HSWA, LANL G/m/S

State of New Mexico
ENVIRONMENT DEPARTMENT
DOE OVERSIGHT BUREAU
P.O. Box 1663, MS/J-993
Los Alamos, New Mexico 87545

GARY E. JOHNSON
GOVERNOR

MARK E. WEIDLER
SECRETARY

March 3, 1997

MAR RECEIVED

Mat Johansen, DOE/AIP/POC
Department of Energy
Los Alamos Area Office
528 35 th Street
MS: A316
Los Alamos, NM 87544

Re: **(Tentative) list of Constituents of Potential Ecological Concern (COPECs) which are considered to be bioconcentrators and/or biomagnifiers.**

Dear Mr. Johansen:

At the January 23, 1997, LANL/NMED monthly technical meeting in Santa Fe, DOE Oversight Bureau (DOE OB) representatives expressed the concern that Environmental Restoration (ER) sites having Constituents of Potential Ecological Concern (COPECs) which bioconcentrate or biomagnify in the food chain should be given a high priority for the assessment of potential surface water quality impacts.. The ER representative requested a list of COPECs that the DOE OB considers to be bioconcentrators.

In response to the request, the DOE OB has compiled the following LANL specific list of bioconcentrators. The list is for guidance purposes only. It does not represent the regulatory position of the New Mexico Environment Department (NMED).

The list was generated by comparing the LANL Environmental Restoration Project list of COPECs for screening to the U. S. EPA Region VIII CWA § 304(a) Criteria Chart for 126 Priority Toxic Pollutants. The EPA Region VIII chart indicates published criteria, updated human health values and Biologic Concentration Factors (BCF) current as of July 1, 1993, and is included as Appendix A. BCFs and octanol-water partition coefficients (K_{ow}) for organic compounds were also compiled from additional referenced material. The Concentration Factors (CF) for radioisotopes were obtained from the 1994 U. S. Fish and Wildlife report, *Radiation Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review* by Ronald Eisler.

12970

TC

Two criteria were used to determine whether a COPEC was a bioconcentrator. Any COPEC with a Bioconcentration Factor (BCF) >100 or a K_{ow} > 3 (octanol-water partition coefficient) were considered bioconcentrators. This criteria excluded COPECs such as arsenic, lead, zinc, nickel, and cadmium from the list (BCF of 44-64) and may under-estimate the ultimate number of bioconcentrators of concern. The literature review for octanol-water partition coefficients for organic compounds is incomplete and as supplementary information is located, may also result in the addition of COPECs to the list.

Please contact Ralph Ford-Schmid at 827-1536 if you have any questions regarding this matter.

Sincerely,

Stephen Yanicak

Steve Yanicak, LANL POC
Department of Energy Oversight Bureau

SY:rfs

cc: Ed Kelly, NMED, Division Director, Water & Waste Division
John Parker, NMED, Chief, DOE OB
Marcy Leavitt, NMED,Chief, GWQB
Benito Garcia, NMED,Chief, HRMB
Glen Saums, NMED, Program Manager, SWQB
Jorg Jansen, LANL EM/ER, Program Manager, MS M992
Ted Taylor, DOE LAAO, Program Manager, MS A316

Mat Johansen
March 3, 1997
"List of COPECs considered to be bioconcentrators"

(Tentative) LANL SPECIFIC LIST OF BIOCONCENTRATORS
Critera for selection = BCF>100; or K_{ow} >3.0 (- indicates no information found)

STATUS BIOCONCENTRATOR?	Proposed LANL COPEC	BCF	K_{ow}
Yes	Aldrin	46670**	-
No	Aluminum	-	
Yes	Anthracene	912 - 917 (6, 8 in A)	4.45(3 in A)
Yes	All Aroclors (PCBs)	31200**	5.1 - 6.72 (4,5,11 in A)
?	Arsenic	44**	
?	Barium	-	
No	Benzene	5.2**	2.13(4 in A)
Yes	Benzo(a)pyrene	22 - 3000 (10 in A)	6.04(3 in A)
Probably not	Beryllium	19**	
?	Cadmium	64**	
Yes	Chlordane	14100**	5.48(9 in A)
Probably not	Chromium	16**	
Probably not	Copper	6**	
Yes	DDE	53600**	-
Yes	DDT	53600**	-
Yes	1,4-Dichlorobenzene	55.6**	3.52 (1); 3.38(4,5 in A)
Yes	Dieldrin	4670**	5.01 - 5.34 (2)
Probably not	Dinitrotouluene	3.8**	-
?	HMX	-	-
?	Lead	49**	
Yes	Lindane	100 - 442(1,2 in A)	3.70(A)
Probably not	Manganese	-	
Yes	Mercury	5500**	
?	Nickel	47**	
Yes	Phenanthrene	325 - 23,800(6,7,8 in A)	4.28 - 4.63 (3)
Yes	Pyrene	2,692 - 36,300(6,7,8, in A)	-
?	RDX	-	-
No	Silver	0.5**	
Yes	Thallium	119**	
No	Toulene	10.7**	2.69(4,5 inA)
No	Trichloroethylene	10.6**	2.29(3 in A)
?	Trinitrotoluene	-	-
?	Uranium	-	
?	Vanadium	-	
?	Xylene	-	-
?	Zinc	47**	

** From EPA region VIII CWA §304(a) Criteria Chart Indicating Published Criteria and Updated Human Health Values; Current as of July 1, 1993 - (126 Priority Toxic Pollutants)

