03.13-03/18/96-00665

FINAL

SITE SCREENING PROCESS REPORT FOR SITE SCREENING AREAS 1, 6, 7, AND 15

NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

CONTRACT TASK ORDER 0228

VOLUME II APPENDICES - G-O

MARCH 18, 1996

Prepared for:

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES
ENGINEERING COMMAND
Norfolk, Virginia

Under:

LANTDIV CLEAN Program
Contract N62470-89-D-4814

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SITE SCREENING AREA (SSA) DECISION
SIGNATURE PAGE

SSA Name and Location

SSA 1 - Building 428 Teague Road Disposal Area
SSA 6 - Aviation Field and Environs
SSA 7 - Building 373 Rocket Plant/Group 18 Magazines/Main Road Disposal Area
SSA 15 - Sewage Treatment Plant#1/Sludge Drying Beds and Discharge Area

Naval Weapons Station Yorktown
Yorktown, Virginia

Decision Statement

The Site Screening Process (SSP) is a mechanism by which former Resource Conservation Recovery Act (RCRA) Solid Waste Management Units (SWMUs), RCRA Areas of Concern (AOCs) and Comprehensive Environmental Response, Compensation and Liability Act of 1980 as amended (CERCLA) sites can be addressed uniformly by the CERCLA process. The Federal Facilities Agreement (FFA) for WPNSTA Yorktown mandates that decisions concerning SSAs be made by respective project managers to determine whether: 1) no further investigation of the SSA is necessary (i.e., no further action) or; 2) the SSA should be included as a site under the Department of Defense (DoD) Installation Restoration (IR) Program. SSAs included as sites will be numbered in ascending order in the Site Management Plan (SMP) for WPNSTA Yorktown, ranked using the DoD's Relative Risk Ranking (R^3)Program and scheduled for further investigation. The SSP Report provides the basis for SSA decision making by a review of environmental conditions, analytical data obtained at each SSA and risk screening for both potential human and ecological receptors.

The Department of the Navy (DoN) has obtained concurrence from the Commonwealth of Virginia and the United States Environmental Protection Agency (USEPA) Region III on the decisions for SSAs 1, 6, 7 and 15. These decisions are summarized below.

SSA 1 - Due to the presence of Polynuclear Aromatic Hydrocarbons (PAH) in surface soils and potential ecological impacts associated with inorganic contaminants in the unnamed ditch, this SSA will be retained for remedial investigation. The Remedial Investigation (RI) will focus on the vertical extent of PAH contamination in soils and potential ecological impacts from the unnamed ditch.

SSA 6 - Polychlorinated Biphenyls (PCBs) detected in subsurface soils samples in the vicinity of the helo-pad require further investigation. SSA 6 will, therefore, be retained as a site for further RI work to determine the extent of subsurface soil contamination specific to the helo-pad area and potential local affects on shallow groundwater.

SSA 7 - Groundwater in the vicinity of the wastewater UST has been impacted by chlorinated volatiles including 1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene and trichloroethene (TCE). A removal action is scheduled for the summer of 1996 at SSA 7. The UST will be removed and confirmational soil samples will be obtained from surrounding subsurface soils. The area around the UST will be retained for further RI work because of the impact on shallow groundwater from past activities and to determine the efficacy of the removal action.

SSA 15 - No further investigation is recommended for this SSA because potential human health risks and ecological affects for contaminants associated with sludge drying beds (derived using the risk screening approach) fall within acceptable ranges. Surface water concentrations of TCE detected in one side gradient surface water sample is associated with an upgradient groundwater source emanating from the industrial area. The upgradient source of TCE to SSA 15 surface waters and potential impacts of this contamination on Ballard Creek will be addressed in the Site 12 Record of Decision (ROD).

