APPENDIX A
Aquatic Toxicity Data

Table A-1. Acute toxicity of synfuels chemicals to aquatic animals.

RAC	Representative chemical(s)	Test organism[a]	Test type	Duration (h)	Concentration (mg/L)	Notes	Reference
1	Carbon monoxide					No toxicity data	
2	Sulfur oxides					Aquatic problems associated with pH, not direct toxicity	
3	Nitrogen oxides					Aquatic problems associated with pH, not direct toxicity	
4	H_2S	Scud (Gammarus pseudolimnaeus)	LC_{50}	96	0.022		Oseid and Smith, 1974
		Bluegill					
		(Adults)	TLm	96	0.0448	Flow-through test	Smith et al., 1976
		(Juveniles)	TLm	96	0.0478	Flow-through test	Smith et al., 1976
		(Fry, 35-day-old)	TLm	96	0.0131	Flow-through test	Smith et al., 1976
		(Eggs)	TLm	72	0.0190	Flow-through test	Smith et al., 1976
		Northern pike			0.034-		
		(Eggs)	TLm	96	0.037	DO=2-6 ppm	Adelman and Smith, 1970
		(Fry)	TLm	96	0.009-0.026	DO=2-6 ppm	Adelman and Smith, 1970
5	Ammonia	Rainbow trout					
		(Fry, 85-day-old)	TLm	24	0.068		Rice and Stokes, 1975
		(Adults)	TLm	24	0.097		Rice and Stokes, 1975
		Rainbow trout	LC_{50}	24	0.50		Herbert and Shurben, 1963
		Rainbow trout	LC_{50}	24	0.47		Lloyd and Orr, 1969
		Rainbow trout (Fry)	LC_{50}	24	0.2		EIFAC, 1970
		(Fingerlings)	LC_{50}	24	0.2		EIFAC, 1970
6	Heptane	Mosquitofish	TLm	96	4,924		Wallen et al., 1957
7	Formaldehyde	Several fish sp.	LC_{50}	24	50-120		National Research Council, 1981
8	Carbon tetrachloride	Daphnia magna	LC_{50}	48	35.2		U.S. EPA, 1980a
		Fathead minnow	LC_{50}	96	43.1	Flow-through test	U.S. EPA, 1980a
		Bluegill	LC_{50}	96	27.3		U.S. EPA, 1980a
		Bluegill	LC_{50}	96	125.0		U.S. EPA, 1980a
	Chloroform	D. magna	LC_{50}	48	28.9		U.S. EPA, 1980b
		Bluegill	LC_{50}	96	100.0		U.S. EPA, 1980b
		Bluegill	LC_{50}	96	115.0		U.S. EPA, 1980b
		Rainbow trout	LC_{50}	96	43.8		U.S. EPA, 1980b
9	Acetic acid	Fathead minnow	LC_{50}	96	88.0		Mattson et al, 1976
		Mosquitofish	TLm	96	251.0		Wallen et al., 1957

Table A-1. (continued).

RAC	Representative chemical(s)	Test organism[a]	Test type	Duration (h)	Concentration (mg/L)	Notes	Reference
10	Volatile O&S heterocyclics					No toxicity data	
11	Pyridine	Ciliate (Tetrahymena pyriformа)	LC_{50}	72	1211.8	50% growth inhibition	Schultz et al., 1980
		D. magna	LC_{50}	48	1165		Canton and Adema, 1978
		D. magna	LC_{50}	48	1755		Canton and Adema, 1978
12	Benzene	D. magna	LC_{50}	48	203.0-620.0		U.S. EPA, 1980c
		D. magna	LC_{50}	48	426.0		Canton and Adema, 1978
		Fathead minnow	LC_{50}	96	32.0		U.S. EPA, 1980c
		Fathead minnow	LC_{30}	96	15.1	Flow-through test	DeGraeve et al., 1982
		Mosquitofish	LC_{50}	96	1300.0		Wallen et al., 1957
		Rainbow trout	LC_{50}	96	5.3	Flow-through test	U.S. EPA, 1980c
13	Cyclohexane	Fathead minnow	LC_{50}	96	93.0		Mattson et al., 1976
		Fathead minnow	TLm	96	42.3	Hard water	Pickering and Henderson, 1966a
		Fathead minnow	TLm	96	32.7	Soft water	Pickering and Henderson, 1966a
		Bluegill	TLm	96	34.7	Soft water	Pickering and Henderson, 1966a
	Indan	Fathead minnow	LC_{50}	96	14.0		Mattson et al., 1976
14	Toluene	D. magna	LC_{50}	48	39.22		Millemann et al. 1984
		Fathead minnow	TLm	96	42.3	Hard water	Pickering and Henderson, 1966a
		Fathead minnow	TLm	96	34.3	Soft water	Pickering and Henderson, 1966a
		Bluegill	TLm	96	24.0	Soft water	Pickering and Henderson, 1966a
		Bluegill	LC_{50}	96	12.7		U.S. EPA, 1980d
	Naphthalene	D. magna	LC_{50}	48	2.16		Millemann et al., 1984
		D. magna	LC_{50}	48	8.57		U.S EPA, 1980e
		Fathead minnow	LC_{50}	48	3.14		Millemann et al., 1984
		Fathead minnow	LC_{50}	96	4.90-8.90	2 tests	U.S EPA, 1980e
		Rainbow trout	LC_{50}	96	2.30		U.S EPA, 1980e
	Xylene	Fathead minnow	TLm	96	42.0		Mattson et al., 1976
		Goldfish	TLm	96	17.0		Brenniman et al., 1976
15	Anthracene					Not toxic to fish, even in super-saturated solutions	McKee and Wolf, 1963

Table A-1. (continued).

RAC	Representative chemical(s)	Test organism[a]	Test type	Duration (h)	Concentration (mg/L)	Notes	Reference
	Phenanthrene	D. magna	LC_{50}	48	0.75		Millemann et al., 1984
		D. magna	LC_{50}	48	1.10		Parkhurst, 1981
		Rainbow trout (Embryo-larvae)	LC_{50}	96	0.04		Birge and Black, 1981
	Fluoranthene	D. magna	LC_{50}	48	325.0		U.S. EPA, 1980f
		Bluegill	LC_{50}	96	3.9		U.S. EPA, 1980f
16	Aliphatic amines					No toxicity data	
17	Aniline	D. magna	LC_{50}	48	0.65		Canton and Adema, 1978
		Daphnia cucullata	LC_{50}	48	0.68		Canton and Adema, 1978
		D. magna	LC_{50}	48	0.58		Millemann et al., 1984
	3,5-Dimethylaniline	D. magna	LC_{50}	48	1.29		Millemann et al., 1984
18	Quinoline	Ciliate (T. pyriforma)	LC_{50}	72	125.7	50% growth inhibition	Schultz et al., 1980
		D. magna	LC_{50}	48	30.28		Millemann et al., 1984
		Fathead minnow	LC_{50}	48	1.50		Millemann et al., 1984
		Fathead minnow	LC_{50}	96	46.0		Mattson et al., 1976
	2-Methylquinoline	Ciliate (T. pyriforma)	EC_{50}	72	48.7	50% growth inhibition	Schultz et al., 1980
	2,6-Dimethylquinoline	Ciliate (T. pyriforma)	EC_{50}	72	33.0	50% growth inhibition	Schultz et al., 1980
19	Neutral N,O,S heterocyclics					No toxicity data	
20	Benzoic acid	Mosquitofish	TLm	96	180		Wallen et al., 1957
21	Phenol	D. magna	LC_{50}	48	19.79		Millemann et al., 1984
		D. magna	LC_{50}		9.6		U.S. EPA, 1980g
		D. magna (Young)	TLm	50	7.0		Dowden and Bennett, 1965
		Copepod (Mesocyclops leukarti)	LC_{50}		108.0		U.S. EPA, 1980g
		Fathead minnow	LC_{50}	48	25.6		Millemann et al., 1984
		Fathead minnow	LC_{50}	96	24.0-67.5	4 tests	U.S. EPA, 1980g
		Bluegill	LC_{50}		11.5-23.9	6 tests	U.S. EPA, 1980g
		Rainbow trout	LC_{50}		8.9-11.6	2 Flow-through tests	U.S. EPA, 1980g
	2-Methyphenol	D. magna	LC_{50}	48	9.2		U.S. EPA, 1980g
		D. magna	LC_{50}	48	23.5		U.S. EPA, 1980g
		Fathead minnow	TLm	96	12.55	Soft water	Pickering and Henderson, 1966a
		Fathead minnow	TLm	96	13.42	Hard water	Pickering and Henderson, 1966a

Table A-1. (continued).

