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Table 2-12
Human Health Risk Summary
AOC FS-2 Soils

Exposure Scenario		Exposure Point	Exposure Route	HI	ELCR
Current Land Use	Trespasser - Surface Soil 0-2 feet bgs	Soil 0-2 feet bgs	Ingestion	0.02	1E-06
			Dermal	0.009	7E-07
			Dust Inhalation	0.00000009	6E-11
			Soil 0-2 ft bgs	0.03	2E-06
			Total Receptor Risk	**0.03**	**2E-06**
Future Land Use	Child Resident - Surface Soil 0-2 feet bgs	Soil 0-2 feet bgs	Ingestion	0.1	5E-06
			Dermal	0.02	1E-06
			Dust Inhalation	0.0000004	1E-10
			Soil 0-2 ft bgs	0.1	6E-06
			Total Child Risk	**0.1**	**6E-06**
	Adult Resident - Surface Soil 0-2 feet bgs	Soil 0-2 feet bgs	Ingestion	0.01	2E-06
			Dermal	0.004	6E-07
			Dust Inhalation	0.0000004	6E-10
			Soil 0-2 ft bgs	0.02	3E-06
			Total Adult Risk	**0.02**	**3E-06**
			Total Receptor Risk	**NA**	**9E-06**
	Child Resident - Surface Soil 0-10 feet bgs	Soil 0-10 feet bgs	Ingestion	0.1	9E-06
			Dermal	0.03	3E-06
			Dust Inhalation	0.0000005	2E-10
			Soil 0-10 ft bgs	0.2	1E-05
			Total Child Risk	**0.2**	**1E-05**
	Adult Resident - Surface Soil 0-10 feet bgs	Soil 0-10 feet bgs	Ingestion	0.01	4E-06
			Dermal	0.004	2E-06
			Dust Inhalation	0.0000005	6E-10
			Soil 0-10 ft bgs	0.02	6E-06
			Total Adult Risk	**0.02**	**6E-06**
			Total Receptor Risk	**NA**	**2E-05**
	Construction Worker - Surface Soil 0-10 feet bgs	Soil 0-10 feet bgs	Ingestion	0.03	3E-07
			Dermal	0.006	2E-07
			Dust Inhalation	0.0000009	2E-11
			Soil 0-10 ft bgs	0.03	5E-07
			Total Receptor Risk	**0.03**	**5E-07**
	Construction Worker - Subsurface Soil 0-20 feet bgs	Soil 0-20 feet bgs	Ingestion	0.03	9E-08
			Dermal	0.007	7E-08
			Dust Inhalation	0.0000009	1E-12
			Soil 0-20 ft bgs	0.04	2E-07
			Total Receptor Risk	**0.04**	**2E-07**

Notes:
ELCR = Excess Lifetime Cancer Risk
ft bgs = feet below ground surface
HI = Hazard Index
NA = not applicable
ND = no dose-response values available for contaminants of potential concern.

Table 2-13
Occurrence and Distribution of Contaminants of Potential Ecological Concern for Terrestrial Receptors
AOC FS-2 Surface Soils (0-2 feet bgs)

