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STATE OF MINNESOTA

Office Memorandum

JOSLYN

VP 9730

DEPARTMENT: POLLUTION CONTROL AGENCY

DATE: March 24, 1999

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SUBJECT: Human Health Limited Risk Assessment for Closure of the Former Joslyn Manufacturing Company Superfund Site

I have attached a copy of the Human Health Limited Risk Assessment for the Former Joslyn Manufacturing Site. The attached evaluation includes copies of the risk calculation tables as well as documentation of the basis of the Soil Reference Values (SRVs) utilized in the evaluation.

If you have any questions or concerns please feel free to contact me.

SCREENING RISK ASSESSMENT OF THE SOIL – HUMAN HEALTH PATHWAY AT THE FORMER JOSLYN MANUFACTURING COMPANY SITE

1.0 Introduction

A screening risk evaluation was conducted to assist in determining closure requirements at the Joslyn Superfund Site. The evaluation was based on potential health risk resulting from exposure to contaminated soils remaining at the site. The results of the screening evaluation are based on limited data and should be utilized as one piece of information to guide the site team in developing site closure requirements. NOTE: the screening evaluation addresses surface soils only. It is assumed that restrictions will be placed on the site such that subsurface soils would not be disturbed without prior approval by MPCA.

Potential impacts to ecological receptors are not addressed in this screening evaluation. Issues such as odor, aesthetics, property values, etc. were also not considered although these issues may be of concern to the community.

Contaminated soil can be a source of direct and indirect exposure to contaminants. Exposure of humans to contaminants in soil occurs primarily through inhalation of soil vapors/particles, incidental ingestion of soil particles, dermal contact with soil, and ingestion of food or water contaminated via transfer from soil.

The health risk posed by environmental contaminants is a function of the magnitude of the exposure to the contaminant and the toxic potential of the contaminant. Generic Soil Reference Values (SRVs) have been developed that represent acceptable soil concentrations for specific exposure scenarios. The exposure pathways incorporated into the generic SRV exposure scenarios are: incidental ingestion of soil, dermal contact with soil, and inhalation of soil vapors or resuspended particulate. If the cross media transfer of contaminants from soil to ground water or soil to the foodchain is of concern it will need to be addressed through an additional assessment.

The SRVs are based on risk assessment methodology, modeling, and risk management policy. It is acknowledged that risk assessment can not be completely accurate in reflecting actual site conditions, due to a number of scientific uncertainties. Nevertheless this process has been utilized, accepting the uncertainty, because the methodology is the best available, and it provides a consistent approach to making risk-based decisions.

In calculating SRVs, a set of acceptable risk levels has been established to ensure the same level of protection of human health regardless of the receptor or intended property use. The acceptable risk levels targeted by the risk-based evaluation process are as follows:

- Carcinogenic effects - a total or cumulative site excess lifetime cancer risk (ELCR) not to exceed 1 in 100,000 (i.e., 1E-5) for chronic exposure. In other words, the acceptable risk level is a maximum of one additional case of cancer per 100,00 chronically exposed individuals above background cancer rates in the general population. For subchronic exposure (e.g., 1 year) the acceptable cumulative ELCR is limited to ten percent of the chronic ELCR (i.e., 1E-6); and

- Noncarcinogenic effects - a noncancer risk not to exceed a hazard quotient (HQ) of 0.2 per contaminant for chronic exposure or 1 for subchronic and acute exposure and a cumulative hazard index (HI) of 1 for multiple contaminants with similar target endpoints. The HQ is determined by dividing the site contaminant exposure by the contaminant reference dose, which is an estimate of the daily exposure that is not likely to result in an appreciable risk of

deleterious effects. The HI is determined by adding the HQs for each contaminant with similar endpoints.

The individual SRVs are calculated such that risk to human health will be at or below the acceptable risk levels established by the MPCA. Risk is evaluated separately for carcinogenic (cancer-causing) and noncarcinogenic effects. It assumes that the risk posed by individual contaminants with similar target endpoints (i.e., that affect the same parts of the body, such as liver or kidney, or cause the same effect, such as cancer) is additive. Therefore, when multiple contaminants having carcinogenic or noncarcinogenic effects are present at a site, the combined risk posed by the contaminants must be evaluated. The combined risks are referred to as the cumulative site risks.

The SRVs are intended to be protective without being unduly stringent (i.e., avoiding "cascading conservatism"). The exposure scenarios utilized represent reasonable maximum exposure (RME) activities for the planned use of the site. These activities represent full use of the site and may not be presently occurring but are consistent with the planned use of the property. Recommended chronic and short-term default exposure parameters have been developed for residential (applicable to unrestricted commercial use), industrial (applicable to restricted commercial use) and recreational property use settings. Note that these property categories were developed to aid in determining exposure potential, not to correspond to zoning categories. The exposure equations and default values are presented in Appendix 4 "Exposure Equations and Default Values".

Pentachlorophenol (PCP), carcinogenic polyaromatic hydrocarbons (cPAHs), and dioxins and furans been identified as the chemicals of concern at the site. The chemical-specific information utilized in the development of the SRVs for these contaminants is presented in Appendix 5 "Chemical-Specific Information". The generic SRVs for these contaminants are presented in Appendix 6.

Since the SRVs represent soil concentrations which correspond to specific risk levels, the screening evaluation consists of comparing the potential site exposure concentrations to the SRVs to calculate potential risk. Site sampling data was utilized to determine potential exposure concentrations.

2.0 Site Exposure Concentrations

The site sampling data consisted mainly of composite samples. Composite samples provide an efficient way of estimating the average concentration of the subsamples. However, important information about the subsample concentrations is lost and complete information on the range and distribution of concentrations within the area sampled is not available. Compositing was allowed for release sampling at this site because the site team felt that past site remedial activities resulted in fairly homogeneous residual levels within each area of the site. The West Area is a potential exception since limited investigation and remedial activities occurred in this area.

Three areas of the site were identified for the screening risk evaluation: the East Area, the Land Treatment Unit (LTU), and the West Area. The soil sampling results reported in Table 3 from the Release Sampling Results Report (submitted by Earth Tech, Feb. 23, 1999) were utilized in generating potential exposure concentrations.

2.1 East Area –

The East Area was separated into eight sampling grids. Within each grid five random subsamples were taken and composited into a single sample. Each composite sample was analyzed for PAHs, PCP and TPH. The three composite samples containing the highest PCP concentrations were also analyzed for dioxins and furans. The concentrations of detected cPAHs (as BaP equivalents) ranged from 0.6 to 2.6 mg/kg. The concentrations of detected PCP ranged from 0.5 to 64 mg/kg. The concentrations of detected dioxins and

furans (as TCDD equivalents) ranged from 0.000238 to 0.000496 mg/kg. For non-detect values a surrogate of one-half the detection limit was utilized as the concentration.

Because the samples were composite samples and the number of samples was small, statistical manipulation (e.g., mean concentration, 95% upper confidence limit of the mean, etc.) was not performed. Instead a grid by grid evaluation was performed. However, dioxin/furan information was only available for 3 of the 8 grids. The relationship between PCP and dioxins/furans was evaluated to determine if a correlation existed. Based on the three grids for which PCP and dioxin/furan data was available a quantitative correlation did not exist. Examination of the PCP and dioxin/furan concentrations across the site does suggest a qualitative pattern, i.e., lower levels of dioxins/furans are associated with lower levels of PCP. In the absence of data the dioxin/furan concentration from the low end of the dioxin/furan concentration range (i.e., 0.0002 mg/kg) was utilized as a surrogate concentration for the remaining 5 grids.

2.2 Land Treatment Unit (LTU)

Twenty-two subsamples were taken from random locations within the LTU Area. For the analysis of PCP, PAHs and TPH two adjacent subsamples were composited resulting in 11 composite samples. In addition, the 22 subsamples were composited into 5 composite samples and analyzed for dioxins/furans. The concentrations of detected cPAHs (as BaP equivalents) ranged from 0.6 to 8.3 mg/kg. The concentrations of detected PCP ranged from 2.9 to 92 mg/kg. The concentrations of detected dioxins and furans (as TCDD equivalents) ranged from 0.000401 to 0.00263 mg/kg. For non-detect values a surrogate of one-half the detection limit was utilized as the concentration.

Because the samples were composite samples and the number of samples was small, statistical manipulation (e.g., mean concentration, 95% upper confidence limit of the mean, etc.) was not performed. Instead each composite sample was evaluated. However, the dioxin/furan compositing pattern did not correspond with the sampling pattern for the other contaminants of concern. It was noted that the concentrations of dioxins/furans within the LTU area were very consistent. For the purpose of the screening risk evaluation the average concentration, i.e., 0.002 mg/kg, was utilized as the dioxin/furan concentration across the LTU area.

2.3 West Area

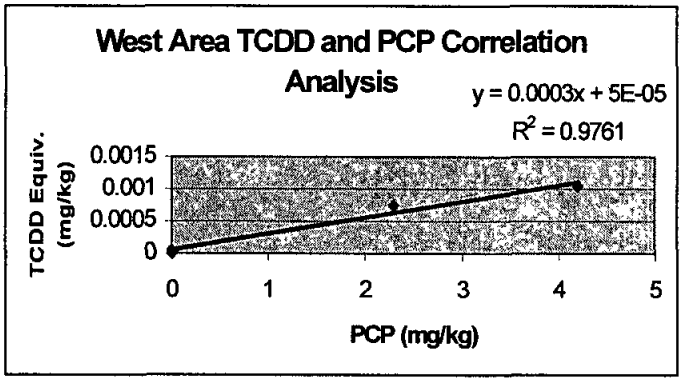
The West Area was separated into five soil sampling areas. Within each area five subsamples were taken and composited into a single sample. Each composite sample was analyzed for PAHs, PCP, dioxins/furans and TPH. The concentrations of detected cPAHs (as BaP equivalents) ranged from 0.3 to 3.8 mg/kg. The concentrations of detected PCP ranged from 0.2.3 to 880 mg/kg. The concentrations of detected dioxins and furans (as TCDD equivalents) ranged from 0.0000042 to 0.01087 mg/kg. For non-detect values a surrogate of one-half the detection limit was utilized as the concentration.

Because the samples were composite samples and the number of samples was small, statistical manipulation (e.g., mean concentration, 95% upper confidence limit of the mean, etc.) was not performed. Instead each composite sample was evaluated.

One of the initial 5 soil samples (i.e., WA-3) identified an area of high concentration PCP (composite concentration of 880 mg/kg). A second phase of sampling was performed in the vicinity and consisted of 5 additional discrete grab samples. The additional grab samples were analyzed for PAHs and PCP. The analytical results reported for 3 of the 5 additional samples indicated high detection limits for cPAHs (i.e., > 1 ppm). Using one-half the detection limit for non-detect values the concentrations of cPAHs (as BaP equivalents) ranged from 0.77 to 5.9 mg/kg. The concentrations of detected PCP ranged from 20 to 130 mg/kg.

Dioxin/furans were not analyzed for in the additional grab samples. Utilizing the analytical results reported in 4 of the initial 5 composite soil samples a correlation between PCP and dioxin/furans (as TCDD equivalents) was determined. The fifth initial sample was excluded because the concentrations were extremely high. The average TCDD Equivalent concentration from the duplicate WA-5 samples was utilized in the correlation analysis. Also, since the TCDD Equivalent concentrations in the non-detect samples were at or below background levels a value of zero was utilized for the PCP concentration instead of one-half the detection limit. The resulting correlation and estimated TCDD Equivalent concentrations are shown below.

Sample	PCP	TCDD Equiv
WA-5	0	0.0000468
WA-4	0	0.0000042
WA-2	2.3	0.000743
WA-1	4.2	0.001044



Estimated Concentrations Using Correlation

Sample ID	PCP (mg/kg)	TCDD Equiv (mg/kg)
6WA-3	55	0.01655
7WA-3	30	0.00905
8WA-3	20	0.00605
9WA-3	130	0.03905
10WA-3	44	0.01325

Soil/sediment samples were also collected in the area of Pond 1 (composite WA-7) and Pond 2 (composite WA-6). Five subsamples were composited into a single sample for each of the pond areas. The composite samples were analyzed for PCP and PAHs. The analytical results reported indicated higher than usual detection limits for cPAHs (i.e., > 0.33 ppm). Using one-half the detection limit for non-detect values the concentrations of cPAHs (as BaP equivalents) were from 0.767 and 4.53 mg/kg for Pond 1 and 2, respectively. The concentrations of detected PCP were 1.1 and 49 mg/kg for Pond 1 and 2, respectively.

The Pond samples were not evaluated for dioxin/furans. Utilizing the correlation above dioxin/furan (as TCDD equivalents) were estimated to be 0.00038 and 0.01475 mg/kg for Pond 1 and 2, respectively. There was no apparent consensus among the site team as to whether the samples represented soil or sediment. As a result, two evaluations were conducted. One evaluation assessed the samples as accessible soil. The second assessed the samples as sediment with potential exposure to children wading. The exposure parameter tables for the child wading scenario are contained in Appendix 4A.

3.0 Result of Screening Evaluation

The acceptable target risk levels utilized in the screening evaluation are summarized below:

- Carcinogenic effects - a total or cumulative site excess lifetime cancer risk (ELCR) not to exceed 1 in 100,000 (i.e., 1E-5) for chronic exposure. In other words, the acceptable risk level is a maximum of one additional case of cancer per 100,00 chronically exposed individuals above background cancer rates in the general population. For subchronic exposure (e.g., 1 year) the acceptable cumulative ELCR is limited to ten percent of the chronic ELCR (i.e., 1E-6); and

- Noncarcinogenic effects - a noncancer risk not to exceed a hazard quotient (HQ) of 0.2 per contaminant for chronic exposure or 1 for subchronic and acute exposure and a cumulative hazard index (HI) of 1 for multiple contaminants with similar target endpoints. The HQ is determined by dividing the site contaminant exposure by the contaminant reference dose, which is an estimate of the daily exposure that is not likely to result in an appreciable risk of deleterious effects. The HI is determined by adding the HQs for each contaminant with similar endpoints.

The estimated risk level does not necessarily indicate the actual risk posed by site contaminants but does indicate areas of concern.

3.1 East Area –

The results of the screening evaluation of the East Area based on the surface soil data provided by Earth Tech are summarized in the table below.

Table 1. East Area - - Summarization of Calculated Cumulative Excess Lifetime Cancer Risk

Sample ID	Exposure Scenario			
	Chronic Residential/ Recreational	Subchronic Child	Chronic Industrial Worker	Short-term Worker
G1/G2 *	1.3E-5	1.3E-6	7E-6	3E-7
G3/H3 *	1.7E-5 (60% TCDD + 39% cPAH)	1.6E-6 (63% TCDD + 34% cPAH)	9E-6	3.8E-7
H1 and H2 *	1.4E-5	1.3E-6	7.5E-6	3E-7
I1	4.6E-5 (52% TCDD + 28% cPAHs)	4.3E-6 (57% TCDD + 26% cPAHs)	2.5E-5 (56% TCDD + 26% cPAHs)	1E-6
I2/J2	1.6E-5 (76% TCDD)	1.5E-6 (79% TCDD)	9E-6	3.7E-7
J1	2.9E-5 (86% TCDD)	2.8E-6 (88% TCDD)	1.4E-5	6E-7
K1/L1	1.2E-5	1E-6	6.7E-6	3E-7

* 0.0002 mg/kg was utilized as surrogate TCDD Equivalent concentration

The estimated risks from several grids (denoted by gray shading) exceeded the MPCA target risk levels when evaluated under the residential/recreational exposure scenarios. The estimated risk from Grid I1 exceeded the MPCA target risk level for a chronic industrial worker exposure scenario. None of the grids evaluated produced estimated risks which exceeded the MPCA subchronic target risk level when evaluated under a short-term worker exposure scenario. None of the grids exceeded the upper end value of the EPA risk range, i.e., 1E-4. However, note that EPA usually applies the lower end value of the EPA risk range, 1E-6, for residential settings. All of the grids in the East Area exceed the lower end of the EPA risk range under the residential exposure scenario.

3.2 LTU Area –

The results of the screening evaluation of the LTU Area based on the surface soil data provided by Earth Tech are summarized in the table below.

Table 2. LTU Area - - Summarization of Calculated Cumulative Excess Lifetime Cancer Risk

Sample ID	Exposure Scenario			
	Chronic Residential/ Recreational	Subchronic Child	Chronic Industrial Worker	Short-term Worker
10D/11C1	1E-4 (98% TCDD)	1E-5 (98% TCDD)	5.8E-5 (98% TCDD)	2.5E-6 (98% TCDD)
1D2/8D3	1E-4 (93% TCDD)	1E-5 (93% TCDD)	6E-5 (93% TCDD)	2.7 E-6 (94% TCDD)
15D4/3D4	1.2E-4 (83% TCDD)	1.2E-5 (85% TCDD)	6.7E-5 (85% TCDD)	2.9E-6 (86% TCDD)
14C5/13D5	1.2E-4 (83% TCDD)	1.2E-5 (85% TCDD)	6.8E-5 (84% TCDD)	3E-6 (85% TCDD)
5D3/2D3	1.5E-4 (68% TCDD + 28% cPAHs)	1.4E-5 (71% TCDD + 26% cPAHs)	8E-5 (70% TCDD + 26% cPAHs)	3.5E-6 (72% TCDD + 24% cPAHs)
6C4/2C4	1.3E-4 (76% TCDD)	1.3E-5 (79% TCDD)	7.3E-5 (78% TCDD)	3.2E-6 (79% TCDD)
7E3/9F3	1E-4 (94% TCDD)	1E-5 (95% TCDD)	6E-5 (95% TCDD)	2.6E-6 (95% TCDD)
6C3/2C3	1.4E-4 (69% TCDD + 22% cPAHs)	1.4E-5 (72% TCDD + 20% cPAHs)	8E-5 (71% TCDD + 20% cPAHs)	3.5E-6 (72% TCDD)
12C2/2C2	1.2E-4 (85% TCDD)	1.2E-5 (87% TCDD)	6.6E-5 (87% TCDD)	2.9E-6 (87% TCDD)
13D2/5D2	1.1E-4 (88% TCDD)	1.1E-5 (89% TCDD)	6.4E-5 (89% TCDD)	2.8E-6 (90% TCDD)
10E4/15F4	1E-4 (97% TCDD)	1E-5 (97% TCDD)	5.9E-5 (97% TCDD)	2.6E-6 (97% TCDD)

* 0.002 mg/kg was utilized as surrogate TCDD Equivalent concentration for all grids.

The estimated risks from all grids within the LTU Area exceeded the MPCA target risk levels regardless of which exposure scenario was evaluated. The level of TCDD equivalents within the LTU was the main source of the estimated risk levels. None of the grids exceeded the upper end value of the EPA risk range, i.e., 1E-4. However, note that EPA usually applies the lower end value of the EPA risk range, 1E-6, for residential settings. All of the grids within the LTU Area would significantly exceed the lower end of the EPA risk range under the residential exposure scenario.

3.3 West Area –

The results of the screening evaluation of the West Area based on the surface soil data provided by Earth Tech are summarized in the table below.

Table 3. West Area - - Summarization of Calculated Cumulative Excess Lifetime Cancer Risk in Composite Samples

Sample ID	Exposure Scenario			
	Chronic Residential/ Recreational	Subchronic Child	Chronic Industrial Worker	Short-term Worker
WA-1	7E-5 (73% TCDD + 26% cPAHs)	7E-6 (75% TCDD + 24% cPAHs)	4E-5 (75% TCDD + 24% cPAHs)	1.7E-6 (77% TCDD)
WA-2	4E-5 (93% TCDD)	4E-6 (94% TCDD)	2.3E-5 (94% TCDD)	1E-6
WA-3 (a)	6.7E-4 (81% TCDD + 19% PCP)	6.4E-5 (84% TCDD + 16% PCP)	3.8E-4 (82% TCDD + 17% PCP)	1.7E-5 (81% TCDD + 18% PCP)
WA-4	Not evaluated since no detectable levels of PCP or cPAHs and TCDD Equivalent levels were below the SRV for TCDD Equivalents.			
WA-5	Not evaluated since no detectable levels of PCP or cPAHs and TCDD Equivalent levels were below the SRV for TCDD Equivalents.			
WA-6 assessed as soil *	7.8E-4 (96% TCDD)	7.6E-5 (97% TCDD)	4.4E-4 (97% TCDD)	1.9E-5 (96% TCDD)
WA-6 assessed as sediment *	Child Wader: 1.8E-4 (95% TCDD)			
WA-7 assessed as soil *	2.3E-5 (83% TCDD)	2.2E-6 (84% TCDD)	1.3E-5	5.6E-7
WA-7 assessed as sediment *	Child Wader: 5.7E-6			

(a) also evaluated for acute toxicity risk

* TCDD Equivalent concentration was determined utilizing correlation presented in Section 2.3.

The estimated risks from all composite samples except WA-4, WA-5, and WA-7 (if evaluated as sediment) exceeded the MPCA target risk levels when evaluated under the residential/recreational exposure scenarios. The estimated risk from composite samples WA-1, WA-2, WA-3, and WA-6 (if evaluated as soil) exceeded the MPCA target risk level for a chronic industrial worker exposure scenario. Composite samples WA-1, WA-3, and WA-6 (if evaluated as soil) exceeded the MPCA subchronic target risk level when evaluated under a short-term worker exposure scenario.

Composite samples WA-3 and WA-6 did exceed the upper end value of the EPA risk range, i.e., 1E-4. However, note that EPA usually applies the lower end value of the EPA risk range, 1E-6, for residential settings. All of the grids in the West Area except WA-4 and WA-5 would exceed the lower end of the EPA risk range under the residential exposure scenario.

Composite WA-3 was identified as area of high PCP contamination. The composite concentration for PCP also represent an acute toxicity risk to small children. Acute ingestion can occur at a single location. The composite concentration exceeded the acute soil concentration by a factor of 4. The composite concentration is the average of 5 subsamples. The subsample believed to contain the high concentration of PCP was 5-WA-3. The true exceedence is likely to be greater than a factor of 4 since the composite concentration represents a dilution of the highest concentration.

A second phase of sampling was performed in the vicinity and consisted of 5 additional discrete grab samples (i.e., 6-, 7-, 8-, 9-, and 10-WA-3). Utilizing the correlation presented in Section 2.3 the estimated TCDD concentrations would be:

6 - WA-3	0.01655 ppm
7 - WA-3	0.00905 ppm
8 – WA-3	0.00605 ppm
9 – WA-3	0.03905 ppm
10 – WA-3	0.01325 ppm

The estimated risk associated with the above levels of TCDD Equivalents alone would be:

Sample	Chronic Residential/ Recreational	Subchronic Child	Chronic Industrial Worker	Short-term Worker
6- WA-3	8.3E-4	8.3E-5	4.7E-4	2E-5
7 - WA-3	4.5E-4	4.5E-5	2.6E-4	1.1E-5
8 - WA-3	3E-4	3E-5	1.7E-4	7.6E-5
9 – WA-3	1.9E-3	1.9E-4	1.1E-3	4.9E-5
10 - WA-3	6.6E-4	6.6E-5	3.8E-4	1.6E-5

It is clear that the area around subsample 5 – WA-3 is contaminated with levels which exceed the acceptable target risk levels. Estimated risk levels also exceeded EPA's upper risk range value.

4.0 Uncertainty

Exposure concentrations utilized-

Sampling data were limited and were composed mainly of composite samples. The potential exposure concentration for TCDD equivalents was often a surrogate based on available site data.

Exposure pathways and input parameters –

The industrial worker scenario includes exposure resulting from outdoor as well as indoor work activities. If work activities are limited to the indoor environment and site soil/dust is not transported indoors the screening risk estimates would overestimate the risk..

The risk evaluation for the child wader did not include exposure to contaminated surface water. If contact with surface water occurs the screening risk estimate would underestimate the potential risk from wading.

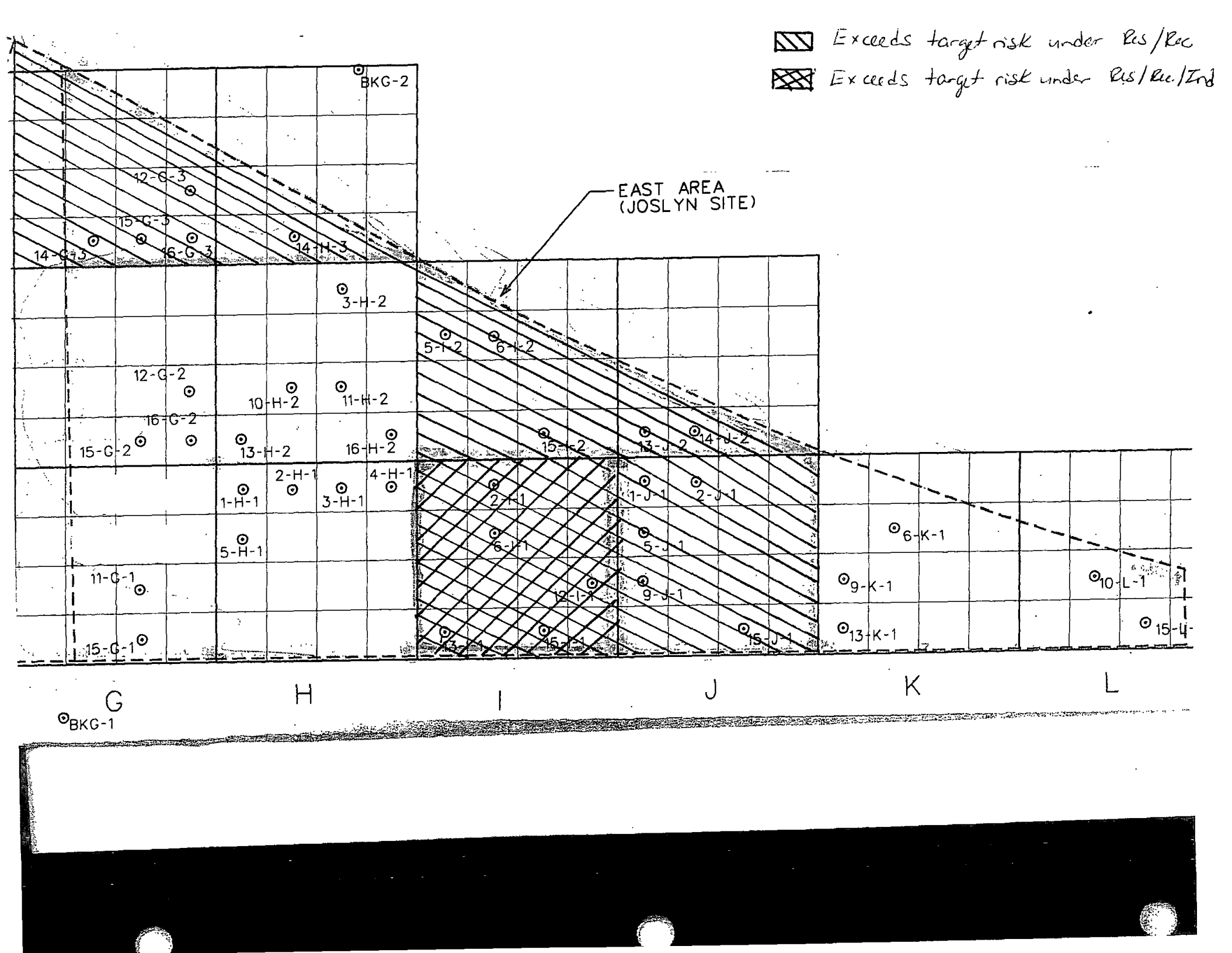
Toxicity –

Risk resulting from synergistic or antagonistic effects were not quantified. Simultaneous administration of PAHs including benzo(e)pyrene, benzo[g,h,i]perylene, fluoranthene, or pyrene has been shown to significantly elevate the benzo(a)pyrene induced tumor incidence. Benzo[a]fluoranthene, benzo[k]fluoranthene, chrysene, perylene, and a mixture containing anthracene, phenanthrene, and pyrene have been shown to significantly inhibit benzo(a)pyrene induced injection site sarcomas.

The noncarcinogenic health effects of cPAHs and dioxin/furans were not evaluated due to the lack of noncancer toxicity values. These contaminants are known to elicit noncancer health effects (e.g., immune suppression, reproductive effects, developmental effects, etc.).

APPENDIX 1

EAST AREA SCREENING RISK CALCULATION TABLES


Exceeds target risk under Res/Rec
Exceeds target risk under Res/Rec/Ind
EAST AREA
(JOSLYN SITE)
BKG-2
12-G-3
15-G-3
16-G-3
14-G-3
14-H-3
3-H-2
5-I-2
6-I-2
12-G-2
10-H-2
11-H-2
16-G-2
15-G-2
13-H-2
16-H-2
15-I-2
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5-J-1
6-K-1
5-H-1
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9-J-1
9-K-1
10-L-1
11-G-1
13-I-1
15-I-1
15-J-1
13-K-1
15-L-1
15-G-1
G
H
I
J
K
L
BKG-1

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0.000								0.000				0 000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	0.39	0.000		Or						0.000	0.000								8.31E-08	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv Calculation spreadsheeet)	50328		2	0.6																		3.00E-06	B2		Or
Fluoranthene	206440		1080		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		850		0.000				0 000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0.000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-04																		1.00E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.31E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5)

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system, SKIN - skin irritation or other effects; SPLEEN, THYROID,
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	0.99	0.000	In	Or									0.000						6.70E-09	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2.3	0.9	NA																	2.61E-07	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0 000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-04	NA																	1.00E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.27E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney, LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0.000								0.000				0 000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		136		0.000		Or							0 000	0.000								4.37E-08	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5260		0.000		In								0 000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo(a)pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		4																				1.50E-06	B2		Or
Fluoranthene	206440		6800		0.000		Or			0.000				0.000	0 000								NA	D		
Fluorene	86737		4120		0.000		Or In			0 000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5800		0.000		Or							0.000									NA	D		
Quinoline	91225		2.6																				0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	2.00E-04																			5.71E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.26E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system, SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the industrial worker SRV presented here.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203		78		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	0.59	0.000	In	Or										0.000						2.03E-09	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000		0.000		In								0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		10	0.6	(1/2 DL)																		6.00E-08	B2		Or
Fluoranthene	206440		48600		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		17240		0.000		In			0.000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000		0.000		Or							0.000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	2.00E-04	NA																		2.50E-07	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.12E-07			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.

Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0 000								0.000				0 000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	1	0.000		Or						0 000	0.000								1.41E-07	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2	1.5																		6.50E-06	B2		Or
Fluoranthene	206440		1080		0.000		Or		0 000				0.000	0.000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0 000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-04																		1.00E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.66E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system, EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin imtation or other effects; SPLEEN, THYROID,
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	voc	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88		0.001	In	Or									0.001						1.14E-08	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2.3	1.13	NA																	5.65E-07	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-04	NA																	1.00E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	1.58E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways ,Or = oral, De= Dermal, In = Inhalation; ? = not known

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0 000								0 000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135	1	0.000		Or							0 000	0 000								7.41E-08	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		4	1.3																			3.25E-06	B2		Or
Fluoranthene	206440		6800		0.000		Or			0 000				0.000	0.000								NA	D		
Fluorene	86737		4120		0.000		Or In			0 000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5800		0.000		Or							0 000									NA	D		
Quinoline	91225		2.5																				0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	2.0E-04																			5.71E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	9.04E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN, THYROID, WHOLE BODY - increased mortality, decreased growth rate, etc.

NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the industrial worker SRV presented here.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203		78		0.000		In			0.000								0 000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	11	0.000	In	Or										0.000						3.45E-09	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000		0.000		In								0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		10	1.3																			1.30E-07	B2		Or
Fluoranthene	206440		48600		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		17240		0.000		In			0.000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000		0.000		Or							0 000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	2.0E-04	NA																		2.50E-07	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.83E-07			

VOC? - "Y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system, SKIN - skin irritation or other effects; SPLEEN, THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidental soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral, De= Dermal; In = inhalation; ? = not known

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0 000								0.000				0 000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	0.55	0.000		Or						0.000	0.000								7.75E-08	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7860		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2	0.7																		3.50E-06	B2		Or
Fluoranthene	206440		1080		0.000		Or		0.000				0 000	0 000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0.000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-04																		1.00E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.36E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV)

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e , 1 E-5)

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	0.55	0.000	In	Or									0.000						6.25E-09	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2.3	07	NA																	3.04E-07	B2		Or
Fluoranthene	206440		21200		0.000		Or		0 000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0 000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-04	NA																	1.00E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.31E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney, LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system, SKIN - skin irritation or other effects; SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans, B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135	0.56	0.000		Or							0.000	0.000								4.07E-08	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		4	0.7																			1.75E-06	B2		Or
Fluoranthene	206440		6800		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		4120		0.000		Or In			0.000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		6800		0.000		Or							0.000									NA	D		
Quinoline	91225		2.5																				0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	2.00E-04																			5.71E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.51E-06			

VOC? - 'Y' indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID, WHOLE BODY - increased mortality, decreased growth rate, etc.

NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the Industrial worker SRV presented here.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Mssing	Pathways Drlving	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Mssing	Pathways Drlving
Volatile Organics																										
Naphthalene	91203		78		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	0.55	0.000	In	Or										0.000						1.90E-09	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000		0.000		In								0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		10	0.7	NA																		7.00E-08	B2		Or
Fluoranthene	206440		48600		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		17240		0.000		In			0.000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000		0.000		Or							0.000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	2.00E-04	NA																		2.50E-07	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.22E-07			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.

Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system, KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidental soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	64	0.018		Or						0.018	0.018								9.01E-06	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2	2.6																		1.30E-05	B2		Or
Fluoranthene	206440		1080		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0.000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	4.65E-04																		2.43E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.018	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.63E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system,
PROST - prostrate, REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Refefence Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	64	0.051	In	Or									0.051						7.27E-07	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2.3	2.6	NA																	1.13E-06	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	4.85E-04	NA																	2.43E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.051	0.000	0.000	0.000	0.000	0.000	4.28E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

Joslyn East Area - Maximum (Grid I1)

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways. Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Mlssing	Pathways Drlving	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Mlssing	Pathways Drlving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0 000								0 000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135	84	0.004		Or							0.004	0.004								4.74E-06	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		4	2.6																			6.50E-06	B2		Or
Fluoranthene	206440		5500		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		4120		0.000		Or In			0.000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5500		0.000		Or							0.000									NA	D		
Quinoline	91225		2.5																				0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	4.90E-04																			1.42E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.64E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV)

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the Industrial worker SRV presented here.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SOIL REFERENCE VALUE RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Miss Ing	Pathways Drl Ing	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Miss Ing	Pathways Drl Ing
Volatile Organics																										
Naphthalene	91203		78	0	0.000		In			0.000								0.000				0 000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	64	0.018	In	Or										0.018						2.21E-07	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000	0	0.000		In								0.000								NA	NA		
Anthracene	120127		100000	0	0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		10	2.6	NA																		2.60E-07	B2		Or
Fluoranthene	206440		48600	0	0.000		Or			0.000				0 000	0.000								NA	D		
Fluorene	86737		17240	0	0.000		In			0 000													NA	D		
Naphthalene - see Volatile Organics				0																						
Pyrene	129000		43000	0	0.000		Or							0.000									NA	D		
Quinoline	91225		6	0	NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	4.95E-04	NA																		6.20E-07	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.018	0.000	0.000	0.000	0.000	0.000	1.10E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint

Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	1.8	0.000		Or						0.000	0.000								2.11E-07	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2	0.7																		3.50E-06	B2		Or
Fluoranthene	206440		1080		0.000		Or		0 000				0.000	0.000								NA	D		
Fluorene	86737		850		0.000				0 000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0.000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.38E-04																		1.19E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.66E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5)

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system, KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN, THYROID,
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways. Or = oral; De= Dermal; In = inhalation; ? = not known

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0 000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	1.5	0.001	In	Or									0.001						1.70E-08	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2.3	0.7	NA																	3.04E-07	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.3E-04	NA																	1.19E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	1.51E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney, LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concent (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0 000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135	1.8	0.000		Or							0.000	0.000								1.11E-07	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo(a)pyrene equivalents (see BaP equiv Calculation spreadsheeet)	50328		4	0.07																			1.75E-06	B2		Or
Fluoranthene	206440		6800		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		4120		0.000		Or In			0.000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5800		0.000		Or							0 000									NA	D		
Quinoline	91225		2.6																				0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	2.3E-04																			6.80E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.66E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID;
WHOLE BODY - Increased mortality, decreased growth rate, etc.
NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the industrial worker SRV presented here.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203		78		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	1.5	0.000	In	Or										0.000						5.17E-09	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000		0.000		In								0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		10	0.7																			7.00E-08	B2		Or
Fluoranthene	206440		48600		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		17240		0.000		In			0.000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000		0.000		Or							0.000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	2.8E-04	NA																		2.98E-07	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.73E-07			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint

Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE, CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral, De= Dermal; In = inhalation; ? = not known.

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	10	4.5	0.000		In		0 000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	4.2	0.001		Or						0.001	0.001								5.92E-07	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2	0.7																		3.50E-06	B2		Or
Fluoranthene	206440		1080		0.000		Or		0.000				0.000	0 000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0.000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	4.90E-04																		2.45E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.86E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system, KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN, THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans, B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral, De= Dermal; In = Inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	99	[illegible]	0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	4.2	0.003	In	Or									0.003						4.77E-08	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400	[illegible]	0.000		Or							0.000								NA	NA		
Anthracene	120127		100000	[illegible]	0.000			Soil Maximum Utilized. HQ should not > 1.														NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2.3	0.7	NA																	3.04E-07	B2		Or
Fluoranthene	206440		21200	[illegible]	0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500	[illegible]	0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800	[illegible]	0.000		Or						0.000									NA	D		
Quinoline	91225		1.4	[illegible]	NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	4.80E-04	NA																	2.45E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	2.80E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. terstogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral, De= Dermal; In = inhalation; ? = not known.

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135	4.1	0.000		Or							0.000	0.000								3.11E-07	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		4	0																			0.00E+00	B2		Or
Fluoranthene	206440		6800		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		4120		0.000		Or In			0.000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5800		0.000		Or							0.000									NA	D		
Quinoline	91225		2.5																				0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	4.9E-04																			1.42E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.45E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the industrial worker SRV presented here.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SOIL REFERENCE VALUE RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																										
Naphthalene	91203		78	0	0.000		In			0 000								0 000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	4.2	0.001	In	Or										0.001						1.45E-08	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000	0	0.000		In								0.000								NA	NA		
Anthracene	120127		100000	0	0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv Calculation spreadsheeet)	50328		10	0	NA																		0.00E+00	B2		Or
Fluoranthene	206440		48600	0	0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		17240	0	0.000		In			0.000													NA	D		
Naphthalene - see Volatile Organics				0																						
Pyrene	129000		43000	0	0.000		Or							0.000									NA	D		
Quinoline	91225		6	0	NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	4.6E-04	NA																		6.20E-07	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	6.34E-07	?		

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.

Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways. Or = oral; De= Dermal; In = Inhalation; ? = not known

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0 000								0.000				0 000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	0.94	0.000		Or						0 000	0 000								7.61E-08	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2	0.4																		2.00E-06	B2		Or
Fluoranthene	206440		1080		0.000		Or		0.000				0 000	0.000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0.000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-04																		1.00E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.21E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5)

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0 000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87885		88	0.54	0.000	In	Or									0.000						6.14E-09	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2.3	0.4	NA																	1.74E-07	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	in	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-04	NA																	1.00E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.16E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.

Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135	0.84	0.000		Or							0.000	0.000								4.00E-08	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		4	0.4																			1.00E-06	B2		Or
Fluoranthene	206440		6800		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		4120		0.000		Or In			0.000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5800		0.000		Or							0.000									NA	D		
Quinoline	91225		2.5																				0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	2.00E-04																			5.71E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.75E-06			

VOC? - 'Y' indicates that the contaminant is considered volatile

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5)

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system, KIDN - kidney; LIV/GI - liver/gastrointestinal system, PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN, THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the industrial worker SRV presented here.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation, ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203		78		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	0.54	0.000	In	Or										0.000						1.86E-09	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000		0.000		In								0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv Calculation spreadsheeet)	50328		10	0.4																			4.00E-08	B2		Or
Fluoranthene	206440		48600		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		17240		0.000		In			0.000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000		0.000		Or							0.000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	2.00E-04	NA																		2.50E-07	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.92E-07			

VOC? - "y" indicates that the contaminant is considered volatile.

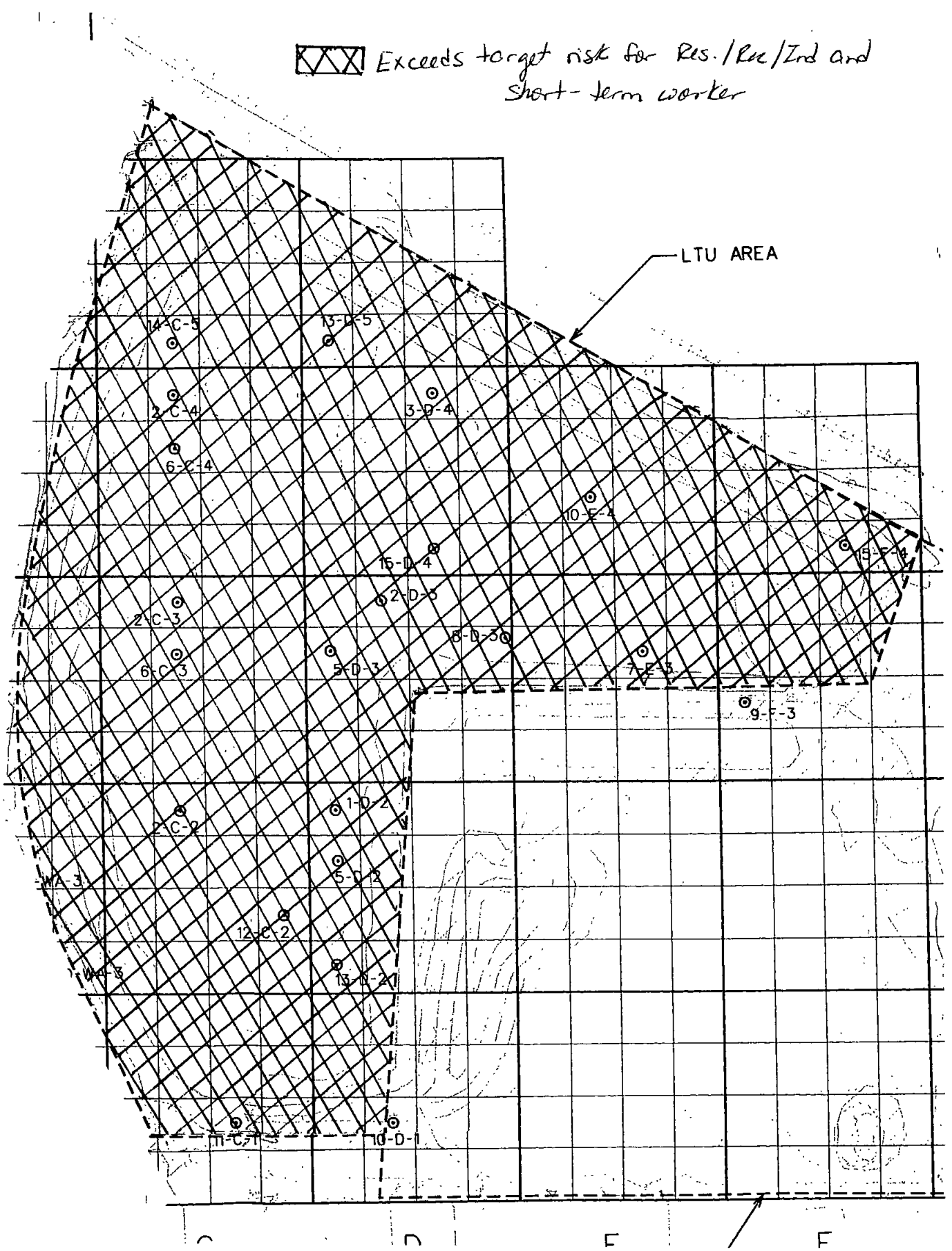
(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

APPENDIX 2

LTU AREA SCREENING RISK CALCULATION TABLES


Exceeds target risk for Res./Rec/Znd and short-term worker
LTU AREA
14-C-5
13-C-5
2-C-4
3-D-4
6-C-4
10-E-4
15-F-4
15-D-4
2-D-3
2-C-3
8-D-3
6-C-3
5-D-3
7-E-3
9-F-3
1-D-2
2-C-2
5-D-2
12-C-2
15-D-2
11-C-1
10-D-1
C
D
E
F

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0 000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	0.185	0.000		Or						0 000	0.000								2.32E-08	B2		Or
Polyaromatic Hydrocarbons																						NA	NA		
Acenaphthene	83329		1200		0.000		Or							0.000								NA	D		
Anthracene	120127		7880		0.000		Or															2.00E-06	B2		Or
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2	0.4																		NA	D		
Fluoranthene	206440		1080		0.000		Or		0.000				0 000	0.000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																						NA	D		
Pyrene	129000		890		0.000		Or						0 000									0.00E+00	C	In	Or
Quinoline	91225		1.2																			1.00E-04	B2		Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03																					
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.02E-04			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin imtation or other effects; SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen. (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	0.165	0.000	In	Or									0.000						1.88E-09	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2.3	0.4																		1.74E-07	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
* Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03	NA																	1.00E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.02E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system, KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal, In = Inhalation; ? = not known.

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0 000								0 000				0 000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135	0.165	0.000		Or							0 000	0 000								1.22E-08	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		--
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		4	0.4																			1.00E-06	B2		Or
Fluoranthene	206440		5800		0.000		Or			0 000				0.000	0 000								NA	D		
Fluorene	86737		4120		0.000		Or In			0.000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5800		0.000		Or							0 000									NA	D		
Quinoline	91225		2.5																				0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	2.00E-03																			5.71E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	5.82E-05			

VOC? - 'y' indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal, BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system, EYE, IMMUN - immune system, KIDN - kidney, LIV/GI - liver/gastrointestinal system, PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the industrial worker SRV presented here.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans, B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways. Or = oral; De= Dermal; In = Inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203		78		0.000		In			0.000								0 000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	0.165	0.000	In	Or										0.000						5.69E-10	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000		0.000		In								0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		10	0.4	NA																		4.00E-08	B2		Or
Fluoranthene	206440		48600		0.000		Or			0.000				0 000	0.000								NA	D		
Fluorene	86737		17240		0.000		In			0 000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000		0.000		Or							0.000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	2.00E-03	NA																		2.50E-06	B2		Or
Cumulative Site Soil Risk (1) =								0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.54E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system, EYE; IMMUN - immune system, KIDN - kidney, LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system, SKIN - skin irritation or other effects; SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidental soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways, Or = oral; De= Dermal, In = Inhalation; ? = not known

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	6.3	0.002		Or						0 002	0.002								8.87E-07	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2	1.5																		7.50E-06	B2		Or
Fluoranthene	206440		1080		0.000		Or		0.000				0 000	0 000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0 000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03																		1.00E-04	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.08E-04			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects, SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	8.3	0.005	In	Or									0.005						7.16E-08	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2.3	1.5	---																	6.52E-07	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03	NA																	1.00E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	1.07E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.

Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system, CNS/PNS - central/peripheral nervous system; EYE, IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;

PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system, SKIN - skin irritation or other effects; SPLEEN; THYROID;

WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

Joslyn LTU: 1D2/8D3 (ave. TCDD 0.002 ppm)

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways. Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0 000								0 000				0.000	NA	D		
Non/Semi Volatile Organics																							4.67E-07	B2	0	Or
Pentachlorophenol	87865		135	6.3	0.000		Or							0 000	0.000											
Polyaromatic Hydrocarbons																							NA	NA		
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	D		
Anthracene	120127		45400		0.000		Or																			
Benzo[a]pyrene equivalents (see BaP equiv Calculation spreadsheeet)	50328		4	1.8																			3.75E-06	B2		Or
Fluoranthene	206440		6800		0.000		Or			0 000				0.000	0 000								NA	D		
Fluorene	86737		4120		0.000		Or In			0 000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5800		0.000		Or							0 000									NA	D		
Quinoline	91225		2.5																				0.00E+00	C	In	Or
Dioxins and Furans																							5.71E-05	B2		Or
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	2.00E-03																						
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.14E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV) Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system,
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc
NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the industrial worker SRV presented here.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways. Or = oral, De= Dermal; In = Inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																										
Naphthalene	91203		78		0.000		In			0.000								0 000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	6.3	0.002	In	Or										0 002						2.17E-08	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000		0.000		In								0 000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		10	1.5	NA																		1.50E-07	B2		Or
Fluoranthene	206440		48600		0.000		Or			0.000				0 000	0 000								NA	D		
Fluorene	86737		17240		0.000		In			0 000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000		0.000		Or							0 000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	2.00E-03	NA																		2.50E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	2.67E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint

Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6)

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/penpheral nervous system; EYE; IMMUN - immune system; KIDN - kidney, LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID, WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral, De= Dermal; In = inhalation, ? = not known.

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	23	0.006		Or						0.006	0.006								3.24E-06	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2	3.4																		1.70E-05	B2		Or
Fluoranthene	206440		1080		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0.000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03																		1.00E-04	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.006	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.20E-04			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID,
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	23	0.018	In	Or									0.018						2.61E-07	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2.3	3.4																		1.48E-06	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03	NA																	1.00E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.018	0.000	0.000	0.000	0.000	0.000	1.17E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/penpheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin imtation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

Joslyn LTU: 15D4/3D4 (ave. TCDD 0.002 ppm)

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0.000								0 000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		136	33	0.001		Or							0.001	0 001								1.70E-06	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		4	3.4																			8.50E-06	B2		Or
Fluoranthene	206440		6800		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		4120		0.000		Or In			0.000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5800		0.000		Or							0.000									NA	D		
Quinoline	91225		2.6																				0.00E+00	C	In	Or
Dioxins and Furans																							5.71E-05	B2		Or
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	2.00E-03																						
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.73E-05			

VOC? - 'Y' indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV)

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE, IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system, PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects), RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the Industrial worker SRV presented here.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																										
Naphthalene	91203		78		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	23	0.006	In	Or										0.006						7.93E-08	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000		0.000		In								0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		10	3.4	NA																		3.40E-07	B2		Or
Fluoranthene	206440		48600		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		17240		0.000		In			0.000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000		0.000		Or							0.000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	2.00E-03	NA																		2.60E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.000	0.000	0.000	0.000	0.000	2.92E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint

Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system, EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0.000								0 000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	28	0.008		Or						0.008	0.008								3.94E-06	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2	3.5																		1.75E-05	B2		Or
Fluoranthene	206440		1080		0.000		Or		0.000				0.000	0 000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0 000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03																		1.00E-04	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.008	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.21E-04			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system, PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system, SKIN - skin irritation or other effects; SPLEEN, THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal, In = Inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0.000				0 000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	25	0.022	In	Or									0 022						3.18E-07	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0 000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2.3	3.5																		1.52E-06	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0 000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03	NA																	1.00E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.022	0.000	0.000	0.000	0.000	0.000	1.18E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID, WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0.000								0 000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135	28	0.002		Or							0.002	0 002								2.07E-06	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo(a)pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		4	2.8																			8.75E-06	B2		Or
Fluoranthene	206440		6800		0.000		Or			0.000				0 000	0.000								NA	D		
Fluorene	86737		4120		0.000		Or In			0 000													NA	D		
Naphthalene - see Volatile Organics	0																						NA	D		
Pyrene	129000		5800		0.000		Or							0.000									NA	D		
Quinoline	91225		2.5																				0.00E+00	C	In	Or
Dioxins and Furans																							5.71E-05	B2		Or
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	2.80E-03																						
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.80E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.
NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the industrial worker SRV presented here.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

Joslyn LTU - -14C5, 13D5 Grid (use 0.0002 mg/kg TCDD)

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pathway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																										
Naphthalene	91203		78		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	24	0.008	In	Or										0.008						9.66E-08	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000		0.000		In								0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		10	1.5	NA																		3.50E-07	B2		Or
Fluoranthene	206440		48600		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		17240		0.000		In			0.000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000		0.000		Or							0.000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	2.00E-03	NA																		2.80E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.000	2.91E-06	(1)		

VOC? - "Y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects, SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	43	0.012		Or						0.012	0.012								6.06E-06	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2	6.3	(1/2 DL)																	4.15E-05	B2		Or
Fluoranthene	206440		1080		0.000		Or		0.000				0.000	0 000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0.000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03																		1.00E-04	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.012	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.48E-04			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i e , 1 E-5)

(2) ADREN - adrenal, BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE, IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects), RESP - respiratory system, SKIN - skin irritation or other effects; SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	43	0.034	In	Or									0.034						4.89E-07	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2.3	8.3	(1/2 DL)																	3.61E-06	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03	NA																	1.00E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.034	0.000	0.000	0.000	0.000	0.000	1.41E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135	43	0.003		Or							0.003	0.003								3.19E-06	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		4	8.7																			2.08E-05	B2		Or
Fluoranthene	206440		5800		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		4120		0.000		Or In			0.000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5800		0.000		Or							0.000									NA	D		
Quinoline	91225		2.5																				0.00E+00	C	In	Or
Dioxins and Furans																							5.71E-05	B2		Or
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	2.00E-43																						
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.11E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i e., 1 E-5)

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;

PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID;

WHOLE BODY - increased mortality, decreased growth rate, etc.

NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the Industrial worker SRV presented here.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation, ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203		78		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	44	0.012	In	Or										0.012						1.48E-07	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000		0.000		In								0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		10	8.3	NA																		8.30E-07	B2		Or
Fluoranthene	206440		48600		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		17240		0.000		In			0.000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000		0.000		Or							0.000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	2.00E-03	NA																		2.59E-08	B2		Or
Cumulative Site Soil Risk (1) =								0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.012	0.000	0.000	0.000	0.000	0.000	3.48E-06			

VOC? - "Y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system, SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral, De= Dermal, In = Inhalation; ? = not known.

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	6.4	0.002		Or						0.002	0.002								9.01E-07	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2	1																		5.00E-06	B2		Or
Fluoranthene	206440		1080		0.000		Or		0 000				0.000	0.000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0.000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03																		1.00E-04	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.06E-04			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i e., 1 E-5)

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (Incl teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	voc	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	6.4	0.005	In	Or									0.005						7.27E-08	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2.3	1																		4.35E-07	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03	NA																	1.00E-05	B2		Or
Cumulative Site Soil Risk (1) =								0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	1.05E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.

Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney, LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

Joslyn LTU: 7E3/9F3 (ave. TCDD 0.002 ppm)

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation, ? = not known

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0.000								0 000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135	6.4	0.000		Or							0.000	0 000								4.74E-07	B2	0	Or
Polyaromatic Hydrocarbons																							NA	NA		✓
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	D		?
Anthracene	120127		45400		0.000		Or																			
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		4																				2.60E-06	B2		Or
Fluoranthene	206440		6800		0.000		Or			0.000				0.000	0 000								NA	D		
Fluorene	86737		4120		0.000		Or In			0.000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5800		0.000		Or							0.000									NA	D		
Quinoline	91225		2.5																				0.00E+00	C	In	Or
Dioxins and Furans																							5.71E-05	B2		Or
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	2.00E-03																						
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.01E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV)

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects, SPLEEN, THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the industrial worker SRV presented here.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																										
Naphthalene	91203		78		0.000		In			0 000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	6.4	0.002	In	Or										0.002						2.21E-08	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000		0.000		In								0 000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		10		NA																		1.00E-07	B2		Or
Fluoranthene	206440		48600		0.000		Or			0.000				0 000	0.000								NA	D		
Fluorene	86737		17240		0.000		In			0.000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000		0.000		Or							0.000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	2.00E-03	NA																		2.50E-06	B2		Or
Cumulative Site Soil Risk (1) =								0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	2.62E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system, PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0 000								0 000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	65	0.018		Or						0.018	0.018								9.15E-06	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2	4.8																		2.25E-05	B2		Or
Fluoranthene	206440		1080		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0.000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03																		1.00E-04	B2		Or
Cumulative Site Soil Risk (1) =								0.000	0.000	0.000	0.000	0.000	0.018	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.32E-04			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV)
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans, B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	65	0.052	In	Or									0.052						7.39E-07	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2.3	4.5																		1.96E-06	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03	NA																	1.00E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.052	0.000	0.000	0.000	0.000	0.000	1.27E-05			

VOC? - "y" indicates that the contaminant is considered volatile

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135		0.004		Or							0.004	0.004								4.81E-06	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		4																				1.13E-05	B2		Or
Fluoranthene	206440		6800		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		4120		0.000		Or In			0.000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5800		0.000		Or							0 000									NA	D		
Quinoline	91225		2.5																				0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	2.00E-11																			5.71E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.32E-05			

VOC? - 'Y' indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the Industrial worker SRV presented here.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen. (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203		78		0.000		In			0.000								0 000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290		0.018	In	Or										0 018						2.24E-07	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000		0.000		In								0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		10		NA																		4.60E-07	B2		Or
Fluoranthene	206440		48600		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		17240		0.000		In			0.000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000		0.000		Or							0.000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	2.00E-09	NA																		2.40E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.018	0.000	0.000	0.000	0.000	0.000	3.17E-06			

VOC? - "Y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN, THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	92	0.026		Or						0.026	0.026								1.30E-05	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0 000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2	6.5																		3.25E-05	B2		Or
Fluoranthene	206440		1080		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		850		0.000				0 000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0 000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03																		1.00E-04	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.026	0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.45E-04			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN, THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal, In = Inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	92	0.073	In	Or									0.073						1.05E-06	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2.3	6.6																		2.83E-06	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03	NA																	1.00E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.073	0.000	0.000	0.000	0.000	0.000	1.39E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135	682	0.005		Or							0.005	0.005								6.81E-06	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5250		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		4	16.5																			1.63E-05	B2		Or
Fluoranthene	206440		6800		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		4120		0.000		Or In			0.000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5600		0.000		Or							0.000									NA	D		
Quinoline	91225		2.5																				0.00E+00	C	In	Or
Dioxins and Furans																							5.71E-05	B2		Or
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	2.00E-03																						
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.02E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system, SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the industrial worker SRV presented here.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Mlssing	Pathways: Drlving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Mlssing	Pathways: Drlving
Volatile Organics																										
Naphthalene	91203		78		0.000		In			0 000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	2.92	0.025	In	Or										0.025						3.17E-07	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000		0.000		In								0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		10	0.6	NA																		6.50E-07	B2		Or
Fluoranthene	206440		48600		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		17240		0.000		In			0 000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000		0.000		Or							0.000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	2.90E-03	NA																		2.50E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.025	0.000	0.000	0.000	0.000	0.000	3.67E-06			

VOC? - "Y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral, De= Dermal; In = Inhalation; ? = not known

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	49	0.014		Or						0.014	0.014								6.90E-06	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2	2.1																		1.05E-05	B2		Or
Fluoranthene	206440		1080		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0.000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03																		1.00E-04	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.014	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.17E-04			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney, LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects, SPLEEN; THYROID,
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	48	0.039	In	Or									0.039						5.57E-07	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2.3	2.1																		9.13E-07	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03	NA																	1.00E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.039	0.000	0.000	0.000	0.000	0.000	1.15E-05			

VOC? - "y" indicates that the contaminant is considered volatile

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects, SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pathway exposure scenario (i.e., incidental soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0 000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135	49	0.003		Or							0.003	0 003								3.63E-06	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		4	2.1																			5.25E-06	B2		Or
Fluoranthene	206440		6800		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		4120		0.000		Or In			0 000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5800		0.000		Or							0.000									NA	D		
Quinoline	91225		2.5																				0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	2.00E-11																			5.71E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.60E-05			

VOC? - 'Y' indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostate; REPRO - reproductive system (incl. teratogenic/developmental effects), RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.
NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the industrial worker SRV presented here.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

Joslyn LTU - -12C2, 2C2 Grid (use 0.0002 mg/kg TCDD)

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203		78		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	48	0.014	In	Or										0.014						1.69E-07	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000		0.000		In								0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv Calculation spreadsheeet)	50328		10	2.1	NA																		2.10E-07	B2		Or
Fluoranthene	206440		48600		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		17240		0.000		In			0.000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000		0.000		Or							0.000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	2.00E-03	NA																		~~2.50E-05~~	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.014	0.000	0.000	0.000	0.000	0.000	~~2.65E-06~~			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways. Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	27	0.008		Or						0.008	0.008								3.80E-06	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2	2																		1.00E-05	B2		Or
Fluoranthene	206440		1080		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0.000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03																		1.00E-04	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.008	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.14E-04			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system, KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects, SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral, De= Dermal; In = Inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	27	0.021	In	Or									0.021						3.07E-07	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2.3	2																		8.70E-07	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03	NA																	1.00E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.021	0.000	0.000	0.000	0.000	0.000	1.12E-05			

VOC? - "Y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral, De= Dermal; In = Inhalation; ? = not known

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135	27	0.002		Or							0.002	0.002								2.00E-06	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv Calculation spreadsheeet)	50328		4	2																			5.00E-06	B2		Or
Fluoranthene	206440		6800		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		4120		0.000		Or In			0.000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5800		0.000		Or							0.000									NA	D		
Quinoline	91225		2.5																				0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	2.00E-03																			5.71E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.41E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV)

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney, LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID, WHOLE BODY - increased mortality, decreased growth rate, etc.

NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the Industrial worker SRV presented here.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2)														CANCER		Pathways	
								ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	ELCR (1)	Class	Missing	Driving
Volatile Organics																									
Naphthalene	91203		78		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		290	27	0.007	In	Or										0.007						9.31E-08	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		19000		0.000		In								0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		10	2	NA																		2.00E-07	B2		Or
Fluoranthene	206440		48600		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		17240		0.000		In			0 000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		43000		0.000		Or							0 000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	2.00E-03	NA																		2.50E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.000	0.000	0.000	0.000	0.000	2.79E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system, KIDN - kidney; LIV/GI - liver/gastrointestinal system, PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system, SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	2.9	0.001		Or						0.001	0.001								4.08E-07	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2	0.6																		3.00E-06	B2		Or
Fluoranthene	206440		1080		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0.000									0.00E+00	C	In	Or
Quinoline	91225		1.2																			1.00E-04	B2		Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03																					
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.03E-04			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system, KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	2.9	0.002	In	Or									0.002						3.30E-08	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2.3	0.6																		2.61E-07	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	2.00E-03	NA																	1.00E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	1.03E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.

Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID, WHOLE BODY - increased mortality, decreased growth rate, etc

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal, In = Inhalation, ? = not known.

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135	2.9	0.000		Or							0.000	0.000								2.15E-07	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		4	0.6																			1.50E-06	B2		Or
Fluoranthene	206440		6800		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		4120		0.000		Or In			0.000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5800		0.000		Or							0.000									NA	D		
Quinoline	91225		2.5																				0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	2.00E-03																			5.71E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	5.89E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV) Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).

