00	NUREG/CR-5512		
Zn	30											1.60E+00	PNNL-13421	Fr89	
Zn	30									3.70E-01					Sheppard et al. (2010b)
Zn	30									2.00E-01					Uchida et al. (2009)
Zn	30									2.40E-01					Uchida et al. (2009)
Zn	30	86	2.00E-02	1.40E+01					2.70E+00	1.80E+00			TRS_472		
Zr	40					1.00E-03							Napier et al. (2012)		TRS_364
Zr	40	1				1.00E-03							Napier et al. (2012)		TRS_472
Zr	40					5.00E-03		4.00E-03					Napier et al. (2012)		
Zr	40											5.00E-04	NUREG/CR-5512		
Zr	40											1.00E-03	PNNL-13421	Ng82b	
Zr	40									7.00E-03					Sheppard et al. (2010b)

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S2.1

S2.2

T2.1

T2.3

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TRS_472

OV = specifically, an “other vegetable” value, but Gv2 combines other and root vegetables in modeling.

RV = specifically, a “root vegetable” value, but Gv2 combines other and root vegetables in modeling.

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Appendix D

Food Categories

Appendix D

Food Categories

An extensive list of crop groups is listed in 40 CFR 180, Tolerances and Exemptions for Pesticide Chemical Residues in Food, Subpart B – Procedural Regulations (180.41 Crop group tables). This list was used simply because of its broad coverage of various crop types in an established manner. By no means does its use imply that the Gv2 code is useable for environmental modeling of pesticides.

The crop listing tabulated here indicates the crop group, subgroups, and examples, then indicates the Gv2 food type that would best model the members of the group. In some cases, Gv2 models do not adequately model the crop group.

There are several crops intentionally not listed; they are shown at the end of the table.

Table D.1. [caption]

Crop Group-Subgroup	Name	Examples Included in This Group	Corresponding GENIIv2 Food or Feed Category
1	Root and tuber vegetables		
1A	Root vegetable subgroup	Carrot, radish, sugar beet, garden beet, edible burdock, ginseng, horseradish, parsnip, rutabaga, turnip.	Root/other vegetables
1B	Root vegetables (except sugar beet) subgroup	See 1-1A, but exclude sugar beet.	Root/other vegetables
1C	Tuberous and corm vegetables subgroup	Potato, Jerusalem artichoke, cassava, ginger, sweet potato, yam.	Root/other vegetables
1D	Tuberous and corm vegetables (except potato) subgroup	See 1-1C, but exclude potato.	Root/other vegetables
2	Leaves of Root and tuber vegetables (food or feed crops)		
2	<no subgroups>	Sugar or garden beet leaves, carrot leaves, turnip leaves, radish leaves.	Leafy vegetables
3	Bulb vegetables (Allium spp)		
3-07A	Onion, bulb, subgroup	Garlic bulb, onion bulb, pearl onion bulb, shallot bulb.	Root/other vegetables
3-07B	Onion, green, subgroup	Chive leaves, leek, green onions, shallot leaves.	Leafy vegetables for air pathways; root/other vegetables for water pathways
4	Leafy vegetables (except Brassica vegetables)		
4A	Leafy greens subgroup	Head lettuce, leaf lettuce, spinach, garden cress, dandelion, dock, endive, parsley, radicchio, New Zealand spinach, vine spinach.	Leafy vegetables
4B	Leafy petioles subgroup	Celery, rhubarb, Swiss chard.	Leafy vegetables
5	Brassica (cole) leafy vegetables		
5A	Head and stem brassica group	Broccoli, cauliflower, cabbage, Chinese mustard, kohlrabi, Brussels sprouts.	Leafy vegetables
5B	Leafy brassica greens subgroup	Broccoli raab, bok choy, collards, kale, mustard greens, rape greens.	Leafy vegetables

Table D.1. (contd)

Crop Group-Subgroup	Name	Examples Included in This Group	Corresponding GENIIv2 Food or Feed Category
6	Legume vegetables (succulent or dried)		
6A	Edible-podded legume vegetables subgroup	Snap bean, wax bean, yardlong bean, edible-pod pea, snow pea, sugar-snap pea, immature seed of soybean.	Root/other vegetables
6B	Succulent shelled pea and bean subgroup	Lima bean, fresh broad bean, fresh black-eyed pea, freah green pea.	Root/other vegetables
6C	Dried shelled pea (except soybean) subgroup	Dried field bean, dried kidney bean, dried navy bean, dried pinto bean, dried black-eyed pea, mung bean, chickpea, lentil.	Root/other vegetables
7	Foliage of legume vegetables		
7A	Foliage of legume vegetables (except soybeans) subgroup	ANIMAL FEED ONLY – plant parts of any legume vegetable (except soybeans) included in Group 6 that will be used as animal feed.	Meat animal forage, milk animal forage, meat animal feed, milk animal feed.
8	Fruiting vegetables (except cucurbits)		
8-10A	Tomato subgroup	Standard sized tomato, bush tomato, garden huckleberry, sunberry, tomatillo, tree tomato.	Root/other vegetables
8-10B	Pepper/eggplant subgroup	African eggplant, bell pepper, nonbell pepper.	Root/other vegetables
8-10C	Nonbell pepper/eggplant subgroup	Okra.	Root/other vegetables
9	Cucurbit vegetables		
9A	Melon subgroup	Cantaloupe, citron melon, muskmelon, watermelon, honeydew melon.	Root/other vegetables
9B	Squash/cucumber subgroup	Cucumber, gherkin, hubbard squash, zucchini, pumpkin, summer squash, winter squash, chayote fruit.	Root/other vegetables
10	Citrus fruits (citrus spp., Fortunella spp.)		
10-10A	Orange subgroup	Sweet orange, sour orange, mandarin orange, tangerine, tangelo.	Fruit
10-10B	Lemon/lime subgroup	Lime, lemon, kumquat.	Fruit
10-10C	Grapefruit subgroup	Grapefruit, pummelo.	Fruit
11	Pome fruits		
11-10	Pome fruits	Apple, crabapple, pear, quince.	Fruit

Table D.1. (contd)

Crop Group-Subgroup	Name	Examples Included in This Group	Corresponding GENIIv2 Food or Feed Category
12	Stone fruits		
12	<no subgroups>	Apricot, sweet cherry, tart cherry, nectarine, peach, plum, fresh prune.	Fruit
13	Berries		
13A	Caneberry subgroup	Blackberry, loganberry, raspberry.	Root/other vegetables
13B	Bushberry subgroup	Blueberry, currant, elderberry, gooseberry, huckleberry.	Root/other vegetables
13-07	Berry and small fruits		
13-07A	Caneberry subgroup	Blackberry, loganberry, raspberry.	Root/other vegetables
13-07B	Bushberry subgroup	Blueberry, currant, elderberry, gooseberry, huckleberry, edible honeysuckle, lignonberry.	Root/other vegetables
13-07C	Large shrub/tree berry subgroup	Bayberry, chokecherry, mulberry	Root/other vegetables OR Fruit
13-07D	Small fruit vine climbing subgroup	Grape, fuzzy kiwifruit.	Root/other vegetables OR Fruit
13-07E	Small fruit vine climbing subgroup (except grape)	See 13-07D, but exclude grape.	Root/other vegetables OR Fruit
13-07F	Small fruit vine climbing subgroup (except kiwifruit)	See 13-07D, but exclude kiwifruit.	Root/other vegetables OR Fruit
13-07G	Low growing berry subgroup	Strawberry, cranberry, lingonberry.	Root/other vegetables
13-07H	Low growing berry subgroup (except strawberry)	See 13-07G, but exclude strawberry.	Root/other vegetables
14	Tree nuts		
14	<no subgroups>	almond, beech nut, brazil nut, cashew, chestnut, chinquapin, filber (hazelnut), hickory nut, macadamia (bush) nut, pecan, walnut	<not adequately addressed with Gv2.10>
15	Cereal grains		
15	<no subgroups>	barley, buckwheat, corn, millet, oats, popcorn, rice, rye, sorghum, triticale, wheat, wild rice.	Grain, milk animal feed, meat animal feed, poultry feed, egg feed.
16	Forage, fodder, and straw of cereal grains		
16	<no subgroups>	ANIMAL FEED ONLY – non-grain portion of group 15.	Meat animal forage, Milk animal forage, Meat animal feed, Milk animal feed.

Table D.1. (contd)

Crop Group-Subgroup	Name	Examples Included in This Group	Corresponding GENIIv2 Food or Feed Category
17	Grass forage, fodder, and hay		
17	<no subgroups>	ANIMAL FEED ONLY – Bermuda grass, bluegrass, bromegrass, fescue. Any grass (green or cured) except sugarcane and those included in the cereal grains group that will be fed to or grazed by livestock. All pasture and range grasses grown for hay or silage.	Milk animal feed, milk animal forage, meat animal feed, meat animal forage, poultry feed, egg feed.
18	Nongrass animal feeds (forage, fodder, straw, and hay)		
18	<no subgroups>	ANIMAL FEED ONLY – alfalfa, clover, kudzu, trefoil, vetch.	Milk animal feed, milk animal forage, meat animal feed, meat animal forage, poultry feed, egg feed.
19	Herbs and spices		
19A	Herb subgroup	basil, camomile, catnip, chive, dillweed, lavender, lemongrass, bay, rosemary, parsley, thyme, sage.	Leafy vegetables
19B	Spice subgroup	Allspice, anise seed, caper buds, cumin, mustard seed, nutmeg, saffron, vanilla.	Leafy vegetables OR root/other vegetables.
20	Oilseeds		
20A	Rapeseed subgroup	Rapeseed and canola varieties, flax seed, poppy seed, sesame.	<not adequately addressed with Gv2.10>
20B	Sunflower subgroup	Castor oil plant, euphorbia, rose hip, safflower, sunflower, tea oil plant.	<not adequately addressed with Gv2.10>
20C	Cottonseed subgroup	Cottonseed varieties.	<not adequately addressed with Gv2.10>
21	Edible fungi		
21	<no subgroups>	White button mushroom, oyster mushroom, shiitake mushroom, truffle, morel.	<not adequately addressed with Gv2.10>
INTENTIONALLY NOT LISTED in 40 CFR 180			
NA	NA	Asparagus, hops	Leafy vegetable
NA	NA	Avocado, fig, mango, papaya, pawpaw, persimmon	Fruit
NA	NA	Globe artichoke	Root/other vegetable

Table D.1. (contd)

Crop Group-Subgroup	Name	Examples Included in This Group	Corresponding GENIIv2 Food or Feed Category
NA	NA	Banana	<not adequately addressed with Gv2.10>
NA	NA	Peanut, pineapple	Possibly root/other, but careful review of modeling should be done.
NA	NA	Water chestnut, watercress	aquatic plant

References

40 CFR Part 180, Subpart B – *Procedural Regulations*. Section 180.41 Crop Group Tables.

Appendix E

Rainfall Rate

Appendix E

Rainfall Rate

The National Climatic Data Center (NCDC) provides access to climatological normals based on 30-years (1981-2010) of data for thousands of stations throughout the United States.[1] Climatological values include normal annual precipitation amount and the normal number of days with precipitation greater than a trace (i.e., 0.01 inches or greater). The average daily rainfall rate can be estimated by dividing the normal precipitation amount by the normal number of precipitation days. Data are provided in this appendix for numerous locations throughout the United States and some of its territories. More locations are available at the NCDC website. The procedure to acquire the data is summarized in Section 7.1.2 (RAIN Rainfall Rate) of the main text.

[1] See http://www1.ncdc.noaa.gov/pub/data/normals/1981-2010/station-inventories/prcp-inventory.txt.

Table E.1. Rainfall Rate

Name[a]	State	Average d/yr with Precipitation >0.254 mm	Normal Precipitation (mm/yr)	RAIN (mm/d)[b]
DILLINGHAM FAA AP	AK	141	643.1	4.6
PUNTILLA	AK	96	369.8	3.9
ANNETTE ISLAND AP	AK	231	2581.4	11.2
JUNEAU INTL AP	AK	230	1581.7	6.9
GUSTAVUS	AK	224	1508	6.7
KETCHIKAN INTL AP	AK	234	3587.8	15.3
PETERSBURG 1	AK	233	2774.4	11.9
PALMER MUNI AP	AK	87	302	3.5
SITKA AIRPORT	AK	236	2205	9.4
SKAGWAY AP	AK	154	687.1	4.5
YAKUTAT STATE AP	AK	240	3940	16.4
KODIAK AP	AK	203	1981.2	9.8
KING SALMON	AK	156	495	3.2
ILIAMNA AP	AK	125	633.2	5.1
HOMER AP	AK	151	618.2	4.1
COLD BAY AP	AK	249	1058.4	4.2
ADAK	AK	266	1389.4	5.2
ST PAUL ISLAND AP	AK	203	601.2	3.0
ELMENDORF AFB	AK	112	399.5	3.6
CORDOVA M K SMITH AP	AK	220	2296.7	10.4
FAIRBANKS INTL AP	AK	109	274.6	2.5
NORTHWAY AP	AK	92	266.4	2.9
BIG DELTA AP	AK	97	295.1	3.0
GULKANA AP	AK	101	286	2.8
SEWARD AP	AK	172	1862.3	10.9
VALDEZ WSO	AK	200	1753.4	8.8
ANCHORAGE INTL AP	AK	115	421.1	3.7
UMIAT	AK	40	122.2	3.1
MCGRATH AP	AK	142	457.2	3.2
MINCHUMINA	AK	99	353.3	3.6
KENAI MUNI AP	AK	124	462.5	3.7
TALKEETNA AP	AK	143	710.4	5.0
TANANA CALHOUN MEM AP	AK	101	294.4	2.9
BETTLES AP	AK	125	378.5	3.0
BETHEL AP	AK	146	470.9	3.2
KOTZEBUE RALPH WEIN AP	AK	113	279.4	2.5
NOME MUNI AP	AK	133	427	3.2
WALES	AK	90	303.8	3.4
BARROW POST ROGERS AP	AK	88	115.1	1.3
SHEMYA USAF BASE	AK	239	809.5	3.4
HUNTSVILLE INTL AP	AL	117	1380.2	11.8
CENTREVILLE 6 SW	AL	113	1453.6	12.9
BIRMINGHAM AP	AL	117	1364.5	11.7

Table E.1. (contd)

Name[a]	State	Average d/yr with Precipitation >0.254 mm	Normal Precipitation (mm/yr)	RAIN (mm/d)[b]
MOBILE	AL	115	1680.2	14.6
MONTGOMERY AP	AL	104	1348	12.9
ALABASTER SHELBY CO AP	AL	124	1388.9	11.2
LITTLE ROCK	AR	107	1270.8	11.8
FT SMITH RGNL AP	AR	98	1154.7	11.8
HARRISON BOONE CO AP	AR	116	1121.2	9.7
PAGE	AZ	48	173.5	3.6
FLAGSTAFF PULLIAM AP	AZ	88	555.2	6.3
TUCSON INTL AP	AZ	53	294.4	5.6
PHOENIX SKY HARBOR INTL AP	AZ	37	204	5.6
WINSLOW MUNI AP	AZ	53	178.1	3.4
YUMA WSO AP	AZ	18	83.8	4.7
DOUGLAS BISBEE INL AP	AZ	64	332.7	5.2
LEMOORE REEVES NAS	CA	46	200.9	4.4
LONG BEACH DAUGHERTY FLD	CA	35	311.4	8.8
BURBANK GLENDALE PASADENA AP	CA	37	439.7	12.0
BAKERSFIELD AP	CA	39	164.3	4.2
BISHOP AP	CA	28	131.6	4.8
LOS ANGELES INTL AP	CA	36	325.6	9.1
SANDBERG	CA	38	313.2	8.3
SAN DIEGO LINDBERGH FLD	CA	42	262.6	6.3
SANTA BARBARA MUNI AP	CA	37	451.1	12.1
SACRAMENTO EXECUTIVE AP	CA	60	470.4	7.8
SALINAS MUNICIPAL AP	CA	57	325.9	5.8
SAN FRANCISCO INTL AP	CA	68	524.5	7.7
STOCKTON METRO AP	CA	57	357.1	6.3
ALAMEDA NAS	CA	66	527.8	7.9
MOFFETT FEDERAL AIRFIELD	CA	64	372.9	5.8
CONCORD BUCHANAN FLD	CA	59	418.1	7.1
SANTA MARIA PUBLIC AP	CA	48	354.3	7.4
EUREKA WFO WOODLEY ISLAND	CA	128	1024.4	8.0
RED BLUFF MUNI AP	CA	73	622	8.5
REDDING MUNI AP	CA	82	879.3	10.7
EL TORO MCAS	CA	43	365.3	8.6
SAN DIEGO MIRAMAR NAS	CA	43	283.5	6.5
POINT MUGU NF	CA	35	324.9	9.3
TUSTIN MCAF	CA	38	304.5	8.0
FRESNO YOSEMITE INTL AP	CA	48	292.1	6.1
HAYWARD AIR TERMINAL	CA	65	458.2	7.1
DENVER INTL AP	CO	80	379	4.8
ALAMOSA SAN LUIS AP	CO	67	185.7	2.8
DENVER-STAPLETON	CO	87	395.7	4.6
GRAND JUNCTION WALKER FLD	CO	74	239.3	3.2
LIMON WSMO	CO	83	395.2	4.7

Table E.1. (contd)