RAC	Representative chemical(s)	Test organism[a]	Test type	Duration (h)	Concentration (mg/L)	Notes	Reference
		Bluegill	TLm	96	20.78	Soft water	Pickering and Henderson, 1966a
	4-Methylphenol	Fathead minnow	TLm	96	19.0		Mattson et al., 1976
	Mixed cresol isomers	Aquatic life	TLm	96	1.0-10.0		Kingsbury et al., 1979
	2,4-Dimethylphenol	D. magna	LC_{50}	48	2.12		U.S. EPA, 1980h
		Fathead minnow (Juvenile)	LC_{50}	96	16.75	Flow-through test	U.S. EPA, 1980h
		Bluegill	LC_{50}	96	7.75		U.S. EPA, 1980h
	3,4-Dimethylphenol	Fathead minnow	LC_{50}	96	14.0		Mattson et al., 1976
	2,5-Dimethylphenol	D. magna	LC_{50}	48	0.96		Millemann et al., 1984
22	Acrolein	D. magna	LC_{50}	48	0.057		U.S. EPA, 1980i
		D. magna	LC_{50}	48	0.080		U.S. EPA, 1980i
		Mosquitofish	LC_{50}	48	0.061		National Research Council, 1981
		Bluegill	LC_{50}	96	0.100		U.S. EPA, 1980i
		Bluegill	LC_{50}	96	0.090		U.S. EPA, 1980i
		Brown trout	LC_{50}	24	0.046		National Research Council, 1981
		Rainbow trout	LC_{50}	24	0.065		National Research Council, 1981
		Largemouth bass	LC_{50}	96	0.160		U.S. EPA, 1980i
	Acetaldehyde	Bluegill	LC_{50}	96	53.0		National Research Council, 1981
	Acetone	D. magna	LC_{50}	48	12,600		Canton and Adema, 1978
23	Nonheterocylic organo sulfur					No toxicity data	
24	Alcohols					No toxicity data	
25	Nitroaromatics					No toxicity data	
26	Di-2-entylhexyl phthalate	D. magna	LC_{50}		11.1		U.S. EPA, 1980j
	Diethyl phthalate	D. magna	LC_{50}		52.1		U.S. EPA, 1980j
		Bluegill	LC_{50}		98.2		U.S. EPA, 1980j
	Butylbenzl phthalate	D. magna	LC_{50}		92.3		U.S. EPA, 1980j
		D. magna	LC_{50}	48	3.7		Gledhill et al., 1980
		Fathead minnow	LC_{50}	96	5.3	160 mg/L hardness as $CaCO_3$	Gledhill et al., 1980
		Fathead minnow	LC_{50}	96	2.1	40 mg/L hardness	Gledhill et al., 1980
		Bluegill	LC_{50}		43.3		U.S. EPA, 1980j

Table A-1. (continued).

RAC	Representative chemical(s)	Test organism[a]	Test type	Duration (h)	Concentration (mg/L)	Notes	Reference
		Bluegill	LC_{50}	96	1.7		Gledhill et al., 1980
		Rainbow trout	LC_{50}	96	3.3		Gledhill et al., 1980
	Di-n-butyl phthalate	Scud (G. pseudo-limnaeus)	LC_{50}	96	2.1		Mayer and Sanders, 1973
		Fathead minnow	LC_{50}	96	1.3		Mayer and Sanders, 1973
		Bluegill	LC_{50}	96	0.73		Mayer and Sanders, 1973
		Rainbow trout	LC_{50}	96	6.47		Mayer and Sanders, 1973
27	Amides					No toxicity data	
28	Acrylonitrile	D. magna	LC_{50}		7.55		U.S. EPA, 1980k
		Fathead minnow	LC_{50}	96	14.3		U.S. EPA, 1980k
		Fathead minnow	LC_{50}	96	18.1		U.S. EPA, 1980k
		Fathead minnow	LC_{50}	96	10.1	Flow-through test	U.S. EPA, 1980k
		Bluegill	LC_{50}	96	11.8		U.S. EPA, 1980k
		Bluegill	LC_{50}		10.1		U.S. EPA, 1980k
29	Tars					No aquatic emissions	
30	Respirable particles					No aquatic emissions	
31	Arsenic	D. magna	TLm	48	7.4		Hohreiter, 1980
		D. magna	EC_{50}	48	5.28	Immobilization	Anderson, 1946
		Daphnia pulex	EC_{50}	48	1.04	Immobilization	Sanders and Cope, 1966
		Stonefly (Pteronarcys californica)	LC_{50}	96	22.04		Sanders and Cope, 1968
		Fathead minnow (Juvenile)	LC_{50}	96	15.66	Flow-through test	Cardwell et al., 1976
		Bluegill (Juvenile)	LC_{50}	96	41.76	Flow-through test	Cardwell et al., 1976
		Bluegill	LC_{50}		15.37		U.S. EPA, 1980l
		Rainbow trout	LC_{50}		13.34		U.S. EPA, 1980l
		Brook trout	LC_{50}	93	14.96	Flow-through test	Cardwell et al., 1976
32	Mercury (inorganic)	D. magna	LC_{50}	48	0.005		Biesinger and Christensen, 1972
		Stonefly (Acroneuria lycorius)	TLm	96	2.0		Warnick and Bell, 1969
		Fathead minnow	LC_{50}		0.19		U.S. EPA, 1980m
		Rainbow trout	LC_{50}		0.31		Hohreiter, 1980
		Coho salmon	LC_{50}		0.24		U.S. EPA, 1980m
		Rainbow trout (Juvenile)	LC_{50}		0.155-0.4	4 tests	U.S. EPA, 1980m
	Methylmercury	Rainbow trout	LC_{50}		0.03		Hohreiter, 1980
		Rainbow trout (Sac fry)	LC_{50}	96	0.024		Hohreiter, 1980
		(Fingerling)	LC_{50}	96	0.042		Hohreiter, 1980
		(Juvenile)	LC_{50}		0.025		U.S. EPA, 1980m
		Brook trout (Juvenile)	LC_{50}	96	0.084	Flow-through test	McKim et al., 1976
		(Yearling)	LC_{50}	96	0.065	Flow-through test	McKim et al., 1976

Table A-1. (continued).