Individual chemical specific HQ should not exceed 0 2 (except where noted), cumulative HI should not exceed 1 for each target endpoint

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system, CNS/PNS - central/peripheral nervous system; EYE, IMMUN - immune system, KIDN - kidney, LIV/GI - liver/gastrointestinal system, PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects), RESP - respiratory system, SKIN - skin irritation or other effects; SPLEEN; THYROID, WHOLE BODY - increased mortality, decreased growth rate, etc

NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the industrial worker SRV presented here.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Miss. Ing	Pathways Driving
Volatile Organics																										
Naphthalene	91203		78		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	2.9	0.001	In	Or										0.001						1.00E-08	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000		0.000		In								0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		10	0.6	NA																		6.00E-08	B2		Or
Fluoranthene	206440		48600		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		17240		0.000		In			0.000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000		0.000		Or							0.000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	2.00E-03	NA																		2.50E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	2.67E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

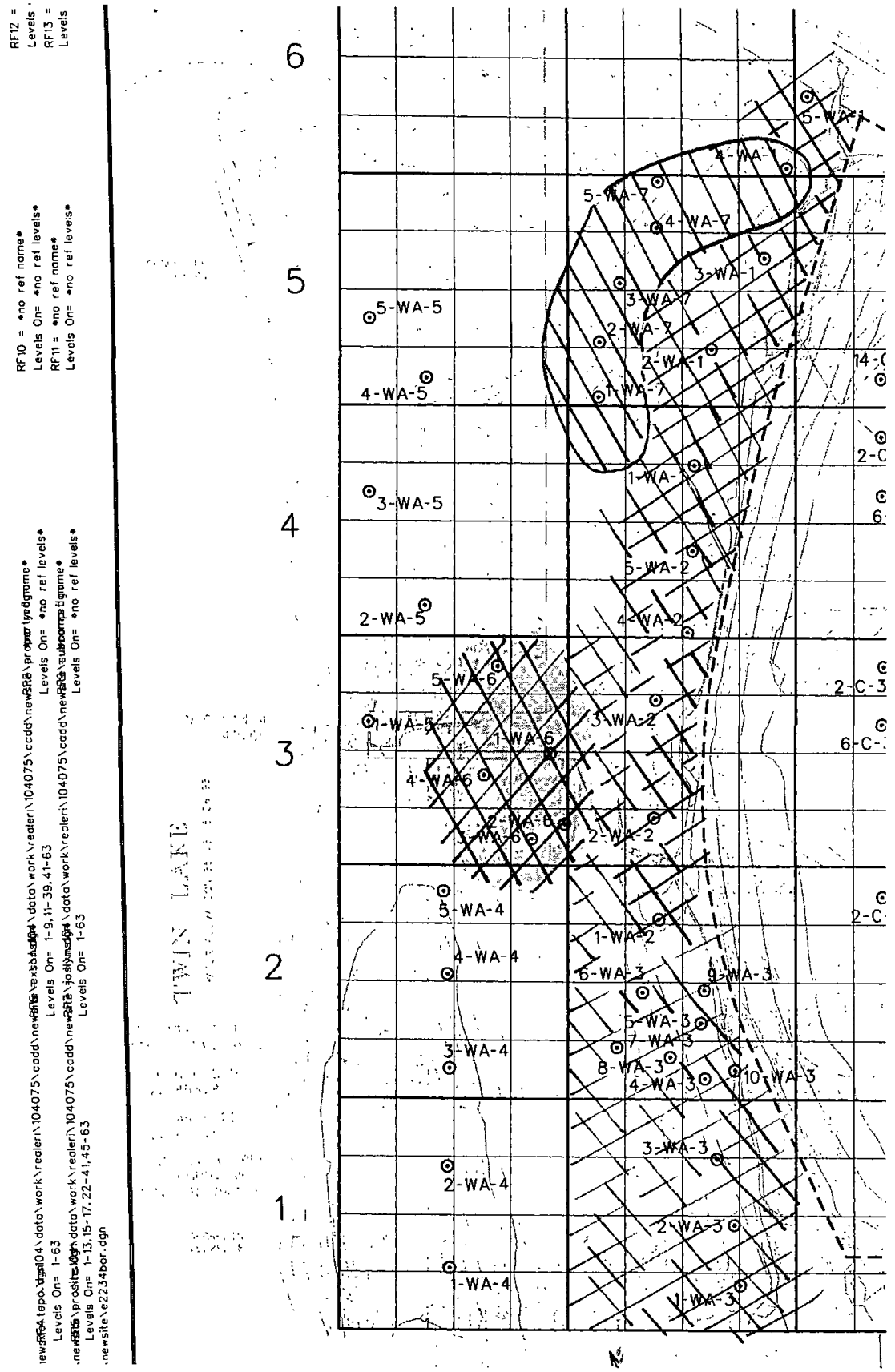
(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system, KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN, THYROID, WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

APPENDIX 3

WEST AREA SCREENING RISK CALCULATION TABLES



Exceeds target risk level for Res/Rec

Exceeds target risk level for Res/Rec + Ind

Exceeds target risk level for child wader if evaluated as sediment.

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = inhalation; ? = not known.

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	4.2	0.001		Or						0.001	0.001								5.92E-07	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2	4.6																		1.90E-05	B2		Or
Fluoranthene	206440		1080		0.000		Or		0.000				0.000	0 000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0.000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	1.04E-03																		5.22E-05	[3]B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.18E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal, BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/penpheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system,
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin imtation or other effects; SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Recreational Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known

Tier 2 Recreational Scenario Risk Evaluation

Chemical	CAS No.	VOC	Recreational SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	24		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		67		0.001		Or						0.001	0.001								6.27E-07	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	1860		0.000		Or							0.000								NA	NA		
Anthracene	120127		10000		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2		NA																	1.90E-05	B2		Or
Fluoranthene	206440		1290		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		1200		0.000		Or		0.000													NA	D		
Naphthalene - see Volatile Organics	0																						0		
Pyrene	129000		1060		0.000		Or						0.000									NA	D		
Quinoline	91225		1.2		NA																	0.00E+00	C		Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	1.0E-03	NA																	5.22E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.18E-05			

VOC? - "y" indicates that contaminant is considered volative.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney, LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation, ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class (3)	Pathways Missing	Pathways Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	4.1	0.003	In	Or									0.003						4.77E-08	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2.3	3.5	NA																	1.65E-06	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17600		0.000		Or						0 000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	1.04E-03	NA																	5.22E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	6.92E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.

Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal, In = Inhalation; ? = not known.

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0.000								0 000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135		0.000		Or							0.000	0.000								3.11E-07	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		4																				9.60E-08	B2		Or
Fluoranthene	206440		6800		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		4120		0.000		Or In			0 000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5800		0.000		Or							0.000									NA	D		
Quinoline	91225		2.5																				0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	1.0E-03																			2.98E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.98E-05			

VOC? - 'y' indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative Hi should not exceed 1 for each target endpoint.

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the industrial worker SRV presented here.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but edequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203		78		0.000		In			0 000								0.000				0 000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	4.2	0.001	In	Or										0 001						1.45E-08	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000		0.000		In								0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		10	1.4	NA																		3.80E-07	B2		Or
Fluoranthene	206440		46600		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		17240		0.000		In			0.000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000		0.000		Or							0.000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	1.04E-03	NA																		1.31E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	1.70E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN, THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	23	0.001		Or						0.001	0.001								3.24E-07	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2	0.9																		2.50E-06	B2		Or
Fluoranthene	206440		1080		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0.000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	7.43E-04																		3.72E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.00E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system, SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Recreational Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Recreational Scenario Risk Evaluation

Chemical	CAS No.	VOC	Recreational SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	24	[illegible]	0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		67	2.1	0.001		Or						0.001	0.001								3.43E-07	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	1860	[illegible]	0.000		Or							0.000								NA	NA		
Anthracene	120127		10000	[illegible]	0.000		Or															NA	D		
Benzo(a)pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2	0.4	NA																	2.60E-06	B2		Or
Fluoranthene	206440		1290	[illegible]	0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		1200	[illegible]	0.000		Or		0.000													NA	D		
Naphthalene - see Volatile Organics	0			[illegible]																			0		
Pyrene	129000		1060	[illegible]	0.000		Or						0.000									NA	D		
Quinoline	91225		1.2	[illegible]	NA																	0.00E+00	C		Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	7.4E-04	NA																	3.72E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.00E-05			

VOC? - "y" indicates that contaminant is considered volative.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways. Or = oral, Da= Dermal; In = Inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	2.9	0.002	In	Or									0.002						2.61E-08	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2.3	0.5	NA																	2.17E-07	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	7.43E-04	NA																	3.72E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	3.96E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE, CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0.000								0.000				0 000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135	2.3	0.000		Or							0.000	0.000								1.70E-07	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		4	0.8																			1.25E-06	B2		Or
Fluoranthene	206440		6800		0.000		Or			0 000				0.000	0.000								NA	D		
Fluorene	86737		4120		0.000		Or In			0.000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5800		0.000		Or							0.000									NA	D		
Quinoline	91225		2.6																				0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	7.43E-04																			2.12E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.26E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative Hi should not exceed 1 for each target endpoint

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the industrial worker SRV presented here.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203		78		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	2.3	0.001	In	Or										0.001						7.93E-09	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000		0.000		In								0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		10	9.5	NA																		5.00E-08	B2		Or
Fluoranthene	206440		48600		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		17240		0.000		In			0.000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000		0.000		Or							0.000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	7.43E-04	NA																		9.29E-07	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	9.87E-07			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system, EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID,
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Path-ways Missing	Path-ways Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	880	0.248		Or						0.248	0.248								1.24E-04	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2	0.3																		1.50E-06	B2		Or
Fluoranthene	206440		1080		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0 000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	1.09E-02																		5.44E-04	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.248	0.248	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.69E-04			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV)
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5)

(2) ADREN - adrenal; BONE, CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system, KIDN - kidney, LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN, THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Recreational Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal, In = Inhalation; ? = not known.

Tier 2 Recreational Scenario Risk Evaluation

Chemical	CAS No.	VOC	Recreational SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	24		0.000		In		0 000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		67	550	0.263		Or						0.263	0.263								1.31E-04	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	1860		0.000		Or							0.000								NA	NA		
Anthracene	120127		10000		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2	0.2	NA																	1.50E-06	B2		Or
Fluoranthene	206440		1290		0.000		Or		0.000				0 000	0.000								NA	D		
Fluorene	86737		1200		0.000		Or		0.000													NA	D		
Naphthalene - see Volatile Organics	0																						0		
Pyrene	129000		1050		0.000		Or						0.000									NA	D		
Quinoline	91225		1.2		NA																	0.00E+00	C		Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	1.0E-02	NA																	5.44E-04	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.263	0.263	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.76E-04			

VOC? - "y" indicates that contaminant is considered volative.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	voc	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Path-ways Missing	Path-ways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Path-ways Missing	Path-ways Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	880	0.700	In	Or									0.700						1.00E-05	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.														NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2.3	0.3	NA																	1.30E-07	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	1.00E-02	NA																	5.44E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.700	0.000	0.000	0.000	0.000	0.000	5.45E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Acute Soil Reference Values (SRV)

NOTE: Based on incidental ingestion of a bolus of soil. Other exposure pathways are NOT addressed.

Source (if multiple sources the source of the driving pathway is given): A = ATSDR; C = Calabrese et al., 1997; O = Other.

Tier 2 Child Acute Ingestion Risk Evaluation

Chemical	CAS No.	Source	Acute Exposure Concentration (mg/kg)	Maximum Site Concentration (mg/kg) dry weight	Acute HQ (1)	Acute Effect(s)
##						
Non/Semi Volatile Organics						
Pentachlorophenol	87865	A	220	880	4	Cardiovascular effects.

→ composite concentration subsample concentration of hot spot would be higher.

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen. (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135		0.052		Or							0.052	0.052								6.52E-05	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	6260		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		4																				7.50E-07	B2		Or
Fluoranthene	206440		6800		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		4120		0.000		Or In			0.000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5800		0.000		Or							0.000									NA	D		
Quinoline	91225		2.5																				0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035																				3.11E-04	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.052	0.052	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.77E-04			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system, KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the industrial worker SRV presented here.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203		75	[illegible]	0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	680	0.243	In	Or										0.243						3.03E-06	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000	[illegible]	0.000		In								0.000								NA	NA		
Anthracene	120127		100000	[illegible]	0.000			Soil Maximum Utilized. HQ should not > 1.																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		10	0.3	NA																		3.00E-08	B2		Or
Fluoranthene	206440		45600	[illegible]	0.000		Or			0 000				0 000	0.000								NA	D		
Fluorene	86737		17240	[illegible]	0.000		In			0.000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000	[illegible]	0.000		Or							0.000									NA	D		
Quinoline	91225		6	[illegible]	NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	1.05E-02	NA																		1.36E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.243	0.000	0.000	0.000	0.000	0.000	1.67E-05			

VOC? - "Y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protactive of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal, In = Inhalation; ? = not known.

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways Missing	Pathways Driving	NONCANCER TARGET ENDPOINTS (2) ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER ELCR (1)	Class	Pathways Missing	Pathways Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	49	0.014		Or						0.014	0.014								6.90E-06	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2	4.526	(1/2 DL)																	2.26E-05	B2		Or
Fluoranthene	206440		1080		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0.000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	1.48E-02																		7.38E-04	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.014	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.67E-04			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system, KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0 000								0 000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	49	0.039	In	Or									0.039						5.57E-07	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2.3	4.53E	(1/2 DL)																	1.97E-06	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	1.48E-02	NA																	7.38E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.039	0.000	0.000	0.000	0.000	0.000	7.63E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e . 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system,
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral, De= Dermal; In = Inhalation; ? = not known.

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0.000								0 000				0 000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135	49	0.003		Or							0.003	0 003								3.63E-06	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv Calculation spreadsheeet)	50328		4	4.53E	(1/2 DL)																		1.13E-05	B2		Or
Fluoranthene	206440		6800		0.000		Or			0.000				0.000	0 000								NA	D		
Fluorene	86737		4120		0.000		Or In			0 000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5800		0.000		Or							0.000									NA	D		
Quinoline	91225		2.5																				0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	1.48E-02																			4.21E-04	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.36E-04			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).

Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.

Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects, SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the industrial worker SRV presented here.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203		78		0.000		In			0 000								0.000				0 000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	49	0.014	In	Or										0.014						1.69E-07	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000		0.000		In								0 000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		10	4.528	(1/2 DL)																		4.53E-07	B2		Or
Fluoranthene	206440		48800		0.000		Or			0 000				0 000	0.000								NA	D		
Fluorene	86737		17240		0.000		In			0.000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000		0.000		Or							0.000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	1.48E-02	NA																		1.84E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.014	0.000	0.000	0.000	0.000	0.000	1.91E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6)

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

Intake (mg/kg-day) = (Cs x IRs x CF x EF x ED)/(BW x AT)

Child Wader1. Exposure Calculation for Incidental Sediment Ingestion

Chemical	Cs (mg/kg)	IRs (mg/event)	CF (kg/mg)	EF (event/yr)	ED (yr)	BW (kg)	AT (days) (Noncarcin)	Noncarcin Intake (mg/kg-d)	AT (days) (Carcin)	Carcin Intake (mg/kg-d)
Benzo(a)pyrene	4.528	31	1.00E-06	36	7	33	2555	4 20E-07	25550	4.20E-08
Pentachlorophenol	49	31	1.00E-06	36	7	33	2555	4 54E-06	25550	4.54E-07
2,3,7,8-TCDD Equiv.	0 01475	31	1.00E-06	36	7	33	2555	1.37E-09	25550	1.37E-10

Dose (mg/kg-day) = (CsxSAXCFxAFxABSxEFxED)/(BWxAT)

Child Wader2. Exposure Calculation for Dermal Contact with Sediment.

Chemical	Cs (mg/kg)	SA (cm2/event)	CF (kg/mg)	AF (mg/cm2)	ABS	EF (events/yr)	ED (years)	BW (kg)	AT (days) (Noncarcin)	Noncarcin Intake (mg/kg-d)	AT (days) (Carcin)	Carcin Intake (mg/kg-d)
Benzo(a)pyrene	4 528	2200	1 00E-06	2	0 130	36	7	33	2555	7.74E-06	25550	7.74E-07
Pentachlorophenol	49	2200	1.00E-06	2	0.250	36	7	33	2555	1.61E-04	25550	1.61E-05
2,3,7,8-TCDD Equiv.	0.01475	2200	1.00E-06	2	0 030	36	7	33	2555	5 82E-09	25550	5.82E-10

Child Wader3. Summary of Exposure and Noncarcinogenic Risk Calculations.

Chemical	Oral RfD (mg/kg-d)	Sediment Ingestion (mg/kg/d)	Sediment Ingestion AAF(a)	Sediment Ingestion HQ	% Total	Dermal Contact (mg/kg/d)	Absorb Dose AF(b)	Dermal Contact HQ	% Total	Combined Pathway HQ
Benzo(a)pyrene	NA	4.20E-07	1.00			7.74E-06	0.80			
Pentachlorophenol	3.00E-02	4.54E-06	1.00	0 000	2%	1.61E-04	0.90	0.006	98%	0.01
2,3,7,8-TCDD Equiv.	NA	1.37E-09	0 55			5 82E-09	0.55			

(a) Absorption adjustment for differences in absorption efficiency from soil from medium utilized in toxicity study.
(b) Absorption adjustment factor utilized to adjust the toxicity value for absorbed dose.

Child Wader4. Summary of Exposure and Carcinogenic Risk Calculations.

Chemical	Oral CSF (mg/kg-d)-1	Sediment Ingestion (mg/kg/d)	Sediment Ingestion AAF (a)	Sediment Ingestion ECR	% Total	Dermal Contact (mg/kg/d)	Absorb Dose AF(b)	Dermal Contact ECR	% Total	Combined Pathway Total
Benzo(a)pyrene	7.30E+00	4.20E-08	1 00	3 06E-07	4%	7 74E-07	0.80	7.06E-06	96%	7.37E-06
Pentachlorophenol	1.20E-01	4.54E-07	1 00	5.45E-08	2%	1.61E-05	0.90	2.15E-06	98%	2.20E-06
2,3,7,8-TCDD Equiv.	1.50E+05	1.37E-10	0.55	1.12E-05	7%	5 82E-10	0.55	1.59E-04	93%	1.70E-04

ECR = Excess Cancer Risk
(a) Absorption adjustment for differences in absorption efficiency from soil from medium utilized in toxicity study.
(b) Absorption adjustment factor utilized to adjust the toxicity value for absorbed dose.

Total ELCR 1.79E-04

October, 1998 Working Draft Tier 2 Residential Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Residential Soil Reference Value Risk Evaluation

Chemical	CAS No.	VOC?	Residential SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	10		0.000		In		0.000								0 000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		71	1.1	0.000		Or						0.000	0.000								1.55E-07	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329		1200		0.000		Or							0.000								NA	NA		
Anthracene	120127		7880		0.000		Or															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		2	0.767	(1/2 DL)																	3.84E-06	B2		Or
Fluoranthene	206440		1080		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		850		0.000				0.000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		890		0.000		Or						0 000									NA	D		
Quinoline	91225		1.2																			0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	3.80E-04																		1.90E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.30E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Child Subchronic Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways Or = oral; De= Dermal; In = Inhalation; ? = not known.

Tier 2 Child Subchronic Scenario Risk Evaluation

Chemical	CAS No.	VOC	Child Subchronic SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																									
Naphthalene	91203	y	99		0.000		In		0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																									
Pentachlorophenol	87865		88	1.1	0.001	In	Or									0.001						1.25E-08	B2		Or
Polyaromatic Hydrocarbons																									
Acenaphthene	83329	y	17400		0.000		Or							0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized. HQ should not > 1.															NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheet)	50328		2.3	0.767	(1/2 DL)																	3.33E-07	B2		Or
Fluoranthene	206440		21200		0.000		Or		0.000				0.000	0.000								NA	D		
Fluorene	86737		13500		0.000		In		0 000													NA	D		
Naphthalene - see Volatile Organics																									
Pyrene	129000		17800		0.000		Or						0.000									NA	D		
Quinoline	91225		1.4		NA																	0.00E+00	C	In	Or
Dioxins and Furans																									
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0002	3.80E-04	NA																	1.90E-06	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	2.25E-06			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.
Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Industrial Soil Reference Values (SRV)

NOTE:
Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways. Or = oral; De= Dermal; In = Inhalation, ? = not known

Tier 2 Industrial Scenario Risk Evaluation

Chemical	CAS No.	VOC	Industrial SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203	y	28		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		135	1)	0.000		Or							0 000	0.000								8.15E-08	B2	0	Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329	y	5260		0.000		In								0.000								NA	NA		
Anthracene	120127		45400		0.000		Or																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		4	0.767	(1/2 DL)																		1.92E-06	B2		Or
Fluoranthene	206440		6800		0.000		Or			0.000				0.000	0.000								NA	D		
Fluorene	86737		4120		0.000		Or In			0.000													NA	D		
Naphthalene - see Volatile Organics	0																						NA			
Pyrene	129000		5800		0.000		Or							0 000									NA	D		
Quinoline	91225		2.5																				0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.00035	3.90E-04																			1.09E-05	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.29E-05			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ /SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR/SRV).
Individual chemical specific HQ should not exceed 0.2 (except where noted), cumulative HI should not exceed 1 for each target endpoint.
Individual excess lifetime cancer risk as well as cumulative excess lifetime cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system,
PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID;
WHOLE BODY - increased mortality, decreased growth rate, etc.
NOTE: Not Protective of High Short-term Exposure - SRV based on short-term worker scenario (e.g., construction worker, utility worker, landscaper, etc.) is significantly lower than the Industrial worker SRV presented here.

(3) Class A - Known human carcinogen
Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
Class C - Possible human carcinogen
Class D - Not Classifiable
NA - No EPA Classification Available.

October, 1998 Working Draft Tier 2 Short-term Worker Soil Reference Values (SRV)

NOTE:

Based on LIMITED multiple pahtway exposure scenario (i.e., incidential soil/dust ingestion, dermal contact and inhalation of outdoor dust and vapors). If multiple contaminants are present cumulative risk MUST be evaluated. Soil reference values may not be protective of impacts to ecological receptors and to ground water. Impacts to ecological receptors and/or ground water must be evaluated by utilizing other methods.

Pathways: Or = oral; De= Dermal; In = Inhalation; ? = not known.

TIER 2 SHORT-TERM WORKER SCENARIO RISK EVALUATION

Chemical	CAS No.	VOC	Short-term Worker SRV (mg/kg)	Site Concen (mg/kg) dry weight	Site HQ (1)	Pathways: Missing	Pathways: Driving	NONCANCER TARGET ENDPOINTS (2): ADREN	BONE	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	THYROID	WHOLE BODY	CANCER: ELCR (1)	Class	Pathways: Missing	Pathways: Driving
Volatile Organics																										
Naphthalene	91203		78		0.000		In			0.000								0.000				0.000	NA	D		
Non/Semi Volatile Organics																										
Pentachlorophenol	87865		290	1.1	0.000	In	Or										0.000						3.79E-09	B2		Or
Polyaromatic Hydrocarbons																										
Acenaphthene	83329		19000		0.000		In								0.000								NA	NA		
Anthracene	120127		100000		0.000			Soil Maximum Utilized, HQ should not > 1.																NA	D		
Benzo[a]pyrene equivalents (see BaP equiv. Calculation spreadsheeet)	50328		10	0.767	(1/2 DL)																		7.67E-08	B2		Or
Fluoranthene	206440		48500		0.000		Or			0 000				0.000	0.000								NA	D		
Fluorene	86737		17240		0.000		In			0.000													NA	D		
Naphthalene - see Volatile Organics																										
Pyrene	129000		43000		0.000		Or							0.000									NA	D		
Quinoline	91225		6		NA																		0.00E+00	C	In	Or
Dioxins and Furans																										
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746016		0.0008	3.60E-04	NA																		4.75E-07	B2		Or
			Cumulative Site Soil Risk (1) =					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	5.55E-07			

VOC? - "y" indicates that the contaminant is considered volatile.

(1) Individual subchronic chemical specific HQ should not exceed 1. Cumulative subchronic HI should not exceed 1 for each target endpoint.

Individual subchronic excess lifetime cancer risk as well as cumulative subchronic excess lifetime cancer risk should not exceed 1 per 1,000,000 (i.e., 1 E-6).

(2) ADREN - adrenal; BONE; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE; IMMUN - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; PROST - prostrate; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; THYROID; WHOLE BODY - increased mortality, decreased growth rate, etc.

(3) Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Class D - Not Classifiable

NA - No EPA Classification Available.

Intake (mg/kg-day) = (Cs x IRs x CF x EF x ED)/(BW x AT)

Child Wader1. Exposure Calculation for Incidental Sediment Ingestion

Chemical	Cs (mg/kg)	IRs (mg/event)	CF (kg/mg)	EF (event/yr)	ED (yr)	BW (kg)	AT (days) (Noncarcin)	Noncarcin Intake (mg/kg-d)	AT (days) (Carcin)	Carcin Intake (mg/kg-d)
Benzo(a)pyrene	0.767	31	1.00E-06	36	7	33	2555	7 11E-08	25550	7.11E-09
Pentachlorophenol	1.1	31	1.00E-06	36	7	33	2555	1.02E-07	25550	1.02E-08
2,3,7,8-TCDD Equiv.	0.00038	31	1.00E-06	36	7	33	2555	3.52E-11	25550	3 52E-12

Dose (mg/kg-day) = (CsxSAXCFxAFxABSxEFxED)/(BWxAT)

Child Wader2. Exposure Calculation for Dermal Contact with Sediment.

Chemical	Cs (mg/kg)	SA (cm2/event)	CF (kg/mg)	AF (mg/cm2)	ABS	EF (events/yr)	ED (years)	BW (kg)	AT (days) (Noncarcin)	Noncarcin Intake (mg/kg-d)	AT (days) (Carcin)	Carcin Intake (mg/kg-d)
Benzo(a)pyrene	0.767	2200	1.00E-06	2	0.130	36	7	33	2555	1.31E-06	25550	1.31E-07
Pentachlorophenol	1.1	2200	1.00E-06	2	0 250	36	7	33	2555	3 62E-06	25550	3.62E-07
2,3,7,8-TCDD Equiv.	0.00038	2200	1.00E-06	2	0.030	36	7	33	2555	1 50E-10	25550	1.50E-11

Child Wader3. Summary of Exposure and Noncarcinogenic Risk Calculations.

Chemical	Oral RfD (mg/kg-d)	Sediment Ingestion (mg/kg/d)	Sediment Ingestion AAF(a)	Sediment Ingestion HQ	% Total	Dermal Contact (mg/kg/d)	Absorb Dose AF(b)	Dermal Contact HQ	% Total	Combined Pathway HQ
Benzo(a)pyrene	NA	7.11E-08	1.00			1.31E-06	0.80			
Pentachlorophenol	3 00E-02	1.02E-07	1.00	0.000	2%	3 62E-06	0.90	0 000	98%	0.00
2,3,7,8-TCDD Equiv.	NA	3.52E-11	0.55			1 50E-10	0.55			

(a) Absorption adjustment for differences in absorption efficiency from soil from medium utilized in toxicity study

(b) Absorption adjustment factor utilized to adjust the toxicity value for absorbed dose.

Child Wader4. Summary of Exposure and Carcinogenic Risk Calculations.

Chemical	Oral CSF (mg/kg-d)-1	Sediment Ingestion (mg/kg/d)	Sediment Ingestion AAF (a)	Sediment Ingestion ECR	% Total	Dermal Contact (mg/kg/d)	Absorb Dose AF(b)	Dermal Contact ECR	% Total	Combined Pathway Total
Benzo(a)pyrene	7.30E+00	7.11E-09	1.00	5 19E-08	4%	1.31E-07	0.80	1.20E-06	96%	1.25E-06
Pentachlorophenol	1.20E-01	1.02E-08	1.00	1.22E-09	2%	3.62E-07	0.90	4.82E-08	98%	4.94E-08
2,3,7,8-TCDD Equiv.	1.50E+05	3 52E-12	0.55	2.88E-07	7%	1 50E-11	0.55	4.09E-06	93%	4.38E-06

ECR = Excess Cancer Risk

(a) Absorption adjustment for differences in absorption efficiency from soil from medium utilized in toxicity study.

(b) Absorption adjustment factor utilized to adjust the toxicity value for absorbed dose.

Total ELCR 5.67E-06

APPENDIX 4

EXPOSURE EQUATIONS AND DEFAULT VALUES

TABLE OF CONTENTS

1.0 INTRODUCTION

This Appendix contains the exposure equations and default exposure assumptions used in the exposure assessment to calculate dose. In the absence of site specific, or otherwise justifiable exposure information, the use of default values will result in realistic yet adequately conservative dose estimates. The selection of all exposure assumptions should be described in narrative form, accompanied by a referenced summary table.

It is important to differentiate between site-specific information which can be appropriately used to modify site-specific parameters and professional judgment about the scientific evidence which supports generic assumptions. Modification of MPCA/SRS default exposure assumptions in a site-specific risk assessment will not be allowed unless there is a reasonable basis for site-specific differences. Default values will be revised as new information becomes available.

Most exposure parameters have a range of values. Exposure parameters were chosen with the intent that the combination of variables for a given pathway would result in an estimate of the Reasonable Maximum Exposure (RME). Under this approach some exposure variables represent average values, but when combined with other variables, which are set at an more conservative value, will result in an RME estimate. If the default exposure variables set at the more conservative value are modified downward, other variables would need to be adjusted to a more conservative value to maintain an RME evaluation.

Contact rate, exposure frequency and exposure duration are believed to be the most sensitive parameters in each equation (RAGS, EPA 1989). When adequate distributional data were available the 90th or 95th percentile values were selected for exposure duration. When adequate distributional data were not available for exposure frequency estimates an upper-end estimate was made using available data and professional judgment. Central-tendency or average values were typically utilized for contact rates. As indicated above, if the exposure frequency or duration are adjusted to represent a central-tendency value the contact rate may need to be increased to maintain a RME estimate.

2.0 RESIDENTIAL PROPERTY USE - DIRECT SOIL EXPOSURE PATHWAY EVALUATION

2.1 Residential - Chronic Exposure

2.1.1 General Exposure Factors

There are five exposure factors which recur throughout the equations used to estimate the dose of contaminant experienced by a potential receptor:

- C_{soil}, Contaminant Concentration
- CF, Units Conversion Factors
- ED, Exposure Duration
- BW, Body Weight
- AT, Averaging Time

These factors are generally used in the same manner regardless of the exposure pathway under investigation, so it is useful to discuss them separately.

2.1.1.1 C_{soil}, Contaminant Concentration

The concentration of the contaminant used to quantify exposure is the Exposure Concentration. The exposure concentration is expressed in terms of mass of the material per unit mass (or volume) of the exposure medium (e.g., mg contaminant/kg soil). The exposure point concentration should *not* be adjusted for receptor exposure frequency, duration, etc. as those factors are generally addressed in the exposure calculations.

2.1.1.2 CF, Units Conversion Factors

The exposure factors and analytical data used for a given calculation may come in several forms. Units conversion factors are necessary to insure that the result of the calculation (the dose) is expressed in the correct units (e.g., mg/kg/day). Use of a units conversion factors (CF) is equivalent to multiplication by one. The numerator and denominator of the factor must be an equivalent quantity expressed in different terms.

2.1.1.3 ED, Exposure Duration

The exposure duration (ED) describes the length of time over which the receptor comes into contact with the contaminant. The exposure duration depends upon the type of activities which lead a receptor to be exposed. Remember that the receptor may be exposed continuously, at regular intervals, or sporadically, depending upon the activity being modeled, so the exposure duration would be the length of time between the first exposure experienced and the last.

As discussed previously, exposure duration is believed to be one of the more sensitive parameters in the exposure equation. In keeping with the RME approach the upper-end estimate was utilized as the default for the duration of chronic exposure. National statistics are available for residential occupancy (US Bureau of Census data). The 90th percentile value for years lived in the current home for the Minneapolis/St. Paul metropolitan area was determined to be 33 years. No statistical data on childhood residential occupancy time are available. For the purpose of calculating the SRVs, children (defined here as infants to 6 years old) are assumed to reside at a single residence (i.e., exposure duration for children is 6 years). This does not appear to be an upper-end estimate for young children (Johnson and Capel, 1992 as cited in Exposure Factors Handbook, EPA 1997).

2.1.1.4 BW, Body Weight

A receptor's body weight is relevant throughout the dose equations since dose is expressed in terms of mass of contaminant per unit body weight per day (mg/kg/day). When each receptor of concern is identified, the receptor is often described in terms of occupation (resident, construction worker), age (a child age 1 to 6 years) and sometimes gender. The receptor's body weight is dependent upon its age and gender. Since body weight is easily measured, there are numerous summaries of age and gender-specific body weights. Table A4.1 provides age-specific body weights for children and adults. The body weights are 50th percentile values for males and females and are presented annually for children and at longer intervals for adults (EPA Exposure Factors Handbook, 1997).

TABLE A4.1 AGE-SPECIFIC BODY WEIGHTS FOR CHILDREN AND ADULTS

AGE (Years)	Mean BW for Females (kg)	Mean BW for Males (kg)	Default BW Recommended (kg)
< 1	8.8	9.4	
1 < 2	10.8	11.8	1 - 2 years: 11 kg
2 < 3	13.0	13.6	
3 < 4	14.9	15.7	
4 < 5	17.0	17.8	
5 < 6	19.6	19.8	≤ 6 years: 15 kg
6 < 7	22.1	23.0	
7 < 8	24.7	25.1	
8 < 9	27.9	28.2	
9 < 10	31.9	31.1	
10 < 11	36.1	36.4	
11 < 12	41.8	40.3	
12 < 13	46.4	44.2	
13 < 14	50.9	49.9	
14 < 15	54.8	57.1	
15 < 16	55.1	61.0	
16 < 17	58.1	67.1	
17 < 18	59.6	66.7	> 6 - 18 years: 43 kg
18 < 25	60.6	73.8	> 6 - 33 years : 58 kg
25 < 34	64.2	78.7	> 18 - 33 years: 70 kg

The receptor body weight (BW, typically expressed in kilograms, kg) must be matched to the age and gender identified in the exposure profile. Since exposure is often assumed to occur over a period of several years, the changes in body weight which might occur during the period of exposure must also be considered. An average body weight is estimated across the age group under consideration. Within a given age/sex combination, there is some variability of body weight for that subpopulation. This variation is well defined, and the distribution of body weights for this subpopulation of concern may be used as part of a probabilistic assessment of exposure. For deterministic evaluations (i.e., evaluations using a point estimate of body weight) the 50th percentile body weigh for the subpopulation under consideration is recommended, unless there is strong evidence that the potentially exposed subpopulation is biased in some manner.