Name[(a)]	State	Average d/yr with Precipitation >0.254 mm	Normal Precipitation (mm/yr)	RAIN (mm/d)[(b)]
COLORADO SPRINGS MUNI AP	CO	92	420.1	4.6
PUEBLO MEM AP	CO	72	319.3	4.4
HARTFORD BRADLEY INTL AP	CT	130	1164.6	9.0
BRIDGEPORT SIKORSKY MEM AP	CT	122	1085.6	8.9
WILMINGTON NEW CASTLE CO AP	DE	118	1094.2	9.3
ORLANDO INTL AP	FL	117	1288.5	11.0
GAINESVILLE RGNL AP	FL	114	1204.2	10.5
APALACHICOLA AP	FL	93	1465.6	15.8
DAYTONA BEACH INTL AP	FL	115	1260.3	11.0
KEY WEST INTL AP	FL	106	1011.7	9.5
MELBOURNE INTL AP	FL	116	1320.8	11.4
MIAMI INTL AP	FL	135	1572.3	11.6
TAMPA INTL AP	FL	105	1176	11.2
VERO BEACH INTL AP	FL	123	1317.5	10.7
WEST PALM BEACH INTL AP	FL	136	1583.2	11.6
FT LAUDERDALE HOLLYWOOD AP	FL	122	1579.4	12.9
JACKSONVILLE	FL	114	1330.7	11.7
PENSACOLA RGNL AP	FL	109	1657.9	15.3
TALLAHASSEE	FL	111	1504.4	13.5
FT STEWART	GA	99	1259.1	12.7
MACON MIDDLE GA RGNL AP	GA	106	1160.3	11.0
AUGUSTA BUSH FLD AP	GA	105	1106.7	10.6
SAVANNAH INTL AP	GA	108	1218.2	11.3
WAYCROSS WSMO	GA	108	1188.5	11.0
ALMA BACON CO AP	GA	106	1184.9	11.1
ATHENS BEN EPPS AP	GA	110	1176.8	10.7
ATLANTA HARTSFIELD INTL AP	GA	113	1262.6	11.1
GUAM INTL AP	GU	272	2480.1	9.1
HAINA 214	HI	171	1854.2	10.9
KULA BRANCH STN 324.5	HI	77	590.6	7.6
UPOLU POINT USCG 159.2	HI	180	835.7	4.6
WAIMANALO EXP F 795.1	HI	184	1099.1	6.0
HILO INTL AP	HI	272	3218.7	11.8
BARKING SANDS	HI	67	500.1	7.5
BARBERS POINT NAS	HI	69	406.9	5.9
KAHULUI AP	HI	95	452.9	4.8
KANEOHE BAY MCAS	HI	176	815.1	4.6
HONOLULU INTL AP	HI	89	434.3	4.9
MOLOKAI AP	HI	99	626.9	6.4
LIHUE WSO AP 1020.1	HI	195	941.1	4.8
SPENCER 1 N	IA	102	749.6	7.3
BURLINGTON MUNI AP	IA	114	977.4	8.6
DES MOINES INTL AP	IA	113	914.7	8.1
SIOUX CITY GATEWAY AP	IA	101	704.6	7.0

Table E.1. (contd)

Name[a]	State	Average d/yr with Precipitation >0.254 mm	Normal Precipitation (mm/yr)	RAIN (mm/d)[b]
CEDAR RAPIDS MUNI AP	IA	111	879.1	7.9
DUBUQUE RGNL AP	IA	120	921.8	7.7
WATERLOO MUNI AP	IA	112	877.8	7.8
BOISE AIR TERMINAL	ID	88	297.9	3.4
LEWISTON NEZ PERCE CO AP	ID	103	312.7	3.0
POCATELLO RGNL AP	ID	97	308.1	3.2
SALEM	IL	110	1114.6	10.2
CHICAGO MIDWAY AP	IL	123	992.9	8.1
PEORIA GTR PEORIA AP	IL	117	926.8	8.0
MOLINE QUAD CITY INTL AP	IL	117	964.2	8.2
SPRINGFIELD CAPITAL AP	IL	113	950.7	8.4
QUINCY RGNL AP	IL	111	948.2	8.5
ROCKFORD GTR ROCKFORD AP	IL	119	920.5	7.7
CHICAGO OHARE INTL AP	IL	124	937	7.6
FT WAYNE INTL AP	IN	134	973.8	7.3
SOUTH BEND MICHIANA RGNL AP	IN	145	965.2	6.6
EVANSVILLE REGIONAL AP	IN	116	1150.9	10.0
INDIANAPOLIS	IN	129	1078	8.3
WICHITA	KS	88	829.1	9.4
MEDICINE LODGE	KS	80	689.4	8.7
CONCORDIA MUNI AP	KS	90	708.4	7.8
DODGE CITY	KS	77	548.6	7.1
TOPEKA MUNI AP	KS	100	926.1	9.3
GOODLAND	KS	81	499.4	6.2
PADUCAH	KY	110	1246.6	11.3
LONDON CORBIN AP	KY	134	1197.4	8.9
JACKSON	KY	144	1227.8	8.5
CINCINNATI NORTHERN KY AP	KY	132	1080	8.2
LEXINGTON BLUEGRASS AP	KY	130	1147.3	8.8
LOUISVILLE INTL AP	KY	123	1140.7	9.3
SLIDELL AP	LA	116	1555.8	13.4
LAKE CHARLES	LA	109	1460.2	13.5
BOOTHVILLE ASOS	LA	121	1508.3	12.5
NEW ORLEANS INTL AP	LA	115	1591.6	13.9
SHREVEPORT	LA	101	1305.8	12.9
CHATHAM	MA	125	1194.8	9.5
BOSTON LOGAN INTL AP	MA	126	1111.8	8.8
BLUE HILL	MA	136	1356.9	10.0
WORCESTER RGNL AP	MA	139	1221	8.8
PATUXENT RIVER NAS	MD	116	1184.9	10.3
SALISBURY WICOMICO RGNL AP	MD	117	1160.3	9.9
BALTIMORE WASH INTL AP	MD	116	1063.8	9.2
EASTPORT	ME	141	1163.8	8.3
GRAY	ME	139	1275.6	9.2

Table E.1. (contd)

Name[a]	State	Average d/yr with Precipitation >0.254 mm	Normal Precipitation (mm/yr)	RAIN (mm/d)[b]
BANGOR INTL AP	ME	133	1065	8.0
CARIBOU MUNI AP	ME	160	977.6	6.1
BRUNSWICK NAS	ME	131	1297.9	9.9
PORTLAND INTL JETPORT	ME	131	1200.2	9.2
GAYLORD 9SSW	MI	172	923.8	5.4
WHITEFISH POINT	MI	175	819.2	4.7
ESCANABA	MI	118	728.2	6.2
FLINT BISHOP INTL AP	MI	136	796.8	5.9
LANSING CAPITAL CITY AP	MI	137	807	5.9
MARQUETTE	MI	150	739.9	4.9
MUSKEGON CO AP	MI	141	850.6	6.0
SAULT STE MARIE SANDERSON FLD	MI	163	836.9	5.1
HANCOCK HOUGHTON CO AP	MI	152	705.9	4.6
HOUGHTON LK ROSCOMMON AP	MI	139	730.3	5.3
DETROIT METRO AP	MI	135	850.1	6.3
ALPENA CO RGNL AP	MI	146	713.7	4.9
MARQUETTE	MI	164	906.3	5.5
GRAND RAPIDS	MI	145	972.1	6.7
DULUTH	MN	131	786.4	6.0
INTL FALLS INTL AP	MN	128	615.2	4.8
MINNEAPOLIS/ST PAUL AP	MN	117	777.5	6.7
ROCHESTER INTL AP	MN	121	838.7	7.0
ST CLOUD RGNL AP	MN	109	704.3	6.5
MONETT 4SW	MO	100	1164.6	11.6
SPICKARD 7 W	MO	103	988.3	9.6
WEST PLAINS	MO	102	1199.4	11.8
CAPE GIRARDEAU MUNI AP	MO	114	1189	10.5
COLUMBIA RGNL AP	MO	112	1082.5	9.6
KANSAS CITY INTL AP	MO	105	987	9.4
ST JOSEPH ROSECRANS AP	MO	108	904.2	8.3
ST LOUIS LAMBERT INTL AP	MO	113	1040.4	9.2
SPRINGFIELD	MO	111	1157.5	10.4
VICHY ROLLA NATIONAL AP	MO	111	1107.7	9.9
JACKSON INTL AP	MS	109	1375.2	12.7
MERIDIAN KEY FLD	MS	111	1426.5	12.8
GREENWOOD LEFLORE AP	MS	102	1315	12.9
TUPELO RGNL AP	MS	110	1397.3	12.7
KALISPELL GLACIER AP	MT	132	431.5	3.3
BILLINGS LOGAN INTL AP	MT	97	347	3.6
MILES CITY F WILEY FLD	MT	84	316	3.8
BUTTE BERT MOONEY AP	MT	108	324.4	3.0
CUT BANK MUNI AP	MT	78	275.6	3.5
DILLON AP	MT	80	266.7	3.4
GREAT FALLS INTL AP	MT	100	374.7	3.8

Table E.1. (contd)

Name[(a)]	State	Average d/yr with Precipitation >0.254 mm	Normal Precipitation (mm/yr)	RAIN (mm/d)[(b)]
HELENA RGNL AP	MT	92	285	3.1
MISSOULA INTL AP	MT	123	358.9	2.9
GLASGOW	MT	91	296.2	3.3
HAVRE CITY CO AP	MT	87	284.5	3.3
HICKORY FAA AP	NC	113	1175	10.4
ASHEVILLE RGNL AP	NC	128	1157.5	9.0
POPE AFB	NC	113	1158	10.3
RALEIGH DURHAM INTL AP	NC	114	1100.8	9.6
PIEDMONT TRIAD INTL AP	NC	111	1072.6	9.7
WILMINGTON INTL AP	NC	135	1463.3	10.9
CHERRY POINT MCAS	NC	121	1425.7	11.8
ELIZABETH CITY CGAS	NC	125	1183.1	9.5
CHARLOTTE DOUGLAS AP	NC	110	1057.4	9.6
CAPE HATTERAS AP	NC	120	1474.2	12.2
FARGO HECTOR INTL AP	ND	106	573.5	5.4
GRAND FORKS INTL AP	ND	103	528.6	5.1
BISMARCK	ND	98	453.4	4.6
THEODORE ROOSEVELT AP	ND	87	400.6	4.6
WILLISTON SLOULIN INTL AP	ND	97	365	3.8
GRAND ISLAND AP	NE	89	677.2	7.6
LINCOLN MUNI AP	NE	95	735.3	7.7
NORFOLK KARL STEFAN AP	NE	96	696.2	7.2
OMAHA EPPLEY AIRFIELD	NE	101	777.7	7.7
NORTH PLATTE RGNL AP	NE	87	513.8	5.9
SCOTTSBLUFF HEILIG AP	NE	87	401.1	4.6
SIDNEY MUNI AP	NE	92	470.9	5.1
VALENTINE MILLER FLD	NE	88	508.5	5.8
OMAHA #1	NE	98	792.7	8.1
CONCORD MUNI AP	NH	131	1031.5	7.9
MT WASHINGTON	NH	210	2460.5	11.7
NEWARK INTL AP	NJ	122	1174.8	9.6
ATLANTIC CITY INTL AP	NJ	115	1060.5	9.2
ROSWELL IND AIR PK	NM	55	327.9	6.0
ALBUQUERQUE INTL AP	NM	61	240	3.9
CLAYTON MUNI AIR PK	NM	68	401.1	5.9
MERCURY DESERT ROCK AP	NV	32	150.6	4.7
EUREKA AIRPORT	NV	80	228.6	2.8
ELY YELLAND FLD AP	NV	75	247.9	3.3
LAS VEGAS MCCARRAN AP	NV	27	106.4	4.0
RENO TAHOE INTL AP	NV	52	188	3.6
WINNEMUCCA MUNI AP	NV	71	210.3	3.0
BINGHAMTON	NY	159	998.2	6.3
ISLIP LI MACARTHUR AP	NY	119	1174.5	9.9
NEW YORK LAGUARDIA AP	NY	118	1136.1	9.6

Table E.1. (contd)

Name[a]	State	Average d/yr with Precipitation >0.254 mm	Normal Precipitation (mm/yr)	RAIN (mm/d)[b]
BUFFALO	NY	167	1028.2	6.2
ALBANY AP	NY	138	999.5	7.3
GLENS FALLS AP	NY	132	992.1	7.5
ROCHESTER GTR INTL AP	NY	167	870.5	5.2
SYRACUSE HANCOCK INTL AP	NY	174	977.1	5.6
NEW YORK CNTRL PK TWR	NY	122	1268.5	10.4
NEW YORK JFK INTL AP	NY	119	1086.4	9.1
CLEVELAND	OH	155	994.2	6.4
COLUMBUS PORT COLUMBUS INTL AP	OH	139	998.5	7.2
YOUNGSTOWN RGNL AP	OH	160	988.3	6.2
MANSFIELD LAHM MUNI AP	OH	150	1122.4	7.5
AKRON CANTON RGNL AP	OH	158	1005.8	6.4
DAYTON INTL AP	OH	136	1042.9	7.7
TOLEDO EXPRESS AP	OH	132	869.7	6.6
OKLAHOMA CITY WILL ROGERS AP	OK	84	927.6	11.0
TULSA INTL AP	OK	93	1039.6	11.2
PONCA CITY MUNI AP	OK	84	884.9	10.5
GAGE AP	OK	66	558	8.4
PENDLETON	OR	98	321.6	3.3
EUGENE MAHLON SWEET AP	OR	144	1170.9	8.2
MEDFORD ROGUE VLY AP	OR	103	466.1	4.5
PORTLAND INTL AP	OR	155	915.2	5.9
REDMOND ROBERTS FLD	OR	80	225.6	2.8
SALEM MCNARY FLD	OR	144	1007.6	7.0
BURNS MUNI AP	OR	94	277.4	3.0
ASTORIA RGNL AP	OR	191	1708.4	8.9
PHILADELPHIA INTL AP	PA	118	1054.9	8.9
MIDDLETOWN HARRISBURG INTL AP	PA	122	1034.8	8.5
ALLENTOWN INTL AP	PA	127	1151.9	9.1
HARRISBURG CPTL CY AP	PA	127	1039.4	8.2
WILKES-BARRE INTL AP	PA	139	971.8	7.0
WILLIAMSPORT	PA	133	1048.5	7.9
ERIE INTL AP	PA	166	1070.9	6.4
PITTSBURGH INTL AP	PA	151	970	6.4
SAN JUAN L M MARIN AP	PR	199	1431.3	7.2
PROVIDENCE T F GREEN AP	RI	125	1198.4	9.6
GREER	SC	114	1198.6	10.5
CHARLESTON INTL AP	SC	113	1296.2	11.5
COLUMBIA	SC	107	1132.6	10.6
ANDERSON CO AP	SC	111	1122.9	10.1
PICKSTOWN	SD	85	613.7	7.2
ABERDEEN	SD	94	551.7	5.8
HURON RGNL AP	SD	93	581.7	6.3
SIOUX FALLS	SD	105	670.1	6.4

Table E.1. (contd)

Name[a]	State	Average d/yr with Precipitation >0.254 mm	Normal Precipitation (mm/yr)	RAIN (mm/d)[b]
PIERRE RGNL AP	SD	88	506.2	5.8
RAPID CITY RGNL AP	SD	94	413.8	4.4
CROSSVILLE MEM AP	TN	137	1399.3	10.2
BRISTOL TRI CITY AP	TN	134	1041.7	7.8
CHATTANOOGA LOVELL AP	TN	120	1333	11.1
KNOXVILLE MCGHEE TYSON AP	TN	125	1215.6	9.7
MEMPHIS INTL AP	TN	108	1363.5	12.7
NASHVILLE INTL AP	TN	119	1200.2	10.1
OAK RIDGE ASOS	TN	125	1293.1	10.4
FT WORTH WSFO	TX	81	960.1	11.9
COLLEGE STN	TX	91	1017.5	11.2
DALLAS FT WORTH AP	TX	80	918	11.5
LONGVIEW WSMO	TX	92	1258.1	13.7
STEPHENVILLE	TX	77	801.1	10.4
VICTORIA RGNL AP	TX	94	1047	11.1
PORT ARTHUR SE TX AP	TX	105	1535.9	14.6
HOUSTON HOBBY AP	TX	104	1388.1	13.4
BROWNSVILLE	TX	74	697	9.4
SAN ANTONIO INTL AP	TX	83	819.7	9.9
CORPUS CHRISTI	TX	77	806.7	10.5
HOUSTON INTERCONT AP	TX	104	1264.2	12.2
AUSTIN BERGSTROM AP	TX	82	816.6	9.9
AUSTIN-CAMP MABRY	TX	88	869.7	9.9
WACO RGNL AP	TX	82	881.1	10.8
DALLAS LOVE FLD	TX	81	954.3	11.8
FT WORTH MEACHAM FLD	TX	80	916.7	11.5
ABILENE RGNL AP	TX	69	630.4	9.1
WICHITA FALLS MUNI AP	TX	74	734.1	9.9
DEL RIO INTL AP	TX	61	495.8	8.1
CHILDRESS MUNI AP	TX	69	607.6	8.8
MIDLAND ODESSA	TX	52	370.8	7.2
SAN ANGELO	TX	62	539.8	8.7
LUBBOCK	TX	66	485.6	7.3
EL PASO INTL AP	TX	53	246.6	4.6
AMARILLO	TX	72	517.1	7.2
DALHART MUNI AP	TX	64	446.8	7.0
ROOSEVELT RADIO	UT	61	189.2	3.1
DELTA	UT	66	218.7	3.3
MILFORD MUNI AP	UT	68	265.4	3.9
SALT LAKE CITY INTL AP	UT	96	408.9	4.3
WENDOVER AP AWOS	UT	38	102.9	2.7
LANGLEY AFB	VA	109	1186.2	10.9
LYNCHBURG RGNL AP	VA	116	1055.9	9.1
NORFOLK INTL AP	VA	117	1181.9	10.1

Table E.1. (contd)

Name[a]	State	Average d/yr with Precipitation >0.254 mm	Normal Precipitation (mm/yr)	RAIN (mm/d)[b]
RICHMOND INTL AP	VA	114	1107.4	9.7
ROANOKE RGNL AP	VA	116	1047.8	9.0
WASHINGTON REAGAN AP	VA	114	1009.4	8.8
WASHINGTON DC DULLES AP	VA	119	1055.1	8.9
WALLOPS ISLAND FLIGHT FAC	VA	118	1037.3	8.8
CHRISTIANSTED AP	VI	174	982.2	5.6
CHARLOTTE AMALIE AP	VI	168	999.2	5.9
NEWPORT	VT	175	1050.3	6.0
BURLINGTON INTL AP	VT	156	935.2	6.0
SAINT JOHNSBURY	VT	164	1003.3	6.1
EPHRATA MUNI AP	WA	69	199.4	2.9
SPOKANE INTL AP	WA	112	420.6	3.7
OLYMPIA AP	WA	163	1270	7.8
SEATTLE TACOMA INTL AP	WA	152	952.2	6.3
YAKIMA AIR TERMINAL	WA	72	209.8	2.9
WHIDBEY ISLAND NAS	WA	145	515.4	3.6
QUILLAYUTE STATE AP	WA	206	2528.3	12.3
PARK FALLS DNR HQ	WI	124	813.3	6.6
MADISON DANE RGNL AP	WI	125	875.8	7.0
MILWAUKEE MITCHELL AP	WI	127	882.9	7.0
WAUSAU DWTN AP	WI	129	823.2	6.4
GREEN BAY	WI	123	749.8	6.1
LA CROSSE MUNI AP	WI	119	839.7	7.1
PARKERSBURG WOOD CO AP	WV	141	1046.2	7.4
HUNTINGTON TRI STATE AP	WV	139	1081.8	7.8
BECKLEY RALEIGH CO AP	WV	157	1046.2	6.7
ELKINS RANDOLPH CO AP	WV	175	1166.6	6.7
CHARLESTON YEAGER AP	WV	151	1118.4	7.4
CHEYENNE	WY	104	404.9	3.9
LANDER HUNT FLD AP	WY	71	321.6	4.5
ROCK SPRINGS AP	WY	78	217.4	2.8
SHERIDAN CO AP	WY	101	359.7	3.6
RAWLINS MUNI AP	WY	85	235	2.8
CASPER NATRONA CO AP	WY	95	318	3.4
BIG PINEY MARBLETON AP	WY	55	164.6	3.0

(a) AP = airport; CO = County, RGNL = regional, INTL = international, AFB = Air Force Base, FAC = Facility, MUN = municipal; FLD = field.

