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D-2 COMPARISION TO BACKGROUND

TABLE D-2
COMPARISON OF MAXIMUM SITE DATA TO AVERAGE BACKGROUND DATA

Receptor	Fraction	Parameter	CasNo	Units	AvgBkg	MaxOfSiteDetects
OU4Soil0to15	OS	Benzo(b)fluoranthene	205992	MG/KG	0	3.6
OU4Soil0to15	OS	Benzo(g,h,i)perylene	191242	MG/KG	0	2.7
OU4Soil0to15	OS	Benzo(k)fluoranthene	207089	MG/KG	0	3.9
OU4Soil0to15	OS	bis(2-Ethylhexyl)phthalate	117817	MG/KG	0	2.1
OU4Soil0to15	OS	Butylbenzylphthalate	85687	MG/KG	0	0.083
OU4Soil0to15	OS	Carbazole	86748	MG/KG	0	0.46
OU4Soil0to15	OS	Chrysene	218019	MG/KG	0	5.6
OU4Soil0to15	ASB	Asbestos	ASBESTOS	%	0.99	60
OU4Soil0to15	M	Aluminum	7429905	MG/KG	12900	16200
OU4Soil0to15	M	Antimony	7440360	MG/KG	2.86	13.5
OU4Soil0to15	M	Arsenic	7440382	MG/KG	5.67	45.5
OU4Soil0to15	M	Barium	7440393	MG/KG	57.47	18800
OU4Soil0to15	M	Beryllium	7440417	MG/KG	0.72	1.2
OU4Soil0to15	M	Cadmium	7440439	MG/KG	0.40	19.3
OU4Soil0to15	M	Calcium	7440702	MG/KG	1600	9100
OU4Soil0to15	M	Chromium	7440473	MG/KG	16.97	234
OU4Soil0to15	M	Cobalt	7440484	MG/KG	6.35	40.4
OU4Soil0to15	M	Copper	7440508	MG/KG	28.79	193000
OU4Soil0to15	M	Copper	7440508	MG/KG	28.79	193000
OU4Soil0to15	M	Iron	7439896	MG/KG	16000	96200
OU4Soil0to15	M	Lead	7439921	MG/KG	80.76	172000
OU4Soil0to15	M	Lead	7439921	MG/KG	80.76	172000
OU4Soil0to15	M	Magnesium	7439954	MG/KG	3250	114000
OU4Soil0to15	M	Manganese	7439965	MG/KG	306	1530
OU4Soil0to15	M	Mercury	7439976	MG/KG	0.11	6.2
OU4Soil0to15	M	Nickel	7440020	MG/KG	12.52	644
OU4Soil0to15	M	Potassium	7440097	MG/KG	961	3760
OU4Soil0to15	M	Selenium	7782492	MG/KG	0.50	7.3
OU4Soil0to15	M	Silver	7440224	MG/KG	0.51	18.6
OU4Soil0to15	M	Sodium	7440235	MG/KG	76.43	1120
OU4Soil0to15	M	Thallium	7440280	MG/KG	0.37	6.4
OU4Soil0to15	M	Vanadium	7440622	MG/KG	34.21	93.6
OU4Soil0to15	M	Zinc	7440666	MG/KG	112	23500
OU4Soil0to15	OS	1,4-Dichlorobenzene	106467	MG/KG	0	0.061
OU4Soil0to15	OS	2,4-Dimethylphenol	105679	MG/KG	0	35
OU4Soil0to15	OS	2-Methylnaphthalene	91576	MG/KG	0	1.4
OU4Soil0to15	OS	2-Methylphenol	95487	MG/KG	0	3.1
OU4Soil0to15	OS	3,3'-Dichlorobenzidine	91941	MG/KG	0	0.1
OU4Soil0to15	OS	4-Methylphenol	106445	MG/KG	0	9.5
OU4Soil0to15	OS	Acenaphthene	83329	MG/KG	0	0.42
OU4Soil0to15	OS	Acenaphthylene	208968	MG/KG	0	1.1
OU4Soil0to15	OS	Anthracene	120127	MG/KG	0	2.5
OU4Soil0to15	OS	Benzo(a)anthracene	56553	MG/KG	0	5.3
OU4Soil0to15	OS	Benzo(a)pyrene	50328	MG/KG	0	4.4
OU4Soil0to15	OS	Di-n-Butylphthalate	84742	MG/KG	0	0.57
OU4Soil0to15	OS	Di-n-octylphthalate	117840	MG/KG	0	0.056
OU4Soil0to15	OS	Dibenzo(a,h)anthracene	53703	MG/KG	0	0.8
OU4Soil0to15	OS	Dibenzofuran	132649	MG/KG	0	0.42
OU4Soil0to15	OS	Diethylphthalate	84662	MG/KG	0	0.12
OU4Soil0to15	OS	Fluoranthene	206440	MG/KG	0	14
OU4Soil0to15	OS	Fluorene	86737	MG/KG	0	0.97
OU4Soil0to15	OS	Indeno(1,2,3-cd)pyrene	193395	MG/KG	0	2.2
OU4Soil0to15	OS	N-Nitroso-di-n-propylamine	621647	MG/KG	0	0.044
OU4Soil0to15	OS	N-Nitroso-diphenylamine	86306	MG/KG	0	2
OU4Soil0to15	OS	Naphthalene	91203	MG/KG	0	2.7
OU4Soil0to15	OS	Pentachlorophenol	87865	MG/KG	0	0.053
OU4Soil0to15	OS	Phenanthrene	85018	MG/KG	0	11
OU4Soil0to15	OS	Phenol	108952	MG/KG	0	110
OU4Soil0to15	OS	Pyrene	129000	MG/KG	0	12
OU4Soil0to15	OV	1,1,1-Trichloroethane	71556	MG/KG	0	0.001
OU4Soil0to15	OV	1,1-Dichloroethane	75343	MG/KG	0	0.001
OU4Soil0to15	OV	2-Butanone	78933	MG/KG	0	0.031

TABLE D-2
COMPARISON OF MAXIMUM SITE DATA TO AVERAGE BACKGROUND DATA

Receptor	Fraction	Parameter	CasNo	Units	AvgBkg	MaxOfSiteDetects
OU4Soil0to15	OV	Acetone	67641	MG/KG	0	0.35
OU4Soil0to15	OV	Benzene	71432	MG/KG	0	1.1
OU4Soil0to15	OV	Bromomethane	74839	MG/KG	0	0.002
OU4Soil0to15	OV	Carbon Disulfide	75150	MG/KG	0	0.4
OU4Soil0to15	OV	Chlorobenzene	108907	MG/KG	0	47
OU4Soil0to15	OV	Chloroform	67663	MG/KG	0	0.18
OU4Soil0to15	OV	Ethylbenzene	100414	MG/KG	0	8.6
OU4Soil0to15	OV	Toluene	108883	MG/KG	0	1.9
OU4Soil0to15	OV	Total Xylenes	1330207	MG/KG	0	4.8
OU4Soil0to15	OV	Trichloroethene	79016	MG/KG	0	0.54
OU4Soil0to15	OV	Vinyl Chloride	75014	MG/KG	0	0.001
OU4Soil0to15	PESTP	4,4'-DDD	72548	MG/KG	0.0046	0.042
OU4Soil0to15	PESTP	4,4'-DDE	72559	MG/KG	0.0167	0.71
OU4Soil0to15	PESTP	4,4'-DDT	50293	MG/KG	0.0291	0.71
OU4Soil0to15	PESTP	Aldrin	309002	MG/KG	0.0024	0.0039
OU4Soil0to15	PESTP	alpha-BHC	319846	MG/KG	0.0024	0.0088
OU4Soil0to15	PESTP	alpha-Chlordane	5103719	MG/KG	0.0049	0.13
OU4Soil0to15	PESTP	Aroclor-1016	12674112	MG/KG	0.0499	0.2
OU4Soil0to15	PESTP	Aroclor-1221	11104282	MG/KG	0.0930	0.047
OU4Soil0to15	PESTP	Aroclor-1232	11141165	MG/KG	0.0471	0.21
OU4Soil0to15	PESTP	Aroclor-1242	53469219	MG/KG	0.0461	3
OU4Soil0to15	PESTP	Aroclor-1248	12672296	MG/KG	0.0461	0.16
OU4Soil0to15	PESTP	Aroclor-1262	37324235	MG/KG	0.0368	110
OU4Soil0to15	PESTP	Aroclor-1268	11100144	MG/KG	0.0461	230
OU4Soil0to15	PESTP	beta-BHC	319857	MG/KG	0.0024	0.014
OU4Soil0to15	PESTP	delta-BHC	319868	MG/KG	0.0023	0.0039
OU4Soil0to15	PESTP	Dieldrin	60571	MG/KG	0.0131	0.13
OU4Soil0to15	PESTP	Endosulfan I	959988	MG/KG	0.0045	0.041
OU4Soil0to15	PESTP	Endosulfan II	33213659	MG/KG	0.0047	0.039
OU4Soil0to15	PESTP	Endosulfan Sulfate	1031078	MG/KG	0.0047	0.0027
OU4Soil0to15	PESTP	Endrin	72208	MG/KG	0.0048	0.17
OU4Soil0to15	PESTP	Endrin Aldehyde	7421934	MG/KG	0.0046	0.047
OU4Soil0to15	PESTP	Endrin Ketone	53494705	MG/KG	0.0053	0.53
OU4Soil0to15	PESTP	gamma-BHC	58899	MG/KG	0.0024	0.0067
OU4Soil0to15	PESTP	gamma-Chlordane	5103742	MG/KG	0.0027	0.22
OU4Soil0to15	PESTP	Heptachlor	76448	MG/KG	0.0022	0.13
OU4Soil0to15	PESTP	Heptachlor Epoxide	1024573	MG/KG	0.0023	0.038
OU4Soil0to15	PESTP	Methoxychlor	72435	MG/KG	0.0223	0.01
OU4Soil0to15	TOC	Total Organic Carbon	7440440	MG/KG	0	6400

D-3 CONNECTICUT RSRS

Brown & Root Environmental

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C-49-03-8-156

March 20, 1998

Brown & Root Environmental Project Number 7237

Mr. Mark Lewis
Connecticut Department of Environmental Protection
Water Management Bureau
Permitting, Enforcement, and Remediation Division
Federal Remediation Program
79 Elm Street
Hartford, Connecticut 06106-5127

Reference: CLEAN Contract No. N62472-90-D-1298
Contract Task Order No. 0260

Subject: Responses to CTDEP's Comments on Calculated Remediation Standards
Lower Subase Remedial Investigation
Naval Submarine Base - New London, Groton, Connecticut

Dear Mr. Lewis:

Brown & Root (B&R) Environmental and the Navy received your February 27, 1998 comment letter regarding the Remediation Standards that were calculated for use in the Lower Subase Remedial Investigation. Responses to CTDEP's comments have been prepared and the appropriate revisions have been made to Tables 1 and 2, which were previously enclosed in B&R Environmental's December 23, 1997 letter. B&R Environmental, on the behalf of the United States Navy, Northern Division Facilities Engineering Command and Naval Submarine Base - New London, has enclosed the Navy's responses to CTDEP's comments and the revised tables for your review and approval.

If you have any questions regarding the responses or the information provided in the revised tables, please contact Mr. Mark Evans at (610) 595-0567 (ext. 162) or me at (412) 921-8244. It is anticipated that any remaining issues can be resolved during a conference call.

Very truly yours,

Corey A. Rich, P.E.
Project Manager

Enclosure(s)

c: Mr. Roger Boucher, NORTHDIV (letter only)
Mr. Mark Evans, NORTHDIV
Mr. Andy Stackpole, NSB-NLON Environmental
Mr. John Trepanowski, B&R Environmental
Mr. Daryl Hutson, B&R Environmental (letter only)
Ms. Karen Smecker, B&R Environmental
File: CTO 0260

RESPONSES TO CTDEP'S COMMENTS (2/27/98)
ON THE CALCULATED CTDEP REMEDIATION STANDARDS (12/23/97)
CTO 260 - LOWER SUBASE REMEDIAL INVESTIGATION
NAVAL SUBMARINE BASE-NEW LONDON, GROTON, CONNECTICUT
MARCH 20, 1998

I. SURROGATE CHEMICALS USED TO SUPPLY TOXICITY VALUES

Comment:

1. **The Navy has used naphthalene as a surrogate to represent the toxicity of benzo(g,h,I)perylene. As noted in Dr. Ginsberg's memorandum, pyrene (RfD 0.03 mg/kg/d) is a more appropriate surrogate. The RfD for naphthalene has been withdrawn from IRIS. Please recalculate the direct exposure, pollutant mobility, and ground water protection criteria for benzo(g,h,i)perylene using this approach. This approach is appropriate for a screening level risk assessment. However, the uncertainties involved with this approach should be acknowledged if these two chemicals are found to be major risk drivers at the site.**

Response:

The direct exposure, pollutant mobility, and groundwater protection criteria for benzo(g,h,i)perylene will be recalculated using pyrene as a surrogate. Benzo(g,h,i)perylene was detected in soil and groundwater at the Lower Subase but was not found to be a major risk driver at any of the zones that were evaluated in the risk assessment. Benzo(g,h,i)perylene was only identified as a COC in groundwater at Zone 4 where it was detected in one sample at a concentration exceeding the State's Ambient Water Quality Criteria (AWQC) for the protection of human health. Consequently, this does not have any impact on the human health risk assessment.

Comment:

2. **It is unclear why the Navy calculated criteria for phenanthrene since the regulations list direct exposure, pollutant mobility, and groundwater protection criteria for this compound. Please use the criteria listed in the Regulations for this compound. The Navy should either withdraw their request for approval of criteria for phenanthrene, or, if the Navy is requesting approval of alternative criteria for this compound under the Regulations, the Navy should so state.**

Response:

The Navy retracts its request for approval of criteria for phenanthrene. The promulgated criteria for phenanthrene were used in the selection of COCs in the human health risk assessment. Consequently, this does not have any impact on the human health risk assessment.

Comment:

3. **Bromodichloromethane should be used as a surrogate for bromochloromethane. Please use the criteria calculated for bromodichloromethane in place of those calculated using chloromethane as a surrogate.**

Response:

Bromodichloromethane will be used as a surrogate for bromochloromethane. Bromodichloromethane was not detected in soil and groundwater samples for any of the zones evaluated in the human health risk assessment, consequently this does not have any impact on the analysis.

Comment:

4. **The Navy's proposal to use 3-methylphenol as a surrogate for 4-chloro-3-methylphenol is not appropriate, due to structural differences between the two compounds. The use of a qualitative risk assessment would be acceptable assuming that concentrations of this chemical do not exceed the low part-per-billion range. Please see Dr. Ginsberg's comments for additional details.**

Response:

No criteria will be developed for 4-chloro-3-methylphenol. Instead, as suggested, 4-chloro-3-methylphenol will be evaluated qualitatively. 4-Chloro-3-methylphenol was only detected in one soil sample at the Lower Subase and at a low concentration (34 ppb), consequently, this does not have any impact on the human health risk assessment.

II. INCORRECT OR UNSUPPORTED POTENCY VALUES

Comment:

5. **Several of the CSFs or RfDs used by the Navy appeared to be incorrect, based on a comparison to the values listed in the EPA Region III Risk Based Concentrations table, IRIS, or HEAST. Please recalculate the direct exposure, pollutant mobility, and ground water protection criteria using correct values for total 1,2-dichloroethene. Please assume that this value pertains to the mixture of *cis* and *trans* isomers. The RfD for the mixture should be 9E-3 mg/kg/d.**

Response:

The direct exposure, pollutant mobility, and groundwater protection criteria for total 1,2-dichloroethene will be recalculated using an oral reference dose of 9E-3 mg/kg/day. This revision does not impact the human health risk assessment since all detected concentrations of total 1,2-dichloroethene are less than the recalculated criteria.

