MODIFICATIONS TO
THE ACTION LEVELS & STANDARDS FRAMEWORK
FOR SURFACE WATER, GROUND WATER, AND SOILS

Attachment 5 of the Rocky Flats Cleanup Agreement

August 30, 1996

The following text describes clarifications and resolutions of issues that were reached after the Rocky Flats Cleanup Agreement (RFCA) went out for public comment and was signed.

The Action Levels and Standards Framework (ALF) in Attachment 5 of RFCA describes action levels, cleanup levels, put-back levels and standards. Action levels are numeric levels that, when exceeded, trigger an evaluation, remedial action, and/or management action. Action levels will remain in effect and guide removal actions and other remedial efforts during the period of active remediation. For interim cleanup actions, interim cleanup levels will equal Tier I action levels unless some other ALF provision requires a greater level of cleanup (e.g., protection of surface water). Following implementation of interim actions, final remedial/corrective action decisions, including final cleanup levels, will be determined in a Corrective Action Decision (CAD)/Record of Decision (ROD). The final remedial/corrective actions specified in a CAD/ROD may require additional work based on the final cleanup levels to ensure an adequate remedy.

A standard is an enforceable narrative and/or numeric restriction established by regulation and applied so as to protect one or more existing or potential future uses. Within this framework, standards associated with surface water use classifications are being applied to surface water, but standards are not being directly applied to ground water or soils. Closure performance standards apply to Resource Conservation and Recovery Act (RCRA) units.

Put-back levels are those levels at which excavated soil will be allowed to be placed back into the ground. For non-radionuclide chemicals, put-back levels are equivalent to interim cleanup levels.

Soils with radionuclide levels below Tier II action levels may be replaced; soils containing radionuclide levels above Tier I action levels may not be replaced. Decisions regarding soils containing radionuclide levels between Tier I and Tier II will be determined on a case-by-case basis. Because many of the variables used to determine put-back levels are project-specific, put-back level decisions should be made and explained within the decision documents associated with those actions. Decision factors to be considered include remedy effectiveness and protectiveness, anticipated future land uses, contaminant levels in surrounding soils, and costs.

Action levels for non-radionuclide chemicals are risk-based and chemical risk is considered additive when multiple chemicals are present. Radionuclide action levels are dose-based and radiation dose is considered additive when multiple radionuclides are present. Radionuclides and non-radionuclides will be assessed independently on a project-specific basis using methodology that is protective of human health and the environment. The cumulative effects of radionuclides and non-radionuclide chemicals will be assessed on a project-specific basis if the chemical risk and

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radiation dose are near their respective Tier I action levels.

Section 5 of the ALF commits to forming a working group to investigate the applicability of using a dose basis rather than a risk basis for calculating action levels for radionuclides in surface soils. This working group determined that dose-based values are more appropriate and should be used. A document entitled Action Levels for Radionuclides for the Rocky Flats Cleanup Agreement presents these proposed action levels for radionuclides as well as justification for their derivation. This document also contains proposed modifications to Table 5 and Sections 4 and 5 of the ALF.

Tier I action levels for organic compounds in subsurface soils have been calculated based on each compound's ability to leach to groundwater. Those calculated values are in Table 4. Since the subsurface soils at RFETS are highly heterogeneous and because of other variables, it is not currently possible to accurately model transport of inorganics in subsurface soils. Therefore, it is proposed that the action levels for inorganic contaminants (e.g., metals and radionuclides) in subsurface soil be the same as action levels for the corresponding contaminants in surface soil. These action levels are, therefore, human-health risk-based for the appropriate land-use receptor (office worker or open-space recreational user). This application of surface soil action levels as subsurface soil action levels is conservative since the controlled future land use scenarios for RFETS do not include contact with subsurface soil.

The following language is proposed to replace the referenced sections of the ALF. Bolded words are proposed additions; struck-out words are proposed deletions.

4.0 SUBSURFACE SOILS

4.2 Action Levels
[as is]

A. Tier I

1. All subsurface soils capable of leaching ~~contaminants~~ **organic compounds** to ground water at concentrations greater than or equal to 100 x MCLs. Where an MCL for a particular contaminant is lacking, the residential ground water ingestion-based PPRG value will apply. Contaminant-specific Tier I action levels for ~~volatile~~ organics ~~contaminants~~ have been determined using a soil/water partitioning equation and a dilution factor from EPA's Draft Soil Screening Guidance (1994). These derived values and ~~the~~ parameters used to derive them.....the derived values may need to be recalculated.

2. Tier I action levels for inorganic contaminants in subsurface soil are the same as Tier I actions levels for the corresponding contaminants in surface soil. These action levels are, therefore, human-health risk-based for the appropriate land-use receptor (office worker or

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open space recreational user). If an accurate subsurface soil leaching model can be developed for RFETS in the future and is agreed upon by the RFCA parties, this application may need to be updated.

~~3. Table 4 also includes certain inorganic contaminants that may be of concern at RFETS. Contaminant-specific Tier I action levels for these targeted inorganic contaminants, including radionuclides, have not yet been included in Table 4, but are currently under development in a manner consistent with the action levels in 4.2.A.1 above. Table 4 will be updated to include these action levels as soon as they are developed.~~

3. Tier I action levels derived for <u>radionuclides</u> in surface soil are also applied as Tier I action levels for radionuclides in subsurface soils. They are the more conservative of :

a. An annual radiation dose limit of 15 mrem for the appropriate land use receptor, or

b. An annual radiation dose limit of 85 mrem for a hypothetical future resident assuming failure of passive control measures.