Data are based on 30-year averages (1981–2010) from the National Climatic Data Center (e.g., http://www.ncdc.noaa.gov/oa/climate/research/cag3/cag3.html).

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Data last accessed at: http://www1.ncdc.noaa.gov/pub/data/normals/1981-2010/station-inventories/prcp-inventory.txt.

Appendix F

Growing Periods

Appendix F

Growing Periods

The growing period for each human food crop type defines the deposition period for irrigation and atmospheric deposition to plants. For a given location, the user should review available data sources relevant to their region. To the extent possible, the growing period should reflect the growing period of the edible portion of the crop. Values for each crop type may be determined from a number of available data sources (e.g., frost-free days, days to maturity, planting-to-harvest dates).

The growing periods provided in this Appendix are based on planting and harvesting dates from USDA Agricultural Census data. USDA (2010) provided data on the planting and harvesting dates for a number of crops and by state. The data reflect 2008 or 2009 data. In reviewing this appendix information for parameter determinations, be cognizant of whether the crop is harvested multiple times over the growing season (e.g., melons, tomatoes, berries) or harvested at the end of its growth cycle (e.g., wheat, potatoes, corn). For those harvested multiple times, a best estimate growing period closer to the minimum Appendix value would be more appropriate. In contrast, end-of-season crops are better approximated by average values.

The USDA (2010) information was used for appendix data. For all the following calculations, corrections were included to account for harvesting in the calendar year after the planting calendar year.

Minimum and Maximum growing period for each state is calculated by determining the state-specific overall minimum and overall maximum of the following four calculations:

a. “Usual1” = (Usual Harvest $Date_{begin}$) - (Usual Plant $Date_{begin}$)
b. “MostActive1” = (Most Active Harvest $Date_{start}$) - (Most Active Planting $Date_{start}$)
c. “MostActive2” = (Most Active Harvest $Date_{end}$) - (Most Active Planting $Date_{end}$)
d. “Usual2” = (Usual Harvest $Date_{end}$) - (Usual Plant $Date_{end}$)

The Average (most active) growing period for each state is determined as follows: average of “MostActive1” and “MostActive2”.

For alfalfa hay, the Most Active (harvest and planting) data are not provided. Many state-specific Average (most active) cells are indicated as ND for alfalfa hay.

The growing period for “Summary-all US” was calculated as a simple average of state-specific values.

For Other Hay growing periods the corn-for-grain planting dates were assumed, because hay plant dates were not reported. Assumed start of growing season reflected in the corn-for-grain values.
AK planting date is assumed to be the maximum date of all other states.

Table F.1. Corn for Grain Growing Periods by State

Table F.2. Corn for Silage Growing Periods by State

Table F.1. Corn for Grain Growing Periods by State

	2009 Harvested Area	2009 Growing Period Estimates		
	Corn for Grain	Corn for Grain	Corn for Grain	Corn for Grain
	2009 Data	2009 Minimum	2009 Maximum	2009 Average (most active)
	acre (thousands)	d	d	d
Alabama	250	139	150	143.5
Arizona	20	170	183	176.5
Arkansas	410	143	150	147
California	160	123	183	153
Colorado	990	162	177	170
Delaware	163	143	161	147.5
Florida	37	136	149	138.5
Georgia	370	145	156	150.5
Idaho	80	161	168	168
Illinois	11,800	153	168	160.5
Indiana	5,460	148	168	157.5
Iowa	13,400	155	179	169
Kansas	3,860	148	169	155.5
Kentucky	1,150	148	155	150.5
Louisiana	610	140	150	146.5
Maryland	425	142	163	150
Michigan	2,090	137	187	172
Minnesota	7,150	158	178	169
Mississippi	695	147	156	150.5
Missouri	2,920	148	193	155
Montana	26	161	189	181.5
Nebraska	8,850	152	183	169.5
Nevada	ND	ND	ND	ND
New Jersey	70	153	165	163.5
New Mexico	50	163	184	168.5
New York	595	154	170	158.5
North Carolina	800	146	170	160.5
North Dakota	1,740	155	185	167
Ohio	3,140	162	185	175
Oklahoma	320	149	156	151.5
Oregon	32	168	199	173
Pennsylvania	920	148	179	168.5
South Carolina	320	137	158	155.5
South Dakota	4,680	151	176	165
Tennessee	590	146	158	151
Texas	1,960	139	175	151.5

Table F.1. (contd)

	2009 Harvested Area	2009 Growing Period Estimates		
	Corn for Grain	Corn for Grain	Corn for Grain	Corn for Grain
	2009 Data	2009 Minimum	2009 Maximum	2009 Average (most active)
	acre (thousands)	d	d	d
Utah	17	163	188	163
Virginia	330	148	164	154.5
Washington	105	168	179	173.5
West Virginia	30	148	168	160
Wisconsin	2,930	159	177	169.5
Wyoming	45	164	187	177.5
Summary – all U.S.	79,590	154	168	161

Summary – all U.S. data: Harvested Acres (total). Minimum: lowest minimum. Maximum: highest maximum. Average: average of state specific values.
ND = No data available.

Table F.2. Corn for Silage Growing Periods by State

	2009 Harvested Area	2009 Growing Period Estimates		
	Corn for Silage	Corn for Silage	Corn for Silage	Corn for Silage
	2009 Data	2009 Minimum	2009 Maximum	2009 Average (most active)
	acre (thousands)	d	d	d
Arizona	30	170	183	176.5
Colorado	85	130	133	131.5
Delaware	5	117	125	121
Florida	30	87	102	91.5
Idaho	215	133	140	133
Indiana	110	96	117	106
Iowa	220	94	125	123.5
Kentucky	60	107	122	114
Maryland	40	126	134	133
Michigan	220	127	136	132.5
Minnesota	380	127	139	135
Mississippi	10	117	131	120.5
Montana	45	122	128	125.5
“New England”	161	123	129	127
New Jersey	9	132	142	132.5
New Mexico	78	139	165	143.5
New York	470	110	138	119.5
North Carolina	55	122	153	140
North Dakota	170	123	132	128.5
Ohio	170	126	137	132
Oregon	28	97	119	105
Pennsylvania	420	122	138	130.5
South Dakota	250	120	131	127.5
Tennessee	50	113	128	122.5
Texas	140	61	139	95
Utah	47	127	138	135.5
Virginia	135	129	131	130.5
Washington	65	127	148	140
West Virginia	16	102	127	115
Wisconsin	850	134	139	136.5
Wyoming	32	127	133	131.5
Overall average days	4596	119	135	127

Overall average Harvested Area is the sum of all reported data.

Table F.3. Wheat Growing Periods by State

	2009 Harvested Area			2009 Growing Period Estimates								
	Durum Wheat	Spring Wheat	Winter Wheat	Durum Wheat	Durum Wheat	Durum Wheat	Spring Wheat	Spring Wheat	Spring Wheat	Winter Wheat	Winter Wheat	Winter Wheat
	2009 Data	2009 Data	2009 Data	2009 Minimum	2009 Maximum	2009 Average (most active)	2009 Minimum	2009 Maximum	2009 Average (most active)	2009 Minimum	2009 Maximum	2009 Average (most active)
	acre (thousands)	acre (thousands)	acre (thousands)	d	d	d	d	d	d	d	d	d
Alabama	0	0	180	0	0	0	0	0	0	201	216	216
Arizona	124	0	5	151	186	173.5	0	0	0	151	186	173.5
Arkansas	0	0	390	0	0	0	0	0	0	213	241	226.5
California	170	0	315	182	237	214.5	0	0	0	165	237	205
Colorado	0	29	2450	0	0	0	116	129	120	291	299	293
Delaware	0	0	67	0	0	0	0	0	0	238	257	246
Florida	0	0	14	0	0	0	0	0	0	167	198	174
Georgia	0	0	250	0	0	0	0	0	0	185	224	196.5
Idaho	20	530	700	119	129	122	126	136	128	315	318	316
Illinois	0	0	820	0	0	0	0	0	0	252	260	256
Indiana	0	0	450	0	0	0	0	0	0	256	267	261.5
Iowa	0	0	22	0	0	0	0	0	0	280	291	281.5
Kansas	0	0	8800	0	0	0	0	0	0	256	278	268
Kentucky	0	0	390	0	0	0	0	0	0	231	256	243
Louisiana	0	0	175	0	0	0	0	0	0	188	210	197
Maryland	0	0	195	0	0	0	0	0	0	243	260	251
Michigan	0	0	560	0	0	0	0	0	0	277	296	286
Minnesota	0	1550	45	0	0	0	104	113	106.5	329	350	336.5
Mississippi	0	0	165	0	0	0	0	0	0	213	244	225
Missouri	0	0	730	0	0	0	0	0	0	233	260	248.5
Montana	535	2350	2420	108	113	111.5	115	118	116	305	319	313
Nebraska	0	0	1600	0	0	0	0	0	0	288	298	294.5
Nevada	0	2	11	0	0	0	102	108	105	308	314	311
New Jersey	0	0	29	0	0	0	0	0	0	256	269	266
New Mexico	0	0	140	0	0	0	0	0	0	273	294	286

Table F.3. (contd)

	2009 Harvested Area			2009 Growing Period Estimates								
	Durum Wheat	Spring Wheat	Winter Wheat	Durum Wheat	Durum Wheat	Durum Wheat	Spring Wheat	Spring Wheat	Spring Wheat	Winter Wheat	Winter Wheat	Winter Wheat
	2009 Data	2009 Data	2009 Data	2009 Minimum	2009 Maximum	2009 Average (most active)	2009 Minimum	2009 Maximum	2009 Average (most active)	2009 Minimum	2009 Maximum	2009 Average (most active)
	acre (thousands)	acre (thousands)	acre (thousands)	d	d	d	d	d	d	d	d	d
New York	0	0	105	0	0	0	0	0	0	286	306	305.5
North Carolina	0	0	600	0	0	0	0	0	0	217	252	230
North Dakota	1570	6300	545	105	119	110	106	114	108.5	307	313	310
Ohio	0	0	980	0	0	0	0	0	0	256	275	269
Oklahoma	0	0	3500	0	0	0	0	0	0	239	271	256
Oregon	0	127	750	0	0	0	120	141	130.5	265	298	279
Pennsylvania	0	0	175	0	0	0	0	0	0	284	309	293
South Carolina	0	0	150	0	0	0	0	0	0	182	243	199.5
South Dakota	9	1470	1530	0	0	0	100	111	105	301	310	306
Tennessee	0	0	340	0	0	0	0	0	0	217	253	232.5
Texas	0	0	2450	0	0	0	0	0	0	231	263	251.5
Utah	0	12	135	0	0	0	117	127	126.5	288	334	321.5
Virginia	0	0	210	0	0	0	0	0	0	223	257	237.5
Washington	0	585	1640	0	0	0	118	132	125.5	314	327	320.5
West Virginia	0	0	5	0	0	0	0	0	0	262	283	272.5
Wisconsin	0	0	315	0	0	0	0	0	0	289	308	297
Wyoming	0	0	132	0	0	0	0	0	0	321	329	325
Summary – all U.S.	2428	12955	34485	131	146	139	116	119	117	254	274	264

Summary – all U.S. data: Harvested Acres (total). Minimum: lowest minimum. Maximum: highest maximum. Average: average of state specific values.

Table F.4. Hay Growing Periods by State

	2009 Harvested Area		2009 Growing Period Estimates					
	Alfalfa Hay	Other Hay	Alfalfa Hay	Alfalfa Hay	Alfalfa Hay	Other Hay	Other Hay	Other Hay
2.5 alfalfa harvests assumed, except CA, AZ where 3.5 harvests assumed	2009 Data	2009 Data	2009 Minimum	2009 Maximum	2009 Average (most active)	2009 Minimum	2009 Maximum	2009 Average (most active)
	acre (thousands)	acre (thousands)	d	d	d	d	d	d
Alabama	ND	800	ND	ND	ND	22	60	43
Alaska	ND	20	ND	ND	ND	20	45	29
Arizona	280	30	21	52	ND	21	52	ND
Arkansas	15	1400	14	52	34.4	14	52	34
California	980	540	25	37	ND	22	61	ND
Colorado	850	750	13	66	34.2	25	44	30
Delaware	5	12	12	70	ND	11	66	ND
Florida	ND	300	ND	ND	ND	28	80	44
Georgia	ND	700	ND	ND	ND	25	72	ND
Idaho	1140	370	12	53	ND	16	37	ND
Illinois	340	270	10	43	27.2	11	17	13
Indiana	300	320	10	41	0.0	10	41	ND
Iowa	920	300	14	50	31.0	19	40	28
Kansas	850	1700	14	64	37.6	19	45	31
Kentucky	220	2300	12	40	26.2	16	50	30
Louisiana	ND	380	ND	ND	ND	14	60	ND
Maryland	40	170	9	70	ND	8	66	ND
Michigan	700	290	16	52	30.4	16	52	39
Minnesota	1300	750	13	47	ND	18	37	ND
Mississippi	ND	700	ND	ND	ND	10	58	ND
Missouri	280	3600	17	32	31.4	18	30	24
Montana	1700	800	21	44	ND	22	50	ND
Nebraska	950	1750	12	59	ND	19	49	ND

Table F.4. (contd)

2.5 alfalfa harvests assumed, except CA, AZ where 3.5 harvests assumed	2009 Harvested Area		2009 Growing Period Estimates					
	Alfalfa Hay	Other Hay	Alfalfa Hay	Alfalfa Hay	Alfalfa Hay	Other Hay	Other Hay	Other Hay
	2009 Data	2009 Data	2009 Minimum	2009 Maximum	2009 Average (most active)	2009 Minimum	2009 Maximum	2009 Average (most active)
	acre (thousands)	acre (thousands)	d	d	d	d	d	d
Nevada	280	210	28	54	ND	39	42	ND
New England	65	481	14	53	ND	14	53	ND
New Jersey	25	85	12	56	ND	10	49	ND
New Mexico	240	80	6	61	ND	6	61	ND
New York	350	1010	14	45	ND	14	47	ND
North Carolina	7	840	12	74	ND	12	74	ND
North Dakota	1780	1180	18	38	ND	22	36	ND
Ohio	380	660	12	47	28.2	13	54	33
Oklahoma	320	2900	12	60	ND	12	62	ND
Oregon	400	630	16	39	ND	22	49	ND
Pennsylvania	500	1050	6	61	ND	12	41	ND
South Carolina	ND	350	ND	ND	ND	26	73	ND
South Dakota	2500	1300	13	43	28.4	18	32	26
Tennessee	15	1900	12	52	ND	12	52	ND
Texas	120	4500	18	50	ND	24	54	ND
Utah	530	160	19	57	ND	32	34	ND
Virginia	90	1090	10	58	ND	20	50	ND
Washington	490	320	14	49	30.0	14	42	27
West Virginia	25	600	12	41	ND	12	57	ND
Wisconsin	1550	370	10	51	ND	12	41	ND
Wyoming	690	580	17	48	ND	22	38	ND
Summary – all U.S.	21,227	38,548	14	52	37.7	18	49	49

Summary – all U.S. data: Harvested Acres (total).
ND = No data available.

Table F.5. Alfalfa Hay Growing Periods by Reporting Region

	2009 Harvested Area	2009 Growing Period Estimates		
	Alfalfa Hay	Alfalfa Hay	Alfalfa Hay	Alfalfa Hay
2.5 alfalfa harvests assumed, except CA, AZ where 3.5 harvests assumed	2009 Data	2009 Minimum	2009 Maximum	2009 Average (most active)
	acres (thousands)	d	d	d
Ag Census Reporting Region (see Figure 7.2)				
1	3420	11.7	53.2	32.9
2	167	11.0	62.6	n/a
3 (except FL)	975	13.6	51.0	32.9
4	9630	17.9	49.7	31.3
5	2030	14.3	46.9	30
6	1260	23.0	44.4	N/A
7	N/A	N/A	N/A	N/A

Table F.6. Other Hay Growing Period by Reporting Region

	Other Hay	Other Hay	Other Hay	Other Hay
2.5 alfalfa harvests assumed, except CA, AZ where 3.5 harvests assumed	2009 Data	2009 Minimum	2009 Maximum	2009 Average (most active)
	acres (thousands)			
Ag Census Reporting Region (see Figure 7.2)				
1	7,056	13.8	47.4	32.0
2	4,562	17.1	64.7	43.2
3	13,860	15.8	57.2	34.3
4	5,730	24.8	39.2	27.8
5	1,340	18.3	43.3	28.0
6	570	21.9	56.4	N/A
7	N/A	N/A	N/A	N/A

Table F.7. Leafy Vegetables Growing Periods

Leafy Vegetables		2008 Harvested Area	GRWPA, GRWP 2009 Minimum	GRWPA, GRWP 2009 Maximum	GRWPA, GRWP 2009 Average
		ac	d	d	d
Head Lettuce, winter	Arizona	38,310	61	90	76
Head Lettuce, winter	California	200,470	91	136	114
Romaine Lettuce, winter	Arizona	see above	61	90	76
Romaine Lettuce, winter	California	see above	77	136	107
AVERAGE, Lettuce, winter			73	113	93
Head Lettuce, spring	California	see above	91	122	106
Head Lettuce, spring	New Jersey	918	56	92	72
Romaine Lettuce, spring	California	see above	91	122	106
AVERAGE, Lettuce, spring			79	112	95
Head Lettuce, summer	California	see above	61	92	76
Head Lettuce, summer	Colorado	4,471	75	97	83
Romaine Lettuce, summer	California	see above	61	92	76
AVERAGE, Lettuce, summer			66	94	78
Head lettuce fall	California	see above	60.5	61	61
Head lettuce fall	New Jersey	see above	73	112	90
Romaine Lettuce, summer	California	see above	60.5	61	61
AVERAGE, Lettuce, fall			65	78	71
Celery, winter	California		101	121.5	115
Celery, spring	California		106	121	116
Celery, summer	California		91.5	111	98
Celery, summer	Michigan		71	107	89
Celery, fall	California		92	137.5	122
AVERAGE, Celery			92	120	108
AVERAGE, Leafy Vegetables			75	103	89

Harvested area of “see above” has the total for all lettuce types from the state in another cell.