Because body weights changes with age it is necessary to calculate an age-adjusted body weight when exposure occurs throughout childhood and into adult years. The average daily dose (ADD) should be calculated to reflect age-related differences in exposure rates that are experienced by a receptor throughout the exposure period or in the case of cancer evaluation a lifetime. Because of their low body weight and behavioral characteristics, young children receive a larger potential dose per unit body weight than older children and adults. The results of utilizing a simple age-weighted averaging approach to calculate age-adjusted body weight is shown below:

$$BW_{age-adjusted} = \frac{(15\ kg \times 6\ yrs) + (43\ kg \times 12\ yrs) + (70\ kg \times 15\ yrs)}{33\ yrs} = 51\ kg$$

2.1.1.5 AT, Averaging Time

The averaging time (AT) is the time over which the total intake is normalized. For the evaluation of *noncancer risk*, the Average Daily Dose (ADD) calculated should be representative of the exposure received while exposure is on-going (i.e., during the exposure period). Thus the values for exposure period duration (ED) and the averaging time (AT) are equivalent.

The Lifetime Average Daily Dose (LADD) is calculated for the evaluation of *cancer risk*. While the duration of the exposure period (ED) might range from one day to an entire lifetime, the total intake during that exposure is traditionally normalized to a lifetime. The averaging time for assessment of cancer risk is therefore typically set at 70 years. For exposures lasting less than a lifetime, the values for ED and AT will be different. For some contaminants or subpopulations of receptors this approach (normalizing over a lifetime) may not be health protective (e.g., vinyl chloride exposure to children). The existence of critical periods of susceptibility during a lifetime and the intensity of exposure may influence cancer risk. These factors may warrant deviation from the traditional approach. When possible, the biological basis or mechanism by which a carcinogen acts should be used to characterize risk from the carcinogenic contaminant.

2.1.2 Incidental Soil Ingestion Pathway

The Average Daily Dose due to the *chronic* incidental ingestion of contaminated soil ($ADD_{soil\ ingestion}$) may be calculated utilizing the equation presented in Table A4.2.

2.1.2.1 C_{soil}, Contaminant Concentration

See Section 2.1.1.1.

2.1.2.2 IR, Soil Ingestion Rate

Soil ingestion is assumed to occur incidentally, from hand-to-mouth contact, during outdoor activities in the warmer months of the year and through the inhalation of larger particles. Soil from outdoors can also be brought indoors (e.g., on clothing, shoes and tools) or can enter the house as windblown dust. Therefore, some incidental soil/dust ingestion can also occur indoors.

Soil ingestion rates represent **daily** rates. It is **not** appropriate to modify the soil ingestion rate to account for an exposure which occurs for a portion of a day as the studies on which the soil ingestion rates are based do not indicate whether soil ingestion is a sporadic event or whether it occurs evenly throughout the exposure period.

Several studies have been conducted to estimate the amount of soil incidentally ingested by children. The studies upon which the incidental soil ingestion rate was estimated utilized mass balance equations and tracer levels in soil and dust (indoor as well as outdoor) and in feces. Children were monitored for several days and an average daily rate was calculated. It is inappropriate to "limit" exposure time to outdoor time since the estimated incidental ingestion rate includes indoor as well as outdoor sources.

The central tendency value of 100 - 200 mg/day is recommended by EPA (EPA, 1997) for young children. Stanek and Calabrese's (1995) have utilized previously obtained data to estimate an annual average median daily soil ingestion of 75 mg/day. The middle value of 100 mg/day was selected as the default annual daily ingestion rate for a young child in a residential setting. Since the annual daily soil ingestion rate was, in part, based on data derived by averaging the median soil ingestion rates over 365 days the default exposure frequency must be set at a minimum of 350 days per year. The use of an average daily ingestion rate for

chronic exposure is believed to be consistent with the RME approach when combined with conservative estimates for exposure duration.

Table A4.2. Residential - Chronic Incidental Ingestion of Soil.

$$\text{LADD or ADD}_{soil\ ingestion} = \frac{Csoil \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

Variable	Definition	Default Value	Percentile	Reference
LADD or $ADD_{soil\ ingestion}$	Average daily potential dose of contaminant received through the ingestion of soil (mg/kg-day).			
C_{soil}	Soil Concentration (mg/kg)	Representative site exposure concentration		
IR	Annual daily soil ingestion rate (mg/day)	100 (< 6 yr) 75 (> 6 - 18 yr) 50 (> 18 - 33 yrs) 68 (age-adjusted)	C	EPA 1997, Stanek & Calabrese, 1995.
CF	Conversion Factor	1E-6 kg/mg		
FI	Fraction of ingested soil which is from contaminated soil	1	NA	
EF	Number of exposure days during the exposure period (days/year).	350	C	Utilized with annual average daily soil ingestion rate.
ED	Duration of the exposure period (years).	6 (< 6 yr) 12 (> 6 - 18 yrs) 15 (> 18 - 33 yr) 33 (age-adjusted)	C U U	American Housing Survey for the Minneapolis/St. Paul Metro Area in 1993. 33 years = 90th percentile resident tenure.
BW	Body weight of the receptor of concern during the exposure period (kg).	15 (< 6 yr) 43 (> 6 - 18 yrs) 70 (> 18 - 33 yr) 51 (age-adjusted)	C C C	EPA 1997 Exposure Factors Handbook
AT	Averaging Time (days)	2190 (< 6 yr) 4380 (> 6 - 18 yrs) 5475 (> 18 - 33 yr) 12045 (age-adjusted) 25550 (lifetime)		Noncancer AT = ED LADD calculation: AT = 70 year lifetime

C = Central Tendency Value (e.g., average)
U = Upper Tendency Value

Older children and adults may incidentally ingestion soil that adhere to food or their hands or through the inhalation of larger particles. Information on soil ingestion among adults is very limited. An annual average daily ingestion rate of 50 mg/day for soil and household dust is recommended as the default for older children and adults in a residential setting or working indoors. Since the 50 mg/day ingestion rate was based on adult volunteers, this value may underestimate the soil ingestion rate for older children (> 6 - 18 yrs). In the absence of information a soil ingestion rate of 75 mg/day (i.e., midway between rate for young children and adults) is assumed for older children.

Because soil ingestion rates differ for children, older children and adults, it is necessary to calculate an age-adjusted soil ingestion rate when exposure occurs throughout childhood and into adult years. The average daily dose (ADD) should be calculated to reflect age-related differences in exposure rates that are experienced by a receptor throughout the exposure period. Because of their low body weight and behavioral characteristics, young children receive a larger potential dose per unit body weight than older children and adults. Therefore, the age-adjusted exposure should be calculated in a way that does not "dilute" the higher exposure rates experienced by young children with lower exposure rates experienced by older children and adults.

There are a number of averaging methods that can be used to calculate a ADD that reflects the higher exposure rates experienced by young children. One method which can be used to calculate the age-adjusted average daily dose is a simple age-weighted averaging approach. In the case of the incidental soil ingestion pathway this simple averaging approach would result in calculating a weighted total daily dose for the three age groups evaluated. The weighted total daily dose then calculated as the sum of the three doses averaged over the exposure period. For example, the calculation for the soil ingestion rate would be:

$$IR_{age-adjusted} = \frac{(100\ mg/d \times 6\ yrs) + (75\ mg/d \times 12\ yrs) + (50\ mg/d \times 15\ yrs)}{33\ yrs} = 68\ mg/d$$

2.1.2.3 CF, Units Conversion Factors

See Section 2.1.1.2 for discussion of CF parameter.

2.1.2.4 FI, Fraction of Ingested Soil

Since soil ingestion rates represent **daily** rates. It is **not** appropriate to modify the soil ingestion rate to account for an exposure which occurs for a portion of a day as the studies on which the soil ingestion rates are based do not indicate whether soil ingestion is a sporadic event or whether it occurs evenly throughout the exposure period. It is assumed that the daily ingestion occurs within the exposure area.

2.1.2.5 EF, Exposure Frequency

A receptor may be exposed to a contaminant continuously, at regular intervals, or in a sporadic manner. The frequency of exposure term describes how often the exposure event or contact occurs over a given period of time. Contact rates which are on the scale of days are the most common. The ingestion pathway is typical of this case. While estimates have been published on the amount of soil ingested during a *day*, there can be no reliable estimate of average *hourly* ingestion rates as incidental ingestion of soil is a sporadic event depending upon human behavior (e.g., activities, habits). For such exposures (including soil ingestion and dermal contact) EF is by definition 1 day/event. During that "1 event" the receptor is assumed to receive the daily intake of the contaminant.

Frequency of exposure is site- and activity-specific. The exposure frequency selected must be appropriate for the duration and contact rate chosen Since long-term contact rates are assumed for all exposure pathways, a daily exposure frequency (350 days/year for residential) to contaminants is assumed. For children this value does not represents an upper-end estimate since the ingestion rate represents an annual daily average.

2.1.2.6 ED, Exposure Duration

See Section 2.1.1.3 for discussion of ED parameter.

2.1.2.7 BW, Body Weight

See Section 2.1.1.4 for discussion of the BW parameter.

2.1.2.8 AT, Averaging Time

See Section 2.1.1.5 for discussion of AT parameter.

2.1.3 Dermal Contact Pathway

Dermal absorption of contaminants is a potentially significant route of exposure whenever direct contact with soil may occur. In fact, dermal absorption from soils may be more significant than incidental ingestion for chemicals which have a percent absorption exceeding about 10% (USEPA, EPA/600/8-91/011B, January, 1992). Contaminants exhibiting percentage absorption less than 10% also contribute to cumulative risk estimates and therefore these contaminants must also be evaluated. The absorption of contaminants from soil depends upon chemical-specific factors (e.g., lipophilicity) as well as the characteristics of the soil. The Average Daily Dose due to chronic dermal contact with contaminated soil ($ADD_{dermal\ absorption}$) may be calculated as shown in Table A4.3.

2.1.3.1 C_{soil}, Contaminant Concentration

See Section 2.1.1.1 for discussion of C_{soil} parameter.

2.1.3.2 CF, Units Conversion Factors

See Section 2.1.1.2 for discussion of CF parameter.

2.1.3.3 SA, Skin Surface Area

The surface area parameter (SA) describes the amount of skin exposed to the contaminated media. The amount of skin exposed depends on the receptor and the exposure scenario. Clothing is expected to limit the extent of the exposed surface area for most activities. All SA estimates used 50th percentile values in order to correlate with the average body weights used for exposure estimations. This is done to prevent inconsistent parameter combinations since body weight and surface area are not independent variables. The age-specific 50th percentile total body surface areas are shown in Table A4.4.

The exposure frequency for dermal exposure is limited to the warmer months of the year. For the purpose of calculating the dermal dose it was assumed that the forearms, lower legs, hands, and feet were exposed. The age-specific percentage of total body surface area by body part are shown in Table A4.5. This exposed area constitutes approximately 28% in the < 6 year young child receptor and 25% in the > 6 - 18 older child and > 18 - 33 year adult receptor. Surface areas of 2,000, 3300 and 4,500 cm^2 were calculated by incorporating data from the EPA Exposure Factors Handbook (EPA 1997) as presented in Tables A4.4 and A4.5. Since some studies have suggested that exposure can occur under clothing (EPA, 1992, Dermal Guidance) this scenario is not considered to be unduly conservative.

Table A4.3 Residential - Chronic Dermal Contact with Soil

$$\text{LADD or ADD}_{dermal\ absorption} = \frac{Csoil \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Variable	Definition	Default Value	Percentile	Reference
LADD or ADD_{dermal}	Average daily dose absorbed through dermal contact (mg/kg-day).			
C_{soil}	Soil Concentration (mg/kg)	Representative site exposure concentration		
CF	Conversion Factor	1E-6 kg/mg		
SA	Skin surface area (cm^2)	2000 (< 6 yr) 3300 (> 6 - 18 yrs) 4500 (> 6 - 33 yr) 3609 (age-adjusted)	C	28 - 25% of the average total body SA (EPA, 1992 and EPA, 1997)
AF	Skin adherence factor (mg/cm^2)	0.2 (< 18 yrs) 0.13 (> 18 - 33 yrs) 0.17 (age-adjusted)	C	Kissel et. al., (as cited in EPA, 1997)and EPA, 1992
ABS	Absorption factor	Chemical specific		
EF	Number of exposure days during the exposure period (days/year).	150 (< 6 yr) 100 (> 6 - 18 yr) 74 (>18 - 33 yr) 97 (age-adjusted)	NA	5 d/wk for warmer 7 mons. 2 d/wk for 4 mo + 5 d/wk for 3 mo. 2 d/wk for 4 mo + 3 d/wk for 3 mo
ED	Duration of the exposure period (years).	6 (< 6 yr) 12 (> 6 - 18 yrs) 15 (> 18 - 33 yr) 33 (age-adjusted)	C U U	American Housing Survey, 1993. 33 years = 90th percentile resident tenure.
BW	Body weight of the receptor of concern during the exposure period (kg).	15 (< 6 yr) 43 (>6 - 18 yrs) 70 (> 18 - 33 yr) 51 (age-adjusted)	C C C	EPA 1997
AT	Averaging Time (days)	2190 (< 6 yr) 4380 (> 6 -18 yrs) 5475 (> 18 - 33 yr) 12045 (age-adjusted) 25550 (lifetime)		Noncancer AT = ED LADD: AT = 70 year lifetime

NA = Not Available
C = Central Tendency Value
U = Upper Tendency Value

Because body surface area changes with age it is necessary to calculate an age-adjusted skin surface area when exposure occurs throughout childhood and into adult years. The average daily dose (ADD) should be calculated to reflect age-related differences in exposure rates that are experienced by a receptor throughout the exposure period. The results of utilizing a simple age-weighted averaging approach to calculating age-adjusted surface area is shown below:

$$SA_{age-adjusted} = \frac{(2000\ cm^2 \times 6\ yrs) + (3300\ cm^2 \times 12\ yrs) + (4500\ cm^2 \times 15\ yrs)}{33\ years} = 3600\ cm^2$$

TABLE A4.4 AGE-SPECIFIC TOTAL BODY SURFACE AREA

AGE (Years)	Mean SA for Females (cm^2)	Mean SA for Males (cm^2)	Default Total Body Surface Area (cm^2)
< 1 (a)	4271	4487	
1 < 2 (a)	4980	5324	
2 < 3	5790	6030	
3 < 4	6490	6640	
4 < 5	7060	7310	
5 < 6	7790	7930	≤ 6 years: 7000 cm^2
6 < 7	8430	8660	
7 < 8	9170	9360	
8 < 9	10000	10000	
9 < 10	10600	10700	
10 < 11	11700	11800	
11 < 12	13000	12300	
12 < 13	14000	13400	
13 < 14	14800	14700	
14 < 15	15500	16100	
15 < 16	15700	17000	
16 < 17	16000	17600	
17 < 18	16300	18000	> 6 - < 18 years: 13120 cm^2
> 18	16900	19400	> 18 - 33 years: 18150 cm^2

(a) Utilized formula developed by Costeff (as cited in Exposure Factors Handbook,1997): SA = (4BW + 7)/(BW + 90).

TABLE A4.5. Age-Specific Percentage of Total Body Surface by Body Part

AGE (Years)	Mean Total Body Surface Area (cm^2)	Mean Percentage of Total Body Surface Area by Part					
		Head	Trunk	Arms	Hands	Legs	Feet
<1	4379	18.2	35.7	13.7	5.3	20.6	6.5
1<2	5152	16.5	35.5	13	5.7	23	6.3
2<3	5910	14.2	38.5	11.8	5.3	23.2	7.1
3<4	6565	13.6	31.9	14.4	6.1	26.8	7.2
4<5	7185	13.8	31.5	14	5.7	27.8	7.3
5<6	7860	NA	NA	NA	NA	NA	NA
6<7	8545	13.1	35.1	13.1	4.71	27.1	6.9
7<8	9265	NA	NA	NA	NA	NA	NA
8<9	10000	NA	NA	NA	NA	NA	NA
9<10	10650	12	34.2	12.3	5.3	28.7	7.58
10<11	11750	NA	NA	NA	NA	NA	NA
11<12	12650	NA	NA	NA	NA	NA	NA
12<13	13700	8.74	34.7	13.7	5.4	30.5	7.03
13<14	14750	9.97	32.7	12.1	5.11	32.0	8.02
14<15	15800	NA	NA	NA	NA	NA	NA
15<16	16350	NA	NA	NA	NA	NA	NA
16<17	16800	7.96	32.7	13.1	5.68	33.6	6.93
17<18	17150	7.58	31.7	17.5	5.13	30.8	7.28
> 18	18150	7.5	35.4	14	5.2	31.8	6.8

2.1.3.4 AF, Soil Adherence Factor

The adherence factor (AF) describes the amount of soil that adheres to the skin. The EPA Exposure Factors Handbook (EPA 1997) recommends utilizing the Kissel, et al., study for estimating soil adherence. The results of this study showed that generally soil adherence could be directly correlated with soil moisture and activity and inversely correlated with particle size. The default AFs are based on the central tendency value recommended in EPA's Dermal Guidance (EPA 1992) and a review of the body-part-specific and activity-specific adherence factors reported by Kissel et al., 1996 (as cited in the EPA Exposure Factors Handbook, 1997).

The data available for young children (< 6 years) is very limited. The studies by Kissel et al., for this age group evaluated adherence in an indoor setting. The exposure frequency utilized in the dermal exposure pathway is based on outdoor activity. Kissel et al., also studied older children, age 9 to 14 years. Unfortunately, the setting was playing in mud at the shore of a lake. This scenario is not likely to be representative of a residential setting. In the absence of appropriate data a default AF of 0.2 mg/cm2 is recommended for individuals less than 18 years old. Given the limited data and the variability in the existing data this is not considered to be unduly conservative.

For the adult resident (> 18 - 33 years) the gardening scenario was utilized as the most likely residential activity. This activity included weeding, pruning, and digging. The weighted adherence factor for the adult resident was calculated utilizing the equation below:

$$\text{Weighted AF} = \frac{(SA1 \times AF1) + (SA2 \times AF2) + \ldots + (SAi \times AFi)}{(SA1 + SA2 + \ldots + SAi)}$$

where:

SAi = surface area for body part "i", cm^2
AFi = soil-to-skin adherence factor for body part "i", mg/cm^2-event

The body part specific surface area information can be found in Table A4.6. Kissel, et al. presented the body part specific AFs for two subsets of gardeners. The highest geometric mean value of the two subsets was utilized when calculating the weighted AF. The selection of the highest mean AF is not unduly conservative considering that the value represents a central tendency value, the reported high variability, and the clothing worn by the study participants (e.g., 75% wore long pants, intermittent use of gloves). The calculation of the adult resident AF is shown below:

$$\text{Weighted AF} = \frac{(1000 \times 0.054) + (900 \times 0.2) + (1700 \times 0.072) + (900 \times 0.26)}{(4500)} = 0.13$$

Because the AF changes with age it is necessary to calculate an age-adjusted AF when exposure occurs throughout childhood and into adult years. The average daily dose (ADD) should be calculated to reflect age-related differences in exposure rates that are experienced by a receptor throughout the exposure period. The results of utilizing a simple age-weighted averaging approach is shown below:

$$AF_{age-adjusted} = \frac{(0.2\ mg/cm^2 \times 18\ yrs) + (0.13\ mg/cm^2 \times 15\ yrs)}{33\ years} = 0.17\ mg/cm^2$$

TABLE A4.6 DEFAULT MEAN EXPOSED SURFACE AREA BY BODY PART

Age (years)	Total SA Exposed (cm^2)	Surface Area Exposed (cm^2)			
		Lower Arms	Hands	Lower Legs	Feet
< 6	2000 (28%)	400 (6%)	400 (5.6%)	700 (10%)	500 (7%)
> 6 - < 18	3300 (25%)	700 (5.5%)	650 (5%)	1300 (10%)	650 (5%)
> 18 - 33	4500 (25%)	1000 (6%)	900 (5%)	1700 (9.5%)	900 (5%)

( ) represents percent of total body surface area. Default total body surface area of < 6 years, > 6 - < 18 years and > 18 - 33 years are 7000, 13120 and 18150 cm^2 (see Table A4.4). It was assumed that the forearm constituted 45% of the total arm and the lower leg constituted 40% of the total leg based on data from adult males (EPA Exposure Factors Handbook 1997, Table 6-5)

2.1.3.5 ABS, Absorption Factor

The dermal absorption factor (ABS) is the fraction of the contaminant contacting the skin that is absorbed. At this time only limited information is available to derive soil ABS values. In the absence of contaminant specific information default ABS values have been incorporated. The recommended default values are:

- 1 - 10% for volatile organic contaminants, depending on volatility. It is assumed that volatilization will be a competing process;
- 10% for semi-volatile and non-volatile organic contaminants; and
- 0.1 - 1% for inorganic compounds, depending on qualitative evidence of absorption. Note: The default ABS was set such that dermal absorption would not be greater than 10% of oral absorption.

The default values are based on the EPA Dermal Workgroup recommendations and professional judgment. The recommended ABS values are listed in Table A.5.1 of Appendix 5.

2.1.3.6 EF, Exposure Frequency

A receptor may be exposed to a contaminant continuously, at regular intervals, or in a sporadic manner. The frequency of exposure term describes how often the exposure event or contact occurs over a given period of time. Contact rates which are on the scale of days are the most common. The event duration in the AF studies varied from several minutes to over 8 hours. There can be no reliable estimate of an average *hourly* rate since contact with soil is a sporadic event depending upon human behavior (e.g., activities, habits). For such exposures EF is by definition 1 day/event.

Frequency of exposure is site- and activity-specific. The exposure frequency selected must be appropriate for the duration and contact rate chosen. Dermal contact with contaminated soil is assumed to occur mainly during outdoor activities. For young children this is assumed to be an average of 5 days a week during the warmer 7 months of the year (April - October) for a total of 150 days per year. For school-age individuals the exposure frequency is assumed to be an average of 2 days a week in the spring and fall increasing

to an average of 5 days a week during the 3 months of summer. The resulting exposure frequency is 100 days per year. For adults the exposure frequency is assumed to be an average of 2 days per week in the spring and fall increasing to an average of 3 days a week during the 3 months of summer. The resulting exposure frequency for adults is 74 days per year.

Because the EF changes with age it is necessary to calculate an age-adjusted EF when exposure occurs throughout childhood and into adult years. The average daily dose (ADD) should be calculated to reflect age-related differences in exposure rates that are experienced by a receptor throughout the exposure period or in the case of cancer evaluation a lifetime. The results of utilizing a simple age-weighted averaging approach is shown below:

$$EF_{age-adjusted} = \frac{(150 \text{ days x } 6 \text{ yrs}) + (100 \text{ days x } 12 \text{ yrs}) + (74 \text{ days x } 15 \text{ yrs})}{33 \text{ years}} = 97 \text{ days}$$

2.1.3.7 ED, Exposure Duration

See Section 2.1.1.3 for discussion of ED parameter.

2.1.3.8 BW, Body Weight

See Section 2.1.1.4 for discussion of BW parameter.

2.1.3.9 AT, Averaging Time

See Section 2.1.1.5 for discussion of AT parameter.

2.1.4 Inhalation of Vapors or Resuspended Particulate Pathway

The toxicity information generally used to evaluate the risk of harm to health associated with inhalation exposures, Reference Concentrations and Units Risk values, are air *concentrations*. These values are intended to be used in combination with Average Daily Concentration expressed as applied concentrations, *not* dose.

The Average Daily Concentration of the contaminant in air (ADC_{air}) is dependent upon the frequency and duration of the assumed exposures. Note that the equation is a simple adjustment of the exposure point concentration to account for the amount of time the receptor spends in the area with contaminated air. The Average Daily Concentration (ADC_{air}) may be calculated as shown in Table A4.7.

Table A4.7 Residential - Chronic Inhalation of Vapors or Particulate from Soil

$$\text{LADC or ADC}_{air} = \frac{Cair \times EF \times ED \times CF}{AT}$$

Variable	Definition	Default Value	Percentile	Reference
LADC or ADC_{aie}	Average daily concentration in air (mg/m^3 or ug/m^3).			
C_{air}	Air Concentration (mg/m^3 or ug/m^3) = C_{soil} x (1/PEF + 1/VF)	Measured or Modeled Representative site exposure concentration		
CF	Conversion Factor	1E+3 µg/mg		Utilized for LADC calculation since toxicity values are in ug/m^3
EF	Number of exposure days during the exposure period (days/year).	350	C	1/PEF and 1/VF are based on annual estimates.
ED	Duration of the exposure period (years).	6 (< 6 yr) 12 (> 6 - 18 yrs) 15 (> 18 - 33 yr) 33 (age-adjusted)	C U U	American Housing Survey for the Minneapolis/St. Paul Metro Area in 1993. 33 years = 90th percentile resident tenure.
AT	Averaging Time (days)	2190 (< 6 yr) 4380 (> 6 - 18 yrs) 5475 (> 18 - 33 yr) 12045 (age-adjusted) 25550 (lifetime)		Noncancer AT = ED LADC calculation AT = 70 year lifetime

C = Central Tendency Value
U = Upper Tendency Value

2.1.4.1 C_{air}, Air Concentration

To calculate an average daily air concentration, the particulate emission factor and volatilization factor must be calculated. Separate Particulate Emission Factor-based (PEF) and Volatilization Factor-based (VF) equations were developed by EPA (EPA Soil Screening Guidance: Technical Background Document, 1996). The derivations of PEF and VF have been updated since RAGS, part B was published and are discussed fully in Sections 2.4.2 and 2.4.5, respectively, of the EPA Soil Screening Guidance (EPA 1996).

The particulate emission factor (PEF) relates the concentration of contaminant in soil with the concentration of dust particles in the air. The PEF equation is based on the "unlimited reservoir" model from Cowherd et al. (1985) developed to estimate particulate emissions due to wind erosion. Unlike volatile contaminants, meteorological conditions (i.e., the intensity and frequency of wind) affect both the dispersion and emissions of particulate matter. Table A4.8 presents the PEF equation and the default input values.

Table A4.8 Residential - Calculation of Chronic Particulate Emission Factor

$$PEF(m^3/kg) = Q/C \times \frac{3{,}600 s/h}{(0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x))}$$

Variable	Definition	Default Value	Reference
PEF	Particulate emission factor (m^3/kg)	7.7E+08	Calculated based on default inputs.
Q/C	Inverse of the mean concentration at the center of the source (g/m^2-s per kg/m^3)	61.03	Annual estimate Q/C value for Minneapolis/St. Paul for a 5 acre source (EPA, 1996). (Use site specific information regarding source size if available).
V	Fraction of vegetative cover	0.5	Default. (Use Cowherd et al., 1985 and site data to develop site-specific value)
U_m	Mean annual windspeed (m/s)	4.92	Based on climatic data for Minneapolis/St. Paul metropolitan area (Use Cowherd et al., 1985 and site data to develop site-specific value)
U_t	Equivalent threshold value of windspeed at 7 meters (m/s)	11.32	Default (EPA, 1996). (Use Cowherd et al., 1985 and site data to develop site-specific value)
F(x)	Function dependent upon U_m/U_t	0.194	Default EPA, 1996). (Use Cowherd et al., 1985 and site data to develop site-specific value)

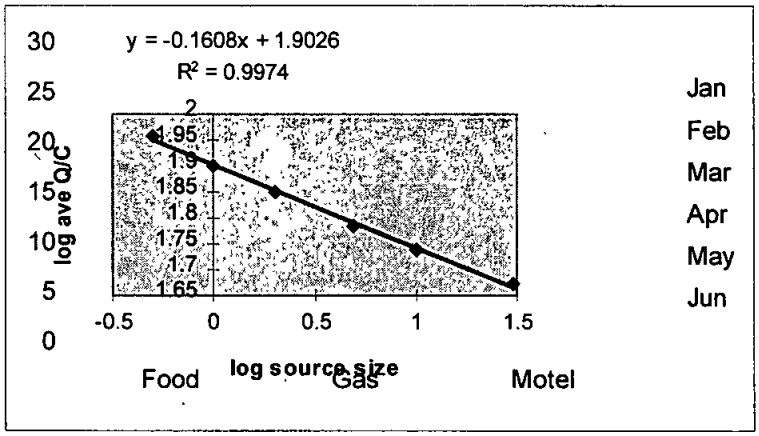
Table 3 of the EPA Soil Screening Guidance: Technical Background Document (EPA, 1996) provides the estimated annual Q/C values for 0.5, 1, 2, 5, 10 and 30 acre source areas for the city of Minneapolis. An intermediate source size of 5 acres was selected for the default source size. A linear inverse relationship exists between the log of the source size and the log of the annual Q/C as shown in Figure A4.1. This relationship can be utilized to estimate the annual Q/C for source sizes which are not included in Table 3 of the EPA Soil Screening Guidance.

The Q/C value, is used in the determination of both PEF and VF. For a detailed site-specific assessment of the inhalation pathway, a site-specific Q/C can be determined using the Industrial Source Complex Model platform in the short-term mode (ISCST3). The ISCST3 model will output an air concentration when the concentration model option is selected. Numerous site-specific input parameters must be determined, e.g., the surface area of the contaminated soil source, contaminant area emission rate (g/m2-s), hourly meteorological data, etc.

The fraction of vegetation will vary from site to site. A default value of 0.5 (50% of source area is vegetated) was selected.

Figure A4.1 Estimation of Chronic Q/C

	Minneapolis		log Source	log Annual Mpls
Source Size	Annual Ave Q/C		Size	Ave Q/C
(acres)	(g/m2-s per kg/m3)		(acres)	(g/m2-s per kg/m3)
0.5	90.8		-0.30103	1.958085849
1	79.68		0	1.901349325
2	70.64		0.30103	1.849050691
5	61.03		0.69897	1.78554337
10	54.9		1	1.739572344
30	46.92		1.47712125	1.671358003
(from Table 3 (EPA 1996)				



It is generally assumed that the concentration of the contaminant in the particulate is equal to the concentration of the contaminant in soil. This assumption may underestimate the concentration of contaminant in the inhalable fraction (i.e., PM10 fraction), since smaller particulate fractions sometimes contain contaminant concentrations that are enriched relative to larger fractions. However, the data needed to derive more accurate concentration estimates are typically not available. To calculate the airborne particulate contaminant concentration simply multiple the soil concentration by the inverse of the particulate emission factor (e.g., 3.1E-3 mg/m^3)

Inhalation of contaminated particulate matter is of particular concern in cases where contaminated soil is likely to be disturbed (e.g., grading, excavation, vehicle traffic). Activities likely to disturb soil in a residential setting are typically of short-tem duration. The above model is applicable for estimating chronic particulate emissions. To assess short-term (e.g., subchronic) exposures utilization of default particulate concentration values may be necessary.

For evaluation of volatile contaminants the soil-to-air volatilization factor (VF) model is utilized to define the relationship between the concentration of the contaminant in soil and the flux of the volatilized contaminant to air. Table A4.9 presents the VF equation and default values. The VF equation is based on the volatilization model developed by Jury et al. (1984) for infinite sources and Jury et al. (1990) for finite sources and represents an update of EPA's Risk Assessment Guidance for Superfund (RAGS, 1989) (EPA, 1996).

Table A4.9 Residential - Calculation of Chronic Volatilization Factor

$$VF(m^3/kg) = Q/C \times \frac{(3.14 \times D_A \times T)^{1/2}}{(2 \times \rho_b \times D_A)} \times 10^{-4} (m^2/cm^2)$$

Variable	Definition	Default Value	Reference
VF	Volatilization Factor (m^3/kg)	Contaminant Specific	
Q/C	Inverse of the mean concentration at the center of the source (g/m^2-s per kg/m^3)	61.03	Annual estimate Q/C value for Minneapolis/St. Paul for a 5 acre source (EPA 1996). (Use site specific information if available).
Da	Apparent diffusivity (cm^2/s)	Contaminant Specific	See Table A4.10.
T	Exposure interval (s)	1.89E+08 (< 6 yrs) 3.8E+08 (> 6 - 18 yrs) 4.7E+08 (> 18 - 33 yrs) 1.0E+09 (age-adjusted)	
ρ_b	Dry soil density (g/cm^3)	1.5	Default (EPA, 1996). (Use site data to develop site-specific value)

Other than initial soil concentration, air-filled soil porosity is the most significant soil parameter affecting the final steady-state flux of volatile contaminants from soil. In other words, the higher the air-filled soil porosity, the greater the emission flux of volatile constituents. Air-filled porosity is calculated the total soil porosity (n) minus the water-filled soil porosity (θ_w). The total soil porosity is based on the dry soil bulk density (ρ_b) and the soil particle density (ρ_s). Of these parameters, water-filled soil porosity (θ_w) has the most significant effect on air-filled soil porosity and hence volatile contaminant emissions.