The total dose from multiple radionuclides will be accounted for by applying the sum-of-ratios method.

B. Tier II

1. Tier II action levels for <u>inorganic contaminants</u> in subsurface soil are the same as Tier II actions levels for the corresponding contaminants in surface soil. These action levels are, therefore, based on risk to the appropriate land-use receptor (office worker or open space recreational user). If an accurate subsurface soil leaching model can be developed for RFETS in the future and is agreed upon by the RFCA parties, this application may need to be updated.

2. Tier II action levels derived for <u>radionuclides</u> in surface soil are also applied as Tier II action levels for radionuclides in subsurface soils. Action levels for radionuclides will be an annual radiation dose of 15 mrem to a hypothetical future resident. The total dose from multiple radionuclides will be accounted for by applying the sum-of-ratios method.

3. Additional subsurface soil may need to be remediated or managed to protect surface water quality via ground water transport or ecological resources. Subsurface soil presenting unacceptable ecological risks (hazard

index [HI] greater than or equal to 1) identified using the approved methodology will be evaluated for remediation or management.

5.0 SURFACE SOILS

5.2. Action Levels

[as is]

A. Tier I

1. [as is]

2. Action levels for radionuclides will be the more conservative of :

a. **An annual** radiation dose limit of 15 mrem ~~per year~~ for the appropriate land use receptor, or

b. An annual radiation dose limit of 85 mrem for a hypothetical future resident assuming failure of passive control measures.

The total dose from multiple radionuclides will be accounted for by applying the sum-of-ratios method.

B. Tier II

1. Action levels for ~~radionuclides and~~ non-radionuclides are human-health risk-based (carcinogenic risk of 10E-06 and/or an HI of 1) for the appropriate land-use receptor. Table 5 presents the calculated action levels for these exposure scenarios:

a. [as is]

b. [as is]

2. Action levels for radionuclides will be an annual radiation dose of 15 mrem to a hypothetical future resident. The total dose from multiple radionuclides will be accounted for by applying the sum-of-ratios method.

3. Additional surface soil may need to be remediated or managed to protect surface water quality or ecological resources. The amount of soil and the

protective remediation levels and/or management technique will be determined on a case-by-case basis. Surface soil presenting unacceptable ecological risks (an HI greater than or equal to 1) identified using the approved methodology will be evaluated for remediation or management.

5.3 Action Determinations

A. [as is]

B. When contaminant level in surface soil exceed Tier II action levels, they will be managed. Management may include, but is not limited to, "hotspot" removal, capping, or designating land uses that preclude unacceptable exposure. ~~In addition, if aggregate risks at any source area exceed 10-4, remedial action will be required~~. Actions will consider the following:

[as is]

