Human Health Risk Assessment

Appendix 6

Intake Factors and Receptor Assumptions for the Assessment of the Rodney Street Community

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A6-1 Intake Factors and Receptor Assumptions

Several sources were considered in selecting the physiological and behaviourial characteristics used to assess the Rodney Street community. These included:

- Compendium of Canadian Human Exposure Factors for Risk Assessment (O'Connor, 1997);
- EPA Exposure Factors Hand Book (US EPA, 1997);
- EPA Dermal Exposure Assessment and Supplemental Guidance (US EPA, 1992; 2000a);
- EPA Child-Specific Exposure Factors Handbook (US EPA, 2000b);
- Environmental Health Directorate Working Group on Reference Values (EHD, 1993);
- Canadian Environmental Protection Act (1994);
- Canadian Council of the Ministers of the Environment (CCME, 1996; 2000); and
- Health Canada (1995).

The following sections provide detailed information, in the form of tables and text where appropriate, for each of the receptor parameters utilized in the assessment. Selected values are highlighted and discussed. For the most part, the Compendium of Canadian Human Exposure Factors for Risk Assessment (O'Connor, 1997) was used as a primary source of receptor data. This source was selected since it characterizes Canadian populations and as a result would best represent the Rodney Street community. It relies on published and reliable reference sources, such as Health Canada, Statistics Canada and the Canadian Fitness and Lifestyles Research Institute and has been used in the past on several assessments conducted by the ministry and the CCME. In cases where this data set was unable to adequately describe certain time activity patterns and/or behaviourial/physiological characteristics, other data sources, such as the US EPA Exposure Factors Handbook (US EPA, 1997) were used.

A6-2 Time Spent in Age Group

As defined by Health Canada (1995) and CEPA (1994), the following age classifications were used for the HHRA:

- Infant (0 to 6 months);
- Toddler (7 months to <5 years);
- Child (5 years to <12 years);
- Teen (12 to <20 years); and
- Adult (20 years and over).

A6-3 Body Weight

Available body weight data are summarized in Table A6-7a. Mean values provided by O'Connor (1997) and CCME (2000) were selected for the HHRA, as this was the most recent data

characterizing the Canadian population, and is similar to other data sources available for the Canadian and U.S. populations.

A6-4 Inhalation Rate

Inhalation of airborne chemicals is a potential source of chemical exposure for the residents of the Rodney Street community. Available inhalation rate data are summarized in Table A6-7b. Mean values provided by O'Connor (1997) were selected for the HHRA, as this was the most recent data characterizing the Canadian population. It should be noted that this data need not be used in the direct assessment of inhalation toxicity since the dose response factors used in the HHRA to characterize inhalation toxicity are expressed on a concentration basis ($\mu g/m^3$), rather than a dose basis (µg/kg/day), allowing direct comparison of these factors with measured and/or predicted air concentrations. However, inhalation rate data is necessary in the calculation of incremental exposures through this pathway.

A6-5 Water Intake Rate

Drinking water is municipally supplied in the Rodney Street community with water taken from Lake Erie that is not likely to be directly impacted by contamination in the Port Colborne area. None the less, drinking water is a potential source of exposure to the chemicals of concern in the Rodney Street community. Available water intake data are summarized in Table A6-7c. Mean values provided by O'Connor (1997) were selected for the HHRA, as this was the most recent data characterizing the Canadian population, and is similar to other data sources available for the Canadian and U.S. populations.

A6-6 Soil Ingestion Rate

The ingestion of soil is a potential source of exposure to chemicals in the Rodney Street community. The potential for exposure to chemicals through inadvertent soil ingestion is greater for children as a result of behavioral patterns present during childhood. Inadvertent soil ingestion among children may occur through the mouthing of objects or hands. This mouthing behavior is considered to be a normal phase of childhood development. Adults may also ingest soil or dust particles that adhere to food, cigarettes, or their hands. Deliberate soil ingestion is defined as pica and is discussed below. Available soil ingestion data are summarized in Table A6-7d. The average soil ingestion rates recommended by the EPA (US EPA, 2000b; 1997) for assessing risks associated with chemicals in soil were selected for the assessment of toddlers and children. Recent publications (Stanek et al., 2001) and past assessment conducted by the MOE are in agreement with the assumptions made in this assessment. Ingestion rates recommended by CCME (1996) and used by MOE in the past were selected for other receptors.

A6-6.1 Pica

Deliberate soil ingestion is defined as pica and is relatively uncommon in the general population. The scientific literature define pica as "the repeated eating of non-nutritive substances" (Feldman, 1986), however, for this study, the concern is related to deliberately high soil ingestion. Information on the incidence of soil pica is limited, but it appears that soil pica is not common. Five key tracer studies (Binder et al., 1986; Clausing et al., 1987; Van Wïjnen et al., 1990; Davis et al., 1990; and Calabrese et al., 1989) reviewed by the US EPA (1997) revealed only one child out of the more than 600 children involved in these studies ingested an amount of soil significantly greater than the range for other children. These studies did not include data for all populations and were representative of short term ingestion only. However, it can be assumed that the incidence rate of deliberate soil ingestion behavior in the general population is low. US EPA (1997, 2000b) recommend a soil ingestion rate of 10 g/day for children who deliberately ingest soil. However, this value is only intended for use in acute exposure assessments and these exposures cannot be compared with chronic health criteria.