The VF equation given above represents a simple approach that requires a limited number of easily obtained soil parameters and chemical property parameters. The equation incorporates a number of conservative, simplifying assumptions, e.g., infinite source, steady state conditions. Part 3 of the Soil Screening Guidance: Technical Background Document (EPA 1996) includes information on models for a more detailed evaluation. These models can accommodate finite contaminant sources and fractionate contaminants between pathways and predict the subsequent impact on ambient air. However, caution should be used when employing a finite source model, the uncertainties inherent in site-specific estimates of subsurface contaminant distributions should be recognized and conservative estimates of source size and concentrations should be used to allow for such uncertainties. In addition, model predictions should be validated against actual site conditions to the extent possible. If contaminant concentrations vary significantly over the exposure period a short-term as well as chronic exposure assessment should be conducted.

There are several site situations for which the VF model is not applicable:

- if municipal or sanitary wastes have been disposed with contaminants, because decomposition of solid waste would generate landfill gases which can greatly enhance volatile emission rates;
- if shallow ground water is contaminated with VOCs; and
- if the soil contaminant concentration above saturation (Csat). Note: Saturation conditions also affect the bioavailability and mobility of a contaminant.

Table A4.10 Residential - Calculation of Apparent Diffusivity (Da)

$$D_a\,(\mathrm{cm}^2/\mathrm{s}) = \frac{\left[\left(\theta_a^{10/3} \times D_i \times H'\right) + \left(\theta_w^{10/3} \times D_w\right) \Big/ n^2\right]}{\left[\left(\rho_b \times K_d\right) + \theta_w + \left(\theta_a \times H'\right)\right]}$$

Variable	Definition	Default Value	Reference
Da	Apparent Diffusivity (cm^2/s)	Contaminant Specific	
θ_a	Air filled soil porosity ($= n - \theta_w$)	0.28	Calculated
n	Total soil porosity ($= 1 - (\rho_b/\rho_s)$)	0.43	Calculated
θ_w	Water filled soil porosity ($= f_m \times \rho_b$)	0.15	Calculated
ρ_b	Dry soil density (g/cm^3)	1.5	Default (EPA, 1996. Mode of the range for US soils). (Use site data to develop site-specific value)
ρ_s	Soil particle density (g/cm^3)	2.65	Default (EPA, 1996). (Use site data to develop site-specific value)
f_m	Average soil moisture content (cm^3 water per gram soil)	0.1	Default. (Use site data to develop site-specific value)
D_i	Diffusivity in air (cm^2/s)	Contaminant Specific	
H	Henry's constant ($atm\text{-}m^3/mol$)	Contaminant Specific	
H'	Dimensionless Henry's constant ($= H \times 41$)	Contaminant Specific	
D_w	Diffusivity in water (cm^2/s)	Contaminant Specific	
K_d	Soil-water partition coefficient (cm^3/g) ($= K_{oc} \times f_{oc}$)	Contaminant Specific	
K_{oc}	Organic carbon partition coefficient (cm^3/g)	Contaminant Specific	
f_{oc}	Organic carbon content of soil	0.005	Default. (Use site data to develop site-specific value)

The soil saturation limit (Csat) represents the concentration of a contaminant in soil at which the absorptive limits of the soil particles, the solubility limits of the soil pore water, and the saturation of soil pore air have been reached. The determination of Csat is important as it sets the upper concentration limit at which the soil-to-air volatilization model is valid. The Henry's Law constant used in the VF model is invalid above the saturation limit. Above the Csat concentration the soil contaminant may be present in free phase, nonaqueous phase liquids (NAPLS) for contaminants that are liquid at ambient soil temperatures and pure solid phases for contaminants that are solid at ambient soil temperatures. When a calculated SRV exceeds Csat, the allowable SRV in soil is set at Csat to minimize the potential for NAPL. Table A4.11 presents the Csat equation and default values.

Table A4.11 Residential - Calculation of Soil Saturation Limit (Csat)

$$Csat(mg/kg) = (S/\rho_b) \times [(Kd \times \rho_b) + \theta_w + (H' \times \theta_a)]$$

Variable	Definition	Default Value	Reference
C_{sat}	Soil Saturation Concentration (mg/kg)	Calculated	
S	Solubility in water (mg/L)	Contaminant Specific	
ρ_b	Dry soil density (g/cm^3)	1.5	Default (EPA, 1996. Mode of the range for US soils). (Use site data to develop site-specific value)
K_d	Soil-water partition coefficient (cm^3/g) (= K_{oc} x f_{oc})	Contaminant Specific	
K_{oc}	Organic carbon partition coefficient (cm^3/g)	Contaminant Specific	
f_{oc}	Organic carbon content of soil	0.005	Default. (Use site data to develop site-specific value)
θ_w	Water filled soil porosity (= f_m x ρ_b)	0.15	Calculated
f_m	Average soil moisture content (cm^3 water per gram soil)	0.1	Default. (Use site data to develop site-specific value)
H	Henry's constant (atm-m^3/mol)	Contaminant Specific	
H'	Dimensionless Henry's constant (= H x 41)	Contaminant Specific	
θ_a	Air filled soil porosity = n - θ_w	0.28	Calculated
n	Total soil porosity = 1 - (ρ_b/ρ_s)	0.43	Calculated
ρ_s	Soil particle density (g/cm^3)	2.65	Default (EPA, 1996). (Use site data to develop site-specific value)

2.1.4.2 CF, Units Conversion Factors

See Section 2.1.1.2 for discussion of the CF parameter.

2.1.4.3 EF, Exposure Frequency

The frequency of exposure term describes how often the exposure event or contact occurs over a given period of time. Contact rates which are on the scale of days are the most common. Frequency of exposure is site- and activity-specific. The exposure frequency selected must be appropriate for the duration and contact rate chosen Since long-term contact rates are assumed for all chronic exposure pathways, a daily exposure frequency (350 days/year) to contaminants is assumed.

2.1.4.4 ED, Exposure Duration

See Section 2.1.1.3 for additional discussion of ED parameter.

2.1.4.5 AT, Averaging Time

See Section 2.1.1.5 for discussion of AT parameter.

2.1.5 Indirect Exposure Pathways

Contaminated soil can also be a source of indirect exposure to contaminants. Exposure can occur through the ingestion of food products (e.g., meat, produce, milk) contaminated via transfer from soil to plants and/or animals. Methods for the evaluation of food related exposure pathways are under development.

2.2 Residential Subchronic Exposure

The effect (noncarcinogenic and carcinogenic) of a contaminant depends in part on the dose and the rate at which the dose is administered. A specific dose given in a short-period of time may not produce the same effect when given over a longer period of time. To adequately evaluate the potential receptors, the risk assessor may need to look at several specific subpopulations of receptors which may experience higher rates of exposure. Because of their low body weight and behavioral characteristics, young children receive a larger potential dose per unit body weight than older children and adults. A young child (< 6 years) was chosen as the receptor for the subchronic exposure scenario. The exposure time selected was the summer months due to higher exposure potential, i.e., higher potential contact with soil.

2.2.1 General Exposure Factors

There are five exposure factors which recur throughout the equations used to estimate the dose of contaminant experienced by a potential receptor:

- C_{soil}, Contaminant Concentration
- CF, Units Conversion Factors
- EF, Exposure Frequency
- BW, Body Weight
- AT, Averaging Time

These factors are generally used in the same manner regardless of the exposure pathway under investigation, so it is useful to discuss them separately.

2.2.1.1 C_{soil}, Contaminant Concentration

The concentration of the contaminant used to quantify exposure is the Exposure Concentration. The exposure concentration is expressed in terms of mass of the material per unit mass (or volume) of the exposure medium (e.g., mg contaminant/kg soil). The exposure point concentration should *not* be adjusted for receptor exposure frequency, duration, etc. as those factors are generally addressed in the exposure calculations.

2.2.1.2 CF, Units Conversion Factors

The exposure factors and analytical data used for a given calculation may come in several forms. Units conversion factors are necessary to insure that the result of the calculation (the dose) is expressed in the correct units (e.g., mg/kg/day). Use of a units conversion factors (CF) is equivalent to multiplication by one. The numerator and denominator of the factor must be an equivalent quantity expressed in different terms.

2.2.1.3 EF, Exposure Frequency

The frequency of exposure term describes how often the exposure event or contact occurs over a given period of time. While estimates have been published on the amount of soil ingested during a *day*, there can be no reliable estimate of average *hourly* ingestion rates as incidental ingestion of soil is a sporadic event depending upon human behavior (e.g., activities, habits). For such exposures (including soil ingestion and dermal contact) EF is by definition 1 day/event. During that "1 event" the receptor is assumed to receive the daily intake of the contaminant. Frequency of exposure is site- and activity-specific. The exposure frequency selected for subchronic exposure is an average of 5 days per week during the 3 summer months (i.e., 65 days).

2.2.1.4 BW, Body Weight

A receptor's body weight is relevant throughout the dose equations since dose is expressed in terms of mass of contaminant per unit body weight per day (mg/kg/day). See Appendix Section 2.1.17 for additional discussion of BW parameter. Age-specific body weights are summarized in Table A4.1. The body weights are 50th percentile values (EPA Exposure Factors Handbook, 1997).

2.2.1.5 AT, Averaging Time

The averaging time (AT) is the time over which the total intake is normalized. For the evaluation of *noncancer risk*, the Average Daily Dose calculated should be representative of the exposure received while exposure is on-going (i.e., during the exposure period). The exposure period evaluated for the subchronic exposure scenario is 90 days (i.e., 3 summer months). The averaging time (AT) is equivalent to the exposure period, i.e., 3 months.

The Lifetime Average Daily Dose (LADD) is calculated for the evaluation of *cancer risk*. While the duration of the exposure period might range from one day to an entire lifetime, the total intake during that exposure is traditionally normalized to a lifetime. The averaging time for assessment of cancer risk is therefore typically set at 70 years. See Appendix 4 Section 2.1.1.8 for additional discussion. Note that for the evaluation of cancer risks resulting from subchronic exposure the target risk is 1 in 1,000,000.

2.2.2 Incidental Soil Ingestion Pathway

The Average Daily Dose during an exposure period of less than or equal to 1 year (i.e., *subchronic*) may be calculated utilizing the equation presented in Table A4.12.

2.2.2.1 C_{soil}, Contaminant Concentration

See Section 2.2.1.1 for discussion of the C_{soil} parameter.

2.2.2.2 IR, Soil Ingestion Rate

Soil ingestion is assumed to occur incidentally, from hand-to-mouth contact, during outdoor activities in the warmer months of the year and through the inhalation of larger particles. Soil from outdoors can also be brought indoors (e.g., on clothing, shoes and tools) or can enter the house as windblown dust. Soil ingestion rates represent **daily** rates. It is **not** appropriate to modify the soil ingestion rate to account for an exposure which occurs for a portion of a day as the studies on which the soil ingestion rates are based do not indicate whether soil ingestion is a sporadic event or whether it occurs evenly throughout the exposure period.

based do not indicate whether soil ingestion is a sporadic event or whether it occurs evenly throughout the exposure period.

Table A4.12 Residential - Subchronic Incidental Ingestion of Soil By Child

$$\text{LADD or ADD}_{\text{ingestion}} = \frac{Csoil \times IR \times CF \times FI \times EF}{BW \times AT}$$

Variable	Definition	Default Value	Percentile	Reference
LADD or $ADD_{soil\ ingestion}$	Average daily potential dose of contaminant received through the ingestion of soil (mg/kg-day).			
C_{soil}	Soil Concentration (mg/kg)	Representative site exposure concentration		
IR	Daily soil ingestion rate (mg/day)	300 (< 6 yr)	C	Stanek & Calabrese, 1995. 40 days at 500 mg/day and 50 days at 100 mg/day.
CF	Conversion Factor	1E-6 kg/mg		
FI	Fraction of ingested soil which is from contaminated soil	1	NA	
EF	Number of exposure days during the exposure period	65	C	3 summer months, average of 5 d/wk.
BW	Body weight during the exposure period (kg).	15 (< 6 yr)	C	EPA, 1997
AT	Averaging Time (days)	90 25550		Noncancer AT = 3 months LADD calculation: AT = 70 year lifetime. Note: Subchronic target cancer risk ≤ 1E-6.

C = Central Tendency Value (e.g., average)
U = Upper Tendency Value

Several studies have been conducted to estimate the amount of soil incidentally ingested by children. Stanek and Calabrese's (1995) have estimated that 31% of children will ingest greater than 500 mg/day on 35 to 40 days per year. The exposure period selected for the subchronic evaluation is the three summer months, approximately 90 days. Assuming an incidental soil ingestion rate of 500 mg/day for 40 days and an incidental soil ingestion rate of 100 mg/day for the remaining 50 days a simple time-weighted average of approximately 300 mg/day is calculated. Given that 500 mg/day represents a lower limit of ingestion for 31% of the children as well as the limited data and the variability in the existing data the value of 300 mg/day is not considered to be unduly conservative.

2.2.2.3 CF, Units Conversion Factors

See Section 2.2.1.2 for discussion of the CF parameter.

2.2.2.4 FI, Fraction of Ingested Soil

Since soil ingestion rates represent **daily** rates. It is **not** appropriate to modify the soil ingestion rate to account for an exposure which occurs for a portion of a day as the studies on which the soil ingestion rates are based do not indicate whether soil ingestion is a sporadic event or whether it occurs evenly throughout the exposure period. It is assumed that the daily ingestion occurs within the exposure area.

2.2.2.5 EF, Exposure Frequency

See Section 2.2.1.3 for discussion of the EF parameter.

2.2.2.6 BW, Body Weight

See Section 2.2.1.4 for discussion of the BW parameter.

2.2.2.7 AT, Averaging Time

See Section 2.2.1.5 for discussion of the AT parameter.

2.2.3 Dermal Contact Pathway

Dermal absorption of contaminants is a potentially significant route of exposure whenever direct contact with soil may occur. The absorption of contaminants from soil depends upon chemical-specific factors (e.g., lipophilicity) as well as the characteristics of the soil (e.g., organic carbon content). The Average Daily Dose during an exposure period of less than or equal to 1 year (i.e., *subchronic*) may be calculated as shown in Table A4.13.

Table A4.13 Residential - Subchronic Dermal Contact with Soil

$$\text{LADD or ADD}_{\text{dermal absorption}} = \frac{Csoil \times CF \times SA \times AF \times ABS \times EF}{BW \times AT}$$

Variable	Definition	Default Value	Percentile	Reference
LADD or ADD_{dermal}	Average daily dose absorbed through dermal contact (mg/kg-day).			
C_{soil}	Soil Concentration (mg/kg)	Representative site exposure concentration		
CF	Conversion Factor	1E-6 kg/mg		
SA	Skin surface area (cm^2)	2000	C	28% of the average total body SA per exposure event (EPA, 1997)
AF	Skin adherence factor (mg/cm^2)	0.35	C	Kissel et. al., (as cited in EPA, 1997) and EPA, 1992
ABS	Absorption factor	Chemical specific		
EF	Number of exposure days during the exposure period	65	NA	3 summer months, average of 5 d/wk.
BW	Body weight during the exposure period (kg).	15 (< 6 yr)	C	EPA, 1997
AT	Averaging Time (days)	90 25550		Noncancer AT = 3 months LADD calculation: AT = 70 year lifetime. Note: Subchronic target cancer risk ≤ 1E-6.

NA = Not Available
C = Central Tendency Value
U = Upper Tendency Value

2.2.3.1 C_{soil}, Contaminant Concentration

See Section 2.2.1.1 for discussion of the C_{soil} parameter.

2.2.3.2 CF, Units Conversion Factors

See Section 2.2.1.2 for discussion of the CF parameter.

2.2.3.3 SA, Skin Surface Area

The surface area parameter (SA) describes the amount of skin exposed to the contaminated media. The amount of skin exposed depends on the receptor and the exposure scenario. Clothing is expected to limit the extent of the exposed surface area for most activities. All SA estimates used 50th percentile values in order to correlate with the average body weights used for exposure estimations. This is done to prevent inconsistent parameter combinations since body weight and surface area are not independent variables. The age-specific 50th percentile total body surface areas are shown in Table A4.4.

The subchronic exposure frequency for dermal exposure is limited to the summer months. For the purpose of calculating the dermal dose it was assumed that the forearms, lower legs, hands, and feet were exposed. The age-specific percentage of total body surface area by body part are shown in Table A4.5. This exposed area constitutes approximately 28% in the < 6 year young child receptor. A surface area of 2,000 cm^2 was calculated by incorporating data from the EPA Exposure Factors Handbook (EPA 1997) as presented in Tables A4.4 and A4.5. Since some studies have suggested that exposure can occur under clothing (EPA, 1992) and the exposure period is limited to the summer months this scenario is not considered to be unduly conservative.

2.2.3.4 AF, Soil Adherence Factor

The adherence factor (AF) describes the amount of soil that adheres to the skin. The EPA Exposure Factors Handbook (EPA 1997) recommends utilizing the Kissel, et al., study for estimating soil adherence. The results of this study showed that generally soil adherence could be directly correlated with soil moisture and activity and inversely correlated with particle size. The default AFs are based on the central tendency value recommended in EPA's Dermal Guidance (EPA 1992) and a review of the body-part-specific and activity-specific adherence factors reported by Kissel et al., 1996 (as cited in the EPA Exposure Factors Handbook, 1997).

The data available for young children (< 6 years) is very limited. The studies by Kissel et al., for this age group evaluated adherence in an indoor setting. The exposure frequency utilized in the dermal exposure pathway is based on outdoor activity. Kissel et al., also studied older children, age 9 to 14 years. Unfortunately, the setting was playing in mud at the shore of a lake. This scenario is not likely to be representative of outdoor soil contact in a residential setting. In the absence of appropriate data for young children the data from adult rugby players was utilized. The conditions included recreational activities on a field of grass and bare soil. The weighted adherence factor was calculated utilizing the equation below:

$$\text{Weighted AF} = \frac{(SA1 \times AF1) + (SA2 \times AF2) + \ldots + (SAi \times AFi)}{(SA1 + SA2 + \ldots + SAi)}$$

where:

SAi = surface area for body part "i", cm^2
AFi = soil-to-skin adherence factor for body part "i", mg/cm^2-event

The body part specific surface area information can be found in Table A4.6. Kissel, et al. presented the body part specific AFs for three subsets of rugby players. The highest geometric mean values were utilized when calculating the weighted AF. The AF reported for legs was utilized for feet. The

selection of the highest mean AF is not considered unduly conservative since the value represents a central tendency value and given the reported high variability. The calculation of the AF is shown below.

$$\text{Weighted AF} = \frac{(400 \times 0.27) + (400 \times 0.4) + (700 \times 0.36) + (500 \times 0.36)}{(2000)} = 0.35$$

2.2.3.5 ABS, Absorption Factor

The dermal absorption factor (ABS) is the fraction of the contaminant contacting the skin that is absorbed. At this time only limited information is available to derive soil ABS values. In the absence of contaminant specific information default ABS values have been incorporated. The recommended default values are discussed in Section 2.1.3.5. The recommended default ABS values are listed in Table A.5.1 of Appendix 5.

2.2.3.6 EF, Exposure Frequency

See Section 2.2.1.3 for discussion of the EF parameter.

2.2.3.7 BW, Body Weight

See Section 2.2.1.4 for discussion of the BW parameter.

2.2.3.8 AT, Averaging Time

See Section 2.2.1.5 for discussion of the AT parameter.

2.2.4 Inhalation of Vapors or Resuspended Particulate Pathway

The toxicity information generally used to evaluate the risk of harm to health associated with inhalation exposures, Reference Concentrations and Units Risk values, are air *concentrations*. These values are intended to be used in combination with Average Daily Concentration expressed as applied concentrations, *not* dose.

Contaminants may be inhaled by the receptor of concern whenever the receptor is at or near the site. The Average Daily Concentration of the contaminant in air (ADC_{air}) is dependent upon the frequency and duration of the assumed exposures. Note that the equation is a simple adjustment of the exposure point concentration to account for the amount of time the receptor spends in the area with contaminated air. The Average Daily Concentration (ADC_{air}) for exposure period of less than or equal to 1 year (i.e., *subchronic*) may be calculated as shown in Table A4.14.

2.2.4.1 C_{air}, Air Concentration

To calculate an average daily air concentration, the particulate emission factor (PEF) and volatilization factor (VF) must be calculated. See Section 2.1.4.1 for a more detailed discussion of the PEF and VF equations. Table A4.15 presents the PEF equation and the default input values for subchronic exposure.

Table A4.14 Residential - Subchronic Inhalation of Vapors or Particulate from Soil

$$\text{LADC or ADC}_{air} = \frac{C_{air} \times EF \times CF}{AT}$$

Variable	Definition	Default Value	Percentile	Reference
LADC or ADC_{aie}	Average daily concentration in air (mg/m^3 or ug/m^3).			
C_{air}	Air Concentration (mg/m^3 or ug/m^3) = C_{soil} x (1/PEF + 1/VF)	Measured or Modeled Representative site exposure concentration		
CF	Conversion Factor	1E+3 µg/mg		Utilized for LADC calculation since toxicity values are in ug/m^3
EF	Number of exposure days during the exposure period	65		3 summer months, average of 5 d/wk.
AT	Averaging Time (days)	90 25550		Noncancer AT = 3 months LADC calculation: AT = 70 year lifetime. Note: Subchronic target cancer risk < 1E-6.

C = Central Tendency Value
U = Upper Tendency Value

Table A4.15 Residential - Calculation of Subchronic Particulate Emission Factor

$$PEF(m^3/kg) = Q/C \times \frac{3{,}600\,s/h}{(0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x))}$$

Variable	Definition	Default Value	Reference
PEF	Particulate emission factor (m^3/kg)	3.8E+08	Calculated based on default inputs.
Q/C	Inverse of the mean concentration at the center of the source (g/m^2-s per kg/m^3)	45.93	Annual estimate Q/C value for Los Angeles for a 5 acre source (EPA, 1996). (Use site specific information regarding source size if available).
V	Fraction of vegetative cover	0.25	Default. (Use Cowherd et al., 1985 and site data to develop site-specific value)
U_m	Mean annual windspeed (m/s)	4.92	Based on climatic data for Minneapolis/St. Paul metropolitan area. (Use Cowherd et al., 1985 and site data to develop site-specific value)
U_t	Equivalent threshold value of windspeed at 7 meters (m/s)	11.32	Default (EPA, 1996). (Use Cowherd et al., 1985 and site data to develop site-specific value)
F(x)	Function dependent upon U_m/U_t	0.194	Default (EPA, 1996). (Use Cowherd et al., 1985 and site data to develop site-specific value)

Table 3 of the EPA Soil Screening Guidance: Technical Background Document (EPA, 1996) provides the estimated annual Q/C values for various locations (i.e., city and climatic zone) and source area sizes. Since the subchronic exposure evaluation is based on exposure during the summer months the location which best approximated the 90th percentile of the annual Q/C values (based on the 29 locations evaluated) was selected instead of the annual Q/C value for Minneapolis. An intermediate source size of 5 acres was selected for the default source size. A linear inverse relationship exists between the log of the source size

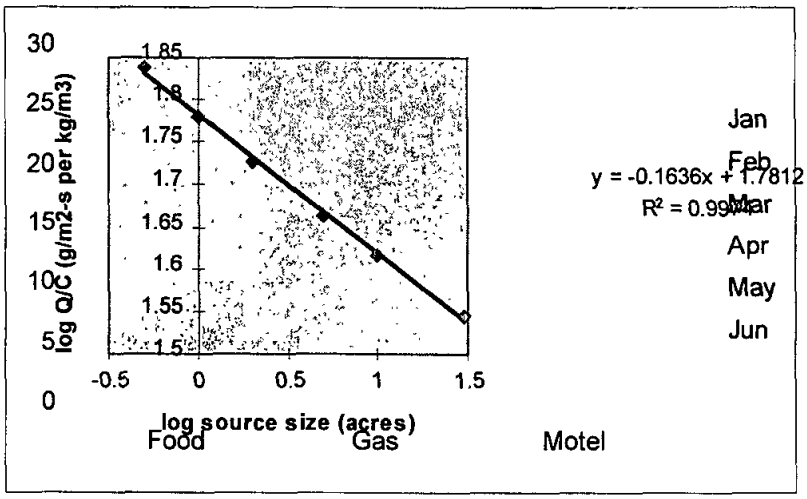
and the log of the annual Q/C as shown in Figure A4.2. This relationship can be utilized to estimate the annual Q/C for source sizes which are not included in Table 3 of the EPA Soil Screening Guidance. The Q/C value, is used in the determination of both PEF and VF. The fraction of vegetation will vary from site to site. The exposure area for the subchronic evaluation is assumed to be a playarea which is only partially vegetated. A default value of 0.25 was selected.

It is generally assumed that the concentration of the contaminant in the particulate is equal to the concentration of the contaminant in soil. This assumption may underestimate the concentration of contaminant in the inhalable fraction (i.e., PM10 fraction), since smaller particulate fractions sometimes contain contaminant concentrations that are enriched relative to larger fractions. However, the data needed to derive more accurate concentration estimates are typically not available. To calculate the airborne particulate contaminant concentration simply multiple the soil concentration by the inverse of the particulate emission factor (3E-3 mg/m^3).

Inhalation of contaminated particulate matter is of particular concern in cases where contaminated soil is likely to be disturbed (e.g., grading, excavation, vehicle traffic). The above model addresses mainly wind erosion. If activities likely to physically disturb soil occur with regular frequency the default PEF may not be protective.

Figure A4.2 Estimation of Subchronic Q/C

	Los Angeles		log Source	nual Los Angeles	
Source Size	nnual Ave Q/C		Size	Ave Q/C	
(acres)	2-s per kg/m3)		(acres)	2-s per kg/m3)	
0.5	68.81		-0.30103	1.8376516	
1	60.24		0	1.779885	
2	53.3		0.30103	1.7267272	
5	45.93		0.69897	1.6620964	
10	41.24		1	1.6153187	
30	35.15		1.4771213	1.5459253	
(from Table 3 (EPA 1996))					



Inhalation of contaminated particulate matter is of particular concern in cases where contaminated soil is likely to be disturbed (e.g., grading, excavation, vehicle traffic). The above model

addresses mainly wind erosion. If activities likely to physically disturb soil occur with regular frequency the default PEF may not be protective.

For evaluation of volatile contaminants the soil-to-air volatilization factor (VF) model is utilized to define the relationship between the concentration of the contaminant in soil and the flux of the volatilized contaminant to air. Table A4.16 presents the VF equation and default values for subchronic exposure.

Table A4.16 Residential - Calculation of Subchronic Volatilization Factor

$$VF\,(m^3/kg) = Q/C \times \frac{(3.14 \times D_A \times T)^{1/2}}{(2 \times \rho_b \times D_A)} \times 10^{-4}\,(m^2/cm^2)$$

Variable	Definition	Default Value	Reference
VF	Volatilization Factor (m^3/kg)	Contaminant Specific	
Q/C	Inverse of the mean concentration at the center of the source (g/m^2-s per kg/m^3)	45.93	Annual estimate Q/C value for Los Angeles for a 5 acre source (EPA, 1996). (Use site specific information regarding source size if available).
Da	Apparent diffusivity (cm^2/s)	Contaminant Specific	See Table A4.10 and Appendix Section 2.1.3.1.
T	Exposure interval (s)	7.8E+06	Assumes 90 day exposure period.
ρ_b	Dry soil density (g/cm^3)	1.5	Default (EPA, 1996). (Use site data to develop site-specific value)

The VF equation given above represents a simple approach that requires a limited number of easily obtained soil parameters and chemical property parameters. The equation incorporates a number of conservative, simplifying assumptions, e.g., infinite source, steady state conditions. Part 3 of the Soil Screening Guidance: Technical Background Document (EPA 1996) includes information on models for a more detailed evaluation.

There are several site situations for which the VF model is not applicable:

- if municipal or sanitary wastes have been disposed with contaminants, because decomposition of solid waste would generate landfill gases which can greatly enhance volatile emission rates;
- if shallow ground water is contaminated with VOCs; and
- if the soil contaminant concentration above saturation (Csat). Note: Saturation conditions also affect the bioavailability and mobility of a contaminant.

The soil saturation limit (Csat) represents the concentration of a contaminant in soil at which the absorptive limits of the soil particles, the solubility limits of the soil pore water, and the saturation of soil pore air have been reached. Above the Csat concentration the soil contaminant may be present in free phase, nonaqueous phase liquids (NAPLS) for contaminants that are liquid at ambient soil temperatures and pure solid phases for contaminants that are solid at ambient soil temperatures. When a calculated SRV exceeds Csat, the allowable SRV in soil is set at Csat to minimize the potential for NAPL. Table A4.11 presents the Csat equation and default values.

2.2.4.2 CF, Units Conversion Factors

See Section 2.2.1.1 for discussion of the CF parameter.

2.2.4.3 EF, Exposure Frequency

See Section 2.2.1.3 for discussion of the EF parameter.

2.2.4.4 AT, Averaging Time

See Section 2.2.1.5 for discussion of the AT parameter.

2.3 Residential Acute Exposure

The presence of acutely toxic contaminants in accessible soil could pose a significant health risk from a "one-time" exposure. With acutely toxic contaminants, the risk estimate for a "one time" exposure may exceed the risks from long term exposures when the magnitude of exposure during the acute episode is very high. Acute (i.e., "one time") risk estimates are based on the highest concentration detected. The Acute Dose due to the incidental ingestion of a bolus of contaminated soil ($AD_{ingestion}$) may be calculated utilizing the equation presented in Table A4.17.

Table A4.17 Residential - Acute Incidental Ingestion of Soil

$$AD_{soil\ ingestion} = \frac{Csoil \times IR \times CF}{BW}$$

Variable	Definition	Default Value	Percentile	Reference
$AD_{soil\ ingestion}$	Acute dose of contaminant received through the ingestion of soil (mg/kg-day).			
C_{soil}	Soil Concentration (mg/kg)	Maximum site concentration		
IR	Annual daily soil ingestion rate (mg/day)	10,000		Stanek & Calabrese, 1995.
CF	Conversion Factor (kg/mg)	1E-6		
BW	Mean Body weight (kg).	11	C	Mean BW for 1 - 2 year olds (EPA 1997).

2.3.1 C_{soil}, Contaminant Concentration

For acute exposure assessments, the exposure concentration should represent a conservative estimate of the concentration to which a receptor might be exposed over the period of a single event (e.g., ingestion of a bolus of soil) or a single day. Generally, the highest detected concentration should be employed when one-time exposure could result in adverse health effects.

2.3.2 IR, Soil Ingestion Rate

Based on results reported by Stanek and Calabrese's (1995) the ingestion of a bolus of soil is common among young children. These authors estimated that approximately 33% of children will ingest greater than 10,000 mg of soil on 1 to 2 days per year. Because of their low body weight young children could potentially receive a large dose per unit body weight as a result of ingesting a bolus of soil. A toddler (1 - 2 years of age) ingesting a bolus of soil is the recommended receptor for assessing acute exposure to soil contaminants. Given that 10,000 mg/day represents a lower limit of ingestion as well as the limited data and the magnitude of variability the recommended default ingestion rate is not considered to be unduly conservative.

2.3.3 CF, Units Conversion Factors

Units conversion factors are necessary to insure that the result of the calculation (the dose) is expressed in the correct units (e.g., mg/kg/day). Use of the units conversion factors (CF) (1E-6 kg per mg) is equivalent to multiplication by one.

2.3.4 BW, Body Weight

A receptor's body weight is relevant throughout the dose equations since dose is expressed in terms of mass of contaminant per unit body weight per day (mg/kg/day). See Appendix Section 2.1.17 for additional discussion of BW parameter. Age-specific body weights are summarized in Table A4.2. The body weights are 50th percentile values for males and females age 1 - 2 years old (EPA Exposure Factors Handbook, 1997).

3.0 RECREATIONAL PROPERTY USE - DIRECT SOIL EXPOSURE PATHWAY EVALUATION

3.1 Recreational - Chronic Exposure

3.1.1 General Exposure Factors

There are six exposure factors which recur throughout the equations used to estimate the dose of contaminant experienced by a potential receptor:

- C_{soil}, Contaminant Concentration
- CF, Units Conversion Factors
- EF Exposure Frequency
- ED, Exposure Duration
- BW, Body Weight
- AT, Averaging Time

These factors are generally used in the same manner regardless of the exposure pathway under investigation, so it is useful to discuss them separately.

3.1.1.1 C_{soil}, Contaminant Concentration

The concentration of the contaminant used to quantify exposure is the Exposure Concentration. The exposure concentration is expressed in terms of mass of the material per unit mass (or volume) of the exposure medium (e.g., mg contaminant/kg soil). The exposure point concentration should *not* be adjusted for receptor exposure frequency, duration, etc. as those factors are generally addressed in the exposure calculations.

