5807 U-007-304 .24

ISSUES CONCERNING THE OPERABLE UNIT 5 REMEDIAL INVESTIGATION REPORT, DATED JUNE 24, 1994

08/03/94

DOE-2174-94
DOE-FN EPA
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RESPONSES

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Department of Energy
Fernald Environmental Management Project
P. O. Box 398705
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AUG 03 1994
DOE-2174-94

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U-007-304.24

Mr. James A. Saric, Remedial Project Director
U.S. Environmental Protection Agency
Region V - 5HRE-8J
77 W. Jackson Boulevard
Chicago, Illinois 60604-3590

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2086

Dear Mr. Saric and Mr. Schneider:

ISSUES CONCERNING THE OPERABLE UNIT 5 REMEDIAL INVESTIGATION REPORT, DATED JUNE 24, 1994

During an internal review of the referenced report, the Department of Energy (DOE) has identified two problems. First, in Appendix T, Plate Data Files, some of the sample number and dates are not listed with the appropriate results. The results provided in the Plates and Appendix T are correct. Appendix T will reflect the correct sample numbers and dates for all sampling results before the final Operable Unit 5 Remedial Investigation (RI) Report is issued.

Secondly, several figures and tables were inadvertently omitted from Appendix A, the Baseline Risk Assessment. The missing pages are enclosed for insertion in Volume 2 according to the instructions listed below. DOE regrets any inconvenience these omissions may have caused any of the reviewers.

In order to accommodate your review, please insert the following tables after Table A.2-12 at the back of Section A.2:

A.2-13	Major Chemicals/Radioactive Process Materials Used at the FEMP
A.2-14	Radiologicals Associated with Process Materials
A.2-15	Organic Constituents of Potential Concern - Operable Unit 5

Please insert the following tables in their correct order in Section A.4:

A.4-2	Characteristics of Radionuclides Associated with FEMP Operable Unit 5
A.4-4	Dioxin and Furan Toxicity Equivalent Factors
A.4-5	Toxicity Equivalency Factors (TEFs) and Corresponding Oral and Inhalation Slope Factors for the Group B PAHs
A.4-6	Dermal Reference Doses and Cancer Slope Factors for Constituents of Concern

Please insert the following table after the text in Section A.6. If Tables 6-1 through 6-7 were inadvertently duplicated in Section A.6, please verify that these tables are included in their proper location - Section 6.0 of Volume 1. If so, then discard the duplicates.

A.6-1	Uncertainties Associated with Estimated Risks for Operable Unit 5

Please insert the following tables behind Table A.III-1, found in Attachment A.III to Appendix A:

A.III-2	Risk-Based Screening Levels for Radionuclides and Chemicals in Groundwater/Surface Water
A.III-3	Risk-Based Screening Levels for Radionuclides and Chemicals in Soil/Sediment

Please insert these figures at the end of Section A.7, following Table A.7-26

A.7-1	Total Estimated Air Pathway Risk, Current Scenario, for U-238, U-234, U-235/-237, Ra-226
A.7-2	Total Estimated Air Pathway Risk, Agricultural Scenario, for U-238, U-234, U-235/-236, Ra-226
A.7-3	Estimated Cancer Risk for Total Uranium in Groundwater - Type 1 Wells
A.7-4	Estimated Cancer Risk for Total Uranium in Groundwater - Type 2 Wells
A.7-5	Estimated Cancer Risk for Total Uranium in Groundwater - Type 3 and 4 Wells
A.7-6	Estimated Cancer Risk for Total Uranium in Surface Soil

A new Table of Contents, List of Tables, and List of Figures for Appendix A has been generated and should replace the previous version in its entirety.

If you have any questions concerning the enclosed material, please call Kathleen Nickel at (513) 648-3166.

Sincerely,

Johnny Reising

for Jack R. Craig
Fernald Remedial Action
Project Manager

FN:Nickel

Enclosures: As Stated

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TABLE A.2-13

MAJOR CHEMICALS/RADIOACTIVE PROCESS MATERIALS USED AT THE FEMP

Plant	Chemical	Use
1	a. Magnesium fluoride (slag), MgF_2	Grind for Plant 2/3
	[1]b. Nitric Acid, HNO_3	Digestion of enriched feed materials
	c. Uranium, metal	Recycle feed to Plant 2/3
	[1]d. Uranium dioxide, UO_2	Recycle feed to Plant 2/3
	e. Uranium octo-oxide (yellowcake), U_38_0	Feed material to Plant 2/3
	[1]f. Uranyl nitrate hexahydrate (UNH), $UO_2(NO_3)_2 \bullet 6H_20$	Feed from digestion of enriched feed materials to Plant 2/3
2/3	[1]a. Calcium Oxide, lime, CaO	Neutralize raffinate and other wastes for disposal
	b. Kerosene	Solvent for TBP for uranyl nitrate extraction
	c. Magnesium fluoride (slag), MgF_2	Recycle from Plant 5 for leaching with HNO_3 to recover enriched or natural uranium
	[1]d. Nitric acid, HNO_3	Digestion of uranium feed and recycled oxides, leachate for MgF_2, scrubber acid
	[1]e. Sodium carbonate, Na_2CO_3	Treat TBP solvent after uranyl nitrate back-extraction into water
	[1]f. Sodium diuranate, $Na_2\ U_2O_7$	Recycle material from Plant 8 ADU process
	g. Tributyl phosphate (TBP), $(C_4H_9)_3PO_4$	Solvent extraction of uranyl nitrate
	[1]h. Thorium nitrate hexahydrate, TNT, $Th(NO_3)_4 \bullet 6H_2O$	Product, and perhaps converted to THO_2
	[1]i. Thorium oxide (thoria), ThO_2	Product of TNT denitration

TABLE A.2-13 (Continued)

Plant	Chemical	Use
	j. Uranium, metal	Feed material
	[1]k. Uranyl ammonium phosphate (UAP), $UO_2NH_4PO_4$	Recycle material from Plant 8 UAP process
	[1]l. Uranium dioxide, UO_2	Feed material from Plant 1
	m. Uranium octo-oxide U_3O_8	Recycle material from Plant 8 oxidation furnaces
	n. Uranium tri-oxide (uranyl oxide), UO_3	Product of UNH denitration for Plant 4
	o. Uranyl nitrate hexahydrate (UNH), $UO_2(NO_3)_2 \bullet 6H_2O$	Product of digestion for denitration to UO_3 for Plant 4
4	a. Ammonia, gas, NH_3	Produce H_2
	b. Hydrofluoric acid, HF	Convert UO_2 to UF_4, convert ThO_2 to ThF_4
	c. Thorium oxide (thoria), ThO_2	Product of Plant 9 for conversion to ThF_4
	d. Thorium tetrafluoride, ThF_4	Produced by reaction of ThO_2 from Plant 9 and HF for return to Plant 9
	e. Uranium dioxide, UO_2	Convert to UF_4 with HF or U_3O_8 with O_2
	f. Uranium octo-oxide, U_3O_8	Convert to UO_2
	g. Uranium tetrafluoride, UF_4	Product by reaction of UO_2 and HF for Plant 5
	h. Uranium tri-oxide (uranyl oxide), UO_3	Convert to UO_2 by reaction with H_2
5	a. Magnesium, metal	Reduce UF_4 to uranium metal
	b. Magnesium fluoride (slag), MgF_2	Line reaction pot; leach to recover enriched/nat U.
	c. Uranium, metal	Product of UF_4 reduction for Plants 6, 9
	d. Uranium tetrafluoride, UF_4	Product of Plant 4 for reduction to uranium metal

TABLE A.2-13 (Continued)

Plant	Chemical	Use
6	a. Degreasers	Degreasing uranium scrap
	[1]b. Detergent	Degreasing uranium scrap
	c. Lithium carbonate, Li_2CO_3	Salt bath
	[1]d. Nitric acid, HNO_3	Pickling uranium scrap
	e. Oil	Quench for uranium after salt bath
	f. Potassium carbonate, K_2CO_3	Salt bath
	g. Uranium, metal	Product
7	a. Ammonia, gas, NH_3	Produce H_2
	b. Uranium hexafluoride, UF_6	Feed for conversion to UF_4
	c. Uranium tetrafluoride, UF_4	Product for Plant 4 produced by reducing UF_6 with H_2
8	a. Ammonia, NH_3, aqueous	ADU/UAP process, neutralize waste in UAP process
	b. Ammonium diuranate (ADU),$(NH_4)_2U_2O_7$	Convert to $Na_2U_2O_7$ for recycle in Plant 2/3
	c. Calcium fluoride, CaF_2	Product of CaO reaction with UF_4 for recycle to CaU_2O_7
	[1]d. Calcium oxide (lime), CaO	Convert UF_4 scrap to CaU_2O_7, neutralize waste in Winlo Process for settling pond
	e. Calcium diurante, CaU_2O_7	Produced by reaction of UF_4 scrap with CaO
	f. Copper sulfate pentahydrate, $CuSO_4 \bullet 5H_2O$	Used in Winlo Process
	g. Hydrochloric acid, HU	Dissolve thorium residues, digest MgF_2 slag in ADU/UAP process, neutralize waste in ADU process, digest UO_2/UAP in Winlo Process
	h. Hydrofluoric acid, HF	Revert ThF_4 to $Th(OH)_4$, ppt UF_4 in Winlo Process
	i. Magnesium fluoride (slag), MgF_2	Feed for ADU/UAP process

TABLE A.2-13 (Continued)

Plant	Chemical	Use
	j. Nitric acid, HNO_3	Digestion of UO_2 or UAP in Winlo Process
	[1]k. Oxalic acid, $H_2C_2O_4$	Convert dissolved thorium residues from HCl digestion to $Th(C_2O_4)_2$
	l. Phosphoric acid, H_3PO_4	Used in UAP process
	m. Sodium hydroxide (caustic), NaOH	Scrubbers, caustic wash for drums, convert $Th(C_2O_4)_2$ to $Th(OH)_4$, convert ADU to $Na_2U_2O_7$
	[1]n. Sodium chlorate, $NaClO_3$	Digest MgF_2 with HCl to recover uranium in ADU/UAP process
	[1]o. Sodium diuranate, $Na_2U_2O_7$	Produced by conversion of ADU with NaOH
	p. Thorium hydroxide (thoria gel), $Th(OH)_4$	Produced by reversion of the ThF_4 with HF
	q. Thorium oxalate, $Th(C_2O_4)_2$	Product to dissolved thorium residues and $H_2C_2O_4$ to convert to $Th(OH)_4$ for Pilot Plant
	r. Thorium tetrafluoride, TF_4	Convert to $Th(OH)_4$ with HF in reversion process
	s. Uranium, metal	Recycle in furnaces for oxidation to U_3O_8 for Plant 2/3
	t. Uranyl ammonium phosphate (UAP), $UO_2NH_4PO_4$	Feed for Winlo Process
	[1]u. Uranium dioxide (black oxide*), UO_2	Feed for Winlo Process
	v. Uraniuym octo-oxide, U_3O_8	Product of oxidation of uranium in furnaces for recycling in Plant 2/3
	w. Uranium tetrafluoride, UF_4	Low grade UF_4 residues leached for uranium recovery, convert to CaU_2O_7 with CaO, produced by Winlo Process for feed to Plant 4
9	a. Aluminum, metal	Cladding on rejected cores for recycle
	[1]b. Calcium, metal	Reduction of ThF_4 to thorium metal
	[1]c. Calcium fluoride, CaF_2	Product of ThF_4 reduction to thorium metal
	[1]d. Calcium oxide (lime), CaO	ZIRNLO process

TABLE A.2-13 (Continued)

Plant	Chemical	Use
	e. Copper, metal	Recycle of coextruded cladding from Hanford
	f. Hydrofluoric acid, HF	Dissolve Zircaloy 2 cladding, digestion of recycled cores, ppt. of ThF_4
	g. Lithium carbonate, Li_2CO_3	Salt bath for uranium metal products
	h. Nickel, metal	Cladding on rejected cores for recycle
	[1]i. Nitric acid, HNO_3	Digestion of recycled cores, pickling of derbies and cores, dissolution of TNT, washing uranium and thorium chips
	[1]j. Oxalic acid, $H_2C_2O_4$	Precipitate $Th(C_2O_4)_2$ from TNT
	k. Potassium carbonate, K_2CO_3	Salt bath for uranium metal products
	l. Sodium hydroxide (caustic), NaOH	Dissolve aluminum cladding on recycled cores
	m. Thorium, metal	Product
	[1]n. Thorium nitrate tetrahydrate (TNT), $Th(NO_3)_4 \bullet 4H_2O$	Convert to thorium metal
	[1]o. Thorium oxalate, $Th(C_2O_4)_2$	Product of TNT and $H_2C_2O_4$ to be converted to ThO_2
	[1]p. Thorium oxide (thoria), ThO_2	Product of $Th(C_2O_4)_2$ conversion for Plant 4
	q. Thorium tetrafluoride, ThF_4	Product of Plant 4 for conversion to thorium metal
	r. Uranium, metal	Product
	[1]s. Zinc, metal	Product of ThF_4 reduction to thorium metal
	[1]t. Zinc chloride, $ZnCl_2$	Reduce ThF_4 to thorium metal
	u. Zirconium, metal	Cladding on rejected cores for recycle

TABLE A.2-13 (Continued)

Plant	Chemical	Use
Pilot Plant	a. Ammonia, gas and aqueous, NH_3	Produce H_2, convert TNT to $Th(OH)_4$
	b. Calcium, metal	Reduce ThF_4 to thorium metal
	c. Calcium fluoride, CaF_2	Product of ThF_4 reduction to thorium metal
	[1]d. Barium carbonate, $BaCO_3$	Treat raffinate from TNT extraction with DAAP/DSBBP
	[1]e. Diamyl amylphosphonate DAAP	Solvent for TNT extraction
	[1]f. Disectbutyl phenyl phosphonate (DSBBP)	Solvent for TNT extraction
	g. Hydrofluoric acid, HF	Product of UF_6 reduction, convert TNT to ThF_4
	[1]h. Kerosene	Solvent for DAAP/DSBBP in TNT extraction
	[1]i. Nitric acid, HNO_3	Dissolve TNT, convert thorium oxidues/residues to TNT
	[1]j. Oxalic acid, $H_2C_2O_4$	Convert TNT to $Th(C_2O_4)_2$
	[1]k. Sodium carbonate, Na_2CO_3	Treat DAAP/DSBBP solvent in TNT extraction
	[1]l. Sodium hydroxide (caustic), NaOH	Scrubber liquid for ThF_4 (may not have been used), treat raffinate from TNT extraction, neutralize waste in TNT extraction
	m. Thorium, metal	Product
	[1]n. Thorium hydroxide (thoria gel), $Th(OH)_4$	Product of TNT and NH_4/CO_2 for conversion to ThO_2 elsewhere, product
	[1]o. Thorium nitrate tetrahydrate (TNT),$Th(NO_3)_4 \bullet 4H_2O$	Product, convert to $Th(OH)_4$, convert to ThF_4, convert to $Th(C_2O_4)_2$
	[1]p. Thorium oxalate, $Th(C_2O_4)_2$	Convert to TNT, product (convert to ThO_2 elsewhere)
	[1]q. Thorium oxide (thoria), ThO_2	Convert to TNT
	r. Uranium hexafluoride, UF_6	Convert to UF_4
	[1]s. Uranium octo-oxide, U_3O_8	Product of conversion of waste uranium for recycle

TABLE A.2-13 (Continued)

Plant	Chemical	Use
	t. Uranium tetrafluoride, UF_4	Product for Plant 4
	u. Thorium tetrafluoride, ThF_4	Product of TNT and HF
	v. Zinc, metal	Product of ThF_4 reduction to thorium metal
	w. Zinc, fluoride, ZnF_2	Reduce ThF_4 to thorium metal
Site	a. Hydrochloric acid, HCl	Decontamination
	b. Nitric acid, HNO_3	Decontamination
	c. Sodium hydroxide (caustic), NaOH	Decontamination

*"black oxide" was assumed to be UO_2

Chemicals Described in:
1. WMCO:PT:89-108, March 8, 1989, "Historical Process Descriptions", C.A. Hill to T.R. Clark
2. "A Closer Look at Uranium Metal Production", Feed Materials Production Center, Fernald, Ohio, March 1988.

Chemicals identified with superscript [1] are not in Table 2-3 of FEMP-SWCR-4 DRAFT

TABLE A.2-14

RADIOLOGICALS ASSOCIATED WITH PROCESSED MATERIALS

Source		Radionuclide	Half-Life[a]	Decay Mode[b]	Significant Level in Processed Material[c]
1. Uranium Series	a.	^{238}U	4.468×10^9 y	α	Y
	b.	^{234}Th	24.10 d	β^-	Y
	c.	^{234m}Pa	1.17 m	β^-, IT	Y
	d.	^{234}Pa	6.70 h	β^-	N
	e.	^{234}U	2.445×10^5 y	α	Y
	f.	^{230}Th	7.7×10^4 y	α	Y
	g.	^{226}Ra	1,600 y	α	Y
	h.	^{222}Rn	3.8235 d	α	Y
	i.	^{218}Po	3.05 m	α	Y
	j.	^{214}Pb	26.8 m	β^-	Y
	k.	^{214}Bi	19.9 m	β^-	Y
	l.	^{214}Po	163.7 μs	α	Y
	m.	^{210}Pb	22.26 y	β^-	Y
	n.	^{210}Bi	5.013 d	β^-	Y
	o.	^{212}Po	138.378 d	α	Y
2. Actinium Series	a.	^{235}U	7.038×10^8 y	α	P
	b.	^{231}Th	25.52 h	β^-	P
	c.	^{231}Pa	3.276×10^4 y	α	Y
	d.	^{227}Ac	21.773 y	β^-, α	Y
	e.	^{227}Th	18.718 d	α	Y

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TABLE A.2-14 (Continued)

Source		Radionuclide	Half-Life[a]	Decay Mode[b]	Significant Level in Processed Material[c]
	f.	^{223}Fr	21.8 m	β^-	N
	g.	^{223}Ra	11.434 d	α	N
	h.	^{219}Rn	3.96 s	α	N
	i.	^{215}Po	1.778 m	α	N
	j.	^{211}Pb	36.1 m	β^-	N
	k.	^{211}Bi	2.13 m	α, β^-	N
	l.	^{207}Tl	4.77 m	β^-	N
	m.	^{211}Po	0.516 s	α	N
3. Thorium Series	a.	^{232}Th	1.405×10^{10} y	α	Y
	b.	^{228}Ra	5.75 y	β^-	Y
	c.	^{228}Ac	6.13 h	β^-	Y
	d.	^{228}Th	1.9132 y	α	Y
	e.	^{224}Ra	3.62 d	α	Y
	f.	^{220}Rn	55.61 s	α	Y
	g.	^{216}Po	0.146 s	α	Y
	h.	^{212}Pb	10.643 h	β^-	Y
	i.	^{212}Bi	60.55 m	β^-, α	Y
	j.	^{210}Po	0.298 μs	α	Y
	k.	^{208}Tl	3.053 m	β^-	Y

TABLE A.2-14 (Continued)

Source		Radionuclide	Half-Life[a]	Decay Mode[b]	Significant Level in Processed Material[c]
4. Activation Products	a.1	^{241}Pu	14.4 y	β^-	N
	a.2	^{241}Am	432.2 y	α	N
	a.3	^{237}Np	2.14×10^6 y	α	N
	b.	^{240}Pu	6,569 y	α	N
	c.	^{239}Pu	24,131 y	α	N
	d.	^{238}Pu	87.75 y	α	N
	e.	^{236}U	2.341×10^7 y	α	P
5. Fission Products	a.1	^{90}Sr	28.6 y	β^-	N
	a.2	^{90}Y	64.1 h	β^-	N
	b.	^{99}Tc	2.13×10^5 y	β^-	P
	c.1	^{106}Ru	368.2 d	β^-	N
	c.2	^{106}Rh	29.92 s	β^-	N
	d.1	^{137}Cs	30.17 y	β^-	N
	d.2	^{137m}Ba	2.552 m	IT	N

[a]David C. Kocher, "Radioactive Decay Data Tables," Technical Information Center, Department of Energy, DOE/TIC-11026, April 1981.
[b]α = alpha, β = beta, IT = internal transition.
[c]Y = yes, N = no, P = possible; material could be present at significant levels in unprocessed material.

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TABLE A.2-15

ORGANIC CONSTITUENTS OF POTENTIAL CONCERN
OPERABLE UNIT 5

Parameter	Groundwater	Surface Soil	Subsurface Soil	Surface Water	Sediments
Volatile Organic Compounds					
1,1,1-Trichloroethane	X	X	X		
1,1,2,2-Tetrachloroethane	X				
1,1-Dichloroethane	X		X		
1,1-Dichloroethene	X		X		
1,2-Dichloroethane	X	X			
1,2-Dichloroethene	X			X	
1,4-Dioxane	X				
2-Butanone	X				
4-Methyl-2-pentanone	X				
Acetone	X				
Acetonitrile	X				
Acrolein	X				
Acrylonitrile	X				
Benzene	X	X	X		
Bromoform	X				
Carbon tetrachloride	X	X			
Carbon disulfide	X				
Chloroform	X	X	X		
Chloromethane	X				
Isobutyl alcohol	X				
Methylene chloride	X	X	X		X
Tetrachloroethene	X	X	X	X	
Toluene	X				
Trichloroethene	X	X	X	X	
Vinyl chloride	X		X		
trans-1,4-Dichloro-2-butene	X				

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TABLE A.2-15 (Continued)

Parameter	Groundwater	Surface Soil	Subsurface Soil	Surface Water	Sediments
Pesticides/PCBs					
Aroclor 1254		X	X		X
Aroclor 1260		X	X		
Dieldrin		X			
Dioxins/Furans					
Dioxins					
2,3,7,8-Tetrachlorodibenzo-p-dioxin	X				
Tetrachlorodibenzo-p-dioxins	X				
1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin	X				
Heptachlorodibenzo-p-dioxins	X				
Octachlorodibenzo-p-dioxin	X	X	X		
Furans					
2,3,7,8-Tetrachlorodibenzofuran	X				
Tetrachlorodibenzofurans	X		X		
1,2,3,7,8-pentachlorodibenzofuran	X				
2,3,4,7,8-pentachlorodibenzofuran	X				
Pentachlorodibenzofurans	X				
Hexachlorodibenzofurans	X				
Heptachlorodibenzofurans	X	X			
Octachlorodibenzofuran	X	X	X		X
Semivolatile Organic Compounds					
1,2,4-Trichlorobenzene	X				
2,4-Dimethylphenol	X				
2,4-Dinitrophenol	X				
2,6-Dinitrotoluene	X				
2-Chlorophenol	X				
4-Methylphenol					X
Benzo(a)anthracene		X	X		X
Benzo(a)pyrene		X	X		X

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TABLE A.2-15 (Continued)

Parameter	Groundwater	Surface Soil	Subsurface Soil	Surface Water	Sediments
Benzo(b)fluoranthene		X	X		X
Benzo(k)fluoranthene		X	X		X
Carbazole	X	X			X
Chrysene		X			X
Di-n-butylphthalate					X
Di-n-octylphthalate				X	
Dibenzo(a,h)anthracene		X	X		X
Dibenzofuran					X
Fluoranthene		X	X		X
Indeno(1,2,3-cd)pyrene		X	X		X
N-Nitroso-di-n-propylamine	X				
N-Nitrosodiethylamine	X				
N-Nitrosodiphenylamine	X			X	
Nitrobenzene	X				
Pentachlorophenol	X				
Phenanthrene		X			
Pyrene		X			X
Tributyl phosphate	X				
Bis(2-ethylhexyl)phthalate	X	X	X	X	X

5807

TABLE A.4-2

CHARACTERISTICS OF RADIONUCLIDES ASSOCIATED WITH FEMP OPERABLE UNIT 5

		Average Radiation Energies (MeV/decay)		
Radionuclide	Half-life	Alpha	Beta	Gamma
Uranium-238 Series				
Uranium-238	4.5×10^9 y	4.20 (75%) 4.15 (25%)	0.030 0.043	NA
Uranium-234	2.5×10^5 y	4.77 (72%) 4.72 (28%)	NA	0.053 (0.2%) 0.117 (4×10^{-5}%) 0.48 (4×10^{-5}%) 0.58 (1.2×10^{-5}%)
Thorium-230	8.0×10^4 y	4.68 (76%) 4.62 (24%)	0.051 0.064	0.068 (0.6%) 0.142 (0.07%) 0.184 (0.014%) 0.253 (0.017%)
Radium-226	1.6×10^3 y	4.78 (95%) 4.60 (6%)	0.087 0.170	0.186 (4%) 0.26 (0.007%) 0.42 (2×10^{-4}%) 0.61 (2×10^{-4}%)
Radon-222	3.8×10^0 d	5.49 (100%)	NA	0.510 (0.07%)
Lead-210	2.0×10^1 y	3.72	0.061 0.030 0.043	0.047 (4%)
Uranium-235 Series				
Uranium-235	7.1×10^8 y	4.58 (8%, doublet) 4.40 (57%) 4.37 (18%) 5.06 (10%) 5.02 (23%)	NA 0-0.10 0.195	0.143 (11%) 0.185 (54%) 0.204 (5%) 0.027 (6%) 0.29 (6%, complex)
Palladium-231	3.3×10^4y	5.01 (24%) 4.95 (22%) 4.73 (11%)	0.323 0.350	

TABLE A.4-2 (Continued)

Radionuclide	Half-life	Average Radiation Energies (MeV/decay)		
		Alpha	Beta	Gamma
Actinium-227	2.2×10^{1} y	4.95 (1.2%, doublet) 4.86 (0.18%, doublet)	0.046 0.005 0.010	0.070 (0.08%) 0.166 0.190
Thorium-232 Series				
Thorium-232	1.4×10^{-10} y	4.01 (76%) 3.95 (24%)	0.042 0.055	NA
Radium-228	6.7×10^{0} y	NA	0.005 0.050	NA
Thorium-228	1.9×10^{0} y	5.43 (71%) 5.34 (28%)	0.067 0.080	0.084 (1.6%) 0.132 (0.2%) 0.167 (0.1%) 0.214 (0.3%)
Fission Products				
Strontium-90	2.8×10^{1} y	NA	0.546	NA
Technetium-99	2.1×10^{5} y	NA	0.292	NA

5807

TABLE A.4-4

DIOXIN AND FURAN TOXICITY EQUIVALENT FACTORS[a]

Compound	TEF
Dioxins	
Mono-, Di-, and Trichlorodibenzo-p-dioxins	0
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1
Other TCDDs	0
2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDDs)	0.5
Other PeCDDs	0
2,3,7,8-Hexachlorodibenzo-p-dioxins (HxCDDs)	0.1
Other HxCDDs	0
2,3,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	0.01
Other HpCDDs	0
Octachlorodibenzo-p-dioxin (OCDD)	0.001
Furans	
Mono-, Di-, and Trichlorodibenzo-p-furans	0
2,3,7,8-Tetrachlorodibenzo-p-furan (TCDF)	0.1
Other TCDFs	0
1,2,3,7,8-Pentachlorodibenzo-p-furan (PeCDF)	0.05
2,3,4,7,8-Pentachlorodibenzo-p-furan (PeCDF)	0.5
Other PeCDFs	0
2,3,7,8-Hexachlorodibenzo-p-furans (HxCDFs)	0.1
Other HxCDFs	0
2,3,7,8-Heptachlorodibenzo-p-furans (HpCDFs)	0.01
Other HpCDFs	0
Octachlorodibenzo-p-furan (OCDF)	0.001