Comment:

6. **The Department was unable to verify the potency factors listed by the Navy for several chemicals. Please either provide references to support the listed potency factors, or derive criteria using acceptable surrogates for the following compounds: chloroethane, 4,6-dinitro-2-methylphenol, 2-hexanone, and 2-methylnaphthalene. Please note that naphthalene is not an appropriate surrogate for 2-methylnaphthalene as the RfD for naphthalene has been withdrawn from IRIS. Please refer to Dr. Ginsberg's memo for additional guidance.**

Response:

The toxicity criteria for chloroethane, 4,6-dinitro-2-methylphenol, 2-hexanone, and 2-methylnaphthalene were obtained from the current U.S. EPA Region III Risk-based Concentration (RBC) Table dated October 22, 1997. The RBC table cites EPA's National Center for Environmental Assessment (NCEA) as the source for the values for chloroethane, 4,6-dinitro-2-methylphenol, and 2-methylnaphthalene. Although not cited in the RBC table, EPA Region III stated in telephone call on March 12, 1998, that NCEA is also the source for the toxicity criteria for 2-hexanone. Therefore, there are no changes necessary to the proposed values.

Comment:

7. **The Department was unable to verify the RfD listed by the Navy for 4-nitrophenol (8.00E-3 mg/kg/d). Please either provide a reference for the listed value, or use the default RfD currently listed in the RBC tables (6.2E-2 mg/kg/d).**

Response:

The current RBC table lists 8.00E-3 mg/kg/day as the oral RfD for 4-nitrophenol and cites EPA's NCEA as the source for the value. The value of 6.2E-2 mg/kg/day was listed in the previous, outdated version of the RBC table. Therefore, there are no changes necessary to the proposed criteria.

III. POLLUTANT MOBILITY CRITERIA FOR METALS

Comment:

8. **The ground water protection criterion for cobalt was calculated correctly by the Navy. However, the approach used by the Navy in calculating pollutant mobility criteria for cobalt is unacceptable. Rather than using the calculated ground water protection criterion (420 μg/l) to establish a pollutant mobility criterion for cobalt, the Navy used the EPA Region III Risk Based Criteria for tap water (2,200 μg/L) as the GAA/GA pollutant mobility criterion. This approach is less conservative than using the calculated ground water protection criterion. The correct pollutant mobility criteria for cobalt, based on the groundwater protection criteria calculated by the Navy, are 420 μg/L for a GAA/GA area, and 4,200 μg/L for a GB area (measurement by TCLP or SPLP).**

Response:

The pollutant mobility criteria for cobalt will be changed to 420 µg/L for a GAA/GA area and 4,200 µg/L for a GB area. This revision has no impact on the human health risk assessment because of the following reasons: (1) none of the historical soil samples that were analyzed by TCLP had leachates that were analyzed for cobalt, and (2) only the soil samples from Zone 6 had SPLP leachates that were analyzed for cobalt and all of the results were nondetects.

Comment:

9. **The ground water protection criterion for manganese was calculated correctly by the Navy. Rather than using the calculated ground water protection criterion (160 µg/l) to establish a pollutant mobility criterion for manganese, the Navy used the EPA Secondary MCL for drinking water (50 µg/L) as the GAA/GA pollutant mobility criterion. This approach is acceptable as it is more conservative than using the calculated ground water protection criterion.**

Response:

No response required.

IV. GB POLLUTANT MOBILITY CRITERIA FOR DIMETHYLPHTHALATE

Comment:

10. **The GB pollutant mobility criteria listed for dimethylphthalate (1,400 mg/kg) in the Navy's Table 2 appears to be a typo. The correct value should be listed as 14,000 mg/kg.**

Response:

The GB pollutant mobility criteria for dimethylphthalate will be corrected to 14,000 mg/kg. This revision has no impact on the analysis since dimethylphthalate was not detected in soil samples in any of the zones that were evaluated in the human health risk assessment.

V. BIS(2-CHLOROETHOXY)METHANE

Comment:

11. **The Navy proposes a qualitative risk assessment for this compound. This approach is acceptable provided that the compound is not present at concentrations above the low part-per-billion range. As noted by Dr. Ginsberg, if it is present above this range, a more quantitative risk assessment may be required.**

Response:

Bis(2-chloroethoxy)methane was not detected in soil or groundwater samples for any of the zones evaluated in the human health risk assessment, consequently this does not have any impact on the analysis.

TABLE 1

SOURCE OF CONNECTICUT REMEDIATION STANDARDS
CTO 260 LOWER SUBASE RI
NEW LONDON, GROTON, CONNECTICUT

Chemical	CAS Number	Chemical Fraction	Basis of Value to be Used in RI Report		
			Promulgated Value[1]	Calculated Value[2]	Surrogate Calculated Value[3]
Acenaphthene	83329	SVOC		X	
Acenaphthylene	208968	SVOC	X		
Anthracene	120127	SVOC	X		
Acetone	67641	VOC	X		
Aldrin	309002	PEST		X	
Aluminum	7429905	INORG	[4]	[4]	[4]
Antimony	7440360	INORG	X		
Arsenic	7440382	INORG	X		
Barium	7440393	INORG	X		
Benzene	71432	VOC	X		
Benz(a)anthracene	56553	SVOC	X		
Benzo(b)fluoranthene	205992	SVOC	X		
Benzo(k)fluoranthene	207089	SVOC	X		
Benzo(g,h,i)perylene	191242	SVOC			X (pyrene)
Benzo(a)pyrene	50328	SVOC	X		
Beryllium	7440417	INORG	X		
BCH (alpha-)	319846	PEST		X	
BCH (beta-)	319857	PEST		X	
BCH (delta-)	319868	PEST			X (alpha-BHC)
BCH (gamma-; Lindane)	58899	PEST	X		
Bis(2-chloroethoxy)methane	111911	SVOC	[5]	[5]	[5]
Bis(2-chloroethyl)ether	111444	SVOC	X		
Bis(2-ethylhexyl)phthalate	117817	SVOC	X		
Bromochloromethane	74975	VOC			X (bromodichloro-methane)
Bromodichloromethane	75274	VOC		X	
Bromoform	75252	VOC	X		
Bromomethane	74839	VOC		X	
4-Bromophenyl-phenylether	101553	SVOC		X	
2-Butanone	78933	VOC	X		
Butylbenzylphthalate	85687	SVOC	X		
Cadmium	7440439	INORG	X		
Calcium	7440702	INORG	[6]	[6]	[6]
Carbazole	86748	SVOC		X	
Carbon disulfide	75150	VOC		X	
Carbon tetrachloride	56235	VOC	X		
Chlordane (alpha-)	57749	PEST	X[7]		
Chlordane (gamma-)	57749	PEST	X[7]		
4-Chloroaniline	106478	SVOC		X	
Chlorobenzene	108907	VOC	X		
Chlorodibromomethane	124481	VOC	X		
Chloroethane	75003	VOC		X	
Chloroform	67663	VOC	X		
Chloromethane	74873	VOC		X	
4-Chloro-3-methylphenol	59507	SVOC	[5]	[5]	[5]

TABLE 1

SOURCE OF CONNECTICUT REMEDIATION STANDARDS
CTO 260 LOWER SUBASE RI
NEW LONDON, GROTON, CONNECTICUT

Chemical	CAS Number	Chemical Fraction	Basis of Value to be Used in RI Report		
			Promulgated Value[1]	Calculated Value[2]	Surrogate Calculated Value[3]
2-Chloronaphthalene	91587	SVOC		X	
2-Chlorophenol	95578	SVOC	X		
4-Chlorophenyl-phenylether	7005723	SVOC			X (4-Bromophenyl-phenylether)
Chromium (total)		INORG	X[8]		
Chrysene	218019	SVOC		X	
Cobalt	7440484	INORG		X	
Copper	7440508	INORG	[4]	[4]	[4]
4,4'-DDD	72548	PEST		X	
4,4'-DDE	72559	PEST		X	
4,4'-DDT	50293	PEST		X	
Dibenzofuran	132649	SVOC		X	
Dibenz(a,h)anthracene	53703	SVOC		X	
1,2-Dibromo-3-chloropropane	96128	VOC		X	
1,2-Dibromoethane	106934	VOC		X	
1,2-Dichlorobenzene	95501	VOC/SVOC	X		
1,3-Dichlorobenzene	541731	VOC/SVOC	X		
1,4-Dichlorobenzene	106467	VOC/SVOC	X		
3,3'-Dichlorobenzidine	91941	SVOC		X	
1,1-Dichloroethane	75343	VOC	X		
1,2-Dichloroethane	107062	VOC	X		
1,1-Dichloroethene	75354	VOC	X		
1,2-Dichloroethene (cis-)	156592	VOC	X		
1,2-Dichloroethene (trans-)	156605	VOC	X		
1,2-Dichloroethene (total)	156605	VOC		X	
2,4-Dichlorophenol	120832	SVOC	X		
1,2-Dichloropropane	78875	VOC	X		
1,3-Dichloropropene (cis-)	542756	VOC	X		
1,3-Dichloropropene (trans-)	542756	VOC	X		
Dieldrin	60571	PEST	X		
Diethyl phthalate	84662	SVOC		X	
2,4-Dimethylphenol	105679	SVOC		X	
Dimethylphthalate	131113	SVOC		X	
Di-n-butylphthalate	84742	SVOC	X		
Di-n-octylphthalate	117840	SVOC	X		
4,6-Dinitro-2-methylphenol	534521	SVOC		X	
2,4-Dinitrophenol	51285	SVOC		X	
2,4-Dinitrotoluene	121142	SVOC		X	
2,6-Dinitrotoluene	606202	SVOC		X	
Endosulfan I	115297	PEST		X[9]	
Endosulfan II	115297	PEST		X[9]	
Endosulfan sulfate	1031078	PEST			X (endosulfan)
Endrin	72208	PEST	X		
Endrin aldehyde	7421363	PEST			X (endrin)
Endrin ketone	53494705	PEST			X (endrin)

TABLE 1

SOURCE OF CONNECTICUT REMEDIATION STANDARDS
CTO 260 LOWER SUBASE RI
NEW LONDON, GROTON, CONNECTICUT

Chemical	CAS Number	Chemical Fraction	Basis of Value to be Used in RI Report		
			Promulgated Value[1]	Calculated Value[2]	Surrogate Calculated Value[3]
Ethylbenzene	100414	VOC	X		
Fluoranthene	206440	SVOC	X		
Fluorene	86737	SVOC	X		
Heptachlor	76448	PEST	X		
Heptachlor epoxide	1024573	PEST	X		
Hexachlorobenzene	118741	SVOC	X		
Hexachlorobutadiene	87683	SVOC		X	
Hexachlorocyclopentadiene	77474	SVOC		X	
Hexachloroethane	67721	SVOC	X		
2-Hexanone	73663715	VOC		X	
Indeno(1,2,3-cd)pyrene	193395	SVOC		X	
Iron	7439896	INORG	(4)	(4)	(4)
Isophorone	78591	SVOC		X	
Lead	7439291	INORG	X		
Magnesium	7439954	INORG	(6)	(6)	(6)
Manganese	7439965	INORG		X	
Mercury	7439976	INORG	X		
Methoxychlor	72435	PEST	X		
Methylene chloride	75092	VOC	X		
2-Methylnaphthalene	91576	SVOC		X	
4-Methyl-2-pentanone	108101	VOC	X		
2-Methylphenol	95487	SVOC		X	
4-Methylphenol	106445	SVOC		X	
Naphthalene	91203	SVOC	X		
Nickel	7440020	INORG	X		
2-Nitroaniline	88744	SVOC		X	
3-Nitroaniline	99092	SVOC		X	
4-Nitroaniline	100016	SVOC		X	
Nitrobenzene	98953	SVOC		X	
2-Nitrophenol	88755	SVOC			X (4-nitrophenol)
4-Nitrophenol	100027	SVOC		X	
N-Nitrosodiphenylamine	86306	SVOC		X	
N-Nitrosodi-n-propylamine	621647	SVOC		X	
2,2'-Oxybis(1-chloropropane)	108601	SVOC	(5)	(5)	(5)
Pentachlorophenol	87865	SVOC	X		
Phenanthrene	85018	SVOC	X		
Phenol	108952	SVOC	X		
Potassium	7440097	INORG	(6)	(6)	(6)
Pyrene	129000	SVOC	X		
Selenium	7782492	INORG	X		
Silver	7440224	INORG	X		
Sodium	7440235	INORG	(6)	(6)	(6)
Styrene	100425	VOC	X		
1,1,2,2-Tetrachloroethane	79345	VOC	X		
Tetrachloroethylene	127184	VOC	X		
Thallium	6533739	INORG	X		
Toluene	108883	VOC	X		
Toxaphene	8001352	PEST	X		

TABLE 1

SOURCE OF CONNECTICUT REMEDIATION STANDARDS
CTO 260 LOWER SUBASE RI
NEW LONDON, GROTON, CONNECTICUT

Chemical	CAS Number	Chemical Fraction	Basis of Value to be Used in RI Report		
			Promulgated Value[1]	Calculated Value[2]	Surrogate Calculated Value[3]
1,2,4-Trichlorobenzene	120821	SVOC		X	
1,1,1-Trichloroethane	71556	VOC	X		
1,1,2-Trichloroethane	79005	VOC	X		
Trichloroethylene	79016	VOC	X		
2,4,5-Trichlorophenol	95954	SVOC		X	
2,4,6-Trichlorophenol	88062	SVOC		X	
Vanadium	7440622	INORG	X		
Vinyl chloride	75014	VOC	X		
Xylene (total)	1330207	VOC	X		
Zinc	7440666	INORG	X		

INORG Inorganic
PEST Pesticide
SVOC Semivolatile organic compound
VOC Volatile organic compound

1 State of Connecticut Remediation Standard Regulations, Section 22a-133k (January 1996).
2 Published toxicity criteria is available. Toxicity criteria from the current USEPA Region III Risk-Based Concentration Table (October 22, 1997) will be used to calculate a value using the methodology presented in the State guidance (January 1996).
3 No toxicity criteria is available. Toxicity criteria for a similarly structured chemical (noted in parentheses) will be used to calculate a value.
4 Region I does not advocate a quantitative evaluation of this chemical. Exposure to this chemical will be addressed in a qualitative fashion.
5 No promulgated value or published toxicity criteria are available. A similarly structured chemical with published toxicity criteria could not be identified. Exposure to this chemical will be addressed in a qualitative fashion.
6 Chemical is an essential nutrient.
7 Value for chlordane is used.
8 Value for hexavalent chromium is used for conservative purposes.
9 Value for endosulfan is used.