A6-6.2 Soil/Dust Ratio Methodology

In the outdoor environment, soil ingestion, hence the intake of various contaminants, represents a significant exposure pathway for children. Studies have shown that soil enters the house as dust by atmospheric transport, as well as being brought into the house by animals and humans on their bodies, clothes or shoes (ATSDR, 1988). While there is adequate evidence of a relationship between the levels of contaminants found outside the homes with those inside the homes, the extent of the relationship is not clear.

Study undertaken by Rutz et al., (1997) suggested that between 20 - 30% of indoor contamination was from outdoor soil sources. The authors found that the tracking of soil was the primary mechanism for uranium to enter the residence with the re-entrained dust being a factor as well.

The Integrated Exposure Uptake BioKinetic (IEUBK) model used by the EPA for modeling the metal lead has suggested that the mass fraction of soil in indoor dust is related to the level of lead in the outdoor soil concentration by a ratio of about 0.7. This means that the indoor lead dust levels on a weight-by-weight basis were designated to be about 0.7 of the outdoor soil level. According to the EPA, this value is only a recommended value for input into the IEUBK model in the absence of site-specific data on lead as current information regarding practical techniques to estimate the indoor/outdoor mass fraction ratio are limited. Additionally, it has been noted that lead is not an appropriate model for nickel due to the significant indoor sources of lead in indoor dust.

In the course of this risk assessment, the MOE was provided with a study conducted by PTI Environmental Services (PTI, 1994) at a zinc contaminated site in Bartlesville, Oklahoma. One

component of this study was the evaluation of the relationship between the soil concentration and the indoor dust concentration of the metal. This study measured the indoor and outdoor levels of arsenic, cadmium, lead, and zinc and found the ratio of indoor dust level to the soil concentration levels to be 0.20, 0.35, 0.50 and 0.36, respectively.

Recently, a study conducted by Rasmussen et al., (2001) in the city of Ottawa, found that dust generated from sources in the house contribute significantly to exposures to elements such as lead, cadmium, antimony and mercury. While the study did consider the indoor and outdoor levels of the aforementioned metals, the study concluded that it would be "difficult-to-impossible" to predict indoor dust concentration based on the low metal levels found in the local soils. Additionally, this study only looked at particles in the 100 - 250 um size range which is of questionable relevance.

Hwang et al., (1997) and Calabrese (unpublished, as reported in Walker and Griffin, 1997) have undertaken comprehensive studies which in part examine the relationship of interior surface dust levels of arsenic to outdoor soil concentration of arsenic. Both Hwang et al., (1997) and Calabrese (unpublished) sampled interior dust and outdoor soil concentrations using different methodologies from the same subset of 25 households in Anaconda, Montana. The reported average outdoor soil and interior dust concentrations were significantly different, 192 mg/kg and 75.14 mg/kg, respectively from the Hwang et al., (1997) study, versus 75 mg/kg and 29 mg/kg from the Calabrese study, respectively. However, the relationship between the average interior surface dust concentration and outdoor soil concentrations were very similar. The ratio of the average interior dust to outdoor soil concentrations were calculated to be 0.391 and 0.387 for the Hwang and Calabrese studies, respectively. These ratios have been validated in a recent study conducted in Deloro, Ontario where indoor dust samples were compared with outdoor soil samples (MOE, 1999).

Calabrese and Stanek (1992) have estimated that 30% of household dust is derived from outdoor soil, with the remaining 70% originating from other sources. Other studies have found similar relationships between outdoor soil and indoor dust concentrations for several metals (Murgueytio et al., 1998).

It was concluded that using the most comprehensive environmental media sampled within the Rodney Street community (outdoor soil) and the relationship described by the Hwang and Calabrese studies above would not only result in the appropriate expression of interior dust levels for use in an exposure assessment, but would also inherently correlate soil and interior dust on a spatial basis. The ratio derived from the Hwang and Calabrese studies (0.39) was selected as it considered metals similar to nickel with respect to the expected relationship of indoor dust and outdoor soil concentrations, it has been validated in a recent Ontario study (MOE, 1999) and it is substantiated by the other studies cited above (Murgueytio et al., 1998; PTI, 1994; Calabrese and Stanek, 1992; Rutz et al., 1997).