Table 4 - Tier I Subsurface Soil Action Levels

Analyte	CAS No.	Henry's Constant	Kd	Dilution Factor	Tier I (mg/kg)
ORGANICS:					
Acenaphthene (V)	83-32-9	7.54E-03	14.21	7.8	***2.47E+04***
Acetone (V)	67-64-1	1.18E-03	0.80	7.8	***2.74E+03***
Aldrin	309-00-2	4.22E-03	114.25	7.8	***4.48E-01***
Anthracene (V)	120-12-7	4.55E-03	8.81	7.8	***7.73E+04***
Aroclor-1016	12674-11-2	4.39E-02	241.87	7.8	9.50E+01
Aroclor-1221	11104-28-2	4.39E-02	1173.39	7.8	4.60E+02
Aroclor-1232	11141-16-5	4.39E-02	1173.39	7.8	4.60E+02
Aroclor-1242	53469-21-9	4.39E-02	1173.39	7.8	4.60E+02
Aroclor-1248	12672-29-6	4.39E-02	1173.39	7.8	4.60E+02
Aroclor-1254	11097-69-1	4.39E-02	1790.01	7.8	7.01E+02
Aroclor-1260	11096-82-5	4.39E-02	9746.45	7.8	3.82E+03
Benzene (V)	71-43-2	2.24E-01	1.88	7.8	8.08E+00
alpha-BHC	319-84-6	2.78E-04	7.11	7.8	***7.69E-02***
beta-BHC	319-85-7	1.42E-05	8.28	7.8	***3.12E-01***
gamma-BHC (Lindane)	58-89-9	1.39E-04	6.15	7.8	1.07E+00
Benzo(a)anthracene	56-55-3	1.48E-04	791.73	7.8	***7.19E+01***
Benzo(a)pyrene	50-32-8	3.43E-05	2022.64	7.8	3.17E+02
Benzo(b)fluoranthene	205-99-2	2.53E-04	1949.54	7.8	***1.77E+02***
Benzo(k)fluoranthene	207-08-9	1.62E-03	1217.44	7.8	***1.11E+03***
Benzoic Acid	65-85-0				N/V
Benzyl Alcohol	100-51-6				N/V
bis(2-Chloroethyl)ether (V)	111-44-4	8.77E-04	1.46	7.8	***2.06E-02***
bis(2-Chloroisopropyl)ether (V)	108-60-1	4.63E-03	1.05	7.8	***4.01E-01***
bis(2-Ethylhexyl)phthalate	117-81-7	3.43E-04	197.76	7.8	9.32E+02
Bromodichloromethane (V)	75-27-4	1.30E-01	1.80	7.8	1.96E+02
Bromoform (V)	75-25-2	2.52E-02	1.59	7.8	1.79E+02
Bromomethane (V)	74-83-9	5.82E-01	1.22	7.8	***1.24E+01***
2-Butanone (V)	78-93-3				N/V
Butylbenzylphthalate	85-68-7	7.83E-05	79.05	7.8	***4.53E+05***
Carbon disulfide (V)	75-15-0	5.21E-01	1.78	7.8	***4.32E+01***
Carbon tetrachloride (V)	56-23-5	1.18E+00	2.53	7.8	1.10E+01
alpha-Chlordane	5103-71-9	2.73E-03	120.00	7.8	1.89E+02
beta-Chlordane	5103-74-2	2.73E-03	120.00	7.8	1.89E+02
gamma-Chlordane	5103-74-2	2.73E-03	120.00	7.8	1.89E+02
4-Chloroaniline	106-47-8	4.80E-05	1.68	7.8	***2.10E+02***
Chlorobenzene (V)	108-90-7	4.80E-05	2.68	7.8	2.64E+02
Chloroethane (V)	75-00-3	3.48E-01	1.42	7.8	***3.53E+04***
Chloroform (V)	67-66-3	1.65E-01	1.76	7.8	1.52E+02
Chloromethane (V)	74-87-3	9.72E-02	1.13	7.8	***2.36E+00***
2-Chloronaphthalene (V)	91-58-7				N/V
2-Chlorophenol (V)	95-57-8	5.33E-04	1.18	7.8	***2.82E+02***
4,4-DDD	72-54-8	3.26E-04	1701.84	7.8	***4.72E+02***
4,4-DDE	72-55-9	2.79E-03	9690.52	7.8	***1.90E+03***
4,4-DDT	50-29-3	2.10E-02	542.41	7.8	***1.06E+02***
Dibenzo(a,h)anthracene	53-70-3	4.59E-07	3979.74	7.8	***3.61E+01***
Di-n-butylphthalate	84-74-0	5.86E-05	7.54	7.8	***2.20E+03***
1,2-Dichlorobenzene (V)	95-50-1	8.61E-02	3.67	7.8	2.05E+03
1,4-Dichlorobenzene (V)	106-46-7	1.15E-01	3.94	7.8	2.72E+02
3,3-Dichlorobenzidine	91-94-1	8.53E-07	8.35	7.8	***1.26E+00***
1,1-Dichloroethane (V)	107-06-2	7.54E-03	1.66	7.8	***1.44E+03***
1,2-Dichloroethane (V)	107-06-2	5.25E-02	1.45	7.8	6.33E+00

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Table 4 - Tier I Subsurface Soil Action Levels