TABLE 2

CALCULATED AND SURROGATE CALCULATED VALUES
CTO 260 LOWER SUBASE RI
NEW LONDON, GROTON, CONNECTICUT

Chemical	Published Toxciological Criteria[1]		Calculated Remediation Standards[2]				
	RfD_{oral} (mg/kg/day)	CSF_{oral} (kg/day/mg)	Soil (mg/kg)				Groundwater (ug/L)
			RES DE[3]	I/C DE[3]	GA/GAA PM	GB PM	GA/GAA GP
Acenaphthene	6.00E-02	NA	1000[4]	2500[4]	8.4	84	420
Aldrin	3.00E-05	1.70E+01	0.036	0.34	0.000041	0.00041	0.0021
Benzo(g,h,i)perylene	NA	NA	1000[5]	2500[5]	4[5]	40[5]	200[5]
BCH (alpha-)	NA	6.30E+00	0.097	0.91	0.00011	0.0011	0.0056
BCH (beta-)	NA	1.80E+00	0.34	3.2	0.00039	0.0039	0.0194
BCH (delta-)	NA	NA	0.097[6]	0.91[6]	0.00011[6]	0.0011[6]	0.0056[6]
Bromochloromethane	NA	NA	9.9[7]	92[7]	0.011[7]	0.11[7]	0.56[7]
Bromodichloromethane	2.00E-02	6.20E-02	9.9	92	0.011	0.11	0.56
Bromomethane	1.40E-03	NA	95	1000[4]	0.2	2	9.8
4-Bromophenyl-phenylether	5.80E-02	NA	500[4]	1000[4]	8.2	82	410
Carbazole	NA	2.00E-02	31	290	0.036	0.36	1,8
Carbon disulfide	1.00E-01	NA	500[4]	1000[4]	14	140	700
4-Chloroaniline	4.00E-03	NA	270	2500[4]	0.56	5.6	28
Chloroethane	4.00E-01	2.90E-03	210	1000[4]	0.24	2.4	12
Chloromethane	NA	1.30E-02	47	440	0.054	0.54	2.7
4-Chloro-3-methylphenol	NA	NA	NA[8]	NA[8]	NA[8]	NA[8]	NA[8]
2-Chloronaphthalene	8.00E-02	NA	1000[4]	2500[4]	11	110	560
4-Chlorophenyl-phenylether	NA	NA	500[9]	1000[9]	8.2[9]	82[9]	410[9]
Chrysene	NA	7.30E-03	84	780	0.096	0.96	4.8
Cobalt	6.00E-02	NA	1000[4]	2500[4]	420[10]	4200[10]	420
4,4'-DDD	NA	2.40E-01	2.6	24	0.0029	0.029	0.15
4,4'-DDE	NA	3.40E-01	1.8	17	0.0021	0.021	0.1
4,4'-DDT	5.00E-04	3.40E-01	1.8	17	0.0021	0.021	0.1
Dibenzofuran	4.00E-03	NA	270	2500[4]	0.56	5.6	28
Dibenz(a,h)anthracene	NA	7.30E+00	0.084	0.78	0.000096	0.00096	0.0048
1,2-Dibromo-3-chloropropane	NA	1.40E+00	0.44	4.1	0.0005	0.005	0.025
1,2-Dibromoethane	NA	8.50E+01	0.0072	0.067	0.0000082	0.000082	0.00041
3,3'-Dichlorobenzidine	NA	4.50E-01	1.4	13	0.0016	0.016	0.078
1,2-Dichloroethene (total)	9.00E-03	NA	500[4]	1000[4]	1.2	12	63
Diethyl phthalate	8.00E-01	NA	1000[4]	2500[4]	110	1100	5600
2,4-Dimethylphenol	2.00E-02	NA	1000[4]	2500[4]	2,8	28	140
Dimethylphthalate	1.00E+01	NA	1000[4]	2500[4]	1400	14000	70000

TABLE 2

CALCULATED AND SURROGATE CALCULATED VALUES
CTO 260 LOWER SUBASE RI
NEW LONDON, GROTON, CONNECTICUT

Chemical	Published Toxciological Criteria[1]		Calculated Remediation Standards[2]				
	RfD_{oral} (mg/kg/day)	CSF_{oral} (kg/day/mg)	Soil (mg/kg)				Groundwater (ug/L)
			RES DE[3]	I/C DE[3]	GA/GAA PM	GB PM	GA/GAA GP
4,6-Dinitro-2-methylphenol	1.00E-04	NA	6.8	200	0.014	0.14	0.7
2,4-Dinitrophenol	2.00E-03	NA	140	2500[4]	0.28	2.8	14
2,4-Dinitrotoluene	2.00E-03	NA	140	2500[4]	0.28	2.8	14
2,6-Dinitrotoluene	1.00E-03	NA	68	2000	0.14	1.4	7
Endosulfan I	6.00E-03	NA	410	1200	0.84	8.4	42
Endosulfan II	6.00E-03	NA	410	1200	0.84	8.4	42
Endosulfan sulfate	NA	NA	410[12]	1200[12]	0.84[12]	8.4[12]	42[12]
Endrin aldehyde	NA	NA	20[13]	610[13]	NE[13]	NE[13]	NE[13]
Endrin ketone	NA	NA	20[13]	610[13]	NE[13]	NE[13]	NE[13]
Hexachlorobutadiene	2.00E-04	7.80E-02	7.9	73	0.009	0.09	0.45
Hexachlorocyclopentadiene	7.00E-03	NA	470	2500[4]	0.98	9.8	49
2-Hexanone	4.00E-02	NA	500[4]	1000[4]	5.6	56	280
Indeno(1,2,3-cd)pyrene	NA	7.30E-01	0.84	7.8	0.00096	0.0096	0.045
Isophorone	2.00E-01	9.50E-04	640	2500[4]	0.74	7.4	37
Manganese	2.30E-02	NA	1600	47000	50[10][14]	500[10][14]	160
2-Methylnaphthalene	4.00E-02	NA	1000[4]	2500[4]	5.6	56	280
2-Methylphenol	5.00E-02	NA	1000[4]	2500[4]	7	70	350
4-Methylphenol	5.00E-03	NA	340	2500[4]	0.7	7	35
2-Nitroaniline	6.00E-05	NA	4.1	1200	0.0084	0.084	0.42
3-Nitroaniline	3.00E-03	NA	200	2500[4]	0.42	4.2	21
4-Nitroaniline	3.00E-03	NA	200	2500[4]	0.42	4.2	21
Nitrobenzene	5.00E-04	NA	34	1000	0.07	0.7	3.5
2-Nitrophenol	NA	NA	540[15]	2500[15]	1.1[15]	11[15]	56[15]
4-Nitrophenol	8.00E-03	NA	540	2500[4]	1.1	11	56
N-Nitrosodiphenylamine	NA	4.90E-03	130	1200	0.14	1.4	7.1
N-Nitrosodi-n-propylamine	NA	7.00E+00	0.088	0.82	0.0001	0.001	0.005
1,2,4-Trichlorobenzene	1.00E-02	NA	680	2500[4]	1.4	14	70
2,4,5-Trichlorophenol	1.00E-01	NA	1000[4]	2500[4]	14	140	700
2,4,6-Trichlorophenol	NA	1.10E-02	56	520	0.064	0.64	3.2

RfD Reference dose
CSF Cancer slope factor

TABLE 2

CALCULATED AND SURROGATE CALCULATED VALUES
CTO 260 LOWER SUBASE RI
NEW LONDON, GROTON, CONNECTICUT

RES DE	Direct exposure criteria for residential land use
I/C DE	Direct exposure criteria for industrial/commercial land use.
GA/GAA PM	Pollutant mobility criteria for a GA/GAA classified area
GB PM	Pollutant mobility criteria for a GB classified area
GA/GAA GP	Groundwater protection criteria for a GA/GAA classified area
NA	Not available
NE	None established by Connecticut DEP (January 1996)

1 Values obtained from current USEPA Region III Risk-Based Concentration Table (October 22, 1997)
2 Calculated using methodologies presented in State guidance (January 1996).
3 Calculated value for direct exposure for volatile and semivolatile organics is replaced with the appropriate ceiling limit if the calculated value exceeds the ceiling limit. Ceiling limit for volatiles is 500 mg/kg for residential exposure and 1000 mg/kg for industrial/commercial exposure. Ceiling limit for semivolatiles is 1000 mg/kg for residential exposure and 2500 mg/kg for industrial/commercial exposure.
4 Ceiling limit. Calculated value exceeds the ceiling limit.
5 Value for pyrene is used.
6 Value for alpha-BHC is used.
7 Value for bromodichloromethane is used.
8 Chemical will be addressed qualitatively at CTEP's request
9 Value for 4-bromophenyl-phenylether is used.
10 Value is for aqueous units (ug/L) and is based on SPLP or TCLP analytical results.
11 Value is based on the Region III RBC for tap water (2200 ug/L).
12 Value for endosulfan is used.
13 Value for endrin is used.
14 Value is based on the secondary Federal MCL for drinking water (50 ug/L).
15 Value for 4-nitrophenol is used.

Brown & Root Environmental

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C-49-12-7-188

December 23, 1997

Brown & Root Environmental Project Number 7237

Mr. Mark Lewis
Connecticut Department of Environmental Protection
Water Management Bureau
Permitting, Enforcement, and Remediation Division
Federal Remediation Program
79 Elm Street
Hartford, Connecticut 06106-5127

Reference: CLEAN Contract No. N62472-90-D-1298
Contract Task Order No. 0260

Subject: Calculated CTDEP Remediation Standards
Lower Subase Remedial Investigation
Naval Submarine Base - New London, Groton, Connecticut

Dear Mr. Lewis:

In preparation of the Lower Subase Remedial Investigation (RI) Report, Brown & Root (B&R) Environmental has calculated Remediation Standards following the State of Connecticut Remediation Standard Regulations of January 1996. Standards were developed for all chemicals that were analyzed for during the RI sampling and analysis program that did not have previously established CTDEP standards. The intent of this memo is to identify the sources of the standards to be used in the RI Report and to identify those values which have been developed by B&R Environmental using the State guidance.

Background information and the calculated Remediation Standards are provided in Table 1 and Table 2, respectively, which are enclosed. Table 1 summarizes the basis for the chemical-specific remediation standards (i.e., promulgated, calculated, or calculated using a surrogate) to be included in the RI. The calculated soil Direct Exposure and Pollutant Mobility standards, as well as the Groundwater Standard, are provided in Table 2.

It should be noted that pollutant mobility and groundwater standards for GA classified groundwater are provided in Table 2 for completeness. The groundwater at the Lower Subase is classified as GB, therefore standards applicable to GB classified groundwater will be emphasized in the Lower Subase RI Report.

B&R Environmental intends on using these criteria, as well as Region III RBCs, as part of the human health risk assessment for the Lower Subase RI to screen for chemicals of potential concern. Therefore, B&R Environmental, on the behalf of the United States Navy, requests that the CTDEP review and approve the standards in Table 2. It is hoped that prior approval of the criteria will alleviate unnecessary revisions to the RI Report in the future and expedite any additional risk-related work required by the State (i.e., application for use of alternative criteria).

Due to the current time constraints for preparing the Lower Subase RI, it is requested that the CTDEP complete their review by no later than January 16, 1997. If you have any questions regarding the information provided in the tables or the schedule for the review please contact Mr. Mark Evans at (610) 595-0567 (ext. 162) or me at (412) 921-8244.

Very truly yours,

Corey A. Rich, P.E.
Project Manager

Enclosure(s)

c: Mr. Mark Evans, NORTHDIV
Mr. Richard Conant, NSB-NLON Environmental
Ms. Karen Smecker, B&R Environmental
File: CTO 0260

TABLE 1

SOURCE OF CONNECTICUT REMEDIATION STANDARDS
CTO 260 LOWER SUBASE RI
NEW LONDON, GROTON, CONNECTICUT

Chemical	CAS Number	Chemical Fraction	Basis of Value to be Used in RI Report		
			Promulgated Value[1]	Calculated Value[2]	Surrogate Calculated Value[3]
Acenaphthene	83329	SVOC		X	
Acenaphthylene	208968	SVOC	X		
Anthracene	120127	SVOC	X		
Acetone	67641	VOC	X		
Aldrin	309002	PEST		X	
Aluminum	7429905	INORG	[4]	[4]	[4]
Antimony	7440360	INORG	X		
Arsenic	7440382	INORG	X		
Barium	7440393	INORG	X		
Benzene	71432	VOC	X		
Benz(a)anthracene	56553	SVOC	X		
Benzo(b)fluoranthene	205992	SVOC	X		
Benzo(k)fluoranthene	207089	SVOC	X		
Benzo(g,h,i)perylene	191242	SVOC			X (naphthalene)
Benzo(a)pyrene	50328	SVOC	X		
Beryllium	7440417	INORG	X		
BCH (alpha-)	319846	PEST		X	
BCH (beta-)	319857	PEST		X	
BCH (delta-)	319868	PEST			X (alpha-BHC)
BCH (gamma-; Lindane)	58899	PEST	X		
Bis(2-chloroethoxy)methane	111911	SVOC	[5]	[5]	[5]
Bis(2-chloroethyl)ether	111444	SVOC	X		
Bis(2-ethylhexyl)phthalate	117817	SVOC	X		
Bromochloromethane	74975	VOC			X (chloromethane)
Bromodichloromethane	75274	VOC		X	
Bromoform	75252	VOC	X		
Bromomethane	74839	VOC		X	
4-Bromophenyl-phenylether	101553	SVOC		X	
2-Butanone	78933	VOC	X		
Butylbenzylphthalate	85687	SVOC	X		
Cadmium	7440439	INORG	X		
Calcium	7440702	INORG	[6]	[6]	[6]
Carbazole	86748	SVOC		X	
Carbon disulfide	75150	VOC		X	
Carbon tetrachloride	56235	VOC	X		
Chlordane (alpha-)	57749	PEST	X[7]		
Chlordane (gamma-)	57749	PEST	X[7]		
4-Chloroaniline	106478	SVOC		X	
Chlorobenzene	108907	VOC	X		
Chlorodibromomethane	124481	VOC	X		
Chloroethane	75003	VOC		X	
Chloroform	67663	VOC	X		
Chloromethane	74873	VOC		X	

TABLE 1

SOURCE OF CONNECTICUT REMEDIATION STANDARDS
CTO 260 LOWER SUBASE RI
NEW LONDON, GROTON, CONNECTICUT

Chemical	CAS Number	Chemical Fraction	Basis of Value to be Used in RI Report		
			Promulgated Value[1]	Calculated Value[2]	Surrogate Calculated Value[3]
4-Chloro-3-methylphenol	59507	SVOC			X (3-methylphenol)
2-Chloronaphthalene	91587	SVOC		X	
2-Chlorophenol	95578	SVOC	X		
4-Chlorophenyl-phenylether	7005723	SVOC			X (4-Bromophenyl-phenylether)
Chromium (total)		INORG	X[8]		
Chrysene	218019	SVOC		X	
Cobalt	7440484	INORG		X	
Copper	7440508	INORG	[4]	[4]	[4]
4,4'-DDD	72548	PEST		X	
4,4'-DDE	72559	PEST		X	
4,4'-DDT	50293	PEST		X	
Dibenzofuran	132649	SVOC		X	
Dibenz(a,h)anthracene	53703	SVOC		X	
1,2-Dibromo-3-chloropropane	96128	VOC		X	
1,2-Dibromoethane	106934	VOC		X	
1,2-Dichlorobenzene	95501	VOC/SVOC	X		
1,3-Dichlorobenzene	541731	VOC/SVOC	X		
1,4-Dichlorobenzene	106467	VOC/SVOC	X		
3,3'-Dichlorobenzidine	91941	SVOC		X	
1,1-Dichloroethane	75343	VOC	X		
1,2-Dichloroethane	107062	VOC	X		
1,1-Dichloroethene	75354	VOC	X		
1,2-Dichloroethene (cis-)	156592	VOC	X		
1,2-Dichloroethene (trans-)	156605	VOC	X		
1,2-Dichloroethene (total)	156605	VOC		X	
2,4-Dichlorophenol	120832	SVOC	X		
1,2-Dichloropropane	78875	VOC	X		
1,3-Dichloropropene (cis-)	542756	VOC	X		
1,3-Dichloropropene (trans-)	542756	VOC	X		
Dieldrin	60571	PEST	X		
Diethyl phthalate	84662	SVOC		X	
2,4-Dimethylphenol	105679	SVOC		X	
Dimethylphthalate	131113	SVOC		X	
Di-n-butylphthalate	84742	SVOC	X		
Di-n-octylphthalate	117840	SVOC	X		
4,6-Dinitro-2-methylphenol	534521	SVOC		X	
2,4-Dinitrophenol	51285	SVOC		X	
2,4-Dinitrotoluene	121142	SVOC		X	
2,6-Dinitrotoluene	606202	SVOC		X	
Endosulfan I	115297	PEST		X[9]	
Endosulfan II	115297	PEST		X[9]	
Endosulfan sulfate	1031078	PEST			X (endosulfan)