Based on Walker and Griffin (1997), it has been assumed that 55% of a receptors soil ingestion rate is allocated to indoor dust exposure, while the remaining 45% is allocated to outdoor soil exposures. The ratio of soil intake to dust intake is not proportional to the ratio of the number of waking hours that a child spends outdoors versus indoors. Children spend only 15 to 30% of their waking hours playing outside but are more likely to be in contact with bare soil areas during this time. The default outdoor:indoor ingestion ratio of 45:55 has been adopted by the US EPA (1994) as an IEUBK model default.

A6-7 Dermal Routes of Exposure

Dermal exposure can occur during a variety of activities in different environmental media, such as:

- Water (e.g., bathing, washing, swimming);
- Soil (e.g., outdoor recreation, gardening, construction);
- Sediment (e.g., wading, fishing);
- Liquids (e.g., use of commercial products);
- Vapors/fumes (e.g., use of commercial products); and
- Indoors (e.g., carpets, floors, counter tops).

For the Rodney Street assessment, only dermal contact with soils and dusts (indoors) are of concern.

A6-7.1 Soil Adhesion to Skin

Soil adherence to the surface of the skin is a required parameter to calculate dermal dose when the exposures involving dermal contact with chemicals in soil or dust are of concern. Available soil adhesion to skin data are summarized in Table A6-7e. Adhesion factors reported in the literature vary greatly depending on activity and soil conditions. US EPA (2000b) recommends a default adhesion factor of 0.2 mg/cm^2 for children and 0.07 mg/cm^2 for adults. These values were selected for the Rodney Street assessment.

A6-7.2 Area of Exposed Skin Derivation

In order to calculate the area of exposed skin for various receptors, several methods are available. US EPA (1997) recommends an approach where in a moderate climate, 25, 10, 10 and 5% of the whole body surface area is exposed for summer, spring, fall and winter, respectively. Others have considered the surface area of specific body parts considered exposed for each season. Both approaches yield similar results. The latter approach was selected for the Rodney Street assessment, with mean surface areas reported by O'Connor (1997) (Table A6-1). Available surface area data are summarized in Table A6-7f. For the Rodney Street community, the following assumptions were made:

- Hands, arms, legs and feet were considered exposed in July and August;
- Hands, arms and legs were considered exposed in June and September; and
- Hands and arms were considered exposed in all other months.

Table A6-1: Mean Percentage of Total Body Surface Area Exposed

	Skin Surface Areas in m^2				
	Receptor				
Body Part	Infant	Toddler	Child	Teen	Adult
Hands	0.032	0.043	0.059	0.08	0.089
Arms	0.055	0.089	0.148	0.223	0.25
Legs	0.091	0.169	0.307	0.497	0.572
Feet	0.025	0.043	0.072	0.108	0.119
Totals	0.203	0.344	0.586	0.908	1.03

Source: O'Connor, 1997.

A6-8 Backyard Fruit and Vegetable Consumption

The assessment of potential health risks for people living in the homes on Rodney Street, Port Colborne, considers exposures to the metals of concern from all relevant pathways. Eating vegetables grown in backyards where metal levels are above typical levels, represents a potential exposure pathway if the metals present in the soil are taken up into the vegetables. The exposures received by people eating such produce depends upon the concentration of the metals in the vegetables and the amount of vegetables consumed from backyard gardens on an annual basis. Specific data on backyard garden vegetable consumption patterns for the homes on Rodney Street are not available. Therefore it was necessary to estimate likely consumption rates based on studies conducted in other communities in Ontario (MOEE, 1995).

The amounts and types of produce that people might consume from a backyard garden are affected by the size of the garden, the preferences of individuals for the types of crops grown and the yields achieved. In previous risk assessments in other communities, the MOE developed an estimate of backyard garden crop yield of 1.4 kg/m^2 for mixed produce (MOEE, 1995). An assumed garden size of 30 m^2 was used to provide an estimated total annual yield of 42 kg of produce. These assumptions have been used to estimate backyard garden produce consumption for people living on Rodney Street.

In order to estimate the proportion of home grown produce which is fruit and that which is vegetables, it was first necessary to determine the proportion of fruit and fruit juice consumption which could be derived from a home garden in Ontario. The apparent per capita food consumption rates (Statistics Canada, 1991) indicated that the proportion of fruits consumed by typical Canadians (1988 to 1989) which could be grown in this region of Canada (e.g., apples, blueberries, cherries, plums, raspberries and strawberries) was 37 percent of the total fruit consumption. Thus, a typical adult and child would consume fruit which could be grown in Canada at a rate of 90.65 and 99.16 g/d, respectively (see Table A6-2). All of the vegetables consumed by Rodney Street residents were assumed to be grown in Canada, and therefore, potentially in a home garden. Therefore, the total consumption of fruits and vegetables

potentially grown in this region of Canada, and potentially in a home garden, would be 416 and 358 g/d, for adults and children, respectively (i.e., 90.65 g/d + 325 g/d; 99.16 + 259 g/d, respectively) (Table A6-2). Thus, the total consumption of potentially home grown fruits and vegetables for a typical family (2 adults, 2 children) would be 565 kg/year (i.e., 416 g/d x 365 d/yr x 2 + 358 g/d x 365 d/yr x 2 = 565,000 g/year) (Table A6-3). In addition, Table A6-7g lists fruit and vegetable consumption rates from various sources.