3.1.1.2 CF, Units Conversion Factors

Units conversion factors are necessary to insure that the result of the calculation (the dose) is expressed in the correct units. Use of a CF (1E-6 kg/mg or 1E+3 ug/mg) is equivalent to multiplication by one. The numerator and denominator of the factor must be an equivalent quantity expressed in different terms.

3.1.1.3 EF, Exposure Frequency

A receptor may be exposed to a contaminant continuously, at regular intervals, or in a sporadic manner. The frequency of exposure term describes how often the exposure event or contact occurs over a given period of time. While estimates have been published on the amount of soil ingested during a *day*, there can be no reliable estimate of average *hourly* ingestion rates as incidental ingestion of soil is a sporadic event depending upon human behavior (e.g., activities, habits). For such exposures (including soil ingestion and dermal contact) EF is by definition 1 day/event. During that "1 event" the receptor is assumed to receive the daily intake of the contaminant.

Frequency of exposure is site- and activity-specific. The exposure frequency selected must be appropriate for the duration and contact rate chosen Since recreational activities at a non-

residential location (e.g., playground, ballfield, park, etc.) it is assumed that the exposure duration is more limited than the residential exposure scenario. The exposure frequency for young children (< 6 years) and older children (> 6 - 18 years) was assumed to be 106 days, corresponding to approximately 2 days/week during the four spring and fall months and 5 days/week during the three summer months. The exposure frequency for adults was assumed to be 75 days, corresponding to approximately 2 days/week during the four spring and fall months and 3 days/week during the three summer months. Exposure to soil during the 5 colder months of the year (November - March) is assumed to be negligible.

Because the EF changes with age it is necessary to calculate an age-adjusted EF when exposure occurs throughout childhood and into adult years. The average daily dose (ADD) should be calculated to reflect age-related differences in exposure rates that are experienced by a receptor throughout the exposure period or in the case of cancer evaluation a lifetime. The results of utilizing a simple age-weighted averaging approach is shown below.

$$EF_{age-adjusted} = \frac{(106 \text{ days} \times 6 \text{ yrs}) + (106 \text{ days} \times 12 \text{ yrs}) + (75 \text{ days} \times 15 \text{ yrs}}{33 \text{ yrs}} = 92 \text{ days}$$

31.1.4 ED, Exposure Duration

The exposure duration (ED) describes the length of time over which the receptor comes into contact with the contaminant. The exposure duration depends upon the type of activities which lead a receptor to be exposed. Remember that the receptor may be exposed continuously, at regular intervals, or sporadically, depending upon the activity being modeled, so the exposure period would be the length of time between the first exposure experienced and the last.

As discussed previously, exposure duration is believed to be one of the more sensitive parameters in the exposure equation. In keeping with the RME approach what is believed to be an the upper-end estimate was utilized as the default for the duration of exposure. This value is based on the national statistics for residential occupancy (US Bureau of Census data). This may underestimate the exposure duration since a receptor may reside within a given community for a longer period than at a single resident. The 90th percentile value for years lived in the current home for the Minneapolis/St. Paul metropolitan area (33 years) was utilized as the total exposure duration period. No statistical data on childhood residential occupancy time are available. For the purpose of calculating the SRVs, children (defined here as infants to 6 years old) are assumed to reside at a single residence (i.e., exposure duration for children is 6 years). This does not appear to be an upper-end estimate for young children (Johnson and Capel, 1992 as cited in Exposure Factors Handbook, EPA 1997).

3.1.1.5 BW, Body Weight

A receptor's body weight is relevant throughout the dose equations since dose is expressed in terms of mass of contaminant per unit body weight per day (mg/kg/day). The receptor's body weight is dependent upon its age and gender. Since body weight is easily measured, there are numerous summaries of age and gender-specific body weights. Table A4.1 provided age-specific body weights for children and adults. The body weights are 50th percentile values for males and females and are presented annually for children and at longer intervals for adults (EPA Exposure Factors Handbook, 1997).

The receptor body weight (BW, typically expressed in kilograms, kg) must be matched to the age and gender identified in the exposure profile. Since exposure is often assumed to occur over a period of several years, the changes in body weight which might occur during the period of exposure must also be

considered. An average body weight is estimated across the age group under consideration. For deterministic evaluations (i.e., evaluations using a point estimate of body weight) the 50th percentile body weigh for the subpopulation under consideration is recommended, unless there is strong evidence that the potentially exposed subpopulation is biased in some manner. The body weights utilized are 15, 43, and 70 kg for young children (< 6 years), older children (> 6 - 18 years) and adults (> 18), respectively.

Because body weights changes with age it is necessary to calculate an age-adjusted body weight when exposure occurs throughout childhood and into adult years. The average daily dose (ADD) should be calculated to reflect age-related differences in exposure rates that are experienced by a receptor throughout the exposure period or in the case of cancer evaluation a lifetime. Because of their low body weight and behavioral characteristics, young children receive a larger potential dose per unit body weight than older children and adults. The results of utilizing a simple age-weighted averaging approach to calculate age-adjusted body weight is shown below.

$$BW_{age-adjusted} = \frac{(15\ kg \times 6\ years) + (43\ kg \times 12) + (70\ kg \times 15\ years)}{33\ years} = 51\ kg$$

3.1.1.6 AT, Averaging Time

The averaging time (AT) is the time over which the total intake is normalized. For the evaluation of *noncancer risk*, the Average Daily Dose calculated should be representative of the exposure received while exposure is on-going (i.e., during the exposure period). Thus the values for exposure period duration (ED) and the averaging time (AT) are equivalent.

The Lifetime Average Daily Dose (LADD) is calculated for the evaluation of *cancer risk*. While the duration of the exposure period (ED) might range from one day to an entire lifetime, the total intake during that exposure is traditionally normalized to a lifetime. The averaging time for assessment of cancer risk is therefore typically set at 70 years. For exposures lasting less than a lifetime, the values for ED and AT will be different. For some contaminants or subpopulations of receptors this approach (normalizing over a lifetime) may not be health protective (e.g., vinyl chloride exposure to children). The existence of critical periods of susceptibility during a lifetime and the intensity of exposure may influence cancer risk. These factors may warrant deviation from the traditional approach. When possible, the biological basis or mechanism by which a carcinogen acts should be used to characterize risk from the carcinogenic contaminant.

3.1.2 Incidental Soil Ingestion Pathway

The Average Daily Dose due to the *chronic* incidental ingestion of contaminated soil ($ADD_{soil\ ingestion}$) may be calculated utilizing the equation presented in Table A4.18.

3.1.2.1 C_{soil}, Contaminant Concentration

See Section 3.1.1.1 for discussion of the C_{soil}, parameter.

3.1.2.2 IR, Soil Ingestion Rate

Soil ingestion is assumed to occur incidentally, from hand-to-mouth contact, during outdoor activities in the warmer months of the year and through the inhalation of larger particles. Soil from outdoors can also be brought indoors (e.g., on clothing, shoes and tools) or can enter the house as

windblown dust. Although some incidental soil/dust ingestion can also occur indoors it is assumed to be negligible under the recreational exposure setting.

Table A4.18. Recreational - Chronic Incidental Ingestion of Soil.

$$\text{LADD or ADD}_{soil\ ingestion} = \frac{Csoil \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

Variable	Definition	Default Value	Percentile	Reference
LADD or $ADD_{soil\ ingestion}$	Average daily potential dose received through the ingestion of soil (mg/kg-day).			
C_{soil}	Soil Concentration (mg/kg)	Representative site exposure concentration		
IR	Daily soil ingestion rate (mg/day)	250 (< 6 yr) 175 (>6 - 18 yr) 100 (> 6 - 33 yr) 155 (age-adjusted)		Stanek & Calabrese, 1995. Includes higher intake in young children. Assume recreational activity results in disturbance and direct contact with soil.
CF	Conversion Factor	1E-6 kg/mg		
FI	Fraction of ingested soil which is from contaminated soil	1	NA	
EF	Number of exposure days during the exposure period (days/year).	106 (< 6 yr) 106 (> 6 - 18 yr) 74 (> 18 - 33 yr) 92 (age-adjusted)		Approximately 2 d/wk for 4 months and 5 d/wk for 3 months. Approximately 2 d/wk for 4 months and 3 d/wk for 3 months.
ED	Duration of the exposure period (years).	6 (< 6 yr) 12 (> 6 - 18 yrs) 15 (> 18 - 33 yr) 33 (age-adjusted)	C U U	American Housing Survey for the Minneapolis/St. Paul Metro Area in 1993. 33 years = 90th percentile resident tenure.
BW	Body weight of the receptor of concern during the exposure period (kg).	15 (< 6 yr) 43 (> 6 - 18 yrs) 70 (>18 - 33 yr) 51 (age-adjusted)	C C C	EPA, 1997
AT	Averaging Time (days)	2190 (< 6 yr) 4380 (> 6 - 18 yrs) 5475 (> 18 - 33 yr) 12045 (age-adjusted) 25550 (lifetime)		Noncancer AT = ED LADD calculation: AT = 70 year lifetime

C = Central Tendency Value (e.g., average)
U = Upper Tendency Value

Soil ingestion rates represent **daily** rates. It is **not** appropriate to modify the soil ingestion rate to account for an exposure which occurs for a portion of a day as the studies on which the soil ingestion rates are based do not indicate whether soil ingestion is a sporadic event or whether it occurs evenly throughout the exposure period.

Several studies have been conducted to estimate the amount of soil incidentally ingested by children. The central tendency value of 100 mg/day is recommended by EPA (Exposure Factors Handbook, 1997) as a daily average ingestion rate for the child receptor under the residential exposure scenario. Stanek and Calabrese's (1995) have estimated that 31% of children will ingest greater than 500 mg/day on 35 to 40 days per year. Recreational exposure is expected to mainly occur during the warmer seven months of the year (i.e., April through October). Soil exposure is assumed to be negligible during the 5 colder months of the year (i.e., November - March). Since the receptors do not reside on the recreational property it is assumed that

exposure occurs only on a portion of the days within this period. The exposure frequency for young children (< 6 years) was assumed to be 106 days, corresponding to approximately 2 days/week during the four spring and fall months and 5 days/week during the three summer months. During this time period it is assumed that an incidental soil ingestion rate of 500 mg/day for 40 days and an incidental soil ingestion rate of 100 mg/day for the remaining 66 days a simple time-weighted average of approximately 250 mg/day is calculated. Given that 500 mg/day represents a lower limit of ingestion for 31% of the children as well as the limited data and the variability in the existing data the value of 250 mg/day is not considered to be unduly conservative for recreational activities.

An exposure frequency of 106 days was also was utilized for receptors age > 6 - 18 years. The exposure frequency for adults was assumed to be 75 days, corresponding to approximately 2 days/week during the four spring and fall months and 3 days/week during the three summer months. Older children and adults may incidentally ingestion soil that adhere to food or their hands or through the inhalation of larger particles. Information on soil ingestion adults is very limited. A daily incidental ingestion rate of 100 mg/day for soil is recommended as the default for adults. Since it is assumed that recreational activities will result in disturbance of soil and direct contact with soil the default values of 100 mg/day are not considered to be unduly conservative.

In the absence of information regarding soil ingestion in older children (i.e., > 6 - 18 years of age) a value midway between the soil ingestion rates for young children and adults was selected for this age-group (i.e., 175 mg/day).

Because soil ingestion rates vary across age groups it is necessary to calculate an age-adjusted soil ingestion rate when exposure occurs throughout childhood and into adult years. The average daily dose (ADD) should be calculated to reflect age-related differences in exposure rates that are experienced by a receptor throughout the exposure period or in the case of cancer evaluation a lifetime. Because of their low body weight and behavioral characteristics, young children receive a larger potential dose per unit body weight than older children and adults. Therefore, the age-adjusted exposure should be calculated in a way that does not "dilute" the higher exposure rates experienced by young children with lower exposure rates experienced by older children and adults. Utilizing a simple averaging approach an age-weighted average can be calculated . The age-weighted average calculation is shown below.

$$IR_{age-adjusted} = \frac{(250\ mg/d \times 6\ yrs) + (175\ mg/d \times 12\ yrs) + (100\ mg/d \times 15\ yrs)}{33\ yrs} = 155\ mg/d$$

3.1.2.3 CF, Units Conversion Factors

See Section 3.1.1.2 for discussion of the CF parameter.

3.1.2.4 FI, Fraction of Ingested Soil

Since soil ingestion rates represent **daily** rates. It is **not** appropriate to modify the soil ingestion rate to account for an exposure which occurs for a portion of a day as the studies on which the soil ingestion rates are based do not indicate whether soil ingestion is a sporadic event or whether it occurs evenly throughout the exposure period. It is assumed that the daily ingestion occurs during the recreational activity within the exposure area.

3.1.2.5 EF, Exposure Frequency

See Section 3.1.1.3 for discussion of the EF parameter.

3.1.2.6 ED, Exposure Duration

See Section 3.1.1.4 for discussion of the ED parameter.

3.1.2.7 BW, Body Weight

See Section 3.1.1.5 for discussion of the BW parameter.

3.1.2.8 AT, Averaging Time

See Section 3.1.1.6 for discussion of the AT parameter.

3.1.3 Dermal Contact Pathway

Dermal absorption of contaminants is a potentially significant route of exposure whenever direct contact with soil may occur. In fact, dermal absorption from soils may be more significant than incidental ingestion for chemicals which have a percent absorption exceeding about 10% (USEPA, EPA/600/8-91/011B, January, 1992). Contaminants exhibiting percentage absorption less than 10% also contribute to cumulative risk estimates and therefore these contaminants must also be evaluated. The absorption of contaminants from soil depends upon chemical-specific factors (e.g., lipophilicity) as well as the characteristics of the soil (e.g., organic carbon content). The Average Daily Dose due to chronic dermal contact with contaminated soil ($ADD_{dermal\ absorption}$) may be calculated as shown in Table A4.19.

3.1.3.1 C_{soil}, Contaminant Concentration

See Section 3.1.1.1 for discussion of the C_{soil}, parameter.

3.1.3.2 CF, Units Conversion Factors

See Section 3.1.1.2 for discussion of the CF parameter.

3.1.3.3 SA, Skin Surface Area

The surface area parameter (SA) describes the amount of skin exposed to the contaminated media. The amount of skin exposed depends on the receptor and the exposure scenario. Clothing is expected to limit the extent of the exposed surface area for most activities. All SA estimates used 50th percentile values in order to correlate with the average body weights used for exposure estimations. This is done to prevent inconsistent parameter combinations since body weight and surface area are not independent variables. The age-specific 50th percentile total body surface areas are shown in Table A4.4.

The exposure frequency for dermal exposure is limited to the warmer months of the year (i.e., April through October). For the purpose of calculating the dermal dose it was assumed that the forearms, lower legs, hands, and feet were exposed. The age-specific percentage of total body surface area by body part are shown in Table A4.5. This exposed area constitutes approximately 28% in the < 6 year young child receptor and 25% in the > 6 - 18 older child and > 18 - 33 year adult receptor. Surface areas of 2,000, 3300 and 4,500 cm^2 were calculated by incorporating data from the EPA Exposure Factors Handbook (EPA 1997) as presented in Tables A4.4 and A4.5. Since some studies have suggested that exposure can occur under clothing (EPA, 1992) this scenario is not considered to be unduly conservative.

Table A4.19 Recreational - Chronic Dermal Contact with Soil

$$\text{LADD or ADD}_{dermal\ absorption} = \frac{Csoil \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Variable	Definition	Default Value	Percentile	Reference
LADD or ADD_{dermal}	Average daily dose absorbed through dermal contact (mg/kg-day).			
C_{soil}	Soil Concentration (mg/kg)	Representative site exposure concentration		
CF	Conversion Factor	1E-6 kg/mg		
SA	Skin surface area (cm^2)	2000 (< 6 yr) 3300 (> 6 - 18 yr) 4500 (> 18 - 33 yr) 3609 (age-adjusted)	C	28 - 25% of the average total body SA per exposure event (EPA, 1992 and EPA, 1997)
AF	Skin adherence factor (mg/cm^2)	0.35	C	Kissel et. al., as cited in EPA, 1992 and EPA, 1992
ABS	Absorption factor	Chemical specific		
EF	Number of exposure days during the exposure period (days/year).	106 (< 6 yr) 106 (> 6 – 18 yr) 74 (>18 – 33 yr) 92 (age-adjusted)	NA	Approximately 2 d/wk for 4 months and 5 d/wk for 3 months. Approximately 2 d/wk for 4 months and 3 d/wk for 3 months.
ED	Duration of the exposure period (years).	6 (< 6 yr) 12 (> 6 – 18 yrs) 15 (> 18 - 33 yr) 33 (age-adjusted)	C U U	American Housing Survey for the Minneapolis/St. Paul Metro Area in 1993. 33 years = 90th percentile resident tenure.
BW	Body weight of the receptor of concern during the exposure period (kg).	15 (< 6 yr) 45 (> 6 – 18 yrs) 70 (>18 – 33 yr) 51 (age-adjusted)	C C C	EPA 1997
AT	Averaging Time (days)	2190 (< 6 yr) 4380 (> 6 – 18 yrs) 5475 (> 18 - 33 yr) 12045 (age-adjusted) 25550 (lifetime)		Noncancer AT = ED LADD calculation: AT = 70 year lifetime

NA = Not Available
C = Central Tendency Value
U = Upper Tendency Value

Because body surface area changes with age it is necessary to calculate an age-adjusted skin surface area when exposure occurs throughout childhood and into adult years. The average daily dose (ADD) should be calculated to reflect age-related differences in exposure rates that are experienced by a receptor throughout the exposure period or in the case of cancer evaluation a lifetime. The results of utilizing a simple age-weighted averaging approach to calculating age-adjusted surface area is shown below:

$$SA_{age-adjusted} = \frac{(2000\ cm^2 \times 6\ yrs) + (3300\ cm^2 \times 12\ yrs) + (4500\ cm^2 \times 15\ yrs)}{33\ years} = 3600\ cm^2$$

3.1.3.4 AF, Soil Adherence Factor

The adherence factor (AF) describes the amount of soil that adheres to the skin. The EPA Exposure Factors Handbook (EPA 1997) recommends utilizing the Kissel, et al., study for estimating soil adherence. The results of this study showed that generally soil adherence could be directly correlated with soil moisture and activity and inversely correlated with particle size. The default AFs are based on the central tendency value recommended in EPA's Dermal Guidance (EPA 1992) and a review of the body-part-specific and activity-specific adherence factors reported by Kissel et al., 1996 (as cited in the EPA, 1997).

The data available for receptors in a recreational setting is limited. The studies by Kissel et al., (1996) evaluated soccer and rugby players. The exposure frequency utilized in the dermal exposure pathway is based on outdoor activity in a recreational setting. The data from adult rugby players was utilized for all recreational receptors. The weighted adherence factor was calculated utilizing the equation below:

$$\text{Weighted AF} = \frac{(SA1 \times AF1) + (SA2 \times AF2) + \ldots + (SAi \times AFi)}{(SA1 + SA2 + \ldots + SAi)}$$

where:

SAi = surface area for body part "i", cm^2
AFi = soil-to-skin adherence factor for body part "i", mg/cm^2-event

The body part specific surface area information can be found in Table A4.6. Kissel, et al. presented the body part specific AFs for three subsets of rugby players. The highest geometric mean values were utilized when calculating the weighted AF. The AF reported for legs was utilized for feet. The selection of the highest mean AF is not considered unduly conservative considering that the value represents a central tendency value and the high variability. The calculation of the age-group specific AF is shown below:

$$\text{Weighted } AF_{child} = \frac{(400 \times 0.27) + (400 \times 0.4) + (700 \times 0.36) + (500 \times 0.36)}{(2000)} = 0.35$$

$$\text{Weighted } AF_{>6\text{ - }18} = \frac{(700 \times 0.27) + (650 \times 0.4) + (1300 \times 0.36) + (650 \times 0.36)}{(3300)} = 0.35$$

$$\text{Weighted } AF_{adult} = \frac{(1000 \times 0.27) + (900 \times 0.4) + (1700 \times 0.36) + (900 \times 0.36)}{(4500)} = 0.35$$

3.1.3.5 ABS, Absorption Factor

The dermal absorption factor (ABS) is the fraction of the contaminant contacting the skin that is absorbed. At this time only limited information is available to derive soil ABS values. In the absence of contaminant specific information default ABS values have been incorporated. The recommended default values are presented in Section 2.1.3.5. The default values are based on the EPA Dermal Workgroup recommendations and professional judgment. The recommended default ABS values are listed in Table A.5.1 of Appendix 5.

3.1.3.6 EF, Exposure Frequency

See Section 3.1.1.3 for discussion of the EF parameter.

3.1.3.7 ED, Exposure Duration

See Section 3.1.1.4 for discussion of the ED parameter.

3.1.3.8 BW, Body Weight

See Section 3.1.1.5 for discussion of the BW parameter.

3.1.3.9 AT, Averaging Time

See Section 3.1.1.6 for the discussion of the AT parameter.

3.1.4 Inhalation of Vapors or Resuspended Particulate Pathway

The toxicity information generally used to evaluate the risk of harm to health associated with inhalation exposures, Reference Concentrations and Units Risk values, are air *concentrations*. These values are intended to be used in combination with Average Daily Concentration expressed as applied concentrations, *not* dose.

Contaminants may be inhaled by the receptor of concern whenever the receptor is at or near the site. The Average Daily Concentration of the contaminant in air (ADC_{air}) is dependent upon the frequency and duration of the assumed exposures. Note that the equation is a simple adjustment of the exposure point concentration to account for the amount of time the receptor spends in the area with contaminated air. The Average Daily Concentration (ADC_{air}) for chronic recreational exposure may be calculated as shown in Table A4.20.

3.1.4.1 C_{air}, Air Concentration

To calculate an average daily air concentration, the particulate emission factor (PEF) and volatilization factor (VF) must be calculated. See Section 2.1.4.1 for a more detailed discussion of the PEF and VF equations. Table A4.21 presents the PEF equation and the default input values for chronic recreational exposure.

Table A4.20 Recreational - Chronic Inhalation of Vapors or Particulate from Soil

$$\text{LADC or ADC}_{air} = \frac{Cair \times EF \times ED \times CF}{AT}$$

Variable	Definition	Default Value	Percentile	Reference
LADC or ADC_{aie}	Average daily concentration in air (mg/m^3 or ug/m^3).			
C_{air}	Air Concentration (mg/m^3 or ug/m^3). Modeled: C_{soil} x (1/PEF + 1/VF)	Measured or Modeled Representative site exposure concentration		
CF	Conversion Factor	1E+3 µg/mg		Utilized for LADC calculation since toxicity values are in ug/m^3
EF	Number of exposure days during the exposure period (days/year).	106 (< 6 yr) 106 (> 6 - 18 yr) 74 (>18 - 33 yr) 92 (age-adjusted)	NA	Approximately 2 d/wk for 4 months and 5 d/wk for 3 months. Approximately 2 d/wk for 4 months and 3 d/wk for 3 months.
ED	Duration of the exposure period (years).	6 (< 6 yr) 12 (> 6 - 18 yrs) 15 (> 18 - 33 yr) 33 (age-adjusted)	C U U	American Housing Survey for the Minneapolis/St. Paul Metro Area in 1993. 33 years = 90th percentile resident tenure.
AT	Averaging Time (days)	2190 (< 6 yr) 4380 (> 6 - 18 yrs) 5475 (> 18 - 33 yr) 12045 (age-adjusted) 25550 (lifetime)		Noncancer AT = ED LADD calculation: AT = 70 year lifetime

NA = Not Available
C = Central Tendency Value
U = Upper Tendency Value

Table A4.21 Recreational - Calculation of Chronic Particulate Emission Factor

$$PEF(m^3/kg) = Q/C \times \frac{3{,}600 s/h}{(0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x))}$$

Variable	Definition	Default Value	Reference
PEF	Particulate emission factor (m^3/kg)	4.42E+08	Calculated based on default inputs.
Q/C	Inverse of the mean concentration at the center of the source (g/m^2-s per kg/m^3)	45.93	Annual estimate Q/C value for Los Angeles for a 5 acre source (EPA, 1996). (Use site specific information if available).
V	Fraction of vegetative cover	0.25	Default. (Use Cowherd et al., 1985 and site data to develop site-specific value)
U_m	Mean annual windspeed (m/s)	4.7	Based on climatic data for Minneapolis/St. Paul metropolitan area. (Use Cowherd et al., 1985 and site data to develop site-specific value).
U_t	Equivalent threshold value of windspeed at 7 meters (m/s)	11.32	Default (EPA, 1996). (Use Cowherd et al., 1985 and site data to develop site-specific value)
F(x)	Function dependent upon U_m/U_t	0.194	Default (EPA, 1996). (Use Cowherd et al., 1985 and site data to develop site-specific value)

Table 3 of the EPA Soil Screening Guidance: Technical Background Document (EPA, 1996) provides the estimated annual Q/C values for various locations (i.e., city and climatic zone) and source area sizes. Since the recreational exposure evaluation is based on exposure during the warmer months the location which best approximated the 90th percentile of the annual Q/C values (based on the 29 locations evaluated) was selected instead of the annual Q/C value for Minneapolis. An intermediate source size of 5 acres was selected for the default source size. A linear inverse relationship exists between the log of the source size and the log of the annual Q/C. This relationship can be utilized to estimate the annual Q/C for source sizes which are not included in Table 3 of the EPA Soil Screening Guidance. See Section 2.1.4.1. The Q/C value, is used in the determination of both PEF and VF.

The fraction of vegetation will vary from site to site. The exposure area for the recreational exposure evaluation is assumed to be only partially vegetated. A default value of 0.25 was selected.

It is generally assumed that the concentration of the contaminant in the particulate is equal to the concentration of the contaminant in soil. This assumption may underestimate the concentration of contaminant in the inhalable fraction (i.e., PM10 fraction), since smaller particulate fractions sometimes contain contaminant concentrations that are enriched relative to larger fractions. However, the data needed to derive more accurate concentration estimates are typically not available. To calculate the airborne particulate contaminant concentration simply multiple the soil concentration by the inverse of the particulate emission factor (3 E-3 mg/m^3).

Inhalation of contaminated particulate matter is of particular concern in cases where contaminated soil is likely to be disturbed (e.g., grading, excavation, vehicle traffic). The above model addresses mainly wind erosion. If activities likely to physically disturb soil occur with regular frequency the default PEF may not be protective.

For evaluation of volatile contaminants the soil-to-air volatilization factor (VF) model is utilized to define the relationship between the concentration of the contaminant in soil and the flux of the volatilized contaminant to air. Table A4.22 presents the VF equation and default values for subchronic exposure.

Table A4.22 Recreational - Calculation of Chronic Volatilization Factor

$$VF(m^3/kg) = Q/C \times \frac{(3.14 \times D_A \times T)^{1/2}}{(2 \times \rho_b \times D_A)} \times 10^{-4} (m^2/cm^2)$$

Variable	Definition	Default Value	Reference
VF	Volatilization Factor (m^3/kg)	Contaminant Specific	
Q/C	Inverse of the mean concentration at the center of the source (g/m^2-s per kg/m^3)	45.93	Annual estimate Q/C value for Los Angeles for a 5 acre source (EPA, 1996). (Use site specific information regarding source size if available).
Da	Apparent diffusivity (cm^2/s)	Contaminant Specific	See Table A4.10 and Appendix Section 2.1.3.1.
T	Exposure interval (s)	1.89E+8 (< 6 yrs) 3.8E+8 (> 6 - 18 yrs) 4.7E+8 (> 18 - 33 yrs) 1.0E+9 (total duration)	
ρ_b	Dry soil density (g/cm^3)	1.5	Default (EPA, 1996). (Use site data to develop site-specific value)

The VF equation given above represents a simple approach that requires a limited number of easily obtained soil parameters and chemical property parameters. The equation incorporates a number of conservative, simplifying assumptions, e.g., infinite source, steady state conditions. Part 3 of the Soil Screening Guidance: Technical Background Document (EPA 1996) includes information on models for a more detailed evaluation.

There are several site situations for which the VF model is not applicable:

- if municipal or sanitary wastes have been disposed with contaminants, because decomposition of solid waste would generate landfill gases which can greatly enhance volatile emission rates;
- if shallow ground water is contaminated with VOCs; and
- if the soil contaminant concentration above saturation (Csat). Note: Saturation conditions also affect the bioavailability and mobility of a contaminant.

The soil saturation limit (Csat) represents the concentration of a contaminant in soil at which the absorptive limits of the soil particles, the solubility limits of the soil pore water, and the saturation of soil pore air have been reached. Above the Csat concentration the soil contaminant may be present in free phase, nonaqueous phase liquids (NAPLS) for contaminants that are liquid at ambient soil temperatures and pure solid phases for contaminants that are solid at ambient soil temperatures. When a calculated SRV for a VOC exceeds Csat, the allowable SRV in soil is set at Csat to minimize the potential for NAPL. Table A4.11 presented the Csat equation and default values.

3.1.4.2 CF, Units Conversion Factors

See Section 3.1.1.2 for discussion of the CF parameter.

3.1.4.3 EF, Exposure Frequency EF

See Section 3.1.1.3 for discussion of the EF parameter.

3.1.4.4 ED, Exposure Duration

See Section 3.1.1.4 for discussion of the ED parameter.

3.1.4.5 AT, Averaging Time

See Section 3.1.1.6 for discussion of the AT parameter.

3.2 Recreational Subchronic Exposure

The effect (noncarcinogenic and carcinogenic) of a contaminant depends in part on the dose and the rate at which the dose is administered. A specific dose given in a short-period of time may not produce the same effect when given over a longer period of time. Because of their low body weight and behavioral characteristics, young children receive a larger potential dose per unit body weight than older children and adults. A young child (< 6 years) was chosen as the receptor for the subchronic exposure scenario. The exposure time selected was the summer months due to higher exposure potential, i.e., higher potential contact with soil. The default values utilized to evaluate the recreational subchronic exposure scenario are identical to the residential subchronic exposure scenario. See Appendix 4 Section 2.2 for methodology.

3.3 Recreational Acute Exposure

The presence of acutely toxic contaminants in accessible could pose a significant health risk from a "one-time" exposure. With acutely toxic contaminants, the risk estimate for a "one time" exposure may exceed the risks from long term exposures when the magnitude of exposure during the acute episode is very high. Based on results reported by Stanek and Calabrese's (1995) the ingestion of a bolus of soil is common among young children. These authors estimated that approximately 33% of children will ingest greater than 10,000 mg of soil on 1 to 2 days per year. Because of their low body weight young children could potentially receive a large dose per unit body weight as a result of ingesting a bolus of soil. A toddler (1 - 2 years of age) ingesting a bolus of soil is the recommended receptor for assessing acute exposure to soil contaminants. The default values utilized to evaluate the recreational acute exposure scenario are identical to the residential acute exposure scenario. See Appendix 4 Section 2.3 for methodology.

4.0 INDUSTRIAL PROPERTY USE - DIRECT SOIL EXPOSURE PATHWAY EVALUATION

4.1 Industrial - Chronic Exposure

4.1.1 General Exposure Factors

There are five exposure factors which recur throughout the equations used to estimate the dose of contaminant experienced by a potential receptor:

- C_{soil}, Contaminant Concentration
- CF, Units Conversion Factors
- ED, Exposure Duration
- BW, Body Weight
- AT, Averaging Time

These factors are generally used in the same manner regardless of the exposure pathway under investigation, so it is useful to discuss them separately.

4.1.1.1 C_{soil}, Contaminant Concentration

The concentration of the contaminant used to quantify exposure is the Exposure Concentration. The exposure concentration is expressed in terms of mass of the material per unit mass (or volume) of the exposure medium (e.g., mg contaminant/kg soil). The exposure point concentration should *not* be adjusted for receptor exposure frequency, duration, etc. as those factors are generally addressed in the exposure calculations.

4.1.1.2 CF, Units Conversion Factors

Units conversion factors are necessary to insure that the result of the calculation (the dose) is expressed in the correct units. Use of a CF (1E-6 kg/mg or 1E+3 ug/mg) is equivalent to multiplication by one. The numerator and denominator of the factor must be an equivalent quantity expressed in different terms.

4.1.1.3 ED, Exposure Duration

The exposure duration (ED) describes the length of time over which the receptor comes into contact with the contaminant. Therefore, the exposure period would be the length of time between the first exposure experienced and the last. As discussed previously, exposure duration is believed to be one of the more sensitive parameters in the exposure equation. In keeping with the RME approach the upper-end estimate was utilized as the default for the duration of exposure. National statistics are available for worker tenure (Maguire, 1993). The 95th percentile value for years worked at same location was determined to be 25 years.