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits
	VOCs								
67641	Acetone	5	J	61		µg/kg	32BH0009	3/10	2.3-4.2
75092	Methylene Chloride	6	J	6	J	µg/kg	32BH0010	1/10	4.4-16
127184	Tetrachloroethene	64	J	64	J	µg/kg	32BH0010	1/10	0.4-0.7
108883	Toluene	4	J	6	J	µg/kg	32BH0010	2/10	0.6-1.1
	SVOCs								
83329	Acenaphthene	31	J	71	J	µg/kg	32BH0010	3/10	9.2-10.4
208968	Acenaphthylene	18	J	190	J	µg/kg	32BH0010	4/10	8.7-9.5
120127	Anthracene	32	J	140	J	µg/kg	32BH0002	9/10	11-12
56553	Benzo(a)anthracene	120	J	760		µg/kg	32BH0002	10/10	11.9-13.1
50328	Benzo(a)pyrene	110	J	600		µg/kg	32BH0002	10/10	12.1-13.3
205992	Benzo(b)fluoranthene	140	J	790		µg/kg	32BH0002	10/10	16.1-17.8
191242	Benzo(g,h,i)perylene	58	J	350	J	µg/kg	32BH0002	10/10	8.1-8.9
207089	Benzo(k)fluoranthene	62	J	300	J	µg/kg	32BH0002	10/10	19.7-21.7
117817	Bis(2-ethylhexyl)phthalate	22	J	60	J	µg/kg	32BH0010	6/10	25.6-28.2
86748	Carbazole	21	J	100	J	µg/kg	32BH0010	8/10	14-15.4
218019	Chrysene	120	J	810		µg/kg	32BH0002	10/10	9.1-10.0
53703	Dibenz(a,h)anthracene	20	J	110	J	µg/kg	32BH0002	10/10	9.6-10.5
132649	Dibenzofuran	18	J	550		µg/kg	32BH0010	2/10	13.4-14.8
84742	Di-n-butyl phthalate	43	J	43	J	µg/kg	32BH0007	1/10	16.8-18.5
206440	Fluoranthene	190	J	1,200		µg/kg	32BH0010	10/10	13.8-15.1
86737	Fluorene	28	J	85	J	µg/kg	32BH0010	3/10	15.4-16.9
193395	Indeno(1,2,3-cd)pyrene	90	J	510	J	µg/kg	32BH0002	10/10	11-12.1
91576	2-Methylnaphthalene	1,700		1,700		µg/kg	32BH0010	1/10	17.3-19.1
91203	Naphthalene	1,100		1,100		µg/kg	32BH0010	1/10	18.1-19.9
85018	Phenanthrene	30	J	1,200		µg/kg	32BH0010	10/10	12.1-13.3
129000	Pyrene	140	J	930		µg/kg	32BH0002	10/10	12-13.2
	VPH/EPH Carbon Fractions								
	C11-C22 Aromatics	22		350		mg/kg	32BH0010	2/10	4.5-5.0
	C19-C36 Aliphatics	7		70		mg/kg	32BH0010	4/10	2.4-2.6
	C5-C8 Aliphatics	12		12		mg/kg	32BH0010	1/10	2.1
	C8-C12 Aliphatics	9.1		9.1		mg/kg	32BH0010	1/10	0.6
	C9-C10 Aromatics	4.4		4.4		mg/kg	32BH0010	1/10	1.3-1.4
	C9-C18 Aliphatics	78		78		mg/kg	32BH0010	1/10	0.7
	Inorganics								
7429905	Aluminum	1,490	J	6,730	J	mg/kg	32BH0002	10/10	2-2.9
7440382	Arsenic	0.64	J	7.3	J	mg/kg	32BH0010	10/10	0.3-0.4
7440393	Barium	5.3	J	26.2	J	mg/kg	32BH0010	10/10	0.1
7440702	Calcium	141	J	1,690	J	mg/kg	32BH0008	10/10	1.0-3.6
16065831	Chromium	3.3		15.7		mg/kg	32BH0002	10/10	0.1-0.2
7440484	Cobalt	0.99	J	2.3	J	mg/kg	32BH0003	10/10	0.1-0.6
7440508	Copper	2.0	J	11.4	J	mg/kg	32BH0008	10/10	0.3-0.4
7439896	Iron	3,300	J	9,880	J	mg/kg	32BH0010	10/10	0.6-3.7
7439921	Lead	6.4	J	55.9	J	mg/kg	32BH0001	10/10	0.3
7439954	Magnesium	317	J	1,120		mg/kg	32BH0003	10/10	0.9-1.2
7439965	Manganese	22.7		144		mg/kg	32BH0008	10/10	0.2-0.3
7439976	Mercury	0.01	J	0.012	J	mg/kg	32BH0010	10/10	0.01-0.12
7440020	Nickel	2.4	J	4.8	J	mg/kg	32BH0003	8/10	0.2-2.5
7440097	Potassium	127	J	280	J	mg/kg	32BH0003	10/10	57-72
7782492	Selenium	0.69	J	1.4		mg/kg	32BH0010	2/10	0.5-0.7
7440224	Silver	0.34	J	0.34	J	mg/kg	32BH0009	1/10	0.2-0.6
7440235	Sodium	33	J	33	J	mg/kg	32BH0008	1/10	2.6-62
7440622	Vanadium	6.1	J	10.1	J	mg/kg	32BH0009	5/10	0.2-10.5
7440666	Zinc	4.9		18.7		mg/kg	32BH0007	10/10	0.1-0.3

Notes:

(1) Minimum/maximum detected concentration in soils collected from 0 to 2 feet in depth.

Definitions:

bgs = below ground surface
CAS = Chemical Abstract Service
EPH = extractable petroleum hydrocarbons
J = estimated value
mg/kg = milligrams per kilogram
SVOC = semivolatile organic compound
VOC = volatile organic compound
VPH = volatile petroleum hydrocarbons

Table 2-14
Selection of Contaminants of Potential Ecological Concern for Terrestrial Receptors
AOC FS-2 Surface Soils (0-2 feet bgs)