Assuming the proportions of fruits versus vegetables in a typical home garden would equal the proportions of potentially home grown fruits and vegetables consumed, as calculated above, this would mean that 26% and 74% of home grown produce would be fruits and vegetables, respectively. Apportioning the backyard garden yield of 42 kg/year between fruits and vegetables would therefore indicate that 11 kg/year (or 26% of 42 kg/year) would be fruits, while 31 kg/year would be vegetables (Table A6-3).

Using the estimated yields of a home garden of 11 and 31 kg/year for fruits and vegetables, respectively, the overall contribution of the home garden to fruit and vegetable consumption can be calculated. For a family of four, given a total fruit and fruit juices consumption of 375.5 kg/year and a total vegetable intake of 426.3 kg/year, the proportion potentially obtained from a home garden would be 2.91% and 7.29% for fruits and vegetables, respectively (Table A6-4). This incorporates the assumption that the total yield from the garden is consumed, i.e., that there is no loss due to wildlife browsing or spoilage. It should be noted that this calculation, due to its basis on the yield of a home garden, would not take into account the harvesting and consumption of wild fruits such as berries. However, berry consumption is highly seasonal and would comprise a small fraction of the overall fruit consumption, and thus a very small proportion of the total diet. Therefore, it was concluded that consumption of wild berries would contribute negligibly to total intake via home garden produce.

Table A6-2: Daily Produce Consumption Rates for the Canadian Population[1]

	Produce Consumption Rates (g/day)				
	Infant (0 - 6 mo)	Toddler (7 mo - <5 yr)	Child (5 - <12 yr)	Teen (12 - <20 yr)	Adult (20+ yr)
Root Vegetables	83	105	161	227	188
Other Vegetables	72	67	98	120	137
Fruits and Fruit Juices	136	234	268	258	245
% Fruit Locally grown	37%	37%	37%	37%	37%
Local Fruit	50.32	86.58	99.16	95.46	90.65
Total Daily Consumption of Locally Grown Produce	205	259	358	442	416
Root as a % of Total Daily Local Consumption	40%	41%	45%	51%	45%
Other as a % of Total Daily Local Consumption	35%	26%	27%	27%	33%
Local Fruit as a % of Total Daily Local Consumption	25%	33%	28%	22%	22%

1. From O'Connor, 1997.

Table A6-3: Estimation of Backyard Produce Contribution to Total Produce Consumption

Receptor	Daily Consumption (g/day)	Number	Total Daily Consumption (g/day)	Days/Year	Total Annual Consumption	
					g/year	kg/year
Adult	416	2	832	365	303,680	304
Child	358	2	716	365	261,340	261
Annual Family Consumption of Local Produce					565,020	565
Annual Produce Yield from Backyard Garden[1]					42,000	42
% of backyard garden - vegetables					74%	74%
Annual Vegetable Yield from Backyard Garden					31,080	31
Total Family Vegetable Consumption (all sources)					426,300	426
% of backyard garden - fruits					26%	26%
Annual Fruit Yield from Backyard Garden					10,920	11
Total Family Fruit Consumption (all sources)					375,500	376
% of Annual Vegetable Consumption that comes from Backyard Gardens					7.29%	7.29%
% of Annual Fruit Consumption that comes from Backyard					2.91%	2.91%

1. From MOEE, 1995.

Table A6-4: Estimated Daily Consumption of Backyard Garden Produce for all Age Groups

	Produce Consumption Rates (g/day)				
	Infant (0 - 6 mo)	Toddler (7 mo - <5 yr)	Child (5 - <12 yr)	Teen (12 - <20 yr)	Adult (20+ yr)
Total Daily Consumption of Root Vegetables	83	105	161	227	188
% Consumed as Backyard Garden Vegetables	7.29%	7.29%	7.29%	7.29%	7.29%
Daily Consumption of Backyard Root Vegetables	6.05	7.7	11.7	16.5	13.7
Total Daily Consumption of Other Vegetables	72	67	98	120	137
% Consumed as Backyard Garden Vegetables	7.29%	7.29%	7.29%	7.29%	7.29%
Daily Consumption of Other Backyard Vegetables	5.25	4.88	7.14	8.7	10.0
Total Daily Consumption of Fruits	136	234	268	258	245
% Consumed as Backyard Garden Fruits	2.91%	2.91%	2.91%	2.91%	2.91%
Daily Consumption of Backyard Fruits	3.96	6.81	7.80	7.5	14.1

A6-9 Time Activity Patterns

The US EPA Exposure Factors Handbook ,Volume III (US EPA, 1997) contains a wide variety of summarized activity pattern statistics for a broad range of categories (i.e., gender specific, seasonal, regional, age class, etc.). Data describing the number of minutes spent outdoors (outside the residence) per 24 hour period were used to help define activity values for the residents of the Rodney Street community.