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USEPA Region III VA/WV Superfund Federal Facilities

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APPENDIX G
QUALITY ASSURANCE/QUALITY CONTROL SUMMARY
(ORGANICS AND INORGANICS)

FREQUENCY OF DETECTION
RINSATE BLANKS
SITE SCREENING AREA 1
SEMIVOLATILE COMPOUNDS
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	OHMRB-01	OHMRIN-02	OHMRIN-08
Sample Date	11/02/94	11/03/94	12/06/94
Units	ug/L	ug/L	ug/L
SEMIVOLATILES			
Phenol	21 U	10 U	10 U
bis(2-Chloroethyl)ether	21 U	10 U	10 U
2-chlorophenol	21 U	10 U	10 U
1,3-Dichlorbenzene	21 U	10 U	10 U
1,4-Dichlorobenzene	21 U	10 U	10 U
1,2-Dichlorobenzene	21 U	10 U	10 U
2-Methylphenol	21 U	10 U	10 U
2,2'-oxybis(1-chloropropene)	21 U	10 U	10 U
4-Methylphenol	21 U	10 U	10 U
N-Nitroso-di-n-propylamine	21 U	10 U	10 U
Hexachloroethane	21 U	10 U	10 U
Nitrobenzene	21 U	10 U	10 U
Isophorone	21 U	10 U	10 U
2-Nitrophenol	21 U	10 U	10 U
2,4-Dimethylphenol	21 U	10 U	10 U
Bis(2-chloroethoxy)-methane	21 U	10 U	10 U
2,4-Dichlorophenol	21 U	10 U	10 U
1,2,4-Trichlorobenzene	21 U	10 U	10 U
Naphthalene	21 U	10 U	10 U
4-chloroaniline	21 U	10 U	10 U
Hexachlorobutadiene	21 U	10 U	10 U
4-Chloro-3-methylphenol	21 U	10 U	10 U
2-Methylnaphthalene	21 U	10 U	10 U
Hexachlorocyclopentadiene	21 U	10 U	10 U
2,4,6-Trichlorophenol	21 U	10 U	10 U
2,4,5-Trichlorophenol	21 U	10 U	10 U
2-chloronapthalene	21 U	10 U	10 U
2-Nitroaniline	21 U	10 U	10 U
Dimethylphthalate	21 U	10 U	10 U
Acenaphthylene	21 U	10 U	10 U
2,6-Dinitrotoluene	21 U	10 U	10 U
3-Nitroaniline	21 U	10 U	10 U
Acenapthene	21 U	10 U	10 U
2,4-Dinitrophenol	110 U	10 U	51 U

FREQUENCY OF DETECTION
RINSATE BLANKS
SITE SCREENING AREA 1
SEMIVOLATILE COMPOUNDS
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	OHMRB-01	OHMRIN-02	OHMRIN-08
Sample Date	11/02/94	11/03/94	12/06/94
Units	ug/L	ug/L	ug/L
4-Nitrophenol	110 U	50 U	51 U
SEMIVOLATILES			
Dibenzofuran	21 U	50 U	10 U
2,4-Dinitrotoluene	21 U	10 U	10 U
Diethylphthalate	21 U	10 U	10 U
4-Chlorophenyl-phenylether	21 U	10 U	10 U
Fluorene	21 U	10 U	10 U
4-Nitroaniline	21 U	10 U	10 U
4,6-Dinitro-2-methylphenol	53 U	25 U	26 U
4-bromophenyl-phenylether	21 U	10 U	10 U
N-Nitrosodiphenylamine	21 U	10 U	10 U
Hexachlorobenzene	21 U	10 U	10 U
Pentachlorophenol	21 U	10 U	10 U
Phenanthrene	21 U	10 U	10 U
Anthracene	21 U	10 U	10 U
Carbazole	21 U	10 U	10 U
Di-n-butylphthalate	21 U	10 U	10 U
Fluoranthene	21 U	10 U	10 U
Pyrene	21 U	10 U	10 U
Butylbenzylphthalate	21 U	10 U	10 U
3,3-Dichlorobenzidine	21 U	10 U	10 U
Benzo(a)anthracene	21 U	10 U	10 U
Chrysene	21 U	10 U	10 U
Bis(2-ethylhexyl)-phthalate	21 U	10 U	9 J
Di-n-octylphthalate	21 U	10 U	10 U
Benzo(b)fluoranthene	21 U	10 U	10 U
Benzo(k)fluoranthene	21 U	10 U	10 U
Benzo(a)pyrene	21 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	21 U	10 U	10 U
Dibenzo(a,h)anthracene	21 U	10 U	10 U
Benzo(g,h,i)perylene	21 U	10 U	10 U