[a]U.S. EPA, 1989j

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TABLE A.4-5

TOXICITY EQUIVALENCY FACTORS (TEFs) AND CORRESPONDING ORAL AND INHALATION SLOPE FACTORS FOR THE GROUP B2 PAHs

PAH	Relative Potency	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$
Benzo(a)pyrene	1.0	7.3	6.1
Benzo(a)anthracene	0.145	1.1	0.89
Benzo(b)fluoranthene	0.1228	0.90	0.75
Benzo(k)fluoranthene	0.0523	0.38	0.32
Chrysene	0.0044	0.032	0.027
Dibenzo(a,h)anthracene	1.11	8.1	6.8
Indeno(1,2,3-cd)pyrene	0.278	2.0	1.7

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TABLE A.4-6

DERMAL REFERENCE DOSES AND CANCER SLOPE FACTORS FOR CHEMICAL CONSTITUENTS OF POTENTIAL CONCERN IN FEMP OPERABLE UNIT 5

Chemical	Gastrointestinal Absorption Fraction	Dermal Reference Dose (mg/kg-day)	Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$
Inorganics			
Aluminum	0.05[m]	1.5E-01	ND[b]
Ammonia	0.3[i]	ND	ND
Antimony	0.15[a]	6.0E-05	ND
Arsenic	0.95[h]	2.85×10^{-4}	1.84
Barium	0.91[g,h]	6.4E-02	ND
Beryllium	0.01[h]	5.0E-05	4.3E+02
Boron	0.05[c]	4.5E-03	ND
Cadmium (water)	0.05[a]	2.5E-05	ND
Chromium	0.45[a]	2.5E-05	ND
Cobalt	0.45[a]	2.7E-02	ND
Copper	0.6[g]	ND	ND
Cyanide	0.72[d]	ND[h]	ND
Fluoride	1.0[g]	6.0E-02	ND
Magnesium	0.05[n]	4.9E-01	ND
Manganese	0.03[a]	4.2×10^{-3}	ND
Mercury	0.15[h]	4.5E-05	ND
Molybdenum	0.38[a]	1.9E-03	ND
Nickel	0.05[c]	2.0E-03	ND
Nitrate	ND	ND	ND
Selenium	0.8[a]	4.0E-03	ND
Silver	0.05[c]	ND[h]	ND
Thallium	1[a]	7×10^{-5}	ND
Thorium	ND	ND	ND
Uranium	0.05[c]	1.5E-04	ND
Vanadium	0.05[c]	3.5E-04	ND

TABLE A.4-6 (Continued)

Chemical	Gastrointestinal Absorption Fraction	Dermal Reference Dose (mg/kg-day)	Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$
Organics			
1,1-Dichloroethane	0.9[l]	ND	ND
1,1-Dichloroethene	0.9[h]	8.1E-03	6.7E-01
1,1,1-Trichloroethane	0.9[l]	ND	ND
1,1,2-Trichloroethane	0.9[l]	3.6E-03	6.3E-02
1,1,2,2-Tetrachloroethane	0.9[l]	ND	2.2E-01
1,2-Dichloroethane	0.9[h]	ND	10×10^{-3}
cis-1,2-Dichloroethene	0.9[l]	9.0E-03	ND
trans-1,2-Dichloroethene	0.9[l]	1.8E-02	ND
total-1,2-Dichloroethene	0.9[l]	8.1E-03	ND
2-Chlorophenol	0.9[l]	4.5E-03	ND
2,3,7,8-TCDD	0.5[k]	ND	3×10^{5}
2,4-Dinitrophenol	0.9[l]	1.8E-03	ND
2,4-Dinitrotoluene	0.9[l]	1.8E-03	7.6E-01
2,6-Dinitrotoluene	0.9[l]	9.0E-04	7.6E-01
4-Methyl-2-pentanone	0.9[f]	4.5E-02	ND
4-Nitrophenol	0.9[f]	5.4×10^{-2}	ND
Acetone	0.83[h]	8.3E-02	ND
Aldrin	0.9[g]	2.7E-05	1.9E+01
Alpha-BHC	0.97[h]	ND	6.5E+00
Aroclor-1248	0.75[a]	ND	1.0E+01
Aroclor-1254	0.75[a]	ND	1.0E+01
Aroclor-1260	0.75[a]	ND	1.0E+01
Benzene	0.9[j]	ND	3.0E-02
Benzo(a)anthracene	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND
Beta-BHC	0.9[h]	ND	2.0E-00
Bis(2-ethylhexyl)phthalate	0.9[f]	1.8E-02	1.6E-02
Bromodichloromethane	0.9[j]	1.8E-02	6.9E-02
Bromoform	0.9[i]	1.8E-02	8.8E-03

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TABLE A.4-6 (Continued)

Chemical	Gastrointestinal Absorption Fraction	Dermal Reference Dose (mg/kg-day)	Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$
Carbazole	0.9[l]	ND	2.2E-02
Carbon tetrachloride	0.9[f]	6.3E-04	1.4E-01
Carbon disulfide	0.9[l]	9.0E-02	ND
Chlorobenzene	0.31[i]	6.2E-03	ND
Chloroform	1[j]	1.0E-02	6.1E-03
Chloromethane	0.9[l]	ND	1.4E-02
Chrysene	0.43[a]	ND	ND
DDD	0.9[h]	ND	2.7E-01
DDE	0.9[g]	ND	3.8E-01
DDT	0.9[g]	4.5E-04	3.8E-01
Diazinon	0.9[l]	8.1E-04	ND
Dibenzo(a,h)anthracene	ND	ND	ND
Dieldrin	0.9[g]	4.5E-05	1.8E+01
Endosulfan II	0.9[g]	4.5E-05	ND
Endosulfan I	0.9[g]	$5.4E^{-3}$	ND
Ethylbenzene	0.92[i]	9.2E-02	ND
Fluoranthene	0.43[a]	1.7E-02	ND
Gamma-BHC	0.99[h]	3.0E-04	ND
Heptachlor	0.4[j]	2.0E-04	1.1E+01
Heptachlor epoxide	0.9[g]	1.4E-05	1.0E+01
Hexachloroethane	0.9[l]	9.0E-04	1.6E-02
Indeno(1,2,3-cd)pyrene	ND	ND	ND
Malathion	0.9[l]	1.8E-02	ND
Methoxychlor	0.9[h]	4.5E-03	ND
Methylene chloride	1[a]	6.0E-02	7.5E-03
N-nitroso-di-n-propylamine	0.9[f]	ND	7.8E+00
Pentachlorophenol	1[h]	3.0E-02	1.2E-01
Phenol	0.9[f]	5.4E-01	ND
Styrene	0.9[l]	1.8E-01	3.3E-02
Tetrachloroethene	0.9[f]	9.0E-03	5.8E-02
Toluene	1[g]	2.0E-01	ND

TABLE A.4-6 (Continued)

Chemical	Gastrointestinal Absorption Fraction	Dermal Reference Dose (mg/kg-day)	Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$
Total xylenes	0.9[h]	1.8E+00	ND
Toxaphene	0.9[i]	ND	1.2E+00
Trichloroethene	0.98[j]	5.9E-03	1.1E-02
Vinyl chloride	1[j]	ND	1.9E+00
General Chemistry			
Chloride	0.05[m]	ND	ND
Nitrite	0.05[m]	5.0E-03	ND
Sulfate	0.05[m]	ND	ND

[a]See the Toxicity Profile for this chemical in Attachment V.
[b]ND - not derived.
[c]EPA, 1989a, "Risk Assessment Guidance for Superfund. Volume I, Human Health Evaluation Manual (Part A)," EPA/540/1-89/002, pp. A-2 to A-3.
[d]ATSDR (Agency for Toxic Substances and Disease Registry), 1988a, "Toxicological Profile for Cyanide," Draft for Public Comment. U.S. Public Health Service, Atlanta, Georgia.
[e]The carcinogenicity of uranium is due to its radioactivity rather than chemical toxicity; its cancer potency due to penetrating external radiation is presented in Table A.4-3.
[f]Section A.4.1.4.
[g]Jones, T. D. and B. A. Owen, 1989, "Health Risks from Mixtures of Radionuclides and Chemicals in Drinking Water," Oak Ridge National Laboratory, Oak Ridge, Tennessee, ORNL-6533.
[h]ATSDR (Agency for Toxic Substances and Disease Registry), October 1992, "Toxicological Profile," Draft for Public Comment. U.S. Public Health Service, Atlanta, Georgia.
[i]ATSDR (Agency for Toxic Substances and Disease Registry), October 1989, "Toxicological Profile," Draft for Public Comment. U.S. Public Health Service, Atlanta Georgia.
[j]ATSDR (Agency for Toxic Substances and Disease Registry), October 1991, "Toxicological Profile," Draft for Public Comment. U.S. Public Health Service, Atlanta, Georgia.
[k]ATSDR (Agency for Toxic Substances and Disease Registry), October 1990, "Toxicological Profile for 2,3,7,8-Tetrachlorodibenzo-p-dioxin," Draft for Public Comment. U.S. Public Health Service, Atlanta, Georgia.
[l]Default value for organic compounds acquired from U.S. Dept. of Energy, 1994, "Revised Risk Assessment Work Plan Addendum, Draft," Remedial Investigation and Feasibility Study, Fernald Environmental Management Project, U.S. Dept of Energy, Fernald Field Office, Fernald, Ohio.
[m]Default value for inorganics acquired from U.S. Dept. of Energy, 1994, "Revised Risk Assessment Work Plan Addendum, Draft," Remedial Investigation and Feasibility Study, Fernald Environmental Management Project, U.S. Dept of Energy, Fernald Field Office, Fernald Ohio.

TABLE A.6-1

UNCERTAINTIES ASSOCIATED WITH ESTIMATED RISKS FROM OPERABLE UNIT 5

Source of Uncertainty	Magnitude[a]	Expected Direction[b]	Remark
Selection of CPCs:			
• Adequacy of database	Moderate	Increases or decreases conservatism	Principal constituents were identified. However, exposure concentrations will change in the DRAFT submittal to EPA.
Exposure Assessment:			
• Calculated exposure point concentrations - positive bias in sampling	Moderate	Increases conservatism	Environmental media concentrations based on 95% UCL or maximum. Sampling was biased for radiological CPCs
- conservative modeling assumptions	High	Increases conservatism	Modeled concentrations were conservative.
• Determination of land uses			
- current scenario	Low	Increases conservatism	Scenario based on current environmental setting.
- future scenario	High	Increases conservatism	Worst case scenario assumed.
• Assumptions for source terms			
- current source term	Low	Increases or decreases conservatism	Current source term assumes buildings have been removed.
- future source term	Moderate	Increases conservatism	Future source term assumes stormwater basin and effluent line are nonfunctional.
• Selection of receptors			
- current scenario	Low	Increases conservatism	Scenario based on current environmental setting.
- future scenario	High	Increases conservatism	Worst case scenario assumed.
• Determination of exposure factors	Low to moderate	Increases conservatism	Receptor and exposure pathway specific.

TABLE A.6-1 (Continued)

Source of Uncertainty	Magnitude[a]	Expected Direction[b]	Remark
Toxicity Assessment:			
• Dose-response assessment			
- chemical CPCs	High	Increases conservatism	Dose-response based on animal data.
- radiological CPCs			
internal	Low	Increases conservatism	Dose-response based on human data.
external	Moderate to high	Increases conservatism	Conservative assumptions made for external exposure.
• Other OU5 CPCs			
- dose-response for PAHs	Low	Increases conservatism	PAHs pose relatively low risk.
- dose-response for PCBs	Low	Increases conservatism	PCBs pose relatively low risk.
- dose-response for dioxins/furans	Low	Increases conservatism	Furans/dioxins relatively low risk.
- dose-response for Rn-222 (indoors)	Low to moderate	Increases conservatism	Assumptions for indoor Rn-222 differ from those made for the CSF.
Risk Characterization:			
• Additivity	Low to moderate	Increases conservatism	Health effects dominated from few CPCs and exposure pathways.
• Failure to consider antagonism	Unknown	Increases conservatism	Data unknown.
• Failure to consider synergism	Unknown	Decreases conservatism	Data unknown.
• Failure to consider segregation of Hazard Indices	Low	Increases conservatism	HIs dominated by few CPCs and exposure pathways.
Overall	High	Increases conservatism	High uncertainty from combining low, moderate, ad highly uncertain parameters.

[a]Magnitude is assessed qualitatively based on professional judgment and includes the following:
Low-impact risk by a factor of 10 or less.
Moderate-impact risk by a factor of 10 to 100.
High-impact risk by a factor of 100 or more.
[b]Direction is assessed qualitatively where an increased conservatism increases final health effects and a decreased conservatism decreases final health effects calculated in risk assessment.

TABLE A.III-2
RISK-BASED SCREENING LEVELS FOR
RADIONUCLIDES AND CHEMICALS IN GROUNDWATER/SURFACE WATER
RESIDENTIAL SCENARIO
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT, FERNALD, OHIO
OPERABLE UNIT #5

FILE: WATERSL.WK3
REVISED: 05-23-94

This spreadsheet calculates risk-based groundwater concentrations under an adult residential drinking water exposure scenario. The risk-based concentrations will be used as screening levels for the selection of CPCs in groundwater and surface water. Spreadsheet calculations and input values for exposure parameters are those presented in RAGS, Part 1B (U.S. EPA, 1991). Screening levels calculated for carcinogenic and noncarcinogenic constituents of 1.0E-07 and 0.1, respectively.

1.) Calculation of risk-based concentration for radionuclides in groundwater:

$$Cw = TR/\{(EF \times ED)[(SFo \times IR) + (SFi \times K \times IRAa)]\}$$

2.) Calculation of risk-based concentration for carcinogenic chemicals in groundwater:

2a) Organics:

$$Cw = (TR \times BWa \times ATc \times CF)/\{(EF \times ED)[(SFo \times IR) + (SFi \times K \times IRAa)]\}$$

2b) Inorganics:

$$Cw = (TR \times BWa \times ATc)/\{(EF \times ED)[(SFo \times IR) + (SFi \times K \times IRAa)]\}$$

3.) Calculation of risk-based concentration for noncarcinogenic chemicals in groundwater:

3a) Organics:

$$Cw = (THQ \times BWa \times ATn \times CF)/\{(EF \times ED)[((1/RfDo) \times IR) + ((1/RfDi) \times K \times IRAa)]\}$$

3b) Inorganics:

$$Cw = (THQ \times BWa \times ATn)/\{(EF \times ED)[((1/RfDo) \times IR) + ((1/RfDi) \times K \times IRAa)]\}$$

Parameter	Description (Units)	Constants
Cw	Risk-based concentration of constituent in groundwater (pCi/L, ug/L, mg/L)	NA
TR	Target risk level (unitless)	1.0E-07
THQ	Target hazard quotient (unitless)	1.0E-01
SFo	Oral cancer slope factor (Risk/pCi; kg-day/mg)	CSV
SFi	Inhalation cancer slope factor (Risk/pCi; kg-day/mg)	CSV
RfDo	Oral reference dose (mg/kg/day)	CSV
RfDi	Inhalation reference dose (mg/kg/day)	CSV
BWa	Body weight, adult (kg)	70
ATc	Averaging time (carcinogen) = 70 years x 365 days/year	25550
ATn	Averaging time (noncarcinogen) = ED (years) x 365 days/year	10950
IR	Daily water ingestion rate (L/day)	2
IRAa	Daily inhalation rate (m3/day)	15
K	Volatilization factor (L/m3) = 0.0005 x 1,000 L/m3	CSV
EF	Exposure frequency (days/year)	350
ED	Exposure duration (years)	30
CF	Conversion factor, organics (ug/mg) (Conversion factor not necessary for radionuclides and inorganics.)	1000

	Constituent-Specific Variables					Cw (pCi/L)			
Radionuclide/Chemical	SFo (Risk/pCi)	SFi (Risk/pCi)	RfDo (mg/kg/day)	RfDi (mg/kg/day)	K [1] (L/m3)	SF-Based (TR=1.0E-07)	RfD-Based (THQ=0.1)	MCL (pCi/L)	Screening Level [2][3] (pCi/L)
Radionuclides, pCi/L									
Actinium-227	2.8E-10	8.0E-08	NA	NA	0	0.017	NA	NA	0.017
Actinium-227+7D [4]	3.5E-10	8.8E-08	NA	NA	0	0.014	NA	NA	0.014
Cesium-137	2.8E-11	1.9E-11	NA	NA	0	0.17	NA	NA	0.17
Cesium-137+1D	2.8E-11	1.9E-11	NA	NA	0	0.17	NA	NA	0.17
Lead-210	5.1E-10	1.3E-09	NA	NA	0	0.0093	NA	NA	0.0093
Lead-210+2D	6.6E-10	4.0E-09	NA	NA	0	0.0072	NA	NA	0.0072
Neptunium-237	2.2E-10	2.9E-08	NA	NA	0	0.022	NA	NA	0.022
Neptunium-237+1D	2.2E-10	2.9E-08	NA	NA	0	0.022	NA	NA	0.022
Plutonium-238	2.2E-10	3.9E-08	NA	NA	0	0.022	NA	NA	0.022
Plutonium-239	2.3E-10	3.8E-08	NA	NA	0	0.021	NA	NA	0.021
Plutonium-240	2.3E-10	3.8E-08	NA	NA	0	0.021	NA	NA	0.021
Polonium-210	1.5E-10	2.6E-09	NA	NA	0	0.032	NA	NA	0.032
Potassium-40	1.1E-11	7.6E-12	NA	NA	0	0.43	NA	NA	0.43
Protactinium-231	9.2E-11	3.6E-08	NA	NA	0	0.052	NA	NA	0.052
Radium-224	3.8E-11	1.2E-09	NA	NA	0	0.13	NA	NA	0.13
Radium-226	1.2E-10	3.0E-09	NA	NA	0	0.040	NA	20	0.040
Radium-226+5D [5]	1.2E-10	7.7E-12	NA	NA	0.5	0.032	NA	NA	0.032
Radium-226+8D [5][6]	7.8E-10	7.7E-12	NA	NA	0.5	0.0059	NA	NA	0.0059
Radium-228	1.0E-10	6.6E-10	NA	NA	0	0.048	NA	20	0.048
Radium-228+1D	1.0E-10	6.9E-10	NA	NA	0	0.048	NA	NA	0.048
Radon-222	1.4E-12	7.3E-13	NA	NA	0.5	1.2	NA	300	1.2
Radon-222+4D	1.7E-12	7.7E-12	NA	NA	0.5	0.16	NA	NA	0.16
Ruthenium-106	9.5E-12	4.4E-10	NA	NA	0	0.50	NA	NA	0.50
Strontium-90	3.3E-11	5.6E-11	NA	NA	0	0.14	NA	NA	0.14
Strontium-90+1D	3.6E-11	6.2E-11	NA	NA	0	0.13	NA	NA	0.13
Technetium-99	1.3E-12	8.3E-12	NA	NA	0	3.7	NA	NA	3.7
Thorium-228	1.1E-11	7.7E-08	NA	NA	0	0.43	NA	NA	0.43
Thorium-228+7D	5.5E-11	7.8E-08	NA	NA	0	0.087	NA	NA	0.087
Thorium-230	1.3E-11	2.9E-08	NA	NA	0	0.37	NA	NA	0.37
Thorium-232	1.2E-11	2.8E-08	NA	NA	0	0.40	NA	NA	0.40
Thorium-232+10D [6]	1.7E-10	1.1E-07	NA	NA	0	0.028	NA	NA	0.028
Thorium-234	4.0E-12	3.2E-11	NA	NA	0	1.2	NA	NA	1.2
Uranium-233	1.6E-11	2.7E-08	NA	NA	0	0.30	NA	NA	0.30
Uranium-234	1.6E-11	2.6E-08	NA	NA	0	0.30	NA	NA	0.30
Uranium-235	1.6E-11	2.5E-08	NA	NA	0	0.30	NA	NA	0.30
Uranium-235+1D	1.6E-11	2.5E-08	NA	NA	0	0.30	NA	NA	0.30
Uranium-236	1.5E-11	2.5E-08	NA	NA	0	0.32	NA	NA	0.32
Uranium-238	1.6E-11	2.4E-08	NA	NA	0	0.30	NA	NA	0.30
Uranium-238+2D	2.8E-11	5.2E-08	NA	NA	0	0.17	NA	NA	0.17

TABLE A.III-2 (CON'T.)

Radionuclide/Chemical	Constituent-Specific Variables					Cw (ug/L)		MCL	Screening Level
	SFo (mg/kg/day)$^{-1}$	SFI (mg/kg/day)$^{-1}$	RfDo (mg/kg/day)	RfDi (mg/kg/day)	K [1] (L/m3)	SF-Based (TR=1.0E-07)	RfD-Based (THQ=0.1)	(ug/L)	[2] (ug/L)
Volatile Organic Compounds, ug/L									
1,1,1,2-Tetrachloroethane	2.6E-02	2.6E-02	3.0E-02	NA	0.5	0.069	110	NA	0.069
1,1,1-Trichloroethane	NA	NA	ND	2.9E-01	0.5	NA	151	200	151
1,1,2,2-Tetrachloroethane	2.0E-01	2.0E-01	NA	NA	0.5	0.0090	NA	NA	0.0090
1,1,2-Trichloroethane	5.7E-02	5.6E-02	4.0E-03	NA	0.5	0.032	15	5	0.032
1,1-Dichloroethane	NA	NA	NA	1.0E-01	0.5	NA	97	NA	97
1,1-Dichloroethene	6.0E-01	1.8E-01	9.0E-03	NA	0.5	0.0067	33	7	0.0067
1,2,3-Trichloropropane	NA	NA	6.0E-03	NA	0.5	NA	22	NA	22
1,2-Dibromo-3-chloropropane	1.4E+00	6.9E-07	NA	5.7E-05	0.5	0.0061	0.055	0.2	0.0061
1,2-Dibromoethane	8.5E+01	7.7E-01	NA	5.7E-05	0.5	0.00010	NA	NA	0.00010
1,2-Dichloroethane	9.1E-02	9.1E-02	NA	NA	0.5	0.020	NA	5	0.020
cis-1,2-Dichloroethene	NA	NA	1.0E-02	NA	0.5	NA	37	70	37
1,4-Dioxane	1.1E-02	NA	NA	NA	0	0.77	NA	NA	0.77
2-Butanone	NA	NA	6.0E-01	2.9E-01	0	NA	2,190	NA	2,190
2-Chloro-1,3-butadiene	NA	NA	NA	2.0E-03	0.5	NA	19	NA	19
2-Chloroethylvinyl ether	NA	NA	NA	NA	0.5	NA	NA	NA	NA
2-Hexanone	NA	NA	4.0E-02	NA	0	NA	146	NA	146
2-Picoline	NA	NA	NA	NA	0	NA	NA	NA	NA
3-Chloropropene	NA	NA	NA	NA	0	NA	NA	NA	NA
4-Methyl-2-pentanone	NA	NA	5.0E-02	2.3E-02	0	NA	183	NA	183
Acetone	NA	NA	1.0E-01	NA	0	NA	365	NA	365
Acetonitrile	NA	NA	6.0E-03	1.4E-02	0	NA	22	NA	22
Acrolein	NA	NA	NA	5.7E-06	0	NA	73	NA	73
Acrylonitrile	5.4E-01	2.4E-01	NA	5.7E-04	0	0.016	NA	NA	0.016
Benzene	2.9E-02	2.9E-02	NA	NA	0.5	0.062	NA	5	0.062
Bromochloromethane	NA	NA	NA	NA	0	NA	NA	NA	NA
Bromodichloromethane	6.2E-02	NA	2.0E-02	NA	0.5	0.14	73	100	0.14
Bromoform	7.9E-03	3.8E-03	2.0E-02	NA	0.5	0.38	73	100	0.38
Bromomethane	NA	NA	1.4E-03	1.4E-03	0.5	NA	1.08	NA	1.08
Carbon tetrachloride	1.3E-01	5.2E-02	7.0E-04	NA	0.5	0.026	2.6	5	0.026
Carbon disulfide	NA	NA	1.0E-01	2.9E-03	0.5	NA	2.8	NA	2.8
Chlorobenzene	NA	NA	2.0E-02	5.7E-03	0.5	NA	5.2	100	5.2
Chloroethane	NA	NA	NA	2.9E+00	0.5	NA	2,784	NA	2,784
Chloroform	6.1E-03	8.0E-02	1.0E-02	NA	0.5	0.028	37	100	0.028
Chloromethane	1.3E-02	6.3E-03	NA	NA	0.5	0.23	NA	NA	0.23
Cumene	NA	NA	4.0E-02	2.6E-03	0	NA	146	NA	146
Dibromochloromethane	8.4E-02	NA	2.0E-02	NA	0.5	0.10	73	NA	0.10
Dibromomethane	NA	NA	NA	NA	0.5	NA	NA	NA	NA
1,2-Dichloropropane	NA	6.8E-02	NA	1.1E-03	0.5	0.033	1.07	NA	0.033
Dichlorodifluoromethane	NA	NA	2.0E-01	5.7E-02	0.5	NA	52	NA	52
Ethyl cyanide	NA	NA	NA	NA	0	NA	NA	NA	NA
Ethyl methacrylate	NA	NA	9.0E-02	NA	0	NA	329	NA	329
Methyl methacrylate	NA	NA	8.0E-02	NA	0	NA	292	NA	292
Ethylbenzene	NA	NA	1.0E-01	2.9E-01	0.5	NA	158	700	158
Iodomethane	NA	NA	NA	NA	0.5	NA	NA	NA	NA
Isobutyl alcohol	NA	NA	3.0E-01	NA	0.5	NA	1,095	NA	1,095
Methacrylonitrile	NA	NA	NA	2.0E-04	0	NA	NA	NA	NA
Methylene chloride	7.5E-03	1.6E-03	6.0E-02	8.6E-01	0.5	0.63	174	5	0.63
Pentachloroethane	NA	NA	NA	NA	0	NA	NA	NA	NA
Pyridine	NA	NA	1.0E-03	NA	0	NA	3.7	NA	3.7
Styrene	3.0E-02	NA	2.0E-01	2.9E-01	0.5	0.28	202	100	0.28
Tetrachloroethene	5.2E-02	2.0E-03	1.0E-02	NA	0.5	0.14	37	5	0.14
Toluene	NA	NA	2.0E-01	1.1E-01	0.5	NA	93.37	1000	93
Total Xylenes	NA	NA	2.0E+00	NA	0.5	NA	7,300	10000	7,300
Trichloroethene	1.1E-02	6.0E-03	6.0E-03	NA	0.5	0.25	22	5	0.25
Trichlorofluoromethane	NA	NA	3.0E-01	2.0E-01	0.5	NA	165	NA	165
Vinyl acetate	NA	NA	1.0E+00	5.7E-02	0	NA	3,650	NA	3,650
Vinyl chloride	1.9E+00	3.0E-01	NA	NA	0.5	0.0028	NA	2	0.0028
cis-1,3-Dichloropropene	1.8E-01	1.3E-01	NA	NA	0.5	0.013	NA	NA	0.011
trans-1,2-Dichloroethene	NA	NA	2.0E-02	NA	0.5	NA	73	100	73
trans-1,3-Dichloropropene	1.8E-01	1.3E-01	NA	NA	0.5	0.013	NA	NA	0.013
trans-1,4-Dichloro-2-butene	NA	9.3E+00	NA	NA	0.5	0.00024	NA	NA	0.00024

TABLE A.III-2 (CON'T.)