During the two months of summer where toddlers, children and adolescents are not in school, it has been estimated that a receptor may spend up to eight hours/day, seven days/week outside. For the remaining six months of the summer season (for the purpose of characterizing receptor activities, it was assumed that "summer" in Port Colborne included mid March to mid November), receptors were assumed (based on literature estimates) to spend approximately three hours/day, seven days/week outside. The following illustrates the calculations used to estimate the average amount of time spent outside during the summer season.

$$\text{Time}_{avg} = [(2/8 \text{ months}) * (8\text{hrs/day} * 7\text{days/wk})] + [(6/8) * (3.0\text{hrs/day} * 7\text{days/wk})]$$

The daily average value has therefore been estimated to be approximately 4.3 hours/day outside in the summer. For winter months, original mean estimates based on literature data were used for these receptors. For infants and adults, literature data was used for both summer and winter. The

following table contains the typical mean and plausible maximum daily average values for each receptor. Other available data are summarized in Table A6-7h.

Table A6-5: Average Time Spent Outdoors During Summer and Winter

Receptor Description	Time Spent Outdoors During the Summer* (hours/day)	Time Spent Outdoors During the Winter (hours/day)
Infant	3	2
Toddler	4.3	2
Child	4.3	2
Teen	4.3	2
Adult	3	2

* For the purpose of characterizing receptor activities, it was assumed that "summer" in Port Colborne included mid March to mid November.

Although the amount of time spent outside versus inside should be estimated as accurately as possible, it is not expected to have a great influence on overall exposure estimates. Since exposure from soil ingestion is not proportional to the amount of time a receptor spends outside (Walker and Griffin, 1997), it is expected this variable will have a negligible impact on exposure estimates relative to other parameters.

A6-9.1 Amount of Time Spent Within the Rodney Street Community

Typical values have been assigned to the amount of time a receptor may spend in the Rodney Street community, either at home or at parks in the immediate area. The following is a breakdown of the average time assumed to be spent away from the Rodney Street community per day for all receptors (i.e., at school and/or work where appropriate). These activity patterns were assumed not to vary significantly throughout the year, except for the two summer months per year which children and adolescents are not in school (July and August). During this time it was assumed these receptors would spend more time within the Rodney Street community (Table A6-6).

Table A6-6: Average Amount of Time Spent Within the Rodney Street Community Per Day

Receptor	Typical	July and August
Infant	23 hours/day (1 hour/day)	23 hours/day (1 hour/day)
Toddler	23 hours/day (1 hour/day)	23 hours/day (1 hour/day)
Child	16 hours/day (8 hours/day)	23 hours/day (1 hour/day)
Teen	14 hours/day (10 hours/day)	23 hours/day (1 hour/day)
Adult*	23 hours/day (1 hour/day)	23 hours/day (1 hour/day)

( ) represents the amount of time spent away from the Rodney Street community but still within Port Colborne.
*Adults were assumed to be stay at home parents.

A6-10 References

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Table A6-7a: Body Weight Receptor Parameters

		Infant	Toddler						Child	Teen	Adult	Source
		0-0.5y	0.5-1 y	1-1.5 y	1.5-2 y	2-2.5y	3y	4y	5-11y	12-19y	20+ y	
Time Spent in Age Group	Yrs	0.5	4.5						7	8	50	
Body Weight	Kg	7	13						27	57	70	CEPA, 1994; Health Canada, 1995; CCME, 1996
		6.28 F 7.20 M	9.23 F 9.83 M	10.39 F 10.7 M	11.66 F 12.5 M	12.17 F 12.69 M	13.94 F 14.85 M	16.42 F 17.14 M	26.4 F 26.4 M	54.3 F 60.1 M	70	EHD[1], 1993
		-	16.5						-	-	70.7	CCME, 2000
		8.2	16.5						32.9	59.7	70.7	O'Connor, 1997

Parameter	Unit	Infant	Toddler					Child	Teen	Adult	Source
		0 - 0.5 y	6-11 mo	1 y	2 y	3 y	4 y	5 -11 y	12 -19 y	18-74 y	
Time Spent in Age Group	Yrs	0.5	0.5	1	1	1	1	7	8	57	
Body Weight	Kg	n/av	9.1	11.3	13.3	15.3	17.4	29.2	58.3	71.8	US EPA, 1997[2]

1. EHD (Environmental Health Directorate Working Group on Reference Values). 1993. Reference Values for Canadian Populations. Updated May 1997. Infant, toddler, and child data are from the Nutrition Canada Survey, 1970-72; teen data are from the Canada Fitness Survey, 1981.
2. US EPA recommended values; from NCHS, 1997; weights include clothing weight estimate 0.09-0.28kg; no body weight value available for infants 0-5 months of age; adult range here is 18 to 74 years of age, thus 18 and 19 year olds are accounted for in both the teen and adult age categories.