FREQUENCY OF DETECTION
RINSATE BLANKS
SITE SCREENING AREA 1
SEMIVOLATILE COMPOUNDS
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sample Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
SEMIVOLATILES						
Phenol	10 U	21 U	ND	ND		0/3
bis(2-Chloroethyl)ether	10 U	21 U	ND	ND		0/3
2-chlorophenol	10 U	21 U	ND	ND		0/3
1,3-Dichlorbenzene	10 U	21 U	ND	ND		0/3
1,4-Dichlorobenzene	10 U	21 U	ND	ND		0/3
1,2-Dichlorobenzene	10 U	21 U	ND	ND		0/3
2-Methylphenol	10 U	21 U	ND	ND		0/3
2,2'-oxybis(1-chloropropene)	10 U	21 U	ND	ND		0/3
4-Methylphenol	10 U	21 U	ND	ND		0/3
N-Nitroso-di-n-propylamine	10 U	21 U	ND	ND		0/3
Hexachloroethane	10 U	21 U	ND	ND		0/3
Nitrobenzene	10 U	21 U	ND	ND		0/3
Isophorone	10 U	21 U	ND	ND		0/3
2-Nitrophenol	10 U	21 U	ND	ND		0/3
2,4-Dimethylphenol	10 U	21 U	ND	ND		0/3
Bis(2-chloroethoxy)-methane	10 U	21 U	ND	ND		0/3
2,4-Dichlorophenol	10 U	21 U	ND	ND		0/3
1,2,4-Trichlorobenzene	10 U	21 U	ND	ND		0/3
Naphthalene	10 U	21 U	ND	ND		0/3
4-chloroaniline	10 U	21 U	ND	ND		0/3
Hexachlorobutadiene	10 U	21 U	ND	ND		0/3
4-Chloro-3-methylphenol	10 U	21 U	ND	ND		0/3
2-Methylnaphthalene	10 U	21 U	ND	ND		0/3
Hexachlorocyclopentadiene	10 U	21 U	ND	ND		0/3
2,4,6-Trichlorophenol	10 U	21 U	ND	ND		0/3
2,4,5-Trichlorophenol	10 U	21 U	ND	ND		0/3
2-chloronapthalene	10 U	21 U	ND	ND		0/3
2-Nitroaniline	10 U	21 U	ND	ND		0/3
Dimethylphthalate	10 U	21 U	ND	ND		0/3
Acenaphthylene	10 U	21 U	ND	ND		0/3
2,6-Dinitrotoluene	10 U	21 U	ND	ND		0/3
3-Nitroaniline	10 U	21 U	ND	ND		0/3
Acenapthene	10 U	21 U	ND	ND		0/3
2,4-Dinitrophenol	10 U	110 U	ND	ND		0/3