Table F.8. Root/Other Vegetables Growing Periods

Other and Root Vegetables		2008 Harvested Area	GRWPA, GRWP 2009 Minimum	GRWPA, GRWP 2009 Maximum	GRWPA, GRWP 2009 Average
		ac	d	d	d
Onions fresh, spring	Arizona	ND	212	212	212
Onions fresh, spring	California	ND	89.5	152	116
Onions fresh, spring	Georgia	ND	124	158	146
Onions fresh, spring	Texas	ND	113.5	152	139
AVERAGE, Onion fresh, spring			135	168	153
Onions fresh, summer	California	ND	152.5	184	173
Onions fresh, summer	Nevada	ND	153	170	161
Onions fresh, summer	New Mexico	ND	128	182.5	150
Onions fresh, summer	Texas	ND	151	155	153
Onions fresh, summer	Washington	ND	149	205.5	177
AVERAGE, Onion fresh, summer			147	179	163
Onions for storage, summer	California	ND	213	365	274
Onions for storage, summer	Colorado	ND	127	174	148
Onions for storage, summer	Idaho	ND	153	193	178
Onions for storage, summer	Michigan	ND	110	153	135
Onions for storage, summer	New York	ND	135.5	204	163
Onions for storage, summer	Ohio	ND	134	153	141
Onions for storage, summer	Oregon	ND	148	173	161
Onions for storage, summer	Utah	ND	162	203	183
Onions for storage, summer	Washington	ND	129	209	169
Onions for storage, summer	Wisconsin	ND	87	133	113
AVERAGE, Onion for storage			140	196	166
Carrots fresh, winter	Arizona	ND	137	387	284
Carrots fresh, winter	California	ND	123	152	138
Carrots fresh, winter	Georgia	ND	136	182.5	167
Carrots fresh, winter	Texas	ND	91	120	106
AVERAGE, Carrots, fresh winter			122	210	173
Carrots fresh, spring	California	ND	136	211	179
Carrots fresh, spring	Texas	ND	120	212	161
AVERAGE, Carrots, fresh spring			128	212	170
Carrots, summer	California	ND	122	151	134
Carrots, summer	Colorado	ND	108	123	114
Carrots, summer	Michigan	ND	86	138	115
Carrots, summer	Washington	ND	106	153	125
AVERAGE, Carrots, summer			106	141	122

Table F.8. (contd)

Other and Root Vegetables		2008 Harvested Area	GRWPA, GRWP 2009 Minimum	GRWPA, GRWP 2009 Maximum	GRWPA, GRWP 2009 Average
		ac	d	d	d
Carrots fresh, fall	California	ND	122	153	138
Carrots fresh, fall	Texas	ND	92	153	123
AVERAGE, Carrots, fresh fall			107	153	130
Tomatoes fresh, winter	Florida	37,617	60	90	75
Tomatoes fresh, spring	California	see below	106	122	112
Tomatoes fresh, spring	Florida	see above	99	121	109
Tomatoes fresh, spring	Texas	256	121	150	140
AVERAGE, Tomatoes, winter, spring			96	121	109
Tomatoes fresh, summer	Alabama	1,145	106	122	114
Tomatoes fresh, summer	Arkansas	2,349	61	143	93
Tomatoes fresh, summer	California	234,239	93	122	107
Tomatoes fresh, summer	Georgia	2,496	75	107	89
Tomatoes fresh, summer	Indiana	3,979	61	122	93
Tomatoes fresh, summer	Michigan	6,952	80	138	106
Tomatoes fresh, summer	New Jersey	1,997	82	148	112
Tomatoes fresh, summer	New York	492	65	122	95
Tomatoes fresh, summer	North Carolina	852	61	132	97
Tomatoes fresh, summer	Ohio	3,034	50	77	59
Tomatoes fresh, summer	Pennsylvania	1,918	62	138	101
Tomatoes fresh, summer	South Carolina	2,837	76	92	87
Tomatoes fresh, summer	Tennessee	1,896	70	97.5	86
Tomatoes fresh, summer	Virginia	886	82	122	96
AVERAGE, Tomatoes, summer			73	120	95
Tomatoes fresh, fall	California	see above	91	152	112
Tomatoes fresh, fall	Florida	see above	61	77	68
Tomatoes fresh, fall	Georgia	see above	78	107	92
Tomatoes fresh, fall	Ohio	see above	61	114	87
AVERAGE, Tomatoes, fall			73	113	90
Potatoes, fall	Colorado	55.2	127	139	136
Potatoes, fall	Idaho	319	131	147	147
Potatoes, fall	Michigan	43.5	99	142	124
Potatoes, fall	Minnesota	45	117	135	131
Potatoes, fall	Montana	9.7	128	140	133
Potatoes, fall	Maine	55.5	120	130	129
Potatoes, fall	Massachusetts	3.4	98	145	125
Potatoes, fall	Rhode Island	0.4	98	131	120
Potatoes, fall	New Mexico	6.4	134	163	156

Table F.8. (contd)

Other and Root Vegetables		2008 Harvested Area	GRWPA, GRWP 2009 Minimum	GRWPA, GRWP 2009 Maximum	GRWPA, GRWP 2009 Average
		ac	d	d	d
Potatoes, fall	New York	16.5	78	135	107
Potatoes, fall	North Dakota	75	127	132	129
Potatoes, fall	Ohio	2.1	110	131	121
Potatoes, fall	Oregon	37	122	178	169
Potatoes, fall	Washington	145	102	168	135
AVERAGE, Potatoes, fall			114	144	133
Potatoes, summer	Alaska	0.7	108	117	113
Potatoes, summer	Colorado	3.9	120	140	128
Potatoes, summer	Delaware	1.6	90	133	109
Potatoes, summer	New Jersey	2.1	80	136	107
AVERAGE, Potatoes, summer			100	132	114
Potatoes, spring	Florida	28.9	106	138	122
Potatoes, spring	North Carolina	15	96	107	102
AVERAGE, Potatoes, spring			101	123	112
Beans, dry edible	Colorado	53	104	117	111
Beans, dry edible	Idaho	99	98	119	112
Beans, dry edible	Minnesota	140	114	124	119
Beans, dry edible	Montana	11.5	114	124	119
Beans, dry edible	New Mexico	12.4	92	122	113
Beans, dry edible	New York	15.6	92	94	92
Beans, dry edible	North Dakota	580	108	135	119
Beans, dry edible	Washington	60	122	129	126
Beans, dry edible	Washington, dry peas	85	97	122	99
Beans, dry edible	Wyoming	34	108	128	117
AVERAGE, Dry beans			105	121	113
AVERAGE, Other Vegetables			110	152	132

Harvested area of “see above” or “see below” has the crop total for all types from the state in another cell.
Harvested Area of ND has no data available.

Table F.9. Fruits Modeled as Root/Other Vegetables Growing Periods

Other and Root Vegetables (melon and strawberries)		2008 Harvested Area	GRWPA, GRWP 2009 Minimum	GRWPA, GRWP 2009 Maximum	GRWPA, GRWP 2009 Average
Cantaloupes fresh spring	Arizona	ND	76	90	83
Cantaloupes fresh spring	California	ND	89.5	135	112
Cantaloupes fresh spring	Georgia	ND	75	107	89
Cantaloupes fresh spring	Texas	ND	61	122	92
AVERAGE, Cantaloupe, spring			75	114	94
Cantaloupes fresh summer	California	ND	93	121	104
Cantaloupes fresh summer	Colorado	ND	101	138	117
Cantaloupes fresh summer	Indiana	ND	66	92	79
Cantaloupes fresh summer	Maryland	ND	105	138	122
Cantaloupes fresh summer	Pennsylvania	ND	71	92	81
Cantaloupes fresh summer	South Carolina	ND	77	92	82
Cantaloupes fresh summer	Texas	ND	61	107	87
AVERAGE, Cantaloupe, summer			82	111	96
Cantaloupes fresh fall	Arizona	ND	91	92	91
Cantaloupes fresh fall	California	ND	91	106	96
AVERAGE, Cantaloupe, fall			91	99	94
Strawberries winter	Florida	10,184	66	166	118
Strawberries spring	California	74,362	114	183	146
Strawberries spring	New York	13,012	38	51	45
Strawberries spring	North Carolina	105	181	221	203
Strawberries spring	Ohio	468	36	40	38
Strawberries spring	Oregon	17,275	51	62	55
AVERAGE, Strawberries, winter, spring			81	121	101
Strawberries summer	California	see above	91	183	139
Strawberries summer	Michigan	17,714	60.5	61	61
Strawberries summer	Pennsylvania	826	56	70	64
Strawberries summer	Washington	N/A	61	66	64
Strawberries summer	Wisconsin	123	44	46	45
AVERAGE, Strawberries, summer			63	85	75
AVERAGE, “Fruit” Vegetables			77	108	92

Harvested area of “see above” has the total for all strawberries from the state in another cell. Harvested Area of ND has no data available.

References

USDA. 2010. *Field Crops, Usual Planting and Harvesting Dates*. Handbook Number 628, USDA National Agricultural Statistics Service, Washington, D.C. Last accessed at: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1251 (documentID varies according to which table accessed)

Appendix G

Biomass and Yield

Appendix G

Biomass and Yield Tables

The data presented in this Appendix provide detailed values for biomass and yield values for various food and feed categories. The detailed values can be evaluated to approximate values appropriate to the location of interest. It is unlikely that one feed or food is consumed over the year, so generalizations are necessary. The best approximation of the annual value would be entered in the Exposure module.

The Gv2 standing biomass is the total above-ground plant mass (wet weight) used to estimate interception fractions for wet and dry deposition.

The Gv2 yield of each crop type gives the total annual production of edible crop mass (wet weight) per unit area of farmland. The yield is used to calculate the harvest removal losses from the soil. Radionuclide removal due to harvesting is modeled when opted on the Agriculture/General tab. This parameter only impacts scenarios that evaluate exposures which occur more than one-year after the release.

		Feed or Forage Consumed		
Type	Animal Product	Grain	Hay	Grass
Feed	Meat	X		
	Poultry	X		
	Milk		X	
	Egg	X		
Forage	Meat		X	
	Milk			X

Table G.1. Leafy Vegetable Biomass

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food Type	Reference	Units Cited	Comment	Data Reported	Average Estimate	Minimum	Maximum	Units
EXPOSURE	BIOMAS	kg_wet/m^2	Biomass for Leafy Vegetables	1.Leafy	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)	Head lettuce (U.S. average, 1998-2010)	Assumed biomass equals half the yield	2.04	1.85	2.13	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^3	Biomass for Leafy Vegetables	1.Leafy	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)	All lettuce, cabbage, broccoli, spinach (U.S. average, 1998-2010)	Assumed biomass equals yield	2.67	1.35	4.25	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^4	Biomass for Leafy Vegetables	1.Leafy	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)	Spinach (U.S. average, 1998-2010)	Assumed biomass equals yield	1.71	1.42	2.09	kg_wet/m^2

Table G.2. Root/Other Vegetable Biomass

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food Type	Reference	Units Cited	Comment	Data Reported	Average Estimate	Minimum	Maximum	Units
EXPOSURE	BIOMAS	kg_wet/m^2	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)	Celery (U.S. average, 1998-2010)	Assumed biomass equals half the yield	3.90	3.71	3.99	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^2	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)	Onion, all (U.S. average, 1998-2010)	Assumed biomass equals half the yield	2.55	2.21	2.81	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^2	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1377. Last accessed 7/17/12 SFS; Table D-8. Strawberries	1000 cwt; ac (calculated to lb/ac)	Strawberries (U.S. average, 1998-2010)	Assumed biomass equals half the yield	2.42	2.03	2.81	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^2	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1235. Last accessed 7/17/12 SFS. Table 1	1000 cwt; harvested 1000ac (calculated to lb/ac)	Fall potatoes (U.S. average, 1998-2006). Assumed leaf mass negligible compared to potato mass.	Assumed biomass equals half the yield	2.15	2.00	2.28	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^2	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1235. Last accessed 7/17/12 SFS. Table 1	calculated wtd average of winter, spring, summer, fall potatoes; wtd by acreage	Total potatoes (U.S. average, 1998-2006). Assumed leaf mass negligible compared to potato mass.	Assumed biomass equals half the yield	2.06	1.91	2.20	kg_wet/m^2

Table G.2. (contd)

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food Type	Reference	Units Cited	Comment	Data Reported	Average Estimate	Minimum	Maximum	Units
EXPOSURE	BIOMAS	kg_wet/m^2	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1235. Last accessed 7/17/12 SFS. Table 1	1000 cwt; harvested 1000 ac (calculated to lb/ac)	Summer potatoes (U.S. average, 1998-2006). Assumed leaf mass negligible compared to potato mass.	Assumed biomass equals half the yield	1.77	1.57	1.92	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^2	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)	Carrots (U.S. average, 1998-2010)	Assumed biomass equals half the yield	1.75	1.61	1.88	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^2	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)	Tomatoes (U.S. average, 1998-2010)	Assumed biomass equals half the yield	1.66	1.51	1.75	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^2	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)	Bell peppers (U.S. average, 1998-2010)	Assumed biomass equals half the yield	1.64	1.44	1.84	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^2	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1235. Last accessed 7/17/12 SFS. Table 1	1000 cwt; harvested 1000 ac (calculated to lb/ac)	Spring potatoes (U.S. average, 1998-2006). Assumed leaf mass negligible compared to potato mass.	Assumed biomass equals half the yield	1.59	1.31	1.76	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^2	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)	Watermelon (U.S. average, 1998-2010)	Assumed biomass equals half the yield	1.52	1.23	1.79	kg_wet/m^2

Table G.2. (contd)

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food Type	Reference	Units Cited	Comment	Data Reported	Average Estimate	Minimum	Maximum	Units
EXPOSURE	BIOMAS	kg_wet/m^3	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1235. Last accessed 7/17/12 SFS. Table 1	1000 cwt; harvested 1000 ac (calculated to lb/ac)	Winter potatoes (U.S. average, 1998-2006). Assumed leaf mass negligible compared to potato mass.	Assumed biomass equals half the yield	1.45	1.12	1.65	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^4	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12 sfs. Table 003.	1E6 cwt/ 1000 ac (calculated to lb/ac)	All melons, (U.S. average, 1998-2010)	Assumed biomass equals half the yield	1.44	1.21	1.65	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^5	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)	Cantaloupe (U.S. average, 1998-2010)	Assumed biomass equals half the yield	1.38	1.17	1.55	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^6	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)	Pumpkins (U.S. average, 1998-2010)	Assumed biomass equals half the yield	1.29	1.16	1.41	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^7	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)	Honeydew (U.S. average, 1998-2010)	Assumed biomass equals half the yield	1.21	1.05	1.35	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^8	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)	Cucumbers (U.S. average, 1998-2010)	Assumed biomass equals half the yield	1.07	0.97	1.17	kg_wet/m^2

Table G.2. (contd)

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food Type	Reference	Units Cited	Comment	Data Reported	Average Estimate	Minimum	Maximum	Units
EXPOSURE	BIOMAS	kg_wet/m[9]	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)	Broccoli (U.S. average, 1998-2010)	Assumed biomass equals yield	1.55	1.35	1.73	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m[10]	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)	Snap beans (U.S. average, 1998-2010)	Assumed biomass equals yield	0.69	0.62	0.76	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m[11]	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1377. Last accessed 7/18/12. sfs. Table D-2.	lb/ac	Blueberries (AL, AR, CA, FL, GA, IN, MI, MS, NJ, NY, NC, OR, WA averages, mostly 1998-2010)	Assumed biomass equals yield	0.49	0.32	0.64	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m[12]	Biomass for root/other vegetables	2.other	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)	Asparagus (U.S. average, 1998-2010)	Assumed biomass equals yield	0.24	0.19	0.28	kg_wet/m^2

Table G.3. Fruit Biomass

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food Type	Reference	Units Cited	Comment	Data Reported	Average Estimate	Units
EXPOSURE	BIOMAS	kg_wet/m^2	Biomass for Fruit trees	3.fruit	Jenkins et al. (2004)	<calculation>	Tree foliage biomass – 15 cm diameter tree. Average of Aspen, soft maple, mixed hardwood values.	Results from calculations of foliage mass	2.19	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^2	Biomass for Fruit trees	3.fruit	Jenkins et al. (2004)	<calculation>	Tree foliage biomass – 20 cm diameter tree. Average of Aspen, soft maple, mixed hardwood values.	Results from calculations of foliage mass	2.80	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^2	Biomass for Fruit trees	3.fruit	Jenkins et al. (2004)	<calculation>	Tree foliage biomass – 25 cm diameter tree. Average of Aspen, soft maple, mixed hardwood values.	Results from calculations of foliage mass	3.33	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^2	Biomass for Fruit trees	3.fruit	Jenkins et al. (2004)	<calculation>	Tree foliage biomass – 30 cm diameter tree. Average of Aspen, soft maple, mixed hardwood values.	Results from calculations of foliage mass	3.80	kg_wet/m^2

Table G.4. Evergreen Tree Biomass

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food Type	Reference	Units Cited	Comment	Data Reported	Average Estimate	Units
EXPOSURE	BIOMAS	kg_wet/m^2	Biomass for Fruit trees	3.fruit	Jenkins et al. (2004)	<calculation>	Model forested areas as fruit-tree covered area. Douglas fir values. 15-30 cm diameter trees.	Results from calculations of foliage mass	5.30	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^2	Biomass for Fruit trees	3.fruit	Jenkins et al. (2004)	<calculation>	Model forested areas as fruit-tree covered area. True Fir and Spruce. 15-30 cm diameter trees.	Results from calculations of foliage mass	4.40	kg_wet/m^2
EXPOSURE	BIOMAS	kg_wet/m^2	Biomass for Fruit trees	3.fruit	Jenkins et al. (2004)	<calculation>	Model forested areas as fruit-tree covered area. Pine. 15-30 cm diameter trees.	Results from calculations of foliage mass	3.80	kg_wet/m^2