Radionuclide/Chemical	Constituent-Specific Variables SFo (mg/kg/day)$^{-1}$	SFI (mg/kg/day)$^{-1}$	RfDo (mg/kg/day)	RfDi (mg/kg/day)	K [1] (L/m3)	Cw (ug/L) SF-Based (TR=1.0E-07)	Cw (ug/L) RfD-Based (THQ=0.1)	MCL (ug/L)	Screening Level [2] (ug/L)
Semivolatile Organic Compounds, ug/L									
1,2,4,5-Tetrachlorobenzene	NA	NA	3.0E-04	NA	0.5	NA	1.1	NA	1.1
1,2,4-Trichlorobenzene	NA	NA	1.0E-02	2.6E-03	0.5	NA	2.3	70	2.3
1,2-Dichlorobenzene	NA	NA	9.0E-02	5.7E-02	0.5	NA	47	600	47
1,3,5-Trinitrobenzene	NA	NA	5.0E-05	NA	0	NA	0.18	NA	0.18
1,3-Dichlorobenzene	NA	NA	NA	NA	0.5	NA	NA	600	NA
1,3-Dinitrobenzene	NA	NA	1.0E-04	NA	0	NA	0.37	NA	0.37
1,4-Dichlorobenzene	2.4E-02	NA	NA	2.3E-01	0.5	0.35	224	75	0.35
1,4-Naphthaquinone	NA	NA	NA	NA	0	NA	NA	NA	NA
1-Hexadecyne	NA	NA	NA	NA	0	NA	NA	NA	NA
1-Naphthylamine	NA	NA	NA	NA	0	NA	NA	NA	NA
2,3,4,6-Tetrachlorophenol	NA	NA	3.0E-02	NA	0	NA	110	NA	110
2,4,5-Trichlorophenol	NA	NA	1.0E-01	NA	0	NA	365	NA	365
2,4,6-Trichlorophenol	1.1E-02	1.1E-02	NA	NA	0	0.77	NA	NA	0.77
2,4-Dichlorophenol	NA	NA	3.0E-03	NA	0	NA	11	NA	11
2,4-Dimethylphenol	NA	NA	2.0E-02	NA	0	NA	73	NA	73
2,4-Dinitrophenol	NA	NA	2.0E-03	NA	0	NA	7.3	NA	7.3
2,4-Dinitrotoluene	6.8E-01	NA	2.0E-03	NA	0	0.013	7.3	NA	0.013
2,6-Dichlorophenol	NA	NA	NA	NA	0.5	NA	NA	NA	NA
2,6-Dinitrotoluene	6.8E-01	NA	1.0E-03	NA	0	0.013	3.7	NA	0.013
2-Acetylaminofluorene	NA	NA	NA	NA	0	NA	NA	NA	NA
2-Chloronaphthalene	NA	NA	8.0E-02	NA	0	NA	292	NA	292
2-Chlorophenol	NA	NA	5.0E-03	NA	0	NA	18	NA	18
2-Methylnaphthalene [7]	NA	NA	NA	NA	0	NA	NA	NA	146
2-Methylphenol	NA	NA	5.0E-02	NA	0	NA	183	NA	183
2-Naphthylamine	NA	NA	NA	NA	0	NA	NA	NA	NA
2-Nitroaniline	NA	NA	NA	6.0E-05	0	NA	NA	NA	NA
2-Nitrophenol	NA	NA	NA	NA	0	NA	NA	NA	NA
3,3'-Dichlorobenzidine	4.5E-01	NA	NA	NA	0	0.019	NA	NA	0.019
3,3'-Dimethylbenzidine	9.2E+00	NA	NA	NA	0	0.00093	NA	NA	0.00093
3-Methylcholanthrene	NA	NA	NA	NA	0	NA	NA	NA	NA
3-Methylphenol	NA	NA	5.0E-02	NA	0	NA	183	NA	183
3-Nitrophenol	NA	NA	NA	NA	0	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol	NA	NA	NA	NA	0.5	NA	NA	NA	NA
4-Aminobiphenyl	NA	NA	NA	NA	0	NA	NA	NA	NA
4-Bromophenyl phenyl ether	NA	NA	5.8E-02	NA	0	NA	212	NA	212
4-Chloro-3-methylphenol [8]	NA	NA	NA	NA	0	NA	NA	NA	NA
4-Chloroaniline	NA	NA	4.0E-03	NA	0	NA	15	NA	15
4-Chlorophenyl phenyl ether	NA	NA	NA	NA	0	NA	NA	NA	NA
4-Methylphenol	NA	NA	5.0E-03	NA	0	NA	18	NA	18
4-Nitroaniline	NA	NA	3.0E-03	NA	0	NA	11	NA	11
4-Nitrophenol	NA	NA	6.2E-02	NA	0	NA	226	NA	226
4-Nitroquinoline-1-oxide	NA	NA	NA	NA	0	NA	NA	NA	NA
5-Nitro-o-toluidine	NA	NA	NA	NA	0	NA	NA	NA	NA
7,12-Dimethylbenz(a)anthracene	NA	NA	NA	NA	0	NA	NA	NA	NA
Acenaphthene	NA	NA	6.0E-02	NA	0	NA	219	NA	219
Acenaphthylene	NA	NA	NA	NA	0.5	NA	NA	NA	NA
Acetophenone	NA	NA	1.0E-01	1.0E+01	0.5	NA	0.0055	NA	0.0055
Aniline	5.7E-03	NA	NA	2.9E-04	0	1.5	NA	NA	1.5
Anthracene	NA	NA	3.0E-01	NA	0	NA	1,095	NA	1,095
Aramite	2.5E-02	2.5E-01	5.0E-02	NA	0	0.34	183	NA	0.34
Benzo(a)anthracene	1.1E+00	8.9E-01	NA	NA	0	0.0077	NA	0.1	0.0077
Benzo(a)pyrene	7.3E+00	6.1E+00	NA	NA	0	0.0012	NA	0.2	0.0012
Benzo(b)fluoranthene	9.0E-01	7.5E-01	NA	NA	0	0.0095	NA	0.2	0.0095
Benzo(g,h,i)perylene	NA	NA	NA	NA	0	NA	NA	NA	NA
Benzo(k)fluoranthene	3.8E-01	3.2E-01	NA	NA	0	0.022	NA	0.2	0.022
Benzoic Acid	NA	NA	4.0E+00	NA	0	NA	14,600	NA	14,600
Benzyl alcohol	NA	NA	3.0E-01	NA	0	NA	1,095	NA	1,095
Butyl benzyl phthalate	NA	NA	2.0E-01	NA	0	NA	730	100	730
Carbazole	2.0E-02	NA	NA	NA	0	0.43	NA	NA	0.43
Chlorobenzilate	NA	NA	2.0E-02	NA	0	NA	73	NA	73
Chrysene	3.2E-02	2.7E-02	NA	NA	0	0.27	NA	0.2	0.20
Di-n-butylphthalate	NA	NA	1.0E-01	NA	0	NA	365	NA	365
Di-n-octylphthalate	NA	NA	2.0E-02	NA	0	NA	73	NA	73
Diallate	6.1E-02	NA	NA	NA	0.5	0.14	NA	NA	0.14
Dibenzo(a,h)anthracene	8.1E+00	6.8E+00	NA	NA	0	0.0011	NA	0.3	0.0011
Dibenzofuran	NA	NA	4.0E-03	NA	0	NA	15	NA	15
Diethyl phthalate	NA	NA	8.0E-01	NA	0	NA	2,920	NA	2,920
Dimethoate	NA	NA	2.0E-04	NA	0	NA	0.73	NA	0.73
Dimethyl phthalate	NA	NA	1.0E+01	NA	0	NA	36,500	NA	36,500
Diphenylamine	NA	NA	2.5E-02	NA	0	NA	91	NA	91
Ethyl methanesulfonate	NA	NA	NA	NA	0	NA	NA	NA	NA
Famphur	NA	NA	NA	NA	0	NA	NA	NA	NA
Fluoranthene	NA	NA	4.0E-02	NA	0	NA	146	NA	146
Fluorene	NA	NA	4.0E-02	NA	0	NA	146	NA	146
Hexachlorobenzene	1.6E+00	1.6E+00	8.0E-04	NA	0.5	0.0011	2.9	1	0.0011
Hexachlorobutadiene	7.8E-02	7.7E-02	NA	NA	0.5	0.023	NA	NA	0.023
Hexachlorocyclpentadiene	NA	NA	7.0E-03	2.0E-05	0.5	NA	0.019	50	0.019
Hexachloroethane	1.4E-02	1.4E-02	1.0E-03	NA	0.5	0.13	3.7	NA	0.13
Hexachlorophene	NA	NA	3.0E-04	NA	0	NA	1.1	NA	1.1
Hexachloropropene	NA	NA	NA	NA	0	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	2.0E+00	1.7E+00	NA	NA	0	0.0043	NA	0.4	0.0043
Isodrin	NA	NA	NA	NA	0	NA	NA	NA	NA
Isophorone	9.5E-04	NA	2.0E-01	NA	0	9.0	730	NA	9.0
Isosafrole	NA	NA	NA	NA	0	NA	NA	NA	NA
Kepone	NA	NA	NA	NA	0	NA	NA	NA	NA
Methapyrilene	NA	NA	NA	NA	0	NA	NA	NA	NA
Methyl methanesulfonate	NA	NA	NA	NA	0	NA	NA	NA	NA
N-Nitroso-di-n-propylamine	7.0E+00	NA	NA	NA	0	0.0012	NA	NA	0.0012
N-Nitroso-di-n-butylamine	5.4E+00	5.6E+00	NA	NA	0	0.0016	NA	NA	0.0016

TABLE A.III-2 (CON'T.)

Radionuclide/Chemical	Constituent-Specific Variables					Cw (ug/L)		MCL (ug/L)	Screening Level [2] (ug/L)
	SFo (mg/kg/day)$^{-1}$	SFI (mg/kg/day)$^{-1}$	RfDo (mg/kg/day)	RfDi (mg/kg/day)	K [1] (L/m3)	SF-Based (TR=1.0E-07)	RfD-Based (THQ=0.1)		
Semivolatile Organic Compounds, ug/L (Con't.)									
N-Nitrosodiethylamine	1.5E+02	1.5E+02	NA	NA	0	0.000057	NA	NA	0.000057
N-Nitrosodimethylamine	5.1E+01	4.9E+01	NA	NA	0	0.00017	NA	NA	0.00017
N-Nitrosodiphenylamine	4.9E-03	NA	NA	NA	0	1.7	NA	NA	1.7
N-Nitrosomethylethylamine	2.2E+01	NA	NA	NA	0	0.00039	NA	NA	0.00039
N-Nitrosomorpholine	NA	NA	NA	NA	0	NA	NA	NA	NA
N-Nitrosopiperidine	NA	NA	NA	NA	0	NA	NA	NA	NA
N-Nitrosopyrrolidine	2.1E+00	2.1E+00	NA	NA	0	0.00406	NA	NA	0.00406
Naphthalene	NA	NA	4.0E-02	NA	0	NA	146	NA	146
Nitrobenzene	NA	NA	5.0E-04	5.7E-04	0.5	NA	0.43	NA	0.43
o,o,o-Triethylphosphorothioate	NA	NA	NA	NA	0	NA	NA	NA	NA
Pentachlorobenzene	NA	NA	8.0E-04	NA	0.5	NA	2.9	NA	2.9
Pentachloronitrobenzene	2.6E-01	NA	3.0E-03	NA	0.5	0.033	11	NA	0.033
Pentachlorophenol	1.2E-01	NA	3.0E-02	NA	0	0.071	110	1	0.071
Phenacetin	NA	NA	NA	NA	0	NA	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	0	NA	NA	NA	NA
Phenol	NA	NA	6.0E-01	NA	0	NA	2,190	NA	2,190
Phorate	NA	NA	2.0E-04	NA	0	NA	0.73	NA	0.73
Pronamide	NA	NA	7.5E-02	NA	0	NA	274	NA	274
Pyrene	NA	NA	3.0E-02	NA	0	NA	110	NA	110
Safrole	NA	NA	NA	NA	0	NA	NA	NA	NA
Thionazin	NA	NA	NA	NA	0	NA	NA	NA	NA
Tributyl phosphate	NA	NA	5.0E-03	NA	0	NA	18	NA	18
a,a-Dimethylphenethylamine	NA	NA	NA	NA	0	NA	NA	NA	NA
Bis(2-Chloroethoxy)methane	NA	NA	NA	NA	0	NA	NA	NA	NA
Bis(2-Chloroethyl)ether	NA	1.1E+00	NA	NA	0.5	0.00206	NA	NA	0.00206
Bis(2-Chloroisopropyl)ether	7.0E-02	3.5E-02	NA	NA	0.5	0.042	NA	NA	0.042
Bis(2-ethylhexyl)phthalate	1.4E-02	NA	2.0E-02	NA	0	0.61	73	6	0.61
o-Toluidine	NA	NA	NA	NA	0	NA	NA	NA	NA
p-Dimethylaminoazobenzene	NA	NA	NA	NA	0	NA	NA	NA	NA
p-Phenylenediamine	NA	NA	1.9E-01	NA	0	NA	694	NA	694
Azinphosmethyl	NA	NA	NA	NA	0	NA	NA	NA	NA

TABLE A.III-2 (CON'T.)

Radionuclide/Chemical	Constituent-Specific Variables: SFo (mg/kg/day)$^{-1}$	SFI (mg/kg/day)$^{-1}$	RfDo (mg/kg/day)	RfDI (mg/kg/day)	K [1] (L/m3)	Cw (ug/L): SF-Based (TR=1.0E-07)	Cw (ug/L): RfD-Based (THQ=0.1)	MCL (ug/L)	Screening Level [2] (ug/L)
Pesticides/PCBs, ug/L									
4-4'-DDD	2.4E-01	NA	NA	NA	0	0.035	NA	NA	0.035
4-4'-DDE	3.4E-01	NA	NA	NA	0	0.025	NA	NA	0.025
4-4'-DDT	3.4E-01	NA	5.0E-04	NA	0	0.025	1.8	NA	0.025
Aldrin	1.7E+01	1.7E+01	3.0E-05	NA	0	0.00050	0.11	NA	0.00050
Arochlor 1016	7.7E+00	NA	NA	NA	0	0.0011	NA	0.5	0.0011
Arochlor 1221	7.7E+00	NA	NA	NA	0	0.0011	NA	0.5	0.0011
Arochlor 1232	7.7E+00	NA	NA	NA	0	0.0011	NA	0.5	0.0011
Arochlor 1242	7.7E+00	NA	NA	NA	0	0.0011	NA	0.5	0.0011
Arochlor 1248	7.7E+00	NA	NA	NA	0	0.0011	NA	0.5	0.0011
Arochlor 1254	7.7E+00	NA	NA	NA	0	0.0011	NA	0.5	0.0011
Arochlor 1260	7.7E+00	NA	NA	NA	0	0.0011	NA	0.5	0.0011
Chlordane	1.3E+00	1.3E+00	6.0E-05	NA	0	0.0066	0.22	2	0.0066
Demeton	NA	NA	4.0E-05	NA	0	NA	0.15	NA	0.15
Diazinon	NA	NA	9.0E-04	NA	0	NA	3.3	NA	3.3
Dieldrin	1.6E+01	1.6E+01	5.0E-05	NA	0	0.00053	0.18	NA	0.00053
Disulfoton	NA	NA	4.0E-05	NA	0	NA	0.15	NA	0.15
Endosulfan II [10]	NA	NA	6.0E-03	NA	0.5	NA	21.9	NA	21.9
Endosulfan sulfate [11]	NA	NA	NA	NA	0.5	NA	NA	NA	21.9
Endosulfan I [10]	NA	NA	6.0E-03	NA	0.5	NA	21.9	NA	21.9
Endrin	NA	NA	3.0E-04	NA	0	NA	1.1	2	1.1
Endrin aldehyde [12]	NA	NA	NA	NA	0	NA	NA	NA	1.1
Endrin ketone	NA	NA	NA	NA	0	NA	NA	NA	NA
Ethion	NA	NA	5.0E-04	NA	0	NA	1.8	NA	1.8
Heptachlor	4.5E+00	4.6E+00	5.0E-04	NA	0.5	0.00039	1.8	0.4	0.00039
Heptachlor epoxide	9.1E+00	9.1E+00	1.3E-05	NA	0.5	0.00020	0.047	0.2	0.00020
Malathion	NA	NA	2.0E-02	NA	0	NA	73	NA	73
Methoxychlor	NA	NA	5.0E-03	NA	0	NA	18	40	18
Ethyl parathion	NA	NA	NA	NA	0	NA	NA	NA	NA
Methyl parathion	NA	NA	2.5E-04	NA	0	NA	0.91	NA	0.91
Toxaphene	1.1E+00	1.1E+00	NA	NA	0	0.0077	NA	3	0.0077
Alpha-BHC	6.3E+00	6.3E+00	NA	NA	0	0.0014	NA	NA	0.0014
Alpha-Chlordane	1.3E+00	1.3E+00	6.0E-05	NA	0	0.0066	0.22	NA	0.0066
Beta-BHC	1.8E+00	1.9E+00	NA	NA	0	0.0047	NA	NA	0.0047
Delta-BHC	NA	NA	NA	NA	0	NA	NA	NA	NA
Gamma-BHC (Lindane)	NA	NA	3.0E-04	NA	0	NA	1.1	NA	1.1
Gamma-Chlordane	1.3E+00	1.3E+00	6.0E-05	NA	0	0.0066	0.22	NA	0.0066
Dioxins/Furans, ug/L [13]									
Dioxins									
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1.5E+05	1.5E+05	NA	NA	0	0.000000057	NA	0.00003	5.7E-08
1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin	NA	NA	NA	NA	0	0.000005678	NA	NA	5.7E-06
Heptachlorodibenzo-p-dioxins	NA	NA	NA	NA	0	0.000005678	NA	NA	5.7E-06
Octachlorodibenzo-p-dioxin	NA	NA	NA	NA	0	0.000056778	NA	NA	5.7E-05
Furans									
2,3,7,8-tetrachlorodibenzofuran	NA	NA	NA	NA	0	0.000000568	NA	NA	5.7E-07
Tetrachlorodibenzofurans	NA	NA	NA	NA	0	0.000000568	NA	NA	5.7E-07
1,2,3,7,8-pentachlorodibenzofuran	NA	NA	NA	NA	0	0.000001136	NA	NA	1.1E-06
2,3,4,7,8-pentachlorodibenzofuran	NA	NA	NA	NA	0	0.000000114	NA	NA	1.1E-07
Pentachlorodibenzofurans	NA	NA	NA	NA	0	0.000000114	NA	NA	1.1E-07
Hexachlorodibenzofurans	NA	NA	NA	NA	0	0.000000568	NA	NA	5.7E-07
Heptachlorodibenzofurans	NA	NA	NA	NA	0	0.000005678	NA	NA	5.7E-06
Octachlorodibenzofuran	NA	NA	NA	NA	0	0.000056778	NA	NA	5.7E-05
Herbicides, ug/L									
2,4,5-T	NA	NA	1.0E-02	NA	0	NA	37	NA	37
2,4,5-TP (Silvex)	NA	NA	8.0E-03	NA	0	NA	29	50	29
2,4-D	NA	NA	1.0E-02	NA	0.5	NA	37	70	37
Dinoseb	NA	NA	1.0E-03	NA	0	NA	3.7	7	3.7

TABLE A.III-2 (CON'T.)

Radionuclide/Chemical	Constituent-Specific Variables					Cw (mg/L)		MCL (mg/L)	Screening Level [2] (mg/L)
	SFo (mg/kg/day)$^{-1}$	SFI (mg/kg/day)$^{-1}$	RfDo (mg/kg/day)	RfDI (mg/kg/day)	K [1] (L/m3)	SF-Based (TR=1.0E-07)	RfD-Based (THQ=0.1)		
Inorganics, mg/L									
Aluminum	NA	NA	2.9E+00	NA	0	NA	10.58500	NA	NA
Antimony	NA	NA	4.0E-04	NA	0	NA	0.0015	0.006	0.0015
Arsenic	1.8E+00	1.5E+01	3.0E-04	NA	0	0.0000049	0.0011	0.05	0.0000049
Barium	NA	NA	7.0E-02	1.4E-04	0	NA	0.26	2	0.26
Beryllium	4.3E+00	8.4E+00	5.0E-03	NA	0	0.0000020	0.018	0.004	0.0000020
Boron	NA	NA	9.0E-02	5.7E-03	0	NA	0.33	NA	0.33
Cadmium	NA	6.3E+00	5.0E-04	NA	0	NA	0.0018	0.005	0.0018
Calcium	NA	NA	NA	NA	0	NA	NA	NA	NA
Chromium, hexavalent	NA	4.2E+01	5.0E-03	NA	0	NA	0.018	0.1	0.018
Chromium, trivalent	NA	NA	1.0E+00	NA	0	NA	3.7	NA	3.7
Cobalt	NA	NA	6.0E-02	3.0E-07	0	NA	0.22	NA	0.22
Copper	NA	NA	3.7E-02	NA	0	NA	0.14	NA	0.14
Cyanide	NA	NA	2.0E-02	NA	0	NA	0.073	0.2	0.073
Iron	NA	NA	NA	NA	0	NA	NA	NA	NA
Lead	NA	NA	NA	NA	0	NA	NA	NA	NA
Magnesium	NA	NA	9.7E+00	NA	0	NA	35	NA	35
Manganese	NA	NA	5.0E-03	1.4E-05	0	NA	0.018	NA	0.018
Mercury	NA	NA	3.0E-04	8.6E-05	0	NA	0.0011	0.002	0.0011
Molybdenum	NA	NA	5.0E-03	NA	0	NA	0.018	NA	0.018
Nickel	NA	8.4E-01	2.0E-02	NA	0	NA	0.073	0.1	0.073
Osmium	NA	NA	NA	NA	0	NA	NA	NA	NA
Selenium	NA	NA	5.0E-03	NA	0	NA	0.018	0.05	0.018
Silver	NA	NA	5.0E-03	NA	0	NA	0.018	NA	0.018
Thallium	NA	NA	7.0E-05	NA	0	NA	0.00026	0.002	0.00026
Tin	NA	NA	6.0E-01	NA	0	NA	2.2	NA	2.2
Vanadium	NA	NA	7.0E-03	NA	0	NA	0.026	NA	0.026
Zinc	NA	NA	3.0E-01	NA	0	NA	1.1	NA	1.1
Conventional Parameters, mg/L									
Ammonia	NA	NA	NA	2.9E-02	0	NA	NA	NA	NA
Fluoride	NA	NA	6.0E-02	NA	0	NA	0.22	4	0.22
Nitrate	NA	NA	1.6E+00	NA	0	NA	5.8	10	5.8
Nitrite	NA	NA	1.0E-01	NA	0	NA	0.37	1	0.37
Sulfate [14]	NA	NA	NA	NA	NA	NA	NA	250	250

Notes:

[1] Default value = 0.5 used for organics with Henry's Law constant (H) > 1E-05; 0 was used for organics with H < 1E-05 and inorganics.
[2] The screening level selected for each constituent represents the minimum value of the risk-based concentrations and MCL.
[3] Screening levels for radionuclides are not to be used for COC selection in the risk assessment, but rather as points of reference only for the purposes of fate and transport modeling.
[4] "+D" indicates that risks from primary decay chain products are incorporated into the slope factor presented.
[5] The SFI for Rn-222+4D is used for Ra-226+5D and Ra-226+8D since this is a daughter product in both decay chains.
[6] Slope factors will be used to evaluate future exposure scenarios involving parent isotope in equilibrium with daughters.
[7] Screening level for naphthalene used as a surrogate.
[8] Screening level for 2-methylphenol used as a surrogate.
[9] Oral RfD acquired from U.S.EPA Environmental Criteria Assessment Office, 1993.
[10] Reference dose for endosulfan (U.S. EPA Region III Tables for Risk-Based Concentrations) used for endosulfan I and II.
[11] Screening level for endosulfan I and II used as a surrogate for endosulfan sulfate.
[12] Screening level for endrin used as a surrogate.
[13] Risk-based concentrations (RBC) for dioxin/furan congeners were calculated by dividing the 2378-TCDD RBC by the toxic equivalent factor (TEF) presented in Table A.4-
[14] Secondary MCL for sulfate.
NA - Not applicable
CSV - Constituent-specific value

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TABLE A.III-3
RISK-BASED SCREENING LEVELS FOR
RADIONUCLIDES AND CHEMICALS IN SOILS/SEDIMENTS
RESIDENTIAL SCENARIO
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT, FERNALD, OHIO
OPERABLE UNIT #5

FILE: SOSDSL.WK3
REVISED: 05-23-94

This spreadsheet calculates risk-based soil/sediment concentrations under an adult residential soil exposure scenario. The risk-based concentrations will be used as screening levels for the selection of CPCs in soils and sediments. Spreadsheet calculations and input values for exposure parameters are based on those presented in RAGS, Part 1B (U.S. EPA, 1991). Screening levels calculated for carcinogenic and noncarcinogenic constituents of 1.0E-07 and 0.1, respectively.

1.) Calculation of risk-based concentration for radionuclides in soil:
$Cs = TR/[(SFo \times EF \times IFr \times CFr) + (ED \times SFe \times (1-Se) \times Te)]$

2.) Calculation of risk-based concentration for carcinogenic chemicals in soil:
2a.) Organics:
$Cs = (TR \times ATc)/(SFo \times CFo \times EF \times IFc)$
2b.) Inorganics:
$Cs = (TR \times ATc)/(SFo \times CFi \times EF \times IFc)$

3.) Calculation of risk-based concentration for noncarcinogenic chemicals in soil:
3a.) Organics:
$Cs = (THQ \times ATn)/[(1/RfDo) \times CFo \times EF \times IFc)]$
3b.) Inorganics:
$Cs = (THQ \times ATn)/[(1/RfDo) \times CFi \times EF \times IFc)]$

4.) Calculation of IF (age-adjusted soil ingestion factor):
4a.) Radionuclides:
$IFr = (IRc \times EDc) + (IRa \times EDa)$
4a.) Chemicals:
$IFc = [(IRc \times EDc)/BWc] + [(IRa \times EDa)/BWa]$

Parameter	Description (Units)	Constants
Cs	Risk-based concentration of constituent in soils (pCi/g, ug/Kg, mg/Kg)	NA
TR	Target risk level (unitless)	1.0E-07
THQ	Target hazard quotient (unitless)	1.0E-01
SFo	Oral cancer slope factor (Risk/pCi; kg-day/mg)	CSV
SFe	Cancer slope factor, external radiation (Risk-g/pCi-yr)	CSV
RfDo	Oral reference dose (mg/kg/day)	CSV
BWc	Body weight, child (kg)	15
BWa	Body weight, adult (kg)	70
ATc	Averaging time (carcinogen) = 70 years x 365 days/year	25550
ATn	Averaging time (noncarcinogen) = ED (30 years) x 365 days/year	10950
IRc	Daily water ingestion rate, child (mg/day)	200
IRa	Daily water ingestion rate, adult (mg/day)	100
EDc	Exposure duration, child (years)	6
EDa	Exposure duration, adult (years)	24
ED	Exposure duration, (years)	30
IFr	Age-adjusted ingestion factor, radionuclides (mg-yr/day)	3600
IFc	Age-adjusted ingestion factor, chemicals (mg-yr/kg-day)	114
EF	Exposure frequency (days/year)	350
CFr	Conversion factor, radionuclides (g/mg)	1.0E-03
CFo	Conversion factor, organics (0.001 ug-chem/mg-chem x 0.000001 kg-soil/mg-soil)	1.0E-09
CFi	Conversion factor, inorganics (kg/mg)	1.0E-06
Se	Gamma shielding factor (unitless)	0.2
Te	Gamma exposure time factor (unitless)	1

Radionuclide/Chemical	Constituent-Specific Variables			Cs (pCi/g)		SCREENING LEVEL (pCi/g)
	SFo (Risk/pCi)	SFe (Risk-g / pCi-yr)	RfDo (mg/kg/day)	SF-Based (TR=1.0E-07)	RfD-Based (THQ=0.1)	
Radionuclides, pCi/g						
Actinium-227	2.8E-10	2.6E-11	NA	0.28	NA	0.28
Actinium-227+7D [2]	3.5E-10	8.5E-07	NA	0.0048	NA	0.0048
Cesium-137	2.8E-11	0.0E+00	NA	2.8	NA	2.8
Cesium-137+1D	2.8E-11	2.0E-06	NA	0.0021	NA	0.0021
Lead-210	5.1E-10	1.3E-10	NA	0.15	NA	0.15
Lead-210+2D	6.6E-10	1.6E-10	NA	0.12	NA	0.12
Neptunium-237	2.2E-10	7.8E-09	NA	0.22	NA	0.22
Neptunium-237+1D	2.2E-10	4.3E-07	NA	0.0094	NA	0.0094
Plutonium-238	2.2E-10	2.8E-11	NA	0.36	NA	0.36
Plutonium-239	2.3E-10	2.7E-11	NA	0.34	NA	0.34
Plutonium-240	2.3E-10	2.7E-11	NA	0.34	NA	0.34
Polonium-210	1.5E-10	2.9E-11	NA	0.53	NA	0.53
Potassium-40	1.1E-11	5.4E-07	NA	0.0077	NA	0.0077
Protactinium-231	9.2E-11	2.6E-08	NA	0.14	NA	0.14
Radium-224	3.8E-11	2.3E-08	NA	0.17	NA	0.17
Radium-226	1.2E-10	1.2E-08	NA	0.23	NA	0.23
Radium-226+5D [3]	1.2E-10	6.0E-06	NA	0.00069	NA	0.00069

TABLE A.III-3 (CON'T.)