CAS Number	Chemical	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Preliminary Background Value (2) (UTL)	Screening Benchmark Concentrations: Plant Phyto-toxicity (3)	Screening Benchmark Concentrations: Soil, Litter Invertebrates Heterotrophic Processes (4)	Soil PRG for Wildlife (5): White-Footed Mouse	Soil PRG for Wildlife (5): Short-Tailed Shrew	Soil PRG for Wildlife (5): American Woodchuck	Preliminary Remediation Goals for Terrestrial Ecological Endpoint (5): Conc.	Preliminary Remediation Goals for Terrestrial Ecological Endpoint (5): Endpoint	COPEC Flag	Rationale for Containment Deletion or Selection (6)
	VOCs															
67641	Acetone	61		µg/kg	32BH0009	3/10	NA								N	LPER
75092	Methylene Chloride	6	J	µg/kg	32BH0010	1/10	NA								N	LPER
127184	Tetrachloroethene	64	J	µg/kg	32BH0010	1/10	NA								N	LPER
108883	Toluene	6	J	µg/kg	32BH0010	2/10	NA	200,000							N	LPER
	SVOCs															
83329	Acenaphthene	71	J	µg/kg	32BH0010	3/10	ND	20,000					20,000	plant b,c	N	BSL
208968	Acenaphthylene	190	J	µg/kg	32BH0010	4/10	ND								Y	NSL, HX
120127	Anthracene	140	J	µg/kg	32BH0002	9/10	ND								Y	NSL, HX
56553	Benzo(a)anthracene	760		µg/kg	32BH0002	10/10	ND								Y	NSL, HX
50328	Benzo(a)pyrene	600		µg/kg	32BH0002	10/10	ND								Y	NSL, HX
205992	Benzo(b)fluoranthene	790		µg/kg	32BH0002	10/10	ND								Y	NSL, HX
191242	Benzo(g,h,i)perylene	350	J	µg/kg	32BH0002	10/10	ND								Y	NSL, HX
207089	Benzo(k)fluoranthene	300	J	µg/kg	32BH0002	10/10	ND								Y	NSL, HX
117817	Bis(2-ethylhexyl)phthalate	60	J	µg/kg	32BH0010	6/10	ND								Y	NSL, HX
86748	Carbazole	100	J	µg/kg	32BH0010	8/10	ND								Y	NSL, HX
218019	Chrysene	810		µg/kg	32BH0002	10/10	No UTL								Y	NSL, HX
53703	Dibenz(a,h)anthracene	110	J	µg/kg	32BH0002	10/10	ND								Y	NSL, HX
132649	Dibenzofuran	550		µg/kg	32BH0010	2/10	ND								Y	NSL, HX
84742	Di-n-butyl phthalate	43	J	µg/kg	32BH0007	1/10	ND	200,000					200,000	plant b,c	N	BSL
206440	Fluoranthene	1,200		µg/kg	32BH0010	10/10	No UTL								Y	NSL, HX
86737	Fluorene	85	J	µg/kg	32BH0010	3/10	ND		30,000 a						N	BSL
193395	Indeno(1,2,3-cd)pyrene	510	J	µg/kg	32BH0002	10/10	ND								Y	NSL, HX
91576	2-Methylnaphthalene	1,700		µg/kg	32BH0010	1/10	ND								Y	NSL, HX
91203	Naphthalene	1,100		µg/kg	32BH0010	1/10	ND								Y	NSL, HX
85018	Phenanthrene	1,200		µg/kg	32BH0010	10/10	No UTL								Y	NSL, HX
129000	Pyrene	930		µg/kg	32BH0002	10/10	No UTL								Y	NSL, HX
	VPH/EPH Carbon Fractions															
	C11-C22 Aromatics	350		mg/kg	32BH0010	2/10	NA								Y	NSL, HX
	C19-C36 Aliphatics	70		mg/kg	32BH0010	4/10	NA								Y	NSL, HX
	C5-C8 Aliphatics	12		mg/kg	32BH0010	1/10	NA								Y	NSL, HX
	C8-C12 Aliphatics	9.1		mg/kg	32BH0010	1/10	NA								Y	NSL, HX
	C9-C10 Aromatics	4.4		mg/kg	32BH0010	1/10	NA								Y	NSL, HX
	C9-C18 Aliphatics	78		mg/kg	32BH0010	1/10	NA								Y	NSL, HX
	Inorganics															
7429905	Aluminum	6,730	J	mg/kg	32BH0002	10/10	13,016	50	600 b						N	ELEM
7440382	Arsenic	7.3	J	mg/kg	32BH0010	10/10	4	10	60 a, 100 b	149	9.9	102	9.9	shrew, plant	N	BSL
7440393	Barium	26.2	J	mg/kg	32BH0010	10/10	17	500	3000 b	1,775	329	283	283	woodcock b	N	BSL
7440702	Calcium	1,690	J	mg/kg	32BH0008	10/10	209								N	NUT
16065831	Chromium	15.7		mg/kg	32BH0002	10/10	10	1	0.4 a, 10 b	880	110	16.1	0.4 a	earthworm c	Y	ASL
7440484	Cobalt	2.3	J	mg/kg	32BH0003	10/10	2	20	1000 b				20 a	plant b,c	N	BSL
7440508	Copper	11.4	J	mg/kg	32BH0008	10/10	3	100	50 a, 100 b	10,100	370	515	60 d	earthworm c	N	BSL
7439896	Iron	9,880	J	mg/kg	32BH0010	10/10	14,848		200 b						N	NUT
7439921	Lead	55.9	J	mg/kg	32BH0001	10/10	18	50	500 a, 900 b	6,250	740	40.5	40.5	woodcock	Y	ASL

Table 2-14
Selection of Contaminants of Potential Ecological Concern for Terrestrial Receptors
AOC FS-2 Surface Soils (0-2 feet bgs)