FREQUENCY OF DETECTION
RINSATE BLANKS
SITE SCREENING AREA 1
SEMIVOLATILE COMPOUNDS
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sample Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
4-Nitrophenol	50 U	110 U	ND	ND		0/3
SEMIVOLATILES						
Dibenzofuran	10 U	50 U	ND	ND		0/3
2,4-Dinitrotoluene	10 U	21 U	ND	ND		0/3
Diethylphthalate	10 U	21 U	ND	ND		0/3
4-Chlorophenyl-phenylether	10 U	21 U	ND	ND		0/3
Fluorene	10 U	21 U	ND	ND		0/3
4-Nitroaniline	10 U	21 U	ND	ND		0/3
4,6-Dinitro-2-methylphenol	25 U	53 U	ND	ND		0/3
4-bromophenyl-phenylether	10 U	21 U	ND	ND		0/3
N-Nitrosodiphenylamine	10 U	21 U	ND	ND		0/3
Hexachlorobenzene	10 U	21 U	ND	ND		0/3
Pentachlorophenol	10 U	21 U	ND	ND		0/3
Phenanthrene	10 U	21 U	ND	ND		0/3
Anthracene	10 U	21 U	ND	ND		0/3
Carbazole	10 U	21 U	ND	ND		0/3
Di-n-butylphthalate	10 U	21 U	ND	ND		0/3
Fluoranthene	10 U	21 U	ND	ND		0/3
Pyrene	10 U	21 U	ND	ND		0/3
Butylbenzylphthalate	10 U	21 U	ND	ND		0/3
3,3-Dichlorobenzidine	10 U	21 U	ND	ND		0/3
Benzo(a)anthracene	10 U	21 U	ND	ND		0/3
Chrysene	10 U	21 U	ND	ND		0/3
Bis(2-ethylhexyl)-phthalate	10 U	21 U	9 J	9 J	OHMRIN-08	1/3
Di-n-octylphthalate	10 U	21 U	ND	ND		0/3
Benzo(b)fluoranthene	10 U	21 U	ND	ND		0/3
Benzo(k)fluoranthene	10 U	21 U	ND	ND		0/3
Benzo(a)pyrene	10 U	21 U	ND	ND		0/3
Indeno(1,2,3-cd)pyrene	10 U	21 U	ND	ND		0/3
Dibenzo(a,h)anthracene	10 U	21 U	ND	ND		0/3
Benzo(g,h,i)perylene	10 U	21 U	ND	ND		0/3

FREQUENCY OF DETECTION
RINSATE BLANKS
SITE SCREENING AREA 1
VOLATILE COMPOUNDS
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	OHMRIN-02	OHMRIN-3	OHMRIN-08	OHMRIN-07	OHMRIN-04
Sample Date	11/03/94	11/04/94	12/06/94	11/12/94	
Units	ug/L	ug/L	ug/L	ug/L	ug/L
VOLATILES					
Chloromethane	5 U	25 U	2500 U	5 U	5 U
Bromomethane	5 U	25 U	2500 U	5 U	5 U
Vinyl chloride	5 U	25 U	2500 U	5 U	5 U
Chloroethane	5 U	25 U	2500 U	5 U	5 U
Methylene chloride	4 BJ	12 BJ	890 BJ	2 BJ	3 BJ
Acetone	160	270 D	27000	400 U	71
Carbon Disulfide	5 U	25 U	2500 U	5 U	5 U
1,1-Dichloroethene	5 U	25 U	2500 U	5 U	5 U
1,1-Dichloroethane	5 U	25 U	2500 U	5 U	5 U
Chloroform	5 U	25 U	2500 U	2 J	5 U
1,2-Dichloroethane	5 U	25 U	2500 U	1 J	5 U
2-Butanone	10 J	50 R	2500 U	5 R	10 R
1,1,1-Trichloroethane	5 U	25 U	2500 U	5 U	5 U
Carbon Tetrachloride	5 U	25 U	2500 U	5 U	5 U
Bromodibromomethane	5 U	25 U	2500 U	5 U	5 U
1,2-Dichloropropane	5 U	25 U	2500 U	5 U	5 U
cis-1,3-Dichloropropylene	5 U	25 U	2500 U	5 U	5 U
Trichlroethylene	5 U	25 U	2500 U	5 U	5 U
Dichlorobromomethane	5 U	25 U	2500 U	5 U	5 U
1,1,2-Trichloroethane	5 U	25 U	2500 U	5 U	5 U
Benzene	5 U	25 U	2500 U	5 U	5 U
trans-1,3-Dichloropropylene	5 U	25 U	2500 U	5 U	5 U
Bromoform	5 U	25 U	2500 U	5 U	5 U
Methyl-iso-butyl ketone	10 U	50 U	5000 U	10 U	10 U
2-Hexanone	5 U	25 U	2500 U	5 U	5 U
Tetrachloroethene	5 U	25 U	2500 U	5 U	5 U
1,1,2,2-Tetrachloroethane	5 U	25 U	2500 U	5 U	5 U
Toluene	5 U	25 U	2500 U	5 U	5 U
Chlorobenzene	5 U	25 U	2500 U	5 U	5 U
Ethylbenzene	5 U	25 U	2500 U	5 U	5 U
Styrene	5 U	25 U	2500 U	5 U	5 U
Xylenes (Total)	5 U	6 J	2500 U	5 U	5 U
1,2-Trans-dichloroethylene	5 U	25 U	2500 U	5 U	5 U