Radionuclide/Chemical	Constituent-Specific Variables			Cs (pCi/g)		SCREENING LEVEL (pCi/g)
	SFo (Risk/pCi)	SFe (Risk-g / pCi-yr)	RfDo (mg/kg/day)	SF-Based (TR=1.0E-07)	RfD-Based (THQ=0.1)	
Radionuclides, pCi/g (Con't.)						
Radium-226+8D [3][4]	7.8E-10	6.0E-06	NA	0.00069	NA	0.00069
Radium-228	1.0E-10	0.0E+00	NA	0.79	NA	0.79
Radium-228+1D	1.0E-10	2.9E-06	NA	0.0014	NA	0.0014
Radon-222	1.4E-12	1.2E-09	NA	3.3	NA	3.3
Radon-222+4D	1.7E-12	5.9E-06	NA	0.00071	NA	0.00071
Ruthenium-106	9.5E-12	0.0E+00	NA	8.4	NA	8.4
Strontium-90	3.3E-11	0.0E+00	NA	2.4	NA	2.4
Strontium-90+1D	3.6E-11	0.0E+00	NA	2.2	NA	2.2
Technetium-99	1.3E-12	6.0E-13	NA	61	NA	61
Thorium-228	1.1E-11	5.5E-10	NA	3.7	NA	3.7
Thorium-228+7D	5.5E-11	5.6E-06	NA	0.00074	NA	0.00074
Thorium-230	1.3E-11	5.4E-11	NA	5.7	NA	5.7
Thorium-232	1.2E-11	2.6E-11	NA	6.4	NA	6.4
Thorium-232+10D [4]	1.7E-10	8.5E-06	NA	0.00049	NA	0.00049
Thorium-234	4.0E-12	3.5E-09	NA	1.1	NA	1.1
Uranium-233	1.6E-11	4.2E-11	NA	4.7	NA	4.7
Uranium-234	1.6E-11	3.0E-11	NA	4.8	NA	4.8
Uranium-235	1.6E-11	2.4E-07	NA	0.017	NA	0.017
Uranium-235+1D	1.6E-11	2.4E-07	NA	0.017	NA	0.017
Uranium-236	1.5E-11	2.4E-11	NA	5.1	NA	5.1
Uranium-238	1.6E-11	2.1E-11	NA	4.8	NA	4.8
Uranium-238+2D	2.8E-11	3.6E-08	NA	0.11	NA	0.11

TABLE A.III-3 (CON'T.)

Radionuclide/Chemical	Constituent-Specific Variables SFo (mg/kg/day)$^{-1}$	SFe (Risk-g / pCi-yr)	RfDo (mg/kg/day)	Cs (ug/kg) SF-Based (TR=1.0E-07)	Cs (ug/kg) RfD-Based (THQ=0.1)	SCREENING LEVEL (ug/kg)
Volatile Organic Compounds, ug/kg						
1,1,1,2-Tetrachloroethane	2.6E-02	NA	3.0E-02	2,457	821,250	2,457
1,1,1-Trichloroethane	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0E-01	NA	NA	319	NA	319
1,1,2-Trichloroethane	5.7E-02	NA	4.0E-03	1,121	109,500	1,121
1,1-Dichloroethane	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	6.0E-01	NA	9.0E-03	106	246,375	106
1,2,3-Trichloropropane	NA	NA	6.0E-03	NA	164,250	164,250
1,2-Dibromo-3-chloropropane	1.4E+00	NA	NA	46	NA	46
1,2-Dibromoethane	8.5E+01	NA	NA	0.75	NA	0.75
1,2-Dichloroethane	9.1E-02	NA	NA	702	NA	702
cis-1,2-Dichloroethene	NA	NA	1.0E-02	NA	273,750	273,750
1,4-Dioxane	1.1E-02	NA	NA	5,807	NA	5,807
2-Butanone	NA	NA	6.0E-01	NA	16,425,000	16,425,000
2-Chloro-1,3-butadiene	NA	NA	NA	NA	NA	NA
2-Chloroethylvinyl ether	NA	NA	NA	NA	NA	NA
2-Hexanone	NA	NA	4.0E-02	NA	1,095,000	1,095,000
2-Picoline	NA	NA	NA	NA	NA	NA
3-Chloropropene	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone	NA	NA	5.0E-02	NA	1,368,750	1,368,750
Acetone	NA	NA	1.0E-01	NA	2,737,500	2,737,500
Acetonitrile	NA	NA	6.0E-03	NA	164,250	164,250
Acrolein	NA	NA	NA	NA	NA	NA
Acrylonitrile	5.4E-01	NA	NA	118	NA	118
Benzene	2.9E-02	NA	NA	2,203	NA	2,203
Bromochloromethane	NA	NA	NA	NA	NA	NA
Bromodichloromethane	6.2E-02	NA	2.0E-02	1,030	547,500	1,030
Bromoform	7.9E-03	NA	2.0E-02	8,085	547,500	8,085
Bromomethane	NA	NA	1.4E-03	NA	38,325	38,325
Carbon tetrachloride	1.3E-01	NA	7.0E-04	491	19,163	491
Carbon disulfide	NA	NA	1.0E-01	NA	2,737,500	2,737,500
Chlorobenzene	NA	NA	2.0E-02	NA	547,500	547,500
Chloroethane	NA	NA	NA	NA	NA	NA
Chloroform	6.1E-03	NA	1.0E-02	10,471	273,750	10,471
Chloromethane	1.3E-02	NA	NA	4,913	NA	4,913
Cumene	NA	NA	4.0E-02	NA	1,095,000	1,095,000
Dibromochloromethane	8.4E-02	NA	2.0E-02	760	547,500	760
Dibromomethane	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	NA	NA	2.0E-01	NA	5,475,000	5,475,000
Ethyl cyanide	NA	NA	NA	NA	NA	NA
Ethyl methacrylate	NA	NA	9.0E-02	NA	2,463,750	2,463,750
Methyl methacrylate	NA	NA	8.0E-02	NA	2,190,000	2,190,000
Ethylbenzene	NA	NA	1.0E-01	NA	2,737,500	2,737,500
Iodomethane	NA	NA	NA	NA	NA	NA
Isobutyl alcohol	NA	NA	3.0E-01	NA	8,212,500	8,212,500
Methacrylonitrile	NA	NA	NA	NA	NA	NA
Methylene chloride	7.5E-03	NA	6.0E-02	8,517	1,642,500	8,517
Pentachloroethane	NA	NA	NA	NA	NA	NA
Pyridine	NA	NA	1.0E-03	NA	27,375	27,375
Styrene	3.0E-02	NA	2.0E-01	2,129	5,475,000	2,129
Tetrachloroethene	5.2E-02	NA	1.0E-02	1,228	273,750	1,228
Toluene	NA	NA	2.0E-01	NA	5,475,000	5,475,000
Total Xylenes	NA	NA	2.0E+00	NA	54,750,000	54,750,000
Trichloroethene	1.1E-02	NA	6.0E-03	5,807	164,250	5,807
Trichlorofluoromethane	NA	NA	3.0E-01	NA	8,212,500	8,212,500
Vinyl acetate	NA	NA	1.0E+00	NA	27,375,000	27,375,000
Vinyl chloride	1.9E+00	NA	NA	34	NA	34
cis-1,3-Dichloropropene	1.8E-01	NA	NA	355	NA	491
total-1,2-Dichloroethene	NA	NA	9.0E-03			
trans-1,4-Dichloro-2-butene	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	NA	NA	2.0E-02	NA	547,500	547,500
trans-1,3-Dichloropropene	1.8E-01	NA	NA	355	NA	355

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TABLE A.III-3 (CON'T.)

Radionuclide/Chemical	Constituent-Specific Variables SFo (mg/kg/day)$^{-1}$	SFe (Risk-g / pCi-yr)	RfDo (mg/kg/day)	Cs (ug/kg) SF-Based (TR=1.0E-07)	Cs (ug/kg) RfD-Based (THQ=0.1)	SCREENING LEVEL (ug/kg)
Semivolatile Organic Compounds, ug/kg						
1,2,4,5-Tetrachlorobenzene	NA	NA	3.0E-04	NA	8,213	8,213
1,2,4-Trichlorobenzene	NA	NA	1.0E-02	NA	273,750	273,750
1,2-Dichlorobenzene	NA	NA	9.0E-02	NA	2,463,750	2,463,750
1,3,5-Trinitrobenzene	NA	NA	5.0E-05	NA	1,369	1,369
1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA
1,3-Dinitrobenzene	NA	NA	1.0E-04	NA	2,738	2,738
1,4-Dichlorobenzene	2.4E-02	NA	NA	2,661	NA	2,661
1,4-Naphthaquinone	NA	NA	NA	NA	NA	NA
1-Hexadecyne	NA	NA	NA	NA	NA	NA
1-Naphthylamine	NA	NA	NA	NA	NA	NA
2,3,4,6-Tetrachlorophenol	NA	NA	3.0E-02	NA	821,250	821,250
2,4,5-Trichlorophenol	NA	NA	1.0E-01	NA	2,737,500	2,737,500
2,4,6-Trichlorophenol	1.1E-02	NA	NA	5,807	NA	5,807
2,4-Dichlorophenol	NA	NA	3.0E-03	NA	82,125	82,125
2,4-Dimethylphenol	NA	NA	2.0E-02	NA	547,500	547,500
2,4-Dinitrophenol	NA	NA	2.0E-03	NA	54,750	54,750
2,4-Dinitrotoluene	6.8E-01	NA	2.0E-03	94	54,750	94
2,6-Dichlorophenol	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	6.8E-01	NA	1.0E-03	94	27,375	94
2-Acetylaminofluorene	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	NA	NA	8.0E-02	NA	2,190,000	2,190,000
2-Chlorophenol	NA	NA	5.0E-03	NA	136,875	136,875
2-Methylnaphthalene [5]	NA	NA	NA	NA	NA	1,095,000
2-Methylphenol	NA	NA	5.0E-02	NA	1,368,750	1,368,750
2-Naphthylamine	NA	NA	NA	NA	NA	NA
2-Nitroaniline	NA	NA	NA	NA	NA	NA
2-Nitrophenol	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	4.5E-01	NA	NA	142	NA	142
3,3'-Dimethylbenzidine	9.2E+00	NA	NA	6.9	NA	6.9
3-Methylcholanthrene	NA	NA	NA	NA	NA	NA
3-Methylphenol	NA	NA	5.0E-02	NA	1,368,750	1,368,750
3-Nitrophenol	NA	NA	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol	NA	NA	NA	NA	NA	NA
4-Aminobiphenyl	NA	NA	NA	NA	NA	NA
4-Bromophenyl phenyl ether	NA	NA	5.8E-02	NA	1,587,750	1,587,750
4-Chloro-3-methylphenol [6]	NA	NA	NA	NA	NA	1,368,750
4-Chloroaniline	NA	NA	4.0E-03	NA	109,500	109,500
4-Chlorophenyl phenyl ether	NA	NA	NA	NA	NA	NA
4-Methylphenol	NA	NA	5.0E-03	NA	136,875	136,875
4-Nitroaniline	NA	NA	3.0E-03	NA	82,125	82,125
4-Nitrophenol	NA	NA	6.2E-02	NA	1,697,250	1,697,250
4-Nitroquinoline-1-oxide	NA	NA	NA	NA	NA	NA
5-Nitro-o-toluidine	NA	NA	NA	NA	NA	NA
7,12-Dimethylbenz(a)anthracene	NA	NA	NA	NA	NA	NA
Acenaphthene	NA	NA	6.0E-02	NA	1,642,500	1,642,500
Acenaphthylene	NA	NA	NA	NA	NA	NA
Acetophenone	NA	NA	1.0E-01	NA	2,737,500	2,737,500
Aniline	5.7E-03	NA	NA	11,206	NA	11,206
Anthracene	NA	NA	3.0E-01	NA	8,212,500	8,212,500
Aramite	2.5E-02	NA	5.0E-02	2,555	1,368,750	2,555
Benzo(a)anthracene	1.1E+00	NA	NA	58	NA	58
Benzo(a)pyrene	7.3E+00	NA	NA	8.8	NA	8.8
Benzo(b)fluoranthene	9.0E-01	NA	NA	71	NA	71
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	3.8E-01	NA	NA	168	NA	168
Benzoic Acid	NA	NA	4.0E+00	NA	109,500,000	109,500,000
Benzyl alcohol	NA	NA	3.0E-01	NA	8,212,500	8,212,500
Butyl benzyl phthalate	NA	NA	2.0E-01	NA	5,475,000	5,475,000
Carbazole	2.0E-02	NA	NA	3,194	NA	3,194
Chlorobenzilate	NA	NA	2.0E-02	NA	547,500	547,500
Chrysene	3.2E-02	NA	NA	1,996	NA	1,996
Di-n-butylphthalate	NA	NA	1.0E-01	NA	2,737,500	2,737,500
Di-n-octylphthalate	NA	NA	2.0E-02	NA	547,500	547,500
Diallate	6.1E-02	NA	NA	1,047	NA	1,047
Dibenzo(a,h)anthracene	8.1E+00	NA	NA	7.9	NA	7.9
Dibenzofuran [7]	NA	NA	4.0E-03	NA	109,500	109,500
Diethyl phthalate	NA	NA	8.0E-01	NA	21,900,000	21,900,000
Dimethoate	NA	NA	2.0E-04	NA	5,475	5,475
Dimethyl phthalate	NA	NA	1.0E+01	NA	273,750,000	273,750,000
Diphenylamine	NA	NA	2.5E-02	NA	684,375	684,375
Ethyl methanesulfonate	NA	NA	NA	NA	NA	NA
Famphur	NA	NA	NA	NA	NA	NA

TABLE A.III-3 (CON'T.)

Radionuclide/Chemical	Constituent-Specific Variables SFo (mg/kg/day)$^{-1}$	SFe (Risk-g pCi-yr)	RfDo (mg/kg/day)	Cs (ug/kg) SF-Based (TR=1.0E-07)	RfD-Based (THQ=0.1)	SCREENING LEVEL (ug/kg)
Semivolatile Organic Compounds, ug/kg (Con't)						
Fluoranthene	NA	NA	4.0E-02	NA	1,095,000	1,095,000
Fluorene	NA	NA	4.0E-02	NA	1,095,000	1,095,000
Hexachlorobenzene	1.6E+00	NA	8.0E-04	40	21,900	40
Hexachlorobutadiene	7.8E-02	NA	NA	819	NA	819
Hexachlorocyclpentadiene	NA	NA	7.0E-03	NA	191,625	191,625
Hexachloroethane	1.4E-02	NA	1.0E-03	4,563	27,375	4,563
Hexachlorophene	NA	NA	3.0E-04	NA	8,213	8,213
Hexachloropropene	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	2.0E+00	NA	NA	32	NA	32
Isodrin	NA	NA	NA	NA	NA	NA
Isophorone	9.5E-04	NA	2.0E-01	67,237	5,475,000	67,237
Isosafrole	NA	NA	NA	NA	NA	NA
Kepone	NA	NA	NA	NA	NA	NA
Methapyrilene	NA	NA	NA	NA	NA	NA
Methyl methanesulfonate	NA	NA	NA	NA	NA	NA
N-Nitroso-di-n-propylamine	7.0E+00	NA	NA	9.1	NA	9.1
N-Nitroso-di-n-butylamine	5.4E+00	NA	NA	12	NA	12
N-Nitrosodiethylamine	1.5E+02	NA	NA	0.43	NA	0.43
N-Nitrosodimethylamine	5.1E+01	NA	NA	1.3	NA	1.3
N-Nitrosodiphenylamine	4.9E-03	NA	NA	13,036	NA	13,036
N-Nitrosomethylethylamine	2.2E+01	NA	NA	2.9	NA	2.9
N-Nitrosomorpholine	NA	NA	NA	NA	NA	NA
N-Nitrosopiperidine	NA	NA	NA	NA	NA	NA
N-Nitrosopyrrolidine	2.1E+00	NA	NA	30	NA	30
Naphthalene	NA	NA	4.0E-02	NA	1,095,000	1,095,000
Nitrobenzene	NA	NA	5.0E-04	NA	13,688	13,688
o,o,o-Triethylphosphorothioate	NA	NA	NA	NA	NA	NA
Pentachlorobenzene	NA	NA	8.0E-04	NA	21,900	21,900
Pentachloronitrobenzene	2.6E-01	NA	3.0E-03	246	82,125	246
Pentachlorophenol	1.2E-01	NA	3.0E-02	532	821,250	532
Phenacetin	NA	NA	NA	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	NA	NA
Phenol	NA	NA	6.0E-01	NA	16,425,000	16,425,000
Phorate	NA	NA	2.0E-04	NA	5,475	5,475
Pronamide	NA	NA	7.5E-02	NA	2,053,125	2,053,125
Pyrene	NA	NA	3.0E-02	NA	821,250	821,250
Safrole	NA	NA	NA	NA	NA	NA
Thionazin	NA	NA	NA	NA	NA	NA
Tributyl phosphate	NA	NA	5.0E-03	NA	136,875	136,875
a,a-Dimethylphenethylamine	NA	NA	NA	NA	NA	NA
Bis(2-Chloroethoxy)methane	NA	NA	NA	NA	NA	NA
Bis(2-Chloroethyl)ether	NA	NA	NA	NA	NA	NA
Bis(2-Chloroisopropyl)ether	7.0E-02	NA	NA	913	NA	913
Bis(2-ethylhexyl)phthalate	1.4E-02	NA	2.0E-02	4,563	547,500	4,563
o-Toluidine	NA	NA	NA	NA	NA	NA
p-Dimethylaminoazobenzene	NA	NA	NA	NA	NA	NA
p-Phenylenediamine	NA	NA	1.9E-01	NA	5,201,250	5,201,250
Azinphosmethyl	NA	NA	NA	NA	NA	NA

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TABLE A.III-3 (CON'T.)

Radionuclide/Chemical	Constituent-Specific Variables SFo (mg/kg/day)$^{-1}$	SFe (Risk-g / pCi-yr)	RfDo (mg/kg/day)	Cs (ug/kg) SF-Based (TR=1.0E-07)	Cs (ug/kg) RfD-Based (THQ=0.1)	SCREENING LEVEL (ug/kg)
Pesticides/PCBs, ug/kg						
4-4'-DDD	2.4E-01	NA	NA	266	NA	266
4-4'-DDE	3.4E-01	NA	NA	188	NA	188
4-4'-DDT	3.4E-01	NA	5.0E-04	188	13,688	188
Aldrin	1.7E+01	NA	3.0E-05	3.8	821	3.8
Arochlor 1016	7.7E+00	NA	NA	8.3	NA	8.3
Arochlor 1221	7.7E+00	NA	NA	8.3	NA	8.3
Arochlor 1232	7.7E+00	NA	NA	8.3	NA	8.3
Arochlor 1242	7.7E+00	NA	NA	8.3	NA	8.3
Arochlor 1248	7.7E+00	NA	NA	8.3	NA	8.3
Arochlor 1254	7.7E+00	NA	NA	8.3	NA	8.3
Arochlor 1260	7.7E+00	NA	NA	8.3	NA	8.3
Chlordane	1.3E+00	NA	6.0E-05	49	1,643	49
Demeton	NA	NA	4.0E-05	NA	1,095	1,095
Diazinon	NA	NA	9.0E-04	NA	24,638	24,638
Dieldrin	1.6E+01	NA	5.0E-05	4.0	1,369	4.0
Disulfoton	NA	NA	4.0E-05	NA	1,095	1,095
Endosulfan II [8]	NA	NA	NA	NA	NA	164,250
Endosulfan sulfate [9]	NA	NA	NA	NA	NA	164,250
Endosulfan I [8]	NA	NA	NA	NA	NA	164,250
Endrin	NA	NA	3.0E-04	NA	8,213	8,213
Endrin aldehyde [10]	NA	NA	NA	NA	NA	8,213
Endrin ketone	NA	NA	NA	NA	NA	NA
Ethion	NA	NA	5.0E-04	NA	13,688	13,688
Heptachlor	4.5E+00	NA	5.0E-04	14	13,688	14
Heptachlor epoxide	9.1E+00	NA	1.3E-05	7.0	356	7.0
Malathion	NA	NA	2.0E-02	NA	547,500	547,500
Methoxychlor	NA	NA	5.0E-03	NA	136,875	136,875
Ethyl parathion	NA	NA	NA	NA	NA	NA
Methyl parathion	NA	NA	2.5E-04	NA	6,844	6,844
Toxaphene	1.1E+00	NA	NA	58	NA	58
Alpha-BHC	6.3E+00	NA	NA	10	NA	10
Alpha-Chlordane	1.3E+00	NA	6.0E-05	49	1,643	49
Beta-BHC	1.8E+00	NA	NA	35	NA	35
Delta-BHC	NA	NA	NA	NA	NA	NA
Gamma-BHC (Lindane)	NA	NA	3.0E-04	NA	8,213	8,213
Gamma-Chlordane	NA	NA	NA	NA	NA	49
Dioxins/Furans, ug/L [11]						
Dioxins						
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1.5E+05	NA	NA	0.00043	NA	4.3E-04
1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin	NA	NA	NA	0.043	NA	4.3E-02
Heptachlorodibenzo-p-dioxins	NA	NA	NA	0.043	NA	4.3E-02
Octachlorodibenzo-p-dioxin	NA	NA	NA	0.426	NA	4.3E-01
Furans						
2,3,7,8-tetrachlorodibenzofuran	NA	NA	NA	0.0043	NA	4.3E-03
Tetrachlorodibenzofurans	NA	NA	NA	0.0043	NA	4.3E-03
1,2,3,7,8-pentachlorodibenzofuran	NA	NA	NA	0.0085	NA	8.5E-03
2,3,4,7,8-pentachlorodibenzofuran	NA	NA	NA	0.00085	NA	8.5E-04
Pentachlorodibenzofurans	NA	NA	NA	0.00085	NA	8.5E-04
Hexachlorodibenzofurans	NA	NA	NA	0.0043	NA	4.3E-03
Heptachlorodibenzofurans	NA	NA	NA	0.0426	NA	4.3E-02
Octachlorodibenzofuran	NA	NA	NA	0.426	NA	4.3E-01
Herbicides, ug/kg						
2,4,5-T	NA	NA	1.0E-02	NA	273,750	273,750
2,4,5-TP (Silvex)	NA	NA	8.0E-03	NA	219,000	219,000
2,4-D	NA	NA	1.0E-02	NA	273,750	273,750
Dinoseb	NA	NA	1.0E-03	NA	27,375	27,375

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TABLE A.III-3 (CON'T.)