EHD and US EPA data presented in this table are summarized from data from individual years.

n/av = value not available.

Table A6-7b: Inhalation Rate

Parameter	Unit	Infant	Toddler	Child		Teen	Adult	Source
		0-0.5y	0.5-4y	5-11y	9-11y	12-19y	20+ y	
Number of Years Spent in Age Group	Yrs	0.5	4.5	7	-	8	50	
Inhalation Rate	m^3 /day	2	5	12	-	21	23	CEPA, 1994; Health Canada, 1995; EHD, 1993; CCME, 1996
		-	9.3	-	-	-	16.2	CCME, 2000
		2.1	9.3	-	14.5	15.8	15.8	O'Connor, 1997

Parameter	Unit	< 1 y	1-2 y	3-5 y	6-8 y	9-11 y	12-14 y	15-18 y	19-65+ y	Source
Number of Years Spent in Age Group	Yrs	1	2	3	3	3	3	4	51	
Inhalation Rate	m^3 /day	4.5	6.8	8.3	10	14M 13F	15 M 12 F	17 M 12F	11.3 F 15.2 M	US EPA, 1997
		-	-	-	-	-	-	-	20	US EPA, 1991[1]

[1.] Adult age range not specified.
M = male; F = female.

Table A6-7c: Water Intake Rate

Parameter	Unit	Infant	Toddler			Child				Teen		Adult	Source
		0-0.5y	<1 y	<3 y	0.5-4y	1-10 y	3-5y	5-11y	6-17y	11-19y	12-19y	20+ y	
Number of Years Spent in Age Group	Yrs	0.5			4.5			7			8	50	
Water Intake	L /day	0.75	-	-	0.8	-	-	0.9	-	-	1.3	1.5	CEPA, 1994[1]; Health Canada, 1995; CCME, 1996
		-	-	-	0.6	-	-	-	-	-	-	1.5	CCME, 2000
		0.3	-	-	0.6	-	-	0.8	-	-	1	1.5	O'Connor,1997
		0.4/0.8	-	0.61	-	-	0.87	-	1.14	-	-	1.49	EHD[2], 1993
		-	0.3	-	-	0.74	-	-	-	0.97	-	1.4	US EPA, 1997
		-	-	-	-	-	-	-	-	-	-	2	US EPA, 1991[3]

1. Infants here are non-breast fed; it is assumed that exclusively breast fed infants do not require supplementary liquids.
2. Regarding values quoted for infants, values refer to bottle fed infants consuming concentrated and powdered milk, respectively; adult estimate refers to adults 18 years and older.
3. Adult age range not specified; estimate based on consumption 350 days/year for 30 years.

Table A6-7d: Soil Ingestion Rate

Parameter	Units	Infant	Toddler				Child	Teen	Adult	Source
		0-0.5y	0.5-4y	<6 y	1-6 y	1-7y	5-11y	12-19y	20+ y	
Number of Years Spent in Age Group	Years	0.5	4.5	6	6	7	7	8	50	
Soil Ingestion	mg /day	35	50	-	-	-	35	20	20	CEPA, 1994; Health Canada, 1995
		-	-	-	-	70	-		20	EHD, 1993
		20	80	-	-	-	20	20	20	CCME, 1996, 2000
		-	100 (best estimate of mean) 200 (conservative estimate of mean)-					-	50	US EPA, 1997[1]
		-	100 (best estimate of mean) 400 (upper %percentile, short duration) 10,000 (pica, acute only)					-	-	US EPA, 2000b
		-	-	-	200	-	-	-	100 (7+ y)	US EPA, 1991[2]
		-	median 24 mg/day (sd = 4 mg/day) 95th percentile 91 mg/day (sd = 16.6 mg/day)					-	-	Stanek et al., 2001
		35	80	-	-	-	80	20	20	MOEE, 1995[3]

1. 100 mg/day is the best estimate of the mean for children under 6 years of age; 200 mg/day may be used as a conservative estimate of the mean; for pica children, 10 g/day is a reasonable value to be used in acute exposure assessments. Adult age range not specified.
2. Used for calculating a 30 year residential exposure; there is a 6 year exposure duration which accounts for the period of highest soil ingestion and lowest body weight (15 kg), followed by a 24 year exposure for older children and adults, using and adult body weight (70 kg).
3. Soil ingestion rates typically used by MOE in assessing risks associated with chemicals in soil.