(1) Harch, C. et al, 1985 Medchem Project; Claremont, LA: Pomona College. Issue # 26: 3.37

(2) U.S. EPA Sept. 1993. EPA Sediment Quality Criteria for the Protection of Benthic Organisms: Dieldrin. Publication # EPA 822-R93-015

(3) U.S. EPA Sept. 1993. EPA Sediment Quality Criteria for the Protection of Benthic Organisms: Phenanthrene. Publication # EPA 822-R93-014

(A) U.S. G. S. Manmade Organic Compounds in the Surface Waters of the United States – A Review of Current Understanding (Smith et al) U.S. Geological Survey Circular 1007

Mat Johansen
March 3, 1997
"List of COPECs considered to be bioconcentrators"

(Tentative) LANL SECIFIC LIST OF BIOCONCENTRATORS

CONCENTRATION FACTORS FOR SELECTED RADIONUCLIDE COPECS

Criteria for selection = CF>100

STATUS Bioconcentrator?	Proposed LANL Radionuclide COPEC	CF
Yes	Americium(Am)	50 - 8,000 **Table 2** (Morse and Choppin, 1991. *in* Eisler, 1994)
Yes	Cesium (Cs)	600 - 3,000 **Table 1** (Wicker and Schultz, 1992. *in* Eisler, 1994) 100 - 10,000 (Joshi, 1991, *in* Eisler, 1994) 997 - 4,496 (Shure and Gottschalk, 1976. *in* Eisler, 1994)
Yes	Plutonium (Pu)	1 - 6,000 (Joshi, 1991. *in* Eisler, 1994) 40 - 2,000 **Table 2** (Morse and Choppin 1991. *in* Eisler, 1994)
Yes	Strontium (Sr)	200 - 600 **Table 1** (Wicker and Schultz, 1992. *in* Eisler, 1994)
No	Radium (Ra)	
No	Thorium (Th)	
No	Tritium (H^3)	
?	Uranium (U)	

Table 1. Concentration Factors[a] for ^{137}Cs and ^{90}Sr in aquatic organisms (Whicker and Schultz,1992, in Eisler 1994)

Radionuclide	Molluscs, whole	Crustaceans, whole	Fishes, muscle
Cesium-137			
Freshwater	600	4,000	3,000
Marine	8	23	15
Strontium-90			
Freshwater	600	200	200
Marine	1	3	0.1

[a] Bq per gram fresh weight sample/Bq per mL medium.

Table 2. Approximate maximum concentration factors[a] for selected transuranics in marine sediments, macroalgae, and fishes (Morse and Choppin 1991, in Eisler 1994)

	Concentration factor		
Transuranic nuclide	Sediments	Macroalgae	Fish
Neptunium	1,000	5,000	10
Plutonium	100,00	2,000	40
Americium,curium, berkelium, californium	2,000,000	8,000	50

[a] Bq per gram fresh weight sample/Bq per mL water.

In the Great Lakes, the maximum CF values of ^{137}Cs range from 1,000 to 10,000 in algae, amphipods, and fishes and from 100 to 1,000 in zooplankton (Joshi, 1991 in Eisler, 1994)

Maximum concentration factors of ^{137}Cs in a contaminated creek in South Carolina were 4,243 in suspended particulates, 938 in detritus, 4,496 in algae and macrophytes, 997 in omnivores, 1,292 in primary carnivores, and 1,334 to 2,595 in top carnivores such as the redbreast sunfish, largemouth bass, and water snakes (Shure and Gottschalk, 1976 in Eisler, 1994)

Concentration factors of $^{239+240}Pu$ in Lake Michigan were between 1 and 10 in predatory salmonids, 10 and 300 in nonpredatory fishes, 900 and 1200 in amphipods and shrimp, about 200 in zooplankton, and about 6,000 in algae (Joshi, 1991 in Eisler, 1994)

The following discussion is from Eisler, 1994.

> "For transurainc elements, the fraction of the ingested material that was assimilated by the whole organism was always less than 0.01% and usually nearer 0.003% (Whicker and Schultz 1982). The major hazard of plutonium nuclides to terrestrial organisms comes from inhalation, uptake by plants is low and further uptake by humans through the gut is low (Noshkin et al. 1971). Americium-241 is an artificial, toxic bone-seeking radionuclide produced by beta decay of ^{241}Pu (Schoeters et al. 1991). Because of its long half-life, its high-energy alpha irradiation, and its accumulation in the liver and skeleton, consideration

should be given to ^{241}Am in risk estimates of latent effects such as induction of liver cancer, bone cancers, and leukemias. In comparison with ^{226}Ra, ^{241}Am is 20 times more effective in reducing the life-span in mice and 13 times more effective in the rate of death from bone cancer (Schoeters et al. 1991). "

REFERENCES

Eisler, R., 1994. Radiation Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review, National Biological Service, U.S. Department of the Interior, Biological Report 26, Contaminant Hazard Reviews Report 29.

Joshi, S. R., 1991. Radioactivity in the Great Lakes. The Science of the Total Environment 100:61-104 *in* Eisler, 1994. Radiation Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review, National Biological Service, U.S. Department of the Interior, Biological Report 26, Contaminant Hazard Reviews Report 29.

Morse, J. W., and G. R. Choppin. 1991. The chemistry of transuranic elements in natural waters. Reviews in Aquatic Sciences 4:1-22 *in* Eisler 1994. Radiation Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review, National Biological Service, U.S. Department of the Interior, Biological Report 26, Contaminant Hazard Reviews Report 29.