Radionuclide/Chemical	Constituent-Specific Variables SFo (mg/kg/day)$^{-1}$	SFe (Risk-g pCi-yr)	RfDo (mg/kg/day)	Cs (mg/kg) SF-Based (TR=1.0E-07)	RfD-Based (THQ=0.1)	SCREENING LEVEL (mg/kg)
Inorganics, mg/kg						
Aluminum	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	4.0E-04	NA	11	11
Arsenic	1.8E+00	NA	3.0E-04	0.037	8.2	0.037
Barium	NA	NA	7.0E-02	NA	1,916	1,916
Beryllium	4.3E+00	NA	5.0E-03	0.015	137	0.015
Boron	NA	NA	9.0E-02	NA	2,464	2,464
Cadmium	NA	NA	5.0E-04	NA	14	14
Calcium	NA	NA	NA	NA	NA	NA
Chromium, hexavalent	NA	NA	5.0E-03	NA	137	137
Chromium, trivalent	NA	NA	1.0E+00	NA	27,375	27,375
Cobalt	NA	NA	6.0E-02	NA	1,643	1,643
Copper	NA	NA	3.7E-02	NA	1,018	1,018
Cyanide	NA	NA	2.0E-02	NA	548	548
Iron	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	9.7E+00	NA	265,538	265,538
Manganese	NA	NA	5.0E-03	NA	137	137
Mercury	NA	NA	3.0E-04	NA	8.2	8.2
Molybdenum	NA	NA	5.0E-03	NA	137	137
Nickel	NA	NA	2.0E-02	NA	548	548
Osmium	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	5.0E-03	NA	137	137
Silver	NA	NA	5.0E-03	NA	137	137
Thallium	NA	NA	7.0E-05	NA	1.9	1.9
Tin	NA	NA	6.0E-01	NA	16,425	16,425
Vanadium	NA	NA	7.0E-03	NA	192	192
Zinc	NA	NA	3.0E-01	NA	8,213	8,213
Conventional Parameters, mg/kg						
Ammonia	NA	NA	NA	NA	NA	NA
Fluoride	NA	NA	6.0E-02	NA	1,643	1,643
Nitrate	NA	NA	1.6E+00	NA	43,800	43,800
Nitrite	NA	NA	1.0E-01	NA	2,738	2,738
Sulfate	NA	NA	NA	NA	NA	NA

Notes:

[1] Screening levels for radionuclides are not to be used as primary criterionin CPC serlection process.
[2] "+D" Indicates that risks from primary decay chain products are incorporated into the slope factor presented.
[3] The SFi for Rn-222+4D is used for Ra-226+5D and Ra-226+8D since this is a daughter product in both decay chains.
[4] Slope factors will be used to evaluate future exposure scenarios involving parent isotope in equilibrium with daughters.
[5] Screening level for naphthalene used as a surrogate.
[6] Screening level for 2-methylphenol used as a surrogate.
[7] Oral RfD acquired from U.S.EPA Environmental Criteria Assessment Office, 1993.
[8] Reference dose for endosulfan (U.S. EPA Region III Tables for Risk-Based Concentrations) used for endosulfan I and II.
[9] Screening level for endosulfan I and II used as a surrogate for endosulfan sulfate.
[10] Screening level for endrin used as a surrogate.
[11] Risk-based concentrations (RBC) for dioxin/furan congeners were calculated by dividing the 2378-TCDD RBC by the toxic equivalent factor (TE
NA - Not applicable
CSV - Constituent-specific value

TABLE OF CONTENTS

List of Tables			ix
List of Figures			xxxiii
A.1.0	Introduction		A.1-1
	A.1.1	Objectives	A.1-1
	A.1.2	Overview	A.1-4
		A.1.2.1 Environmental Compliance Process	A.1-5
		A.1.2.2 General FEMP Description	A.1-6
	A.1.3	Operable Unit 5 Background	A.1-8
		A.1.3.1 Description of Operable Unit 5	A.1-8
		A.1.3.2 Operable Unit 5 Removal Actions	A.1-14
	A.1.4	Comparison With Risk Assessment Work Plan Addendum Guidance	A.1-16
	A.1.5	Overview Of Operable Unit 5 Conceptual Site Model	A.1-16
		A.1.5.1 Temporal Considerations/Source-Term Scenarios	A.1-18
		A.1.5.2 Populations of Concern	A.1-18
		A.1.5.3 Land-Use Scenarios	A.1-19
		A.1.5.4 Exposure Pathways	A.1-20
A.2.0	Identification Of Constituents Of Potential Concern		A.2-1
	A.2.1	Data Sources	A.2-1
		A.2.1.1 Data Sources for Contaminant Concentrations in Environmental Media	A.2-1
		A.2.1.2 Background Sources	A.2-2
	A.2.2	Analysis Of Data	A.2-3
		A.2.2.1 Data Validation	A.2-3
		A.2.2.2 Statistical Analysis of Data	A.2-5
	A.2.3	Identification Of Constituents Of Potential Concern	A.2-6
		A.2.3.1 Preliminary Screening	A.2-7
		A.2.3.2 Comparison to Background	A.2-9
	A.2.4	Results Of Selecting CPCS	A.2-10
		A.2.4.1 Organic CPCs for Soils	A.2-11

TABLE OF CONTENTS
(continued)

A.2.4.2 Organic CPCs for Groundwater A.2-13
A.2.4.3 Organic CPCs for Surface Water A.2-16
A.2.4.4 Organic CPCs for Sediment A.2-16

A.3.0 Human Exposure Assessment A.3-1

A.3.1 Characterization Of Exposure Setting A.3-2

A.3.1.1 Geologic History A.3-2
A.3.1.2 Geologic Units A.3-3
A.3.1.3 Recharge, Movement, and Discharge in the Great Miami Aquifer A.3-6
A.3.1.4 Surface Water Hydrology A.3-6
A.3.1.5 Climate and Meteorology A.3-8
A.3.1.6 Vegetation and Wildlife A.3-9
A.3.1.7 Demography A.3-10
A.3.1.8 Land Use A.3-11
A.3.1.9 Future Land Use A.3-11
A.3.1.10 Critical Subpopulations A.3-12

A.3.2 Conceptual Model For Operable Unit 5 A.3-14

A.3.2.1 CPCs in Environmental Media A.3-18
A.3.2.2 Release Mechanisms A.3-21

A.3.2.2.1 Potential Release Mechanisms Under Current Land Use A.3-22
A.3.2.2.2 Potential Release Mechanisms Under Future Land Use A.3-23

A.3.2.3 Exposure Mechanisms and Exposure Routes A.3-24

A.3.2.3.1 Exposures from Immersion in Air A.3-24
A.3.2.3.2 Exposures from Aerial Deposition onto Soil and Edible Plants A.3-25
A.3.2.3.3 Exposures from Direct Contact with Soil, Sediment, or Surface Water A.3-25
A.3.2.3.4 Exposures from Livestock and Crops Grown in Soil A.3-25
A.3.2.3.5 Exposures from Use of Shallow Wells A.3-25
A.3.2.3.6 Exposures from Using Aquifer Water for Drinking and Domestic and Agricultural Purposes A.3-25
A.3.2.3.7 Exposures from Using Surface Water as Stock Water A.3-26
A.3.2.3.8 Direct Exposure to Radioactivity A.3-26
A.3.2.3.9 Exposures from Using the Great Miami River

TABLE OF CONTENTS
(continued)

		for Domestic, Agricultural, and Recreational Purposes	A.3-26
	A.3.2.4	Receptor Exposure Pathway Scenarios	A.3-27
		A.3.2.4.1 Current Land Use With Access Controls	A.3-27
		A.3.2.4.2 Current Land Use Without Access Controls	A.3-29
		A.3.2.4.3 Future Land Use With Federal Ownership (Government Reserve)	A.3-30
		A.3.2.4.4 Future Land Use Without Access Controls (Agricultural)	A.3-33
	A.3.2.5	Summary of Selected Exposure Routes	A.3-34
A.3.3	Exposure Point Concentrations		A.3-35
	A.3.3.1	Exposure Point Concentrations of Soil	A.3-35
	A.3.3.2	Exposure Point Concentrations of Air	A.3-36
	A.3.3.3	Exposure Point Concentrations for Groundwater	A.3-37
	A.3.3.4	Exposure Point Concentrations in Surface Water and Sediment	A.3-39
A.3.4	Quantification Of Exposure		A.3-41
	A.3.4.1	Equations Quantifying Intakes and Exposures to Soil or Sediment	A.3-42
		A.3.4.1.1 Incidental Ingestion of Soil/Sediment	A.3-42
		A.3.4.1.2 Dermal Contact	A.3-43
		A.3.4.1.3 Direct Radiation Exposure from Soil/Sediment	A.3-44
	A.3.4.2	Equations Quantifying Intakes and Exposures from Water	A.3-45
		A.3.4.2.1 Water Ingestion Pathway	A.3-45
		A.3.4.2.2 Volatiles Released by Showering and Other Household Water Uses	A.3-46
		A.3.4.2.3 Inhalation of Indoor Concentrations of Radon	A.3-46
		A.3.4.2.4 Dermal Contact While Bathing or Swimming	A.3-47
		A.3.4.3 Equations Quantifying Intakes and Exposures from Inhalation	A.3-48
		A.3.4.4 Equations Quantifying Intakes and Exposures from Food	A.3-48
		A.3.4.4.1 Vegetable and Fruit Ingestion	A.3-49
		A.3.4.4.2 Biouptake of Constituents into Meat and Milk	A.3-53
		A.3.4.4.3 Biouptake of Constituents into Fish	A.3-56
	A.3.4.5	Quantification of Intakes and Exposures from Multiple Pathways	A.3-58

TABLE OF CONTENTS
(continued)

A.3.4.6 Scenario-Specific Assumptions and Exposure Parameters A.3-58

A.3.4.6.1 Exposure Duration (ED) A.3-58
A.3.4.6.2 Exposure Frequency A.3-59
A.3.4.6.3 Exposure Time A.3-62
A.3.4.6.4 Inhalation Rates A.3-64
A.3.4.6.5 Soil/Sediment Ingestion Rates A.3-64
A.3.4.6.6 Water Ingestion Rates A.3-65
A.3.4.6.7 Food Consumption A.3-65
A.3.4.6.8 Body Weights A.3-66
A.3.4.6.9 Surface Areas A.3-66
A.3.4.6.10 Adherence Factors A.3-67
A.3.4.6.11 Averaging Times A.3-67

A.3.5 Summary Of Exposure Assessment A.3-67

A.4.0 Toxicity Assessment A.4-1

A.4.1 Toxicity Information For Constituents Of Potential Concern A.4-2

A.4.1.1 Radiocarcinogens A.4-3
A.4.1.2 Chemical Carcinogens A.4-5
A.4.1.3 Noncarcinogenic Chemicals A.4-7
A.4.1.4 Dermal Reference Doses and Cancer Slope Factors A.4-8

A.4.2 Toxicity Profiles A.4-9

A.4.3 Criteria/Standards A.4-10

A.4.3.1 Maximum Contaminant Levels (MCLs) A.4-10
A.4.3.2 Maximum Contaminant Level Goals (MCLGs) A.4-10
A.4.3.3 Ambient Water Quality Criteria (AWQC) A.4-11
A.4.3.4 Health Advisories (HAs) A.4-11

A.5.0 Health Risk Characterization A.5-1

A.5.1 Methods Used for Risk Characterization A.5-1

A.5.1.1 Radiocarcinogenic Risk A.5-1

A.5.1.1.1 Methods for Calculating Internal Radiation Radiation Exposures A.5-1

A.5.1.1.2 Methods for Calculating External Radiation Exposures A.5-2
A.5.1.2 Chemical Risks A.5-2

TABLE OF CONTENTS
(continued)

		A.5.1.2.1 Method for Calculating Carcinogenic Risk	A.5-2
		A.5.1.2.2 Methods for Calculating Noncarcinogenic Risk	A.5-3
	A.5.1.3	Exposures to Multiple Constituents	A.5-4
	A.5.1.4	Multiple Pathways	A.5-4
A.5.2	Risk Estimates for Current Site Conditions		A.5-4
	A.5.2.1	Groundskeeper	A.5-5
	A.5.2.2	Visitor	A.5-7
	A.5.2.3	Trespassing Youth	A.5-7
	A.5.2.4	Off-Property User of Milk and Meat Products	A.5-8
	A.5.2.5	Off-Property Farmer	A.5-9
	A.5.2.6	Off-Property Child	A.5-11
	A.5.2.7	Great Miami River User	A.5-12
	A.5.2.8	Exploring Youth	A.5-13
A.5.3	Risk Estimates for Future Site Conditions		A.5-14
	A.5.3.1	Groundskeeper	A.5-14
	A.5.3.2	Recreational Receptors	A.5-15
	A.5.3.3	Off-Property Farmer	A.5-16
	A.5.3.4	Off-Property Child	A.5-18
	A.5.3.5	Great Miami River User	A.5-18
	A.5.3.6	On-Property RME Farmer	A.5-19
	A.5.3.7	On-Property CT Farmer	A.5-21
	A.5.3.8	On-Property Child	A.5-22
	A.5.3.9	On-Property User of Perched Groundwater	A.5-23
	A.5.3.10	On-Property Home Builder	A.5-23
	A.5.3.11	Critical Subpopulations	A.5-24
A.5.4	Summary of Health Risk Characterization		A.5-24
	A.5.4.1	Summary of Health Effects Under Current Land-Use Scenarios	A.5-24
	A.5.4.2	Summary of Health Effects Under Future Land-Use Scenarios	A.5-25
A.5.5	Composite Receptors		A.5-26
	A.5.5.1	Groundskeeper	A.5-26
	A.5.5.2	Off-Property Child and Exploring Youth	A.5-27
	A.5.5.3	Off-Property Farmer and Recreational User of the Great Miami River	A.5-27
A.6.0	Uncertainties		A.6-1

TABLE OF CONTENTS
(continued)

A.6.1 Terminology A.6-1
A.6.2 Sources of Uncertainty in Operable Unit 5 A.6-3

A.6.2.1 Adequacy of the Database A.6-4
A.6.2.2 Selection of Constituents of Potential Concern A.6-4
A.6.2.3 Exposure Point Concentrations A.6-6
A.6.2.4 Selection of Receptors A.6-8
A.6.2.5 Selection of Exposure Factors A.6-8
A.6.2.6 Toxicity Assessment A.6-9
A.6.2.7 Risk Characterization A.6-12

A.6.3 Summary of Uncertainties in Operable Unit 5 Baseline Risk Assessment A.6-12

A.7.0 Summary and Comparison to Background A.7-1

A.7.1 Risk Assessment Summary A.7-1
A.7.2 Risks from Natural Background A.7-5
A.7.3 Preliminary Remediation Goals (PRGs) A.7-6
A.7.4 Conclusions A.7-7

TABLE OF CONTENTS
(continued)

References A-R-1

ATTACHMENTS A.I - A.VIII

A.I Background Data for Radionuclides and Chemicals

A.II Statistical Procedures and Equations for FEMP Operable Unit 5 Remedial Investigation Reports

A.III Preliminary Toxicity Screening for Contaminants Detected in Operable Unit 5

A.IV Selection of Constituents of Potential Concern and Exposure Point Concentrations

A.V Toxicity Profiles

A.VI Calculated Intakes

A.VII Incremental Lifetime Cancer Risks and Chronic Hazard Indices

A.VIII Calculation of Rn-222 in Homes Located on Contaminated Soil in OU5

A.IX Radiological and Environmental Monitoring Program Data

A.X Applicable or Relevant and Appropriate Requirements - for Operable Unit 5 Feasibility Study

LIST OF TABLES

Table	Title
A.2-1	Selection of Organic Constituents of Potential Concern in Surface Soils (0 to 1.5 feet)
A.2-2	Selection of Organic Constituents of Potential Concern in Subsurface Soil (>1.5 feet)
A.2-3	Selection of Organic Constituents of Potential Concern in Groundwater - Glacial Overburden Type 1 Monitoring Wells
A.2-4	Selection of Organic Constituents of Potential Concern in Groundwater - Great Miami Aquifer - Type 2 Monitoring Wells
A.2-5	Selection of Organic Constituents of Potential Concern in Groundwater - Great Miami Aquifer, Type 3 Monitoring Wells
A.2-6	Selection of Organic Constituents of Potential Concern in Groundwater - Great Miami Aquifer, Type 4 Monitoring Wells
A.2-7	Selection of Organic Constituents of Potential Concern in Surface Water - Great Miami Aquifer
A.2-8	Selection of Organic Constituents of Potential Concern in Surface Water - Paddys Run
A.2-9	Selection of Organic Constituents of Potential Concern in Surface Water - Production Area
A.2-10	Selection of Organic Constituents of Potential Concern in Sediments - Great Miami Aquifer
A.2-11	Selection of Organic Constituents of Potential Concern in Sediments of Paddys Run
A.2-12	Selection of Organic Constituents of Potential Concern in Sediments of Production Area
A.2.13	Major Chemicals/Radioactive Process Materials Used at the FEMP
A.2.14	Radiologicals Associated with Process Materials
A.2.15	Organic Constituents of Potential Concern Operable Unit 5
A.3-1	Summary of Exposure Pathways Quantitatively Evaluated in the Baseline Risk Assessment
A.3-2A	Potential Receptor Locations/Areas/Exposure Points Current Site Conditions, Land Use - With Access Controls
A.3-2B	Potential Receptor Locations/Areas/Exposure Points Current Site Conditions, Land Use - Without Access Controls
A.3-2C	Potential Receptor Locations/Areas/Exposure Points Future Land Use - Continued Federal Ownership
A.3-2D	Potential Receptor Locations/Areas/Exposure Points Future Land Use - Without Federal Ownership
A.3-3	Summary of Exposure Point Concentrations for Surface Soil On-Property, Current Land Use
A.3-4	Summary of Exposure Point Concentrations for Surface Soil In Grazing Areas, Current Land Use
A.3-5	Summary of Exposure Point Concentrations for Surface Soil, Off-Property, Current Land Use
A.3-6	Summary of Exposure Point Concentrations for Surface Soil, On-Property, Future Land Use

LIST OF TABLES
(continued)

A.3-7	Summary of Exposure Point Concentrations for Surface Soil, Off-Property, Future Land Use
A.3-8	Summary of Exposure Point Concentrations for Subsurface Soil, Future Land Use
A.3-9	Summary of Exposure Point Concentrations for Air Current Land Use, On-Property Receptor Locations
A.3-10	Summary of Exposure Point Concentrations for Air Current Land Use, Off-Property Receptor Locations
A.3-11	Summary of Exposure Point Concentrations for Air Future Land Use, On-Property Receptor Locations
A.3-11b	Representative Air Concentrations for Critical Subpopulations Current Land Use
A.3-12	Summary of Exposure Point Concentrations for Air Future Land Use, Off-Property Receptor Locations
A.3-13	Summary of Exposure Point Concentrations for Groundwater, Off-Property, Current Land Use
A.3-14	Summary of Exposure Point Concentrations for Groundwater, On-Property, Future Land Use
A.3-15	Summary of Exposure Point Concentrations for Groundwater, Off-Property, Future Land Use
A.3-16	Summary of Exposure Point Concentrations for Surface Water, Current Land Use
A.3-17	Summary of Exposure Point Concentrations for Sediments, Current Land Use
A.3-18	Summary of Exposure Point Concentrations for Surface Water, Future Land Use
A.3-19	Summary of Exposure Point Concentrations for Sediments Future Land Use
A.3-20	Exposure Input Parameters, Current Land Use Receptors
A.3-21a	Exposure Input Parameters, Future Land use Receptors
A.3-21b	Exposure Input Parameters, Future Land Use - Recreational Receptors
A.3-22	Summary of Parameters for Bio Uptake Models
A.3-23	Partitioning Coefficients and Biotransfer Factors for Constituents of Potential Concern for OU5
A.4-1	Summary of Cancer Slope Factors Available for FEMP Radionuclide Contaminants
A.4-2	Characteristics of Radionuclides Associated with FEMP Operable Unit 5
A.4-3	Toxicity Criteria for Chemicals Detected in the FEMP Environmental Medial Samples Operable Unit 5
A.4-4	Dioxin and Furan Toxicity Equivalent Factors
A.4-5	Toxicity Equivalency Factors (TEFs) and Corresponding Oral and Inhalation Slope Factors for the Group B PAHs
A.4-6	Dermal Reference Doses and Cancer Slope Factors for Constituents of Potential Concern
A.4-7	Drinking Water Standards, Health Advisories, and Ambient Water Quality Criteria for Chemicals Detected at the FEMP Operable Unit 5
A.5-1	Summary of Cancer Risks and Hazard Indices for Groundskeeper, Current Land Use
A.5-2	Summary of Cancer Risks and Hazard Indices for Visitor, Current Land Use
A.5-3	Summary of Cancer Risks and Hazard Indices for Trespassing Youth, Current Land Use

LIST OF TABLES
(continued)

A.5-4	Summary of Cancer Risks and Hazard Indices for Off-Property User of Meat and Milk Products, Current Land Use
A.5-5	Summary of Cancer Risks and Hazard Indices for Off-Property RME Farmer, Current Land Use
A.5-6	Summary of Cancer Risks and Hazard Indices for Off-Property Child, Current Land Use
A.5-7	Summary of Cancer Risks and Hazard Indices for Great Miami River User, Current Land Use
A.5-8	Summary of Cancer Risks and Hazard Indices for Exploring Youth, Current Land Use
A.5-9	Summary of Cancer Risks and Hazard Indices for Groundskeeper, Future Land Use
A.5-10	Summary of Cancer Risks and Hazard Indices for Recreational Users of the FEMP, Future Land Use
A.5-11	Summary of Cancer Risks and Hazard Indices for Off-Property RME Farmer, Future Land Use
A.5-12	Summary of Cancer Risks and Hazard Indices for Off-Property Child, Future Land Use
A.5-13	Summary of Cancer Risks and Hazard Indices for Great Miami River User, Future Land Use
A.5-14	Summary of Cancer Risks and Hazard Indices for On-Property RME Farmer, Future Land Use
A.5-15	Summary of Cancer Risks and Hazard Indices for On-Property CT Farmer, Future Land Use
A.5-16	Summary of Cancer Risks and Hazard Indices for On-Property Child, Future Land Use
A.5-17	Summary of Cancer Risks and Hazard Indices for On-Property RME Farmer, Use of Perched Groundwater, Future Land Use
A.5-18	Summary of Cancer Risks and Hazard Quotients for Home Builder, Future Land Use
A.6-1	Uncertainties Associated with Estimated Risks from Operable Unit 5
A.7-1	Summary of Cancer Risks and Hazard Indices for On-Property Receptors, Current Land Use, With Access Controls
A.7-2	Summary of Cancer Risks and Hazard Indices for On-Property Receptors, Current Land Use, Without Access Controls
A.7-3	Summary of Cancer Risks and Hazard Indices for Off-Property Receptors, Current Land Use, With Access Controls
A.7-4	Summary of Cancer Risks and Hazard Indices for Off-Property Receptors, Current Land Use, Without Access Controls

LIST OF TABLES
(continued)

A.7-5	Summary of Cancer Risks and Hazard Indices for Off-Property Receptors, Future Land Use, With Access Controls
A.7-6	Summary of Cancer Risks and Hazard Indices for On-Property Receptors, Future Land Use, Without Access Controls
A.7-7	Summary of Cancer Risks and Hazard Indices for Off-Property Receptors, Future Land Use, With and Without Access Controls
A.7-8	Incremental Lifetime Cancer Risks from Exposure to Background Concentrations of Constituents Detected in Surface Soils On-Property RME Farmer
A.7-9	Hazard Quotients from Exposure to Background Concentrations of Constituents Detected in Surface Soils On-Property Farmer
A.7-10	Incremental Lifetime Cancer Risks from Exposure to Background Concentrations of Constituents Detected in Groundwater On-Property RME Farmer
A.7-11	Hazard Quotients from Exposure to Background Concentrations of Constituents Detected in Groundwater On-Property RME Farmer
A.7-12	Incremental Lifetime Cancer Risks from Exposure to Background Concentrations of Constituents Detected in the Perched Groundwater for the On-Property RME Farmer
A.7-13	Hazard Quotients from Exposure to Background Concentrations of Constituents Detected in Perched Groundwater, On-Property RME Farmer
A.7-14	Incremental Lifetime Cancer Risks from Exposure to Background Concentrations of Constituents Detected in Surface Water from Paddys Run, Exploring Youth
A.7-15	Hazard Quotients from Exposure to Background Concentrations of Constituents Detected in Surface Water of Paddys Run, Exploring Youth
A.7-16	Incremental Lifetime Cancer Risks from Exposure to Background Concentrations of Constituents Detected in Sediment Exploring Youth
A.7-17	Hazard Quotients from Exposure to Background Concentrations of Constituents Detected in Sediment Exploring Youth
A.7-18	Incremental Lifetime Cancer Risks from Exposure to Background Concentrations of Constituents Detected in Surface Water of Great Miami River, Great Miami River User
A.7-19	Hazard Quotients from Exposure to Background Concentrations of Constituents Detected in Surface Water of Great Miami River, Great Miami River User
A.7-20	Risk-Based Preliminary Remediation Goals for Surface Soil, Based on Exposures to On-Property RME Farmer and Child
A.7-21	Risk-Based Preliminary Remediation Goals for Great Miami Aquifer, Based on Exposure to On-Property RME Farmer and Child
A.7-22	Risk-Based Preliminary Remediation Goals for Perched Groundwater Based on Exposures to On-Property RME Farmer and Child
A.7-23	Risk-Based Preliminary Remediation Goals for Surface Water in Paddys Run, Based on Exposures to a Consumer of Meat and Milk Products
A.7-24	Risk-Based Preliminary Remediation Goals for Surface Water in Paddys Run, Based on Exposures an Exploring Youth
A.7-25	Risk-Based Preliminary Remediation Goals for Surface Water of the Great Miami River
A.7-26	Risk-Based Preliminary Remediation Goals for Sediment, Based on Exposures to an Exploring Youth

LIST OF TABLES
(continued)

A.III-1	
A.III-2	Risk-Based Screening Levels for Radionuclides and Chemicals in Groundwater/Surface Water Residential Scenario
A.III-3	Risk-Based Screening Levels for Radionuclides and Chemicals in Soils/Sediment Residential Scenario
A.IV-1	Administration Area Surface Soil
A.IV-2	Main Production Area/Process Area Surface Soil
A.IV-3	Northeast Corner of the Production Area Surface Soil
A.IV-4	Northwest Corner of Production Area Surface Soil
A.IV-5	Fire Training Area Surface Soil
A.IV-6	Sewage Treatment Area Surface Soil
A.IV-7	Northeast Corner of the FEMP Surface Soil
A.IV-8	Northwest Corner of the FEMP Surface Soil
A.IV-9	Waste Storage/Disposal Area Surface Soil
A.IV-10	Southern Area of the FEMP Surface Soil
A.IV-11	Trap Range Surface Soil
A.IV-12	Southeast Corner of the FEMP Surface Soil
A.IV-13	Southwest Corner of the FEMP Surface Soil
A.IV-14	Eastern Border Surface Soil
A.IV-15	Southern Border Surface Soil
A.IV-16	Western Border Surface Soil
A.IV-17	Northern Border Surface Soil
A.IV-18	Off-Property:Inner Contour Surface Soil
A.IV-19	Off-Property:Outer Contour Surface Soil
A.IV-20	Grazing Area 1 Surface Soil
A.IV-21	Grazing Area 2 Surface Soil
A.IV-22	Grazing Area 3 Surface Soil
A.IV-23	Grazing Area 4 Surface Soil
A.IV-24	South Plume Surface Soil
A.IV-25	Knollman Farm Surface Soil
A.IV-26	Northeast Farm Surface Soil
A.IV-27	Great Miami Riverbank Surface Soil
A.IV-28	Outfall Line/GMR Surface Soil
A.IV-29	Administration Area Subsurface Soil
A.IV-30	Main Production Area/Process Area Subsurface Soil
A.IV-31	Northeast Corner of the Production Area Subsurface Soil
A.IV-32	Northwest Corner of the Production Area Subsurface Soil
A.IV-33	Fire Training Area Subsurface Soil
A.IV-34	Sewage Treatment Area Subsurface Soil
A.IV-35	Waste Storage/Disposal Area Subsurface Soil
A.IV-36	South Plume Subsurface Soil
A.IV-37	Production Area (Type 1 Wells) Unfiltered Groundwater
A.IV-38	Production Area (Type 1 Wells) Filtered Groundwater
A.IV-39	Eastern Border (Type 1 Wells) Unfiltered Groundwater
A.IV-40	Eastern Border (Type 1 Wells) Filtered Groundwater

LIST OF TABLES
(continued)