FREQUENCY OF DETECTION
RINSATE BLANKS
SITE SCREENING AREA 1
VOLATILE COMPOUNDS
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sample Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
VOLATILES						
Chloromethane	5 U	2500 U	ND	ND		0/5
Bromomethane	5 U	2500 U	ND	ND		0/5
Vinyl chloride	5 U	2500 U	ND	ND		0/5
Chloroethane	5 U	2500 U	ND	ND		0/5
Methylene chloride	2 BJ	890 BJ	ND	ND		0/5
Acetone	400 U	400 U	71	27000	OHMRIN-08	4/5
Carbon Disulfide	5 U	2500 U	ND	ND		0/5
1,1-Dichloroethene	5 U	2500 U	ND	ND		0/5
1,1-Dichloroethane	5 U	2500 U	ND	ND		0/5
Chloroform	5 U	2500 U	2 J	2 J	OHMRIN-07	1/5
1,2-Dichloroethane	5 U	2500 U	1 J	1 J	OHMRIN-07	1/5
2-Butanone	2500 U	2500 U	10 J	10 J	OHMRIN-04	1/2
1,1,1-Trichloroethane	5 U	2500 U	ND	ND		0/5
Carbon Tetrachloride	5 U	2500 U	ND	ND		0/5
Bromodibromomethane	5 U	2500 U	ND	ND		0/5
1,2-Dichloropropane	5 U	2500 U	ND	ND		0/5
cis-1,3-Dichloropropylene	5 U	2500 U	ND	ND		0/5
Trichlroethylene	5 U	2500 U	ND	ND		0/5
Dichlorobromomethane	5 U	2500 U	ND	ND		0/5
1,1,2-Trichloroethane	5 U	2500 U	ND	ND		0/5
Benzene	5 U	2500 U	ND	ND		0/5
trans-1,3-Dichloropropylene	5 U	2500 U	ND	ND		0/5
Bromoform	5 U	2500 U	ND	ND		0/5
Methyl-iso-butyl ketone	10 U	5000 U	ND	ND		0/5
2-Hexanone	5 U	2500 U	ND	ND		0/5
Tetrachloroethene	5 U	2500 U	ND	ND		0/5
1,1,2,2-Tetrachloroethane	5 U	2500 U	ND	ND		0/5
Toluene	5 U	2500 U	ND	ND		0/5
Chlorobenzene	5 U	2500 U	ND	ND		0/5
Ethylbenzene	5 U	2500 U	ND	ND		0/5
Styrene	5 U	2500 U	ND	ND		0/5
Xylenes (Total)	5 U	2500 U	6 J	6 J	OHMRIN-3	1/5
1,2-Trans-dichloroethylene	5 U	2500 U	ND	ND		0/5