Analyte	CAS No.	Henry's Constant	Kd	Dilution Factor	Tier I (mg/kg)
1,1-Dichloroethene (V)	540-59-0	1.04E+00	1.89	7.8	1.19E+01
1,2-Dichloroethene (total)(V)	540-59-0	2.29E-01	1.55	7.8	9.51E+00
2,4-Dichlorophenol	120-83-2	1.13E-04	3.16	7.8	***2.86E+02***
1,2-Dichloropropane (V)	78-87-5	1.15E-01	1.82	7.8	9.83E+00
cis-1,3-Dichloropropene (V)	1006-01-5	1.21E-01	1.58	7.8	***1.74E-01***
trans-1,3-Dichloropropene (V)	10061-02-6	1.21E-01	1.58	7.8	***1.74E-01***
Dieldrin	60-57-1	1.09E-04	29.44	7.8	***1.20E-01***
Diethylphthalate	84-66-2	2.24E-05	2.07	7.8	***5.10E+04***
2,4-Dimethylphenol (V)	105-67-9	2.46E-05	1.59	7.8	***1.00E+03***
Dimethylphthalate	131-11-3	2.37E-05	1.56	7.8	***4.91E+05***
2,4-Dinitrophenol	51-28-5	2.64E-08	1.42	7.8	***9.05E+01***
2,4-Dinitrotoluene	121-14-2	6.03E-06	1.78	7.8	***1.11E+02***
2,6-Dinitrotoluene	606-20-2	5.33E-06	1.69	7.8	***1.81E-01***
Di-n-octylphthalate	117-84-0	3.14E-05	2156204.19	7.8	***>1E+06***
Endosulfan I	959-98-8	9.47E-04	4.50	7.8	***7.99E+02***
Endosulfan II	33213-65-9	9.47E-04	4.50	7.8	***7.99E+02***
Endosulfan (technical)	115-29-7	9.47E-04	4.50	7.8	***7.99E+02***
Endrin (technical)	72-26-8	4.88E-05	3.01	7.8	5.80E+00
Ethylbenzene (V)	100-41-4	3.18E-01	3.01	7.8	1.76E+03
Fluoranthene	206-44-0	3.83E-04	113.21	7.8	***1.30E+05***
Fluorene (V)	86-73-7	2.99E-03	21.22	7.8	***5.44E+04***
Heptachlor	76-44-8	2.41E-02	20.05	7.8	6.50E+00
Heptachlor epoxide	1024-57-3	3.40E-04	20.51	7.8	3.32E+00
Hexachlorobenzene	118-74-1	2.19E-02	88.56	7.8	6.99E+01
Hexachlorobutadiene	87-68-3	9.80E-01	19.94	7.8	***1.73E+01***
Hexachlorocyclopentadiene	77-47-4	7.05E-01	25.96	7.8	1.04E+03
Hexachloroethane	67-72-1	1.48E-01	7.49	7.8	***3.64E+01***
Indeno(1,2,3-cd)pyrene	193-39-5	1.99E-07	9612.54	7.8	***8.73E+02***
Isophorone	78-59-1	2.54E-04	1.56	7.8	***1.20E+02***
Methoxychlor	72-43-5	2.60E-04	175.69	7.8	***2.52E+04***
Methylene chloride (V)	75-09-2	9.70E-02	1.30	7.8	5.77E+00
4-Methyl-2-pentanone (V)	108-10-1	3.85E-03	1.28	7.8	***2.29E+02***
2-Methylphenol	95-48-7				N/V
Naphthalene (V)	91-20-3	1.98E-02	4.89	7.8	***5.77E+03***
Nitrobenzene (V)	98-95-3	8.45E-04	1.86	7.8	***6.63E+00***
n-Nitrosodiphenylamine (V)	86-30-6	2.86E-02	3.15	7.8	***4.49E+01***
n-Nitrosodipropylamine	621-64-7	1.70E-03	1.36	7.8	***1.44E-02***
Pentachlorophenol	87-86-5	1.13E-04	121.64	7.8	9.58E+01
Phenol	108-95-2	1.86E-05	1.40	7.8	***2.67E+04***
Pyrene	129-00-0	3.39E-04	154.99	7.8	***1.34E+05***
Styrene (V)	100-42-5	1.37E-01	4.35	7.8	7.13E+03
1,1,2,2-Tetrachloroethane (V)	79-34-5	1.53E-02	2.10	7.8	***1.58E-01***
Tetrachloroethene (V)	127-18-4	7.09E-01	2.70	7.8	1.15E+01
Toluene (V)	108-88-3	2.52E-01	2.42	7.8	2.04E+03
Toxaphene	8001-35-2	1.38E-04	3.76	7.8	1.05E+01
1,2,4-Trichlorobenzene (V)	120-82-1	1.07E-01	6.87	7.8	***1.21E+03***
1,1,1-Trichloroethane (V)	71-55-6	7.63E-01	2.17	7.8	3.78E+02
1,1,2-Trichloroethane (V)	79-00-5	4.10E-02	1.90	7.8	***5.13E-01***
Trichloroethene (V)	79-01-6	4.35E-01	2.16	7.8	9.27E+00
2,4,5-Trichlorophenol	95-95-4	8.94E-03	3.34	7.8	1.00E+04

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Table 4 - Tier I Subsurface Soil Action Levels

Analyte	CAS No.	Henry's Constant	Kd	Dilution Factor	Tier I (mg/kg)
2,4,6-Trichlorophenol	88-06-2	1.60E-04	7.72	7.8	***4.77E+01***
Vinyl acetate	108-05-4	2.26E-02	1.04	7.8	***3.45E+04***
Vinyl chloride (V)	75-01-4	3.45E+00	1.24	7.8	3.03E+00
Xylene (total)(V)	1330-20-7	2.48E-01	3.08	7.8	2.56E+04

Values for organic compounds have been calculated based on leachability to groundwater at Tier I ground water action levels. Values for organic analytes without an MCL are calculated using the corresponding groundwater ingestion Preliminary Programmatic Remediation Goal (PPRG) and are shown in bold italics. Organic analytes without an MCL or a PPRG are not listed.

Action levels which have a calculated value greater than 1.00E+06 (1,000,000 mg/kg) are shown as ">1E+06".

(V) = Volatile chemical

(N/V) = No value available. Use the corresponding value in surface soil (see Table 5).

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Table 4 - Subsurface Soil Action Levels