A.IV-41	Eastern Border (Type 2 Wells) Unfiltered Groundwater
A.IV-42	Eastern Border (Type 2 Wells) Filtered Groundwater
A.IV-43	Eastern Border (Type 3 Wells) Unfiltered Groundwater
A.IV-44	Eastern Border (Type 3 Wells) Filtered Groundwater
A.IV-45	Eastern Border (Type 4 Wells) Unfiltered Groundwater
A.IV-46	Eastern Border (Type 4 Wells) Filtered Groundwater
A.IV-47	Northern Border (Type 2 and Type 3 Wells) Filtered Groundwater
A.IV-48	Northern Border (Type 2 and Type 3 Wells) Unfiltered Groundwater
A.IV-49	South Plume (Type 2 Wells) Unfiltered Groundwater
A.IV-50	South Plume (Type 2 Wells) Filtered Groundwater
A.IV-51	South Plume (Type 3 Wells) Unfiltered Groundwater
A.IV-52	South Plume (Type 3 Wells) Filtered Groundwater
A.IV-53	South Plume (Type 4 Wells) Unfiltered Groundwater
A.IV-54	South Plume (Type 4 Wells) Filtered Groundwater
A.IV-55	Western Border (Type 2 and Type 3 Wells) Filtered Groundwater
A.IV-56	Western Border (Type 2 and Type 3 Wells) Unfiltered Groundwater
A.IV-57	Paddys Run Road Industries Site (Type 2 Wells) Unfiltered Groundwater
A.IV-58	Paddys Run Road Industries Site (Type 2 Wells) Filtered Groundwater
A.IV-59	Paddys Run Road Industries Site (Type 3 Wells) Unfiltered Groundwater
A.IV-60	Paddys Run Road Industries Site (Type 3 Wells) Filtered Groundwater
A.IV-61	Eastern Wells (Type 2, Type 3, and Type 4 Wells) Filtered Groundwater
A.IV-62	Eastern Wells (Type 2, Type 3, and Type 4 Wells) Unfiltered Groundwater
A.IV-63	Pilot Plant Drainage Ditch (92/93) Unfiltered Surface Water
A.IV-64	Pilot Plant Drainage Ditch (92/93) Filtered Surface Water
A.IV-65	Pilot Plant Drainage Ditch (Pre 1992) Unfiltered Surface Water
A.IV-66	Pilot Plant Drainage Ditch (Pre 1992) Filtered Surface Water
A.IV-67	Paddys Run-Onsite A (92/93) Unfiltered Surface Water
A.IV-68	Paddys Run-Onsite A (92/93) Filtered Surface Water
A.IV-69	Paddys Run-Onsite A (Pre 1992) Unfiltered Surface Water
A.IV-70	Paddys Run-Onsite B (Pre 1992) Unfiltered Surface Water
A.IV-71	Paddys Run-Onsite A (Pre 1992) Filtered Surface Water
A.IV-72	Paddys Run-Onsite B (Pre 1992) Filtered Surface Water
A.IV-73	Storm Sewer Outfall Ditch (92/93) Unfiltered Surface Water
A.IV-74	Storm Sewer Outfall Ditch (92/93) Filtered Surface Water
A.IV-75	Storm Sewer Outfall Ditch (Pre 1992) Unfiltered Surface Water
A.IV-76	Storm Sewer Outfall Ditch (Pre 1992) Filtered Surface Water
A.IV-77	Paddys Run Offsite (92/93) Unfiltered Surface Water
A.IV-78	Paddys Run Offsite (92/93) Filtered Surface Water
A.IV-79	Paddys Run Offsite (Pre 1992) Unfiltered Surface Water
A.IV-80	Paddys Run Offsite (Pre 1992) Filtered Surface Water
A.IV-81	Great Miami River-Between Outfall Line and Confluence with Paddys Run (92/93) Unfiltered Surface Water
A.IV-82	Great Miami River-Between Outfall Line and Confluence with Paddys Run (92/93) Filtered Surface Water
A.IV-83	Great Miami River-Between Outfall Line and Confluence with Paddys Run (Pre 1992) Unfiltered Surface Water

LIST OF TABLES
(continued)

A.IV-84	Great Miami River-Between Outfall Line and Confluence with Paddys Run (Pre 1992) Filtered Surface Water
A.IV-85	Great Miami River-At the Confluence and Below the Confluence of Paddys Run (92/93) Unfiltered Surface Water
A.IV-86	Great Miami River-At the Confluence and Below the Confluence of Paddys Run (92/93) Filtered Surface Water
A.IV-87	Great Miami River-At the Confluence and Below the Confluence of Paddys Run (Pre 1992) Unfiltered Surface Water
A.IV-88	Great Miami River-At the Confluence and Below the Confluence of Paddys Run (Pre 1992) Filtered Surface Water
A.IV-89	Great Miami River-Above Outfall Line (Pre 1992) Unfiltered Surface Water
A.IV-90	Great Miami River-Above Outfall Line (Pre 1992) Filtered Surface Water
A.IV-91	Northern Area Drainage Ditches (Pre 1992) Unfiltered Surface Water
A.IV-92	Northern Area Drainage Ditches (Pre 1992) Filtered Surface Water
A.IV-93	Northern Area Drainage Ditches (92/93) Filtered Surface Water
A.IV-94	Northern Area Drainage Ditches (92/93) Unfiltered Surface Water
A.IV-95	Pilot Plant Drainage Ditch Sediment
A.IV-96	Storm Sewer Outfall Ditch Sediment
A.IV-97	Northern Area Drainage Ditch (B) Sediment
A.IV-98	Paddys Run Onsite A Sediment
A.IV-99	Great Miami River at Confluence with Paddys Run Sediment
A.IV-100	Great Miami River above Outfall Line Sediment
A.IV-101	Great Miami River between Outfall Line and Confluence with Paddys Run Sediment
A.IV-102	Background (W-1) Sediment
A.IV-103	Gravel Pit East Sediment
A.IV-104	Northeast Corner of the FEMP Sediment
A.IV-105	Northern Area Drainage Ditch (A) Sediment
A.IV-106	Paddys Run Offsite Sediment
A.VI-1a	Intakes for Carcinogens for Groundskeeper Area 1, Current Land Use
A.VI-1b	Intakes for Carcinogens for Groundskeeper Area 2, Current Land Use
A.VI-1c	Intakes for Carcinogens for Groundskeeper Area 3, Current Land Use
A.VI-1d	Intakes for Carcinogens for Groundskeeper Area 4, Current Land Use
A.VI-1e	Intakes for Carcinogens for Groundskeeper Area 5, Current Land Use
A.VI-1f	Intakes for Carcinogens for Groundskeeper Area 6, Current Land Use
A.VI-1g	Intakes for Carcinogens for Groundskeeper Area 7, Current Land Use
A.VI-1h	Intakes for Carcinogens for Groundskeeper Area 8, Current Land Use
A.VI-1i	Intakes for Carcinogens for Groundskeeper Area 9, Current Land Use
A.VI-1j	Intakes for Carcinogens for Groundskeeper Area 10, Current Land Use
A.VI-2a	Intakes for Toxicants for Groundskeeper Area 1, Current Land Use
A.VI-2b	Intakes for Toxicants for Groundskeeper Area 2, Current Land Use
A.VI-2c	Intakes for Toxicants for Groundskeeper Area 3, Current Land Use
A.VI-2d	Intakes for Toxicants for Groundskeeper Area 4, Current Land Use
A.VI-2e	Intakes for Toxicants for Groundskeeper Area 5, Current Land Use

LIST OF TABLES
(continued)

A.VI-2f	Intakes for Toxicants for Groundskeeper Area 6, Current Land Use
A.VI-2g	Intakes for Toxicants for Groundskeeper Area 7, Current Land Use
A.VI-2h	Intakes for Toxicants for Groundskeeper Area 8, Current Land Use
A.VI-2i	Intakes for Toxicants for Groundskeeper Area 9, Current Land Use
A.VI-2j	Intakes for Toxicants for Groundskeeper Area 10, Current Land Use
A.VI-3a	Intakes for Carcinogens for Visitor Area 1, Current Land Use
A.VI-3b	Intakes for Carcinogens for Visitor Area 2, Current Land Use
A.VI-3c	Intakes for Carcinogens for Visitor Area 3, Current Land Use
A.VI-3d	Intakes for Carcinogens for Visitor Area 4, Current Land Use
A.VI-4a	Intakes for Toxicants for Visitor Area 1, Current Land Use
A.VI-4b	Intakes for Toxicants for Visitor Area 2, Current Land Use
A.VI-4c	Intakes for Toxicants for Visitor Area 3, Current Land Use
A.VI-4d	Intakes for Toxicants for Visitor Area 4, Current Land Use
A.VI-5a	Intakes for Carcinogens for Trespassing Youth and Exploring Youth Area 5, Current Land Use, With and Without Access Controls
A.VI-5b	Intakes for Carcinogens for Trespassing Youth and Exploring Youth Area 6, Current Land Use, With and Without Access Controls
A.VI-5c	Intakes for Carcinogens for Trespassing Youth and Exploring Youth Area 7, Current Land Use, With and Without Access Controls
A.VI-5d	Intakes for Carcinogens for Trespassing Youth and Exploring Youth Area 8, Current Land Use, With and Without Access Controls
A.VI-5e	Intakes for Carcinogens for Trespassing Youth and Exploring Youth Area 9, Current Land Use, With and Without Access Controls
A.VI-5f	Intakes for Carcinogens for Trespassing Youth and Exploring Youth Area 10, Current Land Use, With and Without Access Controls
A.VI-5g	Intakes for Carcinogens for Exploring Youth Area 1, Current Land Use, With and Without Access Controls
A.VI-5h	Intakes for Carcinogens for Exploring Youth Area 2, Current Land Use, Without Access Controls
A.VI-5i	Intakes for Carcinogens for Exploring Youth Area 3, Current Land Use, Without Access Controls
A.VI-5j	Intakes for Carcinogens for Exploring Youth Area 4, Current Land Use, Without Access Controls
A.VI-5k	Intakes for Carcinogens for Exploring Youth Paddys Run Off-Property, Current Land Use
A.VI-6a	Intakes for Toxicants for Trespassing Youth and Exploring Youth Area 5, Current Land Use, With and Without Access Controls
A.VI-6b	Intakes for Toxicants for Trespassing Youth and Exploring Youth Area 6, Current Land Use, With and Without Access Controls
A.VI-6c	Intakes for Toxicants for Trespassing Youth and Exploring Youth Area 7, Current Land Use, With and Without Access Controls

LIST OF TABLES
(continued)

A.VI-6d	Intakes for Toxicants for Trespassing Youth and Exploring Youth Area 8, Current Land Use, With and Without Access Controls
A.VI-6e	Intakes for Toxicants for Trespassing Youth and Exploring Youth Area 9, Current Land Use, With and Without Access Controls
A.VI-6f	Intakes for Toxicants for Trespassing Youth and Exploring Youth Area 10, Current Land Use, With and Without Access Controls
A.VI-6g	Intakes for Toxicants for Exploring Youth Area 1, Current Land Use, With and Without Access Controls
A.VI-6h	Intakes for Toxicants for Exploring Youth Area 2, Current Land Use, Without Access Controls
A.VI-6i	Intakes for Toxicants for Exploring Youth Area 3, Current Land Use, Without Access Controls
A.VI-6j	Intakes for Toxicants for Exploring Youth Area 4, Current Land Use, Without Access Controls
A.VI-6k	Intakes for Toxicants for Exploring Youth Paddys Run Off-Property, Current Land Use
A.VI-7a	Intakes of Carcinogens for Off-Property User of Meat and Milk Products Grazing Area 1, Current Land Use With and Without Access Controls
A.VI-7b	Intakes of Carcinogens for Off-Property User of Meat and Milk Products Grazing Area 2, Current Land Use With and Without Access Controls
A.VI-7c	Intakes of Carcinogens for Off-Property User of Meat and Milk Products Grazing Area 3, Current Land Use With and Without Access Controls
A.VI-7d	Intakes of Carcinogens for Off-Property User of Meat and Milk Products Grazing Area 4, Current Land Use Without Access Controls
A.VI-8a	Intakes of Toxicants for Off-Property User of Meat and Milk Products Grazing Area 1, Current Land Use With and Without Access Controls
A.VI-8b	Intakes of Toxicants for Off-Property User of Meat and Milk Products Grazing Area 2, Current Land Use With and Without Access Controls
A.VI-8c	Intakes of Toxicants for Off-Property User of Meat and Milk Products Grazing Area 3, Current Land Use With and Without Access Controls
A.VI-8d	Intakes of Toxicants for Off-Property User of Meat and Milk Products Grazing Area 4, Current Land Use Without Access Controls
A.VI-9a	Intakes for Carcinogens for RME Off-Property Farmer Eastern Fenceline, Current Land Use
A.VI-9b	Intakes for Carcinogens for RME Off-Property Farmer North Fenceline, Current Land Use
A.VI-9c	Intakes for Carcinogens for RME Off-Property Farmer South Fenceline, Current Land Use
A.VI-9d	Intakes for Carcinogens for RME Off-Property Farmer Western Fenceline, Current Land Use
A.VI-9e	Intakes for Carcinogens for RME Off-Property Farmer Northeast of FEMP, Current Land Use

LIST OF TABLES
(continued)

A.VI-9f	Intakes for Carcinogens for RME Off-Property Farmer Southeast of FEMP, Current Land Use
A.VI-10a	Intakes for Toxicants for RME Off-Property Farmer Eastern Fenceline, Current Land Use
A.VI-10b	Intakes for Toxicants for RME Off-Property Farmer North Fenceline, Current Land Use
A.VI-10c	Intakes for Toxicants for RME Off-Property Farmer South Fenceline, Current Land Use
A.VI-10d	Intakes for Toxicants for RME Off-Property Farmer Western Fenceline, Current Land Use
A.VI-10e	Intakes for Toxicants for RME Off-Property Farmer Northeast of FEMP, Current Land Use
A.VI-10f	Intakes for Toxicants for RME Off-Property Farmer Southeast of FEMP, Current Land Use
A.VI-11a	Intakes for Carcinogens for RME Off-Property Child Eastern Fenceline, Current Land Use
A.VI-11b	Intakes for Carcinogens for RME Off-Property Child Northern Fenceline, Current Land Use
A.VI-11c	Intakes for Carcinogens for RME Off-Property Child Southern Fenceline, Current Land Use
A.VI-11d	Intakes for Carcinogens for RME Off-Property Child Western Fenceline, Current Land Use
A.VI-11e	Intakes for Carcinogens for RME Off-Property Child Northeast of FEMP, Current Land Use
A.VI-11f	Intakes for Carcinogens for RME Off-Property Child Southeast of FEMP, Current Land Use
A.VI-12a	Intakes for Toxicants for RME Off-Property Child Eastern Fenceline, Current Land Use
A.VI-12b	Intakes for Toxicants for RME Off-Property Child Northern Fenceline, Current Land Use
A.VI-12c	Intakes for Toxicants for RME Off-Property Child Southern Fenceline, Current Land Use
A.VI-12d	Intakes for Toxicants for RME Off-Property Child Western Fenceline, Current Land Use
A.VI-12e	Intakes for Toxicants for RME Off-Property Child Northeast of FEMP, Current Land Use
A.VI-12f	Intakes for Toxicants for RME Off-Property Child Southeast of FEMP, Current Land Use
A.VI-13a	Intakes for Carcinogens for Great Miami River User Great Miami River Outfall, Current Land Use
A.VI-13b	Intakes for Carcinogens for Great Miami River User Confluence with Paddys Run, Current Land Use

LIST OF TABLES
(continued)

A.VI-14a Intakes for Toxicants for Great Miami River user Great Miami River Outfall, Current Land Use

A.VI-14b Intakes for Toxicants for Great Miami River User Confluence with Paddys Run, Current Land User

A.VI-15a Intakes for Carcinogens for Groundskeeper Production Area, Future Land Use

A.VI-15b Intakes for Carcinogens for Groundskeeper Northwest Area, Future Land Use

A.VI-15c Intakes for Carcinogens for Groundskeeper Northeast Area, Future Land Use

A.VI-15d Intakes for Carcinogens for Groundskeeper Southeast Area, Future Land Use

A.VI-15e Intakes for Carcinogens for Groundskeeper Southwest Area, Future Land Use

A.VI-15f Intakes for Carcinogens for Groundskeeper Waste Pit Area, Future Land Use

A.VI-15g Intakes for Carcinogens for Groundskeeper Shooting Range, Future Land Use

A.VI-16a Intakes for Toxicants for Groundskeeper Production Area, Future Land Use

A.VI-16b Intakes for Toxicants for Groundskeeper Northwest Area, Future Land Use

A.VI-16c Intakes for Toxicants for Groundskeeper Northeast Area, Future Land Use

A.VI-16d Intakes for Toxicants for Groundskeeper Southeast Area, Future Land Use

A.VI-16e Intakes for Toxicants for Groundskeeper Southwest Area, Future Land Use

A.VI-16f Intakes for Toxicants for Groundskeeper Waste Pit Area, Future Land Use

A.VI-16g Intakes for Toxicants for Groundskeeper Shooting Range, Future Land Use

A.VI-17a Intakes for Carcinogens for Recreational User, Wildlife Reserve Production Area, Future Land Use, With Access Controls

A.VI-17b Intakes for Carcinogens for Recreational User, Wildlife Reserve Northwest Area, Future Land Use, With Access Controls

A.VI-17c Intakes for Carcinogens for Recreational User, Wildlife Reserve Northeast Area, Future Land Use, With Access Controls

A.VI-17d Intakes for Carcinogens for Recreational User, Wildlife Reserve Southeast Area, Future Land Use, With Access Controls

A.VI-17e Intakes for Carcinogens for Recreational User, Wildlife Reserve Southwest Area, Future Land Use, With Access Controls

A.VI-17f Intakes for Carcinogens for Recreational User, Wildlife Reserve Waste Pit Area, Future Land Use, With Access Controls

A.VI-18a Intakes for Toxicants for Recreational User, Wildlife Reserve Production Area, Future Land Use, With Access Controls

A.VI-18b Intakes for Toxicants for Recreational User, Wildlife Reserve Northwest Area, Future Land Use, With Access Controls

A.VI-18c Intakes for Toxicants for Recreational User, Wildlife Reserve Northeast Area, Future Land Use, With Access Controls

A.VI-18d Intakes for Toxicants for Recreational User, Wildlife Reserve Southeast Area, Future Land Use, With Access Controls

A.VI-18e Intakes for Toxicants for Recreational User, Wildlife Reserve Southwest Area, Future Land Use, With Access Controls

A.VI-18f Intakes for Toxicants for Recreational User, Wildlife Reserve Waste Pit Area, Future Land Use, With Access Controls

LIST OF TABLES
(continued)

A.VI-19a Intakes for Carcinogens for Recreational User, Undeveloped Park Production Area, Future Land Use, With Access Controls
A.VI-19b Intakes for Carcinogens for Recreational User, Undeveloped Park Northwest Area, Future Land Use, With Access Controls
A.VI-19c Intakes for Carcinogens for Recreational User, Undeveloped Park Northeast Area, Future Land Use, With Access Controls
A.VI-19d Intakes for Carcinogens for Recreational User, Undeveloped Park Southeast Area, Future Land Use, With Access Controls
A.VI-19e Intakes for Carcinogens for Recreational User, Undeveloped Park Southwest Area, Future Land Use, With Access Controls
A.VI-19f Intakes for Carcinogens for Recreational User, Undeveloped Park Waste Pit Area, Future Land Use, With Access Controls
A.VI-19g Intakes for Carcinogens for Recreational User, Undeveloped Park Shooting Range, Future Land Use, With Access Controls

A.VI-20a Intakes for Toxicants for Recreational User, Undeveloped Park Production Area, Future Land Use, With Access Controls
A.VI-20b Intakes for Toxicants for Recreational User, Undeveloped Park Northwest Area, Future Land Use, With Access Controls
A.VI-20c Intakes for Toxicants for Recreational User, Undeveloped Park Northeast Area, Future Land Use, With Access Controls
A.VI-20d Intakes for Toxicants for Recreational User, Undeveloped Park Southeast Area, Future Land Use, With Access Controls
A.VI-20e Intakes for Toxicants for Recreational User, Undeveloped Park Southwest Area, Future Land Use, With Access Controls
A.VI-20f Intakes for Toxicants for Recreational User, Undeveloped Park Waste Pit Area, Future Land Use, With Access Controls
A.VI-20g Intakes for Toxicants for Recreational User, Undeveloped Park Shooting Range, Future Land Use, With Access Controls

A.VI-21a Intakes for Carcinogens for Recreational User, Developed Park Production Area, Future Land Use, With Access Controls
A.VI-21b Intakes for Carcinogens for Recreational User, Developed Park Northwest Area, Future Land Use, With Access Controls
A.VI-21c Intakes for Carcinogens for Recreational User, Developed Park Northeast Area, Future Land Use, With Access Controls
A.VI-21d Intakes for Carcinogens for Recreational User, Developed Park Southeast Area, Future Land Use, With Access Controls
A.VI-21e Intakes for Carcinogens for Recreational User, Developed Park Southwest Area, Future Land Use, With Access Controls
A.VI-21f Intakes for Carcinogens for Recreational User, Developed Park Waste Pit Area, Future Land Use, With Access Controls
A.VI-21g Intakes for Carcinogens for Recreational User, Developed Park Shooting Range, Future Land Use, With Access Controls

LIST OF TABLES
(continued)

A.VI-22a	Intakes for Toxicants for Recreational User, Developed Park Production Area, Future Land Use, With Access Controls
A.VI-22b	Intakes for Toxicants for Recreational User, Developed Park Northwest Area, Future Land Use, With Access Controls
A.VI-22c	Intakes for Toxicants for Recreational User, Developed Park Northeast Area, Future Land Use, With Access Controls
A.VI-22d	Intakes for Toxicants for Recreational User, Developed Park Southeast Area, Future Land Use, With Access Controls
A.VI-22e	Intakes for Toxicants for Recreational User, Developed Park Southwest Area, Future Land Use, With Access Controls
A.VI-22f	Intakes for Toxicants for Recreational User, Developed Park Waste Pit Area, Future Land Use, With Access Controls
A.VI-22g	Intakes for Toxicants for Recreational User, Developed Park Shooting Range, Future Land Use, With Access Controls
A.VI-23a	Intakes for Carcinogens for RME Off-Property Farmer Eastern Fenceline, Future Land Use
A.VI-23b	Intakes for Carcinogens for RME Off-Property Farmer Northern Fenceline, Future Land Use
A.VI-23c	Intakes for Carcinogens for RME Off-Property Farmer Southern Fenceline, Future Land Use
A.VI-23d	Intakes for Carcinogens for RME Off-Property Farmer Western Fenceline, Future Land Use
A.VI-23e	Intakes for Carcinogens for RME Off-Property Farmer Northeast of FEMP, Future Land Use
A.VI-23f	Intakes for Carcinogens for RME Off-Property Farmer Southeast of FEMP, Future Land Use
A.VI-23g	Intakes for Carcinogens for RME Off-Property Farmer at Well 2071, Future Land Use
A.VI-23h	Intakes for Carcinogens for RME Off-Property Farmer at Well 2119, Future Land Use
A.VI-23i	Intakes for Carcinogens for RME Off-Property Farmer Near the Great Miami River, Future Land Use
A.VI-24a	Intakes for Toxicants for RME Off-Property Farmer Eastern Fenceline, Future Land Use
A.VI-24b	Intakes for Toxicants for RME Off-Property Farmer North Fenceline, Future Land Use
A.VI-24c	Intakes for Toxicants for RME Off-Property Farmer South Fenceline, Future Land Use
A.VI-24d	Intakes for Toxicants for RME Off-Property Farmer Western Fenceline, Future Land Use
A.VI-24e	Intakes for Toxicants for RME Off-Property Farmer Northeast of FEMP, Future Land Use
A.VI-24f	Intakes for Toxicants for RME Off-Property Farmer Southeast of FEMP, Future Land Use

LIST OF TABLES
(continued)

A.VI-24g	Intakes for Toxicants for RME Off-Property Farmer at Well 2071, Future Land Use
A.VI-24h	Intakes for Toxicants for RME Off-Property Farmer at Well 2119, Future Land Use
A.VI-24i	Intakes for Toxicants for RME Off-Property Farmer Near the Great Miami River, Future Land Use
A.VI-25a	Intakes for Carcinogens for RME Off-Property Child Eastern Fenceline, Future Land Use
A.VI-25b	Intakes for Carcinogens for RME Off-Property Child Northern Fenceline, Future Land Use
A.VI-25c	Intakes for Carcinogens for RME Off-Property Child Southern Fenceline, Future Land Use
A.VI-25d	Intakes for Carcinogens for RME Off-Property Child Western Fenceline, Future Land Use
A.VI-25e	Intakes for Carcinogens for RME Off-Property Child Northeast of FEMP, Future Land Use
A.VI-25f	Intakes for Carcinogens for RME Off-Property Child Southeast of FEMP, Future Land Use
A.VI-25g	Intakes for Carcinogens for Off-Property Child at Well 2071, Future Land Use
A.VI-25h	Intakes for Carcinogens for Off-Property Child at Well 2119, Future Land Use
A.VI-25i	Intakes for Carcinogens for Off-Property Child Near the Great Miami River, Future land Use
A.VI-26a	Intakes for Toxicants for RME Off-Property Child Eastern Fenceline, Future Land Use
A.VI-26b	Intakes for Toxicants for RME Off-Property Child Northern Fenceline, Future Land Use
A.VI-26c	Intakes for Toxicants for RME Off-Property Child Southern Fenceline, Future Land Use
A.VI-26d	Intakes for Toxicants for RME Off-Property Child Western Fenceline, Future Land Use
A.VI-26e	Intakes for Toxicants for RME Off-Property Child Northeast of FEMP, Future Land Use
A.VI-26f	Intakes for Toxicants for RME Off-Property Child Southeast of FEMP, Future Land Use
A.VI-26g	Intakes for Toxicants for Off-Property Child at Well 2071, Future Land Use
A.VI-26h	Intakes for Toxicants for Off-Property Child at Well 2119, Future Land Use
A.VI-26i	Intakes for Toxicants for Off-Property Child Near the Great Miami River, Future land Use
A.VI-27a	Intakes for Carcinogens for Great Miami River User Confluence with Paddys Run, Future Land Use
A.VI-28a	Intakes for Toxicants for Great Miami River User Confluence with Paddys Run, Future Land Use

LIST OF TABLES
(continued)

A.VI-29a	Intakes for Carcinogens for RME On-Property Farmer Production Area, Future Land Use
A.VI-29b	Intakes for Carcinogens for RME On-Property Farmer Northwest Area, Future Land Use
A.VI-29c	Intakes for Carcinogens for RME On-Property Farmer Northeast Area, Future Land Use
A.VI-29d	Intakes for Carcinogens for RME On-Property Farmer Southeast Area, Future Land Use
A.VI-29e	Intakes for Carcinogens for RME On-Property Farmer Southwest Area, Future Land Use
A.VI-29f	Intakes for Carcinogens for RME On-Property Farmer Waste Pit Area, Future Land Use
A.VI-29g	Intakes for Carcinogens for RME On-Property Farmer Shooting Range Area, Future Land Use
A.VI-30a	Intakes for Toxicants for RME On-Property Farmer Production Area, Future Land Use
A.VI-30b	Intakes for Toxicants for RME On-Property Farmer Northwest Area, Future Land Use
A.VI-30c	Intakes for Toxicants for RME On-Property Farmer Northeast Area, Future Land Use
A.VI-30d	Intakes for Toxicants for RME On-Property Farmer Southeast Area, Future Land Use
A.VI-30e	Intakes for Toxicants for RME On-Property Farmer Southwest Area, Future Land Use
A.VI-30f	Intakes for Toxicants for RME On-Property Farmer Waste Pit Area, Future Land Use
A.VI-30g	Intakes for Toxicants for RME On-Property Farmer Shooting Range Area, Future Land Use
A.VI-31a	Intakes for Carcinogens for CT On-Property Farmer Production Area, Future Land Use
A.VI-31b	Intakes for Carcinogens for CT On-Property Farmer Northwest Area, Future Land Use
A.VI-31c	Intakes for Carcinogens for CT On-Property Farmer Northeast Area, Future Land Use
A.VI-31d	Intakes for Carcinogens for CT On-Property Farmer Southeast Area, Future Land Use
A.VI-31e	Intakes for Carcinogens for CT On-Property Farmer Southwest Area, Future Land Use
A.VI-31f	Intakes for Carcinogens for CT On-Property Farmer Waste Pit Area, Future Land Use
A.VI-31g	Intakes for Carcinogens for CT On-Property Farmer Shooting Range Area, Future Land Use
A.VI-32a	Intakes for Toxicants for CT On-Property Farmer Production Area, Future Land Use

LIST OF TABLES
(continued)