CAS Number	Chemical	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Preliminary Background Value (2) (UTL)	Screening Benchmark Concentrations: Plant Phyto-toxicity (3)	Screening Benchmark Concentrations: Soil, Litter Invertebrates Heterotrophic Processes (4)	Screening Benchmark Concentrations: Soil PRG for Wildlife (5): White-Footed Mouse	Screening Benchmark Concentrations: Soil PRG for Wildlife (5): Short-Tailed Shrew	Screening Benchmark Concentrations: Soil PRG for Wildlife (5): American Woodchuck	Preliminary Remediation Goals for Terrestrial Ecological Endpoint (5): Conc.	Preliminary Remediation Goals for Terrestrial Ecological Endpoint (5): Endpoint	COPEC Flag	Rationale for Containment Deletion or Selection (6)
7439954	Magnesium	1,120		mg/kg	32BH0003	10/10	1,015								N	NUT
7439965	Manganese	144		mg/kg	32BH0008	10/10	24	500	100 b						Y	ASL
7439976	Mercury	0.012	J	mg/kg	32BH0010	10/10	No UTL	0.3	0.1 a, 100 b	7.1	0.146	0.00051	0.00051 e	woodcock	Y	ASL
7440020	Nickel	4.8	J	mg/kg	32BH0003	8/10	8	30	200 a, 90 b	1,830	246	121	30	plant c	N	BSL
7440097	Potassium	280	J	mg/kg	32BH0003	10/10	265								N	NUT
7782492	Selenium	1.4		mg/kg	32BH0010	2/10	No UTL	1	70 a, 100 b	0.21			0.21	mouse c	Y	ASL
7440224	Silver	0.34	J	mg/kg	32BH0009	1/10	ND	2	50 b				2 a	plant c	N	BSL
7440235	Sodium	33	J	mg/kg	32BH0008	1/10	ND								N	NUT
7440622	Vanadium	10.1	J	mg/kg	32BH0009	5/10	28	2	20 b	1,120	55		2 a	plant b,c	Y	ASL
7440666	Zinc	18.7		mg/kg	32BH0007	10/10	17	50	200 a, 100 b	35,000	1,600	8.5	8.5	woodcock c	Y	ASL

Notes:

(1) Minimum/maximum detected concentration

(2) Preliminary background data from Ogden Environmental and Energy Services. 1998 (July). *Draft Completion of Work Report*, Volume 5: Appendix F - Evaluation of Background Data. Massachusetts Military Reservation, Cape Cod, MA. Prepared for National Guard Bureau, Arlington, VA.

(3) Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997 (November). *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants, 1997 Revision* ES/ER/TM-85/R3. Oak Ridge National Laboratory, Oak Ridge, TN.

(4) Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997 (November). *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process 1997 Revision*. ES/ER/TM-126/R2. Oak Ridge National Laboratory, Oak Ridge, TN.

a Earthworms

b Soil microorganisms and microbial processes

(5) Efroymson, R.A., G.W. Suter II, B.E. Sample and D.S. Jones. 1997 (August). *Preliminary Remediation Goals for Ecological Endpoints* ES/ER/TM-162/R2. Oak Ridge National Laboratory, Oak Ridge, TN.

a Efroymson et al. have low confidence in this value.

b Toxic concentration benchmarks are not available for earthworms. Therefore, the preliminary remediation goal (PRG) cannot be assumed to protect earthworms.

c Soil-plant uptake models, soil-earthworm uptake models or lowest observed adverse effect levels (LOAELs) were not available for this chemical for at least one wildlife endpoint. Therefore, the PRG cannot be assumed to protect wildlife.

d Efroymson et al. have moderate confidence in this value.

e This value is so low that it may often be within background soil concentrations. Efroymson et al. do not recommend that remedial goals be set within the range of background concentrations.

(6) Rationale Codes

Selection Reason:	Deletion Reason:	Definitions:		
Above Screening Level (ASL)	Below Screening Level (BSL)	bgs = below ground surface	J = estimated value	ND = not detected
No Screening Level (NSL)	Low Persistence (LPER)	CAS = Chemical Abstract Service	NA = not analyzed	UTL = upper tolerance limit
Site History (HX)	Essential Nutrient (NUT)	Conc. = concentration	mg/kg = milligrams per kilogram	Y = Yes
	Abundant Element in Soil (ELEM)	COPEC = chemical of potential ecological concern	N = No	µg/kg = micrograms per kilogram

Table 2-15
Surface Soil Exposure Point Concentrations for COPECs
Soils (0 to 2 feet bgs)
AOC FS-2