Table G.5. [contd]

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food Type	Data Cited Crop	Reference	Units Cited	Comment	Data Reported	Average	Min Value	Max Value	Units
EXPOSURE	YELD	kg_wet/m^2	Food crop yield	1.leafy	Head lettuce (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)			4.08	3.7	4.25	kg_wet/m^2
EXPOSURE	YELD	kg_wet/m^2	Food crop yield	1.leafy	All lettuce, cabbage, broccoli, spinach (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)			2.67	1.35	4.25	kg_wet/m^2
EXPOSURE	YELD	kg_wet/m^2	Food crop yield	1.leafy	Spinach (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)			1.71	1.42	2.09	kg_wet/m^2
EXPOSURE	YELD	kg_wet/m^2	Food crop yield	2.other	Celery (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)			7.79	7.42	7.98	kg_wet/m^2
EXPOSURE	YELD	kg_as_harvested/m^2	Food crop yield	2.other	Onion, all (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)			5.1	4.41	5.61	kg_wet/m^2
EXPOSURE	YELD	kg_fruit_wet/m^2	Food crop yield	2.other	strawberries (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1377. Last accessed 7/17/12 SFS; Table D-8. Strawberries.	1000 cwt, ac (calculated to lb/ac)		annual, U.S. totals, ac, 1000 cwt	4.83	4.05	5.61	kg_wet/m^2
EXPOSURE	YELD	kg_wet/m^2	Food crop yield	2.other	fall potatoes (U.S. average, 1998-2006)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1235. Last accessed 7/17/12 SFS. Table 1.	1000 cwt; harvested 1000 ac (calculated to lb/ac)	Assumed leaf mass negligible compared to potato mass.	annual, U.S. totals, ac, 1000 cwt. 68-88% are fall potatoes	4.29	4	4.55	kg_wet/m^2

Table G.5. (contd)

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food Type	Data Cited Crop	Reference	Units Cited	Comment	Data Reported	Average	Min Value	Max Value	Units
EXPOSURE	YELD	kg_wet/m^2	Food crop yield	2.other	total potatoes (U.S. average, 1998-2006)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1235. Last accessed 7/17/12 SFS. Table 1.	calculated wtd average of winter, spring, summer, fall potatoes; wtd by acreage	Assumed leaf mass negligible compared to potato mass.	annual, U.S. totals, ac, 1000 cwt, all potatoes	4.12	3.81	4.39	kg_wet/m^2
EXPOSURE	YELD	kg_wet/m^2	Food crop yield	2.other	summer potatoes (U.S. average, 1998-2006)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1235. Last accessed 7/17/12 SFS. Table 1.	1000 cwt; harvested 1000 ac (calculated to lb/ac)	Assumed leaf mass negligible compared to potato mass.	annual, U.S. totals, ac, 1000 cwt	3.53	3.13	3.83	kg_wet/m^2
EXPOSURE	YELD	kg_wet/m^2	Food crop yield	2.other	Carrots (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)			3.5	3.21	3.75	kg_wet/m^2
EXPOSURE	YELD	kg_fruit_wet/m^2	Food crop yield	2.other	Tomatoes (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)			3.31	3.01	3.49	kg_wet/m^2
EXPOSURE	YELD	kg_fruit_wet/m^2	Food crop yield	2.other	Bell peppers (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)			3.28	2.88	3.68	kg_wet/m^2
EXPOSURE	YELD	kg_wet/m^2	Food crop yield	2.other	spring potatoes (U.S. average, 1998-2006)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1235. Last accessed 7/17/12 SFS. Table 1.	1000 cwt; harvested 1000 ac (calculated to lb/ac)	Assumed leaf mass negligible compared to potato mass.	annual, U.S. totals, ac, 1000 cwt	3.17	2.62	3.52	kg_wet/m^2
EXPOSURE	YELD	kg_fruit_wet/m^2	Food crop yield	2.other	Watermelon (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)			3.03	2.45	3.57	kg_wet/m^2

Table G.5. (contd)

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food Type	Data Cited Crop	Reference	Units Cited	Comment	Data Reported	Average	Min Value	Max Value	Units
EXPOSURE	YELD	kg_wet/m^2	Food crop yield	2.other	winter potatoes (U.S. average, 1998-2006)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1235. Last accessed 7/17/12 SFS. Table 1.	1000 cwt; harvested 1000 ac (calculated to lb/ac)	Assumed leaf mass negligible compared to potato mass.	annual, U.S. totals, ac, 1000 cwt	2.9	2.23	3.29	kg_wet/m^2
EXPOSURE	YELD	kg_fruit_wet/m^2	Food crop yield	2.other	All melons, (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12 sfs. Table 003.	1E6 cwt/ 1000 ac (calculated to lb/ac)		annual melons, 1e6 cwt. 1000 ac	2.88	2.41	3.29	kg_wet/m^2
EXPOSURE	YELD	kg_fruit_wet/m^2	Food crop yield	2.other	Cantaloupe (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)			2.75	2.34	3.1	kg_wet/m^2
EXPOSURE	YELD	kg_fruit_wet/m^2	Food crop yield	2.other	Pumpkins (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)			2.57	2.31	2.82	kg_wet/m^2
EXPOSURE	YELD	kg_fruit_wet/m^2	Food crop yield	2.other	Honeydew (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)			2.42	2.1	2.7	kg_wet/m^2
EXPOSURE	YELD	kg_fruit_wet/m^2	Food crop yield	2.other	Cucumbers (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)			2.14	1.93	2.34	kg_wet/m^2
EXPOSURE	YELD	kg_wet/m^2	Food crop yield	2.other	Broccoli (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)		1000 cwt, ac.	1.55	1.35	1.73	kg_wet/m^2

Table G.5. (contd)

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food Type	Data Cited Crop	Reference	Units Cited	Comment	Data Reported	Average	Min Value	Max Value	Units
EXPOSURE	YELD	kg_fruit_wet/m^2	Food crop yield	2.other	Snap beans (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)			0.689	0.624	0.756	kg_wet/m^2
EXPOSURE	YELD	kg_fruit_wet/m^2	Food crop yield	2.other	blueberries (AL, AR, CA, FL, GA, IN, MI, MS, NJ, NY, NC, OR, WA, averages, mostly 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1377. Last accessed 7/18/12. sfs. Table D-2.	lb/ac		annual, select states reporting, lb/ac, average average, avg min, avg max	0.489	0.323	0.637	kg_wet/m^2
EXPOSURE	YELD	kg_wet/m^2	Food crop yield	2.other	Asparagus (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)		1000 cwt, ac	0.24	0.19	0.278	kg_wet/m^2
EXPOSURE	YELD	kg_fruit_wet/m^2	Food crop yield	3. fruit	peaches (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1377. Last accessed 7/18/12 sfs. Table B-24, Table A-4.	1E6 pounds; 1000 ac (calculated to lb/ac)		annual, U.S. totals, ac, 1E6 lbs	1.94	1.68	2.19	kg_wet/m^2
EXPOSURE	YELD	kg_fruit_wet/m^2	Food crop yield	3.fruit	FL oranges – assumed all juice (1998-2011 harvest year)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1377. Last accessed 7/18/12 SFS. Table C-19, Table C-21.	short tons/ac (FL)	Juice oranges – Florida only	annual oranges, FL, ton/ac	3.47	2.73	4.32	kg_wet/m^2
EXPOSURE	YELD	kg_fruit_wet/m^2	Food crop yield	3.fruit	apples (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1377. Last accessed 7/17/12 SFS; Table B-4 (Apples) and Table A-4 (Bearing acreage).	1E6 pounds; 1000 ac (calculated to lb/ac)		annual, U.S. totals, ac, 1E6 lbs	2.78	2.38	3.05	kg_wet/m^2

Table G.5. (contd)

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food Type	Data Cited Crop	Reference	Units Cited	Comment	Data Reported	Average	Min Value	Max Value	Units
EXPOSURE	YELD	kg_fruit_wet/m^2	Food crop yield	3.fruit	CA, AZ, TX oranges – assumed all fresh consumption (1998-2010 harvest year)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1377. Last accessed 7/18/12 SFS. Table C-19, Table C-21.	short tons/ac (CA, TX, AZ)	Fresh oranges – CA, TX, AZ only	annual oranges, CA TX, AZ, ton/ac	1.84	1.45	2.59	kg_wet/m^2
EXPOSURE	YELD	kg_fruit_wet/m^2	Food crop yield	3.fruit	grapes (U.S. average, 1998-2009)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1377. Last accessed 7/18/12 SFS. Table B-14, Table A-4.	1000 short tons; 1000 ac (calculated to lb/ac)		annual, U.S. totals, ac, 1000 short tons.	1.65	1.49	1.87	kg_wet/m^2
EXPOSURE	YELD	kg_wet/m^2	Food crop yield	3.fruit	bananas, Hawaii (1998 2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1377. Last accessed 7/17/12 SFS. Table B-10.			annual, Hawaii, ac, 1000 lbs	0.0016	0.0012	0.0024	kg_wet/m^2
EXPOSURE	YELD	kg_wet/m^2	Food crop yield	4.grain	Sweet corn (U.S. average, 1998-2010)	From: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212. Last accessed 7/18/12. Table 006, Table 005.	1000 cwt, ac (calculated to lb/ac)	Assumed most of stalk, leaves also harvested. Assumed stalk and leaf mass equals edible corn mass.		2.58	2.42	2.78	kg_wet/m^2

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Appendix H

Dry-to-Wet Ratios

Appendix H

Dry-to-Wet Ratios

The dry-to-wet ratio for each food crop is used to convert between dry and wet weight bases. These data are also helpful when information found in open literature must be converted to the appropriate dry- or wet-bases for model input. Aquatic plant concentrations are modeled solely from bioconcentration from water with no sediment-to-plant uptake, as done with terrestrial crop models. Therefore, no dry-to-wet ratios for aquatic foods are provided.

Table H.1. Meat Animal Feed

Gv2_module	Gv2_ID	Gv2_Units[a]	Gv2_Description	Feed Type	Reference	Values Cited	Units Cited	Comment	Data Reported	Value in Gv2 Units	Units[a]
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	Ensminger et al. (1990, Table V-1)	0.09	% converted to fraction	fresh turnip root	Datum	0.09	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	IAEA (2009, Table 2)	22	percent dry matter, as fed	sugar beet	Datum	0.22	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	IAEA (2009, Table 2)	26	percent dry matter, as fed	alfalfa, vegetative mass	Datum	0.26	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	IAEA (2009, Table 3)	0.26	dry matter fraction, as fed[b]	grass silage	Datum	0.26	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	IAEA (2009, Table 3)	0.34	dry matter fraction, as fed[b]	lucerne silage (aka alfalfa silage)	Datum	0.34	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	Ensminger et al. (1990, Table V-1)	0.5	% converted to fraction	fresh acorn	Datum	0.5	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1.meat animal feed	IAEA (2009, Table 2)	85.2	percent dry matter	maize (corn), grain	Datum	0.85	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	IAEA (2009, Table 3)	0.86	dry matter fraction, as fed[b]	grass hay	Datum	0.86	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	IAEA (2009, Table 3)	0.86	dry matter fraction, as fed[b]	lucerne hay (aka alfalfa hay)	Datum	0.86	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1.meat animal feed	IAEA (2009, Table 2)	86.7	percent dry matter	oats, grain	Datum	0.87	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1.meat animal feed	IAEA (2009, Table 2)	87	percent dry matter	winter rye, grain	Datum	0.87	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1.meat animal feed	IAEA (2009, Table 2)	87	percent dry matter	barley, grain	Datum	0.87	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1.meat animal feed	IAEA (2009, Table 2)	87	percent dry matter	sorghum, grain	Datum	0.87	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	Ensminger et al. (1990, Table V-1)	0.87	% converted to fraction	rye grain	Datum	0.87	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	IAEA (2009, Table 3)	0.88	dry matter fraction, as fed[b]	"concentrate feed"	Datum	0.88	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1.meat animal feed	IAEA (2009, Table 2)	88	percent dry matter	wheat, grain	Datum	0.88	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	Ensminger et al. (1990, Table V-1)	0.88	% converted to fraction	barley grain	Datum	0.88	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	Ensminger et al. (1990, Table V-1)	0.88	% converted to fraction	corn grain	Datum	0.88	dry/wet

Table H.1. (contd)

Gv2_module	Gv2_ID	Gv2_Units[(a)]	Gv2_Description	Feed Type	Reference	Values Cited	Units Cited	Comment	Data Reported	Value in Gv2 Units	Units[(a)]
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	Ensminger et al. (1990, Table V-1)	0.88	% converted to fraction	durum wheat	Datum	0.88	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	Ensminger et al. (1990, Table V-1)	0.88	% converted to fraction	lentil grain	Datum	0.88	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	Ensminger et al. (1990, Table V-1)	0.88	% converted to fraction	millet	Datum	0.88	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	IAEA (2009, Table 2)	88.6	percent dry matter	soybean seeds	Datum	0.89	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	Ensminger et al. (1990, Table V-1)	0.89	% converted to fraction	dry kidney bean	Datum	0.89	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	Ensminger et al. (1990, Table V-1)	0.89	% converted to fraction	oat grain	Datum	0.89	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	Ensminger et al. (1990, Table V-1)	0.89	% converted to fraction	rice grain	Datum	0.89	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	Ensminger et al. (1990, Table V-1)	0.89	% converted to fraction	sun-cured alfalfa-orchardgrass hay	Datum	0.89	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	Ensminger et al. (1990, Table V-1)	0.89	% converted to fraction	wheat grain	Datum	0.89	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	Ensminger et al. (1990, Table V-1)	0.9	% converted to fraction	sorghum grain	Datum	0.9	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	Ensminger et al. (1990, Table V-1)	0.9	% converted to fraction	soybean mill feed	Datum	0.9	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	Ensminger et al. (1990, Table V-1)	0.91	% converted to fraction	sun-cured alfalfa grass hay	Datum	0.91	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	Ensminger et al. (1990, Table V-1)	0.92	% converted to fraction	soybean seed	Datum	0.92	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	Ensminger et al. (1990, Table V-1)	0.93	% converted to fraction	sun-cured alfalfa timothy grass hay	Datum	0.93	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	1.meat animal feed	Ensminger et al. (1990, Table V-1)	90	% converted to fraction	dry pinto bean	Datum	90	dry/wet

(a) Gv2 units for feed types indicate kg_dry/kg_wet, where kg_wet is the as-fed mass. This can differ from the as-harvested mass of the feed crop.
(b) Corrects error in reported units, which were %.

Table H.2. Poultry Feed

Gv2_module	Gv2_ID	Gv2_Units[a]	Gv2_Description	Feed Type	Reference	Values Cited	Units Cited	Comment	Data Reported	Value in Gv2 Units	Units[a]
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	2.poultry feed	IAEA (2009, Table 3)	0.34	dry matter fraction, as fed[b]	lucerne silage (aka alfalfa silage)	Datum	0.34	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2.poultry feed	IAEA (2009, Table 2)	85.2	percent dry matter	maize (corn), grain	Datum	0.85	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	2.poultry feed	Ensminger et al. (1990, Table V-1)	0.85-0.90	% converted to fraction	dried corn	mean of range	0.88	dry/wet

(a) Gv2 units for feed types indicate kg_dry/kg_wet, where kg_wet is the as-fed mass. This can differ from the as-harvested mass of the feed crop.
(b) Corrects error in reported units, which were %.

Table H.3. Milk Feed

Gv2_module	Gv2_ID	Gv2_Units[a]	Gv2_Description	Feed Type	Reference	Values Cited	Units Cited	Comment	Data Reported	Value in Gv2 Units	Units[a]
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	3. milk feed	see meat animal feed				Datum		dry/wet

(a) Gv2 units for feed types indicate kg_dry/kg_wet, where kg_wet is the as-fed mass. This can differ from the as-harvested mass of the feed crop.

Table H.4. Egg Layer Feed

Gv2_module	Gv2_ID	Gv2_Units[a]	Gv2_Description	Feed Type	Reference	Values Cited	Units Cited	Comment	Data Reported	Value in Gv2 Units	Units[a]
EXPOSURE	DRYFA2	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	4.egg layer feed	IAEA (2009, Table 2)	85.2	percent dry matter	maize (corn), grain	Datum	0.85	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	4.egg layer feed	Ensminger et al. (1990, Table V-1)	0.85-0.90	% converted to fraction	dried corn	Datum	0.875	dry/wet

(a) Gv2 units for feed types indicate kg_dry/kg_wet, where kg_wet is the as-fed mass. This can differ from the as-harvested mass of the feed crop.

Table H.5. Meat Animal Forage

Gv2_module	Gv2_ID	Gv2_Units[a]	Gv2_Description	Feed Type	Reference	Values Cited	Units Cited	Comment	Data Reported	Value in Gv2 Units	Units[a]
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	IAEA (2009, Table 3)	0.25	dry matter fraction, as fed[b]	corn silage	Datum	0.25	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.13-0.38	% converted to fraction	silage- sweet potato	mean of range	0.26	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.22-0.30	% converted to fraction	silage- sugarcane	mean of range	0.26	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.26	% converted to fraction	silage- sunflower	Datum	0.26	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.27	% converted to fraction	silage- corn-soybean	Datum	0.27	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.27	% converted to fraction	silage- oats-vetch	Datum	0.27	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.3	% converted to fraction	silage- clover-grass	Datum	0.3	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.26-0.35	% converted to fraction	silage- grass legume	mean of range	0.31	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.31	% converted to fraction	silage- sweet corn (canning residue)	Datum	0.31	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.33	% converted to fraction	silage- meadow fescue	Datum	0.33	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.34	% converted to fraction	silage- corn-sorghum	Datum	0.34	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.35	% converted to fraction	silage- oats	Datum	0.35	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.33-0.43	% converted to fraction	silage- timothy	mean of range	0.38	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.25-0.54	% converted to fraction	silage-corn	mean of range	0.40	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.26-0.56	% converted to fraction	silage- alfalfa bromegrass	mean of range	0.41	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.27-0.57	% converted to fraction	silage- alfalfa	mean of range	0.42	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.28-0.57	% converted to fraction	silage- alfalfa orchardgrass	mean of range	0.43	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.24-0.62	% converted to fraction	silage- sorghum	mean of range	0.43	dry/wet

Table H.5. (contd)

Gv2_module	Gv2_ID	Gv2_Units[(a)]	Gv2_Description	Feed Type	Reference	Values Cited	Units Cited	Comment	Data Reported	Value in Gv2 Units	Units[(a)]
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.43	% converted to fraction	silage-corn ear with husk	Datum	0.43	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.7	% converted to fraction	silage-corn ear	Datum	0.7	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.78	% converted to fraction	silage-corn husk	Datum	0.78	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.82	% converted to fraction	sun-cured corn fodder with ears, husks, mature	Datum	0.82	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.85	% converted to fraction	sun-cured stover without ears or husks	Datum	0.85	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.88	% converted to fraction	sun-cured barley hay	Datum	0.88	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.88	% converted to fraction	sun-cured clover hay	Datum	0.88	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.88	% converted to fraction	sun-cured red clover grass	Datum	0.88	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.88	% converted to fraction	sun-cured sorghum fodder	Datum	0.88	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.89	% converted to fraction	sun-cured Kentucky bluegrass	Datum	0.89	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.89	% converted to fraction	sun-cured wheat hay	Datum	0.89	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.9	% converted to fraction	sun-cured bahia grass	Datum	0.9	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.9	% converted to fraction	sun-cured sorghum fodder with heads	Datum	0.90	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.91	% converted to fraction	sun-cured Bermuda grass hay	Datum	0.91	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.91	% converted to fraction	sun-cured oats hay	Datum	0.91	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	5.meat animal forage	Ensminger et al. (1990, Table V-1)	0.92	% converted to fraction	immature dehydrated cereals	Datum	0.92	dry/wet

(a) Gv2 units for feed types indicate kg_dry/kg_wet, where kg_wet is the as-fed mass. This can differ from the as-harvested mass of the feed crop.
(b) Corrects error in reported units, which were %.