Noshkin, V. E., V. T. Bowen, K. M. Wong, and J. C. Barke, 1971. Plutonium in North Atlantic Ocean organisms: ecological relationships. Pages 681-688 *in* D. J. Nelson, editor. Radionuclides in ecosystems. Proceedings of the third national symposium on radioecology, 10-12 May 1971, Oak Ridge, Tenn. Volume 2. Available from the National Technical Information Service , Springfield, Va. *in* Eisler 1994. Radiation Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review, National Biological Service, U.S. Department of the Interior, Biological Report 26, Contaminant Hazard Reviews Report 29.

Schoeters, G. E. R., J. R. Maisin, and O. L. V. Vanderborght. 1991. Toxicity of ^{241}Am in male C57BL mice: relative risk versus ^{226} Ra. Radiation Research 126:198-205. *in* Eisler 1994. Radiation Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review, National Biological Service, U.S. Department of the Interior, Biological Report 26, Contaminant Hazard Reviews Report 29.

Whicker , F. W., and V. Schultz. 1982. Radioecology: nuclear energy and the environment. Volume I. CRC Press, Boca Raton, Fla.228 pp. et al. 1991; *in* Eisler 1994. Radiation Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review, National Biological Service, U.S. Department of the Interior, Biological Report 26, Contaminant Hazard Reviews Report 29.

1 in A Grimes, D. J., and Morrison, S. M., 1975, Bacterial bioconcentration of chlorinated hydrocarbon insecticides from aqueous systems: Microbial Ecology, v-2. p. 43-59. *in* Smith, J. A., Witkowski, P. J., and Fusillo, T. V., 1988, Manmade Organic Compounds in the Surface Waters of the United States – A Review of Current Understanding U.S.G.S. Circular 1007.

2 in A Sugiura, Katsura, Washino, Tohuru, Hattori, Mitsuo, Sato, Eiji, and Goto, Miki, 1979, Accumulation of organochlorine compounds in fishes. Difference of accumulation factors by fishes: Chemosphere, v. 8, p 359-364. *in* Smith, J. A., Witkowski, P. J., and Fusillo, T. V., 1988. Manmade Organic Compounds in the Surface Waters of the United States – A Review of Current Understanding U.S.G.S. Circular 1007.

3 in A Callahan, M.A., Slimak, M.W., Gabel, N.W., May, I.P., Fowler, C.F., Freed, J.R., Jennings, Patricia, Durfee, R.L., Whitmore, F.C., Maestri, Bruno, Mabey, W.R., Holt, B.R., and Gould, Constance, 1979, Water-related environmental fate of 129 priority pollutants: U.S. Environmental Protection Agency, EPA-440/4-79-029a,b, *in* Smith, J. A., Witkowski, P. J., and Fusillo, T. V., 1988. Manmade Organic Compounds in the Surface Waters of the United States – A Review of Current Understanding U.S.G.S. Circular 1007.

REFERENCES cont.

4 in A Verschueren, Karel, 1983, Handbook of environmental data on organic chemicals (2d ed.): New York, Van Nostrand Reingold, 1, 310 p. *in* Smith, J. A., Witkowski, P. J., and Fusillo, T. V., 1988. Manmade Organic Compounds in the Surface Waters of the United States – A Review of Current Understanding U.S.G.S. Circular 1007.

5 in A Chiou, C.T., Freed, V.H., Schmedding, D.W., and Kohnert, R.L., 1977, Partition coefficient and bioaccumulation of selected organic chemicals: Environmental Science and Technology, v. 11, no. 5, p. 475-478. *in* Smith, J. A., Witkowski, P. J., and Fusillo, T. V., 1988. Manmade Organic Compounds in the Surface Waters of the United States – A Review of Current Understanding U.S.G.S. Circular 1007.

6 in A Southworth, G.R., Beauchamp, J.J., and Schmieder, P.K., 1978, Bioaccumulation potential of polycylic aromatic hydrocarbons in *Daphnia pulex* : Water Research, v. 12, p 973-977. *in* Smith, J. A., Witkowski, P. J., and Fusillo, T. V., 1988. Manmade Organic Compounds in the Surface Waters of the United States – A Review of Current Understanding U.S.G.S. Circular 1007.

7 in A Casserly, D.M., Davis, E.M., Downs, T.D., and Guthrie, R.K., 1983, Sorbtion of organics by *Selenastrum capricomutum*: Water Research, v. 17, no 11, p. 1591-1594. *in* Smith, J. A., Witkowski, P. J., and Fusillo, T. V., 1988. Manmade Organic Compounds in the Surface Waters of the United States – A Review of Current Understanding U.S.G.S. Circular 1007.

8 in A Mackay, Donald, 1982, Correlation of bioconcentration factors: Environmental Science and Technology, v. 16, no 5, p. 274-278. *in* Smith, J. A., Witkowski, P. J., and Fusillo, T. V., 1988. Manmade Organic Compounds in the Surface Waters of the United States – A Review of Current Understanding U.S.G.S. Circular 1007.

9 in A Mabey, W.R., Smith, J.H., Podoll, R.T., Johnson, H.L., Mill, T., Chou, T.W., Gates, J., Partridge, I.W., Jaber, H., and Bandenberg, D., 1982, Aquatic fate process data for organic priority pollutants: U.S. Environmental Protection Agency, EPA 440/4-81-014,434 p. *in* Smith, J. A., Witkowski, P. J., and Fusillo, T. V., 1988. Manmade Organic Compounds in the Surface Waters of the United States – A Review of Current Understanding U.S.G.S. Circular 1007.