COPEC	Units	Arithmetic Mean	95% UCL of Lognormal Data	Maximum Detected Concentration	Maximum Qualifier	EPC Units
Semivolatile Organics						
2-METHYLNAPHTHALENE	µg/kg	178	846	1700		µg/kg
ACENAPHTHYLENE	µg/kg	30	151	190	J	µg/kg
ANTHRACENE	µg/kg	68	205	140	J	µg/kg
BENZO(A)ANTHRACENE	µg/kg	318	540	760		µg/kg
BENZO(A)PYRENE	µg/kg	251	382	600		µg/kg
BENZO(B)FLUORANTHENE	µg/kg	373	598	790		µg/kg
BENZO(G,H,I)PERYLENE	µg/kg	140	218	350	J	µg/kg
BENZO(K)FLUORANTHENE	µg/kg	132	200	300	J	µg/kg
BIS(2-ETHYLHEXYL) PHTHALATE	µg/kg	25	38	60	J	µg/kg
CARBAZOLE	µg/kg	37	89	100	J	µg/kg
CHRYSENE	µg/kg	336	580	810		µg/kg
DIBENZ(A,H)ANTHRACENE	µg/kg	45	69	110	J	µg/kg
DIBENZOFURAN	µg/kg	63	213	550		µg/kg
FLUORANTHENE	µg/kg	616	997	1200		µg/kg
INDENO(1,2,3-C,D)PYRENE	µg/kg	194	299	510		µg/kg
NAPHTHALENE	µg/kg	119	389	1100		µg/kg
PHENANTHRENE	µg/kg	315	886	1200		µg/kg
PYRENE	µg/kg	423	677	930		µg/kg
Inorganics						
CHROMIUM (TOTAL)	mg/kg	5.9	8.2	16		mg/kg
LEAD (TOTAL)	mg/kg	20	41	56	J	mg/kg
MANGANESE (TOTAL)	mg/kg	56	81	144		mg/kg
MERCURY (TOTAL)	mg/kg	0.034	0.057	0.12		mg/kg
SELENIUM (TOTAL)	mg/kg	0.43	0.65	1.4		mg/kg
VANADIUM (TOTAL)	mg/kg	6.1	8.0	10		mg/kg
ZINC (TOTAL)	mg/kg	11	15	19		mg/kg
Extractable Petroleum Hydrocarbons						
C11-C22 AROMATIC HYDROCARBONS	mg/kg	39	269	350		mg/kg
C19-C36 ALIPHATIC HYDROCARBONS	mg/kg	10	59	70		mg/kg
C9-C18 ALIPHATIC HYDROCARBONS	mg/kg	8.4	37	78		mg/kg
Volatile Petroleum Hydrocarbons						
C5-C8 ALIPHATIC HYDROCARBONS	mg/kg	2.1	3.6	12		mg/kg
C8-C12 ALIPHATIC HYDROCARBONS	mg/kg	1.2	2.8	9.1		mg/kg
C9-C10 AROMATIC HYDROCARBONS	mg/kg	0.74	1.3	4.4		mg/kg

bgs = below ground surface
COPEC = chemical of potential ecological concern
EPC = exposure point concentration
J = estimated value
mg/kg = milligrams per kilogram
UCL = upper confidence limit on the arithmetic mean
µg/kg = micrograms per kilogram

Table 2-16
Life History Parameters for Selected Endpoint Species
AOC FS-2

Receptor	Parameter	Value	Comment	Reference
White-Footed Mouse (*Peromyscus leucopus*)				
	Body weight (kg)	0.022		Sample and Suter 1994
	Food consumption rate (g/d)	3.4		Sample and Suter 1994
	Soil consumption rate (g/d)	0.068	based on 2% of food consumption rate	Sample and Suter 1994
	Diet Composition (%)	invertebrates – 50% plants – 48%		Sample and Suter 1994
	Home Range (ha)	0.059		Sample and Suter 1994
	Habitat Requirements	wooded, brushy areas: sometimes open areas		Sample and Suter 1994
	Population Density (/ha)	6-57		Sample and Suter 1994
	Behavior	While semi-arboreal, spends most of time on ground. Primarily nocturnal. Enters torpor to reduce metabolic demands in winter and during food stress. Exposure duration = 0.67		Sample and Suter 1994
Upland Sandpiper (*Bartramia longicauda*)				
	Body weight (kg)	0.047		http://www.inhs.uiuc.edu/chf/pub/virtualbird/species/upland-sandpiper.html
	Food consumption rate (g/d)	7.95	calculated	EPA 1993
	Soil consumption rate (g/d)	0.24	based on 3% of food consumption rate	EPA 1993 (spotted sandpiper)
	Diet Composition (%)	Invertebrates – 97%		EPA 1993 (spotted sandpiper)
	Home Range (ha)	0.25		EPA 1993 (spotted sandpiper)
	Habitat Requirements	Inhabits grassy open areas, ranging from sandy, sparsely vegetated flats to open, grassy bogs and muskeg.		http://www.npwrc.usgs.gov/resource/1998/forest/species/bartlong.htm
	Population Density (/ha)	3-12		
	Behavior	Nests in depressions on the ground among rank grasses. Prefers to forage where the grasses are low and open enough to provide good visibility, and where grasshoppers and crickets are most abundant. Winters in South America. Exposure duration= 0.67.		http://www.npwrc.usgs.gov/resource/1998/forest/species/bartlong.htm