FREQUENCY OF DETECTION
TRIP BLANKS
SITE SCREENING AREA 1
VOLATILE COMPOUNDS
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	OHMTB-06	OHMTB-05	OHMTB-04	OHMTB-03B	OHMTB03A	OHMTB-02
Sample Date	12/08/94	12/03/94	12/12/94	12/08/94	12/09/94	
VOLATILES						
Chloromethane	5 U	500 U	5 U	5 U	5 U	25 U
Bromomethane	5 U	500 U	5 U	5 U	5 U	25 U
Vinyl chloride	5 U	500 U	5 U	5 U	5 U	25 U
Chloroethane	5 U	500 U	5 U	5 U	5 U	25 U
Methylene chloride	2 BJ	100 BJ	3 BJ	3 BJ	5 BJ	25 U
Acetone	10 U	6900	4500	66	75	42 J
Carbon Disulfide	5 U	500 U	5 U	5 U	5 U	25 U
1,1-Dichloroethene	5 U	500 U	5 U	5 U	5 U	25 U
1,1-Dichloroethane	5 U	500 U	5 U	5 U	5 U	25 U
Chloroform	5 U	500 U	5 U	5 U	5 U	25 U
1,2-Dichloroethane	5 U	500 U	5 U	2 J	5 U	25 U
2-Butanone	5 R	500 U	5 R	5 R	5 R	25 U
1,1,1-Trichloroethane	5 U	500 U	5 U	5 U	5 U	25 U
Carbon Tetrachloride	5 U	500 U	5 U	5 U	5 U	25 U
Bromodibromomethane	5 U	500 U	5 U	5 U	5 U	25 U
1,2-Dichloropropane	5 U	500 U	5 U	5 U	5 U	25 U
cis-1,3-Dichloropropylene	5 U	500 U	5 U	5 U	5 U	25 U
Trichlroethylene	5 U	500 U	5 U	5 U	5 U	25 U
Dichlorobromomethane	5 U	500 U	5 U	5 U	5 U	25 U
1,1,2-Trichloroethane	5 U	500 U	5 U	5 U	5 U	25 U
Benzene	5 U	500 U	5 U	5 U	5 U	25 U
trans-1,3-Dichloropropylene	5 U	500 U	5 U	5 U	5 U	25 U
Bromoform	5 U	500 U	5 U	5 U	5 U	25 U
Methyl-iso-butyl ketone	10 U	1000 U	10 U	10 U	10 U	50 U
2-Hexanone	5 U	500 U	5 U	5 U	5 U	25 U
Tetrachloroethene	5 U	500 U	5 U	5 U	5 U	25 U
1,1,2,2-Tetrachloroethane	5 U	500 U	5 U	5 U	5 U	25 U
Toluene	5 U	500 U	5 U	5 U	5 U	25 U
Chlorobenzene	5 U	500 U	5 U	5 U	5 U	25 U
Ethylbenzene	5 U	500 U	5 U	5 U	1 J	25 U
Styrene	5 U	500 U	5 U	5 U	1 J	25 U
Xylenes (Total)	5 U	500 U	5 U	5 U	3 J	25 U
1,2-Trans-dichloroethylene	5 U	500 U	5 U	5 U	5 U	25 U