Table A6-7e: Soil Adhesion to Skin

Parameter	Unit	Infant	Toddler	Child		Teen	Adult	Source
		0-0.5y	0.5-4y	5-11y	6-17y	12-19y	20+ y	
Number of Years Spent in Age Group	Yrs	0.5	4.5	7	12	8	50	
Soil Adhesion to Skin	g /day	2.2	3.5	5.8	-	9.1	8.7	Health Canada, 1995
	mg /cm^2	-	0.1 (hands only) 0.01 (whole body)					CCME, 2000
		-	0.5 - 1.5			-	0.58 - 1.40	US EPA, 1997[1]
		0.2						US EPA, 1992[2]
		0.2				0.07		US EPA, 2000a

1. Studies cited specify adherence values within the given ranges. Age ranges were not specified.
2. United States Environmental Protection Agency (US EPA), Exposure Assessment Group, Office of Health and Environmental Assessment. Dermal Exposure Assessment: Principles and Applications. EPA/600/8-91/011B. January 1992, Interim Report. Range of values in studies were 0.2 - 1.5 mg/cm^2; since this range is derived from hand measurements only, it may overestimate average adherence for the entire exposed skin area; thus, the lower end of this range (0.2) may be the best value to represent an average overall exposed skin and 1 mg may be a reasonable upper limit. Age ranges not specified.

Table A6-7f: Body Surface Area

Parameter	Unit	Infant	Toddler	Child	Teen	Adult	Source
		0-6 months	7 months- 4 years	5-11 years	12-19 years	20+ years	
Number of Years Spent in Age Group	Years	0.5	4.5	7	8	50	
Total Body	m^2	0.3	-	-	-	-	CCME, 1996
Head, Arms, Hands & Lower Legs		-	0.26	0.41	-	-	
Head, Arms & Hands		-	-	-	0.43	0.43	
Arms	m^2	0.052	0.075	0.121	0.227	0.255	Health Canada, 1995
Hands		0.0185	0.035	0.048	0.081	0.091	
Legs		0.077	0.139	0.2705	0.518	0.582	
Feet		0.022	0.04	0.0725	0.113	0.1275	
Total (Arms, Hands, Legs, & Feet)		0.17	0.289	0.512	0.939	1.06	
Arms	m^2	-				0.412	EHD, 1993
Hands		-				0.082	
Legs		-				0.62	
Feet		-				0.13	
Total (Arms, Hands, Legs, & Feet)		-				1.24	

Parameter	Unit	Infant	Toddler	Child	Teen	Adult	Source
		0-6 months	7 months- 4 years	5-11 years	12-19 years	20+ years	
Number of Years Spent in Age Group	Years	0.5	4.5	7	8	50	
Hands	m^2	0.032	0.043	0.059	0.08	0.089	O'Connor, 1997
Arms		0.055	0.089	0.148	0.223	0.25	
Legs		0.091	0.169	0.307	0.497	0.572	
Feet		0.025	0.043	0.072	0.108	0.119	
Total (Hands, Arms, Legs, & Feet)		0.203	0.344	0.586	0.908	1.03	

Parameter	Unit	Infant	Toddler	Child		Teen	Adult	Source
		<1 year	1-4 years	6 years	9 years	12-17 years	18+ years	
Arms (Means)	%	13.7	13.0 - 14.0	13.1	12.3	12.1 - 17.5	-	US EPA, 1997
Hands (Means)		5.3	5.3 - 6.07	4.71	5.3	5.11 - 5.68	-	
Legs (Means)		20.6	23.1 - 27.8	27.1	28.7	30.5 - 33.6	-	
Feet (Means)		6.54	6.27 - 7.29	6.9	7.58	6.93 - 8.02	-	
Total (Arms, Hands, Legs, & Feet)		46.1	47.7 - 55.2	51.8	53.9	54.6 - 64.8	-	
Exposed Parts of Body	%	In moderate climates, it may be reasonable to assume that 5% of the skin is exposed during the winter, 10% during the spring and fall, and 25% during the summer.						

Parameter	Unit	Toddler	Child	Teen	Adult	Source
		2-4 years	5-11 years	12-17 years	18+ years	
Arms (Means)	m^2	-	--	-	0.219	US EPA, 1997; US EPA, 1992
Hands (Means)		-	--	-	0.0793	
Legs (Means)		-	--	-	0.497	
Feet (Means)		-	--	-	0.105	
Total (Arms, Hands, Legs, & Feet) (Means)		-	-	-	0.9	
Total Body (Medians)		0.579 - 0.731	0.779 - 1.30	1.34 - 1.80	1.815	

Parameter	Unit	Toddler		Child				Teen		Adult	Source
		3 y	3-5 y	6 y	6-8 y	9 y	9-11 y	12-14 y	15-17 y	18+ y	
Arms (Males Only)	m^2	0.096	-	0.11	-	0.13	-	-	-	0.23	US EPA, 1989 (medians)
Hands (Males Only)		0.04	-	0.041	-	0.057	-	-	-	0.082	
Legs (Males Only)		0.18	-	0.24	-	0.31	-	-	-	0.55	
Total Body (Males & Females)		-	0.72	-	0.925	-	1.16	1.49	1.68	1.82	