Analyte	CAS Number	Tier I (a) Industrial Use (mg/kg)	Tier I (a) Open Space Use (mg/kg)	Tier II (b) Industrial Use (mg/kg)	Tier II (b) Open Space Use (mg/kg)
INORGANICS:					
Aluminum	7429-90-5	>1E+6	>1E+6	>1E+6	>1E+6
Antimony	7440-36-0	8.18E+02	3.07E+03	8.18E+02	3.07E+03
Arsenic	7440-38-2	3.27E+02	1.00E+03	3.27E+00	1.00E+01
Barium	7440-39-3	1.41E+05	5.35E+05	1.41E+05	5.35E+05
Beryllium	7440-41-7	1.33E+02	4.08E+02	1.33E+00	4.08E+00
Cadmium	7440-43-9	1.02E+03	3.84E+03	1.02E+03	3.84E+03
Chromium III	7440-47-3	>1E+6	>1E+6	>1E+6	>1E+6
Chrysene	218-01-9	7.84E+04	2.45E+05	7.84E+02	2.45E+03
Cobalt	7440-48-4	1.23E+05	4.61E+05	1.23E+05	4.61E+05
Copper	7440-50-8	8.18E+04	3.07E+05	8.18E+04	3.07E+05
Cyanide	57-12-5	4.09E+04	1.54E+05	4.09E+04	1.54E+05
Fluoride	16984-48-8	1.23E+05	4.61E+05	1.23E+05	4.61E+05
Lithium	7439-93-2	4.09E+04	1.54E+05	4.09E+04	1.54E+05
Manganese	7439-96-5	1.01E+04	3.83E+04	1.01E+04	3.83E+04
Mercury	7439-97-6	6.13E+02	2.31E+03	6.13E+02	2.31E+03
Molybdenum	7439-98-7	1.02E+04	3.84E+04	1.02E+04	3.84E+04
Nickel	7440-02-0	4.09E+04	1.54E+05	4.09E+04	1.54E+05
Nitrate	1-005	>1E+6	>1E+6	>1E+6	>1E+6
Nitrite	1-005	2.04E+05	7.68E+05	2.04E+05	7.68E+05
Selenium	7782-49-2	1.02E+04	3.84E+04	1.02E+04	3.84E+04
Silver	7440-22-4	1.02E+04	3.84E+04	1.02E+04	3.84E+04
Strontium	7440-24-6	>1E+6	>1E+6	>1E+6	>1E+6
Tin	7440-31-5	>1E+6	>1E+6	>1E+6	>1E+6
Vanadium	7440-62-2	1.43E+04	5.38E+04	1.43E+04	5.38E+04
Zinc	7440-66-6	6.13E+05	>1E+6	6.13E+05	>1E+6

Values for inorganics in subsurface soil are equal to the corresponding value in surface soil (see Table 5). These values are based on PPRG calculations for specified land uses: office worker exposure to surface soil in the Industrial Use Area or open space user exposure to soil/sediment in the Open Space Use Area. All toxicity values used in calculations are from IRIS, from HEAST, or are approved by the EAOC. Analytes without PPRGs are not listed.

(a) Tier I values represent either 1.00E-04 carcinogenic risk or a hazard index (HI) of 1 for non-carcinogenic toxicity.
(b) Tier II values represent either 1.00E-06 carcinogenic risk or a hazard index (HI) of 1 for non-carcinogenic toxicity.

Action levels which have a calculated value greater than 1.00E+06 (1,000,000 mg/kg) are shown as ">1E+06".

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Table 4 - Subsurface Soil Action Levels

Analyte	CAS Number	Tier I		Tier II (c)
		Industrial Use (a) (pCi/g)	Open Space Use (b) (pCi/g)	(pCi/g)
RADIONUCLIDES:				
Americium-241	14596-10-2	209	215	38
Plutonium-239 /240	10-12-8	1088	1429	252
Uranium-234	11-08-5	1627	1738	307
Uranium-235	15117-96-1	113	135	24
Uranium-238	7440-61-1	506	586	103

Values for radionuclides in subsurface soil are equal to the corresponding value in surface soil (see Table 5).

(a) Based on an annual dose limit of 15 mrem to an office worker.
(b) Based on an annual dose limit of 85 mrem to a hypothetical future resident.
(c) Based on an annual dose limit of 15 mrem to a hypothetical future resident.

These values apply to single radionuclides only. In order to account for the total dose from multiple radionuclides, the sum-of-ratios method will be applied. Actual values that trigger actions will therefore be lower than the values listed in this table.

Action levels for other radionuclides will be determined as necessary and in the same manner used to calculate the values listed in this table. Measured values for other radionuclides which are present above background will be included in sum-of-ratios calculations.

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Table 5 - Surface Soil Action Levels