Table 2-16
Life History Parameters for Selected Endpoint Species
AOC FS-2

Receptor	Parameter	Value	Comment	Reference
Short-Tailed Shrew (*Blarina brevicauda*)				
	Body weight (kg)	0.017		EPA 1993
	Food consumption rate (g/d)	7.95		EPA 1993
	Soil consumption rate (g/d)	0.159	based on 2% of food consumption rate	
	Diet Composition (%)	plants 13% invertebrates 85%		EPA 1993
	Home Range (ha)	0.39		EPA 1993
	Habitat Requirements	wide and diverse – occur in many habitats, typically prefers cool and moist vegetative areas		EPA 1993
	Population Density (/ha)	2.3 – 11.4		EPA 1993
	Behavior	active year round – does not hibernate		
American Robin (*Turdus migratorius*)				
	Body weight (kg)	0.081	average	EPA 1993
	Food consumption rate (g/d)	97.6	average	EPA 1993
	Soil consumption rate (g/d)	2.91	based on 3% of food consumption rate	EPA 1993
	Diet Composition (%)	fruit/plants -68% invertebrates -32%	summer, eastern United States	EPA 1993
	Home Range (ha)	0.25	average	EPA 1993
	Habitat Requirements	wide and diverse – occur in many habitats, typically prefers cool and moist forests and scrub/shrub habitats		EPA 1993
	Population Density (/ha)	10.3	average of pairs, times two	EPA 1993
	Behavior	assumed to be a year-round resident		

Table 2-16
Life History Parameters for Selected Endpoint Species
AOC FS-2

Receptor	Parameter	Value	Comment	Reference
Eastern Box Turtle (*Terrapena carolina carolina*)				
	Body weight (kg)	0.382		EPA 1993a
	Food consumption rate (g/d)	1.29	based on allometric equation for iguana	EPA 1993a
	Soil consumption rate (g/d)	0.0773	based on 6% of food consumption rate	EPA 1993a
	Diet Composition (%)	invertebrates 55% plants 45%	summer	EPA 1993a
	Home Range (ha)	2.61	average	EPA 1993a
	Habitat Requirements	wooded, brushy areas: sometimes open areas usually moist		EPA 1993a
	Population Density (/ha)	17-35	Maryland forest	EPA 1993a
	Behavior	Species is diurnal, resting at night in hollowed-out depressions; most active in temperate humid conditions, and typically avoids hot weather by burrowing into the ground; hibernates from October to April. Exposure duration=0.67.		EPA 1993a

References: EPA (U.S. Environmental Protection Agency. 1993 (December). *Wildlife Exposure Factors Handbook.* Office of Research and Development, Washington, DC. EPA/600/R-93/187.

Sample, B.E. and G.W. Suter II. 1994 (September). *Estimating Exposure of Terrestrial Wildlife to Contaminants.* Oak Ridge National Laboratory, Oak Ridge, TN.

g/d = grams per day
kg = kilograms

Table 2-17
Bioaccumulation Factors for Selected Ecological Receptor Groups [1]
AOC FS-2

Analyte	Soil-plant (kg/kg)		Soil-invertebrate (kg/kg)		Food-bird (kg/kg)		Food-mammal (kg/kg)	
Chromium	6.50E-02	b	2.45E-01	a	7.64E-05	h	7.64E-05	e
Lead	3.89E-02	b	2.13E-01	a	4.17E-06	h	4.17E-06	e
Manganese	1.13E-01	b	5.40E-02	a	6.94E-04	c	5.56E-06	e
Mercury	6.52E-01	b	3.15E+00	a	4.17E-04	c	3.47E-03	e
Selenium	6.72E-01	b	1.19E+00	a	1.25E-01	c	2.08E-04	e
Vanadium	5.00E-03	b	3.36E-02	a	3.47E-05	h	3.47E-05	e
Zinc	3.66E-01	b	3.03E+00	a	9.72E-02	c	1.39E-03	e
Acenaphthylene	1.52E-01	f,g	2.50E-01	m	7.46E-06	h	7.46E-06	f,j
Anthracene	1.39E-01	f,g	2.50E-01	m	8.76E-06	h	8.76E-06	f,j
Benzo(a)anthracene	2.46E-02	f,g	2.16E-01	l	1.75E-04	h	1.75E-04	f,j
Benzo(a)pyrene	7.03E-02	f	2.72E-01	l	3.49E-04	h	3.49E-04	f,j
Benzo(b)fluoranthene	6.24E-02	f,g	1.68E-01	l	3.49E-05	h	3.49E-05	f,j
Benzo(ghi)perylene	7.41E-03	f,g	2.50E-01	m	1.39E-03	h	1.39E-03	f,j
Benzo(k)fluoranthene	6.24E-02	f,g	1.68E-01	l	3.49E-05	h	3.49E-05	f,j
Bis(2-ethylhexyl)phthalate	5.46E-02	f,g	2.50E-01	m	4.39E-05	h	4.39E-05	f,j
Carbazole	8.70E-03	f,g	5.00E-02	m	0.00E+00	h	0.00E+00	f,j
Chrysene	2.46E-02	f,g	2.50E-01	m	1.75E-04	h	1.75E-04	f,j
Dibenz(a,h)anthracene	5.68E-03	f,g	2.50E-01	m	2.20E-03	h	2.20E-03	f,j
Dibenzofuran	1.65E-01	f,g	2.50E-01	m	0.00E+00		0.00E+00	
Fluoranthene	7.12E-02	f,g	2.50E-01	m	2.77E-05	h	2.77E-05	f,j
Indeno(1,2,3-cd)pyrene	7.41E-03	f,g	2.50E-01	m	1.39E-03	h	1.39E-03	f,j
2-Methylnaphthalene	5.99E-01	f,g	2.50E-01	m	6.96E-07	h	6.96E-07	f,j
Naphthalene	5.99E-01	f,g	2.50E-01	m	6.96E-07	h	6.96E-07	f,j
Phenanthrene	1.06E-01	f,g	2.50E-01	m	1.39E-05	h	1.39E-05	f,j
Pyrene	7.12E-02	f,g	2.50E-01	m	2.77E-05	h	2.77E-05	f,j