4.1.1.4 BW, Body Weight

A receptor's body weight is relevant throughout the dose equations since dose is expressed in terms of mass of contaminant per unit body weight per day (mg/kg/day). Table A4.23 provides age-

specific body weights for adults. The body weights are 50th percentile values for males and females and are presented annually for adults (Table 7-2, EPA Exposure Factors Handbook, 1997). The receptor body weight (BW, typically expressed in kilograms, kg) must be matched to the age and gender identified in the exposure profile. Since exposure is assumed to be limited to an adult worker the average body weight (70 kg) for adults (> 18 - 65 years) is recommended as the default value. Within a given age/sex combination, there is some variability of body weight. If there is strong evidence that the potentially exposed subpopulation is biased in some manner a more site specific value should be utilized.

TABLE A4.23 AGE-SPECIFIC BODY WEIGHTS FOR ADULTS

AGE (Years)	Mean BW for Females (kg)	Mean BW for Males (kg)	Default BW Recommended (kg)
18 < 25	60.6	73.8	
25 < 35	64.2	78.7	
35 < 45	67.1	80.9	
45 < 55	68.0	80.9	
55 < 65	67.9	78.8	> 18 - 65 years: 70 kg

4.1.1.5 AT, Averaging Time

The averaging time (AT) is the time over which the total intake is normalized. For the evaluation of *noncancer risk*, the Average Daily Dose calculated should be representative of the exposure received while exposure is on-going (i.e., during the exposure period). Thus the values for exposure period duration (ED) and the averaging time (AT) are equivalent.

The Lifetime Average Daily Dose (LADD) is calculated for the evaluation of *cancer risk*. While the duration of the exposure period (ED) might range from one day to an entire lifetime, the total intake during that exposure is traditionally normalized to a lifetime. The averaging time for assessment of cancer risk is therefore typically set at 70 years. For exposures lasting less than a lifetime, the values for ED and AT will be different. For some contaminants or subpopulations of receptors this approach (normalizing over a lifetime) may not be health protective. The existence of critical periods of susceptibility during a lifetime and the intensity of exposure may influence cancer risk. These factors may warrant deviation from the traditional approach. When possible, the biological basis or mechanism by which a carcinogen acts should be used to characterize risk from the carcinogenic contaminant.

4.1.2 Incidental Soil Ingestion Pathway

The Average Daily Dose due to the chronic incidental ingestion of contaminated soil ($ADD_{soil\ ingestion}$) may be calculated utilizing the equation presented in Table A4.24.

4.1.2.1 C_{soil}, Contaminant Concentration

See Section 4.1.1.1 for discussion of the C_{soil} parameter.

Table A4.24. Industrial Worker - Chronic Incidental Ingestion of Soil.

$$\text{LADD or ADD}_{soil\ ingestion} = \frac{Csoil \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

Variable	Definition	Default Value	Percentile	Reference
LADD or $ADD_{soil\ ingestion}$	Average daily potential dose of contaminant received through the ingestion of soil (mg/kg-day).			
C_{soil}	Soil Concentration (mg/kg)	Representative site exposure concentration		
IR	Annual daily soil ingestion rate (mg/day)	80	C	Recommended RME Default value. Assume 7 month at 100 mg/day and 5 months at 50 mg/day.
CF	Conversion Factor	1E-6 kg/mg		
FI	Fraction of ingested soil which is from contaminated soil	1	NA	
EF	Number of exposure days during the exposure period (days/year).	250	C	Utilized with daily average soil ingestion rate. Assumes 5 d/wk and 2 wk vacation work schedule.
ED	Duration of the exposure period (years).	25	U	95th percentile worker tenure.(Maguire, 1993).
BW	Body weight of the receptor (kg).	70	C	EPA 1997 Exposure Factors Handbook
AT	Averaging Time (days)	9125 25550		Noncancer AT = ED LADD calculation: AT = 70 year lifetime

NA = Not Available
C = Central Tendency Value (e.g., average)
U = Upper Tendency Value

4.1.2.2 IR, Soil Ingestion Rate

Soil ingestion is assumed to occur incidentally, from hand-to-mouth contact and through the inhalation of larger particles during outdoor activities in the warmer months of the year. Soil from outdoors can also be brought indoors (e.g., on clothing, shoes and tools) or can enter buildings as windblown dust. Therefore, some incidental soil/dust ingestion can also occur indoors. Information on soil ingestion among adults is very limited. An annual average daily ingestion rate of 50 mg/day for soil and indoor dust has been recommended based on a study involving adult volunteers. This value is appropriate for indoor workers only (e.g., office worker). A higher incidental ingestion rate would be more appropriate for industrial workers since industrial setting could involve outdoor work activities and industrial sites are generally dustier. An annual average daily ingestion rate of 80 mg/day for soil and indoor dust is recommended as the RME default for workers in an industrial or restricted commercial setting. This value is based on a simple time-weighted average utilizing 100 mg/day as an ingestion rate during the warmer 7 months of the year and 50 mg/day for the 5 colder months of the year. Given the limited data and the potential for inadvertent ingestion (e.g., inhalation of large particles) under dusty industrial conditions the default is not considered to be unduly conservative.

$$IR_{age-adjusted} = \frac{(100\ mg/day \times 7\ months) + (50\ mg/day \times 5\ months)}{12\ months} = 80\ mg/day$$

Soil ingestion rates represent **daily** rates. It is **not** appropriate to modify the soil ingestion rate to account for an exposure which occurs for a portion of a day as the studies on which the soil ingestion rates are based do not indicate whether soil ingestion is a sporadic event or whether it occurs evenly throughout the exposure period.

4.1.2.3 CF, Units Conversion Factors

See Section 4.1.1.2 for discussion of the CF parameter.

4.1.2.4 FI, Fraction of Ingested Soil

Since soil ingestion rates represent **daily** rates. It is **not** appropriate to modify the soil ingestion rate to account for an exposure which occurs for a portion of a day as the studies on which the soil ingestion rates are based do not indicate whether soil ingestion is a sporadic event or whether it occurs evenly throughout the exposure period. It is assumed that the daily ingestion occurs within the exposure area.

4.1.2.5 EF, Exposure Frequency

A receptor may be exposed to a contaminant continuously, at regular intervals, or in a sporadic manner. The frequency of exposure term describes how often the exposure event or contact occurs over a given period of time. The published estimates are based on the amount of soil ingested during a *day*, there can be no reliable estimate of average *hourly* ingestion rates as incidental ingestion of soil is a sporadic event depending upon human behavior (e.g., activities, habits). For such exposures (including soil ingestion and dermal contact) EF is by definition 1 day/event. During that "1 event" the receptor is assumed to receive the daily intake of the contaminant.

Frequency of exposure is site- and activity-specific. Since long-term contact rates are assumed for all exposure pathways and the incidental ingestion rate is assumed to represent a daily average, an exposure frequency of 250 days/year (5 day/week plus 2 week vacation work schedule) is assumed.

4.1.2.6 ED, Exposure Duration

See Section 4.1.1.3 for discussion of the ED parameter.

4.1.2.7 BW, Body Weight

See Section 4.1.1.4 for discussion of the BW parameter.

4.1.2.8 AT, Averaging Time

See Section 4.1.1.5 for discussion of the AT parameter.

4.1.3 Dermal Contact Pathway

Dermal absorption of contaminants is a potentially significant route of exposure whenever direct contact with soil may occur. In fact, dermal absorption from soils may be more significant than incidental ingestion for chemicals which have a percent absorption exceeding about 10% (USEPA, EPA/600/8-91/011B, January, 1992). Contaminants exhibiting percentage absorption less than 10% also contribute to cumulative risk estimates and therefore these contaminants must also be evaluated. The absorption of contaminants from soil depends upon chemical-specific factors (e.g., lipophilicity) as well as the characteristics of

the soil (e.g., organic carbon content). The Average Daily Dose due to chronic dermal contact with contaminated soil ($ADD_{dermal\ absorption}$) may be calculated as shown in Table A4.25.

Table A4.25 Industrial Worker - Chronic Dermal Contact with Soil

$$LADD \text{ or } ADD_{dermal\ absorption} = \frac{Csoil \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Variable	Definition	Default Value	Percentile	Reference
LADD or ADD_{dermal}	Average daily dose absorbed through dermal contact (mg/kg-day).			
C_{soil}	Soil Concentration (mg/kg)	Representative site exposure concentration		
CF	Conversion Factor	1E-6 kg/mg		
SA	Skin surface area (cm^2)	3400	C	Approximately 20% of the average total body SA (EPA, 1992 and EPA, 1997)
AF	Skin adherence factor (mg/cm^2)	0.13	C	Kissel et. al., (as cited in EPA, 1997) and EPA, 1992
ABS	Absorption factor	Chemical specific		
EF	Number of exposure days during the exposure period (days/year).	150	NA	Assume dermal exposure negligible during 5 months of indoor exposure.
ED	Duration of the exposure period (years).	25	U	95th percentile worker tenure. (Maguire 1993)
BW	Body weight of the receptor (kg).	70	C	EPA, 1997
AT	Averaging Time (days)	9125 25550		Noncancer AT = ED LADD calculation: AT = 70 year lifetime

NA = Not Available
C = Central Tendency Value
U = Upper Tendency Value

4.1.3.1 C_{soil}, Contaminant Concentration

See Section 4.1.1.1 for discussion of the C_{soil} parameter.

4.1.3.2 CF, Units Conversion Factors

See Section 4.1.1.2 for discussion of the CF parameter.

4.1.3.3 SA, Skin Surface Area

The surface area parameter (SA) describes the amount of skin exposed to the contaminated media. The amount of skin exposed depends on the receptor and the exposure scenario. Clothing is expected to limit the extent of the exposed surface area for most activities. All SA estimates used 50th percentile values in order to correlate with the average body weights used for exposure estimations. This is done to prevent inconsistent parameter combinations since body weight and surface area are not independent variables. The 50th percentile total body surface areas for adults are shown in Table A4.4.

The exposure frequency for dermal exposure is limited to the warmer months of the year. For the purpose of calculating the dermal dose it was assumed that the forearms, hands, and head were exposed. The percentage of total body surface area by body part for adults are shown in Table A4.5. This exposed area constitutes approximately 20% of the total body surface area in an adult. A surface area of 3,400 cm^2 was calculated by incorporating data from the EPA Exposure Factors Handbook (EPA 1997) as presented in Tables A4.4 and A4.5. Since some studies have suggested that exposure can occur under clothing (EPA, 1992) this scenario is not considered to be unduly conservative.

4.1.3.4 AF, Soil Adherence Factor

The adherence factor (AF) describes the amount of soil that adheres to the skin. The EPA Exposure Factors Handbook (EPA 1997) recommends utilizing the Kissel, et al., study for estimating soil adherence. The results of this study showed that generally soil adherence could be directly correlated with soil moisture and activity and inversely correlated with particle size. The default AFs are based on the central tendency value recommended in EPA's Dermal Guidance (EPA 1992) and a review of the body-part-specific and activity-specific adherence factors reported by Kissel et al., 1996 (as cited in the EPA Exposure Factors Handbook, 1997).

A variety of work conditions were evaluated by Kissel et al. These conditions included groundskeeping, digging, surface restoration, utility work, and moving or excavation of soil. The exposure conditions under an industrial land use may vary substantially and could include a number of the above conditions. The geometric mean soil adherence values for gardening fall roughly in the middle of the range reported for the various activity categories. The recommended default AF for industrial workers is therefore, the same as for the adult residential receptor which is based on the gardening scenario, i.e., 0.13 mg/cm^2. The selected default AF is not considered unduly conservative considering that the value represents a midpoint of central tendency values reported, the high variability, and the surface area limited to only the lower arms, hands and head. Kissel et al.'s study demonstrated that exposure can occur under clothing, e.g., substantial soil loading on feet even though shoes are worn.

4.1.3.5 ABS, Absorption Factor

The dermal absorption factor (ABS) is the fraction of the contaminant contacting the skin that is absorbed. At this time only limited information is available to derive soil ABS values. In the absence of contaminant specific information default ABS values have been incorporated. The basis of the recommended default values was presented in Appendix 4 Section 2.1.3.5. The default values are based on the EPA Dermal Workgroup recommendations and professional judgment. The recommended default ABS values are listed in Table A.5.1 of Appendix 5.

4.1.3.6 EF, Exposure Frequency

A receptor may be exposed to a contaminant continuously, at regular intervals, or in a sporadic manner. The frequency of exposure term describes how often the exposure event or contact occurs over a given period of time. There can be no reliable estimate of an average *hourly* rate since contact with soil is a sporadic event depending upon human behavior (e.g., activities, habits). For such exposures EF is by definition 1 day/event. During that "1 event" the receptor is assumed to receive the daily intake of the contaminant.

Frequency of exposure is site- and activity-specific. The exposure frequency selected must be appropriate for the duration and contact rate chosen. Dermal contact with contaminated soil is assumed to occur mainly during outdoor activities. Outdoor activities which would result in dermal contact are assumed to occur during the 7 warmer months of the year. It is further assumed that during this period of time the

work activities that would result in dermal contact occur on average 3 days per week. The resulting exposure frequency for industrial workers is 90 days per year.

4.1.3.7 ED, Exposure Duration

See Section 4.1.1.3 for discussion of the ED parameter.

4.1.3.8 BW, Body Weight

See Section 4.1.1.4 for discussion of the ED parameter.

4.1.3.9 AT, Averaging Time

See Section 4.1.1.5 for discussion of the AT parameter.

4.1.4 Inhalation of Vapors or Resuspended Particulate Pathway

The toxicity information generally used to evaluate the risk of harm to health associated with inhalation exposures, Reference Concentrations and Units Risk values, are air *concentrations*. These values are intended to be used in combination with Average Daily Concentration expressed as applied concentrations, *not* dose.

Contaminants may be inhaled by the receptor of concern whenever the receptor is at or near the site. The Average Daily Concentration of the contaminant in air (ADC_{air}) is dependent upon the frequency and duration of the assumed exposures. Note that the equation is a simple adjustment of the exposure point concentration to account for the amount of time the receptor spends in the area with contaminated air. The Average Daily Concentration (ADC_{air}) for chronic industrial exposure may be calculated as shown in Table A4.26.

4.1.4.1 C_{air}, Air Concentration

To calculate an average daily air concentration, the particulate emission factor (PEF) and volatilization factor (VF) must be calculated. See Appendix Section 2.1.4.1 for a more detailed discussion of the PEF and VF equations. Table A4.27 presents the PEF equation and the default input values for chronic industrial exposure. Based on default input values a particulate air concentration (1/PEF) of 2.3 E-9 kg/m^3 (i.e., 2.3 ug/m^3). Since the model only addressed wind disturbance of soil the calculated particulate concentration was multiplied by a factor of approximately 2 in an attempt to account for other common sources of soil disturbance (e.g., vehicle traffic). Therefore, the particulate air concentration utilized for industrial property use is 5 ug/m3. This value is not considered to by unduly conservative given the reported particulate concentrations in industrialized areas (MPCA 1997). If physical disturbance of soil is great and occurs with regular frequency the default PEF may not be protective.

Table A4.26 Industrial Worker - Chronic Inhalation of Vapors or Particulate

$$\text{LADC or ADC}_{air} = \frac{C_{air} \times EF \times ED \times CF}{AT}$$

Variable	Definition	Default Value	Percentile	Reference
LADC or ADC_{aie}	Average daily concentration in air (mg/m^3 or ug/m^3).			
C_{air}	Air Concentration (mg/m^3 or ug/m^3) = C_{soil} x (1/PEF + 1/VF)	Measured or Modeled Representative site exposure concentration		
CF	Conversion Factor	1E+3 µg/mg		Utilized for LADC calculation since toxicity values are in ug/m^3
EF	Number of exposure days during the exposure period (days/year).	250	C	PEF and VF values are based on annual estimates.
ED	Duration of the exposure period (years).	25	U	95th percentile worker tenure. (Maguire 1993)
BW	Body weight of the receptor (kg).	70	C	EPA, 1997
AT	Averaging Time (days)	9125 25550		Noncancer AT = ED LADD calculation: AT = 70 year lifetime

C = Central Tendency Value
U = Upper Tendency Value

Table A4.27 Industrial Worker - Calculation of Chronic Particulate Emission Factor

$$PEF(m^3/kg) = Q/C \times \frac{3{,}600\,s/h}{(0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x))}$$

Variable	Definition	Default Value	Reference
PEF	Particulate emission factor (m^3/kg)	3.8E+08	Calculated based on default inputs.
Q/C	Inverse of the mean concentration at the center of the source (g/m^2-s per kg/m^3)	61.03	Annual estimate Q/C value for Minneapolis/St. Paul for a 5 acre source (EPA, 1996). (Use site specific information regarding source size if available).
V	Fraction of vegetative cover	0	Default. (Use Cowherd et al., 1985 and site data to develop site-specific value)
U_m	Mean annual windspeed (m/s)	4.9	Based on climatic data for Minneapolis/St. Paul metropolitan area. (Use Cowherd et al., 1985 and site data to develop site-specific value)
U_t	Equivalent threshold value of windspeed at 7 meters (m/s)	11.32	Default (EPA, 1996). (Use Cowherd et al., 1985 and site data to develop site-specific value)
F(x)	Function dependent upon U_m/U_t	0.194	Default (EPA, 1996). (Use Cowherd et al., 1985 and site data to develop site-specific value)

Table 3 of the EPA Soil Screening Guidance: Technical Background Document (EPA, 1996) provides the estimated annual Q/C values for 0.5, 1, 2, 5, 10 and 30 acre source areas for the city of Minneapolis. An intermediate source size of 5 acres was selected for the default source size. A linear inverse relationship exists between the log of the source size and the log of the annual Q/C This relationship can be utilized to estimate the annual Q/C for source sizes which are not included in Table 3 of the EPA Soil Screening Guidance. See Appendix 4 Section 2.1.4.1.

The Q/C value, is used in the determination of both PEF and VF. For a detailed site-specific assessment of the inhalation pathway, a site-specific Q/C can be determined using the Industrial Source Complex Model platform in the short-term mode (ISCST3). The ISCST3 model will output an air concentration when the concentration model option is selected. Numerous site-specific input parameters must be determined, e.g., the surface area of the contaminated soil source, contaminant area emission rate (g/m2-s), hourly meteorological data, etc.

The fraction of vegetation will vary from site to site. The exposure area for the industrial exposure evaluation is assumed not to be vegetated.

It is generally assumed that the concentration of the contaminant in the particulate is equal to the concentration of the contaminant in soil. This assumption may underestimate the concentration of contaminant in the inhalable fraction (i.e., PM10 fraction), since smaller particulate fractions sometimes contain contaminant concentrations that are enriched relative to larger fractions. However, the data needed to derive more accurate concentration estimates are typically not available. To calculate the airborne particulate contaminant concentration simply multiple the soil concentration by the inverse of the particulate emission factor (5 E-3 mg/m^3).

For evaluation of volatile contaminants the soil-to-air volatilization factor (VF) model is utilized to define the relationship between the concentration of the contaminant in soil and the flux of the volatilized contaminant to air. Table A4.28 presents the VF equation and default values for chronic exposure.

Table A4.28 Industrial Worker - Calculation of Chronic Volatilization Factor

$$VF(m^3/kg) = Q/C \times \frac{(3.14 \times D_A \times T)^{1/2}}{(2 \times \rho_b \times D_A)} \times 10^{-4} (m^2/cm^2)$$

Variable	Definition	Default Value	Reference
VF	Volatilization Factor (m^3/kg)	Contaminant Specific	
Q/C	Inverse of the mean concentration at the center of the source (g/m^2-s per kg/m^3)	61.03	Annual estimate Q/C value for Minneapolis/St. Paul for a 5 acre source (EPA, 1996). (Use site specific information regarding source size if available).
Da	Apparent diffusivity (cm^2/s)	Contaminant Specific	See Table A4.10 and Appendix Section 2.1.3.1.
T	Exposure interval (s)	7.88E+8	Number of seconds in 25 years.
ρ_b	Dry soil density (g/cm^3)	1.5	Default (EPA, 1996). (Use site data to develop site-specific value)

The VF equation given above represents a simple approach that requires a limited number of easily obtained soil parameters and chemical property parameters. The equation incorporates a number of conservative, simplifying assumptions, e.g., infinite source, steady state conditions. Part 3 of the Soil

Screening Guidance: Technical Background Document (EPA 1996) includes information on models for a more detailed evaluation.

There are several site situations for which the VF model is not applicable:

- if municipal or sanitary wastes have been disposed with contaminants, because decomposition of solid waste would generate landfill gases which can greatly enhance volatile emission rates;
- if shallow ground water is contaminated with VOCs; and
- if the soil contaminant concentration above saturation (Csat). Note: Saturation conditions also affect the bioavailability and mobility of a contaminant.

The soil saturation limit (Csat) represents the concentration of a contaminant in soil at which the absorptive limits of the soil particles, the solubility limits of the soil pore water, and the saturation of soil pore air have been reached. Above the Csat concentration the soil contaminant may be present in free phase, nonaqueous phase liquids (NAPLS) for contaminants that are liquid at ambient soil temperatures and pure solid phases for contaminants that are solid at ambient soil temperatures. When a calculated SRV for a VOC exceeds Csat, the allowable SRV in soil is set at Csat to minimize the potential for NAPL. Table A4.11 presents the Csat equation and default values.

4.1.4.2 CF, Units Conversion Factors

See Section 4.1.1.2 for discussion of the CF parameter.

4.1.4.3 EF, Exposure Frequency

A receptor may be exposed to a contaminant continuously, at regular intervals, or in a sporadic manner. The frequency of exposure term describes how often the exposure event or contact occurs over a given period of time. Frequency of exposure is site- and activity-specific. Since long-term contact rates are assumed for all exposure pathways and the incidental ingestion rate is assumed to represent a daily average, an exposure frequency of 250 days/year (5 day/week plus 2 week vacation work schedule) is assumed.

4.1.4.4 ED, Exposure Duration

See Section 4.1.1.3 for discussion of the ED parameter.

4.1.4.5 AT, Averaging Time

See Section 4.1.1.5 for discussion of the AT parameter.

4.2 Industrial Subchronic Exposure

The effect (noncarcinogenic and carcinogenic) of a contaminant depends in part on the dose and the rate at which the dose is administered. A specific dose given in a short-period of time may not produce the same effect when given over a longer period of time. To adequately evaluate the potential receptors, the risk assessor may need to look at several specific subpopulations of receptors which may experience higher rates of exposure. To evaluate the potential impact from higher rates of exposure to a worker over a subchronic exposure period refer to Appendix Section 5.0 Short-term Worker. In situations where high short-term exposure may occur the lower of the two calculated values (i.e., chronic industrial worker scenario and short-term worker scenario) should be utilized.

4.3 Industrial Acute Exposure

It is not anticipated that there will be high soil acute exposure episodes in adult workers. Acute exposure may be of concern for the inhalation pathway. Direct air monitoring should be conducted if this pathway is of concern.

5.0 SHORT-TERM WORKER SCENARIO

The effect (noncarcinogenic and carcinogenic) of a contaminant depends in part on the dose and the rate at which the dose is administered. A specific dose given in a short-period of time may not produce the same effect when given over a longer period of time. To adequately evaluate the potential receptors, the risk assessor may need to look at several specific subpopulations of receptors which may experience higher rates of exposure. Because of their work conditions construction/utility workers receive a larger potential dose over a shorter period of time than industrial workers.

5.1 General Exposure Factors

There are five exposure factors which recur throughout the equations used to estimate the dose of contaminant experienced by a potential receptor:

- C_{soil}, Contaminant Concentration
- CF, Units Conversion Factors
- EF, Exposure Frequency
- BW, Body Weight
- AT, Averaging Time

These factors are generally used in the same manner regardless of the exposure pathway under investigation, so it is useful to discuss them separately.

5.1.1 C_{soil}, Contaminant Concentration

The concentration of the contaminant used to quantify exposure is the Exposure Concentration. The exposure point concentration should *not* be adjusted for receptor exposure frequency, duration, etc. as those factors are generally addressed in the exposure calculations.

5.1.2 CF, Units Conversion Factors

Units conversion factors are necessary to insure that the result of the calculation (the dose) is expressed in the correct units (e.g., mg/kg/day). Use of the units CF (1E-6 kg per mg or 1000 ug per mg) is equivalent to multiplication by one.

5.1.3 EF, Exposure Frequency

The frequency of exposure term describes how often the exposure event or contact occurs over a given period of time. While estimates have been published on the amount of soil ingested during a *day*, there can be no reliable estimate of average *hourly* ingestion rates as incidental ingestion of soil is a sporadic event depending upon human behavior (e.g., activities, habits). For such exposures (including soil ingestion and dermal contact) EF is by definition 1 day/event. During that "1 event" the receptor is assumed to receive the daily

intake of the contaminant. Frequency of exposure is site- and activity-specific. The exposure frequency selected for subchronic exposure is an average of 5 days per week during a 2 month construction project (i.e., 45 days).

5.1.4 BW, Body Weight

A receptor's body weight is relevant throughout the dose equations since dose is expressed in terms of mass of contaminant per unit body weight per day (mg/kg/day). Table A4.23 provides age-specific body weights for adults. The body weights are 50th percentile values for males and females and are presented annually for adults (Table 7-2, EPA Exposure Factors Handbook, 1997). The receptor body weight (BW, typically expressed in kilograms, kg) must be matched to the age and gender identified in the exposure profile. Since exposure is assumed to be limited to an adult worker the average body weight (70 kg) for adults (> 18 - 65 years) is recommended as the default value. Within a given age/sex combination, there is some variability of body weight. If there is strong evidence that the potentially exposed subpopulation is biased in some manner a more site specific value should be utilized.

5.1.5 AT, Averaging Time

The averaging time (AT) is the time over which the total intake is normalized. For the evaluation of *noncancer risk*, the Average Daily Dose calculated should be representative of the exposure received while exposure is on-going (i.e., during the exposure period). The exposure period evaluated for the subchronic exposure scenario is 90 days (i.e., 3 summer months). The averaging time (AT) is equivalent to the exposure period, i.e. 3 months.

The Lifetime Average Daily Dose (LADD) is calculated for the evaluation of *cancer risk*. While the duration of the exposure period might range from one day to an entire lifetime, the total intake during that exposure is traditionally normalized to a lifetime. The averaging time for assessment of cancer risk is therefore typically set at 70 years. Note that for the evaluation of cancer risks resulting from subchronic exposure the target risk is 1 in 1,000,000.

5.2 Incidental Soil Ingestion Pathway

The Average Daily Dose during an exposure period of less than or equal to 1 year (i.e., *subchronic*) may be calculated utilizing the equation presented in Table A4.29.

5.2.1 C_{soil}, Contaminant Concentration

See Section 5.1.1 for discussion of the C_{soil} parameter.

5.2.2 IR, Soil Ingestion Rate

Soil ingestion is assumed to occur incidentally, from hand-to-mouth contact and through the inhalation of larger particles. Soil from outdoors can also be brought indoors (e.g., on clothing, shoes and tools) or can enter buildings as windblown dust. Soil ingestion rates represent **daily** rates. It is **not** appropriate to modify the soil ingestion rate to account for an exposure which occurs for a portion of a day as the studies on which the soil ingestion rates are based do not indicate whether soil ingestion is a sporadic event or whether it occurs evenly throughout the exposure period.

Information on soil ingestion among adults is very limited. A default soil ingestion rate of 480 mg/day is recommended by EPA (EPA 1989b) for workers engaged in outdoor work activities.

Information on soil ingestion among adults is very limited. A default soil ingestion rate of 480 mg/day is recommended by EPA (EPA 1989b) for workers engaged in outdoor work activities.

Table A4.29 Short-term Worker - Subchronic Incidental Ingestion of Soil

$$\text{LADD or ADD}_{\text{ingestion}} = \frac{Csoil \times IR \times CF \times FI \times EF}{BW \times AT}$$

Variable	Definition	Default Value	Percentile	Reference
LADD or $ADD_{soil\ ingestion}$	Average daily potential dose of contaminant received through the ingestion of soil (mg/kg-day).			
C_{soil}	Soil Concentration (mg/kg)	Representative site exposure concentration		
IR	Daily soil ingestion rate (mg/day)	480	NA	EPA (1989b)
CF	Conversion Factor	1E-6 kg/mg		
FI	Fraction of ingested soil which is from contaminated soil	1	NA	
EF	Number of exposure days during the exposure period (days/year).	45	C	2 months, average of 5 d/wk.
BW	Body weight during the exposure period (kg).	70	C	EPA, 1997
AT	Averaging Time (days)	60 25550		Noncancer AT = 2 months LADD calculation: AT = 70 year lifetime. Note: Subchronic target cancer risk < 1E-6.

C = Central Tendency Value (e.g., average)
U = Upper Tendency Value

5.2.3 CF, Units Conversion Factors

See Section 5.1.2 for discussion of the CF parameter.

5.2.4 FI, Fraction of Ingested Soil

Since soil ingestion rates represent **daily** rates. It is **not** appropriate to modify the soil ingestion rate to account for an exposure which occurs for a portion of a day as the studies on which the soil ingestion rates are based do not indicate whether soil ingestion is a sporadic event or whether it occurs evenly throughout the exposure period. It is assumed that the daily ingestion occurs within the exposure area.

5.2.5 EF, Exposure Frequency

See Section 5.1.3 for discussion of the EF parameter.

5.2.6 BW, Body Weight

See Section 5.1.4 for discussion of the BW parameter.

5.2.7 AT, Averaging Time

See Section 5.1.5 for discussion of the AT parameter.

5.3 Dermal Contact Pathway

Dermal absorption of contaminants is a potentially significant route of exposure whenever direct contact with soil may occur. The absorption of contaminants from soil depends upon chemical-specific factors (e.g., lipophilicity) as well as the characteristics of the soil (e.g., organic carbon content). The Average Daily Dose for subchronic exposure may be calculated as shown in Table A4.30.

5.3.1 C_{soil}, Contaminant Concentration

See Section 5.1.1 for discussion of the C_{soil} parameter.

5.3.2 CF, Units Conversion Factors

See Section 5.1.2 for discussion of the CF parameter.

5.3.3 SA, Skin Surface Area

The surface area parameter (SA) describes the amount of skin exposed to the contaminated media. The amount of skin exposed depends on the receptor and the exposure scenario. Clothing is expected to limit the extent of the exposed surface area for most activities. All SA estimates used 50th percentile values in order to correlate with the average body weights used for exposure estimations. This is done to prevent inconsistent parameter combinations since body weight and surface area are not independent variables. The age-specific 50th percentile total body surface areas were shown in Table A4.4.

The subchronic exposure frequency for dermal exposure is limited to the summer months. For the purpose of calculating the dermal dose it was assumed that the forearms, hands, and head are exposed. The age-specific percentage of total body surface area by body part were shown in Table A4.5. This exposed area constitutes approximately 20 % of the total body surface area. A surface area of 3400 cm^2 was calculated by incorporating data from the EPA Exposure Factors Handbook (EPA 1997) as presented in Tables A4.4 and A4.5. Since some studies have suggested that exposure can occur under clothing (EPA, 1992) and the exposure period is limited to the summer months this scenario is not considered to be unduly conservative.

5.3.4 AF, Soil Adherence Factor

The adherence factor (AF) describes the amount of soil that adheres to the skin. The EPA Exposure Factors Handbook (EPA 1997) recommends utilizing the Kissel, et al., study for estimating soil adherence. The results of this study showed that generally soil adherence could be directly correlated with soil moisture and activity and inversely correlated with particle size. The default AFs are based on the central tendency value recommended in EPA's Dermal Guidance (EPA 1992) and a review of the body-part-specific and activity-specific adherence factors reported by Kissel et al., 1996 (as cited in the EPA Exposure Factors Handbook, 1997).

Table A4.30 Short-term Worker - Subchronic Dermal Contact with Soil

$$\text{LADD or ADD}_{\text{dermal absorption}} = \frac{Csoil \times CF \times SA \times AF \times ABS \times EF}{BW \times AT}$$

Variable	Definition	Default Value	Percentile	Reference
LADD or ADD_{dermal}	Average daily dose absorbed through dermal contact (mg/kg-day).			
C_{soil}	Soil Concentration (mg/kg)	Representative site exposure concentration		
CF	Conversion Factor	1E-6 kg/mg		
SA	Skin surface area (cm^2)	3400	C	Approximately 20% of the average total body SA (EPA, 1997)
AF	Skin adherence factor (mg/cm^2)	0.3	C	Kissel et. al., (as cited in EPA, 1997) and EPA 1992
ABS	Absorption factor	Chemical specific		
EF	Number of exposure days during the exposure period	45	NA	2 summer months, average of 5 d/wk.
BW	Body weight during the exposure period (kg).	70	C	EPA, 1997
AT	Averaging Time (days)	60 25550		Noncancer AT = 2 months LADD calculation: AT = 70 year lifetime. Note: Subchronic target cancer risk $\leq$ 1E-6.