A.VI-32b	Intakes for Toxicants for CT On-Property Farmer Northwest Area, Future Land Use
A.VI-32c	Intakes for Toxicants for CT On-Property Farmer Northeast Area, Future Land Use
A.VI-32d	Intakes for Toxicants for CT On-Property Farmer Southeast Area, Future Land Use
A.VI-32e	Intakes for Toxicants for CT On-Property Farmer Southwest Area, Future Land Use
A.VI-32f	Intakes for Toxicants for CT On-Property Farmer Waste Pit Area, Future Land Use
A.VI-32g	Intakes for Toxicants for CT On-Property Farmer Shooting Range Area, Future Land Use
A.VI-33a	Intakes for Carcinogens for On-Property Child Production Area, Future Land Use
A.VI-33b	Intakes for Carcinogens for On-Property Child Northwest Area, Future Land Use
A.VI-33c	Intakes for Carcinogens for On-Property Child Northeast Area, Future Land Use
A.VI-33d	Intakes for Carcinogens for On-Property Child Southeast Area, Future Land Use
A.VI-33e	Intakes for Carcinogens for On-Property Child Southwest Area, Future Land Use
A.VI-33f	Intakes for Carcinogens for On-Property Child Waste Pit Area, Future Land Use
A.VI-33g	Intakes for Carcinogens for On-Property Child Shooting Range Area, Future Land Use
A.VI-34a	Intakes for Toxicants for On-Property Child Production Area, Future Land Use
A.VI-34b	Intakes for Toxicants for On-Property Child Northwest Area, Future Land Use
A.VI-34c	Intakes for Toxicants for On-Property Child Northeast Area, Future Land Use
A.VI-34d	Intakes for Toxicants for On-Property Child Southeast Area, Future Land Use
A.VI-34e	Intakes for Toxicants for On-Property Child Southwest Area, Future Land Use
A.VI-34f	Intakes for Toxicants for On-Property Child Waste Pit Area, Future Land Use
A.VI-34g	Intakes for Toxicants for On-Property Child Shooting Range Area, Future Land Use
A.VI-35a	Intakes for Carcinogens for RME On-Property Farmer Use of Perched Groundwater in Production Area, Future Land Use
A.VI-36a	Intakes for Toxicants for RME On-Property Farmer Use of Perched Groundwater in Production Area, Future Land Use
A.VI-37a	Intakes for Carcinogens for On-Property Home Builder Future Land Use, Production Area
A.VI-37b	Intakes for Carcinogens for On-Property Home Builder Future Land Use, Northwest Area
A.VI-37c	Intakes for Carcinogens for On-Property Home Builder Future Land Use, Northeast Area
A.VI-37d	Intakes for Carcinogens for On-Property Home Builder Future Land Use, Southeast Area
A.VI-37e	Intakes for Carcinogens for On-Property Home Builder Future Land Use, Southwest Area
A.VI-37f	Intakes for Carcinogens for On-Property Home Builder Future Land Use, Waste Pit Area
A.VI-37g	Intakes for Carcinogens for On-Property Home Builder Future Land Use, Shooting Range

LIST OF TABLES
(continued)

A.VI-38a	Intakes for Toxicants for On-Property Home Builder Future Land Use, Production Area
A.VI-38b	Intakes for Toxicants for On-Property Home Builder Future Land Use, Northwest Area
A.VI-38c	Intakes for Toxicants for On-Property Home Builder Future Land Use, Northeast Area
A.VI-38d	Intakes for Toxicants for On-Property Home Builder Future Land Use, Southeast Area
A.VI-38e	Intakes for Toxicants for On-Property Home Builder Future Land Use, Southwest Area
A.VI-38f	Intakes for Toxicants for On-Property Home Builder Future Land Use, Waste Pit Area
A.VI-38g	Intakes for Toxicants for On-Property Home Builder Future Land Use, Shooting Range
A.VII-1a	ILCRs for Groundskeeper Area 1, Current Land Use
A.VII-1b	ILCRs for Groundskeeper Area 2, Current Land Use
A.VII-1c	ILCRs for Groundskeeper Area 3, Current Land Use
A.VII-1d	ILCRs for Groundskeeper Area 4, Current Land Use
A.VII-1e	ILCRs for Groundskeeper Area 5, Current Land Use
A.VII-1f	ILCRs for Groundskeeper Area 6, Current Land Use
A.VII-1g	ILCRs for Groundskeeper Area 7, Current Land Use
A.VII-1h	ILCRs for Groundskeeper Area 8, Current Land Use
A.VII-1i	ILCRs for Groundskeeper Area 9, Current Land Use
A.VII-1j	ILCRs for Groundskeeper Area 10, Current Land Use
A.VII-2a	Hazard Quotients for Groundskeeper Area 1, Current Land Use
A.VII-2b	Hazard Quotients for Groundskeeper Area 2, Current Land Use
A.VII-2c	Hazard Quotients for Groundskeeper Area 3, Current Land Use
A.VII-2d	Hazard Quotients for Groundskeeper Area 4, Current Land Use
A.VII-2e	Hazard Quotients for Groundskeeper Area 5, Current Land Use
A.VII-2f	Hazard Quotients for Groundskeeper Area 6, Current Land Use
A.VII-2g	Hazard Quotients for Groundskeeper Area 7, Current Land Use
A.VII-2h	Hazard Quotients for Groundskeeper Area 8, Current Land Use
A.VII-2i	Hazard Quotients for Groundskeeper Area 9, Current Land Use
A.VII-2j	Hazard Quotients for Groundskeeper Area 10, Current Land Use
A.VII-3a	ILCRs for Visitor Area 1, Current Land Use
A.VII-3b	ILCRs for Visitor Area 2, Current Land Use
A.VII-3c	ILCRs for Visitor Area 3, Current Land Use
A.VII-3d	ILCRs for Visitor Area 4, Current Land Use
A.VII-4a	Hazard Quotients for Visitor Area 1, Current Land Use
A.VII-4b	Hazard Quotients for Visitor Area 2, Current Land Use
A.VII-4c	Hazard Quotients for Visitor Area 3, Current Land Use
A.VII-4d	Hazard Quotients for Visitor Area 4, Current Land Use

LIST OF TABLES
(continued)

A.VII-5a	ILCRs for Trespassing Youth and Exploring Youth Area 5, Current Land Use, With and Without Access Controls
A.VII-5b	ILCRs for Trespassing Youth and Exploring Youth Area 6, Current Land Use, With and Without Access Controls
A.VII-5c	ILCRs for Trespassing Youth and Exploring Youth Area 7, Current Land Use, With and Without Access Controls
A.VII-5d	ILCRs for Trespassing Youth and Exploring Youth Area 8, Current Land Use, With and Without Access Controls
A.VII-5e	ILCRs for Trespassing Youth and Exploring Youth Area 9, Current Land Use, With and Without Access Controls
A.VII-5f	ILCRs for Trespassing Youth and Exploring Youth Area 10, Current Land Use, With and Without Access Controls
A.VII-5g	ILCRs for Exploring Youth Area 1, Current Land Use, Without Access Controls
A.VII-5h	ILCRs for Exploring Youth Area 2, Current Land Use, Without Access Controls
A.VII-5i	ILCRs for Exploring Youth Area 3, Current Land Use, Without Access Controls
A.VII-5j	ILCRs for Exploring Youth Area 4, Current Land Use, Without Access Controls
A.VII-5k	ILCRs for Exploring Youth Paddys Run Off-Property, Current Land Use
A.VII-6a	Hazard Quotients for Trespassing Youth and Exploring Youth Area 5, Current Land Use, With and Without Access Controls
A.VII-6b	Hazard Quotients for Trespassing Youth and Exploring Youth Area 6, Current Land Use, With and Without Access Controls
A.VII-6c	Hazard Quotients for Trespassing Youth and Exploring Youth Area 7, Current Land Use, With and Without Access Controls
A.VII-6d	Hazard Quotients for Trespassing Youth and Exploring Youth Area 8, Current Land Use, With and Without Access Controls
A.VII-6e	Hazard Quotients for Trespassing Youth and Exploring Youth Area 9, Current Land Use, With and Without Access Controls
A.VII-6f	Hazard Quotients for Trespassing Youth and Exploring Youth Area 10, Current Land Use, With and Without Access Controls
A.VII-6g	Hazard Quotients for Exploring Youth Area 1, Current Land Use, Without Access Controls
A.VII-6h	Hazard Quotients for Exploring Youth Area 2, Current Land Use, Without Access Controls
A.VII-6i	Hazard Quotients for Exploring Youth Area 3, Current Land Use, Without Access Controls
A.VII-6j	Hazard Quotients for Exploring Youth Area 4, Current Land Use, Without Access Controls
A.VII-6k	Hazard Quotients for Exploring Youth Paddys Run Off-Property, Current Land Use
A.VII-7a	ILCRs for Off-Property User of Meat and Milk Products Grazing Area 1, Current Land Use With and Without Access Controls
A.VII-7b	ILCRs for Off-Property User of Meat and Milk Products Grazing Area 2, Current Land Use With and Without Access Controls
A.VII-7c	ILCRs for Off-Property User of Meat and Milk Products Grazing Area 3, Current Land Use With and Without Access Controls

LIST OF TABLES
(continued)

A.VII-7d	ILCRs for Off-Property User of Meat and Milk Products Grazing Area 4, Current Land Use With and Without Access Controls
A.VII-8a	Hazard Quotients for Off-Property User of Meat and Milk Products Grazing Area 1, Current Land Use With and Without Access Controls
A.VII-8b	Hazard Quotients for Off-Property User of Meat and Milk Products Grazing Area 2, Current Land Use With and Without Access Controls
A.VII-8c	Hazard Quotients for Off-Property User of Meat and Milk Products Grazing Area 3, Current Land Use With and Without Access Controls
A.VII-8d	Hazard Quotients for Off-Property User of Meat and Milk Products Grazing Area 4, Current Land Use With and Without Access Controls
A.VII-9a	ILCRs for RME Off-Property Farmer Eastern Fenceline, Current Land Use
A.VII-9b	ILCRs for RME Off-Property Farmer North Fenceline, Current Land Use
A.VII-9c	ILCRs for RME Off-Property Farmer South Fenceline, Current Land Use
A.VII-9d	ILCRs for RME Off-Property Farmer Western Fenceline, Current Land Use
A.VII-9e	ILCRs for RME Off-Property Farmer Northeast of FEMP, Current Land Use
A.VII-9f	ILCRs for RME Off-Property Farmer Southeast of FEMP, Current Land Use
A.VII-10a	Hazard Quotients for RME Off-Property Farmer Eastern Fenceline, Current Land Use
A.VII-10b	Hazard Quotients for RME Off-Property Farmer North Fenceline, Current Land Use
A.VII-10c	Hazard Quotients for RME Off-Property Farmer South Fenceline, Current Land Use
A.VII-10d	Hazard Quotients for RME Off-Property Farmer Western Fenceline, Current Land Use
A.VII-10e	Hazard Quotients for RME Off-Property Farmer Northeast of FEMP, Current Land Use
A.VII-10f	Hazard Quotients for RME Off-Property Farmer Southeast of FEMP, Current Land Use
A.VII-11a	ILCRs for RME Off-Property Child Eastern Fenceline, Current Land Use
A.VII-11b	ILCRs for RME Off-Property Child Northern Fenceline, Current Land Use
A.VII-11c	ILCRs for RME Off-Property Child Southern Fenceline, Current Land Use
A.VII-11d	ILCRs for RME Off-Property Child Western Fenceline, Current Land Use
A.VII-11e	ILCRs for RME Off-Property Child Northeast of FEMP, Current Land Use
A.VII-11f	ILCRs for RME Off-Property Child Southeast of FEMP, Current Land Use
A.VII-12a	Hazard Quotients for RME Off-Property Child Eastern Fenceline, Current Land Use
A.VII-12b	Hazard Quotients for RME Off-Property Child Northern Fenceline, Current Land Use
A.VII-12c	Hazard Quotients for RME Off-Property Child Southern Fenceline, Current Land Use
A.VII-12d	Hazard Quotients for RME Off-Property Child Western Fenceline, Current Land Use
A.VII-12e	Hazard Quotients for RME Off-Property Child Northeast of FEMP, Current Land Use

LIST OF TABLES
(continued)

A.VII-12f	Hazard Quotients for RME Off-Property Child Southeast of FEMP, Current Land Use
A.VII-13a	ILCRs for Great Miami River User Great Miami River Outfall, Current Land Use
A.VII-13b	ILCRs for Great Miami River User Confluence with Paddys Run, Current Land Use
A.VII-14a	Hazard Quotients for Great Miami River User Great Miami River Outfall, Current Land Use
A.VII-14b	Hazard Quotients for Great Miami River User Confluence with Paddys Run, Current Land Use
A.VII-15a	ILCRs for Groundskeeper Production Area, Future Land Use
A.VII-15b	ILCRs for Groundskeeper Northwest Area, Future Land Use
A.VII-15c	ILCRs for Groundskeeper Northeast Area, Future Land Use
A.VII-15d	ILCRs for Groundskeeper Southeast Area, Future Land Use
A.VII-15e	ILCRs for Groundskeeper Southwest Area, Future Land Use
A.VII-15f	ILCRs for Groundskeeper Waste Pit Area, Future Land Use
A.VII-15g	ILCRs for Groundskeeper Shooting Range, Future Land Use
A.VII-16a	Hazard Quotients for Groundskeeper Production Area, Future Land Use
A.VII-16b	Hazard Quotients for Groundskeeper Northwest Area, Future Land Use
A.VII-16c	Hazard Quotients for Groundskeeper Northeast Area, Future Land Use
A.VII-16d	Hazard Quotients for Groundskeeper Southeast Area, Future Land Use
A.VII-16e	Hazard Quotients for Groundskeeper Southwest Area, Future Land Use
A.VII-16f	Hazard Quotients for Groundskeeper Waste Pit Area, Future Land Use
A.VII-16g	Hazard Quotients for Groundskeeper Shooting Range, Future Land Use
A.VII-17a	ILCRs for Recreational User, Wildlife Reserve Production Area, Future Land Use, with Access Controls
A.VII-17b	ILCRs for Recreational User, Wildlife Reserve Northwest Area, Future Land Use, with Access Controls
A.VII-17c	ILCRs for Recreational User, Wildlife Reserve Northeast Area, Future Land Use, with Access Controls
A.VII-17d	ILCRs for Recreational User, Wildlife Reserve Southeast Area, Future Land Use, with Access Controls
A.VII-17e	ILCRs for Recreational User, Wildlife Reserve Southwest Area, Future Land Use, with Access Controls
A.VII-17f	ILCRs for Recreational User, Wildlife Reserve Waste Pit Area, Future Land Use, with Access Controls
A.VII-18a	Hazard Quotients for Recreational User, Wildlife Reserve Production Area, Future Land Use, with Access Controls
A.VII-18b	Hazard Quotients for Recreational User, Wildlife Reserve Northwest Area, Future Land Use, with Access Controls
A.VII-18c	Hazard Quotients for Recreational User, Wildlife Reserve Northeast Area, Future Land Use, with Access Controls

LIST OF TABLES
(continued)

A.VII-18d Hazard Quotients for Recreational User, Wildlife Reserve Southeast Area, Future Land Use, with Access Controls
A.VII-18e Hazard Quotients for Recreational User, Wildlife Reserve Southwest Area, Future Land Use, with Access Controls
A.VII-18f Hazard Quotients for Recreational User, Wildlife Reserve Waste Pit Area, Future Land Use, with Access Controls

A.VII-19a ILCRs for Recreational User, Undeveloped Park Production Area, Future Land Use, with Access Controls
A.VII-19b ILCRs for Recreational User, Undeveloped Park Northwest Area, Future Land Use, with Access Controls
A.VII-19c ILCRs for Recreational User, Undeveloped Park Northeast Area, Future Land Use, with Access Controls
A.VII-19d ILCRs for Recreational User, Undeveloped Park Southeast Area, Future Land Use, with Access Controls
A.VII-19e ILCRs for Recreational User, Undeveloped Park Southwest Area, Future Land Use, with Access Controls
A.VII-19f ILCRs for Recreational User, Undeveloped Park Waste Pit Area, Future Land Use, with Access Controls
A.VII-19g ILCRs for Recreational User, Undeveloped Park Shooting Range Area, Future Land Use, with Access Controls

A.VII-20a Hazard Quotients for Recreational User, Undeveloped Park Production Area, Future Land Use, with Access Controls
A.VII-20b Hazard Quotients for Recreational User, Undeveloped Park Northwest Area, Future Land Use, with Access Controls
A.VII-20c Hazard Quotients for Recreational User, Undeveloped Park Northeast Area, Future Land Use, with Access Controls
A.VII-20d Hazard Quotients for Recreational User, Undeveloped Park Southeast Area, Future Land Use, with Access Controls
A.VII-20e Hazard Quotients for Recreational User, Undeveloped Park Southwest Area, Future Land Use, with Access Controls
A.VII-20f Hazard Quotients for Recreational User, Undeveloped Park Waste Pit Area, Future Land Use, with Access Controls
A.VII-20g Hazard Quotients for Recreational User, Undeveloped Park Shooting Range Area, Future Land Use, with Access Controls

A.VII-21a ILCRs for Recreational User, Developed Park Production Area, Future Land Use, with Access Controls
A.VII-21b ILCRs for Recreational User, Developed Park Northwest Area, Future Land Use, with Access Controls
A.VII-21c ILCRs for Recreational User, Developed Park Northeast Area, Future Land Use, with Access Controls
A.VII-21d ILCRs for Recreational User, Developed Park Southeast Area, Future Land Use, with Access Controls

LIST OF TABLES
(continued)

A.VII-21e	ILCRs for Recreational User, Developed Park Southwest Area, Future Land Use, with Access Controls
A.VII-21f	ILCRs for Recreational User, Developed Park Waste Pit Area, Future Land Use, with Access Controls
A.VII-21g	ILCRs for Recreational User, Developed Park Shooting Range Area, Future Land Use, with Access Controls
A.VII-22a	Hazard Quotients for Recreational User, Developed Park Production Area, Future Land Use, with Access Controls
A.VII-22b	Hazard Quotients for Recreational User, Developed Park Northwest Area, Future Land Use, with Access Controls
A.VII-22c	Hazard Quotients for Recreational User, Developed Park Northeast Area, Future Land Use, with Access Controls
A.VII-22d	Hazard Quotients for Recreational User, Developed Park Southeast Area, Future Land Use, with Access Controls
A.VII-22e	Hazard Quotients for Recreational User, Developed Park Southwest Area, Future Land Use, with Access Controls
A.VII-22f	Hazard Quotients for Recreational User, Developed Park Waste Pit Area, Future Land Use, with Access Controls
A.VII-22g	Hazard Quotients for Recreational User, Developed Park Shooting Range Area, Future Land Use, with Access Controls
A.VII-23a	ILCRs for RME Off-Property Farmer Eastern Fenceline, Future Land Use
A.VII-23b	ILCRs for RME Off-Property Farmer Northern Fenceline, Future Land Use
A.VII-23c	ILCRs for RME Off-Property Farmer Southern Fenceline, Future Land Use
A.VII-23d	ILCRs for RME Off-Property Farmer Western Fenceline, Future Land Use
A.VII-23e	ILCRs for RME Off-Property Farmer Northeast of FEMP, Future Land Use
A.VII-23f	ILCRs for RME Off-Property Farmer Southeast of FEMP, Future Land Use
A.VII-23g	ILCRs for RME Off-Property Farmer At Well 2071, Future Land Use
A.VII-23h	ILCRs for RME Off-Property Farmer At Well 2119, Future Land Use
A.VII-23i	ILCRs for RME Off-Property Farmer Near the Great Miami River, Future Land Use
A.VII-24a	Hazard Quotients for RME Off-Property Farmer Eastern Fenceline, Future Land Use
A.VII-24b	Hazard Quotients for RME Off-Property Farmer Northern Fenceline, Future Land Use
A.VII-24c	Hazard Quotients for RME Off-Property Farmer Southern Fenceline, Future Land Use
A.VII-24d	Hazard Quotients for RME Off-Property Farmer Western Fenceline, Future Land Use
A.VII-24e	Hazard Quotients for RME Off-Property Farmer Northeast of FEMP, Future Land Use
A.VII-24f	Hazard Quotients for RME Off-Property Farmer Southeast of FEMP, Future Land Use
A.VII-24g	Hazard Quotients for RME Off-Property Farmer At Well 2071, Future Land Use
A.VII-24h	Hazard Quotients for RME Off-Property Farmer At Well 2119, Future Land Use

LIST OF TABLES
(continued)

A.VII-24i Hazard Quotients for RME Off-Property Farmer Near the Great Miami River, Future Land Use

A.VII-25a ILCRs for RME Off-Property Child Eastern Fenceline, Future Land Use
A.VII-25b ILCRs for RME Off-Property Child Northern Fenceline, Future Land Use
A.VII-25c ILCRs for RME Off-Property Child Southern Fenceline, Future Land Use
A.VII-25d ILCRs for RME Off-Property Child Western Fenceline, Future Land Use
A.VII-25e ILCRs for RME Off-Property Child Northeast of FEMP, Future Land Use
A.VII-25f ILCRs for RME Off-Property Child Southeast of FEMP, Future Land Use
A.VII-25g ILCRs for RME Off-Property Child At Well 2071, Future Land Use
A.VII-25h ILCRs for RME Off-Property Child At Well 2119, Future Land Use
A.VII-25i ILCRs for RME Off-Property Child Near the Great Miami River, Future Land Use

A.VII-26a Hazard Quotients for RME Off-Property Child Eastern Fenceline, Future Land Use
A.VII-26b Hazard Quotients for RME Off-Property Child Northern Fenceline, Future Land Use
A.VII-26c Hazard Quotients for RME Off-Property Child Southern Fenceline, Future Land Use
A.VII-26d Hazard Quotients for RME Off-Property Child Western Fenceline, Future Land Use
A.VII-26e Hazard Quotients for RME Off-Property Child Northeast of FEMP, Future Land Use
A.VII-26f Hazard Quotients for RME Off-Property Child Southeast of FEMP, Future Land Use
A.VII-26g Hazard Quotients for RME Off-Property Child At Well 2071, Future Land Use
A.VII-26h Hazard Quotients for RME Off-Property Child At Well 2119, Future Land Use
A.VII-26i Hazard Quotients for RME Off-Property Child Near the Great Miami River, Future Land Use

A.VII-27a ILCRs for Great Miami River User Confluence with Paddys Run, Future Land Use

A.VII-28a Hazard Quotients for Great Miami River User Confluence with Paddys Run, Future Land Use

A.VII-29a ILCRs for RME On-Property Farmer Production Area, Future Land Use
A.VII-29b ILCRs for RME On-Property Farmer Northwest Area, Future Land Use
A.VII-29c ILCRs for RME On-Property Farmer Northeast Area, Future Land Use
A.VII-29d ILCRs for RME On-Property Farmer Southeast Area, Future Land Use
A.VII-29e ILCRs for RME On-Property Farmer Southwest Area, Future Land Use
A.VII-29f ILCRs for RME On-Property Farmer Waste Pit Area, Future Land Use
A.VII-29g ILCRs for RME On-Property Farmer Shooting Range Area, Future Land Use

A.VII-30a Hazard Quotients for RME On-Property Farmer Production Area, Future Land Use
A.VII-30b Hazard Quotients for RME On-Property Farmer Northwest Area, Future Land Use
A.VII-30c Hazard Quotients for RME On-Property Farmer Northeast Area, Future Land Use
A.VII-30d Hazard Quotients for RME On-Property Farmer Southeast Area, Future Land Use
A.VII-30e Hazard Quotients for RME On-Property Farmer Southwest Area, Future Land Use
A.VII-30f Hazard Quotients for RME On-Property Farmer Waste Pit Area, Future Land Use
A.VII-30g Hazard Quotients for RME On-Property Farmer Shooting Range Area, Future Land Use

LIST OF TABLES
(continued)

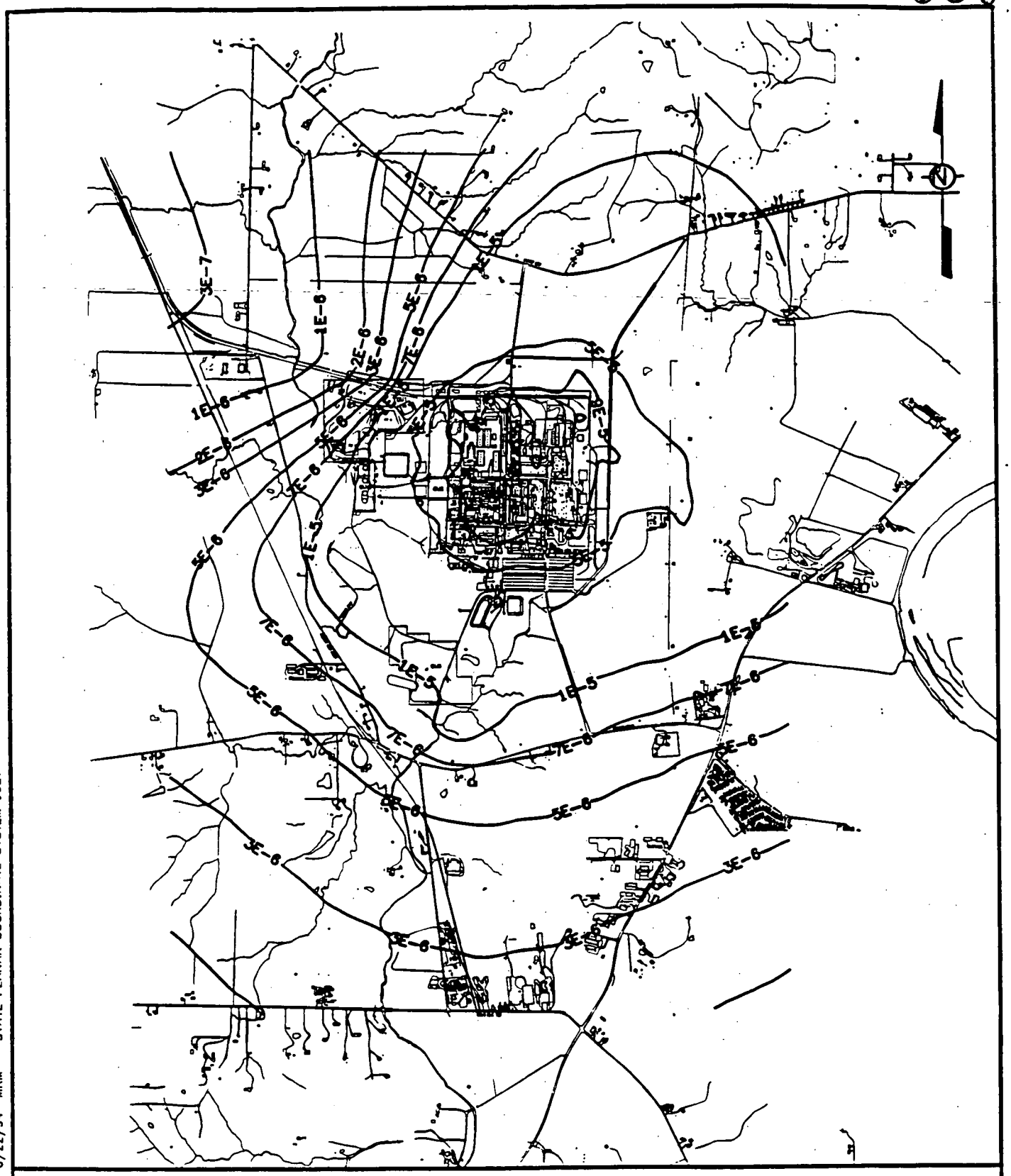
A.VII-31a	ILCRs for CT On-Property Farmer Production Area, Future Land Use
A.VII-31b	ILCRs for CT On-Property Farmer Northwest Area, Future Land Use
A.VII-31c	ILCRs for CT On-Property Farmer Northeast Area, Future Land Use
A.VII-31d	ILCRs for CT On-Property Farmer Southeast Area, Future Land Use
A.VII-31e	ILCRs for CT On-Property Farmer Southwest Area, Future Land Use
A.VII-31f	ILCRs for CT On-Property Farmer Waste Pit Area, Future Land Use
A.VII-31g	ILCRs for CT On-Property Farmer Shooting Range Area, Future Land Use
A.VII-32a	Hazard Quotients for CT On-Property Farmer Production Area, Future Land Use
A.VII-32b	Hazard Quotients for CT On-Property Farmer Northwest Area, Future Land Use
A.VII-32c	Hazard Quotients for CT On-Property Farmer Northeast Area, Future Land Use
A.VII-32d	Hazard Quotients for CT On-Property Farmer Southeast Area, Future Land Use
A.VII-32e	Hazard Quotients for CT On-Property Farmer Southwest Area, Future Land Use
A.VII-32f	Hazard Quotients for CT On-Property Farmer Waste Pit Area, Future Land Use
A.VII-32g	Hazard Quotients for CT On-Property Farmer Shooting Range Area, Future Land Use
A.VII-33a	ILCRs for On-Property Child Production Area, Future Land Use
A.VII-33b	ILCRs for On-Property Child Northwest Area, Future Land Use
A.VII-33c	ILCRs for On-Property Child Northeast Area, Future Land Use
A.VII-33d	ILCRs for On-Property Child Southeast Area, Future Land Use
A.VII-33e	ILCRs for On-Property Child Southwest Area, Future Land Use
A.VII-33f	ILCRs for On-Property Child Waste Pit Area, Future Land Use
A.VII-33g	ILCRs for On-Property Child Shooting Range Area, Future Land Use
A.VII-34a	Hazard Quotients for On-Property Child Production Area, Future Land Use
A.VII-34b	Hazard Quotients for On-Property Child Northwest Area, Future Land Use
A.VII-34c	Hazard Quotients for On-Property Child Northeast Area, Future Land Use
A.VII-34d	Hazard Quotients for On-Property Child Southeast Area, Future Land Use
A.VII-34e	Hazard Quotients for On-Property Child Southwest Area, Future Land Use
A.VII-34f	Hazard Quotients for On-Property Child Waste Pit Area, Future Land Use
A.VII-34g	Hazard Quotients for On-Property Child Shooting Range Area, Future Land Use
A.VII-35a	ILCRs for RME On-Property Farmer Use of Perched Groundwater in Production Area, Future Land Use
A.VII-36a	Hazard Quotients for RME On-Property Farmer Use of Perched Groundwater in Production Area, Future Land Use
A.VII-37a	ILCRs for On-Property Home Builder Future Land Use, Production Area
A.VII-37b	ILCRs for On-Property Home Builder Future Land Use, Northwest Area
A.VII-37c	ILCRs for On-Property Home Builder Future Land Use, Northeast Area
A.VII-37d	ILCRs for On-Property Home Builder Future Land Use, Southeast Area
A.VII-37e	ILCRs for On-Property Home Builder Future Land Use, Southwest Area
A.VII-37f	ILCRs for On-Property Home Builder Future Land Use, Waste Pit Area
A.VII-37g	ILCRs for On-Property Home Builder Future Land Use, Shooting Range