[1] = All transfer factors expressed as dry tissue concentrations. Dry weight calculated by wet wt/ (1-% water in prey).

kg/kg = kilograms per kilogram

a = Efroymson et al. 1997. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants*. U.S. Department of Energy, Oak Ridge, TN.

b = Efroymson et al. 1997. *Toxicological Benchmarks for Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process*. ES/ER/TM-126/R2. Oak Ridge National Laboratory, Oak Ridge, TN.

c = IAEA (1994)

e = Baes et al. 1984. *A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides Through Agriculture*. ORNL-5786. Oak Ridge National Laboratory, Oak Ridge, TN.

f = Travis. C.C. and A.D. Arms. 1988. Bioconcentrations of Organics in Beef, Milk and Vegetation. *Environ. Sci. Tech.* 22: 271-274.

g = Plant uptake factor calculated using the following equation presented by Travis and Arms (1988) unless otherwise noted:

log (plant uptake factor) = 1.588 - 0.578 log K_{ow}; if log K_{ow} < 5,

bioaccumulation factors (BAF) assumed to be 0.02 assuming plant are 80% water.

h = Surrogate mammal BAF was used.

j = Mammal BTF calculated using the following equation presented by Travis and Arms (1988):

log BTF = log K_{ow} - 7.6

where BTF (d/kg wet tissue) can be converted to a BAF by multiplying by the animal's ingestion rate (kg wet food/d)

l = Beyer, W.N. and C. Stafford. 1993. Survey and evaluation of contaminants in earthworms and soils from dredged material at confined disposal facilities in the Great Lakes region. *Environ. Monit. Assess*. 24: 151-165.

m = Menzie et al. 1992. Assessment of methods for estimating risk in terrestrial component: A case study at the Baird and McGuire Superfund site in Holbrook, MA. *Environ. Toxicol. Chem.* 11: 245.260.

Table 2-18
Ecological Screening of Terrestrial Plants for Surface Soil Exposure
AOC FS-2

Contaminant of Concern	Maximum Soil Concentration (mg/kg)	Phytotoxicity Benchmark (mg/kg)	Reference	Exceeds Maximum Benchmark?
SEMIVOLATILE ORGANIC COMPOUNDS				
Acenaphthylene	0.19	20	Efroymson 1997	No
Anthracene	0.14	20	acenaphthylene surrogate	No
Benzo(a)anthracene	0.76	20	acenaphthylene surrogate	No
Benzo(a)pyrene	0.6	20	acenaphthylene surrogate	No
Benzo(b)fluoranthene	0.79	20	acenaphthylene surrogate	No
Benzo(g,h,i)perylene	0.35	20	acenaphthylene surrogate	No
Benzo(k)fluoranthene	0.3	20	acenaphthylene surrogate	No
Bis(2-ethylhexyl)phthalate	0.06	100	Hulzebos et al. 1993	No
Carbozole	0.1	NA		No
Chrysene	0.81	20	acenaphthylene surrogate	No
Dibenz(a,h)anthracene	0.11	20	acenaphthylene surrogate	No
Dibenzofuran	0.55	600	Hulzebos et al. 1993	No
Fluoranthene	1.2	20	acenaphthylene surrogate	No
Indeno(1,2,3-cd)pyrene	0.51	20	acenaphthylene surrogate	No
2-Methylnaphthalene	1.7	10	Hulzebos et al. 1993	No
Napthalene	0.11	10	Hulzebos et al. 1993	No
Phenanthrene	1.2	20	acenaphthylene surrogate	No
Pyrene	0.93	20	acenaphthylene surrogate	No
INORGANIC ANALYTES				
Chromium	16	1	Efroymson 1997	Yes
Lead	56	50	Efroymson 1997	Yes
Manganese	144	500	Efroymson 1997	No
Mercury	0.12	0.3	Efroymson 1997	No
Selenium	1.4	1	Efroymson 1997	Yes
Vanadium	10	2	Efroymson 1997	Yes
Zinc	19	50	Efroymson 1997	No

References: Efroymsen, R.A., M.E. Will and G.W. Suter II. 197 (November). *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestial Plants: 1997 Revision.* ES/ER/TM-85/R3. Oak Ridge National Laboratory, Oak Ridge, TN.