Table H.6. Milk Forage

Gv2_module	Gv2_ID	Gv2_Units[a]	Gv2_Description	Feed Type	Reference	Values Cited	Units Cited	Comment	Data Reported	Value in Gv2 Units	Units[a]
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.13	% converted to fraction	fresh turnip	Datum	0.13	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.14	% converted to fraction	fresh dandelion leaves	Datum	0.14	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.15-0.17	% converted to fraction	fresh sunflower	mean of range	0.16	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.17	% converted to fraction	fresh rape	Datum	0.17	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.17	% converted to fraction	fresh sugar beet with tops, crowns	Datum	0.17	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.18	% converted to fraction	fresh corn-sunflower	Datum	0.18	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	IAEA (2009, Table 2)	20	percent dry matter, as fed	sudan grass, vegetative mass	Datum	0.20	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	IAEA (2009, Table 2)	20	percent dry matter, as fed	annual ryegrass, vegetative mass	Datum	0.20	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	IAEA (2009, Table 2)	20	percent dry matter, as fed	meadow fescue, vegetative mass	Datum	0.20	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	IAEA (2009, Table 3)	0.20	dry matter fraction, as fed[b]	pasture	Datum	0.20	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	IAEA (2009, Table 2)	20.8	percent dry matter, as fed	fussion brome grass, vegetative mass	Datum	0.21	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.21	% converted to fraction	fresh barley	Datum	0.21	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	IAEA (2009, Table 2)	22	percent dry matter, as fed	red clover, vegetative mass	Datum	0.22	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	IAEA (2009, Table 2)	22	percent dry matter, as fed	meadow grass, vegetative mass	Datum	0.22	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.22	% converted to fraction	fresh alfalfa-timothy	Datum	0.22	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.18-0.26	% converted to fraction	fresh clover	mean of range	0.22	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.22	% converted to fraction	fresh wheat	Datum	0.22	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	IAEA (2009, Table 2)	22.6	percent dry matter, as fed	winter rye, vegetative mass, no grain	Datum	0.23	dry/wet

Table H.6. (contd)

Gv2_module	Gv2_ID	Gv2_Units[(a)]	Gv2_Description	Feed Type	Reference	Values Cited	Units Cited	Comment	Data Reported	Value in Gv2 Units	Units[(a)]
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.2-0.26	% converted to fraction	fresh alfalfa	mean of range	0.23	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.23	% converted to fraction	fresh soybean	Datum	0.23	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.24	% converted to fraction	fresh grass	Datum	0.24	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	IAEA (2009, Table 2)	25	percent dry matter, as fed	sorghum, vegetative mass	Datum	0.25	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	IAEA (2009, Table 2)	25.5	percent dry matter, as fed	timothy grass, vegetative mass	Datum	0.26	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.22-0.3	% converted to fraction	fresh tall oatgrasses	mean of range	0.26	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.27	% converted to fraction	fresh ragweed	Datum	0.27	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.2-0.35	% converted to fraction	fresh sorghum	mean of range	0.28	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	IAEA (2009, Table 2)	27.6	percent dry matter, as fed	oats, vegetative mass, no grain	Datum	0.28	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.28	% converted to fraction	fresh meadow fescue	Datum	0.28	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.28	% converted to fraction	fresh meadow foxtail	Datum	0.28	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.28	% converted to fraction	fresh sugarcane	Datum	0.28	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.28	% converted to fraction	fresh tall fescue	Datum	0.28	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.28	% converted to fraction	fresh timothy	Datum	0.28	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.29	% converted to fraction	fresh barley grass	Datum	0.29	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.3	% converted to fraction	fresh bahiagrass	Datum	0.30	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.22-0.38	% converted to fraction	fresh corn plants	Datum	0.30	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	IAEA (2009, Table 2)	34	percent dry matter, as fed	slender wheatgrass, vegetative mass	Datum	0.34	dry/wet

Table H.6. (contd)

Gv2_module	Gv2_ID	Gv2_Units[a]	Gv2_Description	Feed Type	Reference	Values Cited	Units Cited	Comment	Data Reported	Value in Gv2 Units	Units[a]
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.31-0.42	% converted to fraction	fresh bluegrass	mean of range	0.37	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.38	% converted to fraction	fresh rabbitbrush	Datum	0.38	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.22-0.55	% converted to fraction	fresh cheatgrass	mean of range	0.39	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.23-0.34	% converted to fraction	fresh orchard grass	mean of range	0.39	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.48	% converted to fraction	fresh Indian ricegrass	Datum	0.48	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.28-0.75	% converted to fraction	fresh crested wheatgrass	mean of range	0.52	dry/wet
EXPOSURE	DRYFA2	kg_dry/kg_as-fed	Dry-to-wet conversion factor for animal feed.	6. milk forage	Ensminger et al. (1990, Table V-1)	0.28-0.75	% converted to fraction	fresh wheatgrass	mean of range	0.52	dry/wet

(a) Gv2 units for feed types indicate kg_dry/kg_wet, where kg_wet is the as-fed mass. This can differ from the as-harvested mass of the feed crop.
(b) Corrects error in reported units, which were %.

Table H.7. Leafy Vegetables

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food type[(a)]	Reference[(b)]	Values Cited	Units Cited	Comment	Data Reported	Value in Gv2 units	Units
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1. Leafy veg	USDA (2011, Nutrient Database, Release 24)	95.64	g water/100 g veg	head lettuce	Datum	0.05	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1. Leafy veg	USDA (2011, Nutrient Database, Release 24)	95.64	g water/100 g veg	leaf lettuce	Datum	0.05	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1. Leafy veg	Gebhardt and Thomas (2002, H&G Bulletin 72)	96	percent water	butterhead lettuce. Value limited by GENII limit of 0.05.	Datum	0.05	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1. Leafy veg	Gebhardt and Thomas (2002, H&G Bulletin 72)	96	percent water	crisphead (iceberg) lettuce.	Datum	0.05	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1. Leafy veg	Gebhardt and Thomas (2002, H&G Bulletin 72)	95	percent water	romaine lettuce	Datum	0.05	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1. Leafy veg	Gebhardt and Thomas (2002, H&G Bulletin 72)	94	percent water	mustard greens	Datum	0.06	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1. Leafy veg	IAEA (2009, Table 2)	8	percent dry matter	lettuce	Datum	0.08	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1. Leafy veg	IAEA (2009, Table 2)	8	percent dry matter	spinach	Datum	0.08	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1. Leafy veg	Gebhart and Thomas (2002, H&G Bulletin 72)	92	percent water	cabbage	Datum	0.08	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1. Leafy veg	USDA (2011, Nutrient Database, Release 24)	90.55	g water/100 g veg	collard greens	Datum	0.09	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1. Leafy veg	USDA (2011, Nutrient Database, Release 24)	91.4	g water/100 g veg	fresh spinach	Datum	0.09	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1. Leafy veg	IAEA (2009, Table 2)	12	percent dry matter	cabbage	Datum	0.12	dry/wet

Table H.7. (contd)

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food type[(a)]	Reference[(b)]	Values Cited	Units Cited	Comment	Data Reported	Value in Gv2 units	Units
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1. Leafy veg/high SA	IAEA (2009, Table 2)	6	percent dry matter	celery	Datum	0.06	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	1. Leafy veg/high SA	Gebhardt and Thomas (2002, H&G Bulletin 72)	91	percent water	broccoli	Datum	0.09	dry/wet

(a) "Leafy Vegetables" food types further qualified by /high SA to indicate edible crops with high surface area-to-volume ratios, which can be adequately represented by the leafy vegetable model of Gv2. "Other vegetables" food types further qualified as /root, /berry, /melon-cuke, /bean FW (fresh-weight bean), or /bean DW (dried bean) to provide further details. Feed/Forage are leafy or grain materials that can be used for feed or forage by terrestrial animals.

(b) Standard deviation on water fraction provided in USDA (2011) database.

Table H.8. Other Vegetables

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food type[a]	Reference[b]	Values Cited	Units Cited	Comment	Data Reported	Value in Gv2 units	Units
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg	Gebhardt and Thomas (2002, H&G Bulletin 72)	94	percent water	tomato	Datum	0.06	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg	IAEA (2009, Table 2)	6	percent dry matter	tomato	Datum	0.06	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg	USDA (2011, Nutrient Database, Release 24)	92.54	g water/100 g veg	mushroom	Datum	0.08	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg	Gebhardt and Thomas (2002, H&G Bulletin 72)	92	percent water	raw mushroom	Datum	0.08	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg	Gebhardt and Thomas (2002, H&G Bulletin 72)	92	percent water	sweet pepper	Datum	0.08	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg	Gebhardt and Thomas (2002, H&G Bulletin 72)	92	percent water	tomatillo	Datum	0.08	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg	USDA (2011, Nutrient Database, Release 24)	90.95	g water/100 g veg	strawberries, raw	Datum	0.09	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg	USDA (2011, Nutrient Database, Release 24)	90.32	g water/100 g veg	fresh snap bean	Datum	0.10	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg	Gebhardt and Thomas (2002, H&G Bulletin 72)	89	percent water	peas, edible pod	Datum	0.11	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg	Gebhardt and Thomas (2002, H&G Bulletin 72)	89	percent water	snap beans	Datum	0.11	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg	IAEA (2009, Table 2)	11	percent dry matter	cauliflower	Datum	0.11	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg	Gebhardt and Thomas (2002, H&G Bulletin 72)	87	percent water	pineapple	Datum	0.13	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg	USDA (2011, Nutrient Database, Release 24)	76.05	g water/100 g veg	fresh sweet corn. See grain, for dehydrated grain corn.	Datum	0.24	dry/wet

Table H.8. (contd)

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food type[a]	Reference[b]	Values Cited	Units Cited	Comment	Data Reported	Value in Gv2 units	Units
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg	Gebhardt and Thomas (2002, H&G Bulletin 72)	75	percent water	black-eyed peas	Datum	0.25	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg	Gebhardt and Thomas (2002, H&G Bulletin 72)	70	percent water	fresh raw sweet corn kernels	Datum	0.30	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg	Gebhardt and Thomas (2002, H&G Bulletin 72)	69	percent water	soybean, green cooked	Datum	0.31	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/bean DW	IAEA (2009, Table 2)	83	percent dry matter	garden pea, seeds	Datum	0.83	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/bean DW	IAEA (2009, Table 2)	85.1	percent dry matter	field pea, seeds	Datum	0.85	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/bean DW	IAEA (2009, Table 2)	88	percent dry matter	broadbean seeds	Datum	0.88	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/bean DW	IAEA (2009, Table 2)	88.6	percent dry matter	soybean seeds	Datum	0.89	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/berry	IAEA (2009, Table 4)	10.8	percent dry matter, mean	cranberry	Datum	0.11	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/berry	Gebhardt and Thomas (2002, H&G Bulletin 72)	87	percent water	raspberries	Datum	0.13	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/berry	IAEA (2009, Table 4)	13.2	percent dry matter, mean	blueberry	Datum	0.13	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/berry	Gebhardt and Thomas (2002, H&G Bulletin 72)	86	percent water	blackberries	Datum	0.14	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/berry	IAEA (2009, Table 4)	15.4	percent dry matter, mean	wild strawberry	Datum	0.15	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/berry	IAEA (2009, Table 2)	16	percent dry matter	raspberry	Datum	0.16	dry/wet

Table H.8. (contd)

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food type[a]	Reference[b]	Values Cited	Units Cited	Comment	Data Reported	Value in Gv2 units	Units
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/berry	IAEA (2009, Table 4)	17.3	percent dry matter, mean	wild raspberry	Datum	0.17	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/berry	Gebhardt and Thomas (2002, H&G Bulletin 72)	81	percent water	grape, seedless	Datum	0.19	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/melon-cuke	Gebhardt and Thomas (2002, H&G Bulletin 72)	96	percent water	cucumber. Limited by GENII limit of 0.05.	Datum	0.05	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/melon-cuke	IAEA (2009, Table 2)	5	percent dry matter	cucumber.	Datum	0.05	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/melon-cuke	IAEA (2009, Table 2)	5	percent dry matter	zucchini	Datum	0.05	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/melon-cuke	Gebhardt and Thomas (2002, H&G Bulletin 72)	94	percent water	summer squash (zucchini)	Datum	0.06	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/melon-cuke	Gebhardt and Thomas (2002, H&G Bulletin 72)	92	percent water	watermelon	Datum	0.08	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/melon-cuke	Gebhardt and Thomas (2002, H&G Bulletin 72)	90	percent water	cantaloupe, edible portion	Datum	0.10	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/root	IAEA (2009, Table 2)	9	percent dry matter	radish	Datum	0.09	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/root	Gebhardt and Thomas (2002, H&G Bulletin 72)	90	percent water	raw onion	Datum	0.10	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/root	USDA (2011, Nutrient Database, Release 24)	89.11	g water/100 g veg	fresh onion	Datum	0.11	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/root	USDA (2011, Nutrient Database, Release 24)	88.29	g water/100 g veg	fresh carrots, includes tops	Datum	0.12	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/root	Gebhardt and Thomas (2002, H&G Bulletin 72)	88	percent water	fresh carrots	Datum	0.12	dry/wet

Table H.8. (contd)

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food type[(a)]	Reference[(b)]	Values Cited	Units Cited	Comment	Data Reported	Value in Gv2 units	Units
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/root	IAEA (2009, Table 2)	14	percent dry matter	carrot	Datum	0.14	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/root	USDA (2011, Nutrient Database, Release 24)	78.58	g water/100 g veg	fresh potato	Datum	0.21	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/root	IAEA (2009, Table 2)	21	percent dry matter	potato	Datum	0.21	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/root	USDA (2011, Nutrient Database, Release 24)	77.28	g water/100 g veg	fresh sweet potato	Datum	0.23	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	2. Other veg/root	Derived from Gebhardt and Thomas (2002, H&G Bulletin 72)	67	percent water	raw potato (potato skin, peeled potato)	Datum	0.33	dry/wet

(a) "Leafy Vegetables" food types further qualified by /high SA to indicate edible crops with high surface area-to-volume ratios, which can be adequately represented by the leafy vegetable model of Gv2. "Other vegetables" food types further qualified as /root, /berry, /melon-cuke, /bean FW (fresh-weight bean), or /bean DW (dried bean) to provide further details. Feed/Forage are leafy or grain materials that can be used for feed or forage by terrestrial animals.
(b) Standard deviation on water fraction provided in USDA (2011) database.

Table H.9. Fruit

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food type[a]	Reference[b]	Values Cited	Units Cited	Comment	Data Reported	Value in Gv2 units	Units
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit	Gebhardt and Thomas (2002, H&G Bulletin 72)	89	percent water	lemon, no peel	Datum	0.11	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit	Gebhardt and Thomas (2002, H&G Bulletin 72)	88	percent water	Asian pear	Datum	0.12	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit	Gebhardt and Thomas (2002, H&G Bulletin 72)	88	percent water	peach, no pit	Datum	0.12	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit	Gebhardt and Thomas (2002, H&G Bulletin 72)	87	percent water	orange, no peel or seed	Datum	0.13	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit	USDA (2011, Nutrient Database, Release 24)	86.35	g water/100 g veg	apricots, raw	Datum	0.14	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit	USDA (2011, Nutrient Database, Release 24)	85.56	g water/100 g veg	apple, raw with skin	Datum	0.15	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit	Gebhardt and Thomas (2002, H&G Bulletin 72)	85	percent water	plum	Datum	0.15	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit	USDA (2011, Nutrient Database, Release 24)	83.71	g water/100 g veg	pears, raw	Datum	0.16	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit	Gebhardt and Thomas (2002, H&G Bulletin 72)	84	percent water	apple, raw unpeeled	Datum	0.16	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit	Gebhardt and Thomas (2002, H&G Bulletin 72)	84	percent water	pear, cored	Datum	0.16	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit	Gebhardt and Thomas (2002, H&G Bulletin 72)	83	percent water	kiwi fruit, no skin	Datum	0.17	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit	Gebhardt and Thomas (2002, H&G Bulletin 72)	82	percent water	mango, no skin or seed	Datum	0.18	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit	Gebhardt and Thomas (2002, H&G Bulletin 72)	81	percent water	sweet cherries, no pits or stems	Datum	0.19	dry/wet

Table H.9. (contd)

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food type[(a)]	Reference[(b)]	Values Cited	Units Cited	Comment	Data Reported	Value in Gv2 units	Units
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit	USDA (2011, Nutrient Database, Release 24)	78.81	g water/100 g veg	avocado, raw (FLA)	Datum	0.21	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit	Gebhardt and Thomas (2002, H&G Bulletin 72)	74	percent water	banana	Datum	0.26	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit	USDA (2011, Nutrient Database, Release 24)	72.33	g water/100 g veg	avocado, raw (CA)	Datum	0.28	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit	Gebhardt and Thomas (2002, H&G Bulletin 72)	15	percent water	raisins, as eaten	Datum	0.85	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit/nut	Gebhardt and Thomas (2002, H&G Bulletin 72)	5	percent water	Tree growth, other veg - almond (edible nut)	Datum	0.95	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit/nut	Gebhardt and Thomas (2002, H&G Bulletin 72)	5	percent water	Tree growth, other veg - hazelnut (edible nut)	Datum	0.95	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	3. Fruit/nut	Gebhardt and Thomas (2002, H&G Bulletin 72)	4	percent water	Tree growth, other veg - walnut (edible nut). Limited by Gv2 max of 0.95.	Datum	0.95	dry/wet

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(b) Standard deviation on water fraction provided in USDA (2011) database.

