



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
WASHINGTON, D.C. 20460


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OFFICE OF  
SOLID WASTE AND  
EMERGENCY RESPONSE

**OSWER Directive 9200.1-120**

**MEMORANDUM**

**SUBJECT:** Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors

**FROM:** Dana Stalcup, Acting Director   
Assessment and Remediation Division  
Office of Superfund Remediation and Technology Innovation

**TO:** Superfund National Policy Managers, Regions 1 - 10

**Purpose**

The mission of the Superfund program is to protect human health and the environment consistent with the Comprehensive Environmental Response, Compensation and Liability Act, as amended, (CERCLA) and as implemented by the National Oil and Hazardous Substances Pollution Contingency Plan. The purpose of this directive is to update the Interim Final Standard Exposure Factors Guidance (1991), which is reflected in the attached table and is to be used:

- in the CERCLA remedial investigation and feasibility study process (e.g., assessing baseline health risks, developing preliminary remediation goals, evaluating risks of remedial alternatives),
- to evaluate health risks in the CERCLA removal program, and
- in the process of five-year reviews of selected remedies.

This guidance update supplements the *Risk Assessment Guidance for Superfund: Human Health Evaluation Manual, Part A* (RAGS, Part A) that was issued October 13, 1989. This guidance supersedes and replaces certain portions of OSWER Directive 9285.6-03, issued March 25, 1991 and updates the *Risk Assessment Guidance for Superfund, Part E*, issued July 2004 (RAGS, Part E). Other cleanup programs in the Office of Solid Waste and Emergency Response (OSWER) are welcome and encouraged to adopt the recommended exposure factors, much as they have historically adopted other aspects of the *Risk Assessment Guidance for Superfund* (RAGS).

## **Background**

In September 2011, EPA's National Center for Environmental Assessment, Office of Research and Development (ORD/NCEA) issued a substantive update to its exposure assessment recommendations. *Exposure Factors Handbook – 2011 Edition*, referred to as EFH 2011 herein, provides information and recommendations on various physiological and behavioral factors commonly used in assessing exposure of adults and children to environmental chemicals. ORD/NCEA's recommended values for exposure factors are based on the results of studies deemed to be the most up-to-date and scientifically sound, based upon data available up to July 2011, and incorporates revisions made to the *Child-Specific Exposure Factors Handbook*, which was last updated and published in 2008. EFH 2011 is not a Superfund-specific document; rather, it provides a summary of the latest developments in exposure science and provides recommendations for a broad range of EPA programs.

Following the publication of EFH 2011, regional risk assessors received inquiries from other EPA program offices, states, the regulated community, and other interested parties regarding the applicability of the ORD/NCEA's recommendations for use in human health risk assessments. During the October 2011 to August 2012 period, the OSWER Human Health Regional Risk Assessors Forum (OHHRRAF) reviewed the recommendations in EFH 2011 in the context of the default exposure factors used in the Superfund program and to derive Regional screening levels. As a result of a consensus-driven process, the OHHRRAF identified several Superfund-specific default exposure factors that warranted updating, based upon recommendations from ORD/NCEA in EFH 2011. This guidance incorporates and adopts the updates recommended by the OHHRRAF.

## **Objective**

This guidance has been developed to reduce variability and uncertainty in the exposure assumptions used by Regional Superfund staff to characterize exposures to human populations for human health risk assessments.

## **Implementation**

This guidance supplements the *Risk Assessment Guidance for Superfund: Human Health Evaluation Manual* (RAGS), Part A through E. Where numerical values differ from those presented in Part A or E, the factors presented in this guidance should be considered updates to the older values. As new data become available, this Directive may be modified accordingly.

This report can be found at [www.epa.gov/oswer/riskassessment/superfund\\_hh\\_exposure.htm](http://www.epa.gov/oswer/riskassessment/superfund_hh_exposure.htm)  
Please contact Richard Kapuscinski at (703) 305-7411 if you have questions or concerns.

Attachment

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## CITATIONS

U.S. Environmental Protection Agency (EPA). 2011. *Exposure Factors Handbook 2011 Edition (Final)*. National Center for Environmental Assessment, Office of Research and Development. Washington D.C. Currently available on-line at <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=236252>

U.S. Environmental Protection Agency (EPA). 2009. *Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment)*. EPA 540-R-070-002, OSWER 9285.7-82. Office of Superfund Remediation and Technology Innovation. Washington, DC. January. Currently available on-line at <http://www.epa.gov/oswer/riskassessment/ragsf/index.htm>

U.S. Environmental Protection Agency (EPA). 2008. *Child-Specific Exposure Factors Handbook*. PA/600/R-06/096F. National Center for Environmental Assessment, Office of Research and Development. Washington D.C. September. Currently available on-line at <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=199243>