10 in A Biddinger, G.R., and Gloss, S.P., 1984, The importance of trophic transfer in the bioaccumulation of chemical contaminants in aquatic ecosystems: Residue Reviews, v. 91, p. 103-145. *in* Smith, J. A., Witkowski, P. J., and Fusillo, T. V., 1988. Manmade Organic Compounds in the Surface Waters of the United States – A Review of Current Understanding U.S.G.S. Circular 1007.

11 in A Burkhard, L.P., Andren, A.W., and Armstrong, D.E., 1985, Estimation of vapor pressures for polychlorinated biphenyls: A comparison of eleven predictive methods: Environmental Science and Technology, v. 19, no. 6, p. 500-507. *in* Smith, J. A., Witkowski, P. J., and Fusillo, T. V., 1988. Manmade Organic Compounds in the Surface Waters of the United States – A Review of Current Understanding U.S.G.S. Circular 1007.

** From EPA region VIII CWA §304(a) Criteria Chart Indicating Published Criteria and Updated Human Health Values; Current as of July 1, 1993 - (126 Priority Toxic Pollutants)

Harch, C. et al, 1985, Medchem Project; Claremont, LA: Pomona College. Issue # 26: 3.37

(A) Smith, J. A., Witkowski, P. J., and Fusillo, T. V., 1988. Manmade Organic Compounds in the Surface Waters of the United States – A Review of Current Understanding U.S.G.S. Circular 1007.

U.S. EPA Sept. 1993. EPA Sediment Quality Criteria for the Protection of Benthic Organisms: Dieldrin. Publication # EPA 822-R93-015

U.S. EPA Sept. 1993. EPA Sediment Quality Criteria for the Protection of Benthic Organisms: Phenanthrene. Publication # EPA 822-R93-014

Mat Johansen
March 3, 1997
"List of COPECs considered to be bioconcentrators"

APPENDIX A

EPA region VIII CWA §304(a) Criteria Chart
Indicating Published Criteria and Updated Human Health Values;
Current as of July 1, 1993 - (126 Priority Toxic Pollutants)

EPA Region VIII CWA § 304(a) Criteria Chart Indicating Published Criteria and Updated Human Health Values.

Current as of July 1, 1993

PRIORITY TOXIC POLLUTANTS

Chemical Name	CASRN	Published § 304(a) Aquatic Life Criteria CMC	CCC	Date	Published § 304(a) Human Health Criteria Water+Fish	Fish	Updated § 304(a) Human Health Values* Water+Fish	Fish	IRIS Information RfD mg/kg-dy	q1* kg-dy/mg	BCF l/k
1 •Acenaphthene	83-32-9	-	-	-	20 #	-	1200 (20#)	2700	0.06	-	242
2 Acrolein	107-02-8	-	-	-	320	780	320	780	-	-	215
3 Acrylonitrile (c)	107-13-1	-	-	-	0.058	0.65	0.059	0.66	-	0.54	30
4 Benzene (c)	71-43-2	-	-	-	0.66	40	1.2	71	-	0.029	5.2
5 Benzidine (c)	92-87-5	-	-	-	0.00012	0.00053	0.00012	0.00054	0.003	230	87.5
6 Carbon tetrachloride (c)5 (Tetrachloromethane)	6-23-5	-	-	-	0.40	6.94	0.25	4.4	0.0007	0.13	18.75
7 Chlorobenzene (Monochlorobenzene)	108-90-7	-	-	-	20 #(488)	-	680m(20#)	21000	0.02	-	10.3
8 •1,2,4-Trichlorobenzene	120-82-1	-	-	-	-	-	260 m	940	0.01	-	114
9 •Hexachlorobenzene (c)	118-74-1	-	-	-	0.00072	0.00074	0.00075	0.00077	0.0008	1.6	8690
10 1,2-Dichloroethane (c)	107-06-2	-	-	-	0.94	243	0.38	99	-	0.091	1.2
11 •1,1,1-Trichloroethane	71-55-6	-	-	-	200@(184000)	1030000	-m,ntr	-ntr	-	-	5.6
12 Hexachloroethane (c)	67-72-1	-	-	-	1.9	8.74	1.9	8.9	0.001	0.014	86.9
13 1,1-Dichloroethane	75-34-3	-	-	-	-	-	-	-	-	-	-
14 1,1,2-Trichloroethane (c)	79-00-5	-	-	-	0.60	41.8	0.61	42	0.004	0.057	4
15 1,1,2,2-Tetrachloroethane (c)	79-34-5	-	-	-	0.17	10.7	0.17	11	-	0.20	5
16 Chloroethane (Monochloroethane)	75-00-3	-	-	-	-	-	-	-	-	-	-
17 Bis(2-chloroethyl) ether (c)	111-44-4	-	-	-	0.03	1.36	0.031	1.4	-	1.1	6.9
18 2-Chloroethyl vinyl ether (c)	110-75-8	-	-	-	-	-	-	-	-	-	0.557
19 •2-Chloronaphthalene	91-58-7	-	-	-	-	-	1700	4300	0.08	-	202
20 2,4,6-Trichlorophenol (c)	88-06-2	-	-	-	1.2	3.6	2.1	6.5	-	0.011	150
21 p-Chloro-m-cresol	59-50-7	-	-	-	3000#	-	3000#	-	-	-	-
22 Chloroform (HM) (c) (Trichloromethane)	67-66-3	-	-	-	0.19	15.7	5.7	470	0.01	0.0061	3.75
23 2-Chlorophenol	95-57-8	-	-	-	0.1 #	-	120 (0.1#)	400	0.005	-	134
24 1,2-Dichlorobenzene	95-50-1	-	-	-	400	2600	2700 m	17000	0.09	-	55.6
25 1,3-Dichlorobenzene	541-73-1	-	-	-	400	2600	400	2600	-	-	55.6

Except where indicated, all criteria are listed as micrograms per liter (ug/l). A "•" indicates a change in § 304(a) human health values compared to the August 1990 EPA Region VIII criteria chart.