TABLE 1

SOURCE OF CONNECTICUT REMEDIATION STANDARDS
CTO 260 LOWER SUBASE RI
NEW LONDON, GROTON, CONNECTICUT

Chemical	CAS Number	Chemical Fraction	Basis of Value to be Used in RI Report		
			Promulgated Value[1]	Calculated Value[2]	Surrogate Calculated Value[3]
Endrin	72208	PEST	X		
Endrin aldehyde	7421363	PEST			X (endrin)
Endrin ketone	53494705	PEST			X (endrin)
Ethylbenzene	100414	VOC	X		
Fluoranthene	206440	SVOC	X		
Fluorene	86737	SVOC	X		
Heptachlor	76448	PEST	X		
Heptachlor epoxide	1024573	PEST	X		
Hexachlorobenzene	118741	SVOC	X		
Hexachlorobutadiene	87683	SVOC		X	
Hexachlorocyclopentadiene	77474	SVOC		X	
Hexachloroethane	67721	SVOC	X		
2-Hexanone	73663715	VOC		X	
Indeno(1,2,3-cd)pyrene	193395	SVOC		X	
Iron	7439896	INORG	(4)	(4)	(4)
Isophorone	78591	SVOC		X	
Lead	7439291	INORG	X		
Magnesium	7439954	INORG	(6)	(6)	(6)
Manganese	7439965	INORG		X	
Mercury	7439976	INORG	X		
Methoxychlor	72435	PEST	X		
Methylene chloride	75092	VOC	X		
2-Methylnaphthalene	91576	SVOC		X	
4-Methyl-2-pentanone	108101	VOC	X		
2-Methylphenol	95487	SVOC		X	
4-Methylphenol	106445	SVOC		X	
Naphthalene	91203	SVOC	X		
Nickel	7440020	INORG	X		
2-Nitroaniline	88744	SVOC		X	
3-Nitroaniline	99092	SVOC		X	
4-Nitroaniline	100016	SVOC		X	
Nitrobenzene	98953	SVOC		X	
2-Nitrophenol	88755	SVOC			X (4-nitrophenol)
4-Nitrophenol	100027	SVOC		X	
N-Nitrosodiphenylamine	86306	SVOC		X	
N-Nitrosodi-n-propylamine	621647	SVOC		X	
2,2'-Oxybis(1-chloropropane)	108601	SVOC	(5)	(5)	(5)
Pentachlorophenol	87865	SVOC	X		
Phenanthrene	85018	SVOC			X (naphthalene)
Phenol	108952	SVOC	X		
Potassium	7440097	INORG	(6)	(6)	(6)
Pyrene	129000	SVOC	X		

TABLE 1

SOURCE OF CONNECTICUT REMEDIATION STANDARDS
CTO 260 LOWER SUBASE RI
NEW LONDON, GROTON, CONNECTICUT

Chemical	CAS Number	Chemical Fraction	Basis of Value to be Used in RI Report		
			Promulgated Value[1]	Calculated Value[2]	Surrogate Calculated Value[3]
Selenium	7782492	INORG	X		
Silver	7440224	INORG	X		
Sodium	7440235	INORG	(6)	(6)	(6)
Styrene	100425	VOC	X		
1,1,2,2-Tetrachloroethane	79345	VOC	X		
Tetrachloroethylene	127184	VOC	X		
Thallium	6533739	INORG	X		
Toluene	108883	VOC	X		
Toxaphene	8001352	PEST	X		
1,2,4-Trichlorobenzene	120821	SVOC		X	
1,1,1-Trichloroethane	71556	VOC	X		
1,1,2-Trichloroethane	79005	VOC	X		
Trichloroethylene	79016	VOC	X		
2,4,5-Trichlorophenol	95954	SVOC		X	
2,4,6-Trichlorophenol	88062	SVOC		X	
Vanadium	7440622	INORG	X		
Vinyl chloride	75014	VOC	X		
Xylene (total)	1330207	VOC	X		
Zinc	7440666	INORG	X		

INORG Inorganic
PEST Pesticide
SVOC Semivolatile organic compound
VOC Volatile organic compound

1 State of Connecticut Remediation Standard Regulations, Section 22a-133k (January 1996).
2 Published toxicity criteria is available. Toxicity criteria from the current USEPA Region III Risk-Based Concentration Table (October 22, 1997) will be used to calculate a value using the methodology presented in the State guidance (January 1996).
3 No toxicity criteria is available. Toxicity criteria for a similarly structured chemical (noted in parentheses) will be used to calculate a value.
4 Region I does not advocate a quantitative evaluation of this chemical. Exposure to this chemical will be addressed in a qualitative fashion.
5 No promulgated value or published toxicity criteria are available. A similarly structured chemical with published toxicity criteria could not be identified. Exposure to this chemical will be addressed in a qualitative fashion.
6 Chemical is an essential nutrient.
7 Value for chlordane is used.
8 Value for hexavalent chromium is used for conservative purposes.
9 Value for endosulfan is used.

TABLE 2

CALCULATED AND SURROGATE CALCULATED VALUES
CTO 260 LOWER SUBASE RI
NEW LONDON, GROTON, CONNECTICUT

Chemical	Published Toxciological Criteria[1]		Calculated Remediation Standards[2]				
	RfD_{oral} (mg/kg/day)	CSF_{oral} (kg/day/mg)	Soil (mg/kg)				Groundwater (ug/L)
			RES DE[3]	I/C DE[3]	GA/GAA PM	GB PM	GA/GAA GP
Acenaphthene	6.00E-02	NA	1000[4]	2500[4]	8.4	84	420
Aldrin	3.00E-05	1.70E+01	0.036	0.34	0.000041	0.00041	0.0021
Benzo(g,h,i)perylene	NA	NA	1000[5]	2500[5]	5.6[5]	56[5]	280[5]
BCH (alpha-)	NA	6.30E+00	0.097	0.91	0.00011	0.0011	0.0056
BCH (beta-)	NA	1.80E+00	0.34	3.2	0.00039	0.0039	0.0194
BCH (delta-)	NA	NA	0.097[6]	0.91[6]	0.00011[6]	0.0011[6]	0.0056[6]
Bromochloromethane	NA	NA	47[7]	440[7]	0.054[7]	0.54[7]	2.7[7]
Bromodichloromethane	2.00E-02	6.20E-02	9.9	92	0.011	0.11	0.56
Bromomethane	1.40E-03	NA	95	1000[4]	0.2	2	9.8
4-Bromophenyl-phenylether	5.80E-02	NA	500[4]	1000[4]	8.2	82	410
Carbazole	NA	2.00E-02	31	290	0.036	0.36	1,8
Carbon disulfide	1.00E-01	NA	500[4]	1000[4]	14	140	700
4-Chloroaniline	4.00E-03	NA	270	2500[4]	0.56	5.6	28
Chloroethane	4.00E-01	2.90E-03	210	1000[4]	0.24	2.4	12
Chloromethane	NA	1.30E-02	47	440	0.054	0.54	2.7
4-Chloro-3-methylphenol	NA	NA	1000[8]	2500[8]	7[8]	70[8]	350[8]
2-Chloronaphthalene	8.00E-02	NA	1000[4]	2500[4]	11	110	560
4-Chlorophenyl-phenylether	NA	NA	500[9]	1000[9]	8.2[9]	82[9]	410[9]
Chrysene	NA	7.30E-03	84	780	0.096	0.96	4.8
Cobalt	6.00E-02	NA	1000[4]	2500[4]	2200[10][11]	22000[10][11]	420
4,4'-DDD	NA	2.40E-01	2.6	24	0.0029	0.029	0.15
4,4'-DDE	NA	3.40E-01	1.8	17	0.0021	0.021	0.1
4,4'-DDT	5.00E-04	3.40E-01	1.8	17	0.0021	0.021	0.1
Dibenzofuran	4.00E-03	NA	270	2500[4]	0.56	5.6	28
Dibenz(a,h)anthracene	NA	7.30E+00	0.084	0.78	0.000096	0.00096	0.0048
1,2-Dibromo-3-chloropropane	NA	1.40E+00	0.44	4.1	0.0005	0.005	0.025
1,2-Dibromoethane	NA	8.50E+01	0.0072	0.067	0.0000082	0.000082	0.00041
3,3'-Dichlorobenzidine	NA	4.50E-01	1.4	13	0.0016	0.016	0.078
1,2-Dichloroethene (total)	2.00E-02	NA	500[4]	1000[4]	2.8	28	140
Diethyl phthalate	8.00E-01	NA	1000[4]	2500[4]	110	1100	5600

TABLE 2

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CTO 260 LOWER SUBASE RI
NEW LONDON, GROTON, CONNECTICUT

Chemical	Published Toxciological Criteria[1]		Calculated Remediation Standards[2]				
			Soil (mg/kg)				Groundwater (ug/L)
	RfD_{oral} (mg/kg/day)	CSF_{oral} (kg/day/mg)	RES DE[3]	I/C DE[3]	GA/GAA PM	GB PM	GA/GAA GP
2,4-Dimethylphenol	2.00E-02	NA	1000[4]	2500[4]	2,8	28	140
Dimethylphthalate	1.00E+01	NA	1000[4]	2500[4]	1400	1400	70000
4,6-Dinitro-2-methylphenol	1.00E-04	NA	6.8	200	0.014	0.14	0.7
2,4-Dinitrophenol	2.00E-03	NA	140	2500[4]	0.28	2.8	14
2,4-Dinitrotoluene	2.00E-03	NA	140	2500[4]	0.28	2.8	14
2,6-Dinitrotoluene	1.00E-03	NA	68	2000	0.14	1.4	7
Endosulfan I	6.00E-03	NA	410	1200	0.84	8.4	42
Endosulfan II	6.00E-03	NA	410	1200	0.84	8.4	42
Endosulfan sulfate	NA	NA	410[12]	1200[12]	0.84[12]	8.4[12]	42[12]
Endrin aldehyde	NA	NA	20[13]	610[13]	NE[13]	NE[13]	NE[13]
Endrin ketone	NA	NA	20[13]	610[13]	NE[13]	NE[13]	NE[13]
Hexachlorobutadiene	2.00E-04	7.80E-02	7.9	73	0.009	0.09	0.45
Hexachlorocyclopentadiene	7.00E-03	NA	470	2500[4]	0.98	9.8	49
2-Hexanone	4.00E-02	NA	500[4]	1000[4]	5.6	56	280
Indeno(1,2,3-cd)pyrene	NA	7.30E-01	0.84	7.8	0.00096	0.0096	0.045
Isophorone	2.00E-01	9.50E-04	640	2500[4]	0.74	7.4	37
Manganese	2.30E-02	NA	1600	47000	50[10][14]	500[10][14]	160
2-Methylnaphthalene	4.00E-02	NA	1000[4]	2500[4]	5.6	56	280
2-Methylphenol	5.00E-02	NA	1000[4]	2500[4]	7	70	350
4-Methylphenol	5.00E-03	NA	340	2500[4]	0.7	7	35
2-Nitroaniline	6.00E-05	NA	4.1	1200	0.0084	0.084	0.42
3-Nitroaniline	3.00E-03	NA	200	2500[4]	0.42	4.2	21
4-Nitroaniline	3.00E-03	NA	200	2500[4]	0.42	4.2	21
Nitrobenzene	5.00E-04	NA	34	1000	0.07	0.7	3.5
2-Nitrophenol	NA	NA	540[15]	2500[15]	1.1[15]	11[15]	56[15]
4-Nitrophenol	8.00E-03	NA	540	2500[4]	1.1	11	56
N-Nitrosodiphenylamine	NA	4.90E-03	130	1200	0.14	1.4	7.1
N-Nitrosodi-n-propylamine	NA	7.00E+00	0.088	0.82	0.0001	0.001	0.005
Phenanthrene	NA	NA	1000[5]	2500[5]	5.6[5]	56[5]	280[5]
1,2,4-Trichlorobenzene	1.00E-02	NA	680	2500[4]	1.4	14	70

TABLE 2

CALCULATED AND SURROGATE CALCULATED VALUES
CTO 260 LOWER SUBASE RI
NEW LONDON, GROTON, CONNECTICUT

Chemical	Published Toxciological Criteria[1]		Calculated Remediation Standards[2]				
	RfD_{oral} (mg/kg/day)	CSF_{oral} (kg/day/mg)	Soil (mg/kg)				Groundwater (ug/L)
			RES DE[3]	I/C DE[3]	GA/GAA PM	GB PM	GA/GAA GP
2,4,5-Trichlorophenol	1.00E-01	NA	1000[4]	2500[4]	14	140	700
2,4,6-Trichlorophenol	NA	1.10E-02	56	520	0.064	0.64	3.2

RfD	Reference dose
CSF	Cancer slope factor
RES DE	Direct exposure criteria for residential land use
I/C DE	Direct exposure criteria for industrial/commercial land use.
GA/GAA PM	Pollutant mobility criteria for a GA/GAA classified area
GB PM	Pollutant mobility criteria for a GB classified area
GA/GAA GP	Groundwater protection criteria for a GA/GAA classified area
NA	Not available
NE	None established by Connecticut DEP (January 1996)

1 Values obtained from current USEPA Region III Risk-Based Concentration Table (October 22, 1997)
2 Calculated using methodologies presented in State guidance (January 1996).
3 Calculated value for direct exposure for volatile and semivolatile organics is replaced with the appropriate ceiling limit if the calculated value exceeds the ceiling limit. Ceiling limit for volatiles is 500 mg/kg for residential exposure and 1000 mg/kg for industrial/commercial exposure. Ceiling limit for semivolatiles is 1000 mg/kg for residential exposure and 2500 mg/kg for industrial/commercial exposure.
4 Ceiling limit. Calculated value exceeds the ceiling limit.
5 Value for naphthalene is used.
6 Value for alpha-BHC is used.
7 Value for chloromethane is used.
8 Value for 3-methylphenol is used.
9 Value for 4-bromophenyl-phenylether is used.
10 Value is for aqueous units (ug/L) and is based on SPLP or TCLP analytical results.
11 Value is based on the Region III RBC for tap water (2200 ug/L).
12 Value for endosulfan is used.
13 Value for endrin is used.
14 Value is based on the secondary Federal MCL for drinking water (50 ug/L).
15 Value for 4-nitrophenol is used.