U.S. Environmental Protection Agency (EPA). 2004. *Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Final*. Office of Superfund Remediation and Technology Innovation. Washington, DC. July. Currently available on-line at <http://www.epa.gov/oswer/riskassessment/ragse/index.htm>

U.S. Environmental Protection Agency (EPA). 2001. *Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual (Part D, Standardized Planning, Reporting and Review of Superfund Risk Assessments), Final*. December. Currently available on-line at <http://www.epa.gov/oswer/riskassessment/ragsd/tara.htm>

U.S. Environmental Protection Agency (EPA). 2001. *Comprehensive Five-Year Review Guidance*. OSWER 9355.7-03B-P, EPA 540-R-01-007. Office of Emergency and Remedial Response. Washington, DC. June. Currently available on-line at <http://www.epa.gov/superfund/accomp/5year/index.htm>

U.S. Environmental Protection Agency (EPA). 1991. *Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual (Part C, Risk Evaluation of Remedial Alternatives), Interim*. Publication 9285.7-01C. Office of Emergency and Remedial Response. Washington, DC. October. Currently available on-line at <http://www.epa.gov/oswer/riskassessment/ragsc/index.htm>

U.S. Environmental Protection Agency (EPA). 1991. *Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals), Interim*. EPA 540-R-070/003. Publication 9285.7-01B. Office of Emergency and Remedial Response. Washington, DC. December. Currently available on-line at <http://www.epa.gov/oswer/riskassessment/ragsb/index.htm>

## Attachment 1. Recommended Default Exposure Factors (2014)

Symbol	Definition (units)	Previous Default Value	Currently Recommended Value	Source of current recommendation	Source of previous recommendation
<b>Ingestion and Dermal Contact Rates</b>					
IRW <sub>c</sub>	Resident Drinking Water Ingestion Rate - Child (L/day)	1	0.78	U.S. EPA 2011a, Tables 3-15 and 3-33; weighted average of 90th percentile consumer-only ingestion of drinking water (birth to <6 years)	U.S. EPA 1989 (Exhibit 6-11)
IRW <sub>a</sub>	Resident Drinking Water Ingestion Rate - Adult (L/day)	2	2.5	U.S. EPA 2011a, Table 3-33; 90th percentile of consumer-only ingestion of drinking water (≥ 21 years)	U.S. EPA 1989 (Exhibit 6-11)
IRS <sub>c</sub>	Resident Soil Ingestion Rate - Child (mg/day)	200	200	U.S. EPA 2011a (Table 5-1); "upper-bound values" accounting for both soil and dust ingestion	U.S. EPA 1991a (pg. 15)
IRS <sub>a</sub>	Resident Soil Ingestion Rate - Adult (mg/day)	100	100	U.S. EPA 1991a (pp. 6 and 15); EFH 2011 only provides a central tendency value	U.S. EPA 1991a (pg. 15)
IR <sub>iw</sub>	Indoor Worker Soil Ingestion Rate (mg/day)	50	50	U.S. EPA 1991a (pp. 9-10, 15); EFH 2011 values not provided	U.S. EPA 1991a (pg. 15)
IR <sub>ow</sub>	Outdoor Worker Soil Ingestion Rate (mg/day)	100	100	U.S. EPA 1991a (pg. 15), same as adult resident; EFH 2011 value not provided	U.S. EPA 1991a (pg. 15)
SA <sub>c</sub>	Resident skin surface area - child (cm <sup>2</sup> )	2,800	2,690	U.S. EPA 2011a, Tables 7-2 and 7-8; weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, birth to < 6 years)(forearm and lower leg-specific data used when available, ratios for nearest available age group used elsewhere (per EPA 2011b))	U.S. EPA 2002 (Exhibit 1-2)
SA <sub>a</sub>	Resident skin surface area - adult (cm <sup>2</sup> )	5,700	6,032	U.S. EPA 2011a, Tables 7-2 and 7-12; weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, 21+ years)(forearm and lower leg-specific data used for males and female lower leg; ratio of male forearm to arm applied to female arm data.	U.S. EPA 2002 (Exhibit 1-2)
SA <sub>ow</sub>	Worker skin surface area - adult (cm <sup>2</sup> )	3,300	3,470	US EPA 2011a, Table 7-2; weighted average of mean values for head, hands, and forearms (male and female, 21+years) (similar assumptions for forearms as used in EPA 2011b)	U.S. EPA 2002 (Exhibit 1-2)
SA <sub>c</sub>	Resident Water Surface area - child (cm <sup>2</sup> )	6,600	6,378	U.S. EPA 2011a, Table 7.10; weighted average of mean values for children <6 years.	U.S. EPA 2004 (Exhibit 3-2)
SA <sub>a</sub>	Resident Water Surface area - adult (cm <sup>2</sup> )	18,000	20,900	U.S. EPA 2011a, Table 7.10; weighted average of mean values for adults, male and female 21+.	U.S. EPA 2004 (Exhibit 3-2)
AF <sub>c</sub>	Resident soil adherence factor - child (mg/cm <sup>2</sup> )	0.2	0.2	U.S. EPA 2004 (Exhibit 3-5), RAGS Part E	U.S. EPA 2002 (Exhibit 1-2)
AF <sub>a</sub>	Resident soil adherence factor - adult (mg/cm <sup>2</sup> )	0.07	0.07	U.S. EPA 2004 (Exhibit 3-5), RAGS Part E	U.S. EPA 2002 (Exhibit 1-2)
AF <sub>ow</sub>	Worker soil adherence factor - adult (mg/cm <sup>2</sup> )	0.2	0.12	U.S. EPA 2011a, Table 7-20 and Section 7.2.2; arithmetic mean of weighted average of body part-specific (hands, forearms, and face) mean adherence factors for adult commercial/industrial activities	U.S. EPA 2002 (Exhibit 1-2)
BW <sub>c</sub>	Resident Body Weight - child (kg)	15	15	U.S. EPA 2011a, Table 8-1; weighted average of mean body weights (birth to <6 years)	U.S. EPA 1991a (pg. 15)