RAC	Representative chemical(s)	Test organism[a]	Test type	Duration (h)	Concentration (mg/L)	Notes	Reference
33	Nickel	*D. magna*	LC_{50}		1.81	Hardness:51 (mg/L as $CaCO_3$)	U.S. EPA, 1980n
		D. magna	LC_{50}		2.34	Hardness:100	U.S. EPA, 1980n
		Mayfly (*Ephemerella subvaria*)	TLm	96	4.0	Hardness:42	Warnick and Bell, 1969
		Stonefly (*A. lycorius*)	TLm	96	33.5	Hardness:40	Warnick and Bell, 1969
		Damselfly (Unidentified)	TLm	96	21.2	Hardness:50	Rehwoldt et al., 1973
		Midge (*Chironomus* sp.)	TLm	96	8.6	Hardness:50	Rehwoldt et al., 1973
		Caddisfly (Unidentified)	TLm	96	30.2	Hardness:50	Rehwoldt et al., 1973
		Fathead minnow	LC_{50}		4.58-5.18	Hardness:20 2 Flow-through tests	U.S. EPA, 1980n
		Fathead minnow	TLm	96	25.0	Hardness:210 Flow-through test	Pickering, 1974
		Bluegill	TLm	96	5.18-5.36	Hardness:20 2 tests	Pickering and Henderson, 1966b
		Bluegill	TLm	96	39.6	Hardness:360	Pickering and Henderson, 1966b
		Rainbow trout	LC_{50}	96	35.5	Flow-through test	Hale, 1977
		Fish sp., general	LC_{50}	96	4.6-9.8	Soft water	Hohreiter, 1980
		Fish sp., general	LC_{50}	96	39.2-42.4	Hard water	Hohreiter, 1980
34	Cadmium	*D. magna*	LC_{50}		0.0099	Hardness:51	U.S. EPA, 1980o
		D. magna	LC_{50}		0.033	Hardness:104	U.S. EPA, 1980o
		D. magna	LC_{50}		0.049	Hardness:209	U.S. EPA, 1980o
		Mayfly (*Ephemerella grandis grandis*)	TLm	96	28.0		Clubb et al., 1975
		Mayfly (*E. subvaria*)	TLm	96	2.0	Hardness:54	Warnick and Bell, 1969
		Stonefly (*Pteronarcella badia*)	TLm	96	18.0		Clubb et al., 1975
		Damselfly (Unidentified)	TLm	96	8.1	Hardness:50	Rehwoldt et al., 1973
		Midge (*Chironomus*)	TLm	96	1.2	Hardness:50	Rehwoldt et al., 1973
		Caddisfly (Unidentified)	TLm	96	3.4	Hardness:50	Rehwoldt et al., 1973
		Fathead minnow	TLm	96	0.630	Hardness:20	Pickering and Henderson, 1966b
		Fathead minnow	TLm	96	72.6	Hardness:360	Pickering and Henderson, 1966b
		Bluegill	TLm	96	1.94	Hardness:20	Pickering and Henderson, 1966b
		Bluegill	LC_{50}		21.1	Hardness:207	U.S. EPA, 1980o
		Rainbow trout (swim-up and parr)	LC_{50}	96	0.001-0.0013	Hardness:23 2 Flow-through tests	U.S. EPA, 1980o

Table A-1. (continued).

RAC	Representative chemical(s)	Test organism[a]	Test type	Duration (h)	Concentration (mg/L)	Notes	Reference
		Rainbow trout	LC_{50}	96	0.00175	Hardness:31 Flow-through test	U.S. EPA, 1980o
		Carp	LC_{50}		0.24	Hardness:55	U.S. EPA, 1980o
		Chinook salmon (Parr)	LC_{50}		0.0035	Hardness:23	U.S. EPA, 1980o
		Brook trout	LC_{50}		0.0024	Hardness:44 (sodium sulfate)	U.S. EPA, 1980o
		Green sunfish	LC_{50}		2.84	Hardness:20	U.S. EPA, 1980o
		Pumpkinseed	LC_{50}		1.5	Hardness:55	U.S. EPA, 1980o
35	Lead	*D. magna*	LC_{50}		0.612	Hardness:54	U.S. EPA, 1980p
		D. magna	LC_{50}		0.952	Hardness:110	U.S. EPA, 1980p
		Fathead minnow	LC_{50}	96	2.4	Hardness:20	U.S. EPA, 1980p
		Fathead minnow	TLm	96	482.0	Hardness:360	Pickering and Henderson, 1966b
		Bluegill	TLm	96	23.8	Hardness:20	Pickering and Henderson, 1966b
		Bluegill	TLm	96	442.0	Hardness:360	Pickering and Henderson, 1966b
		Rainbow trout (Fry)	LC_{50}	96	0.6		Hohreiter, 1980
		Rainbow trout	LC_{50}	96	1.17	Hardness:32 Flow-through test	Davies et al., 1976
		Rainbow trout	LC_{50}	96	1.0		Hohreiter, 1980
		Rainbow trout	LC_{50}	96	8.0		U.S. EPA, 1980p
		Brook trout	LC_{50}	96	4.1	Hardness:44	U.S. EPA, 1980p
36	Fluorine	*D. magna*		48	270.0	"Toxic threshold"	Hohreiter, 1980
		Goldfish		96	120.0	100% kill	Hohreiter, 1980
		Goldfish		12-29	1000.0	100% kill in soft water	Hohreiter, 1980
		Goldfish		60-102	1000.0	100% kill in hard water	Hohreiter, 1980
		Rainbow trout	TLm	240	2.3-7.5	TLm varies with temperature	Angelovic et al., 1961

[a]Latin binomials are listed in Appendix C.

Table A-2. Chronic toxicity of synfuels chemicals to aquatic animals.

RAC	Representative chemical(s)	Test organism[a]	Test type	Duration (d)	Concentration (mg/L)	Notes	Reference
8	Carbon tetrachloride	Fathead minnow	Embryo-larval		>3.4		U.S. EPA, 1980a
	Chloroform	Rainbow trout	Embryo-larval	27	1.2	200 mg/L water hardness	U.S. EPA, 1980b
		Rainbow trout	Embryo-larval	27	2.0	50 mg/L water hardness	U.S. EPA, 1980b
		Rainbow trout	Embryo	23	10.6	40% teratogenesis	U.S. EPA, 1980b
12	Benzene	Daphnia magna	Life cycle		>98.0		U.S. EPA, 1980c
14	Naphthalene	Fathead minnow	Embryo-larval		0.62		U.S. EPA, 1980e
21	Phenol	Fathead minnow	Embryo-larval		2.56		U.S. EPA, 1980g
	2,4-Dimethylphenol	Fathead minnow	Embryo-larval		2.191		U.S. EPA, 1980h
		Fathead minnow	Embryo-larval		2.475		U.S. EPA, 1980h
22	Acrolein	D. magna	Life cycle		0.024		U.S. EPA, 1980i
		D. magna	Life cycle		0.034	Survival reduced after 64 days	National Research Council, 1981
		Fathead minnow	Life cycle		0.021		U.S. EPA, 1980i
26	Di-2-ethylhexyl phthalate	D. magna	Life cycle		<0.003		U.S. EPA, 1980j
		Rainbow trout	Embryo-larval		0.008		U.S. EPA, 1980j
	Butylbenzyl phthalate	D. magna	Life cycle		0.44		U.S. EPA, 1980j
		Fathead minnow	Embryo-larval		0.22		U.S. EPA, 1980j
28	Acrylonitrile	D. magna	Life cycle		>3.6		U.S. EPA, 1980k
		Fathead minnow	LC_{50}	30	2.6		U.S. EPA, 1980k
31	Arsenic	D. magna	Life cycle		0.912		U.S. EPA, 1980l
		D. magna	TLm	21	2.85		Hohreiter, 1980
		Bass sp., general		10	7.60	Toxic	Hohreiter, 1980
		Pink salmon		10	5.00	Lethal	Hohreiter, 1980
32	Mercuric chloride	D. magna	Life cycle		0.001 - 0.0025	4 tests	U.S. EPA, 1980m
	Methylmercuric chloride	D. magna	Life cycle		0.001		U.S. EPA, 1980m
		Fathead minnow			0.00023	92% dead, 3 months	Hohreiter, 1980
		Brook trout	Life cycle		0.00052		U.S. EPA, 1980m

Table A-2. (continued).