FREQUENCY OF DETECTION
TRIP BLANKS
SITE SCREENING AREA 1
VOLATILE COMPOUNDS
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	OHMTB-01	OHMTB-05
Sample Date		
VOLATILES		
Chloromethane	5 U	5 U
Bromomethane	5 U	5 U
Vinyl chloride	5 U	5 U
Chloroethane	5 U	5 U
Methylene chloride	2 BJ	3 BJ
Acetone	3 J	6900
Carbon Disulfide	5 U	5 U
1,1-Dichloroethene	5 U	5 U
1,1-Dichloroethane	5 U	5 U
Chloroform	5 U	5 U
1,2-Dichloroethane	5 U	5 U
2-Butanone	5 U	5 R
1,1,1-Trichloroethane	5 U	5 U
Carbon Tetrachloride	5 U	5 U
Bromodibromomethane	5 U	5 U
1,2-Dichloropropane	5 U	5 U
cis-1,3-Dichloropropylene	5 U	5 U
Trichlroethylene	5 U	5 U
Dichlorobromomethane	5 U	5 U
1,1,2-Trichloroethane	5 U	5 U
Benzene	5 U	5 U
trans-1,3-Dichloropropylene	5 U	5 U
Bromoform	5 U	5 U
Methyl-iso-butyl ketone	10 U	10 U
2-Hexanone	5 U	5 U
Tetrachloroethene	5 U	5 U
1,1,2,2-Tetrachloroethane	5 U	5 U
Toluene	5 U	5 U
Chlorobenzene	5 U	5 U
Ethylbenzene	5 U	5 U
Styrene	5 U	5 U
Xylenes (Total)	1 BJ	5 U
1,2-Trans-dichloroethylene	5 U	5 U

FREQUENCY OF DETECTION
TRIP BLANKS
SITE SCREENING AREA 1
VOLATILE COMPOUNDS
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sample Date	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	LOCATION OF MAXIMUM	FREQUENCY OF
VOLATILES						
Chloromethane	5 U	500 U	ND	ND		0/8
Bromomethane	5 U	500 U	ND	ND		0/8
Vinyl chloride	5 U	500 U	ND	ND		0/8
Chloroethane	5 U	500 U	ND	ND		0/8
Methylene chloride	2 BJ	100 BJ	ND	ND		0/8
Acetone	10 U	10 U	3 J	6900	OHMTB-05	7/8
Carbon Disulfide	5 U	500 U	ND	ND		0/8
1,1-Dichloroethene	5 U	500 U	ND	ND		0/8
1,1-Dichloroethane	5 U	500 U	ND	ND		0/8
Chloroform	5 U	500 U	ND	ND		0/8
1,2-Dichloroethane	5 U	500 U	2 J	2 J	OHMTB-03B	1/8
2-Butanone	5 U	500 U	ND	ND		0/3
1,1,1-Trichloroethane	5 U	500 U	ND	ND		0/8
Carbon Tetrachloride	5 U	500 U	ND	ND		0/8
Bromodibromomethane	5 U	500 U	ND	ND		0/8
1,2-Dichloropropane	5 U	500 U	ND	ND		0/8
cis-1,3-Dichloropropylene	5 U	500 U	ND	ND		0/8
Trichloroethylene	5 U	500 U	ND	ND		0/8
Dichlorobromomethane	5 U	500 U	ND	ND		0/8
1,1,2-Trichloroethane	5 U	500 U	ND	ND		0/8
Benzene	5 U	500 U	ND	ND		0/8
trans-1,3-Dichloropropylene	5 U	500 U	ND	ND		0/8
Bromoform	5 U	500 U	ND	ND		0/8
Methyl-iso-butyl ketone	10 U	1000 U	ND	ND		0/8
2-Hexanone	5 U	500 U	ND	ND		0/8
Tetrachloroethene	5 U	500 U	ND	ND		0/8
1,1,2,2-Tetrachloroethane	5 U	500 U	ND	ND		0/8
Toluene	5 U	500 U	ND	ND		0/8
Chlorobenzene	5 U	500 U	ND	ND		0/8
Ethylbenzene	5 U	500 U	1 J	1 J	OHMTB03A	1/8
Styrene	5 U	500 U	1 J	1 J	OHMTB03A	1/8
Xylenes (Total)	1 BJ	500 U	3 J	3 J	OHMTB03A	1/8
1,2-Trans-dichloroethylene	5 U	500 U	ND	ND		0/8