Table H.10. Grains

Gv2_module	Gv2_ID	Gv2_Units	Gv2_Description	Food type[a]	Reference[b]	Values Cited	Units Cited	Comment	Data Reported	Value in Gv2 units	Units
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	4. Grain	IAEA (2009, Table 2)	85.2	percent dry matter	maize (corn), grain	Datum	0.85	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	4. Grain	IAEA (2009, Table 2)	86.7	percent dry matter	oats, grain	Datum	0.87	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	4. Grain	IAEA (2009, Table 2)	87	percent dry matter	winter rye, grain	Datum	0.87	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	4. Grain	IAEA (2009, Table 2)	87	percent dry matter	barley, grain	Datum	0.87	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	4. Grain	IAEA (2009, Table 2)	87	percent dry matter	sorghum, grain	Datum	0.87	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	4. Grain	Gebhardt and Thomas (2002, H&G Bulletin 72)	12	percent water	rice, white raw	Datum	0.88	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	4. Grain	IAEA (2009, Table 2)	88	percent dry matter	wheat, grain	Datum	0.88	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	4. Grain	Gebhardt and Thomas (2002, H&G Bulletin 72)	10	percent water	cornmeal, whole grain	Datum	0.90	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	4. Grain	Gebhardt and Thomas (2002, H&G Bulletin 72)	9	percent water	couscous, uncooked	Datum	0.91	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	4. Grain	Gebhardt and Thomas (2002, H&G Bulletin 72)	9	percent water	bulgur, uncooked (wheat)	Datum	0.91	dry/wet
Exposure	DRYFAC	kg_dry/kg_wet	Dry-to-wet conversion factor for food crops.	4.Grain	Gebhardt and Thomas (2002, H&G Bulletin 72)	10	percent water	barley, uncooked	Datum	0.90	dry/wet

(a) "Leafy Vegetables" food types further qualified by /high SA to indicate edible crops with high surface area-to-volume ratios, which can be adequately represented by the leafy vegetable model of Gv2. "Other vegetables" food types further qualified as /root, /berry, /melon-cuke, /bean FW (fresh-weight bean), or /bean DW (dried bean) to provide further details. Feed/Forage are leafy or grain materials that can be used for feed or forage by terrestrial animals.

(b) Standard deviation on water fraction provided in USDA (2011) database.

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Appendix I

Holdup Times

Appendix I

Holdup Times

This appendix lists hold-up times found from a single USDA reference and other reasonable anecdotal values from internet sources. Apply values as they seem reasonable for the behaviors, climate, and practices in the region of interest for the indicated food types.

Table I.1. Holdup Times

Gv2_ module	Gv2_ID	Gv2 Units	Gv2_Description	Food Type	Qualifier	Reference	Values Cited	Units Cited	Comment	Data Reported	Recom-mended	Min Value	Max Value	Units
Exposure	HLDUP	d	Intake delay harvest&consumption	1.leafy vegetable	Fresh, refrigerated	(Internet review)			e.g., lettuce, spinach	range	4	1	7	d
Exposure	HLDUP	d	Intake delay harvest&consumption	1.leafy vegetable	Frozen	(Internet review)			e.g., spinach, collards	range	180	30	360	d
Exposure	HLDUP	d	Intake delay harvest&consumption	1.leafy vegetable	Canned – low acid food	USDA FSIS (2012)	2-5	yr	e.g., spinach (not sauerkraut/cabbage)	datum	365			d
Exposure	HLDUP	d	Intake delay harvest&consumption	1.leafy vegetable	Canned – high acid food	USDA FSIS (2012)	1.5	yr	e.g., sauerkruat	datum	240			d
Exposure	HLDUP	d	Intake delay harvest&consumption	2.other vegetable	Frozen	(Internet review)			e.g., asparagus, carrots, peas, lima beans, broccoli, green beans, mushrooms	range	180	30	360	d
Exposure	HLDUP	d	Intake delay harvest&consumption	2.other vegetable	Frozen	(Internet review)			e.g., bell peppers, tomatoes	range	90	15	240	d
Exposure	HLDUP	d	Intake delay harvest&consumption	2.other vegetable	Canned – low acid food	USDA FSIS (2012)	2-5	yr	e.g., carrot, canned beans (not tomato)	datum	365			d
Exposure	HLDUP	d	Intake delay harvest&consumption	2.other vegetable	Canned – high acid food	USDA FSIS (2012)	1.5	yr	e.g., tomato, pickled beets	datum	240			d
Exposure	HLDUP	d	Intake delay harvest&consumption	2.other vegetable	commercially packaged nuts	USDA FSIS (2012)	6-12	mo	Nuts	range	180	180	360	d
Exposure	HLDUP	d	Intake delay harvest&consumption	3.fruit	Canned – low acid food	USDA FSIS (2012)	2-5	yr	e.g., pears (not pineapple, citrus)	datum	365			d
Exposure	HLDUP	d	Intake delay harvest&consumption	3.fruit	Canned – high acid food	USDA FSIS (2012)	1.5	yr	e.g., pineapple, grapefruit	datum	240			d
Exposure	HLDUP	d	Intake delay harvest&consumption	3.fruit	fresh, refrigerated or room temp	USDA FSIS (2012)	0.4-3	wk	Varies by type	range	12	3	21	d
Exposure	HLDUP	d	Intake delay harvest&consumption	3.fruit	dried	USDA FSIS (2012)	1-6	mo	Minimum is room temperature storage, maximum is refrigerated storage	range	90	30	180	d
Exposure	HLDUP	d	Intake delay harvest&consumption	3.fruit	jams, jellies	USDA FSIS (2012)	6-12	mo	Unopened room temperature or refrigerator storage	range	180	180	365	d
Exposure	HLDUPA	d	Intake delay harvest&consumption	1.meat	FROZEN 0ºF. Quality degrades after cited time.	USDA FSIS (2012)	1-2	mo	Bacon, sausage, ham, hot dogs, lunchmeats	range	45	30	60	d
Exposure	HLDUPA	d	Intake delay harvest&consumption	1.meat	FROZEN 0ºF. Quality degrades after cited time.	USDA FSIS (2012)	4-12	mo	Uncooked, not ground meat	range	180	120	365	d

Table I.1. (contd)

Gv2_ module	Gv2_ID	Gv2 Units	Gv2_Description	Food Type	Qualifier	Reference	Values Cited	Units Cited	Comment	Data Reported	Recom-mended	Min Value	Max Value	Units
Exposure	HLDUPA	d	Intake delay harvest&consumption	1.meat	FROZEN 0ºF. Quality degrades after cited time.	USDA FSIS (2012)	3-4	mo	Uncooked ground meat	range	90	90	120	d
Exposure	HLDUPA	d	Intake delay harvest&consumption	1.meat	FROZEN 0ºF. Quality degrades after cited time.	USDA FSIS (2012)	2-3	mo	Soups and stews	range	75	60	90	d
Exposure	HLDUPA	d	Intake delay harvest&consumption	1.meat	FROZEN 0ºF. Quality degrades after cited time.	USDA FSIS (2012)	8-12	mo	Uncooked wild game	range	240	240	365	d
Exposure	HLDUPA	d	Intake delay harvest&consumption	1.meat	Canned – low acid food	USDA FSIS (2012)	2-5	yr	e.g., canned ham.	datum	365			d
Exposure	HLDUPA	d	Intake delay harvest&consumption	1.meat	fresh, refrigerated	USDA FSIS (2012)	3-5	d	Refrigerated storage after purchase. Assumed 10-14 d for processing and transport.	range	14	13	19	d
Exposure	HLDUPA	d	Intake delay harvest&consumption	1.meat	fresh, refrigerated	USDA FSIS (2012)	1-2	d	Ground meat, stew meat. Assumed 10-14 d for processing and transport.	range	14	11	16	d
Exposure	HLDUPA	d	Intake delay harvest&consumption	1.meat	fresh, refrigerated	USDA FSIS (2012)	5-7	d	Cured ham. Assumed 10-14 d for processing and transport.	range	18	15	21	d
Exposure	HLDUPA	d	Intake delay harvest&consumption	1.meat	fresh, refrigerated	USDA FSIS (2012)	1-2	d	Variety meats (tongue, kidney, heart, liver). Assumed 10-14 d for processing and transport.	range	15	11	16	d
Exposure	HLDUPA	d	Intake delay harvest&consumption	1.meat	fresh, refrigerated	USDA FSIS (2012)	2	wk	Hot dogs and luncheon meats, unopened package. Assumed 5-14 d for processing.	range	20	19	28	d
Exposure	HLDUPA	d	Intake delay harvest&consumption	2.dairy	refrigerated	USDA FSIS (2012)	0.5-6	mo	Cheese, processed or hard. Minimum is sliced.	range	75	14	180	d
Exposure	HLDUPA	d	Intake delay harvest&consumption	3.poultry	FROZEN 0ºF. Quality degrades after cited time.	USDA FSIS (2012)	9-12	mo	Uncooked poultry	range	270	270	365	d
Exposure	HLDUPA	d	Intake delay harvest&consumption	3.poultry	FROZEN 0ºF. Quality degrades after cited time.	USDA FSIS (2012)	4	mo	Cooked poultry	datum	120		120	d
Exposure	HLDUPA	d	Intake delay harvest&consumption	3.poultry	Canned – low acid food	USDA FSIS (2012)	2-5	yr	e.g., canned chicken	datum	365			d

Table I.1. (contd)

Gv2_ module	Gv2_ID	Gv2 Units	Gv2_Description	Food Type	Qualifier	Reference	Values Cited	Units Cited	Comment	Data Reported	Recom-mended	Min Value	Max Value	Units
Exposure	HLDUPA	d	Intake delay harvest&consumption	3.poultry	fresh, refrigerated	USDA FSIS (2012)	1-2	d	Refrigerated storage after purchase. Assumed 5-6 d for processing and transport.	range	7	6	8	d
Exposure	HLDUPA	d	Intake delay harvest&consumption	3.poultry	fresh, refrigerated	USDA FSIS (2012)	1-2	d	Game birds. Assumed 1 d for transport.	range	2	2	3	d
Exposure	HLDUPA	d	Intake delay harvest&consumption	3.poultry	commerically smoked (cooked), refrigerated	USDA FSIS (2012)	7	d	Turkey	datum	7		7	d
Exposure	HLDUPA	d	Intake delay harvest&consumption	3.poultry	commerically smoked (cooked), frozen	USDA FSIS (2012)	6	mo	Turkey	datum	100		180	d
Exposure	HLDUPA	d	Intake delay harvest&consumption	4.egg	FROZEN 0ºF. Quality degrades after cited time.	USDA FSIS (2012)	1	yr	Egg whites	datum	180		365	d
Exposure	HLDUPA	d	Intake delay harvest&consumption	4.egg	fresh, refrigerated	USDA FSIS (2012)	3-5	wk	Maximum refrigerated storage after purchase. Assumed 2-3 d for processing and transport.	range	23	14	38	d
Exposure	HLDUP2	d	Intake delay harvest&consumption	1.fish	fresh, refrigerated	USDA FSIS (2012)	1-2	d	Fresh fish and shellfish. Assumed 1-3 d for transport.	range	3	2	5	d
Exposure	HLDUP2	d	Intake delay harvest&consumption	1.fish	commercially smoked, vacuum package	USDA FSIS (2012); Internet review	1	yr	Salmon. Shelf-stable vacuum package.	datum	180	60	365	d
Exposure	HLDUP2	d	Intake delay harvest&consumption	1.fish	home smoked, not vacuum packed	Iinternet review)					5	1	14	d
Exposure	HLDUP2	d	Intake delay harvest&consumption	1.fish	frozen	USDA FSIS (2012)	1	yr	Frozen seafood entrees	datum	180		365	d
Exposure	HLDUP2	d	Intake delay harvest&consumption	1.fish	frozen	(Internet review)			Frozen lean fish (e.g., cod)		90	30	180	d
Exposure	HLDUP2	d	Intake delay harvest&consumption	1.fish	frozen	(Internet review)			Frozen fatty fish (e.g., salmon)		60	30	90	d
Exposure	HLDUP2	d	Intake delay harvest&consumption	1.fish	frozen	(Internet review)			Commercial fishsticks		270	60	365	d
Exposure	HLDUP2	d	Intake delay harvest&consumption	2.mollusk	fresh, refrigerated	USDA FSIS (2012)	1-2	d	Fresh fish and shellfish. Assumed 1-3 d for transport.	range	3	2	5	d

Table I.1. (contd)

Gv2_ module	Gv2_ID	Gv2 Units	Gv2_Description	Food Type	Qualifier	Reference	Values Cited	Units Cited	Comment	Data Reported	Recom-mended	Min Value	Max Value	Units
Exposure	HLDUP2	d	Intake delay harvest&consumption	3.crustacean	fresh, refrigerated	USDA FSIS (2012)	1-2	d	Fresh fish and shellfish. Assumed 1-3 d for transport.	range	3	2	5	d
Exposure	HLDUP2	d	Intake delay harvest&consumption	3.crustacean	cooked then frozen	(Internet review)			shellfish		90	30	120	d
Exposure	HLDUP2	d	Intake delay harvest&consumption	3.crustacean	cooked then frozen	(Internet review)			crab		30	24	60	d
Exposure	HLDUP2	d	Intake delay harvest&consumption	3.crustacean	live lobster, refrigerated	USDA FSIS (2012)	1-2	d	Lobster. Assumed 1 d for transport.	range	2	2	3	d

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Appendix J

Distribution Assumptions

Appendix J

Distribution Assumptions

Parameters used in an environmental model are simplified to individual values. Such discrete parameter definition results in discrete final results. Models can calculate an uncertainty in the final result by defining the range of values appropriate to a parameter and the distribution of values within that range (i.e., probability density function (PDF)). Software, hardware, and research advancements have enabled more sophistication in the parameter definitions. The PDF and minimum and maximum limits (i.e., the range) for parameters can be defined in more complex models. In addition, parameter correlations may be possible with some software. Care must be taken that assumptions regarding parameter distributions, limits, and correlations do not unrealistically characterize the parameters. Sometime such unrealistic results are not known until results are reviewed in detail.

A full discussion regarding parameter uncertainty is not developed here. Uncertainty is inherent to virtually all environmental parameters. The user can refer to the scientific literature for additional information.

The main text of this document indicates ranges and discrete values for the Gv2 parameters. This section reviews distributions *generally appropriate* to the Gv2 parameter. The term “generally appropriate” is used because geographic application and scenario scope among users is quite broad. The user will ultimately need to decide how best to characterize the parameter distribution and range for their scenario. Possible results from non-discrete parameter definitions vary. Use of broad range(s) can result in such a wide uncertainty that the result is meaningless (e.g., dose ranges from far less than background to a lethal dose).

It is recommended that the next step from discrete parameter values be toward a narrow parameter range definition. The parameters with the strongest technical strength could be defined to the extent supported by research. Then it is suggested that the user experiment between broadening the range and varying the distribution type. The data to support decisions may not be available to the user, so caution is advised for range and distribution assumptions not supported by available information. Given the potential number of parameters for which ranges and distributions can be assigned, this task could be daunting.

Gv2 has a defined set of possible PDFs available in the Sensitivity/Uncertainty Multimedia Modeling module (Napier 2012, Section 5). Table J.1, taken directly from the Gv2 SDD (Napier et al. 2012, Section 4.2.3) indicates distribution names and parameter requirements for that distribution. In order to include parameter distributions in Gv2 scenarios, the user must incorporate the Sensitivity module (see **Figure J.1**. Gv2 example cases 17, 18, and 19 can all be reviewed, as these include uncertainty.

The *generally appropriate* parameter distributions are indicated in Table J.2. The first two columns indicate the module and parameter ID, followed by the distribution recommendation. The parameter description and units follow. The next columns, Explicit and Implicit dependency, provide an indication of other parameters or model considerations that the user-defined distribution depends upon. This is important, for example, if the user wants to apply a certain distribution to the intake rate of one age group,

but not another, then separate evaluations must be done. Sometimes the separate evaluations could be done within one scenario; sometimes it is better to organize the separate evaluation in a separate scenario. Implicit dependencies are good to keep in mind, but generally are considered “givens” for the model. The final columns in Table J.2 provide additional commentary.

The parameter distributions indicated in Table J.2 were determined, to the extent possible from the resources used to assign the discrete values, as described in the main text sections (e.g., the majority of the receptor intake module parameter distributions were determined from review of the EPA Exposure Factors Handbook (EPA 2011)). For parameters with limited data, the simplest distribution (uniform) was typically assigned. For strongly linked parameters such as irrigation rate and irrigation time, the decision was made to keep the time component fixed and suggest a distribution only for the rate. Retaining this practice is up to the user.

As a final note, the user is cautioned to proceed with parameter distribution and limit definitions cautiously and to review results with respect to input values. Full understanding of the assumptions used to generate an impact estimate should be understood prior to finalizing or accepting code output.

Additional information and issues related to determining parameter distributions for environmental modeling include Kamboj et al (2000); Chapter 2 of EPA (2011) which discusses variability and uncertainty; and NCRP Report 76 (NCRP 1984) which discuss environmental parameter uncertainty. ICRP Report 101(ICRP 2006), Annex B, also reviews the topic of probabilistic dose estimation.