EPA Region VIII Criteria Chart
July 1993 (Page 2 of 12)

	Chemical Name	CASRN	Published § 304(a) Aquatic Life Criteria CMC	CCC	Date	Published § 304(a) Human Health Criteria Water+Fish	Fish	Updated § 304(a) Human Health Values* Water+Fish	Fish	IRIS Information RfD mg/kg-dy	q1* kg-dy/mg	BCF l/kg
26	1,4-Dichlorobenzene	106-46-7	-	-	-	75@(400)	2600	400 m	2600	-	-	[illegible]6
27	3,3'-Dichlorobenzidine (c)	91-94-1	-	-	-	0.01	0.02	0.039	0.077	-	0.45	[illegible]2
28	1,1-Dichloroethylene (c)	75-35-4	-	-	-	0.033	1.85	0.057	3.2	0.009	0.6	5.6
29	1,2-trans-Dichloroethylene	156-60-5	-	-	-	-	-	700 m	140000	0.02	-	1.58
30	2,4-Dichlorophenol	120-83-2	-	-	-	0.3 #(3090)	-	93 (0.3#)	790	0.003	-	40.7
31	1,2-Dichloropropane	78-87-5	-	-	-	-	-	0.52 x	39 x	-	-	4.11
32	1,3-Dichloropropylene (1,3-Dichloropropene) (cis and trans isomers)	542-75-6	-	-	-	87	14100	10	1700	0.0003	-	1.91
33	2,4-Dimethylphenol	105-67-9	-	-	-	400 #	-	540 (400#)	2300	0.02	-	93.8
34	2,4-Dinitrotoluene (c)	121-14-2	-	-	-	0.11	9.1	0.11	9.1	0.002	-	3.8
35	2,6-Dinitrotoluene	606-20-2	-	-	-	-	-	-	-	-	-	-
36	1,2-Diphenylhydrazine (c)	122-66-7	-	-	-	0.042	0.56	0.040	0.54	-	0.8	24.9
37	Ethylbenzene	100-41-4	-	-	-	1400	3260	3100 m	29000	0.1	-	37.5
38	Fluoranthene	206-44-0	-	-	-	42	54	300	370	0.04	-	1150
39	4-Chlorophenyl phenyl ether	7005-72-3	-	-	-	-	-	-	-	-	-	1200
40	4-Bromophenyl phenyl ether	101-55-3	-	-	-	-	-	-	-	-	-	1640
41	Bis(2-chloroisopropyl) ether	39638-32-9	-	-	-	34.7	4360	1400	170000	0.04	-	[illegible]
42	Bis(2-chloroethoxy) methane	111-91-1	-	-	-	-	-	-	-	-	-	0.64
43	Methylene chloride (HM) (c) (Dichloromethane)	75-09-2	-	-	-	0.19	15.7	4.7	1600	0.06	0.0075	0.9
44	Methyl chloride (HM) (Chloromethane)	74-87-3	-	-	-	0.19	15.7	- ntr	- ntr	-	-	3.75
45	Methyl bromide (HM) (Bromomethane)	74-83-9	-	-	-	0.19	15.7	48	4000	0.0014	-	3.75
46	Bromoform (HM) (c) (Tribromomethane)	75-25-2	-	-	-	0.19	15.7	4.3	360	0.02	0.0079	3.75
47	Dichlorobromomethane (HM) (c)	75-27-4	-	-	-	0.19	15.7	0.56	46	0.02	0.062	3.75
48	Chlorodibromomethane (HM) (c)	124-48-1	-	-	-	0.19	15.7	0.41	34	0.02	0.084	3.75
49	Hexachlorobutadiene (c)	87-68-3	-	-	-	0.45	50	0.44	50	-	0.078	2.78
50	Hexachlorocyclopentadiene	77-47-4	-	-	-	1.0 #(206)	-	240 m (1.0#)	17000	0.007	-	4.24

Except where indicated, all criteria are listed as micrograms per liter (ug/l). A "-" indicates a change in § 304(a) human health values compared to the August 1990 EPA Region VIII criteria chart.

EPA Region VIII Criteria Chart
July 1993 (Page 3 of 12)