Analyte	CAS Number	Tier I (a) Industrial Use (mg/kg)	Tier I (a) Open Space Use (mg/kg)	Tier II (b) Industrial Use (mg/kg)	Tier II (b) Open Space Use (mg/kg)
Acenaphthene (V)	83-32-9	1.23E+05	4.61E+05	1.23E+05	4.61E+05
Acetone (V)	67-64-1	2.04E+05	7.68E+05	2.04E+05	7.68E+05
Aldrin	309-00-2	3.36E+01	1.03E+02	3.36E-01	1.03E+00
Aluminum	7429-90-5	>1E+6	>1E+6	>1E+6	>1E+6
Anthracene (V)	120-12-7	6.13E+05	2.30E+06	6.13E+05	2.30E+06
Antimony	7440-36-0	8.18E+02	3.07E+03	8.18E+02	3.07E+03
Aroclor-1016	12674-11-2	1.43E+04	5.38E+04	1.43E+02	5.38E+02
Aroclor-1221	11104-28-2	7.43E+01	2.32E+02	7.43E-01	2.32E+00
Aroclor-1232	11141-16-5	7.43E+01	2.32E+02	7.43E-01	2.32E+00
Aroclor-1242	53469-21-9	7.43E+01	2.32E+02	7.43E-01	2.32E+00
Aroclor-1248	12672-29-6	7.43E+01	2.32E+02	7.43E-01	2.32E+00
Aroclor-1254	11097-69-1	7.43E+01	2.32E+02	7.43E-01	2.32E+00
Aroclor-1260	11096-82-5	7.43E+01	2.32E+02	7.43E-01	2.32E+00
Arsenic	7440-38-2	3.27E+02	1.00E+03	3.27E+00	1.00E+01
Barium	7440-39-3	1.41E+05	5.35E+05	1.41E+05	5.35E+05
Benzene (V)	71-43-2	1.97E+04	6.17E+04	1.97E+02	6.17E+02
alpha-BHC	319-84-6	9.08E+01	2.78E+02	9.08E-01	2.78E+00
beta-BHC	319-85-7	3.18E+02	9.75E+02	3.18E+00	9.75E+00
gamma-BHC (Lindane)	58-89-9	4.40E+02	1.38E+03	4.40E+00	1.38E+01
Benzo(a)anthracene	56-55-3	7.84E+02	2.45E+03	7.84E+00	2.45E+01
Benzo(a)pyrene	50-32-8	7.84E+01	2.45E+02	7.84E-01	2.45E+00
Benzo(b)fluoranthene	205-99-2	7.84E+02	2.45E+03	7.84E+00	2.45E+01
Benzo(k)fluoranthene	207-08-9	7.84E+03	2.45E+04	7.84E+01	2.45E+02
Benzoic Acid	65-85-0	>1E+6	>1E+6	>1E+6	>1E+6
Benzyl Alcohol	100-51-6	6.13E+05	>1E+6	6.13E+05	>1E+6
Beryllium	7440-41-7	1.33E+02	4.08E+02	1.33E+00	4.08E+00
bis(2-Chloroethyl)ether (V)	111-44-4	5.20E+02	1.63E+03	5.20E+00	1.63E+01
bis(2-Chloroisopropyl)ether (V)	108-60-1	8.17E+03	2.56E+04	8.17E+01	2.56E+02
bis(2-Ethylhexyl)phthalate	117-81-7	4.09E+04	1.28E+05	4.09E+02	1.28E+03
Bromodichloromethane (V)	75-27-4	9.23E+01	2.89E+02	9.23E+01	2.89E+02
Bromoform (V)	75-25-2	7.24E+02	2.27E+03	7.24E+02	2.27E+03
Bromomethane (V)	74-83-9	2.86E+03	1.08E+04	2.86E+03	1.08E+04
2-Butanone (V)	78-93-3	>1E+6	>1E+6	>1E+6	>1E+6
Butylbenzylphthalate	85-68-7	4.09E+05	>1E+6	4.09E+05	>1E+6
Cadmium	7440-43-9	1.02E+03	3.84E+03	1.02E+03	3.84E+03
Carbon disulfide (V)	75-15-0	2.04E+05	7.68E+05	2.04E+05	7.68E+05
Carbon tetrachloride (V)	56-23-5	4.40E+03	1.38E+04	4.40E+01	1.38E+02
alpha-Chlordane	5103-71-9	4.40E+02	1.35E+03	4.40E+00	1.35E+01
beta-Chlordane	5103-74-2	4.40E+02	1.35E+03	4.40E+00	1.35E+01
gamma-Chlordane	5103-74-2	4.40E+02	1.35E+03	4.40E+00	1.35E+01
4-Chloroaniline	106-47-8	8.18E+03	3.07E+04	8.18E+03	3.07E+04
Chlorobenzene (V)	108-90-7	4.09E+04	1.54E+05	4.09E+04	1.54E+05
Chloroform (V)	67-66-3	9.38E+04	2.93E+05	9.38E+02	2.93E+03
Chloromethane (V)	74-87-3	4.40E+04	1.38E+05	4.40E+02	1.38E+03
2-Chloronaphthalene (V)	91-58-7	1.64E+05	6.14E+05	1.64E+05	6.14E+05
2-Chlorophenol (V)	95-57-8	1.02E+04	3.84E+04	1.02E+04	3.84E+04
Chromium III	7440-47-3	>1E+6	>1E+6	>1E+6	>1E+6
Chromium VI	7440-47-3	4.86E+05	>1E+6	4.86E+03	3.67E+04
Chrysene	218-01-9	7.84E+04	2.45E+05	7.84E+02	2.45E+03