Hulzebos, E.M., D.M.M. Adema, E.M. Dirven-van Breeman, L. Henzen, W.A. van Dis, H.A. Herbold, J.A. Hoekstra, R. Baearselman, and C.A.M. van Gestel. 1993. Phytotoxicity studies with *Lactuca savtiva* in soil and nutrient solution. *Environ. Toxicol. and Chem*. 12: 1079-1094.

mg/kg = milligrams per kilogram

NA = not available

Table 2-19
Background Surface Soil Concentrations for Urban Areas in Massachusetts
AOC FS-2

Analytes	Background Concentration Range (mg/kg)[1]	Maximum Soil Concentration At FS-2 (mg/kg)	Exceeds Background Range?
INORGANIC ANALYTES (mg/kg)			
Aluminum	8930 - 13000	6730	no
Antimony	1.4 - 17.5	-	no
Arsenic	3.6 - 17	7.3	no
Barium	10.4 - 45	26	no
Beryllium	0.4 - 0.65	-	no
Cadmium	1.5 - 2	-	no
Chromium	6.8 - 29	16	no
Cobalt	4.1 - 4.4	2.3	no
Copper	5.2 - 38	11	no
Lead	12.05 - 99	56	no
Manganese	108 - 300	144	no
Mercury	0.06 - 0.3	0.12	no
Nickel	5.2 - 17	4.8	no
Selenium	0.33 - 0.5	1.4	yes
Silver	0.6 - 1.4	0.34	no
Vanadium	15.2 - 29	10	no
Zinc	16 - 116	10	no

[1] Values obtained from the Massachusetts Military Reservation *Risk Assessment Handbook* (ASG 1994) and *Guidance for Disposal Site Risk Characterization* (DEP 1996) (Interim Final Policy BWSC/ORS-95-141), Bureau of Waste Site Cleanup and Office of Research and Standards Massachusetts Department of Environmental Protection.

mg/kg = milligrams per kilogram

Table 2-20
Ecological Screening of Terrestrial Invertebrates for Surface Soil Exposure
AOC FS-2

Contaminant of Concern	Maximum Soil Concentration (mg/kg)	Invertebrate Benchmark (mg/kg)	Reference	Exceeds Maximum Benchmark?
SEMIVOLATILE ORGANIC COMPOUNDS				
Acenaphthylene	0.19	34	Neuhauser et al. 1985	No
Anthracene	0.14	34	Neuhauser et al. 1985	No
Benzo(a)anthracene	0.76	34	Neuhauser et al. 1985	No
Benzo(a)pyrene	0.6	34	Neuhauser et al. 1985	No
Benzo(b)fluoranthene	0.79	34	Neuhauser et al. 1985	No
Benzo(g,h,i)perylene	0.35	34	Neuhauser et al. 1985	No
Benzo(k)fluoranthene	0.3	34	Neuhauser et al. 1985	No
Bis(2-ethylhexyl)phthalate	0.06	630	Neuhauser et al. 1985	No
Carbazole	0.1	NA		
Chrysene	0.81	34	Neuhauser et al. 1985	No
Dibenz(a,h)anthracene	0.11	34	Neuhauser et al. 1985	No
Dibenzofuran	0.55	NA		
Fluoranthene	1.2	34	Neuhauser et al. 1985	No
Indeno(1,2,3-cd)pyrene	0.51	34	Neuhauser et al. 1985	No
2-Methylnaphthylene	1.7	34	Neuhauser et al. 1985	No
Napthalene	0.11	34	Neuhauser et al. 1985	No
Phenanthrene	1.2	34	Neuhauser et al. 1985	No
Pyrene	0.93	34	Neuhauser et al. 1985	No
INORGANIC ANALYTES				
Chromium	16	10	Efroymson et al. 1997	Yes
Lead	56	500	Efroymson et al. 1997	No
Manganese	144	100	Efroymson et al. 1997	Yes
Mercury	0.12	30	Efroymson et al. 1997	No
Selenium	1.4	70	Efroymson et al. 1997	No
Vanadium	10	20	Efroymson et al. 1997	No
Zinc	19	130	Neuhauser et al. 1985	No

References: Efroymsen, R.A., M.E. Will, G.W. Suter II, A.C. Wooten. 1997. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process*. ES/ER/TM-126/R2. Oak Ridge National Laboratory, Oak Ridge, TN.

Neuhauser, E.F., R.C. Loehr, M.R. Malecki, D.L. Milligan, and Durkin. 1995. The toxicity of selected chemicals to the earthworm *Eisenia foetida*. *Journal of Environ. Qual*. 14: 383-388.

mg/kg = milligrams per kilogram
NA = not available

Table 2-21
Hazard Index Summary
for Surface Soil Exposure
AOC FS-2

Ecological Receptor	NOAEL HIs for Maximum Exposure Concentrations	LOAEL HIs for Maximum Exposure Concentraions
White-Footed Mouse	0.642	0.0639
Short-Tailed Shrew	**3.26**	0.333
Selenium	1.72	
Upland Sandpiper	**1.46**	0.145
American Robin	**11.8**	0.737
Chromium	2.94	
Lead	2.18	
Selenium	2.92	
Zinc	1.97	
Box Turtle	0.0311	0.00308

Notes:
Hazard Indexes (HIs) in bold exceed 1; analytes shown are primary risk drivers.
LOAEL = lowest observed adverse effect level
NOAEL = no observed adverse effect level

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