Chemical Name	CASRN	Published § 304(a)P Aquatic Life Criteria CMC	CCC	Date	ublished § 304(a) Human Health Criteria Water+Fish	Fish	Updated § 304(a) Human Health Values* Water+Fish	Fish	IRIS Information RfD mg/kg-dy	q1* kg-dy/mg	BCF l/kg
51 •Isophorone (c)	78-59-1	-	-	-	5200	520000	36	2600	0.2	0.00095	4.38
52 Naphthalene	91-20-3	-	-	-	-	-	-	-	-	-	1[illegible]
53 Nitrobenzene	98-95-3	-	-	-	30 #(19800)	-	17	1900	0.0005	-	2.89
54 2-Nitrophenol	88-75-5	-	-	-	-	-	-	-	-	-	2.33
55 4-Nitrophenol	100-02-7	-	-	-	-	-	-	-	-	-	3.31
56 2,4-Dinitrophenol	51-28-5	-	-	-	70	14300	70	14000	0.002	-	1.5
57 4,6-Dinitro-o-cresol (4,6-Dinitro-2-methylphenol)	534-52-1	-	-	-	13.4	765	13	765	-	-	5.5
58 N-Nitrosodimethylamine (c)	62-75-9	-	-	-	0.0014	16	0.00069	8.1	-	51	0.026
59 N-Nitrosodiphenylamine (c)	86-30-6	-	-	-	4.9	16.1	5.0	16	-	0.0049	136
60 •N-Nitrosodi-n-propylamine (c)	621-64-7	-	-	-	-	-	0.005	1.4	-	7.0	1.13
61 •Pentachlorophenol (c)	87-86-5	20****	13****	9/86	30 #(1010)	-	0.28 (30#)	8.2	0.03	0.12	11
62 Phenol	108-95-2	-	-	-	300 #(3500)	-	21000 (300#)	4600000	0.6	-	1.4
63 Bis(2-ethylhexyl)phthalate (c)	117-81-7	-	-	-	15000	50000	1.8	5.9	0.02	0.014	130
64 Butyl benzyl phthalate	85-68-7	-	-	-	-	-	3000	5200	0.2	-	414
65 Di-n-butyl phthlate	84-74-2	-	-	-	35000	154000	2700	12000	0.1	-	89
66 Di-n-octyl phthlate	117-84-0	-	-	-	-	-	-	-	-	-	-
67 Diethyl phthalate	84-66-2	-	-	-	350000	1800000	23000	120000	0.8	-	[illegible]
68 Dimethyl phthlate	131-11-3	-	-	-	313000	2900000	310000	2900000	-	-	36
69 •Benzo(a)anthracene (PAH) (c) (1,2-Benzanthracene)	56-55-3	-	-	-	0.0028	0.0311	0.0044	0.049	-	-	30
70 •Benzo(a)pyrene (PAH) (c) (3,4-Benzopyrene)	50-32-8	-	-	-	0.0028	0.0311	0.0044	0.049	-	7.3	30
71 •Benzo(b)fluoranthene (PAH) (c) (3,4-Benzofluoranthene)	205-99-2	-	-	-	0.0028	0.0311	0.0044	0.049	-	-	30
72 •Benzo(k)fluoranthene (PAH) (c) (11,12-Benzofluoranthene)	207-08-9	-	-	-	0.0028	0.0311	0.0044	0.049	-	-	30
73 •Chrysene (PAH) (c)	218-01-9	-	-	-	0.0028	0.0311	0.0044	0.049	-	-	30
74 •Acenaphthylene (PAH)	208-96-8	-	-	-	0.0028	0.0311	- ntr	- ntr	-	-	30
75 •Anthracene (PAH)	120-12-7	-	-	-	0.0028	0.0311	9600	110000	0.3	-	30

Except where indicated, all criteria are listed as micrograms per liter (ug/l). A "•" indicates a change in § 304(a) human health values compared to the August 1990 EPA Region VIII criteria chart.

EPA Region VIII Criteria Chart
July 1993 (Page 4 of 12)

Chemical Name	CASRN	Published § 304(a) Aquatic Life Criteria CMC	CCC	Date	Published § 304(a) Human Health Criteria Water+Fish	Fish	Updated § 304(a) Human Health Values* Water+Fish	Fish	IRIS Information RfD mg/kg-dy	q1 kg-dy/mg	BCF l/kg
76 •Benzo(g,h,i)perylene (PAH) (1,12-Benzoperylene)	191-24-2	-	-	-	0.0028	0.0311	- ntr	- ntr	-	-	30
77 •Fluorene (PAH)	86-73-7	-	-	-	0.0028	0.0311	1300	14000	0.04	-	[illegible]
78 •Phenanthrene (PAH)	85-01-8	-	-	-	0.0028	0.0311	- ntr	- ntr	-	-	30
79 •Dibenzo(a,h)anthracene (PAH)(c) (1,2,5,6-Dibenzanthracene)	53-70-3	-	-	-	0.0028	0.0311	0.0044	0.049	-	-	30
80 •Indeno(1,2,3-cd)pyrene (PAH)(c)	193-39-5	-	-	-	0.0028	0.0311	0.0044	0.049	-	-	30
81 •Pyrene (PAH)	129-00-0	-	-	-	0.0028	0.0311	960	11000	0.03	-	30
82 Tetrachloroethylene (c)	127-18-4	-	-	-	0.8	8.85	0.80	8.9	0.01	-	30.6
83 Toluene	108-88-3	-	-	-	14300	424000	6800 m	200000	0.2	-	10.7
84 Trichloroethylene (c)	79-01-6	-	-	-	2.7	80.7	2.7	81	-	-	10.6
85 Vinyl chloride (c) (Cloroethylene)	75-01-4	-	-	-	2.0 @	525	2.0 @	530	-	-	1.17
86 Aldrin (c)	309-00-2	3.0 (1.5**)	-	10/80	0.000074	0.000079	0.00013	0.00014	0.00003	17	4670
87 Dieldrin (c)	60-57-1	2.5 (1.25**)	0.0019	10/80	0.000071	0.000076	0.00014	0.00014	0.00005	16	4670
88 Chlordane (c)	57-74-9	2.4 (1.2**)	0.0043	10/80	0.00046	0.00048	0.00057	0.00059	0.00006	1.3	14100
89 4,4'-DDT (c)	50-29-3	1.1(.55**)	0.001	10/80	0.000024	0.000024	0.00059	0.00059	0.0005	0.34	53600
90 4,4'-DDE (c)	72-55-9	-	-		0.000024	0.000024	0.00059	0.00059	-	0.34	53600
91 4,4'-DDD (c)	72-54-8	-	-	-	0.000024	0.000024	0.00083	0.00084	-	0.24	[illegible]
92 •alpha-Endosulfan	115-29-7	0.22 (.11**)	0.056	10/80	74	159	110 p	240 p	0.006 p	-	[illegible]
93 •beta-Endosulfan	115-29-7	0.22 (.11**)	0.056	10/80	74	159	110 p	240 p	0.006 p	-	270
94 •Endosulfan sulfate	1031-07-8	-	-	-	74	159	110 p	240 p	0.006 p	-	270
95 Endrin	72-20-8	0.18 (.09**)	0.0023	10/80	0.2 @	-	0.76	0.81	0.0003	-	3970
96 Endrin aldehyde	7421-93-4	-	-	-	0.2 @	-	0.76	0.81	0.0003	-	3970
97 Heptachlor (c)	76-44-8	0.52 (.26**)	0.0038	10/80	0.00028	0.00029	0.00021	0.00021	0.0005	4.5	11200
98 Heptachlor epoxide (c)	1024-57-3	0.52 (.26**)	0.0038	10/80	0.00028	0.00029	0.00010	0.00011	0.000013	9.1	11200
99 alpha-BHC (c) (Hexachlorocyclohexane-alpha)	319-84-6	-	-	-	0.0092	0.031	0.0039	0.013	-	6.3	130
100 beta-BHC (c) (Hexachlorocyclohexane-beta)	319-85-7	-	-	-	0.016	0.055	0.014	0.046	-	1.8	130