D-4 SAMPLE EPC CALCULATIONS

Appendix D-4
Raymark OU4
Check UCL Calculations Lead in Soil 0 to 15 feet
By Gary Glennon 6/21/99

Interpolation of $H_{0.95}$ Table

$n = 154$ $s = 2.731$

$n_1 = 101$ $s_1 = 2.50$ $H_1 = 3.920$ $H_2 = 3.729$

$n_2 = 201$ $s_2 = 3.00$ $H_3 = 4.569$ $H_4 = 4.334$

$$H\,interpol\,1 = (((H_2 - H_1)/(n_2 - n_1)) \times (n - n_1)) + H_1$$
$$= (((3.729 - 3.920)/(201 - 101)) \times (154 - 101)) + 3.920$$
$$= 3.819$$

$$H\,interpol\,2 = (((H_4 - H_3)/(n_2 - n_1)) \times (n - n_1)) + H_3$$
$$= (((4.334 - 4.569)/(201 - 101)) \times (154 - 101)) + 4.569$$
$$= 4.444$$

$$H = (((H\,interpol\,2 - H\,interpol\,1)/(s_2 - s_1)) \times (s - s_1)) + H\,interpol\,1$$
$$= (((4.444 - 3.819)/(3.00 - 2.50)) \times (2.731 - 2.50) + 3.819$$
$$= 4.108$$

Interpolation of t

$df = 153$

$df_1 = 120$ $t_1 = 1.658$

$df_2 = 500$ $t_2 = 1.645$

$$t = t_1 + ((df - df_1)/(df_2 - df_1)) \times (t_2 - t_1)$$
$$= 1.658 + ((153 - 120)/(500 - 120)) \times (1.645 - 1.658) = 1.657$$

Calculation of UCL-N

$\bar{x} = 5799$

$t = 1.657$

$s = 18457$

$n = 154$

$$UCL\text{-}N = \bar{x} + t\,(s/\sqrt{n})$$
$$= 5799 + 1.657\,(18457/\sqrt{154})$$
$$= 8263 \cong \boxed{8250}$$

Calculation of UCL-T

$\bar{x} = 5.575$

$H = 4.108$

$s = 2.731$

$n = 154$

$$UCL\text{-}T = e^{(\bar{x} + 0.5 s^2 + sH/\sqrt{n-1})}$$
$$= e^{(5.575 + 0.5(2.731)^2 + (2.731 \times 4.108)/\sqrt{154-1})}$$
$$= 27206 \cong \boxed{27200}$$

TABLE 3.2
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
RAYMARK OU4 - BALLFIELD

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil
Exposure Point: 0 to 15 feet

Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of Normal Data	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale	Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Benzene	ug/kg	54	93	1100		ug/kg	46	95% UCL-T	W-Test(1)	46	95% UCL-T	W-Test(1)
Chlorobenzene	ug/kg	1100	2600	47000		ug/kg	310	95% UCL-T	W-Test(1)	310	95% UCL-T	W-Test(1)
Benzo(a)anthracene	ug/kg	480	670	5300		ug/kg	620	95% UCL-T	W-Test(1)	620	95% UCL-T	W-Test(1)
Benzo(a)pyrene	ug/kg	480	650	4400		ug/kg	650	95% UCL-T	W-Test(1)	650	95% UCL-T	W-Test(1)
Benzo(b)fluoranthene	ug/kg	440	590	3600		ug/kg	570	95% UCL-T	W-Test(1)	570	95% UCL-T	W-Test(1)
Dibenzo(a,h)anthracene	ug/kg	300	400	800	J	ug/kg	380	95% UCL-T	W-Test(1)	380	95% UCL-T	W-Test(1)
Indeno(1,2,3-cd)pyrene	ug/kg	370	490	2200	J	ug/kg	470	95% UCL-T	W-Test(1)	470	95% UCL-T	W-Test(1)
Aroclor, Total	ug/kg	14000	20000	348000		ug/kg	55000	95% UCL-T	W-Test(1)	55000	95% UCL-T	W-Test(1)
Dieldrin	ug/kg	15	21	130	J	ug/kg	30	95% UCL-T	W-Test(1)	30	95% UCL-T	W-Test(1)
Heptachlor	ug/kg	8.5	13	130		ug/kg	16	95% UCL-T	W-Test(1)	16	95% UCL-T	W-Test(1)
Arsenic	mg/kg	6.4	7.7	45.5	J	mg/kg	8.6	95% UCL-T	W-Test(1)	8.6	95% UCL-T	W-Test(1)
Barium	mg/kg	2290	3090	18800	J	mg/kg	9400	95% UCL-T	W-Test(1)	9400	95% UCL-T	W-Test(1)
Cadmium	mg/kg	1.9	2.6	19.3		mg/kg	2.7	95% UCL-T	W-Test(1)	2.7	95% UCL-T	W-Test(1)
Chromium	mg/kg	42.7	52.7	234		mg/kg	110	95% UCL-T	W-Test(1)	110	95% UCL-T	W-Test(1)
Lead	mg/kg	5800	8250	172000	J	mg/kg	27200	95% UCL-T	W-Test(1)	27200	95% UCL-T	W-Test(1)
Thallium	mg/kg	3.4	6	6.4		mg/kg	2.5	95% UCL-T	W-Test(1)	2.5	95% UCL-T	W-Test(1)
Zinc	mg/kg	2310	3230	23500		mg/kg	23500	Max	W-Test(2)	2310	Mean-N	W-Test(2)
Asbestos	%	6	7	60		%	14	95% UCL-T	W-Test(1)	14	95% UCL-T	W-Test(1)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.
W-Test: Developed by Shapiro and Wilk, refer to Supplemental Guidance to RAGS: Calculating the Concentration Term, OSWER Directive 9285.7-081, May 1992.

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-T); Mean of Log-transformed Data (Mean-T); Mean of Normal Data (Mean-N).

(1) Shapiro-Wilk W-Test indicates data are log-normally distributed.
(2) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for RME EPC, lesser of Mean-N or Max used for CTE EPC.
(3) Shapiro-Wilk W Test indicates data are normally distributed.
(4) < 20 sample results. Therefore, maximum concentration used for RME EPC, lesser of Mean-N or Max used for CTE EPC.

Receptor	PARAMETER	n	AvgUse	StDevUse	AvgLogUse	StDevLogUse	UNITS
OU4Soil0to15	Lead	154	5798.55162337662	18456.8261760437	5.5754711001995	2.7307543680571	MG/KG
OU4Soil0to2	Lead	106	562.231132075472	1339.06659195435	5.0586484043059	1.98477779291098	MG/KG

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5

DF	TVALUE
1	6.314
2	2.92
3	2.353
4	2.132
5	2.015
6	1.943
7	1.895
8	1.86
9	1.833
10	1.812
11	1.796
12	1.782
13	1.771
14	1.761
15	1.753
16	1.746
17	1.74
18	1.734
19	1.729
20	1.725
21	1.721
22	1.717
23	1.714
24	1.711
25	1.708
26	1.706
27	1.703
28	1.701
29	1.699
30	1.697
40	1.684
60	1.671
120	1.658
500	1.645

df_1 — 120 — 1.658 — t_1

df_2 — 500 — 1.645 — t_2

S	3	5	7	10	12	15	21	31	51	101 (n_1)	201 (n_2)	301	401	601
0.10	2.75	2.035	1.886	1.802	1.775	1.749	1.722	1.701	1.684	1.670	1.662	1.659	1.658	1.656
0.20	3.295	2.198	1.992	1.881	1.843	1.809	1.771	1.742	1.718	1.697	1.685	1.680	1.677	1.674
0.30	4.109	2.402	2.125	1.977	1.927	1.882	1.833	1.793	1.761	1.733	1.716	1.709	1.705	1.700
0.40	5.22	2.651	2.282	2.089	2.026	1.968	1.905	1.856	1.813	1.770	1.755	1.746	1.740	1.734
0.50	6.495	2.947	2.465	2.220	2.141	2.068	1.989	1.928	1.876	1.830	1.802	1.790	1.784	1.776
0.60	7.807	3.287	2.673	2.368	2.271	2.181	2.085	2.010	1.946	1.891	1.857	1.843	1.835	1.825
0.70	9.12	3.662	2.904	2.532	2.414	2.306	2.191	2.102	2.025	1.960	1.919	1.902	1.892	1.881
0.80	10.43	4.062	3.155	2.710	2.570	2.443	2.307	2.202	2.112	2.035	1.988	1.968	1.957	1.944
0.90	11.74	4.478	3.420	2.902	2.738	2.589	2.432	2.310	2.206	2.117	2.062	2.040	2.027	2.012
1.00	13.05	4.905	3.698	3.103	2.915	2.744	2.564	2.423	2.306	2.205	2.143	2.117	2.102	2.085
1.25	16.33	6.001	4.426	3.639	3.389	3.163	2.923	2.737	2.580	2.447	2.364	2.330	2.310	2.288
1.50	19.6	7.12	5.184	4.207	3.896	3.612	3.311	3.077	2.881	2.713	2.609	2.566	2.542	2.514
1.75	22.87	8.25	5.960	4.795	4.422	4.081	3.719	3.437	3.200	2.997	2.872	2.820	2.791	2.757
2.00	26.14	9.387	6.747	5.396	4.962	4.564	4.141	3.912	3.533	3.295	3.148	3.088	3.053	3.013
S_1 2.50	32.69	11.673	8.339	6.621	6.067	5.557	5.013	4.588	4.228	3.920	3.729	3.650	3.605	3.553
S_2 3.00	39.23	13.97	9.945	7.864	7.191	6.570	5.907	5.388	4.947	4.569	4.334	4.238	4.183	4.119
3.50	45.77	16.27	11.560	9.118	8.326	7.596	6.815	6.201	5.681	5.233	4.956	4.842	4.776	4.700
4.00	52.31	18.58	13.180	10.380	9.469	8.630	7.731	7.024	6.424	5.908	5.588	5.456	5.380	5.293
4.50	58.85	20.88	14.800	11.640	10.620	9.669	8.652	7.854	7.174	6.590	6.227	6.077	5.991	5.892
5.00	65.39	23.19	16.430	12.910	11.770	10.710	9.579	8.688	7.929	7.277	6.871	6.704	6.608	6.497
6.00	78.47	27.81	19.680	15.450	14.080	12.810	11.440	10.360	9.449	8.661	8.170	7.968	7.852	7.718
7.00	91.55	32.43	22.940	18.000	16.390	14.900	13.310	12.050	10.980	10.050	9.479	9.242	9.106	8.949
8.00	104.6	37.06	26.200	20.550	18.710	17.010	15.180	13.740	12.510	11.450	10.790	10.520	10.370	10.190
9.00	117.7	41.68	29.460	123.100	21.030	19.110	17.050	15.430	14.050	12.850	12.110	11.810	11.630	11.430
10.00	130.8	46.31	32.730	25.660	23.350	21.220	18.930	17.130	15.590	14.260	13.430	13.100	12.900	12.670

H_1 H_2 H_3 H_4

6

7

Receptor	NSAMPLE	PARAMETER	LAB_RESULT	qual	UNITS	Use
OU4Soil0to15	001	Lead	300		MG/KG	300
OU4Soil0to15	002	Lead	350		MG/KG	350
OU4Soil0to15	003	Lead	160		MG/KG	160
OU4Soil0to15	004	Lead	170		MG/KG	170
OU4Soil0to15	005	Lead	220		MG/KG	220
OU4Soil0to15	006	Lead	250		MG/KG	250
OU4Soil0to15	007	Lead	350		MG/KG	350
OU4Soil0to15	008	Lead	180		MG/KG	180
OU4Soil0to15	009	Lead	950		MG/KG	950
OU4Soil0to15	010	Lead	370		MG/KG	370
OU4Soil0to15	BF001 (1')	Lead	1750		MG/KG	1750
OU4Soil0to15	BF001 (6")	Lead	770		MG/KG	770
OU4Soil0to15	BF002 (1')	Lead	230		MG/KG	230
OU4Soil0to15	BF002 (6")	Lead	415		MG/KG	415
OU4Soil0to15	BF003 (1')	Lead	200		MG/KG	200
OU4Soil0to15	BF003 (6")	Lead	350		MG/KG	350
OU4Soil0to15	BF004 (1')	Lead	340		MG/KG	340
OU4Soil0to15	BF004 (6")	Lead	320		MG/KG	320
OU4Soil0to15	BF005 (1')	Lead	200		MG/KG	200
OU4Soil0to15	BF005 (6")	Lead	1410		MG/KG	1410
OU4Soil0to15	BF006 (1')	Lead	5300		MG/KG	5300
OU4Soil0to15	BF006 (6")	Lead	295		MG/KG	295
OU4Soil0to15	BF006-MAX	Lead	8270		MG/KG	8270
OU4Soil0to15	BF007 (1.5')	Lead	1040		MG/KG	1040
OU4Soil0to15	BF007 (6")	Lead	3360		MG/KG	3360
OU4Soil0to15	BF008 (1.5')	Lead	200		MG/KG	200
OU4Soil0to15	BF008 (6")	Lead	935		MG/KG	935
OU4Soil0to15	BF009 (1')	Lead	200		MG/KG	200
OU4Soil0to15	BF009 (6")	Lead	200		MG/KG	200
OU4Soil0to15	BF010 (1')	Lead	200		MG/KG	200
OU4Soil0to15	BF010 (6")	Lead	200		MG/KG	200
OU4Soil0to15	BF011 (6")	Lead	250		MG/KG	250
OU4Soil0to15	BF012 (6")	Lead	200		MG/KG	200
OU4Soil0to15	BF013 (6")	Lead	200		MG/KG	200
OU4Soil0to15	BF014 (6")	Lead	200		MG/KG	200
OU4Soil0to15	BF015 (6")	Lead	250		MG/KG	250
OU4Soil0to15	BF016 (6")	Lead	200		MG/KG	200
OU4Soil0to15	BF017 (6")	Lead	200		MG/KG	200
OU4Soil0to15	BF018 (6")	Lead	320		MG/KG	320
OU4Soil0to15	BF019 (6")	Lead	290		MG/KG	290
OU4Soil0to15	BF020 (6")	Lead	200		MG/KG	200
OU4Soil0to15	BF021	Lead	3490		MG/KG	3490
OU4Soil0to15	BF021 (1')	Lead	6200		MG/KG	6200
OU4Soil0to15	BF021 (6")	Lead	2600		MG/KG	2600
OU4Soil0to15	BF022 (6")	Lead	6610		MG/KG	6610
OU4Soil0to15	BF023A	Lead	23		MG/KG	23
OU4Soil0to15	BF024A	Lead	20		MG/KG	20
OU4Soil0to15	BF029	Lead	250		MG/KG	250
OU4Soil0to15	BF031	Lead	500		MG/KG	500