Table J.1. PDFs Implemented in Gv2

Index	Distribution	Parameterization Requirements
0	Constant	Single value
1	Uniform	Lower limit and upper limit
2	Loguniform (base e)	Lower limit and upper limit are in data (not log) units
3	Normal	Mean and standard deviation
4	Lognormal (base e)	Mean and standard deviation of the underlying normal distribution
5	Triangular	Lower limit, mode, and upper limit
6	User-supplied	Table of n pairs of values (x_i,p_i). The x_i must be unique and ordered in increasing value. The p_i must be unique and ordered in increasing value with p_1=0.0 and p_n=1.0

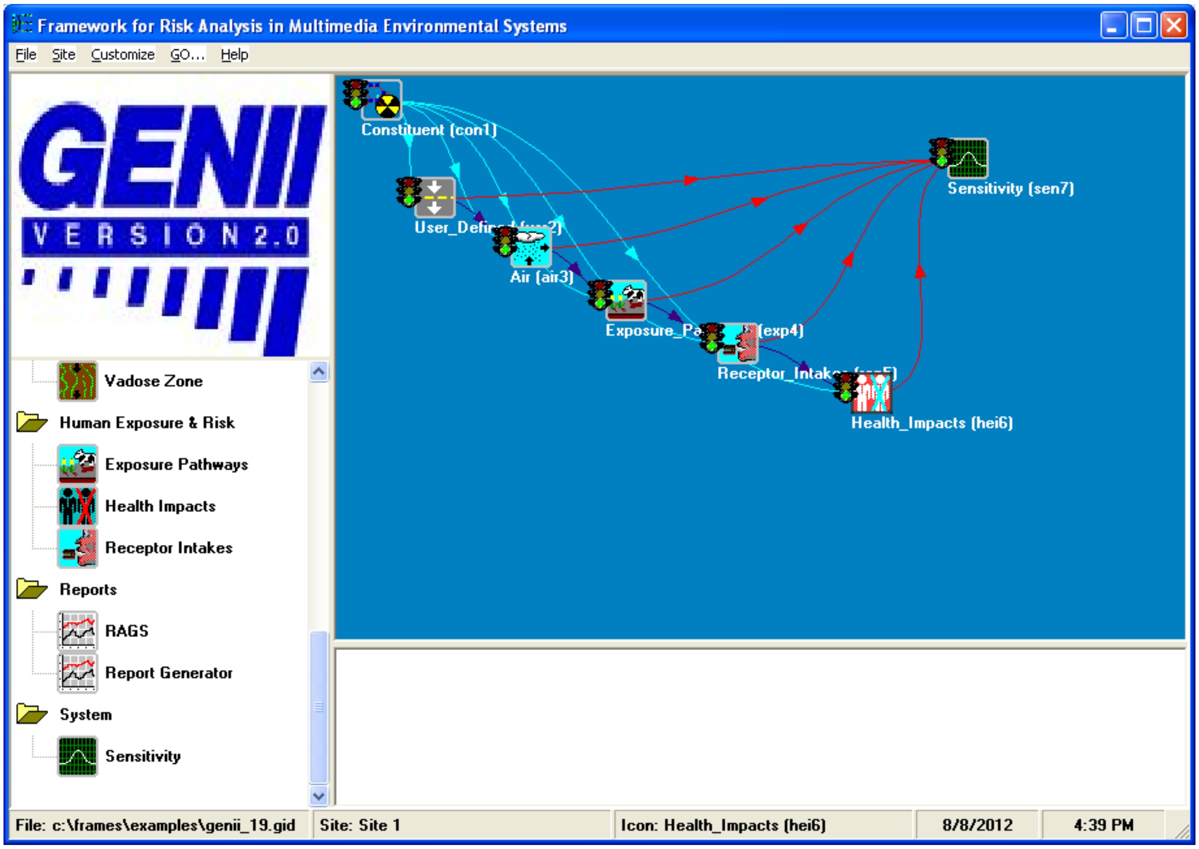

Figure J.1. Gv2.10, Example 19, Indicates Use of Sensitivity Module

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Table J.2. Guideline for Chronic Scenario Parameter Distributions in Gv2

Gv2 Module	GENIIv2 ID	Chronic Scenario Distribution – Assumption	GENII Description	Units	Explicit Dependency	Implicit Dependency	Additional Information Regarding Parameter Distribution	Comment
Constituent	CLWPF	<none suggested>	Water purification factor	unitless	chemical	Type of treatment plant		
Constituent	CLDFAx	lognormal	Inhalation dose factor	rem/pCi	nuclide, age group	ICRP 60/70 modeling and ICRP 66 lung model	Snyder et al. (1994)	
Constituent	CLRDFGx	lognormal	Ingestion dose factor	rem/$pCi_{ingested}$	nuclide, age group	ICRP 60/70 modeling	Snyder et al. (1994)	
Constituent	CLDEX	lognormal	External dose factor, air immersion	mrem/hr per pCi/m^3_{air}	nuclide	ICRP 60 modeling	Snyder et al. (1994)	Adult factors used for all, see Pettousi et al (1991) for discussion of age-dependence.
Constituent	CLDIMR	lognormal	External dose factor, water immersion	mrem/hr per pCi/m^3_{water}	nuclide	ICRP 60 modeling	Snyder et al. (1994)	Adult factors used for all, see Pettousi et al (1991) for discussion of age-dependence.
Constituent	CLDSH15	uniform	External dose factor, ground contamination to 15 cm	mrem/hr per pCi/m^3_{soil} to a soil depth of 15cm	nuclide	ICRP 60 modeling	Snyder et al. (1994)	Adult factors used for all, see Pettousi et al (1991) for discussion of age-dependence.
Constituent	CLBFx, CLBMx	lognormal	Bioaccumulation factor for Aquatic Animals (F=freshwater, M=marine)	L/kg_{wet}	nuclide, freshwater vs. marine; aquatic animal type		ICRP (2009); Kamboj et al. (2000)	Chemical-specific information varies widely in quality and quantity.
Constituent	CLBFP, CLBMP	lognormal	Bioaccumulation factor for Aquatic Plants (F=freshwater, M=marine)	L/kg_{wet}	nuclide, freshwater vs. marine		ICRP (2009)	Chemical-specific information varies widely in quality and quantity.
Constituent	CLFMT	lognormal	Feed to meat transfer factor	d/kg_{wet}	nuclide	Average type of feed consumed	ICRP (2009); Kamboj et al. (2000)	Chemical-specific information varies widely in quality and quantity.
Constituent	CLFMK	lognormal	Feed to milk transfer factor	d/L	nuclide	Average type of feed consumed	ICRP (2009); Kamboj et al. (2000)	Chemical-specific information varies widely in quality and quantity.
Constituent	CLFPL and CLFEG	lognormal	Feed to poultry; and feed to egg transfer factors	d/kg_{wet}	nuclide, poultry or egg	Average type of feed consumed	ICRP (2009)	
Constituent	CLBVx	lognormal	Bioconcentration to edible crop portion from soil	$kg_{dry\_plant}/kg_{dry\_soil}$	nuclide, food type	Value assigned to a food type (e.g., root vegetables) applies to all crops in that category (e.g., potato, tomato)	ICRP (2009); Kamboj et al. (2000)	
Constituent	CLBVAx	lognormal	Bioconcentration to edible feed crop portion from soil	$kg_{dry\_plant}/kg_{dry\_soil}$	nuclide, feed type	Value assigned to a feed type (e.g., meat feed) corresponds to the average value applicable to all feed crops in that category (e.g., corn silage, grass hay)	ICRP (2009); Kamboj et al. (2000)	
Air, Chronic Plume model	ARMINRISESPD	<none suggested>	Minimum air speed during plume rise	m/s				
Air, Chronic Plume model	ARMINSIGYSHIFT	<none suggested>	Sigma shift to semi-infinite cloud shine model	m				
Air, Chronic Plume model	ARTRANSRESIST	<none suggested>	Transfer resistance for iodine and particles	s/m				
Air, Chronic Plume model	ARMINWIND	constant	Maximum wind speed for “calm”	m/s				Determined by instrumentation.
Exposure, Chronic	ABSHUM	normal	Absolute humidity	kg/m^3	spatial, growing season average value	Specific activity equivalence model		Relevant to tritium only

Table J.2. (contd)

Gv2 Module	GENIIv2 ID	Chronic Scenario Distribution – Recommended Assumption	GENII Description	Units	Explicit Dependency	Implicit Dependency	Additional Information Regarding Parameter Distribution	Comment
Exposure, Chronic	RF1	constant	Root fraction	unitless		Relatively uniform distribution of nuclide in top 15 cm of soil.		Assumption is that all roots are in top 15 cm of soil; and that soil contamination is distributed relatively uniformly in the top 15 cm of soil.
Exposure, Chronic	RAIN	normal	Rainfall rate	mm/d	spatial			Suggest that dry years use the same rate. The meteorology file will indicate the number of days it rains and thereby adjust for drier years.
Exposure, Chronic	RIRRR, IRTIMR	normal, constant	Residential land irrigation rate and irrigation time	in/yr and mo/yr	spatial			Dependent parameters – recommend varying one; leave other constant.
Exposure, Chronic	HOLDDW	uniform	Delay time for water distribution	d	typically, distance from treatment plant			
Exposure, Chronic	SEDDN	uniform	Shoreline sediment density	kg/m^2	spatial	Density average across shoreline location of interest.		
Exposure, Chronic	DWFACA, DWATER	constant, normal	Contaminated fraction and animal drinking water rate	fraction and L/d	animal product type	Type of meat animal (e.g., cow, pig, sheep)		Dependent parameters – strongly recommend varying intake rate and leaving DWFACA fixed.
Exposure, Chronic	RIRR, IRTIMT	normal, constant	Food crop irrigation rate and irrigation time	in/yr and mo/yr	spatial	Value assigned to a food type (e.g., root vegetables) applies to all crops in that category (e.g., potato, tomato)		Dependent parameters – recommend varying one; leave other constant.
Exposure, Chronic	RIRRA, IRTIMA	normal, constant	Feed and forage crop irrigation rate and irrigation time	in/yr and mo/yr	spatial, weather, feed type			Dependent parameters -- recommend varying one; leave other constant.
Exposure, Chronic	SLDN, SURCM	uniform, constant	Surface soil areal density and surface soil thickness	kg/m^2 and cm	spatial	Density average across receptor location	Snyder et al. (1994)	Dependent parameters – strongly recommend fixing SURCM at 15 cm and varying SLDN. The SLDN of this module and the Health Impacts module should be consistently parameterized, with difference resulting only from different units.
Exposure, Chronic	XMLF	lognormal	Mass loading factor for resuspension	g/m^3				
Exposure, Chronic	LEAFRS	<none suggested>	Soil to plant resuspension factor	m^{-1}		Parameter applied to all feed, forage, and food crops.		
Exposure, Chronic	DPVRES	constant	Soil to plant deposition velocity	m/s		Parameter applied to all feed, forage, and food crops.		Fixed value recommended.
Exposure, Chronic	WTIM	normal	Plant weathering constant	d		Parameter applied to all feed, forage, and food crops.		Recommend that spatial variability not considered for this parameter
Exposure, Chronic	BIOMA2, GRWPA, YELDA, TRANSA	normal, uniform, normal, loguniform	Animal feed and forage crop field characteristics: biomass; growing period; yield; and translocation factor	kg$_{wet}$/d; d; kg$_{wet\ as\text{-}fed}$/m^2; unitless	spatial, weather, feed type			Dependent parameters – recommend not varying all; leave some as constants.
Exposure, Chronic	CONSUM, STORTM, DIETFR	normal, uniform, constant	Animal feed and forage intake parameters: consumption, storage time, dietfr	kg/d; d; unitless	spatial, feed or forage type			Dependent parameters – recommend not varying all; leave some as constants.

Table J.2. (contd)

Gv2 Module	GENIIv2 ID	Chronic Scenario Distribution – Recommended Assumption	GENII Description	Units	Explicit Dependency	Implicit Dependency	Additional Information Regarding Parameter Distribution	Comment
Exposure, Chronic	DRYFA2	uniform	Dry to wet ratio for animal feeds	unitless	feed crop type	Value assigned to a feed type (e.g., meat feed) corresponds to the average value applicable to all feed crops in that category (e.g., corn silage, grass hay)		
Exposure, Chronic	SLCONA	uniform	Soil intake rate of animals	kg/d	farming practice (e.g., barn, feedlot, pasture)			
Exposure, Chronic	BIOMAS, GRWP, YELD, TRANS	normal, uniform, normal, loguniform	Human food crop field characteristics: biomass; growing period; yield; and translocation factor	kg_{wet}/d; d; kg_{wet}/m^2; unitless	spatial, weather, food crop type			Dependent parameters – recommend not varying all; leave some as constants.
Exposure, Chronic	DRYFAC	uniform	Dry to wet ratio for food crops consumed by humans		food crop type	Value assigned to a food type (e.g., root vegetables) applies to all crops in that category (e.g., potato, tomato)		
Exposure, Chronic	HLDUP, HLDUPA, HLDUP2	uniform	Intake delays between harvest and consumption of food: food crops, animal products, and aquatic foods.	d	MEI/POP, processing and storage conditions			Unless it is known that only canned or frozen foods are consumed, it is generally assumed that food is consumed fresh with the shelflife determined based on refrigeration.
Receptor Intake	<virtually all>	--	--	--	--	--	--	Almost all Receptor intake parameters are dependent on whether the Maximally exposed individual (MEI) or population (POP) is under consideration. In addition, the age of the MEI or POP group also results in variable parameter values.
Receptor Intake	UEXAIR, TEXAIR		External dose from air parameters. Daily hours and annual days the receptor is exposed to the contaminated plume at one location.	hr; d	age, MEI/POP		EPA (2011)	Recommend that TEXAIR; FRINH, FTOUT, FRINHR, and FRINDR (see below) are consistently parameterized.
Receptor Intake	UEXGRD, TEXGRD; FTIN and FTOUT; SHIN and SHOUT	<none suggested>	External dose from soil parameters. Daily hours and annual days the receptor is exposed to the contaminated ground at one location, with consideration of indoor and outdoor fraction to further qualify shielding assumptions when indoors and outdoors.	hr; d; unitless, unitless; unitless, unitless	age, MEI/POP		EPA (2011)	Dependent parameters – recommend not varying all; leave some as constants. Recommend that FTIN and FTOUT; TEXAIR (see above); FRINH, FTOUT, and FRINHR and FRINDR (see below) are consistently parameterized.
Receptor Intake	EVSWIM, TESWIM, TSWIM	lognormal, normal, constant	Surface water dose parameters. Daily swimming events; hours per event; and annual days swimming occurs.	events/d; hr; d	age, MEI/POP		EPA (2011)	Dependent parameters – recommend not varying all; leave some as constants.

Table J.2. (contd)

Gv2 Module	GENIIv2 ID	Chronic Scenario Distribution – Recommended Assumption	GENII Description	Units	Explicit Dependency	Implicit Dependency	Additional Information Regarding Parameter Distribution	Comment
Receptor Intake	USWIM	normal	Ingestion rate of surface water during swimming	L/hr	age, MEI/POP		EPA (2011)	
Receptor Intake	EVBOAT, TEBOAT, TBOAT	normal, constant, constant	Surface water dose parameters. Daily boating events; hours per event; and annual days boating occurs.	events/d; hr; d	age, MEI/POP		EPA (2011)	
Receptor Intake	SFBOAT	<constant >	Shielding factor representative of surface water to receptor distance on boat.	unitless	type of boat		EPA (2011)	
Receptor Intake	UCRP, TCRP	lognormal, constant	Food crop ingestion parameters. Daily intake rate and annual intake days.	kg/d; d/yr	age, MEI/POP, food crop type		EPA (2011)	Dependent parameters – strongly recommend varying intake rate and leaving TCRP fixed at 365 d/yr.
Receptor Intake	UANM, TANM	lognormal, constant	Animal product ingestion parameters. Daily intake rate and annual intake days.	kg/d; d/yr	age, MEI/POP, animal product type		EPA (2011)	Dependent parameters – strongly recommend varying intake rate and leaving TANM fixed at 365 d/yr.
Receptor Intake	UAQU, TAQU	lognormal, constant	Aquatic food ingestion parameters. Daily intake rate and annual intake days.	kg/d; d/yr	age, MEI/POP, aquatic food type		EPA (2011)	Dependent parameters – strongly recommend varying intake rate and leaving TAQU fixed at 365 d/yr.
Receptor Intake	UDW, TDW	normal, constant	Drinking water ingestion parameters. Daily intake rate and annual intake days.	L/d; d/yr	age, MEI/POP; lactating/pregnant status for females			Dependent parameters – strongly recommend varying intake rate and leaving TDW fixed at 365 d/yr.
Receptor Intake	EVSHWR, TESHWR, TSHWR	constant, normal, constant	Incidental shower water ingestion parameters. Daily shower events; hours per event; annual shower days.	events/d; hr; d	age, MEI/POP		EPA (2011)	Dependent parameters – strongly recommend leaving TSHWR fixed at 365 d/yr.
Receptor Intake	USHIN	normal	Incidental shower water consumption rate.	L/hr	age, MEI/POP		EPA (2011)	
Receptor Intake	USOIL, TSOIL	normal, constant	Incidental soil ingestion parameters. Daily intake rate and annual soil contact days	mg/d; d	age, MEI/POP		EPA (2011)	Dependent parameters – strongly recommend leaving TSOIL fixed at 365 d/yr.
Receptor Intake	UINH, TINH, FRINH	lognormal, constant, constant	Plume air inhalation parameters. Daily intake rate; annual days of exposure; fraction of time outdoors.	m^3/d; d/yr; unitless	age, MEI/POP		NCRP (1984)	Dependent parameters – strongly recommend leaving TINH fixed at 365 d/yr. Recommend that FRINH; FTOUT (see above); and FRINHR and FRINDR (see below) are consistently parameterized.
Receptor Intake	UINHR, TINHR, FRINHR	lognormal, constant, constant	Resuspended soil inhalation parameters. Daily intake rate; annual days of exposure; fraction of time outdoors.	m^3/d; d/yr; unitless	age, MEI/POP		NCRP (1984)	Dependent parameters – strongly recommend leaving TINHR fixed at 365 d/yr. Recommend that FRINHR; FRINH and FTOUT (see above); and FRINDR (see below) are consistently parameterized.

Table J.2. (contd)

Gv2 Module	GENIIv2 ID	Chronic Scenario Distribution – Recommended Assumption	GENII Description	Units	Explicit Dependency	Implicit Dependency	Additional Information Regarding Parameter Distribution	Comment
Receptor Intake	UINDRH, TINDRH, FRINDR	lognormal, constant, constant	Indoor air inhalation parameters. Daily intake rate; annual days of exposure; fraction of time indoors.	m^3/d; d/yr; unitless	age, MEI/POP		NCRP (1984)	Dependent parameters – strongly recommend leaving TINDRH fixed at 365 d/yr. Recommend that FRINDR; FRINH, FTOUT, and FRINHR (see above) are consistently parameterized.
Health Impacts	SOILT, SLDN	constant, uniform	Soil thickness and density (to 15 cm).	m; kg/m^3	spatial	Density average across receptor location	Snyder et al. (1994)	Dependent parameters – strongly recommend leaving SOILT at 0.15 m. The SLDN of this module and the Exposure module should be consistently parameterized, with difference resulting only from different units.

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