RAC	Representative chemical(s)	Test organism[a]	Test type	Duration (d)	Concentration (mg/L)	Notes	Reference
33	Nickel	*D. magna*	Life cycle		0.015	Hardness: 51 (mg/L as $CaCO_3$)	U.S. EPA, 1980n
		D. magna	Life cycle		0.123	Hardness: 105	U.S. EPA, 1980n
		Caddisfly (*Clistoronia magnifica*)	Life cycle		0.465	Hardness: 50	U.S. EPA, 1980n
		Fathead minnow	Embryo-larval		0.109	Hardness: 44	U.S. EPA, 1980n
		Fathead minnow	Life cycle		0.527	Hardness: 210	U.S. EPA, 1980n
		Rainbow trout	Embryo-larval		0.350	Hardness: 50	U.S. EPA, 1980n
34	Cadmium	*D. magna*	Life cycle		0.00015	Hardness: 53	U.S. EPA, 1980o
		D. magna	Life cycle		0.00021	Hardness: 103	U.S. EPA, 1980o
		D. magna	Life cycle		0.00044	Hardness: 209	U.S. EPA, 1980o
		Midge (*Tanytarsus dissimilis*)			0.0031		U.S. EPA, 1980o
		Fathead minnow	Life cycle		0.046	Hardness: 201	U.S. EPA, 1980o
		Bluegill	Life cycle		0.050	Hardness: 207	U.S. EPA, 1980o
		Brook trout	Embryo-larval		0.0017	Hardness: 36	U.S. EPA, 1980o
		Brook trout	Embryo-larval		0.0092	Hardness: 187	U.S. EPA, 1980o
35	Lead	*D. magna*	Life cycle		0.012	Hardness: 52	U.S. EPA, 1980p
		D. magna	Life cycle		0.128	Hardness: 151	U.S. EPA, 1980p
		Stonefly (*Acroneuria lycorias*)	LC_{50}	14	64.0		Hohreiter, 1980
		Mayfly (*Ephemerella subvaria*)	LC_{50}	7	16.0		Hohreiter, 1980
		Caddisfly (*Hydropsyche betteri*)	LC_{50}	7	32.0		Hohreiter, 1980
		Bluegill	Embryo-larval		0.092	Hardness: 41	U.S. EPA, 1980p
		Rainbow trout	Embryo-larval		0.019	Hardness: 28	U.S. EPA, 1980p
		Rainbow trout	Embryo-larval		0.102	Hardness: 35	U.S. EPA, 1980p
36	Fluorine	Rainbow trout		21	113.0	100% kill, 45 mg/L $CaCO_3$	Hohreiter, 1980
		Rainbow trout		21	250.0	100% kill, 320 mg/L $CaCO_3$, yearling trout	Hohreiter, 1980

[a]Latin binomials are listed in Appendix C.

Table A-3. Toxicity of synfuels chemicals to algae.

RAC	Representative chemical(s)	Test organism	Test type	Duration (h)	Concentration (mg/L)	Notes	Reference
12	Benzene	Chlorella vulgaris	EC_{50}	48	525.0	Reduction in cell numbers	U.S. EPA, 1980c
14	Toluene	C. vulgaris	EC_{50}	24	245.0	Reduction in cell numbers	U.S. EPA, 1980d
		Selenastrum capricornutum	EC_{50}	96	433.0	Reduction in cell numbers and chlorophyll a production	U.S. EPA, 1980d
	Naphthalene	C. vulgaris	EC_{50}	48	33.0	Reduction in extrapolated cell numbers	U.S. EPA, 1980e
		Chlamydomonas angulosa	EC_{61}	24	34.4	61% mortality of cells	U.S. EPA, 1980e
15	Fluoranthene	S. capricornutum	EC_{50}	96	54.4	Reduction in cell numbers	U.S. EPA, 1980f
		S. capricornutum	EC_{50}	96	54.6	Reduction in chlorophyll a production	U.S. EPA, 1980f
17	Aniline	Agmenellum quadruplicatum			0.010	Diffusion from disk onto algal lawn inhibited growth for 3-7 days	Batterton et al., 1978
	p-Toluidene	A. quadruplicatum			0.010	Same as above for all 4 species	Batterton et al., 1978
		Coccochloris elabens			0.010		
		Eucapsis sp.			0.010		
		Oscillatoria williamsii			0.010		
21	Phenol	S. capricornutum			20.0	Growth inhibition of 12-66% depending on time (2-3 d) and temperature (20, 24, 28°C)	U.S. EPA, 1980g
		S. capricornutum	EC_{50}	24	40.0	Reduction in cell numbers	U.S. EPA, 1980g
		Nitzschia linearis	EC_{50}	120	258.0	Reduction in cell numbers	U.S. EPA, 1980g
		Chlorella pyrenoidosa	EC_{100}	48	1500.0	Complete destruction of chlorophyll	U.S. EPA, 1980g
	2,4-Dimethylphenol	C. vulgaris	EC_{20}	80	470.0	Growth inhibition	U.S. EPA, 1980g
		C. pyrenoidosa	EC_{100}	48	500.0	Complete destruction of chlorophyll	U.S. EPA, 1980g

Table A-3. (continued).

RAC	Representative chemical(s)	Test organism	Test type	Duration (h)	Concentration (mg/L)	Notes	Reference
26	Butylbenzyl phthalate	*S. capricornutum*	EC_{50}	96	0.11	Reduction in chlorophyll *a*	U.S. EPA, 1980j
		S. capricornutum	EC_{50}	96	0.13	Reduction in cell numbers	U.S. EPA, 1980j
		Microcystis aeruginosa	EC_{50}	96	1000.0	Reduction in cell numbers	U.S. EPA, 1980j
		Navicula pelliculosa	EC_{50}	96	0.60	Reduction in cell numbers	U.S. EPA, 1980j
	Dimethyl phthalate	*S. capricornutum*	EC_{50}	96	42.7	Reduction in chlorophyll *a*	U.S. EPA, 1980j
		S. capricornutum	EC_{50}	96	39.8	Reduction in cell numbers	U.S. EPA, 1980j
	Diethyl phthalate	*S. capricornutum*	EC_{50}	96	90.3	Reduction in chlorophyll *a*	U.S. EPA, 1980j
		S. capricornutum	EC_{50}	96	85.6	Reduction in cell numbers	U.S. EPA, 1980j
31	Arsenic	*Cladophora*, *Spirogyra*, *Zygnema* sp.	EC_{100}	336	2.32	100% kill	U.S. EPA, 1980l
		Scenedesmus sp.		96	20.0	Threshold effects	Cushman et al., 1977
32	Mercuric chloride	*C. vulgaris*	EC_{50}	768	1.03	Cell division inhibition	U.S. EPA, 1980m
		Spring diatom assemblages	EC_{50}	2	0.08	Reduction in photosynthetic activity	U.S. EPA, 1980m
	Methylmercuric chloride	*Coelastrum microporum*	EC_{50}		2.4-4.8	Growth inhibition	U.S. EPA, 1980m
33	Nickel	*Chlamydomonas*, *Chlorella*, *Haematococcus*, *Scenedesmus* sp.			0.1-0.7	Growth reduced in all cultures in water with 50 mg/L $CaCO_3$	U.S. EPA, 1980n
		Phormidium ambiguum	EC_{16}	336	0.5-10.0	Growth inhibition	Cushman et al., 1977
		Scenedesmus			1.5	Threshold effects	Cushman et al., 1977
34	Cadmium	*Scenedesmus* sp.			0.0061	Reduction in cell numbers	U.S. EPA, 1980o
		Scenedesmus sp.			0.05-0.5	Growth inhibition	Cushman et al., 1977
		C. pyrenoidosa			0.25	Growth inhibition	U.S. EPA, 1980o
		C. vulgaris	EC_{50}		0.06	Growth reduction	U.S. EPA, 1980o
		S. capricornutum			0.05	Growth reduction	U.S. EPA, 1980o
		Mixed species			0.005	Population reduction	U.S. EPA, 1980o

Table A-3. (continued).