Receptor	NSAMPLE	PARAMETER	LAB_RESULT	qual	UNITS	Use
OU4Soil0to15	BF032	Lead	250		MG/KG	250
OU4Soil0to15	BF033	Lead	280		MG/KG	280
OU4Soil0to15	BF034	Lead	450		MG/KG	450
OU4Soil0to15	BF035	Lead	350		MG/KG	350
OU4Soil0to15	BF036	Lead	300		MG/KG	300
OU4Soil0to15	OU4-SO-401-0204	Lead	330		MG/KG	330
OU4Soil0to15	OU4-SO-401-0608	Lead	4.4	U	MG/KG	2.2
OU4Soil0to15	OU4-SO-401-1012	Lead	3.8	U	MG/KG	1.9
OU4Soil0to15	OU4-SO-402-0002	Lead	104		MG/KG	104
OU4Soil0to15	OU4-SO-402-0204	Lead	2330		MG/KG	2330
OU4Soil0to15	OU4-SO-402-0406-MAX	Lead	28.3		MG/KG	28.3
OU4Soil0to15	OU4-SO-402-0608	Lead	43.8		MG/KG	43.8
OU4Soil0to15	OU4-SO-402-0810	Lead	44.8		MG/KG	44.8
OU4Soil0to15	OU4-SO-402-1012	Lead	61.3		MG/KG	61.3
OU4Soil0to15	OU4-SO-402-1214	Lead	10.9		MG/KG	10.9
OU4Soil0to15	OU4-SO-421-0002	Lead	61.6	J	MG/KG	61.6
OU4Soil0to15	OU4-SO-421-0204	Lead	3360	J	MG/KG	3360
OU4Soil0to15	OU4-SO-421-0406-MAX	Lead	64000		MG/KG	64000
OU4Soil0to15	OU4-SO-421-0810	Lead	172000	J	MG/KG	2E+05
OU4Soil0to15	OU4-SO-422-0002-MAX	Lead	95.6		MG/KG	95.6
OU4Soil0to15	OU4-SO-422-0204	Lead	7.3	J	MG/KG	7.3
OU4Soil0to15	OU4-SO-423-0002	Lead	23.2		MG/KG	23.2
OU4Soil0to15	OU4-SO-423-0204	Lead	12.6		MG/KG	12.6
OU4Soil0to15	OU4-SO-423-0406	Lead	6.8		MG/KG	6.8
OU4Soil0to15	OU4-SO-423-0608	Lead	3.6		MG/KG	3.6
OU4Soil0to15	OU4-SO-423-0810-MAX	Lead	6.3		MG/KG	6.3
OU4Soil0to15	OU4-SO-423-1012	Lead	4.6		MG/KG	4.6
OU4Soil0to15	OU4-SO-423-1214	Lead	3.3		MG/KG	3.3
OU4Soil0to15	OU4-SO-424-0002	Lead	41.4	J	MG/KG	41.4
OU4Soil0to15	OU4-SO-424-0204	Lead	89.3	J	MG/KG	89.3
OU4Soil0to15	OU4-SO-424-0406	Lead	1080	J	MG/KG	1080
OU4Soil0to15	OU4-SO-424-0608	Lead	4550	J	MG/KG	4550
OU4Soil0to15	OU4-SO-424-0810	Lead	45300	J	MG/KG	45300
OU4Soil0to15	OU4-SO-424-1012-MAX	Lead	113		MG/KG	113
OU4Soil0to15	OU4-SO-424-1214	Lead	123	J	MG/KG	123
OU4Soil0to15	OU4-SO-425-0002	Lead	19.2	J	MG/KG	19.2
OU4Soil0to15	OU4-SO-425-0204	Lead	62.7	J	MG/KG	62.7
OU4Soil0to15	OU4-SO-425-0406	Lead	2710	J	MG/KG	2710
OU4Soil0to15	OU4-SO-425-0608	Lead	15700	J	MG/KG	15700
OU4Soil0to15	OU4-SO-425-0810	Lead	37800	J	MG/KG	37800
OU4Soil0to15	OU4-SO-426-0002	Lead	24.1		MG/KG	24.1
OU4Soil0to15	OU4-SO-426-0204	Lead	18400		MG/KG	18400
OU4Soil0to15	OU4-SO-426-0406	Lead	26200		MG/KG	26200
OU4Soil0to15	OU4-SO-426-0608	Lead	54000	J	MG/KG	54000
OU4Soil0to15	OU4-SO-426-0810	Lead	69000	J	MG/KG	69000
OU4Soil0to15	OU4-SO-426-1012	Lead	14500	J	MG/KG	14500
OU4Soil0to15	OU4-SO-426-1214	Lead	325		MG/KG	325
OU4Soil0to15	OU4-SO-427-0002	Lead	74.2		MG/KG	74.2
OU4Soil0to15	OU4-SO-427-0204	Lead	15.7	U	MG/KG	7.85

Receptor	NSAMPLE	PARAMETER	LAB_RESULT	qual	UNITS	Use
OU4Soil0to15	OU4-SO-427-0406	Lead	20000	J	MG/KG	20000
OU4Soil0to15	OU4-SO-427-0608	Lead	27400	J	MG/KG	27400
OU4Soil0to15	OU4-SO-427-0810	Lead	20600	J	MG/KG	20600
OU4Soil0to15	OU4-SO-427-1012-MAX	Lead	19000		MG/KG	19000
OU4Soil0to15	OU4-SO-427-1214	Lead	18600	J	MG/KG	18600
OU4Soil0to15	OU4-SO-TP09G-0708	Lead	53100		MG/KG	53100
OU4Soil0to15	OU4-SO-TP11-0203	Lead	61.9		MG/KG	61.9
OU4Soil0to15	OU4-SO-TP11-0708	Lead	4300		MG/KG	4300
OU4Soil0to15	OU4-SO-TP14-0305	Lead	58700		MG/KG	58700
OU4Soil0to15	OU4-SO-TP15-0103	Lead	30700		MG/KG	30700
OU4Soil0to15	OU4-SO-TP17-0405	Lead	21500		MG/KG	21500
OU4Soil0to15	OU4-SO-TP18-0304	Lead	27200		MG/KG	27200
OU4Soil0to15	RMB 001A	Lead	70	J	MG/KG	70
OU4Soil0to15	RMB 002A	Lead	460		MG/KG	460
OU4Soil0to15	RMB 003A	Lead	600	J	MG/KG	600
OU4Soil0to15	RMF A+00	Lead	110	J	MG/KG	110
OU4Soil0to15	RMF A+050	Lead	110	J	MG/KG	110
OU4Soil0to15	RMF A+100	Lead	100	J	MG/KG	100
OU4Soil0to15	RMF A+150	Lead	110	J	MG/KG	110
OU4Soil0to15	RMF A+200	Lead	150	J	MG/KG	150
OU4Soil0to15	RMF A+250	Lead	80	J	MG/KG	80
OU4Soil0to15	RMF A+300	Lead	0.1	U	MG/KG	0.05
OU4Soil0to15	RMF B+00	Lead	140	J	MG/KG	140
OU4Soil0to15	RMF B+050	Lead	130	J	MG/KG	130
OU4Soil0to15	RMF B+100	Lead	110	J	MG/KG	110
OU4Soil0to15	RMF B+150	Lead	65.2	J	MG/KG	65.2
OU4Soil0to15	RMF B+150-MAX	Lead	66		MG/KG	66
OU4Soil0to15	RMF B+200	Lead	56.3		MG/KG	56.3
OU4Soil0to15	RMF B+250	Lead	0.1	U	MG/KG	0.05
OU4Soil0to15	RMF B+300	Lead	90	J	MG/KG	90
OU4Soil0to15	RMF C+00	Lead	110	J	MG/KG	110
OU4Soil0to15	RMF C+050	Lead	120	J	MG/KG	120
OU4Soil0to15	RMF C+100	Lead	160	J	MG/KG	160
OU4Soil0to15	RMF C+150	Lead	120	J	MG/KG	120
OU4Soil0to15	RMF C+200	Lead	340		MG/KG	340
OU4Soil0to15	RMF C+250	Lead	123	J	MG/KG	123
OU4Soil0to15	RMF C+300	Lead	310		MG/KG	310
OU4Soil0to15	RMF D+00	Lead	150	J	MG/KG	150
OU4Soil0to15	RMF D+050	Lead	60	J	MG/KG	60
OU4Soil0to15	RMF D+100	Lead	130	J	MG/KG	130
OU4Soil0to15	RMF D+150	Lead	120	J	MG/KG	120
OU4Soil0to15	RMF D+200	Lead	110	J	MG/KG	110
OU4Soil0to15	RMF D+250	Lead	220		MG/KG	220
OU4Soil0to15	RMF E+00	Lead	90	J	MG/KG	90
OU4Soil0to15	RMF E+050	Lead	130	J	MG/KG	130
OU4Soil0to15	RMF E+100	Lead	97.1	J	MG/KG	97.1
OU4Soil0to15	RMF E+150	Lead	60	J	MG/KG	60
OU4Soil0to15	RMF E+200	Lead	180	J	MG/KG	180
OU4Soil0to15	RMF E+250	Lead	250		MG/KG	250

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Receptor	NSAMPLE	PARAMETER	LAB_RESULT	qual	UNITS	Use
OU4Soil0to15	RMF F+00	Lead	150	J	MG/KG	150
OU4Soil0to15	RMF F+050	Lead	130	J	MG/KG	130
OU4Soil0to15	RMF F+100	Lead	0.1	U	MG/KG	0.05
OU4Soil0to15	RMF F+150	Lead	0.1	U	MG/KG	0.05
OU4Soil0to15	RMF F+200	Lead	120	J	MG/KG	120
OU4Soil0to15	RMF G+00	Lead	240	J	MG/KG	240
OU4Soil0to15	RMF G+050	Lead	67.4	J	MG/KG	67.4
OU4Soil0to2	001	Lead	300		MG/KG	300
OU4Soil0to2	002	Lead	350		MG/KG	350
OU4Soil0to2	003	Lead	160		MG/KG	160
OU4Soil0to2	004	Lead	170		MG/KG	170
OU4Soil0to2	005	Lead	220		MG/KG	220
OU4Soil0to2	006	Lead	250		MG/KG	250
OU4Soil0to2	007	Lead	350		MG/KG	350
OU4Soil0to2	008	Lead	180		MG/KG	180
OU4Soil0to2	009	Lead	950		MG/KG	950
OU4Soil0to2	010	Lead	370		MG/KG	370
OU4Soil0to2	BF001 (1')	Lead	1750		MG/KG	1750
OU4Soil0to2	BF001 (6")	Lead	770		MG/KG	770
OU4Soil0to2	BF002 (1')	Lead	230		MG/KG	230
OU4Soil0to2	BF002 (6")	Lead	415		MG/KG	415
OU4Soil0to2	BF003 (1')	Lead	200		MG/KG	200
OU4Soil0to2	BF003 (6")	Lead	350		MG/KG	350
OU4Soil0to2	BF004 (1')	Lead	340		MG/KG	340
OU4Soil0to2	BF004 (6")	Lead	320		MG/KG	320
OU4Soil0to2	BF005 (1')	Lead	200		MG/KG	200
OU4Soil0to2	BF005 (6")	Lead	1410		MG/KG	1410
OU4Soil0to2	BF006 (1')	Lead	5300		MG/KG	5300
OU4Soil0to2	BF006 (6")	Lead	295		MG/KG	295
OU4Soil0to2	BF006-MAX	Lead	8270		MG/KG	8270
OU4Soil0to2	BF007 (1.5')	Lead	1040		MG/KG	1040
OU4Soil0to2	BF007 (6")	Lead	3360		MG/KG	3360
OU4Soil0to2	BF008 (1.5')	Lead	200		MG/KG	200
OU4Soil0to2	BF008 (6")	Lead	935		MG/KG	935
OU4Soil0to2	BF009 (1')	Lead	200		MG/KG	200
OU4Soil0to2	BF009 (6")	Lead	200		MG/KG	200
OU4Soil0to2	BF010 (1')	Lead	200		MG/KG	200
OU4Soil0to2	BF010 (6")	Lead	200		MG/KG	200
OU4Soil0to2	BF011 (6")	Lead	250		MG/KG	250
OU4Soil0to2	BF012 (6")	Lead	200		MG/KG	200
OU4Soil0to2	BF013 (6")	Lead	200		MG/KG	200
OU4Soil0to2	BF014 (6")	Lead	200		MG/KG	200
OU4Soil0to2	BF015 (6")	Lead	250		MG/KG	250
OU4Soil0to2	BF016 (6")	Lead	200		MG/KG	200
OU4Soil0to2	BF017 (6")	Lead	200		MG/KG	200
OU4Soil0to2	BF018 (6")	Lead	320		MG/KG	320
OU4Soil0to2	BF019 (6")	Lead	290		MG/KG	290
OU4Soil0to2	BF020 (6")	Lead	200		MG/KG	200
OU4Soil0to2	BF021	Lead	3490		MG/KG	3490

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Receptor	NSAMPLE	PARAMETER	LAB_RESULT	qual	UNITS	Use
OU4Soil0to2	BF021 (1')	Lead	6200		MG/KG	6200
OU4Soil0to2	BF021 (6")	Lead	2600		MG/KG	2600
OU4Soil0to2	BF022 (6")	Lead	6610		MG/KG	6610
OU4Soil0to2	BF023A	Lead	23		MG/KG	23
OU4Soil0to2	BF024A	Lead	20		MG/KG	20
OU4Soil0to2	BF029	Lead	250		MG/KG	250
OU4Soil0to2	BF031	Lead	500		MG/KG	500
OU4Soil0to2	BF032	Lead	250		MG/KG	250
OU4Soil0to2	BF033	Lead	280		MG/KG	280
OU4Soil0to2	BF034	Lead	450		MG/KG	450
OU4Soil0to2	BF035	Lead	350		MG/KG	350
OU4Soil0to2	BF036	Lead	300		MG/KG	300
OU4Soil0to2	OU4-SO-402-0002	Lead	104		MG/KG	104
OU4Soil0to2	OU4-SO-421-0002	Lead	61.6	J	MG/KG	61.6
OU4Soil0to2	OU4-SO-422-0002-MAX	Lead	95.6		MG/KG	95.6
OU4Soil0to2	OU4-SO-423-0002	Lead	23.2		MG/KG	23.2
OU4Soil0to2	OU4-SO-424-0002	Lead	41.4	J	MG/KG	41.4
OU4Soil0to2	OU4-SO-425-0002	Lead	19.2	J	MG/KG	19.2
OU4Soil0to2	OU4-SO-426-0002	Lead	24.1		MG/KG	24.1
OU4Soil0to2	OU4-SO-427-0002	Lead	74.2		MG/KG	74.2
OU4Soil0to2	RMB 001A	Lead	70	J	MG/KG	70
OU4Soil0to2	RMB 002A	Lead	460		MG/KG	460
OU4Soil0to2	RMB 003A	Lead	600	J	MG/KG	600
OU4Soil0to2	RMF A+00	Lead	110	J	MG/KG	110
OU4Soil0to2	RMF A+050	Lead	110	J	MG/KG	110
OU4Soil0to2	RMF A+100	Lead	100	J	MG/KG	100
OU4Soil0to2	RMF A+150	Lead	110	J	MG/KG	110
OU4Soil0to2	RMF A+200	Lead	150	J	MG/KG	150
OU4Soil0to2	RMF A+250	Lead	80	J	MG/KG	80
OU4Soil0to2	RMF A+300	Lead	0.1	U	MG/KG	0.05
OU4Soil0to2	RMF B+00	Lead	140	J	MG/KG	140
OU4Soil0to2	RMF B+050	Lead	130	J	MG/KG	130
OU4Soil0to2	RMF B+100	Lead	110	J	MG/KG	110
OU4Soil0to2	RMF B+150	Lead	65.2	J	MG/KG	65.2
OU4Soil0to2	RMF B+150-MAX	Lead	66		MG/KG	66
OU4Soil0to2	RMF B+200	Lead	56.3		MG/KG	56.3
OU4Soil0to2	RMF B+250	Lead	0.1	U	MG/KG	0.05
OU4Soil0to2	RMF B+300	Lead	90	J	MG/KG	90
OU4Soil0to2	RMF C+00	Lead	110	J	MG/KG	110
OU4Soil0to2	RMF C+050	Lead	120	J	MG/KG	120
OU4Soil0to2	RMF C+100	Lead	160	J	MG/KG	160
OU4Soil0to2	RMF C+150	Lead	120	J	MG/KG	120
OU4Soil0to2	RMF C+200	Lead	340		MG/KG	340
OU4Soil0to2	RMF C+250	Lead	123	J	MG/KG	123
OU4Soil0to2	RMF C+300	Lead	310		MG/KG	310
OU4Soil0to2	RMF D+00	Lead	150	J	MG/KG	150
OU4Soil0to2	RMF D+050	Lead	60	J	MG/KG	60
OU4Soil0to2	RMF D+100	Lead	130	J	MG/KG	130
OU4Soil0to2	RMF D+150	Lead	120	J	MG/KG	120