Table 5 - Surface Soil Action Levels

Analyte	CAS Number	Tier I (a) Industrial Use (mg/kg)	Tier I (a) Open Space Use (mg/kg)	Tier II (b) Industrial Use (mg/kg)	Tier II (b) Open Space Use (mg/kg)
Cobalt	7440-48-4	1.23E+05	4.61E+05	1.23E+05	4.61E+05
Copper	7440-50-8	8.18E+04	3.07E+05	8.18E+04	3.07E+05
Cyanide	57-12-5	4.09E+04	1.54E+05	4.09E+04	1.54E+05
4,4-DDD	72-54-8	2.38E+03	7.46E+03	2.38E+01	7.46E+01
4,4-DDE	72-55-9	1.68E+03	5.26E+03	1.68E+01	5.26E+01
4,4-DDT	50-29-3	1.68E+03	5.16E+03	1.68E+01	5.16E+01
Dibenz(a,h)anthracene	53-70-3	7.84E+01	2.45E+02	7.84E-01	2.45E+00
Dibromochloromethane	124-48-1	6.81E+03	2.13E+04	6.81E+01	2.13E+02
Di-n-butylphthalate	84-74-0	2.04E+05	7.68E+05	2.04E+05	7.68E+05
1,2-Dichlorobenzene (V)	95-50-1	1.84E+05	6.91E+05	1.84E+05	6.91E+05
1,4-Dichlorobenzene (V)	106-46-7	2.38E+04	7.46E+04	2.38E+02	7.46E+02
3,3-Dichlorobenzidine	91-94-1	1.27E+03	3.98E+03	1.27E+01	3.98E+01
1,1-Dichloroethane (V)	107-06-2	2.04E+05	7.68E+05	2.04E+05	7.68E+05
1,2-Dichloroethane (V)	107-06-2	6.29E+03	1.97E+04	6.29E+01	1.97E+02
1,1-Dichloroethene (V)	540-59-0	9.53E+02	2.98E+03	9.53E+00	2.98E+01
1,2-Dichloroethene (total) (V)	540-59-0	1.84E+04	6.91E+04	1.84E+04	6.91E+04
2,4-Dichlorophenol	120-83-2	6.13E+03	2.30E+04	6.13E+03	2.30E+04
1,2-Dichloropropane (V)	78-87-5	8.41E+03	2.63E+04	8.41E+01	2.63E+02
cis-1,3-Dichloropropene (V)	1006-01-5	3.18E+03	9.94E+03	3.18E+01	9.94E+01
trans-1,3-Dichloropropene (V)	10061-02-6	3.18E+03	9.94E+03	3.18E+01	9.94E+01
Dieldrin	60-57-1	3.57E+01	1.10E+02	3.57E-01	1.10E+00
Diethylphthalate	84-66-2	>1E+6	>1E+6	>1E+6	>1E+6
2,4-Dimethylphenol (V)	105-67-9	4.09E+04	1.54E+05	4.09E+04	1.54E+05
Dimethylphthalate	131-11-3	>1E+6	>1E+6	>1E+6	>1E+6
2,4-Dinitrophenol	51-28-5	4.09E+05	>1E+6	4.09E+03	1.54E+04
2,4-Dinitrotoluene	121-14-2	4.09E+05	>1E+6	4.09E+03	1.54E+04
2,6-Dinitrotoluene	606-20-2	8.41E+02	2.63E+03	8.41E+00	2.63E+01
Di-n-octylphthalate	117-84-0	>1E+6	1.28E+05	4.09E+04	1.28E+03
Endosulfan I	959-98-8	>1E+6	>1E+6	1.23E+04	4.61E+04
Endosulfan II	33213-65-9	>1E+6	>1E+6	1.23E+04	4.61E+04
Endosulfan sulfate	1031-07-8	>1E+6	>1E+6	1.23E+04	4.61E+04
Endosulfan (technical)	115-29-7	>1E+6	>1E+6	1.23E+04	4.61E+04
Endrin (technical)	72-26-8	6.13E+02	2.30E+03	6.13E+02	2.30E+03
Ethylbenzene (V)	100-41-4	2.04E+05	7.68E+05	2.04E+05	7.68E+05
Fluoranthene	206-44-0	8.18E+04	3.07E+05	8.18E+04	3.07E+05
Fluorene (V)	86-73-7	8.18E+04	3.07E+05	8.18E+04	3.07E+05
Fluoride	16984-48-8	1.23E+05	4.61E+05	1.23E+05	4.61E+05
Heptachlor	76-44-8	1.27E+02	3.90E+02	1.27E+00	3.90E+00
Heptachlor epoxide	1024-57-3	6.29E+01	1.93E+02	6.29E-01	1.93E+00
Hexachlorobenzene	118-74-1	3.57E+02	1.10E+03	3.57E+00	1.10E+01
Hexachlorobutadiene	87-68-3	7.33E+03	2.25E+04	7.33E+01	2.25E+02
Hexachlorocyclopentadiene	77-47-4	1.42E+04	5.36E+04	1.42E+04	5.36E+04
Hexachloroethane	67-72-1	4.09E+04	1.25E+05	4.09E+02	1.25E+03
Indeno(1,2,3-cd)pyrene	193-39-5	7.84E+02	2.45E+03	7.84E+00	2.45E+01
Isophorone	78-59-1	6.02E+05	>1E+6	6.02E+03	1.88E+04
Lithium	7439-93-2	4.09E+04	1.54E+05	4.09E+04	1.54E+05
Manganese	7439-96-5	1.01E+04	3.83E+04	1.01E+04	3.83E+04
Mercury	7439-97-6	6.13E+02	2.31E+03	6.13E+02	2.31E+03
Methoxychlor	72-43-5	1.02E+04	3.84E+04	1.02E+04	3.84E+04
Methylene chloride (V)	75-09-2	7.63E+04	2.39E+05	7.63E+02	2.39E+03

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Table 5 - Surface Soil Action Levels