Except where indicated, all criteria are listed as micrograms per liter (ug/l). A "•" indicates a change in § 304(a) human health values compared to the August 1990 EPA Region VIII criteria chart.

EPA Region VIII Criteria Chart
July 1993 (Page 5 of 12)

Chemical Name	CASRN	Published § 304(a) Aquatic Life Criteria CMC	CCC	Date	Published § 304(a) Human Health Criteria Water+Fish	Fish	Updated § 304(a) Human Health Values* Water+Fish	Fish	IRIS Information RfD mg/kg-dy	q1 kg-dy/mg	BCF l/kg
101 gamma-BHC (Lindane) (c) (Hexachlorocyclohexane-gamma)	58-89-9	2.0 (1**)	0.08	10/80	0.019	0.063	0.019	0.063	0.0003	-	130
102 delta-BHC (Hexachlorocyclohexane-delta)	319-86-8	-	-	-	-	-	-	-	-	-	13[illegible]
103 PCB 1242 (Arochlor 1242) (c)	1336-36-3	-	0.014	10/80	0.000079	0.000079	0.000044	0.000045	-	7.7	31200
104 PCB-1254 (Arochlor 1254) (c)	1336-36-3	-	0.014	10/80	0.000079	0.000079	0.000044	0.000045	-	7.7	31200
105 PCB-1221 (Arochlor 1221) (c)	1336-36-3	-	0.014	10/80	0.000079	0.000079	0.000044	0.000045	-	7.7	31200
106 PCB-1232 (Arochlor 1232) (c)	1336-36-3	-	0.014	10/80	0.000079	0.000079	0.000044	0.000045	-	7.7	31200
107 PCB-1248 (Arochlor 1248) (c)	1336-36-3	-	0.014	10/80	0.000079	0.000079	0.000044	0.000045	-	7.7	31200
108 PCB-1260 (Arochlor 1260) (c)	1336-36-3	-	0.014	10/80	0.000079	0.000079	0.000044	0.000045	-	7.7	31200
109 PCB-1016 (Arochlor 1016) (c)	1336-36-3	-	0.014	10/80	0.000079	0.000079	0.000044	0.000045	-	7.7	31200
110 Toxaphene (c)	8001-35-2	0.73	0.0002	9/86	0.00071	0.00073	0.00073	0.00075	-	1.1	13100
111 Antimony	7440-36-0	-	-	-	146	45000	14 m	4300	0.0004	-	1.0
112 Arsenic (c)	7440-38-2	360	190	1/85	0.002	0.017	0.018	0.14	0.0003	1.75	44
113 Asbestos (c)	1332-21-4	-	-	-	30000 fibers/l	-	7000000@ f/l	-	-	-	
114 Beryllium (c)	7440-41-7	-	-	-	0.0037	0.064	0.0077 ntr	0.13 ntr	0.005	4.3	19
115 Cadmium	7440-43-9	3.9***	1.1***	1/85	10@(29)	-	14 m,ntr	84 ntr	0.0005	-	64
116 Chromium (III)	7440-47-3	1700***	210***	1/85	50@(170000)	3433000	33000 m,ntr	670000 ntr	1.0	-	16
Chromium (VI)		16	11	1/85	50@	-	170 m,ntr	3400 ntr	0.005		16
117 Copper	7440-50-8	18***	12***	1/85	1000#	-	1300x 1000#	-	-	-	36
118 Cyanide (total)	57-12-5	22	5.2	1/85	200 @	-	700	220000	0.02	-	1.0
119 Lead	7439-92-1	82***	3.2***	1/85	50 @	-	- ntr,m	-	-	-	49
120 Mercury	7439-97-6	2.4	0.012	1/85	0.144	0.146	0.14	0.15	-	-	5500
121 Nickel	7440-02-0	1400***	160***	9/86	13.4	100	610 m	4600	0.02	-	47
122 Selenium	7782-49-2	20	5	9/87	10 @	-	170 m,ntr	9000 ntr	0.005	-	6.0
123 Silver	7440-22-4	4.1***	-	10/80	50 @	-	170 ntr	110000 ntr	0.005	-	0.5
124 Thallium	7440-28-0	-	-	-	13	48	1.7	6.2	0.000068	-	119
125 Zinc	7440-66-6	120***	110***	2/87	5000 #	-	9100 (5000#)	69000	0.3	-	47
126 Dioxin (2,3,7,8-TCDD) (c)	1746-01-6	-	-	-	0.000000013	0.000000014	0.000000013	0.000000014	-	-	5000