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Receptor	NSAMPLE	PARAMETER	LAB_RESULT	qual	UNITS	Use
OU4Soil0to2	RMF D+200	Lead	110	J	MG/KG	110
OU4Soil0to2	RMF D+250	Lead	220		MG/KG	220
OU4Soil0to2	RMF E+00	Lead	90	J	MG/KG	90
OU4Soil0to2	RMF E+050	Lead	130	J	MG/KG	130
OU4Soil0to2	RMF E+100	Lead	97.1	J	MG/KG	97.1
OU4Soil0to2	RMF E+150	Lead	60	J	MG/KG	60
OU4Soil0to2	RMF E+200	Lead	180	J	MG/KG	180
OU4Soil0to2	RMF E+250	Lead	250		MG/KG	250
OU4Soil0to2	RMF F+00	Lead	150	J	MG/KG	150
OU4Soil0to2	RMF F+050	Lead	130	J	MG/KG	130
OU4Soil0to2	RMF F+100	Lead	0.1	U	MG/KG	0.05
OU4Soil0to2	RMF F+150	Lead	0.1	U	MG/KG	0.05
OU4Soil0to2	RMF F+200	Lead	120	J	MG/KG	120
OU4Soil0to2	RMF G+00	Lead	240	J	MG/KG	240
OU4Soil0to2	RMF G+050	Lead	67.4	J	MG/KG	67.4

D-5 SAMPLE INTAKE AND RISK CALCULATIONS

Appendix D-5

RISK ASSESSMENT EXAMPLE CALCULATIONS

Soil Exposure

Two potential exposure routes are associated with soil direct contact at Raymark OU-4 Ballfield Site. These exposure routes include ingestion and dermal contact. Example calculations for each of these routes of exposure are presented in the following text.

Incidental soil ingestion exposure for arsenic is estimated for an adult resident from the following equation (EPA, 1989):

$$IEX = (C \times IR \times OABS \times FI \times EF \times ED \times CF)/(BW \times AT)$$

where:	IEX	= 4.04E-06 mg/kg/day	= Ingestion exposure
	C	= 8.6 mg/kg	= arsenic representative concentration in soil
	IR	= 100 mg soil/day	= Soil ingestion rate
	OABS	= 1.0	= Oral relative absorption factor in soil versus RfD study
	Fi	= 1.0	= Fraction ingested from contaminated source
	EF	= 350 days/yr	= Exposure frequency
	ED	= 24 yrs	= Exposure duration
	BW	= 70 kg	= Body weight
	AT	= 25550 days	= Averaging time for carcinogens (365 days/yr x 70 yrs)
	CF	= 1E-6 kg soil/mg soil	= Conversion factor

The potential receptors for subsurface soil (0 to 15 feet depth) exposure include adult and child residents and an adult commercial worker. For surface soil, an adult and a child recreational receptor were also considered. For an adult or child resident, an EF of 350 days was assumed. For a child resident, an IR of 200 mg soil/day, a BW of 15 kg, and an ED of 6 years were assumed; for an adult resident, an IR of 100 mg soil/day, BW and ED were assumed to be 70 kg and 24 years, respectively. For an adult commercial worker, IR, BW, EF, ED, and FI were assumed to be 100 mg/day, 70 kg, 250 days/yr., 25 years, and 1.0, respectively. For recreational receptors, EF was 150 days/yr. The IR, BW, ED, and FI were the same as the residential receptors. Using the same equation, residential child soil ingestion is 9.24-06 mg/kg/day.

The cancer risk for a lifetime resident from incidental ingestion of soil is calculated as follows:

$$CA = (IEX_{child} + IEX_{adult}) \times SF$$

where:	CA	= 2.02E-5	= incremental (upper bound) risk of developing cancer
	IEX_{child}	= 9.24E-06 mg/kg/day	= Ingestion exposure
	IEX_{adult}	= 4.04-06 mg/kg/day	= Ingestion exposure
	SF	= 1.5 $(mg/kg/day)^{-1}$	= carcinogenic slope factor (upper 95 percent confidence limit of a dose-response curve)

Dermal exposure to arsenic from soil is estimated for an adult resident from the following equation (EPA, 1989; EPA, 1992):

$$DEX = (C \times SA \times AF \times ABS \times EF \times ED \times CF)/(BW \times AT)$$

where:	DEX	= 1.41E-06 mg/kg/day	= Dermal exposure dose
	C	= 8.6 mg/kg	= Chemical concentration in soil
	SA	= 5700 cm^2/event	= Skin surface area available for contact
	AF	= 0.07 mg/cm^2	= Soil-to-skin adherence factor
	ABS	= 0.03	= Chemical-specific absorption factor from soil
	EF	= 350 events/yr	= Exposure frequency
	ED	= 24 yrs	= Exposure duration
	BW	= 70 kg	= Body weight
	CF	= 1E-06 kg soil/mg soil	= Conversion factor
	AT	= 8760 days	= Averaging time, non-carcinogens (365 days/yr x 24 yrs)

Hands, forearms, lower legs, feet, and head are expected to be available for dermal contact with soils for young children. Hands, forearms, lower legs, and head are expected to be available for dermal contact with soils for adults. The calculated available skin surface areas for adults and small children (ages 0-6 years) were 5,700 cm^2, 2,900 cm^2, respectively. Soil-to-skin adherence factors were assumed to be 0.07 for adults and 0.2 for small children.

Absorption factors from Table 5.1 were 3% for arsenic, 14% for PCBs, 1% for cadmium, and 13% for PAHs.

The non-cancer hazard quotient for an adult resident from dermal contact with arsenic in subsurface soil is calculated as follows:

$$NC = DEX / RfD$$

where:	NC	= 4.70E-03	= hazard quotient
	DEX	= 1.41E-06 mg/kg/day	= dermal exposure
	RfD	= 3.0E-4 mg/kg/day	= dermal reference dose (3E-4 Oral RfD x 1.0 GI absorption factor)

D-6 COMPARISION TO INHALATION SSLS

TABLE D-6
COMPARISON OF MAXIMUM SITE DATA TO SSLs FOR INHALATION

Receptor	Fraction	Parameter	CasNo	Units	MaxOfSiteDetects	SSLInhal
OU4Soil0to15	OS	Benzo(b)fluoranthene	205992	MG/KG	3.6	
OU4Soil0to15	OS	Benzo(g,h,i)perylene	191242	MG/KG	2.7	
OU4Soil0to15	OS	Benzo(k)fluoranthene	207089	MG/KG	3.9	
OU4Soil0to15	OS	bis(2-Ethylhexyl)phthalate	117817	MG/KG	2.1	31000
OU4Soil0to15	OS	Butylbenzylphthalate	85687	MG/KG	0.083	930
OU4Soil0to15	OS	Carbazole	86748	MG/KG	0.46	
OU4Soil0to15	OS	Chrysene	218019	MG/KG	5.6	
OU4Soil0to15	ASB	Asbestos	ASBESTOS	%	60	
OU4Soil0to15	M	Aluminum	7429905	MG/KG	16200	
OU4Soil0to15	M	Antimony	7440360	MG/KG	13.5	
OU4Soil0to15	M	Arsenic	7440382	MG/KG	45.5	750
OU4Soil0to15	M	Barium	7440393	MG/KG	18800	690000
OU4Soil0to15	M	Beryllium	7440417	MG/KG	1.2	1300
OU4Soil0to15	M	Cadmium	7440439	MG/KG	19.3	1800
OU4Soil0to15	M	Calcium	7440702	MG/KG	9100	
OU4Soil0to15	M	Chromium	7440473	MG/KG	234	270
OU4Soil0to15	M	Cobalt	7440484	MG/KG	40.4	
OU4Soil0to15	M	Copper	7440508	MG/KG	193000	
OU4Soil0to15	M	Copper	7440508	MG/KG	193000	
OU4Soil0to15	M	Iron	7439896	MG/KG	96200	
OU4Soil0to15	M	Lead	7439921	MG/KG	172000	
OU4Soil0to15	M	Lead	7439921	MG/KG	172000	
OU4Soil0to15	M	Magnesium	7439954	MG/KG	114000	
OU4Soil0to15	M	Manganese	7439965	MG/KG	1530	
OU4Soil0to15	M	Mercury	7439976	MG/KG	6.2	10
OU4Soil0to15	M	Nickel	7440020	MG/KG	644	13000
OU4Soil0to15	M	Potassium	7440097	MG/KG	3760	
OU4Soil0to15	M	Selenium	7782492	MG/KG	7.3	
OU4Soil0to15	M	Silver	7440224	MG/KG	18.6	
OU4Soil0to15	M	Sodium	7440235	MG/KG	1120	
OU4Soil0to15	M	Thallium	7440280	MG/KG	6.4	
OU4Soil0to15	M	Vanadium	7440622	MG/KG	93.6	
OU4Soil0to15	M	Zinc	7440666	MG/KG	23500	
OU4Soil0to15	OS	1,4-Dichlorobenzene	106467	MG/KG	0.061	
OU4Soil0to15	OS	2,4-Dimethylphenol	105679	MG/KG	35	
OU4Soil0to15	OS	2-Methylnaphthalene	91576	MG/KG	1.4	
OU4Soil0to15	OS	2-Methylphenol	95487	MG/KG	3.1	
OU4Soil0to15	OS	3,3'-Dichlorobenzidine	91941	MG/KG	0.1	
OU4Soil0to15	OS	4-Methylphenol	106445	MG/KG	9.5	
OU4Soil0to15	OS	Acenaphthene	83329	MG/KG	0.42	
OU4Soil0to15	OS	Acenaphthylene	208968	MG/KG	1.1	
OU4Soil0to15	OS	Anthracene	120127	MG/KG	2.5	
OU4Soil0to15	OS	Benzo(a)anthracene	56553	MG/KG	5.3	
OU4Soil0to15	OS	Benzo(a)pyrene	50328	MG/KG	4.4	
OU4Soil0to15	OS	Di-n-Butylphthalate	84742	MG/KG	0.57	2300
OU4Soil0to15	OS	Di-n-octylphthalate	117840	MG/KG	0.056	10000
OU4Soil0to15	OS	Dibenzo(a,h)anthracene	53703	MG/KG	0.8	
OU4Soil0to15	OS	Dibenzofuran	132649	MG/KG	0.42	
OU4Soil0to15	OS	Diethylphthalate	84662	MG/KG	0.12	2000
OU4Soil0to15	OS	Fluoranthene	206440	MG/KG	14	
OU4Soil0to15	OS	Fluorene	86737	MG/KG	0.97	
OU4Soil0to15	OS	Indeno(1,2,3-cd)pyrene	193395	MG/KG	2.2	
OU4Soil0to15	OS	N-Nitroso-di-n-propylamine	621647	MG/KG	0.044	
OU4Soil0to15	OS	N-Nitroso-diphenylamine	86306	MG/KG	2	
OU4Soil0to15	OS	Naphthalene	91203	MG/KG	2.7	
OU4Soil0to15	OS	Pentachlorophenol	87865	MG/KG	0.053	
OU4Soil0to15	OS	Phenanthrene	85018	MG/KG	11	
OU4Soil0to15	OS	Phenol	108952	MG/KG	110	
OU4Soil0to15	OS	Pyrene	129000	MG/KG	12	
OU4Soil0to15	OV	1,1,1-Trichloroethane	71556	MG/KG	0.001	1200
OU4Soil0to15	OV	1,1-Dichloroethane	75343	MG/KG	0.001	1300
OU4Soil0to15	OV	2-Butanone	78933	MG/KG	0.031	

TABLE D-6
COMPARISON OF MAXIMUM SITE DATA TO SSLs FOR INHALATION

Receptor	Fraction	Parameter	CasNo	Units	MaxOfSiteDetects	SSLInhal
OU4Soil0to15	OV	Acetone	67641	MG/KG	0.35	100000
OU4Soil0to15	OV	Benzene	71432	MG/KG	1.1	0.8
OU4Soil0to15	OV	Bromomethane	74839	MG/KG	0.002	
OU4Soil0to15	OV	Carbon Disulfide	75150	MG/KG	0.4	720
OU4Soil0to15	OV	Chlorobenzene	108907	MG/KG	47	130
OU4Soil0to15	OV	Chloroform	67663	MG/KG	0.18	0.3
OU4Soil0to15	OV	Ethylbenzene	100414	MG/KG	8.6	400
OU4Soil0to15	OV	Toluene	108883	MG/KG	1.9	650
OU4Soil0to15	OV	Total Xylenes	1330207	MG/KG	4.8	410
OU4Soil0to15	OV	Trichloroethene	79016	MG/KG	0.54	5
OU4Soil0to15	OV	Vinyl Chloride	75014	MG/KG	0.001	0.03
OU4Soil0to15	PESTP	4,4'-DDD	72548	MG/KG	0.042	
OU4Soil0to15	PESTP	4,4'-DDE	72559	MG/KG	0.71	
OU4Soil0to15	PESTP	4,4'-DDT	50293	MG/KG	0.71	
OU4Soil0to15	PESTP	Aldrin	309002	MG/KG	0.0039	3
OU4Soil0to15	PESTP	alpha-BHC	319846	MG/KG	0.0088	0.8
OU4Soil0to15	PESTP	alpha-Chlordane	5103719	MG/KG	0.13	20
OU4Soil0to15	PESTP	Aroclor-1016	12674112	MG/KG	0.2	
OU4Soil0to15	PESTP	Aroclor-1221	11104282	MG/KG	0.047	
OU4Soil0to15	PESTP	Aroclor-1232	11141165	MG/KG	0.21	
OU4Soil0to15	PESTP	Aroclor-1242	53469219	MG/KG	3	
OU4Soil0to15	PESTP	Aroclor-1248	12672296	MG/KG	0.16	
OU4Soil0to15	PESTP	Aroclor-1262	37324235	MG/KG	110	
OU4Soil0to15	PESTP	Aroclor-1268	11100144	MG/KG	230	
OU4Soil0to15	PESTP	beta-BHC	319857	MG/KG	0.014	
OU4Soil0to15	PESTP	delta-BHC	319868	MG/KG	0.0039	
OU4Soil0to15	PESTP	Dieldrin	60571	MG/KG	0.13	1
OU4Soil0to15	PESTP	Endosulfan I	959988	MG/KG	0.041	
OU4Soil0to15	PESTP	Endosulfan II	33213659	MG/KG	0.039	
OU4Soil0to15	PESTP	Endosulfan Sulfate	1031078	MG/KG	0.0027	
OU4Soil0to15	PESTP	Endrin	72208	MG/KG	0.17	
OU4Soil0to15	PESTP	Endrin Aldehyde	7421934	MG/KG	0.047	
OU4Soil0to15	PESTP	Endrin Ketone	53494705	MG/KG	0.53	
OU4Soil0to15	PESTP	gamma-BHC	58899	MG/KG	0.0067	
OU4Soil0to15	PESTP	gamma-Chlordane	5103742	MG/KG	0.22	20
OU4Soil0to15	PESTP	Heptachlor	76448	MG/KG	0.13	0.1
OU4Soil0to15	PESTP	Heptachlor Epoxide	1024573	MG/KG	0.038	5
OU4Soil0to15	PESTP	Methoxychlor	72435	MG/KG	0.01	
OU4Soil0to15	TOC	Total Organic Carbon	7440440	MG/KG	6400	

D-7 LEAD EVALUATION

TABLE D-7.1
SUMMARY OF IEUBK LEAD MODELING RESULTS
CHILD (AGE 1 - 6) EXPOSURE TO SOIL
RAYMARK OU-4 BALLFIELD SITE

MEDIA	LEAD CONC. (MG/KG)	PERCENT OF POPULATION WITH BLOOD-LEAD > 10UG/DL
Surface Soil	562	22.39
Soil (0 - 15 Feet)	5800	99.2

Model Assumptions:

Receptor: Child, Ages 12 to 84 months
RME Exposure point concentration: Arithmetic Mean
CTE Exposure point concentration: Arithmetic Mean
Drinking water lead concentration: 4 ug/L (model default concentration)

LEAD MODEL Version 0.99d

AIR CONCENTRATION: 0.100 ug Pb/m3 DEFAULT
Indoor AIR Pb Conc: 30.0 percent of outdoor.
Other AIR Parameters:

Age	Time Outdoors (hr)	Vent. Rate (m3/day)	Lung Abs. (%)
0-1	1.0	2.0	32.0
1-2	2.0	3.0	32.0
2-3	3.0	5.0	32.0
3-4	4.0	5.0	32.0
4-5	4.0	5.0	32.0
5-6	4.0	7.0	32.0
6-7	4.0	7.0	32.0

DIET: DEFAULT

DRINKING WATER Conc: 4.00 ug Pb/L DEFAULT
WATER Consumption: DEFAULT

SOIL & DUST:
Soil: constant conc.
Dust: constant conc.