RAC	Representative chemical(s)	Test organism	Test type	Duration (h)	Concentration (mg/L)	Notes	Reference
35	Lead	Ankistrodesmus sp.	EC_{24}		1.00	Growth inhibition	U.S. EPA, 1980p
		Chlorella sp.	EC_{53}		0.50	Growth inhibition	U.S. EPA, 1980p
		Scenedesmus sp.	EC_{35}		0.50	Growth inhibition	U.S. EPA, 1980p
		Selenastrum sp.	EC_{52}		0.50	Growth inhibition	U.S. EPA, 1980p
		Anabaena sp.	EC_{50}	24	15.0-26.0	Reduction in CO_2 fixation	U.S. EPA, 1980p
		Chlamydomonas sp.	EC_{50}	24	17.0	Reduction in CO_2 fixation	U.S. EPA, 1980p
		Cosmarium sp.	EC_{50}	24	5.0	Reduction in CO_2 fixation	U.S. EPA, 1980p
		Navicula sp.	EC_{50}	24	17.0-28.0	Reduction in CO_2 fixation	U.S. EPA, 1980p
		Scenedesmus sp.			2.5	Threshold effects	Cushman et al., 1977

APPENDIX B
Terrestrial Toxicity Data

Table B-1. Toxicity of chemicals in air to vascular plants.

RAC	Representative chemical	Test organism[a]	Response	Exposure: Duration (hours)	Exposure: Concentration ($\mu g/m^3$)	Notes[b]	Reference
1	Carbon monoxide	Grapefruit	-CO_2 uptake		1.8 E03	detached leaves	National Research Council, 1977a
		Red clover	-20% N fixation		1.1 E05		National Research Council, 1977a
		Several species	-Growth	552	1.1 E07		National Research Council, 1977a
		Popinac	Defoliation	24	2.3 E07		National Research Council, 1977a
2	Sulfur dioxide[c]	Barley	-44% yield	72/wk	3.9 E02	field, growing season	U.S. EPA, 1982
		Durum wheat	-42% yield	72/wk	3.9 E02	field, growing season	U.S. EPA, 1982
		Alfalfa	-26% foliage	100	1.3 E02	5 hr/d, 5 d/wk, 4 wk	U.S. EPA, 1982
		Tobacco, Bel W3	-22% foliage	100	1.3 E02	5 hr/d, 5 d/wk, 4 wk	U.S. EPA, 1982
		Cocksfoot	-40% total wt.	2070	1.78 E02	103.5 hr/wk, 20 wk	U.S. EPA, 1982
		Broadbean	Reduced net photosynthesis	8	9.2 E01		U.S. EPA, 1982
		White pine	Needle damage threshold	6	6.5 E01	sensitive clone	U.S. EPA, 1982
		Norway spruce	-25% volume growth	1680	1.3 E02		U.S. EPA, 1982
3	Nitrogen dioxide	Wheat	-12% straw yield	334	2 E03		Zahn, 1975
		Bush bean	-27% yield	639	2 E03		Zahn, 1975
		Spruce	-7% linear growth	1900	2-3 E03	-17% linear growth in following year	Zahn, 1975
		Endive	-37% yield	620	2 E03		Zahn, 1975
		Carrot	-30% yield	357	4 E03		Zahn, 1975
		Tobacco, bean, tomato, radish, oat, soybean	Visible foliar injury	4	3.8 E03		Heck and Tingey, 1979
		Cocksfoot and meadow grass	-Yield	2070	2.1 E02	103.5 h/wk, 20 wk	Ashenden and Mansfield, 1978
4	Hydrogen sulfide	Green bean	-20% photosynthesis	3	7.0 E02		Taylor, in press
		Green bean	-25% whole plants yield	64	2.8 E02	4 h/d, 4 d/wk for 4 wk	Taylor, in press
		Alfalfa	-39% yield	672-840	4.2 E02	continuous fumigation	Thompson and Kats, 1978
		Lettuce	-66% yield	2112	4.2 E02	continuous fumigation	Thompson and Kats, 1978
		Douglas-fir	-weight and	5904	4.2 E02	continuous fumigation	Thompson and Kats, 1978
		Sugar beets	-38% sugar	3216	4.2 E02	continuous fumigation	Thompson and Kats, 1978
			+43% sugar	3216	4.2 E01	continuous fumigation	Thompson and Kats, 1978
5	Ammonia	Mustard	Injury	4	2.1 E03		National Research Council, 1979b

Table B-1. (continued).

RAC	Representative chemical	Test organism[a]	Response	Exposure Duration (hours)	Exposure Concentration ($\mu g/m^3$)	Notes[b]	Reference
6	Ethylene	African marigold	Epinasty	20	1.15 E00		National Air Pollution Control Administration, 1970
		Carnation	Flowers do not open	72	1.15 E02		National Air Pollution Control Administration, 1970
		Cotton	Growth inhibition	720	6.85 E02		National Air Pollution Control Administration, 1970
		Lily family	Growth inhibition	168	8.60 E02		National Air Pollution Control Administration, 1970
		Various plants	Growth inhibition	240	2.39 E03		National Air Pollution Control Administration, 1970
7	Formaldehyde	Alfalfa	Injury	5	4.9 E02		National Research Council, 1981
		Petunia	Necrosis and leaf symptoms	48	2.47 E02		Kingsbury et al., 1979
8	Vinyl chloride	Cowpea, cotton, squash	Injury	168	2.6 E05		Heck and Pires, 1962
12	Benzene	Pinto bean	Red-bordered spots	0.6	3.0 E04		Kingsbury et al., 1979
13	Cyclohexene	Runner bean	LD_{50}, toxicity to leaves	1	1.12 E12		Ivens, 1952
14	Toluene	Pinto bean	Bronze color	0.6	1.88 E05		Kingsbury et al., 1979
17	Aniline	Loblolly pine	Damage	3	2.7 E02		Cheeseman and Perry, 1977
22	Acrolein	Alfalfa	Oxident-type damage	9	2.5 E02		Kingsbury et al., 1979
23	Carbonyl sulfide	Runner bean	LD_{50}, toxicity to leaves	1	2.7 E03		Ivens, 1952
		Green bean	-13% growth	64	4.9 E02	4 h/d, 4 d/w for 4 wk	Taylor, in press

Table B-1. (continued).

RAC	Representative chemical	Test organism[a]	Response	Exposure Duration (hours)	Exposure Concentration ($\mu g/m^3$)	Notes[b]	Reference
32	Mercury (metalic)	Rose	Severe damage		1.0 E01		Stahl, 1969
		Sugar beet	Damage	5	2.8 E02		Waldron and Terry, 1975
		English ivy	Damage	12	1.5 E04		Waldron and Terry, 1975
		Coleus, Thevetia and Ricinus	Abscision	168	1.0 E01		Siegel and Siegel, 1979
	Mercuric chloride	Thevetia and Ricinus	Necrosis	168	1.0 E01		Siegel and Siegel, 1979
	Dimethylmercury	Coleus, Thevetia and Ricinus	Abscision	36	1.0 E01		Siegel and Siegel, 1979

[a]Latin binomials are listed in Appendix C.

[b]Unless "field" is noted, results are for laboratory studies.

[c]See also Table 4.

Table B-2. Toxicity of chemicals in soil or solution to vascular plants.