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Symbol	Definition (units)	Previous Default Value	Currently Recommended Value	Source of current recommendation	Source of previous recommendation
BW <sub>a</sub>	Resident Body Weight - adult (kg)	70	80	U.S. EPA 2011a, Table 8-3; weighted mean values for adults 21 – 78	U.S. EPA 1991a (pg. 15)
BW <sub>w</sub>	Worker Body Weight (kg)	70	80	U.S. EPA 2011a, Table 8-3; weighted mean values for adults 21 – 78	U.S. EPA 1991a (pg. 15)
<b>Exposure Frequency, Exposure Duration, and Exposure Time Variables</b>					
EF <sub>r</sub>	Resident Exposure Frequency (days/yr)	350	350	U.S. EPA 1991a (pg. 15); value not provided in EFH 2011	U.S. EPA 1991a (pg. 15)
EF <sub>w</sub>	Worker Exposure Frequency (days/yr)	250	250	U.S. EPA 1991a (pg. 15); value not provided in EFH 2011	U.S. EPA 1991a (pg. 15)
EF <sub>iw</sub>	Indoor Worker Exposure Frequency (days/yr)	250	250	U.S. EPA 1991a (pg. 15); value not provided in EFH 2011	U.S. EPA 1991a (pg. 15)
EF <sub>ow</sub>	Outdoor Worker Exposure Frequency (days/yr)	225	225	U.S. EPA 1991a (pg. 15); value not provided in EFH 2011	U.S. EPA 1991a (pg. 15)
ED <sub>r</sub>	Resident Exposure Duration (yr)	30	26	EPA 2011a, Table 16-108; 90th percentile for current residence time.	U.S. EPA 1991a (pg. 15)
ED <sub>c</sub>	Resident Exposure Duration - child (yr)	6	6	U.S. EPA 1991a, Pages 6 and 15	U.S. EPA 1991a (pg. 15)
ED <sub>a</sub>	Resident Exposure Duration - adult (yr)	24	20	ED <sub>r</sub> (26 years) - ED <sub>c</sub> (6 years)	U.S. EPA 1991a (pg. 15)
ED <sub>w</sub>	Worker Exposure Duration - (yr)	25	25	U.S. EPA 1991a (pg. 15); EFH 2011 only provides a central tendency value	U.S. EPA 1991a (pg. 15)
ED <sub>iw</sub>	Indoor Worker Exposure Duration - (yr)	25	25	U.S. EPA 1991a (pg. 15); EFH 2011 only provides a central tendency value	U.S. EPA 1991a (pg. 15)
ED <sub>ow</sub>	Outdoor Worker Exposure Duration (yr)	25	25	U.S. EPA 1991a (pg. 15); EFH 2011 only provides a central tendency value	U.S. EPA 1991a (pg. 15)
ET <sub>ra</sub>	Resident Air Exposure Time (hours/day)	24	24	The whole day	The whole day
ET <sub>rs</sub>	Resident Soil Exposure Time (hours/day)	24	24	The whole day	The whole day
ET <sub>w</sub>	Worker Air Exposure Time (hr/hr)	8	8	The work day	The work day
ET <sub>ws</sub>	Worker Soil Exposure Time (hours/day)	8	8	The work day	The work day
ET <sub>rw</sub>	Resident Water Exposure Time (hours/day)	24	24	The whole day	The whole day
ET <sub>rwc</sub>	Resident Water Exposure Time - child (hours/event)	1	0.54	U.S. EPA 2011a, Table 16-28; weighted average of 90th percentile time spent bathing (birth to <6 years)	U.S. EPA 2004
ET <sub>rwa</sub>	Resident Water Exposure Time - adult (hours/event)	0.58	0.71	U.S. EPA 2011a, Tables 16-30 and 16-31; weighted average of adult (21 to 78) 90th percentile of time spent bathing/ showering in a day, divided by mean number of baths/showers taken in a day.	U.S. EPA 2004
<b>Miscellaneous Variables; values not provided in EFH 2011</b>					