LIST OF TABLES
(continued)

A.VII-38a	Hazard Quotient for On-Property Home Builder Future Land Use, Production Area
A.VII-38b	Hazard Quotient for On-Property Home Builder Future Land Use, Northwest Area
A.VII-38c	Hazard Quotient for On-Property Home Builder Future Land Use, Northeast Area
A.VII-38d	Hazard Quotient for On-Property Home Builder Future Land Use, Southeast Area
A.VII-38e	Hazard Quotient for On-Property Home Builder Future Land Use, Southwest Area
A.VII-38f	Hazard Quotient for On-Property Home Builder Future Land Use, Waste Pit Area
A.VII-38g	Hazard Quotient for On-Property Home Builder Future Land Use, Shooting Range

LIST OF FIGURES

Figure	Title
A.1-1	FEMP and Surrounding Area
A.1-2	Operable Units for the FEMP RI/FS
A.1-3	Land Use Adjacent to the FEMP
A.1-4	Private Well Locations in the Vicinity of the FEMP
A.1-5	Current and Planned Water Service Areas within a Five-Mile Radius of FEMP
A.2-1	Statistical Analysis Flow Chart for Determination of Constituents of Potential Concern at the FEMP Operable Unit 5
A.3-1	Operable Unit 5 Conceptual Model Current Source Term and Land Use Scenarios
A.3-2	Operable Unit 5 Conceptual Model Future Source Term and Land Use Scenarios
A.3-3	On Property Risk Evaluation Areas (R1-R10) Current Source Term and Land Use Scenario for OU5 Baseline Risk Assessment
A.3-4	Risk Evaluation Areas for Hypothetical Off-Property Farmer - Operable Unit 5 Baseline Risk Assessment - Current Source Term and Land Use Scenario
A.3-5	Current and Possible Future Grazing Areas at the FEMP
A.3-6	Off Property Receptor Locations for OU5 Fate and Transport Modeling and Baseline Risk Assessment
A.3-7	Onsite Risk Evaluation Areas for Operable Unit 5 Baseline Risk Assessment at the FEMP - Future Source Term and Land Use Scenario
A.7-1	Total Estimated Air Pathway Risk, Current Scenario for U-238, U-234, U-235/U-236, Ra-226
A.7-2	Total Estimated Air Pathway Risk, Agricultural Scenario for U-238, U-234, U-235/U-236, RA-226
A.7-3	Estimated Cancer Risk for Total Uranium in Groundwater, Type 1 Wells
A.7-4	Estimated Cancer Risk for Total Uranium in Groundwater, Type 2 Wells
A.7-5	Estimated Cancer Risk for Total Uranium in Groundwater, Types 3 and 4 Wells
A.7-6	Estimated Cancer Risk for Total Uranium in Surface Soils
A.VIII-1	Plot of Soil Ra-226 Concentrations versus Indoor Ra-222 Levels
A.IX-1	Uranium in Apples (pCi/g), 1993
A.IX-2	Uranium in Root Crops: Potatoes and Onions (pCi/g), 1993
A.IX-3	Uranium in Tomatoes (pCi/g) 1993
A.IX-4	Average Uranium in Bell, Green, Red, and Banana Peppers (pCi/g), 1993
A.IX-5	Uranium in Eggplant, Green Beans, Cucumber and Squash (pCi/g), 1993
A.IX-6	Uranium in Corn (pCi/g), 1993
A.IX-7	Uranium in Soybeans (pCi/g), 1993
A.IX-8	Average Total Uranium in Groundwater (ug/l), 1993 Private Wells
A.IX-9	Uranium in Grass (pCi/g), 1993
A.IX-10	Uranium in Soil at 0-2 inches (pCi/g), 1993
A.IX-11	Uranium in Soil at 2-4 inches (pCi/g), 1993
A.IX-12	Average Concentration of Uranium in Fish, Great Miami River, 1992 - 1993 (REM)
A.IX-13	Real-Time Radon Monitoring Locations



LEGEND:

3E-6 ESTIMATED CARCINOGENIC RISK ASSOCIATED WITH THE ISOTOPES OF URANIUM AND RADIUM-226 VIA THE SUM OF ALL AIR PATHWAYS.

SCALE IN FEET

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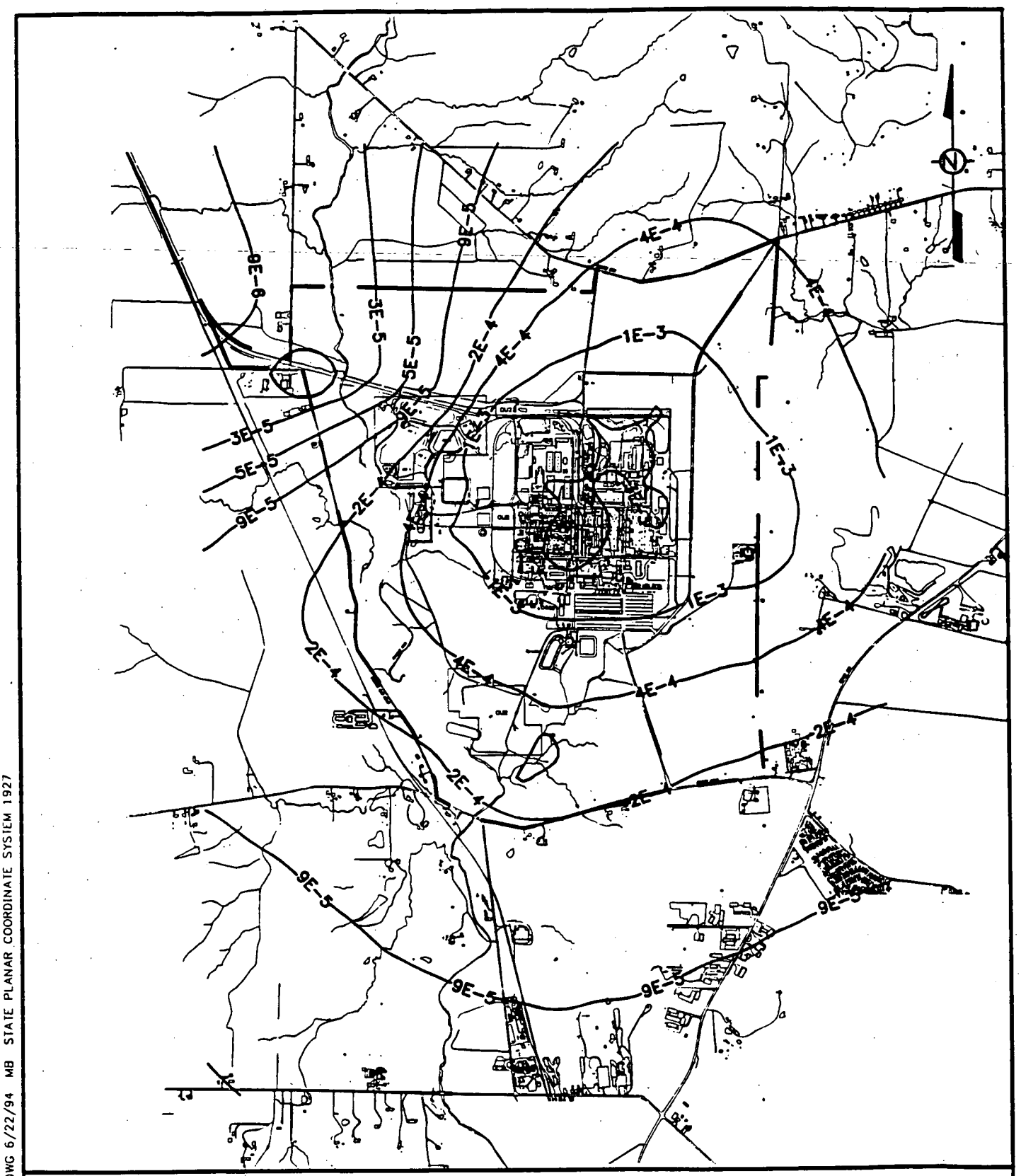
FIGURE A.7-1. TOTAL ESTIMATED AIR PATHWAY RISK, CURRENT SCENARIO, FOR U-238, U-234, U-235/U-236, Ra-226



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3E-6 ESTIMATED CARCINOGENIC RISK ASSOCIATED WITH THE ISOTOPES OF URANIUM AND RADIUM-226 VIA THE SUM OF ALL AIR PATHWAYS.

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FIGURE A.7-2. TOTAL ESTIMATED AIR PATHWAY RISK, AGRICULTURAL SCENARIO, FOR U-238, U-234, U-235/236, Ra-226

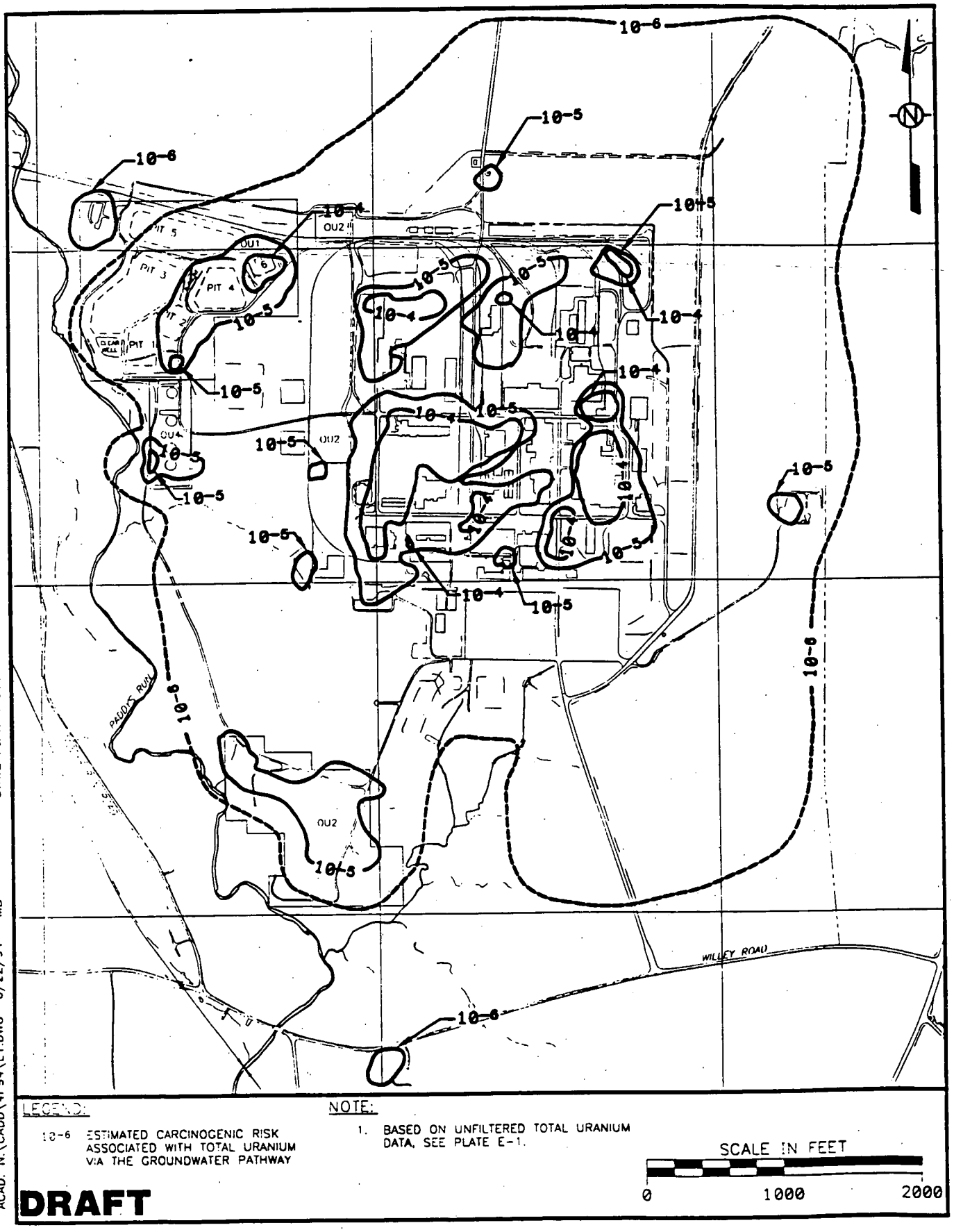

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FIGURE A.7-3. ESTIMATED CANCER RISK FOR TOTAL URANIUM IN GROUNDWATER TYPE 1 WELLS

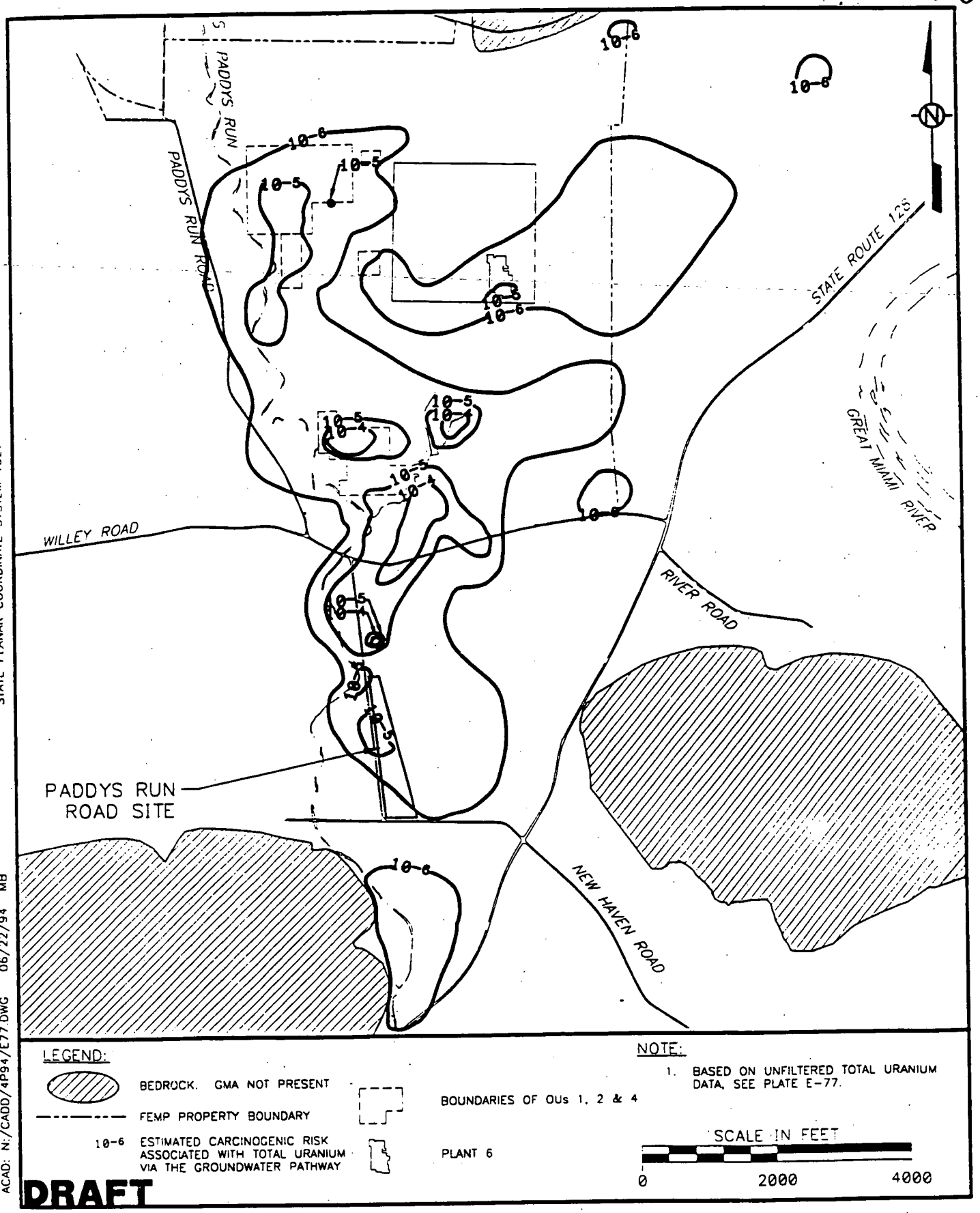

FIGURE A.7-4. ESTIMATED CANCER RISK FOR TOTAL URANIUM IN GROUNDWATER, TYPE 2 WELLS

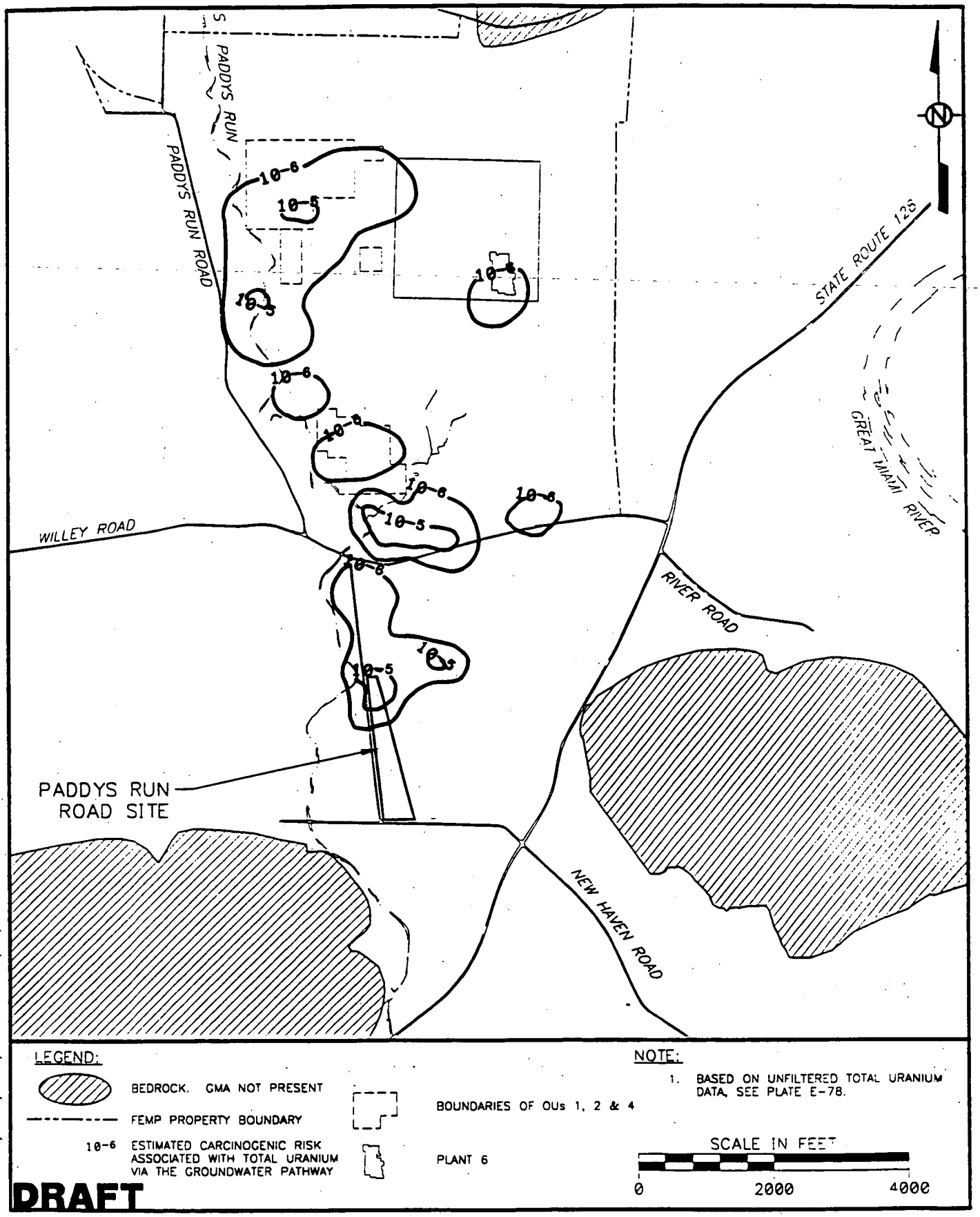

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FIGURE A.7-5. ESTIMATED CANCER RISK FOR TOTAL URANIUM IN GROUNDWATER TYPE 3 & 4 WELLS

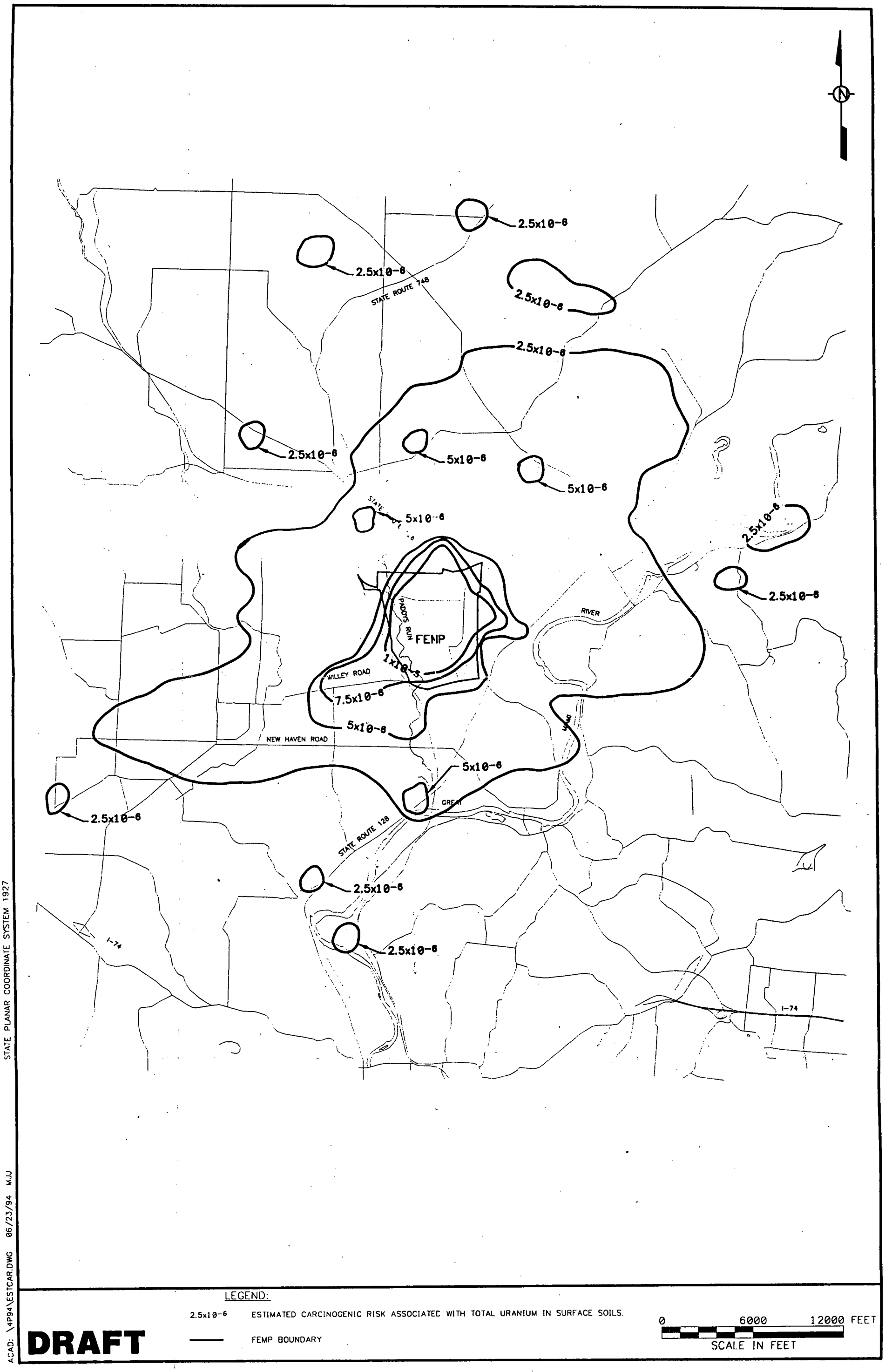

FIGURE A.7-6. ESTIMATED CANCER RISK FOR TOTAL URANIUM IN SURFACE SOILS

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