RAC	Representative chemical	Test organism* and life stage	Test medium	Response	Duration	Concentration (µg/g)	Reference
9	Acetic acid	Barley (seedling)	Solution in sand	Root growth inhibition	5d	600	Lynch, 1977
11	Methyl pyridine	Alfalfa (sprout)	Solution	Root growth inhibition	4d	93.1	Naik et al.,1972
13	Hexene	Oat (seedling)	Solution	Mortality		25.2	Chen and Elofson, 1978
14	Xylene	Sugar beet (seedling)	Solution	Root growth inhibition	2d	100	Allen et al., 1951
15	Benzo(a)pyrene	Corn (sprout)	Solution	Root growth stimulation	6h	0.0005	Deubert et al., 1979
	3,4-benzopyrene	Tobacco (seedling)	Soil	78% growth stimulation	60d	0.01	Graf and Nowak, 1966
	1,2-benzanthracene	Tobacco (seedling)	Soil	80% growth stimulation	60d	0.02	Graf and Nowak, 1966
	1,2,5-6-di-benzanthrancene	Tobacco (seedling)	Soil	130% growth stimulation	60d	0.02	Graf and Nowak, 1966
16	Dimethylalkylamine	Gram, rice	Solution	Mortality		7.0	Dutta et al., 1972
19	Benzothiophene	Cucumber (sprout)	Solution	9% root growth inhibition	4d	10	Schlesinger and Mowry, 1951
	Indole, 3-ethyl-1H	Oat, cress, mustard (sprout)	Solution	Growth inhibition		100	Davies et al., 1937
	Indole-3 -acetic acid, 1H	Oat, cress, mustard (sprout)	Solution	Growth inhibition		100	Davies et al., 1937
		Cucumber	Solution	Mortality	11d	35	Hilton and Nomura, 1964
		Pea (sprout)	Solution	Germination reduced by >50%	8h	10	Shukla, 1972
20	Benzoic acid	Lettuce (seedling)	Solution on filter paper	23% growth inhibition		25	Chou and Patrick, 1976
	2-hydroxy -benzoic acid	Rice (seedling)	Soil	Seedling growth inhibition	5d	1.6	Gaur and Pareek, 1975
		Lettuce (seedling)	Solution on filter paper	61% growth inhibition		25	Chou and Patrick, 1976
21	Phenol	Durum wheat (seed)	Solution	Germination inhibition	4d	2000	Badilescu et al., 1967
22	4-hydroxy -benzaldehyde	Lettuce (seedling)	Solution on filter paper	26% growth inhibition		100	Chou and Patrick, 1976

Table B-2. (continued).

RAC	Representative chemical	Test organism* and life stage	Test medium	Response	Duration	Concentration (µg/g)	Reference
22	Acrolein	Alfalfa		Oxidant-type damage	9h	0.1	Kingsbury et al., 1979
23	Carbon disulfide	Apple	Soil	Root injury		420	Underhill and Cox, 1940
24	Ethanol	Lettuce (seed)	Solution	Germination inhibition	44h	1,000,000	Meyer and Mayer, 1971
27	N,N-dimetnyl-formamide	Lettuce (seed)	Solution	Nearly total suppression of germination	24h	1,000,000	Meyer and Mayer, 1971
	2-methyl -benzamide	Poppy, chickweed, carrot, ryegrass corn, lucerne (mature)	Soil	13-87% reduction in yield	3-5w	220,000	Pizey and Wain, 1959
31	Arsenic[a]	Corn (seedling)	Soil	10% growth reduction (wet tissue weight)	4w	64	Woolson, et al., 1971
		Cotton (mature)	Soil (fine sandy loam)	Approx. 55% reduction in yield	6w	8[b]	Deuel and Swoboda, 1972
		Cotton (mature)	Soil (clay)	Approx. 40% reduction in yield	6w	28[b]	Deuel and Swoboda, 1972
		Soybean (mature)	Soil (fine sandy loam)	Approx. 45% reduction in yield	6w	3[b]	Deuel and Swoboda, 1972
		Soybean (mature)	Soil (clay)	Approx. 40% reduction in yield	6w	12[b]	Deuel and Swoboda, 1972
		Cowpea	-	Retarded growth	-	1[b]	Albert and Arndt, 1932
32	Mercury	Barley (seed-sprout)	Solution	12% growth reduction (fresh weight)	7d post germination	5 (as Hg^{++})	Mukhiya et al., 1983
		Barley (seed-sprout)	Solution	12% growth reduction (fresh weight)	7d post germination	1 (as PMA)[c]	Mukhiya et al., 1983
		Lettuce (seed-sprout)	Solution	68% reduction in elongation of lettuce hypocotyl	5d post germination	109 (as $HgCl_2$)	Nag et al., 1980
33	Nickel	Corn (mature)	Solution	10% decrease in net photosynthesis	7d	5	Carlson et al., 1975
		Sunflower (mature)	Solution	10% decrease in net photosynthesis	7d	0.8	Carlson et al., 1975

Table B-2. (continued).

RAC	Representative chemical	Test organism* and life stage	Test medium	Response	Duration	Concentration (µg/g)	Reference
33		Oats (seeds-seedlings)	Solution in coarse sand	Stunted growth	Up to 22d post germination	10	Vergnano and Hunter, 1963
		Oats (mature)	Soil	Decreased grain yield	Whole life	50	Halstead et al., 1969
		Barley (seedling)	Solution in sand	Over 50% reduction in whole plant fresh weight	3w	281 ($NiSO_4 \cdot 7H_2O$)	Agarwala et al., 1977
34	Cadmium	Corn (mature)	Solution	10% decrease in net photosynthesis	7d	0.9	Carlson et al., 1975
		Sunflower (mature)	Solution	10% decrease in net photosynthesis	7d	0.45	Carlson et al., 1975
		Soybeans (mature)	Solution in sand and vermiculite	35% decrease in fresh weight of pods	90d	2	Huang et al., 1974
		Bean (5 weeks old)	Solution	50% growth reduction	3w	0.2	Page et al., 1972
		Beet (5 weeks old)	Solution	50% growth reduction	3w	0.2	Page et al., 1972
		Turnip (5 weeks old)	Solution	50% growth reduction	3w	0.2	Page et al., 1972
		Corn (5 weeks old)	Solution	50% growth reduction	3w	1.2	Page et al., 1972
		Lettuce (5 weeks old)	Solution	50% growth reduction	3w	0.9	Page et al., 1972
		Tomato (5 weeks old)	Solution	50% growth reduction	3w	4.8	Page et al., 1972
		Barley (5 weeks old)	Solution	50% growth reduction	3w	5.6	Page et al., 1972
		Pepper (5 weeks old)	Solution	50% growth reduction	3w	2.0	Page et al., 1972
		Cabbage (5 weeks old)	Solution	50% growth reduction	3w	9.0	Page et al., 1972
		Soybean (seedling)	Soil (silty clay loam)	15% reduction in yield (dry weight)	5w	2.5	Haghiri, 1973
		Wheat (seedling)	Soil (silty clay loam)	20% reduction in yield (dry weight)	5w	2.5	Haghiri, 1973
		Lettuce (mature)	Soil (silty clay loam)	40% reduction in yield (fresh weight)	Whole life	2.5	Haghiri, 1973

Table B-2. (continued).

RAC	Representative chemical	Test organism* and life stage	Test medium	Response	Duration	Concentration (µg/g)	Reference
34		Sycamore (sapling)	Soil (6:1 silty clay loam & perlite)	25% reduction in new stem growth	90d	39	Carlson and Bazzaz, 1977
35	Lead	Soybeans (mature)	Solution in sand and vermiculite	35% decrease in fresh weight of pods	90d	62	Huange et al., 1974
		Lettuce (44d old)	Soil (silty clay loam)	25% reduction in yield	30d	1000 $(Pb(NO_3)_2$	John and VanLaerhoven 1972
		Corn (25d seedling)	Vermiculite and solution	20% decrease in photosynthesis	11-21d	1000	Bazzaz et al., 1974
		Soybean (25d seedling)	Vermiculite and solution	20% decrease in photosynthesis	11-21d	2000	Bazzaz et al., 1974
		Sycamore (sapling)	Soil (6:1 silty clay loam & perlite)	25% reduction in new stem growth	90d	500	Carlson and Bazzaz, 1977

*Latin binomials are listed in Appendix C.