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
0-1	562.0	562.0
1-2	562.0	562.0
2-3	562.0	562.0
3-4	562.0	562.0
4-5	562.0	562.0
5-6	562.0	562.0
6-7	562.0	562.0

Additional Dust Sources: None DEFAULT

PAINT Intake: 0.00 ug Pb/day DEFAULT

MATERNAL CONTRIBUTION: Infant Model
Maternal Blood Conc: 2.50 ug Pb/dL

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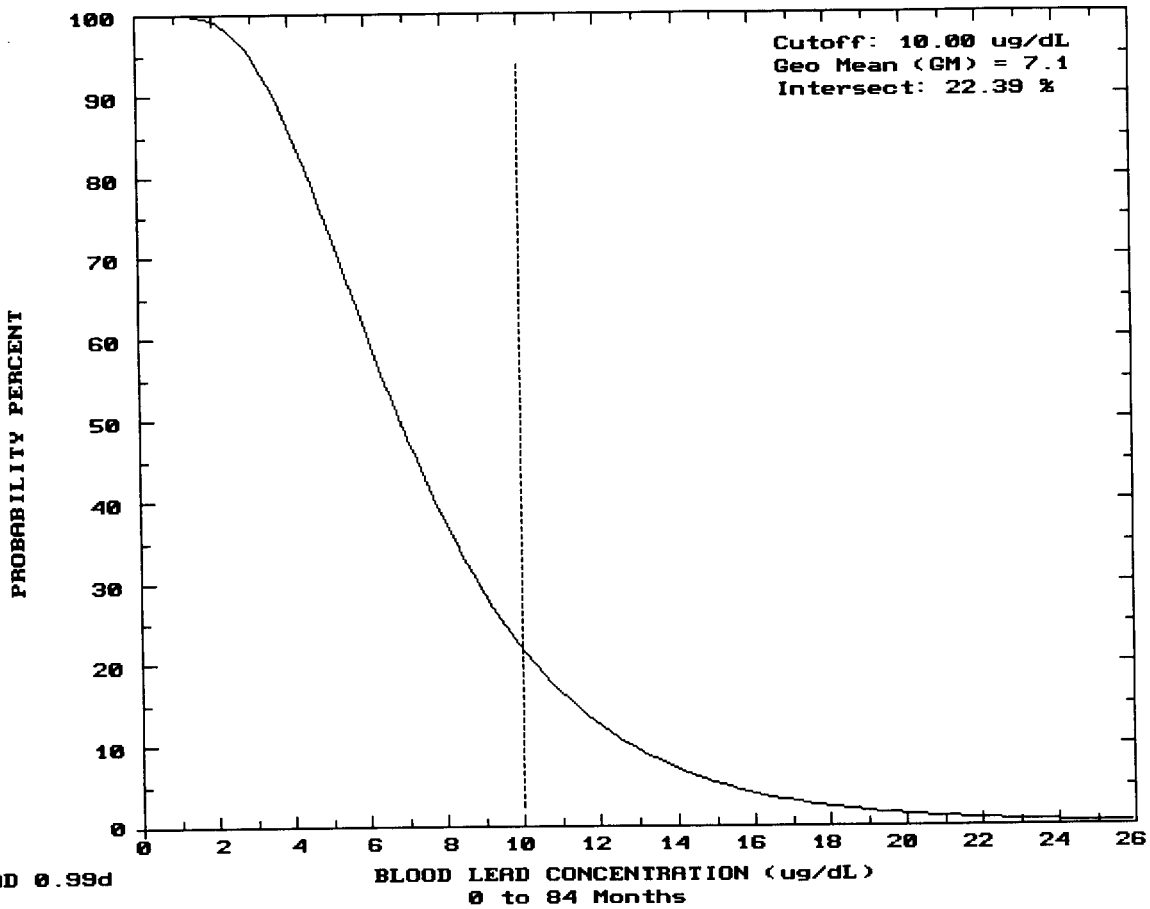
TETRA TECH NUS, INC.
WILMINGTON, MA 01887-1020

CALCULATED BLOOD Pb and Pb UPTAKES:

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
0.5-1:	7.8	14.76	12.07
1-2:	9.0	21.92	18.69
2-3:	8.4	22.81	19.14
3-4:	8.0	23.25	19.59
4-5:	6.7	18.95	15.18
5-6:	5.7	17.96	13.90
6-7:	5.1	17.66	13.24

YEAR	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake (ug/day)

0.5-1:	2.33	0.34	0.00	0.02
1-2:	2.37	0.82	0.00	0.03
2-3:	2.73	0.87	0.00	0.06
3-4:	2.68	0.91	0.00	0.07
4-5:	2.71	0.99	0.00	0.07
5-6:	2.90	1.06	0.00	0.09
6-7:	3.23	1.09	0.00	0.09


Cutoff: 10.00 ug/dL
Geo Mean (GM) = 7.1
Intersect: 22.39 %
PROBABILITY PERCENT
100
90
80
70
60
50
40
30
20
10
0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
BLOOD LEAD CONCENTRATION (ug/dL)
0 to 84 Months

LEAD 0.99d

LEAD MODEL Version 0.99d

AIR CONCENTRATION: 0.100 ug Pb/m3 DEFAULT
Indoor AIR Pb Conc: 30.0 percent of outdoor.
Other AIR Parameters:

Age	Time Outdoors (hr)	Vent. Rate (m3/day)	Lung Abs. (%)
0-1	1.0	2.0	32.0
1-2	2.0	3.0	32.0
2-3	3.0	5.0	32.0
3-4	4.0	5.0	32.0
4-5	4.0	5.0	32.0
5-6	4.0	7.0	32.0
6-7	4.0	7.0	32.0

DIET: DEFAULT

DRINKING WATER Conc: 4.00 ug Pb/L DEFAULT
WATER Consumption: DEFAULT

SOIL & DUST:
Soil: constant conc.
Dust: constant conc.

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
0-1	5800.0	5800.0
1-2	5800.0	5800.0
2-3	5800.0	5800.0
3-4	5800.0	5800.0
4-5	5800.0	5800.0
5-6	5800.0	5800.0
6-7	5800.0	5800.0

Additional Dust Sources: None DEFAULT

PAINT Intake: 0.00 ug Pb/day DEFAULT

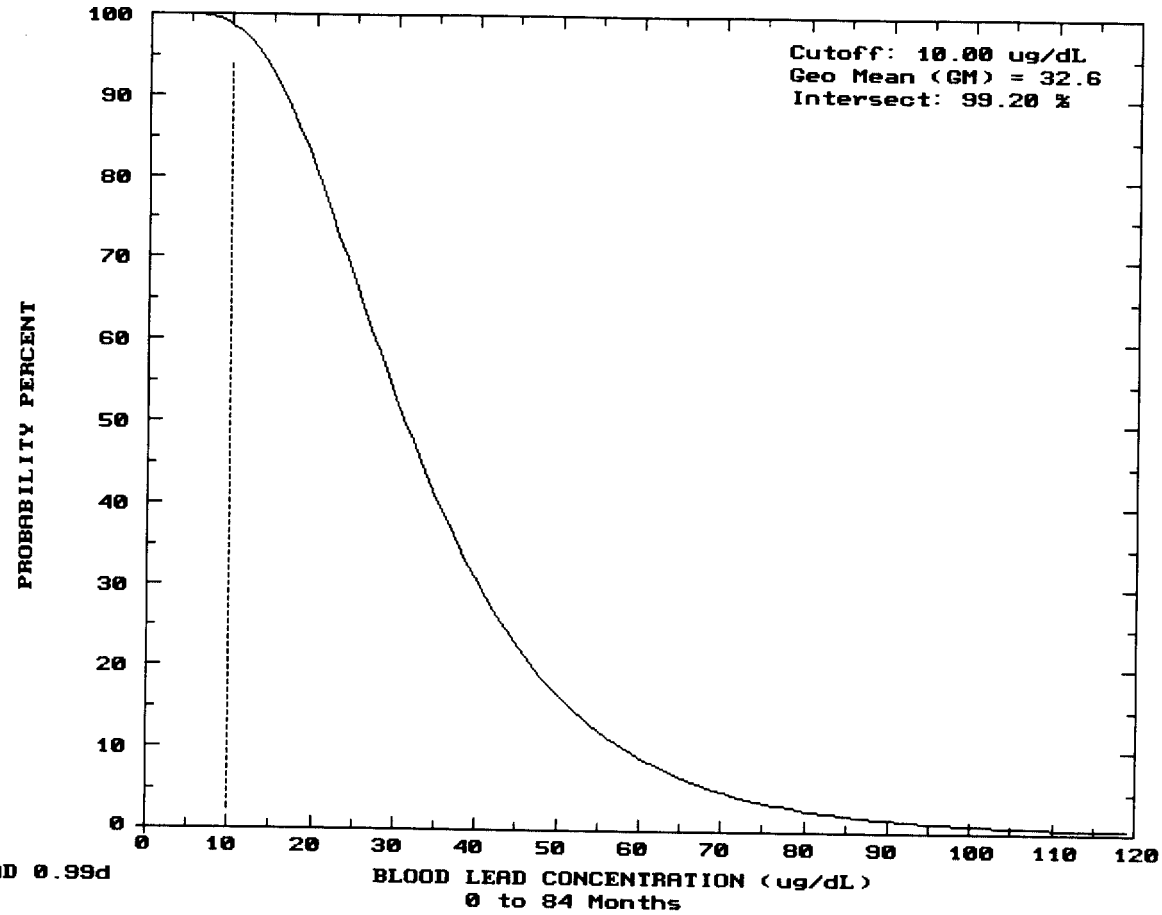
MATERNAL CONTRIBUTION: Infant Model
Maternal Blood Conc: 2.50 ug Pb/dL

CALCULATED BLOOD Pb and Pb UPTAKES:

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
0.5-1:	33.6	69.16	67.69
1-2:	38.5	101.27	99.58
2-3:	36.8	107.85	105.85
3-4:	36.6	114.46	112.40
4-5:	32.5	100.30	97.93
5-6:	28.9	97.74	95.02
6-7:	26.4	96.90	93.84

YEAR	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake (ug/day)

0.5-1:	1.27	0.18	0.00	0.02
1-2:	1.23	0.42	0.00	0.03
2-3:	1.46	0.47	0.00	0.06
3-4:	1.49	0.51	0.00	0.07
4-5:	1.69	0.62	0.00	0.07
5-6:	1.92	0.70	0.00	0.09
6-7:	2.22	0.75	0.00	0.09


Cutoff: 10.00 ug/dL
Geo Mean (GM) = 32.6
Intersect: 99.20 %
PROBABILITY PERCENT
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
110
120
BLOOD LEAD CONCENTRATION (ug/dL)
0 to 84 Months

LEAD 0.99d

Calculations of 95th Percentile Fetal Blood Lead Concentrations for Adult Exposure to Soil

SITE NAME: Raymark OU-4, Ballfield Site
LOCATION:
DATE: 22-May-99

OBJECTIVE: Adult exposure to lead in soil is addressed by an evaluation of the relationship between the site soil lead concentration and the blood lead concentration in the developing fetuses of adult women. This spreadsheet calculates a range of 95th percentile fetal blood lead concentrations from central estimates of blood lead concentrations in pregnant adult women using the exposure parameters identified below (U.S. EPA, Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil, December 1996).

RELEVANT EQUATIONS: $PbB_{adult,\ central} = PbB_{adult,\ 0} + (PbS \times BKSF \times IR_s \times AF_s \times EF_s)/AT$

and

$PbB_{fetal,\ 0.95} = PbB_{adult,\ central} \times GSD_{i,\ adult}^{1.645} \times R_{fetal/maternal}$

Exposure Parameter	Description (units)	RME Exposure Parameters		CTE Exposure Parameters	
	Exposure Point:	Soil, 0-15 ft.	Soil, 0-2 ft.	Soil, 0-15 ft.	Soil, 0-2 ft.
	Receptor:	Commercial Worker	Recreational User	Commercial Worker	Recreational User
$PbB_{adult,\ 0}$	Typical blood lead concentration in adult women of child-bearing age in absence of site exposures (ug/dL)	2.2	2.2	1.7	1.7
PbS	Site-specific soil lead concentration (mg/kg)	5800	562	5800	562
BKSF	Biokinetic slope factor (ug/dL per ug/day))	0.4	0.4	0.4	0.4
IR_s	Intake rate of soil, includes outdoor soil and indoor soil-derived dust (g/day)	0.100	0.100	0.050	0.050
AF_s	Absolute gastrointestinal absorption fraction (unitless)	0.12	0.12	0.12	0.12
EF_s	Exposure frequency (days/year)	250	150	250	150
AT	Averaging time (days/year)	365	365	365	365
$GSD_{i,\ adult}$	Estimate of individual geometric standard deviation among adults (unitless)	2.1	2.1	1.8	1.8
$R_{fetal/maternal}$	Constant of proportionality between fetal blood lead concentraiton at birth and maternal blood lead concentration (unitless)	0.9	0.9	0.9	0.9
$PbB_{adult,\ central}$	Calculated central estimate of blood lead concentrations in adult women of child-bearing age from site exposures (ug/dL)	21.27	3.31	11.23	2.25
$PbB_{fetal,\ 0.95}$	Calculated 95th percentile blood lead concentrations among fetuses born to women having site exposures (ug/dL)	64.87	10.09	26.59	5.34

Note: According to the cited guidance document, this adult exposure model is not applicable for infrequent site exposures, where the EF_s is less than 1 day/week.