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Symbol	Definition (units)	Previous Default Value	Currently Recommended Value	Source of current recommendation	Source of previous recommendation
AT <sub>r</sub>	Averaging time - resident (days/year)	365	365	U.S. EPA 1989 (pg. 6-23)	U.S. EPA 1989 (pg. 6-23)
AT <sub>w</sub>	Averaging time - composite worker (days/year)	365	365	U.S. EPA 1989 (pg. 6-23)	U.S. EPA 1989 (pg. 6-23)
AT <sub>iw</sub>	Averaging time - indoor worker (days/year)	365	365	U.S. EPA 1989 (pg. 6-23)	U.S. EPA 1989 (pg. 6-23)
AT <sub>ow</sub>	Averaging time - outdoor worker (days/year)	365	365	U.S. EPA 1989 (pg. 6-23)	U.S. EPA 1989 (pg. 6-23)
LT	Lifetime (years)	70	70	U.S. EPA 1989 (pg. 6-22), pending additional input from NCEA	U.S. EPA 1989 (pg. 6-22)
IR <sub>fish</sub>	Fish Ingestion Rate (mg/day)	5.4 × 10 <sup>4</sup>	**	Recommend using site-specific values	U.S. EPA 1991a (pg. 15)
IR <sub>produce</sub>	Consumption of homegrown produce (g/day)	42 (fruit); 80 (veg)	**	Recommend using site-specific values	U.S. EPA 1990

*References for Cited Sources:*

[U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual \(Part A\). Interim Final. Office of Emergency and Remedial Response. EPA/540/1-89/002.](#)

U.S. EPA 1990. Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA / 8-89 / 043, March 1990.

[U.S. EPA 1991a. Human health evaluation manual, supplemental guidance: "Standard default exposure factors". OSWER Directive 9285.6-03.](#)

[U.S. EPA 1991b. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual \(Part B, Development of Risk-Based Preliminary Remediation Goals\). Office of Emergency and Remedial](#)

[U.S. EPA. 1996a. Soil Screening Guidance: User's Guide. Office of Emergency and Remedial Response. Washington, DC. OSWER No. 9355.4-](#)

[U.S. EPA. 1996b. Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. Washington, DC. OSWER No. 9355.4-](#)

[U.S. EPA. 1997a. Exposure Factors Handbook. Office of Research and Development, Washington, DC. EPA/600/P-95/002Fa.](#)

[U.S. EPA 2000. Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin \(TCDD\) and Related Compounds. Part I: Estimating Exposure to Dioxin-Like Compounds. Volume 3--](#)

[U.S. EPA, 2001. WATER9. Version 1.0.0. Office of Air Quality Planning and Standards, Research Triangle Park, NC.](#)

[U.S. EPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. December 2002.<http://www.epa.gov/superfund/health/conmedia/soil/index.htm>](#)

[U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual \(Part E, Supplemental Guidance for Dermal Risk Assessment\) Final. OSWER 9285.7-02EP. July](#)

[U.S. EPA. 2005. Guidance on Selecting Age Groups for Monitoring and Assessing Childhood Exposures to Environmental Contaminants. EPA/630/P-03/003F, November, 2005.](#)

[U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual \(Part F, Supplemental Guidance for Inhalation Risk Assessment\) Final. OSWER 9285.7-82.2009.](#)

[U.S. EPA 2011a. Exposure Factors Handbook: 2011 Edition. EPA/ 600/ R-090/052F. September 2011.](#)

[EPA. 2011b. "Regional Screening Levels \(Formerly PRGs\), User's Guide." November. On-Line Address: \[http://www.epa.gov/reg3hwmd/risk/human/rb-concentration\\\_table/usersguide.htm\]\(http://www.epa.gov/reg3hwmd/risk/human/rb-concentration\_table/usersguide.htm\)](#)

*Footnote:* Users are directed to the *Exposure Factors Handbook* (2011) as a source for specific age-group exposure factors as described in EPA, 2005.