[a]Arsenic shows a stimulatory effect on plants when present at low concentrations (40-50 µg/g total As or 5 µg/g extractable As in soil) (Woolson et al., 1971).

[b]Concentration of water extractable contaminant.

[c](PMA-Phenyl mercuric acetate).

Table B-3. Toxicity of chemicals in air to animals.

RAC	Representative chemical	Test organism[a]	Response	Exposure		Notes	Reference
				Duration (hours)	Concentration ($\mu g/m^3$)		
1	Carbon monoxide	Rabbit	Aortic lesions	4	1.51 E05		National Research Council, 1977a
		Dog	Heart damage	1008	4.3 E04		National Research Council, 1977a
		Chicken	75% egg hatch	432	4.9 E05	egg exposed	National Research Council, 1977a
		Rabbit	90% neonate survival	720	1.0 E05	mother exposed	National Research Council, 1977a
		Human	Lethality		9.2 E08		Cleland and Kingsbury, 1977
2	Sulfur dioxide	Guinea pig	Increased airway resistance	1	4.2 E02		U.S. EPA, 1982
		Guinea pig	LT_{50}	1.1	5.8 E06		U.S. EPA, 1982
		Dog	Increased airway resistance	5,400	1.3 E04		U.S. EPA, 1982
		Chicken	Modified nasal clearance		3.7 E03	Intermittent exposure, 7 d	Wakabayashi et al., 1977
	Sulfuric acid	Guinea pig	Respiratory function	1	1.0 E02		Wakabayashi et al., 1977
		Guinea pig	Lethality	8	1.8 E04		Wakabayashi et al., 1977
		Dog	Respiratory function	4,725	8.9 E02		Wakabayashi et al., 1977
3	Nitrogen dioxide	Guinea pig	LC_{50}	1	1.5 E05		National Research Council, 1977b
		Rat	11% lethality	5,120	2.3 E04		National Research Council, 1977b
		Rat	Bronchial damage	24	2.8 E04		National Research Council, 1977b
		Mouse	Defects in pulmonary microbial defense	24	3.8 E03		National Research Council, 1977b
		Rat and mouse	Pulmonary pathologies	Chronic	9.4 E02	Also decreased resistance to infection	National Research Council, 1977b
4	Hydrogen sulfide	Canaries, rats and dogs	Pulmonary irritation	Subacute	7.0 E04	No established chronic effects	National Research Council, 1979a

Table B-3. (continued).

RAC	Representative chemical	Test organism[a]	Response	Exposure Duration (hours)	Exposure Concentration ($\mu g/m^3$)	Notes	Reference
5	Ammonia	Chicken	Increased disease susceptibility	72	1.3 E04	Newcastle virus	National Research Council, 1979b
		Pig	Respiratory irritation	840	4.3 E04		National Research Council, 1979b
		Rabbit	LT_{50}	33	7.0 E06		National Research Council, 1979b
		Mouse	Lethal threshold	16	7.0 E05		National Research Council, 1979b
		Human	Throat irritation	Immediate	2.8 E05		National Research Council, 1979b
6	Acetylene	Human	Unconsciousness	0.08	3.7 E08		National Research Council, 1976
7	Formaldehyde	Rat	LC_{50}	4	5.7 E05		National Research Council, 1981
		Guinea pigs	Increased airway resistance	1	3.6 E02		National Research Council, 1981
		Rat	Respiratory and eye irritation and liver weight loss	1400	1.0 E03		National Research Council, 1981
8	Chloroform	Mouse	LC_{50}		1.4 E05		Kingsbury et al., 1979
		Human	Enlarged liver	Chronic	4.9 E04	In workplace air	Kingsbury et al., 1979
9	Acetic acid	Mouse	LC_{50}	1	1.4 E07		Kingsbury et al., 1979
		Human	Irritation	0.05	2.0 E06		Kingsbury et al., 1979
		Human	Respiratory, stomach and skin irritation	Chronic	1.5 E05	7-12 years, workplace exposure	National Research Council, 1976
10	Furan	Rat	Lethal threshold	8-48	2.4 E08		Kingsbury et al., 1979
	Thiophene	Mouse	Lethal threshold	8-48	3.0 E07		Kingsbury et al., 1979
11	Pyridine	Rat	LC_{50}	4	1.3 E07		Kingsbury et al., 1979
	2-Ethylpyridine	Rat	LC_{100}	3	2.4 E07		Kingsbury et al., 1979
12	Benzene	Human	Lethal threshold	Chronic	1.9 E05	Workplace exposure	National Research Council, 1976

Table B-3. (continued).

RAC	Representative chemical	Test organism[a]	Response	Exposure Duration (hours)	Exposure Concentration ($\mu g/m^3$)	Notes	Reference
13	Pentane	Mouse	Lethality	--	3.8 E08		Kingsbury et al., 1979
	Cyclopentane	Mouse	Lethality	--	1.1 E08		Kingsbury et al., 1979
	Hexane	Mouse	Lethality		1.2 E08		Kingsbury et al., 1979
		Human	Dizziness	0.17	1.8 E07		Kingsbury et al., 1979
	Cyclohexane	Rabbit	Lethality	1	9.2 E07		Kingsbury et al., 1979
		Rabbit	Narcosis and convulsions	1	4.5 E07		Kingsbury et al., 1979
	Heptane	Human	Dizziness	0.10	4.1 E06		Kingsbury et al., 1979
	Butadiene	Human	Respirtory and eye irritation	8	1.8 E07		Kingsbury et al., 1979
	Cyclopentadine	Rat	Liver and kidney damage	245	1.4 E06	expsoure = 7 hr/day for 35 days	Kingsbury et al., 1979
14	Toluene	Rat	Lethal threshold	4	1.5 E07		Kingsbury et al., 1979
		Human	Psychological effects	--	3.8 E05		Kingsbury et al., 1979
	Ethyl benzene	Rat	Lethal threshold	4	1.7 E07		Kingsbury et al., 1979
		Human	Eye irritation	<0.08	8.8 E05		Kingsbury et al., 1979
	p-Xylene	Mouse	Lethal threshold	4	1.5 E07		Kingsbury et al., 1979
	Tetrahydro-napnthalene	Guinea pig	Lethal threshold	136	1.5 E06	8 hours for 17 days	Kingsbury et al., 1979
	Naphthalene	Human	Eye irritation and damage	--	7.9 E04		Kingsbury et al., 1979
15	(No data on respiratory toxicity but several members of this RAC are carcinogens)						Kingsbury et al., 1979
16	Ethylamine	Rat	Lethal threshold	4	5.5 E06		Kingsbury et al., 1979
		"Animals"	Lung, liver and kidney damage	1008	1.8 E05		Kingsbury et al., 1979
	1-Aminopropane	Rat	LC_{50}	4	5.6 E06		Kingsbury et al., 1979
17	Aniline	Rat	LC_{50}	4	9.5 E05		Kingsbury et al., 1979
	Dimethylanaline	Mouse	LC_{50}	7	7.4 E05	Mixed isomers	Kingsbury et al., 1979
18	(No data on respiratory toxicity)						
19	(No data on respiratory toxicity)						
20	(No data on respiratory toxicity)						
21	(No data on respiratory toxicity)						

Table B-3. (continued).

