TABLE C-1-1

COPC INTAKE FROM SOIL

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Description
This equation calculates the daily intake of COPC from soil consumption. The soil concentration will vary with each scenario location, and the soil consumption rate varies for children and adults. Uncertainties associated with this equation include:

(1)   The amount of soil intake is assumed to be constant and representative of the exposed population. This assumption may under- or overestimate I_{soil}.
(2)   The standard assumptions regarding period exposed may not be representative of any actual exposure situation. This assumption may under- or overestimate I_{soil}. |

Equation
$$I_{soil} = \frac{Cs \cdot CR_{soil} \cdot F_{soil}}{BW}$$

Variable	Description	Units	Value
I_{soil}	Daily intake of COPC from soil	mg/kg-day	

TABLE C-1-1

COPC INTAKE FROM SOIL

(Page 2 of 5)

Variable	Description	Units	Value
Cs	Average soil concentration over exposure duration	mg/kg	**Varies** This variable is COPC- and site-specific, and is calculated using the equation in Table B-1-1. *Cs* will vary based on whether the COPC is carcinogenic or noncarcinogenic. For carcinogenic COPCs, this value is equal to the soil concentration averaged over the exposure duration (Table B-1-1) (U.S. EPA 1994 and NC DEHNR 1997). For noncarcinogenic COPCs, this value is equal to the highest annual soil concentration occurring within the exposure duration. The highest annual soil concentration would occur at the end of the time period of combustion (Table B-1-1) (U.S. EPA 1994 and NC DEHNR 1997). Uncertainties associated with this variable include: (1) The time period over which deposition of COPCs due to hazardous waste combustion is assumed to be conservative, long-term value. This assumption may overestimate *Cs*. (2) Exposure durations are based on historical mobility rates, and may not remain constant. This assumption may overestimate or underestimate *Cs*. (3) Mobility studies indicate that most receptors that move remain in the vicinity of the emission source, however, the likelihood that these short distances moves will influence exposure based on factors such as atmospheric transport of pollutants cannot be predicted accurately. This assumption may overestimate or underestimate *Cs*. (4) The use of a value of 0 for T_1 does not account for exposure that may have occurred prior to hazardous waste combustion. This may underestimate *Cs*. (5) For soluble COPCs, leaching may lead to movement below 1 cm in untilled soils; resulting in a greater mixing depth. This uncertainty may overestimate *Cs*. (6) Deposition to hard surfaces may result in dust residues that have negligible dilution compared to other residues. This uncertainty may underestimate *Cs*.

TABLE C-1-1

COPC INTAKE FROM SOIL

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Variable	Description	Units	Value
CR_{soil}	Consumption rate of soil	kg/day	**0.00005 to 0.0001** The soil consumption rate varies for the adult and child receptors (U.S. EPA 1997). Receptor Intake Rate (kg/day) Adult 0.00005 Child 0.0001 U.S. EPA (1997) states that a child intake rate of 0.0002 kg/day for a child receptor may be used as a conservative estimate of exposure. U.S. EPA (1997) references studies done by Hawley (1985) and Calabrese (1990) as the sources used to derive soil consumption rates. Uncertainties associated with this variable include: (1) Tracer studies have resulted in wide ranging estimates of the amount of soil and dust ingested by young children, making it difficult to identify a single value which should be used. Additionally it is extremely difficult to separate the contribution of exposure resulting from exterior soil vs. interior dust. As a result the intake rate is reported as the combined rate for soils and dusts. This uncertainty may under- or overestimate CR_{soil}. (2) The recommended intake rates may not accurately represent behavioral characteristics since they are upper estimates. This uncertainty may overestimate CR_{soil}. (3) The intake rates represent normal mouthing tendencies. Some children exhibit abnormal mouthing behavior or "pica" and would have much higher intake rates. This uncertainty may considerably underestimate CR_{soil}.
F_{soil}	Fraction of soil that is contaminated	unitless	**1.0** U.S. EPA OSW assumes the fraction of consumed soil contaminated is equal to 1.0. This is consistent with NC DEHNR (1997) and U.S. EPA (1994), which assumes the fraction of consumed soil contaminated is 1.0 for all exposure scenarios. Uncertainty associated with this variable include: U.S. EPA guidance recommends the fraction of consumed soil contaminated is equal to 1.0. However, due to variations in the proximity of the receptor to the contaminated source, size of the contaminated source, receptors of concern, mobility of receptors, and nature of exposure, F_{soil} may be overestimated or underestimated.

TABLE C-1-1

COPC INTAKE FROM SOIL

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Variable	Description	Units	Value
BW	Body weight	kg	**15 or 70** U.S. EPA OSW recommends using default values of 70 (adults) and 15 (children). These default values are consistent with U.S. EPA (1991; 1994). Uncertainty associated with this variable include: These body weights represent the average weight of an adult and child. However, depending on the actual receptor, body weights may be higher or lower. These default values may overestimate or underestimate actual body weights. However, the degree of under- or overestimation is not expected to be significant.

TABLE C-1-1

COPC INTAKE FROM SOIL

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REFERENCES AND DISCUSSION

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    This document is cited by U.S. EPA (1997) as a source of information used to derive soil consumption rates.

Hawley, J.K. 1985. Assessment of health risk from exposure to contaminated soil. *Risk Analysis* 5:289-302.

    This document is cited by U.S. EPA (1997) as a source of information used to derive soil consumption rates.

NC DEHNR. 1997. *North Carolina Protocol for Performing Indirect Exposure Risk Assessments for Hazardous Waste Combustion Units. January.*

    This document is one of the sources for the equation in Table C-1-1. This document also states that (1) for carcinogenic COPCs, *Cs* is equal to the soil concentration averaged over the exposure duration; however, no reference document is cited and (2) for noncarcinogenic COPCs, *Cs* is equal to the highest annual soil concentration occurring within the exposure duration; the highest annual soil concentration would occur at the end of the time period of emissions.

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    This document is one of the sources for the equation in Table C-1-1. This document also states that (1) for carcinogenic COPCs, *Cs* is equal to the soil concentration averaged over the exposure duration; however, no reference document is cited and (2) for noncarcinogenic COPCs, *Cs* is equal to the highest annual soil concentration occurring within the exposure duration; the highest annual soil concentration would occur at the end of the time period of emissions.

U.S. EPA. 1997. *Exposure Factors Handbook.* Office of Research and Development. EPA/600/P-95/002F. August.

    This document is the source for soil consumption rates.