This chart lists all 126 of EPA's priority toxic pollutants whether or not criteria recommendations are available. A "-" indicates the absence of criteria recommendations or other information. For carcinogens, the displayed values reflect a 10^{-6} incremental risk factor. Except where indicated, all criteria are listed as micrograms per liter (ug/l). A "+" indicates a change in § 304(a) human health values compared to the August 1990 EPA Region VIII criteria chart.

EPA Region VIII Criteria Chart
July 1993 (Page 6 of 12)

OTHER POLLUTANTS w/§ 304(a) CRITERIA

	Chemical Name	CASRN	Published § 304(a) Aquatic Life Criteria CMC	CCC	Date	Published § 304(a) Human Health Criteria Water+Fish	Fish	Updated § 304(a) Human Health Values* Water+Fish	Fish	IRIS Information RfD mg/kg-dy	q_1^* kg-dy/mg	BCF l/kg
1	Aluminum (pH 6.5-9.0 only)	7429-90-5	750	87	8/88	-	-	-	-	-	-	
2	Ammonia	7664-41-7	♦	♦	1/85	-	-	-	-		-	
3	Barium	7440-39-3	-	-	-	1000@ rb	-	1000@ rb	-	0.07	-	
4	Bis(chloromethyl) Ether (c)	542-88-1	-	-	-	0.00000376	0.00184	0.00016	0.078	-	220	0.63
5	Chloride	16887-00-6	860000	230000	2/88	-	-	-	-	-	-	-
6	Chlorine (TRC)	7782-50-5	19	11	1/85	-	-	-	-	-	-	-
7	Chlorpyrifos	2921-88-2	0.083	0.041	9/86	-	-	-	-	-	-	-
8	Demeton	8065-48-3	-	0.1 rb	7/76	-	-	-	-	-	-	-
9	Dichlorodifluoromethane (HM)	75-71-8	-	-	-	0.19	15.7	6900	570000	0.2	-	3.75
10	2,4-dichlorophenoxy acetic acid (2,4-D)	94-75-7	-	-	-	100@ rb	-	100@ rb m	-	0.01	-	-
11	Dissolved gases	-	110% sat. rb		7/76	-	-	-	-	-	-	-
12	Dissolved oxygen	7782-44-7	*	*	4/86							
13	Dissolved solids	-	-	-	-	see rb	-	see rb	-	-	-	-
14	Guthion	86-50-0	-	0.01 rb	7/76	-	-	-	-	-	-	-
15	Iron	7439-89-6	-	1000 rb	7/76	300@ rb	-	300@ rb	-	-	-	-
16	Malathion	121-75-5	-	0.1 rb	7/76	-	-	-	-	-	-	-
17	Manganese	7439-96-5	-	-	-	50@ rb	-	50@ rb	-	0.02	-	-
18	Methoxychlor	72-43-5	-	0.03 rb	7/76	100@ rb	-	100@ rb m	-	0.005	-	-
19	Mirex	2385-85-5	-	0.001 rb	7/76	-	-	-	-	0.005	-	-
20	Nitrates (as N)	14797-55-8	-	-	-	10000@ rb	-	10000@ rb	-	0.0002	-	-
21	N-nitrosopyrrolidene (c)	930-55-2	-	-	-	0.016	91.9	0.017	93	1.6	-	-
22	Oil and Grease	-	-	& rb	7/76	-	-	-	-	-	2.1	0.055
23	Parathion	56-38-2	0.065	0.013	9/86	-	-	-	-	-	-	-
24	Pentachlorobenzene	608-93-5	-	-	-	74	85	3.5	4.1	0.0008	-	2125
25	Solids	-	-	+ rb	-	-	-	-	-	-	-	-
26	Sulfide-Hydrogen Sulfide	7783-06-4	-	2 rb	7/76	-	-	-	-	-	-	-
27	1,2,4,5-tetrachlorobenzene	95-94-3	-	-	-	38	48	2.3	2.9	0.0003	-	1:25
28	Trichlorofluoromethane (HM)	75-69-4	-	-	-	0.19	15.7	10000	860000	0.3	-	3.75
29	2,4,5-trichlorophenol	95-95-4	-	-	-	1#(2600)	-	2600(1#)	9800	0.1	-	110
30	2-(2,4,5-trichlorophenoxy)-proprionic acid (2,4,5-TP)	93-72-1	-	-	-	10@ rb	-	10@ rb	-	0.008	-	-

This chart lists pollutants not listed in CWA § 307(a) for which EPA has issued criteria guidance under CWA § 304(a). A "-" indicates the absence of criteria recommendations or other information. For carcinogens, the displayed values reflect a 10^{-6} incremental risk factor. Except where indicated, all criteria are listed as micrograms per liter (ug/l).