RAC	Representative chemical	Test organism[a]	Response	Exposure Duration (hours)	Exposure Concentration ($\mu g/m^3$)	Notes	Reference
22	Acrolein	Rat	LC_{50}	4	1.8 E04		National Research Council, 1981
		Monkey	Respiratory system damage	2,160	5.1 E02		National Research Council, 1981
	Acetaldehyde	Mice, rabbits and guinea pigs	LC_{50}	4	2.0 E06		National Research Council, 1981
	Proprionaldehyde	Rat	LC_{50}	0.5	6.2 E07		National Research Council, 1981
		Rat	Reduced weight gain	36	3.1 E06	6 h/d x 6 d	National Research Council, 1981
	Butyraldehyde	Rat	LC_{50}	0.5	1.7 E08		National Research Council, 1981
	Butanone	Mouse	LC_{50}	0.75	6.1 E08		National Research Council, 1981
23	Methyl mercaptan	Rat	Lethal threshold	--	2.0 E07		Kingsbury et al., 1979
	Ethyl mercaptan	Rat	LC_{50}	--	1.1 E07		Kingsbury et al., 1979
		Human	Central nervous system effects	--	1.0 E04		Kingsbury et al., 1979
	n-Butyl mercaptan	Rat	LC_{50}	4	1.5 E07		Kingsbury et al., 1979
		Human	"Toxic effect"	3	1.0 E04		Kingsbury et al., 1979
	Thiophenol	Rat	LC_{50}	4	1.5 E05		Kingsbury et al., 1979
	Carbon disulfide	Human	Central nervous system effects		5.0 E04	7 years exposure	Cleland and Kingsbury, 1977
24	Methanol	Monkey	LC_{50}		1.3 E06		Kingsbury et al., 1979
		Human	Central nervous system effects		7.5 E04		Kingsbury et al., 1979
	Ethanol	Human	Eye and respiratory irritation and mental effects		1.9 E06		Kingsbury et al., 1979
25	(No data on respiratory toxicity)						Kingsbury et al., 1979
26	Methyl acetate	Human	Severe toxic effects	1	1.5 E06		Kingsbury et al., 1979
	Methyl methacrylate	Rat	LC_{50}	1	1.5 E07		Kingsbury et al., 1979
	Butyl acetate	Human	Throat irritation		9.6 E05		Kingsbury et al., 1979
		Human	Toxic effects	1	9.6 E06		Kingsbury et al., 1979
	n-Amyl acetate	Human	Toxic threshold	0.5	1.0 E06		Kingsbury et al., 1979
27	(No data on respiratory toxicity)						Kingsbury et al., 1979
28	Acetonitrile	Rat	Lethal threshold	4	1.3 E07		Kingsbury et al., 1979
		Human	Bronchial effects		2.7 E05		Kingsbury et al., 1979
	Acrylonitrile	Rat	Lethal threshold	4	1.1 E06		Kingsbury et al., 1979

Table B-3. (continued).

RAC	Representative chemical	Test organism[a]	Response	Exposure Duration (hours)	Exposure Concentration ($\mu g/m^3$)	Notes	Reference
29	(No data on respiratory toxicity)						Kingsbury et al., 1979
30	Fly ash	Monkey	Slight lung fibrosis	13,390	4.6 E02		National Research Council, 1979c
31	Arsenic trioxide	Rat	Weight lag and physiological effects	24	2.5 E01		National Research Council, 1977c
32	Mercury (metal)	Human	Toxic threshold		1.0 E03		Cassidy and Furr, 1978
		Rabbit	Toxic threshold		2.9 E04		Cassidy and Furr, 1978
		Human	Central nervous system effects		1.7 E02	40 yr. exposure	Kingsbury et al., 1979
33	Nickel carbonyl	Rat	LC_{50}	0.5	2.4 E05		National Research Council, 1975
34	Cadmium oxide fumes	Human	Lethality	8	5.0 E03		Hammons et al., 1978
	Cadmium oxide dust	Human	Impaired lung function		3.15 E03	20 yr. exposure	Hammons et al., 1978
	Cadmium	Human	Pulmonary and renal effects		1.0-27 E01	Occupational exposure	Kingsbury et al., 1979
35	Lead	Human	Threshold of overt poisoning		5.0 E02	Occupational exposure	National Research Council, 1972

[a]Latin binomials are lised in Appendix C.

APPENDIX C
Common and Scientific Names of Animals and Plants

Animals

Common name	Scientific name
Bigmouth buffalo	Ictiobus cyprinellus
Black crappie	Pomoxis nigromaculatus
Bluegill	Lepomis macrochirus
Brook trout	Salvelinus fontinalis
Brown trout	Salmo trutta
Canary	Serinus canarius
Carp	Cyprinus carpio
Channel catfish	Ictalurus punctatus
Chicken	Gallus gallus
Chinook salmon	Oncorhynchus tshawytacha
Coho salmon	Oncorhynchus kisutch
Dog	Canis familiaris
Fathead minnow	Pimephales promelas
Goldfish	Carassius auratus
Green sunfish	Lepomis cyanellus
Guinea pig	Cavia cobaya
Human	Homo sapiens
Largemouth bass	Micropterus salmoides
Monkey	Macaca sp.
Mosquitofish	Gambusia affinis
Mouse	Mus musculus
Northern pike	Esox lucius
Pig	Sus scrofa
Pink salmon	Oncorhynchus gorbuscha
Pumpkinseed	Lepomis gibbosus
Rabbit	Oryctolagus cuniculus
Rainbow trout	Salmo gairdneri
Rat	Rattus rattus
Smallmouth buffalo	Ictiobus bulbalus
White bass	Morone chrysops

Plants

Common name	Scientific name
African marigold	*Tagetes* sp.
Alfalfa	*Medicago sativa*
Apple	*Malus sylvestris*
Barley	*Hordeum vulgare*
Bean	*Phaseolus vulgaris*
Broadbean	*Vicia faba*
Bush bean	*Phaseolus vulgaris*
Cabbage	*Brassica oleracea*
Carnation	*Dianthus caryophyllos*
Carrot	*Daucus carota*
Chickweed, common	*Stellaria media*
Cocksfoot	*Dactylis glomerata*
Coleus	*Coleus blumei*
Corn	*Zea mays*
Cotton	*Gossypium hirsutum*
Cowpea	*Vigna sinensis*
Cress	*Lepidium sativum*
Cucumber	*Cucumis sativus*
Durum wheat	*Triticum durum*
Endive	*Cicorium endivia*
English ivy	*Hedera helix*
Gram	*Cicer arietinum*
Grapefruit	*Citrus paradisi*
Green bean	*Phaseolus vulgaris*
Lettuce	*Lactuca sativa*
Loblolly pine	*Pinus taeda*
Lucerne	*Medicago sativa*
Meadowgrass	*Poa pratensis*
Mustard	*Brassica alba*
Norway spruce	*Picea abies*
Oat	*Avena sativa*
Oat, wild	*Avena fatua*
Pea	*Psoralea corylifolia*
Pepper	*Capsicum frutescens*
Petunia	*Petunia* sp.
Pinto bean	*Phaseolus vulgaris*
Popinac	*Acacia farnesiana*
Poppy	*Papaver* sp.
Radish	*Raphanus sativus*
Red clover	*Trifolium pratense*
Rice	*Oryza sativa*
Ricinus	*Ricinus communis*
Rose	*Rosa* sp.
Runner bean	*Phaseolus vulgaris*
Ryegrass, Italina	*Lolium multiflorum*
Soybean	*Glycine max*
Spruce	*Picea abies*
Squash	*Cucurbita* sp.

Plants (continued)

Common name	Scientific name
Sugar beet	*Beta vulgaris*
Sunflower	*Helianthus annuus*
Sycamore	*Platanus occidentalis*
Thevetia	*Thevetia neriifolca*
Tobacco	*Nicotiana tabacum*
Tomato	*Lycopersicon esculentum*
Turnip	*Brassica napus*
Wheat	*Triticum durum*
White pine	*Pinus strobus*