NA = Not Available
C = Central Tendency Value
U = Upper Tendency Value

Kissel et al., evaluated construction, utility and equipment operator activities. These activities would be similar to a short-term construction/utility worker. For the short-term construction/utility worker the gardening scenario was utilized. The body part specific surface area information can be found in Table A4.6. Kissel, et al. presented the body part specific AFs. The highest geometric mean value of the construction, utility or equipment operator activity categories was utilized. The selection of the highest mean AF is not considered unduly conservative since the value represents a central tendency value, the reported high variability. The weighted adherence factor was calculated utilizing the equation below:

$$\text{Weighted AF} = \frac{(SA1 \times AF1) + (SA2 \times AF2) + \ldots + (SAi \times AFi)}{(SA1 + SA2 + \ldots + SAi)}$$

where:

SAi = surface area for body part "i", forearms, hands, and head (cm^2)
AFi = soil-to-skin adherence factor for body part "i", mg/cm^2-event

The calculation of the default AF is shown below:

$$\text{Weighted AF} = \frac{(1090 \times 0.3) + (950 \times 0.32) + (1360 \times 0.23)}{(3400)} = 0.3$$

5.3.5 ABS, Absorption Factor

The dermal absorption factor (ABS) is the fraction of the contaminant contacting the skin that is absorbed. At this time only limited information is available to derive soil ABS values. In the absence of contaminant specific information default ABS values have been incorporated. The recommended default values are discussed in Appendix Section 2.1.3.5. The recommended default ABS values are listed in Table A.5.1 of Appendix 5.

5.3.6 EF, Exposure Frequency

See Section 5.1.3 for discussion of the EF parameter.

5.3.7 BW, Body Weight

See Section 5.1.4 for discussion of the BW parameter.

5.3.8 AT, Averaging Time

See Section 5.1.5 for discussion of the AT parameter.

5.4 Inhalation of Vapors or Resuspended Particulate Pathway

The toxicity information generally used to evaluate the risk of harm to health associated with inhalation exposures, Reference Concentrations and Units Risk values, are air *concentrations*. These values are intended to be used in combination with Average Daily Concentration expressed as applied concentrations, *not* dose.

Contaminants may be inhaled by the receptor of concern whenever the receptor is at or near the site. The Average Daily Concentration of the contaminant in air (ADC_{air}) is dependent upon the frequency and duration of the assumed exposures. Note that the equation is a simple adjustment of the exposure point concentration to account for the amount of time the receptor spends in the area with contaminated air. The Average Daily Concentration (ADC_{air}) for subchronic exposure may be calculated as shown in Table A4.31.

5.4.1 C_{air}, Air Concentration

To calculate an average daily air concentration, the particulate emission factor (PEF) and volatilization factor (VF) must be determined. See Appendix Section 2.1.4.1 for a more detailed discussion of the PEF and VF equations.

Inhalation of contaminated particulate matter is of particular concern in cases where contaminated soil is likely to be disturbed (e.g., grading, excavation, vehicle traffic). These activities likely to be common place at construction sites. The PEF model utilized for other receptors is only applicable for estimating long-term particulate emissions due to wind erosion. To assess short-term exposures at sites where extensive soil disturbance occurs the utilization of default particulate concentration values may be necessary. For exposure during construction or utility work, a PM10 value of *at least* 150 $\mu g/m^3$ should be used to estimate concentrations. This value is the 24 hour average PM10 standard. A State ambient monitoring station located near an industrialized area in St. Paul has exceeded this standard on several occasions. (1997 Trend Analysis Report, MPCA). There are a number of uncertainties associated with use of the default PM10 values, including: 1) the sampling locations are not necessarily located near construction activities or large areas of sparsely vegetated soil ; and 2) the published 24 hour averages may underestimate PM10 concentrations attained during

the work day. Therefore, these PM10 values are acceptable for use only in the absence of more representative data.

Table A4.31 Short-term Worker - Subchronic Inhalation of Vapors or Particulate

$$\text{LADC or ADC}_{air} = \frac{Cair \times EF \times CF}{AT}$$

Variable	Definition	Default Value	Percentile	Reference
LADC or ADC_{aie}	Average daily concentration in air (mg/m^3 or ug/m^3).			
C_{air}	Air Concentration (mg/m^3 or ug/m^3) = C_{soil} x (1/PEF + 1/VF)	Measured or Modeled Representative site exposure concentration		
CF	Conversion Factor	1E+3 µg/mg		Utilized for LADC calculation since toxicity values are in ug/m^3
EF	Number of exposure days during the exposure period (days/year).	45		2 summer months, average of 5 d/wk.
AT	Averaging Time (days)	60 25550		Noncancer AT = 2 months LADC calculation: AT = 70 year lifetime. Note: Subchronic target cancer risk < 1E-6.

C = Central Tendency Value
U = Upper Tendency Value

For evaluation of volatile contaminants the soil-to-air volatilization factor (VF) model can be utilized to define the relationship between the concentration of the contaminant in soil and the flux of the volatilized contaminant to air. Table A4.32 presents the VF equation and default values for subchronic exposure.

Table A4.32 Short-term Worker - Calculation of Subchronic Volatilization Factor

$$VF(m^3/kg) = Q/C \times \frac{(3.14 \times D_A \times T)^{1/2}}{(2 \times \rho_b \times D_A)} \times 10^{-4} (m^2/cm^2)$$

Variable	Definition	Default Value	Reference
VF	Volatilization Factor (m^3/kg)	Contaminant Specific	
Q/C	Inverse of the mean concentration at the center of the source (g/m^2-s per kg/m^3)	45.93	Annual estimate Q/C value for Los Angeles for a 5 acre source (EPA, 1996). (Use site specific information regarding source size if available).
Da	Apparent diffusivity (cm^2/s)	Contaminant Specific	See Table A4.10 and Appendix Section 2.1.3.1.
T	Exposure interval (s)	5.2E+06	Assumes 60 day exposure period.
ρ_b	Dry soil density (g/cm^3)	1.5	Default (EPA, 1996). (Use site data to develop site-specific value)

Table 3 of the EPA Soil Screening Guidance: Technical Background Document (EPA, 1996) provides the estimated annual Q/C values for various locations (i.e., city and climatic zone) and source area sizes. Since the subchronic exposure evaluation is based on exposure during the summer months the location which best approximated the 90th percentile of the annual Q/C values (based on the 29 locations evaluated) was

selected instead of the annual Q/C value for Minneapolis. An intermediate source size of 5 acres was selected for the default source size. A linear inverse relationship exists between the log of the source size and the log of the annual Q/C. This relationship can be utilized to estimate the annual Q/C for source sizes which are not included in Table 3 of the EPA Soil Screening Guidance. See Appendix 4 Section 2.1.3.1 for more details.

The VF equation given above represents a simple approach that requires a limited number of easily obtained soil parameters and chemical property parameters. The equation incorporates a number of conservative, simplifying assumptions, e.g., infinite source, steady state conditions. Part 3 of the Soil Screening Guidance: Technical Background Document (EPA 1996) includes information on models for a more detailed evaluation.

There are several site situations for which the VF model is not applicable:

- if municipal or sanitary wastes have been disposed with contaminants, because decomposition of solid waste would generate landfill gases which can greatly enhance volatile emission rates;
- if shallow ground water is contaminated with VOCs; and
- if the soil contaminant concentration above saturation (Csat). Note: Saturation conditions also affect the bioavailability and mobility of a contaminant.

The soil saturation limit (Csat) represents the concentration of a contaminant in soil at which the absorptive limits of the soil particles, the solubility limits of the soil pore water, and the saturation of soil pore air have been reached. Above the Csat concentration the soil contaminant may be present in free phase, nonaqueous phase liquids (NAPLS) for contaminants that are liquid at ambient soil temperatures and pure solid phases for contaminants that are solid at ambient soil temperatures. When a calculated SRV for a VOC exceeds Csat, the allowable SRV in soil is set at Csat to minimize the potential for NAPL. Table A4.11 presented the Csat equation and default values.

5.4.2 CF, Units Conversion Factors

See Section 5.1.2 for discussion of the CF parameter.

5.4.3 EF, Exposure Frequency

See Section 5.1.3 for discussion of the EF parameter.

5.4.4 AT, Averaging Time

See Section 5.1.5 for discussion of the AT parameter.

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APPENDIX 4A

EXPOSURE EQUATIONS AND DEFAULT VALUES FOR SEDIMENT EXPOSURE SCENARIO

Child (6-12 yrs) Wader Exposure Table1. Incidental ingestion of chemicals in sediment.

Intake (mg/kg-day) = (Cs x IRs x CF x EF x ED)/(BW x AT)

Variable	Definition	Value Utilized	Rationale/Reference
Cs	Sediment Concentration (mg/kg)	site concentration or back-calculated	
IRs	Sediment Ingestion Rate (mg/event)	31	Calculated based on ingestion of 0.1 l water/event (EPA 1989a) and heavily suspended sediments from wading activity.
CF	Conversion Factor (kg/mg)	1.00E-06	
EF	Exposure Frequency (events/yr)	36	Default selected by MPCA and MDH staff approx. 2-3 times per week during 3 summer months.
ED	Exposure duration (years)	7	
BW	Body weight (kg)	33	Average body weight for 6 - 12 yr. age group (EPA 1996)
AT	Averaging Time (days)	2555 25550	Noncancer Evaluation AT = exposure duration Cancer Evaluation AT = 70 year lifetime

Child (6 - 12 yrs) Wader Exposure Table2. Dermal contact with chemicals in sediments.

Absorbed Dose (mg/kg-day) = (Cs x CF x SA x AF x ABS x EF x ED)/(BW x AT)

Variable	Definition	Variable Utilized	Rationale/Reference
Cs	Sediment Concentration (mg/kg)	site concentration or back-calculated	
CF	Conversion Factor (kg/mg)	1.00E-06	
SA	Skin surface area in contact with sediment (cm2/event)	2200	20% of total body surface area (11,000 cm2) (EPA 1996) (hands, feet, and lower legs)
AF	Skin Adherence factor (mg/cm2)	2	EPA 1996 Exposure Factors Handbook, kids in mud. Calculated average mean AF weighted by surface area of various exposed body parts = 20 mg/cm2. Assumed only 10% (portion nearest skin) available for absorption.
ABS	Absorption factor	Chemical Specific	
EF	Exposure Frequency (events/yr)	36	Default selected by MPCA and MDH staff approx. 2-3 times per week during 3 summer months.
ED	Exposure Duration (years)	7	
BW	Body Weight (kg)	33	Average body weight for 6 - 12 yr. age group (EPA 1996)
AT	Averaging time (days)	2555 25550	Noncancer Evaluation AT = exposure duration Cancer Evaluation AT = 70 year lifetime

APPENDIX 5

CHEMICAL SPECIFIC INFORMATION

1.0 ABSORPTION VALUES

The Absorption Adjustment Factor (AAF) is used to account for differences in the absorption of a contaminant under assumed exposure conditions at the site (exposure route and matrix) relative to the absorption of the contaminant under the experimental conditions upon which the dose-response value is based. AAFs are used *in lieu of absorption efficiencies* to ensure that the exposures evaluated at the site are comparable to the toxicity information identified in the literature. The AAF relates the exposure and absorption estimated for the exposure pathway under evaluation to the exposure and absorption in the toxicological study on which the dose-response information is based. The AAF is dimensionless and is chemical and pathway specific. When the toxicity value represents an *administered* dose or concentration, the AAF is calculated as the ratio of the absorption efficiency of the route and medium of the exposure route and medium under consideration and the absorption efficiency of the route and medium of the study used as the basis of the toxicity value. In the case of the dermal exposure pathway the exposure is expressed as an absorbed dose. If the toxicity value is based on absorbed dose no adjustment is necessary. If the toxicity value is based on administered dose it must be adjusted for absorption so that it is consistent with the absorbed dose estimate for the dermal contact exposure pathway.

To estimate an AAF, two factors must be identified:

- the absorption efficiency for the contaminant via the route and medium of exposure being evaluated for the site, and
- the absorption efficiency for the route and medium of exposure in the experimental study which is the basis of the dose-response value for the contaminant in question.

Thus, the absorption adjustment is based on these two absorption efficiencies. Typically, two different types of adjustments are done. One involves adjusting the site exposure for differences in absorption efficiency between the route and medium at the site and the route and medium utilized in the toxicity study. The second adjustment involves adjusting the toxicity value based on administered dose for absorbed dose when assessing risk from a dermally absorbed dose. Table A5.2 contains the dermal absorption value utilized to estimate the absorbed dermal dose, the soil/toxicity study absorption adjustment factor, and the absorption efficiency for the exposure in the toxicity study.

Typically, the exposure from incidental ingestion of soil, ingestion of food and inhalation of contaminants in soil estimates a potential dose. The potential dose is analogous to an administered dose in a toxicity study. If the absorption efficiency for the contaminant via the route and medium of exposure at the site differs from the absorption efficiency for the contaminant in the toxicity study an absorption adjustment should be made. Likewise, the toxicity value is typically based on an administered dose but the dermal exposure pathway evaluation results in an estimate of *absorbed* dose. The toxicity value based on administered dose must be adjusted for absorption before it can be utilized to calculate risk posed by the dermal exposure pathway dose.

The risk assessor is reminded that it is very important to determine whether the toxicity value is based on an absorbed or administered dose. An example of the absorption adjustment calculations was presented in Table A5.1.

Table A5.1 Example of Absorption Adjustment

The oral reference dose for Contaminant X is 0.003 mg/kg-day. The oral slope factor for Contaminant X is 20 per mg/kg-day. The toxicity values are based on administration of contaminated drinking water to rats. Based on laboratory studies the oral absorption from drinking water has been estimated to be approximately 80%. Bioavailability studies have indicated that the oral absorption efficiency of Contaminant X in soil is approximately 40% (i.e., half of the oral absorption efficiency in water).

Non-Cancer Risk Evaluation:

Incidental Soil Ingestion Exposure - To incorporate this information into the risk estimate the incidental soil ingestion exposure (mg/kg-day) should be multiplied by 0.5 (i.e., 40%/80%) before it is utilized in estimating the hazard quotient for ingestion of soil for Contaminant X. *Note: in the absence of absorption efficiency information no adjustment for efficiency differences is made.*

Dermal Exposure - To incorporate this information into the risk estimate for dermal exposure the toxicity value (i.e., the reference dose) must be multiplied by 0.8 (i.e., 80%) to adjust the reference dose for absorption. The adjusted reference dose is then utilized in estimating the hazard quotient for dermal exposure to Contaminant X. *Note: in the absence of absorption efficiency information a default absorption efficiency of 90% is used to adjust the oral reference dose. If the actual absorption efficiency is significantly lower the default will underestimate the risk.*

Cancer Risk Evaluation:

Incidental Soil Ingestion Exposure - To incorporate this information into the risk estimate the incidental soil ingestion exposure (mg/kg-day) should be multiplied by 0.5 (i.e., 40%/80%) before it is utilized in estimating the excess cancer risk from ingestion of soil for Contaminant X. *Note: in the absence of absorption efficiency information no adjustment for efficiency differences is made.*

Dermal Exposure - To incorporate this information into the risk estimate for dermal exposure the toxicity value (i.e., the oral slope factor) must be divided by 0.8 (i.e., 80%) to adjust the slope factor for absorption. The adjusted slope factor is then utilized in estimating the excess cancer risk from dermal exposure to Contaminant X. *Note: in the absence of absorption efficiency information a default absorption efficiency of 90% is used to adjust the oral slope factor. If the actual absorption efficiency is significantly lower the default will underestimate the risk.*

The chemical specific absorption values for the chemicals of concern are summarized below in Table A5.2.

Table A5.2 Chemical Specific Absorption Value Information

Chemical	Dermal Absorption Value		Toxicity Study Absorption		Soil/Toxicity Study Absorption Adjustment	
Benzo(a)pyrene	0.13	Wester et.al., 1990 & Yang, et. al., 1989	0.8	Limited studies examining absorption from diet and from soil (Goon, et al., 1990, 1991)	0.8	Toxicity studies utilized diet and gavage. Average absorption from diet (ATSDR Toxicological Profile, 1995)
Pentachlorophenol	0.25	Wester et. al., 1993	1	No adjustment made	0.9	Default.
TCDD	0.03	EPA Dermal Guidance Document 1992	0.55	Absorption from soil 20 – 40 % (M. Callahan (SRA 1996)) and dietary absorption estimate	0.55	EPA Draft Estimating Exposure to Dioxin-like Compounds (1995)

2.0 PHYSICAL CHEMICAL PROPERTY INFORMATION

The soil-to-air volatilization factor (VF) model is utilized to define the relationship between the concentration of the contaminant in soil and the flux of the volatilized contaminant to air. The VF model is a simple approach that requires a limited number of easily obtained soil parameters and chemical property parameters. The chemical property parameters utilized are presented in Table A5.3. For further discussion of the VF model see Appendix 4, Section 2.1.4.

Table A5.3 Physical Chemical Properties

Chemical	Da	Dw	Koc	Henry's Constant (atm-m3/mol)	Solubility (mg/l)	Source of Information
Benzo(a)pyrene	4.3E-2	9E-6	1.06E+6	1.13E-6	1.62E-3	EPA SSL Technical Background Document, 1996
Pentachlorophenol	5.6E-2	6.1E-6	5.92E+2	2.44E-8	1.95+3	EPA SSL Technical Background Document, 1996
TCDD	4.7E-2	8E-6	1.4E+7	3.55E-5	1.93E-5	Texas Draft Risk Reduction Program, 1998

Da – diffusivity in air
Dw – diffusivity in water

3.0 CHEMICAL TOXICITY INFORMATION

Toxicity or dose-response assessment describes the observed or potential toxic effects in humans or animals associated with a particular exposure of a contaminant. This information is obtained from published literature describing studies evaluating the particular contaminant. For most contaminants reported at sites the toxicity information needed to generate generic SRVs or conduct a site-specific risk characterization are found in secondary sources published by the USEPA or other government agencies.

3.1 Noncancer Toxicity Values

For noncarcinogenic health effects it is believed that a dose (or exposure) level exists at and below which no adverse health effects would be expected. This level is referred to as the toxicity threshold dose. Noncarcinogenic toxicity values are estimates of the daily exposure to the human population that is likely to be without appreciable risk of deleterious effects during the exposure period. The toxicity values are typically expressed as reference doses (RfD) in units of mg/kg per day or as reference concentrations (RfC) in units of mg/m^3.

3.1.1 Acute Noncancer Toxicity Values

The acute toxicity of a contaminant refers to its ability to do systemic damage as a result of a one-time exposure to relatively large amounts of the contaminant. Of the contaminants commonly detected

at sites, acutely toxic contaminants are the ones which could pose a significant health risk from a "one-time" exposure to concentrations that can be found in the environment. Quantitative acute toxicity information was only available for pentachlorophenol. The intent of an acute hazard evaluation is to make decisions about the need for immediate action based on an exposure that is associated with an adverse health effect and not an exposure that is associated with no adverse effect (i.e. a "safe" dose).

The lethal dose level for pentachlorophenol has been reported to be approximately 17 mg/kg (ATSDR Toxicological Profile, 1994). Cardiovascular effects have been reported at dose levels as low as 0.2 – 0.5 mg/kg. An acute toxicity value of 1.7 mg/kg (i.e., lethal dose x uncertainty factor of 10) was utilized in the acute exposure scenario. Given that health effects (e.g., tachycardia) have been reported at lower doses that is not considered to be a conservative acute value.

3.1.2 Subchronic Noncancer Toxicity Values

The toxic effect of a contaminant depends in part on the dose and the rate at which the dose is administered. A specific dose given in a short period of time may not produce the same effect when given over a longer period of time. Multiple exposures occurring over a small fraction of an individual's lifetime (e.g., ranging from several months to several years) are considered to be subchronic. The subchronic noncancer toxicity values are presented in Table A5. 4.

Table A5.4 Subchronic Noncancer Toxicity Values

Chemical	Oral Toxicity Value (mg/kg-day)		Inhalation Toxicity Value (mg/m^3)	
Benzo(a)pyrene	NA		NA	
Pentachlorophenol	0.03	HEAST 1996	NA	
TCDD	NA		NA	

NA – not available

3.1.3 Chronic Noncancer Toxicity Values

The toxic effect of a contaminant depends in part on the dose and the rate at which the dose is administered. A specific dose given in a short period of time may not produce the same effect when given over a longer period of time. Multiple exposures occurring over an extended period of time or a significant fraction of an individual's lifetime are considered to be chronic. The chronic noncancer toxicity values are presented in Table A5.5.

Table A5.5 Chronic Noncancer Toxicity Values

Chemical	Oral Toxicity Value (mg/kg-day)		Inhalation Toxicity Value (mg/m^3)	
Benzo(a)pyrene	NA		NA	
Pentachlorophenol	0.03	IRIS 1995	0.1	California EPA 1997
TCDD	NA		NA	

NA – not available

3.2 Cancer Toxicity Values

Unlike noncarcinogenic health effects the toxicity assessment for carcinogens assumes that there is no toxicity threshold dose for carcinogenicity; i.e., that there is no dose of a carcinogenic substance that is not associated with increased risk. The ability of a contaminant to increase the incidence of cancer in a target population is described by one of two measures: the cancer slope factor or the unit risk. The cancer slope factor is expressed as a plausible upper-bound estimate of probability of the risk per unit dose (mg/kg per day). The unit risk values are used in lieu of cancer slope factors when an estimate of a lifetime average media concentration of the contaminant is available. The cancer slope factors and unit risk values utilized are presented in Table A5.6.

Table A5.6 Cancer Toxicity Values

Chemical	Oral Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$		Inhalation Unit Risk Factor $(mg/m^3)^{-1}$	
Benzo(a)pyrene	7.3	IRIS 1995 and MDH Proposed Oral HRV, 1998	9E-4	Provisional EPA value supplied to Regions by NCEA
Pentachlorophenol	1.2E-1	IRIS 1995	3.4E-5	EPA SSL Technical Support Document, 1996
TCDD	1.5E+5	HEAST 1995	3.3E+1	HEAST 1995

NA – not available

The above discussion focuses on the toxicity information available for specific chemicals. There are several groups of closely related compounds for which alternative approaches to the development of toxicity values have been proposed. These groups include:

- Chlorinated Dioxins and Furans
- Carcinogenic Polycyclic Aromatic Hydrocarbons (PAHs)

3.2.1 Chlorinated Dioxins and Furans and Dioxin-like Polychlorinated Biphenyls (PCBs)

The polychlorinated dibenzo-p-dioxins (PCDDs) include 75 individual compounds, and the polychlorinated dibenzofurans (PCDFs) include 135 individual compounds. These individual compounds are technically referred to as congeners. Only 7 of the 75 congeners of PCDDs are thought to have dioxin-like toxicity; these are ones with chlorine substitutions in, at least, the 2,3,7, and 8 positions. Only 10 of the 135 possible congeners of PCDFs are thought to have dioxin-like toxicity; these also are ones with substitutions in the 2,3,7, and 8 positions. There are 209 PCB congeners, of which only 13 are thought to have dioxin-like toxicity. These are PCBs with 4 or more chlorines with just 1 or no substitutions in the ortho position. These 30 dioxin-like compounds are often found in complex mixtures. For risk assessment purposes, a toxicity equivalency procedure was developed to describe the cumulative toxicity of these mixtures. This procedure involves assigning individual toxicity equivalency factors (TEFs) to the PCDD, PCDF and PCB congeners. These TEF values have had international endorsement (EPA/625/3-89/016, March 1989; Ahlborg, et al., Chemosphere 28(6), 1994; EPA website: www.epa.gov/ncea/dchem.htm). 2,3,7,8-TCDD is assigned a TEF of 1. All other congeners have lower TEF values ranging from 0.5 to 0.00001. Recently the World Health Organization (WHO) revised the international TEFs for OCDD (octachlorodibenzo-p-dioxin) and OCDF (octachlorodobenzo-furan). A list of current TEFs is presented in Table A5.7.

Table A5.7 Toxicity Equivalency Factors (TEFs) for Polychlorinated Dioxins and Dibenzofurans

Compound	TEF
DIOXINS:	
2,3,7,8-Tetrachlorinated dibenzo-p-dioxin	1
1,2,3,7,8-Pentachlorinated dibenzo-p-dioxins	1
1,2,3,4,7,8-Hexachlorinated dibenzo-p-dioxins	0.1
1,2,3,6,7,8-Hexachlorinated dibenzo-p-dioxins	0.1
1,2,3,7,8,9-Hexachlorinated dibenzo-p-dioxins	0.1
1,2,3,4,6,7,8-Heptachlorinated dibenzo-p-dioxins	0.01
1,2,3,4,6,7,8-Octachlorinated dibenzo-p-dioxin	0.0001
FURANS:	
2,3,7,8-Tetrachlorinated dibenzofuran	0.1
1,2,3,7,8-Pentachlorinated dibenzofurans	0.05
2,3,4,7,8-Pentachlorinated dibenzofurans	0.5
1,2,3,4,7,8-Hexachlorinated dibenzofurans	0.1
1,2,3,6,7,8-Hexachlorinated dibenzofurans	0.1
1,2,3,7,8,9-Hexachlorinated dibenzofurans	0.1
2,3,4,6,7,8-Hexachlorinated dibenzofurans	0.1
1,2,3,4,6,7,8-Heptachlorinated dibenzofurans	0.01
1,2,3,4,7,8,9-Heptachlorinated dibenzofurans	0.01
1,2,3,4,6,7,8,9-Octachlorinated dibenzofurans	0.0001
PCBs:	
3,3',4,4'-TeCB (PCB 77)	0.0001
3,4,4',5-TeCB (PCB 81)	0.0001
2,3,3',4,4'-PeCB (PCB 105)	0.0001
2,3,4,4',5-PeCB (PCB 114)	0.0005
2,3',4,4',5-PeCB (PCB 118)	0.0001
2',3,4,4',5-PeCB (PCB 123)	0.0001
3,3,'4,4',5-PeCB (PCB 126)	0.1
2,3,3',4,4',5-HxCB (PCB 156)	0.0005
2,3,3',4,4',5'-HxCB (PCB 157)	0.0005
2,3',4,4',5,5'-HxCB (PCB 167)	0.00001
3,3',4,4',5,5'-HxCB (PCB 169)	0.01
2,3,3',4,4',5,5'-HpCB (PCB 189)	0.0001

Source: M. Vander Berg, et al., Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for Humans and Wildlife. Env. Health Perspectives. 106(12)755-792, 1998

3.2.2 Polycylic Aromatic Hydrocarbons (PAHs)

Polycyclic aromatic hydrocarbons are a class of structurally similar chemical compounds characterized by the presence of fused aromatic rings. PAHs are typically formed during the incomplete burning of organic material including coal, oil, gasoline and garbage. PAHs are also found in crude oil, coal tar, creosote and asphalt. PAHs are associated with human activities (the combustion of fossil fuels) and natural occurrences (such as forest fires), and they are considered to be ubiquitous in the environment at some level.

PAHs are often discussed as a group because they are commonly found as mixtures in the environment. It should be noted that, while PAHs are often discussed as a group, the individual chemicals are evaluated as separate chemicals in the risk characterization. There are over 100 chemicals in this family of compounds, although only a smaller number are routinely analyzed for and reported at sites. ***The PAHs which are often present at sites but are unreported may result in the underestimation of potential risks.***

Among the polycyclic aromatic hydrocarbons, the USEPA has classified seven chemicals as *probable (B2) human carcinogens*. The seven include: benzo[a]pyrene (BaP), benz[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene. PAHs which are considered unclassified may also contribute to carcinogenic risk (Nisbet and LaGoy, 1992).

The only cancer slope factor (CSF) published for cPAHs is for benzo[a]pyrene (B[a]P). In 1993, USEPA formally adopted provisional guidance for estimating cancer risks associated with polycyclic aromatics hydrocarbons (USEPA, EPA/600/R-93/089, July, 1993). The procedure uses information from the scientific literature to estimate the carcinogenic potency of several PAHs relative to benzo[a]pyrene. These **relative potencies** have been used to calculate B[a]P-equivalent concentrations for each of the PAHs (which would then be used with the B[a]P slope factor). This approach is similar to that used for the evaluation of dioxin-like compounds. A list of the USEPA relative potency values are presented in Table A5.8 for use in risk characterization.

Table A5.8 Relative Potency Values for Individual Carcinogenic PAHs

Compound	Relative Potency
Benzo[a]pyrene	**1.0**
Benz[a]anthracene	**0.1**
Benzo[b]fluoranthene	**0.1**
Benzo[k]fluoranthene	**0.01**
Chrysene	**0.001**
Dibenz[a,h]anthracene	**1.0**
Indeno[1,2,3-cd]pyrene	**0.1**

Source: EPA Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (EPA/600/R-93/089, July 1993).

Carcinogenic PAHs also exhibit dermal toxicity. EPA has stated that it is inappropriate to use the oral slope factor to evaluate the risks associated with dermal exposure to carcinogens which cause skin cancer through direct action at the point of application. This does not mean that the potential for systemic effects following dermal exposures need not be assessed. It is important to include the potential for systemic effects that may result after dermal exposure. Ideally since it is well established that PAHs cause point of contact tumors the dermal toxicity resulting from dermal exposure to PAHs should also be evaluated. In order to quantify the risk of dermal toxicity associated with dermal exposure to PAHs a dermal cancer slope factor would be required. However, a dermal cancer slope factor for benzo(a)pyrene, or any other PAH, has not been derived. Therefore, it is not currently possible to quantitatively evaluate dermal toxicity associated with dermal exposure to PAHs. ***The inability to include dermal toxicity may result in the underestimation of potential risks.***

APPENDIX 6

GENERIC SOIL REFERENCE VALUES (SRVS)

1.0 BACKGROUND

The soil reference values (SRVs) represent acceptable soil concentrations for specific exposure scenarios. Generic SRVs were developed for facilitate site investigations and remedy selection for sites in the Superfund and Voluntary Investigation and Cleanup programs. The generic SRVs are based on risk assessment methodology, modeling, and risk management policy. The generic SRVs address the three most common exposure pathways - incidental soil ingestion, dermal contact with soil, and inhalation of outdoor vapors and particulates from soil. Appendix 4 contains the exposure equations and input values for the exposure pathways.

In calculating SRVs, a set of acceptable risk levels has been established to ensure the same level of protection of human health regardless of the receptor or intended property use. The acceptable risk levels targeted by the risk-based evaluation process are as follows:

- Carcinogenic effects - a total or cumulative site excess lifetime cancer risk (ELCR) not to exceed 1 in 100,000 (i.e., 1E-5) for chronic exposure. In other words, the acceptable risk level is a maximum of one additional case of cancer per 100,00 chronically exposed individuals above background cancer rates in the general population. For subchronic exposure (e.g., 1 year) the acceptable cumulative ELCR is limited to ten percent of the chronic ELCR (i.e., 1E-6); and

- Noncarcinogenic effects - a noncancer risk not to exceed a hazard quotient (HQ) of 0.2 per contaminant for chronic exposure or 1 for subchronic and acute exposure and a cumulative hazard index (HI) of 1 for multiple contaminants with similar target endpoints. The HQ is determined by dividing the site contaminant exposure by the contaminant reference dose, which is an estimate of the daily exposure that is not likely to result in an appreciable risk of deleterious effects. The HI is determined by adding the HQs for each contaminant with similar endpoints.

The toxic effect of a contaminant depends in part on the dose and the rate at which the dose is administered. A specific dose given in a short period of time may not produce the same effect when given over a longer period of time. To adequately evaluate the potential risk acute , subchronic and chronic exposure scenarios were included in the evaluation.

Recommended default exposure parameters have been developed for residential (applicable to unrestricted commercial use), industrial (applicable to restricted commercial use) and recreational property use settings. The exposure scenarios utilized represent reasonable maximum exposure (RME) activities for the planned use of the site. These activities represent full use of the site and may not be presently occurring but are consistent with the planned use of the property. The exposure equations and default values are presented in Appendix 4 "Exposure Equations and Default Values". The chemical-specific information utilized in the development of the SRVs is presented in Appendix 5 "Chemical-Specific Information".

Table A6.1 Generic Soil Reference Value (SRVs) for Chemicals of Concern

Exposure Scenario	Pentachlorophenol (mg/kg)	BaP Equivalents (mg/kg)	TCDD Equivalents (mg/kg)
Residential Chronic	71	2	0.0002
Recreational Chronic	67	2	0.0002
Child Subchronic	88	2.3	0.0002
Child Acute	220	NA	NA
Industrial Chronic	135	4	0.00035
Short-term Worker	290	10	0.0008