Analyte	CAS Number	Tier I (a) Industrial Use (mg/kg)	Tier I (a) Open Space Use (mg/kg)	Tier II (b) Industrial Use (mg/kg)	Tier II (b) Open Space Use (mg/kg)
4-Methyl-2-pentanone (V)	108-10-1	1.64E+05	6.14E+05	1.64E+05	6.14E+05
2-Methylphenol	95-48-7	1.02E+05	3.84E+05	1.02E+05	3.84E+05
Molybdenum	7439-98-7	1.02E+04	3.84E+04	1.02E+04	3.84E+04
Naphthalene (V)	91-20-3	8.18E+04	3.07E+05	8.18E+04	3.07E+05
Nickel	7440-02-0	4.09E+04	1.54E+05	4.09E+04	1.54E+05
Nitrate	1-005	>1E+6	>1E+6	>1E+6	>1E+6
Nitrite	1-005	2.04E+05	7.68E+05	2.04E+05	7.68E+05
Nitrobenzene (V)	98-95-3	1.02E+03	3.84E+03	1.02E+03	3.84E+03
n-Nitrosodiphenylamine (V)	86-30-6	1.17E+05	3.65E+05	1.17E+03	3.65E+03
n-Nitrosodipropylamine	621-64-7	8.17E+01	2.56E+02	8.17E-01	2.56E+00
Pentachlorophenol	87-86-5	4.77E+03	1.49E+04	4.77E+01	1.49E+02
Phenol	108-95-2	>1E+6	>1E+6	>1E+6	>1E+6
Pyrene	129-00-0	6.13E+04	2.30E+05	6.13E+04	2.30E+05
Selenium	7782-49-2	1.02E+04	3.84E+04	1.02E+04	3.84E+04
Silver	7440-22-4	1.02E+04	3.84E+04	1.02E+04	3.84E+04
Strontium	7440-24-6	>1E+6	>1E+6	>1E+6	>1E+6
Styrene (V)	100-42-5	4.09E+05	>1E+6	4.09E+05	>1E+6
1,1,2,2-Tetrachloroethane (V)	79-34-5	2.86E+03	8.95E+03	2.86E+01	8.95E+01
Tetrachloroethene (V)	127-18-4	1.10E+04	3.44E+04	1.10E+02	3.44E+02
Tin	7440-31-5	>1E+6	>1E+6	>1E+6	>1E+6
Toluene (V)	108-88-3	4.09E+05	>1E+6	4.09E+05	>1E+6
Toxaphene	8001-35-2	5.20E+02	1.59E+03	5.20E+00	1.59E+01
1,2,4-Trichlorobenzene (V)	120-82-1	2.04E+04	7.68E+04	2.04E+04	7.68E+04
1,1,2-Trichloroethane (V)	79-00-5	1.00E+04	3.14E+04	1.00E+02	3.14E+02
Trichloroethene (V)	79-01-6	5.20E+04	1.63E+05	5.20E+02	1.63E+03
2,4,5-Trichlorophenol	95-95-4	2.04E+05	7.68E+05	2.04E+05	7.68E+05
2,4,6-Trichlorophenol	88-06-2	5.20E+04	1.59E+05	5.20E+02	1.59E+03
Vanadium	7440-62-2	1.43E+04	5.38E+04	1.43E+04	5.38E+04
Vinyl acetate	108-05-4	>1E+6	>1E+6	>1E+6	>1E+6
Vinyl chloride (V)	75-01-4	3.01E+02	9.42E+02	3.01E+00	9.42E+00
Xylene (total) (V)	1330-20-7	>1E+6	>1E+6	>1E+6	>1E+6
Zinc	7440-66-6	6.13E+05	>1E+6	6.13E+05	>1E+6

Values are based on PPRG calculations for specified land uses: office worker exposure to surface soil in the Industrial Use Area or open space user exposure to soil/sediment in the Open Space Use Area. All toxicity values used in calculations are from IRIS, from HEAST, or are approved by the EAOC. Analytes without PPRGs are not listed.

(a) Tier I values represent either 1.00E-04 carcinogenic risk or a hazard index (HI) of 1 for non-carcinogenic toxicity.
(b) Tier II values represent either 1.00E-06 carcinogenic risk or a hazard index (HI) of 1 for non-carcinogenic toxicity.

(V) = Volatile chemical

Action levels which have a calculated value greater than 1.00E+06 (1,000,000 mg/kg) are shown as ">1E+06".

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Table 5 - Surface Soil Action Levels

Analyte	CAS Number	Tier I		Tier II (c)
		Industrial Use (a) (pCi/g)	Open Space Use (b) (pCi/g)	(pCi/g)
RADIONUCLIDES:				
Americium-241	14596-10-2	209	215	38
Plutonium-239 /240	10-12-8	1088	1429	252
Uranium-234	11-08-5	1627	1738	307
Uranium-235	15117-96-1	113	135	24
Uranium-238	7440-61-1	506	586	103

(a) Based on an annual dose limit of 15 mrem to an office worker.
(b) Based on an annual dose limit of 85 mrem to a hypothetical future resident.
(c) Based on an annual dose limit of 15 mrem to a hypothetical future resident.

These values apply to single radionuclides only. In order to account for the total dose from multiple radionuclides, the sum-of-ratios method will be applied. Actual values that trigger actions will therefore be lower than the values listed in this table.

Action levels for other radionuclides will be determined as necessary and in the same manner used to calculate the values listed in this table. Measured values for other radionuclides which are present above background will be included in the sum-of-ratios calculations.

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