Table A6-7g: Fruit and Vegetable Consumption

Parameter	Unit	Infant	Toddler	Child	Teen	Adult			Source
		1-2 y	3-5 y	6-11y	12-19 y	20-39 y	40-69 y	70+ y	
Number of Years Spent in Age Group	Years	n/av[1]	n/av[1]	n/av[1]	n/av[1]	n/av[1]	n/av[1]	n/av[1]	
Backyard - Fruits	g/kg/day	8.74	4.07	3.59	1.94	1.95	2.66	2.25	US EPA, 1997
		All Ages: 2.31 (central city), 2.41 (non-metro), 3.07 (suburb), 2.68 (all groups) 1.05 (suburb in northeast), 0.929 (all groups in northeast)							
	g/day	42 (reasonable worst case) (ages not specified)							US EPA , 1991
Backyard - All Vegetables.	g/kg/day	5.2	2.46	2.02	1.48	1.47	2.07	2.51	US EPA, 1997
		All Ages: 1.40 (central city), 2.68 (non-metro), 1.82 (suburb), 2.08 (all groups) 3.05 (non-metro northeast), 1.59 (suburb northeast), 1.78 (all groups northeast)							
	g/day	80 (reasonable worst case) (ages not specified)							US EPA , 1991
Backyard - Exposed Vegetables	g/kg/day	3.48	1.74	1.39	1.07	1.05	1.6	1.68	US EPA, 1997
		All Ages: 1.11 (central city), 1.87 (non-metro), 1.35 (suburb), 1.52 (all groups) 1.65 (all groups in northeast)							
Backyard - Protected Vegetables	g/kg/day	2.46	1.3	1.1	0.776	0.762	0.93	1.05	US EPA, 1997
		All Ages: 0.996 (central city), 1.07 (non-metro), 0.926 (suburb), 1.01 (all groups) 0.701 (all groups in northeast)							
Backyard - Root Vegetables.	g/kg/day	2.52	1.28	1.32	0.937	0.874	1.13	1.22	US EPA, 1997
		All Ages: 0.749 (central city), 1.43 (non-metro), 1.06 (suburb), 1.16 (all groups) 0.838 (all groups in northeast)							

Parameter	Unit	Infant	Toddler	Child	Teen	Adult	Source
		0-0.5 y	0.5-4 y	5-11 y	12-19 y	20+ y	
Number of Years Spent in Age Group	Years	0.5	4.5	7	8	50	
Backyard - Root Vegetables.	g/day	8.18	10.3	15.9	22.4	19.3	MOEE, 1995
Backyard - Other Vegetables.	g/day	7.09	6.6	9.65	11.8	14.1	MOEE, 1995
Backyard - All Vegetables.	kg/harvest	22.8					Gradient, 1995
Parameter	Unit	Child				Adult	Source
		1-4 y				20+ y	
Number of Years Spent in Age Group	Years	n/av[1]				n/av[1]	
Backyard - All Fruits & Vegetables.[2]	g/day	26				34	MOEE, 1994[2]
Parameter	Unit	Infant	Toddler	Child	Teen	Adult	Source
		0-0.5 y	0.5-4 y	5-11 y	12-19 y	20+ y	
Number of Years Spent in Age Group	Years	0.5	4.5	7	8	50	

Parameter	Unit	Infant	Toddler	Child	Teen	Adult	Source
		0-0.5 y	0.5-4 y	5-11 y	12-19 y	20+ y	
Root Vegetables.	g/day	83	105	161	227	188	O'Connor, 1997
Other Vegetables.	g/day	72	67	98	120	137	O'Connor, 1997
All Vegetables.	g/day	42	125	198	250	250	Health Canada, 1995 CEPA, 1994 EHD, 1993
Vegetables.	g/day	200 (ages not specified)					US EPA, 1991
Fruits & Juices	g/day	136	234	268	258	245	O'Connor, 1997
Fruit & Fruit Products	g/day	112	189	202	160	186	EHD, 1993 Health Canada, 1995 CEPA, 1994
Fruit	g/day	140 (ages not specified)					US EPA, 1991

[1] Number of years in age categories not specified.
[2] Calculated as totals of all food group types consumed.

Table A6-7h: Activity Patterns

Parameter	Unit	Infant	Toddler	Child	Teen	Adult	Source
		0-0.5 year	0.5-4 years	5-14 years	15-19 years	20+ years	
Number of Years Spent in Age Group	Years	0.5	4.5	10	5	50	
Time Spent Outdoors	Min/Day	-	-	-	85	85	O'Connor, 1997
Parameter	Unit	Infant	Toddler	Child	Adult		Source
		0-0.5 year	0.5-2 years	3-11 years	12+ years		
Number of Years Spent in Age Group	Years	0.5	2.5	9	58		
Time Spent Outdoors	Hour/Day	-	-	5 (weekdays) 7 (weekends)	1.5		US EPA, 1997