FREQUENCY OF DETECTION
RINSATE BLANKS
SITE SCREENING AREA 1
PESTICIDE/PCB COMPOUNDS
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	OHMRIN-08	OHMRIN-07
Sample Date	12/06/94	11/12/94
Units	ug/L	ug/L
PESTICIDES/PCBs		
Alpha-BHC	0.052 U	0.1 U
Beta-BHC	0.052 U	0.1 U
Delta-BHC	0.052 U	0.1 U
Gamma-BHC	0.052 U	0.1 U
Heptachlor	0.052 U	0.1 U
Aldrin	0.052 U	0.1 U
Heptachlor Epoxide	0.052 U	0.1 U
Endosulfan I	0.052 U	0.1 U
Dieldrin	0.1 U	0.1 U
4,4-DDE	0.1 U	0.1 U
Endrin	0.1 U	0.1 U
Endosulfan II	0.1 U	0.1 U
4,4-DDD	0.1 U	0.1 U
Endosulfan sulfate	0.1 U	0.1 U
4,4-DDT	0.1 U	0.1 U
Methoxychlor	0.52 U	0.1 U
Endrin ketone	0.1 U	0.1 U
Endrin aldehyde	0.1 U	0.1 U
alpha-chlordane	0.052 U	NA
gamma-chlordane	0.052 U	NA
Toxaphene	5.2 U	2 U
Arochlor 1016	1 U	1 U
Arochlor 1221	2.1 U	1 U
Arochlor 1232	1 U	1 U
Arochlor 1242	1 U	1 U
Arochlor 1248	1 U	1 U
Arochlor 1254	1 U	1 U
Arochlor 1260	1 U	1 U
Chlordane	U	1 U

FREQUENCY OF DETECTION
FIELD BLANKS
SITE SCREENING AREA 1
VOLATILE COMPOUNDS
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	OHMFB-01	
Sample Date		
Units	ug/L	
VOLATILES		
Chloromethane	5	U
Bromomethane	5	U
Vinyl chloride	5	U
Chloroethane	5	U
Methylene chloride	2	BJ
Acetone	97	
Carbon Disulfide	5	U
1,1-Dichloroethene	5	U
1,1-Dichloroethane	5	U
Chloroform	5	U
1,2-Dichloroethane	1	J
2-Butanone	5	R
1,1,1-Trichloroethane	5	U
Carbon Tetrachloride	5	U
Bromodibromomethane	5	U
1,2-Dichloropropane	5	U
cis-1,3-Dichloropropylene	5	U
Trichlroethylene	5	U
Dichlorobromomethane	5	U
1,1,2-Trichloroethane	5	U
Benzene	5	U
trans-1,3-Dichloropropylene	5	U
Bromoform	5	U
Methyl-iso-butyl ketone	10	U
2-Hexanone	5	U
Tetrachloroethene	5	U
1,1,2,2-Tetrachloroethane	1	J
Toluene	5	U
Chlorobenzene	1	J
Ethylbenzene	1	J
Styrene	5	U
Xylenes (Total)	3	BJ
1,2-Trans-dichloroethylene	5	U

FREQUENCY OF DETECTION
FIELD BLANKS
SITE SCREENING AREA 1
SEMIVOLATILE COMPOUNDS
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	OHMFB-01	
Sample Date		
Units	ug/L	
SEMIVOLATILES		
Phenol	11	R
bis(2-Chloroethyl)ether	11	U
2-chlorophenol	11	R
1,3-Dichlorbenzene	11	U
1,4-Dichlorobenzene	11	U
1,2-Dichlorobenzene	11	U
2-Methylphenol	11	R
2,2'-oxybis(1-chloropropene)	11	U
4-Methylphenol	11	R
N-Nitroso-di-n-propylamine	11	U
Hexachloroethane	11	U
Nitrobenzene	11	U
Isophorone	11	U
2-Nitrophenol	11	R
2,4-Dimethylphenol	11	R
Bis(2-chloroethoxy)-methane	11	U
2,4-Dichlorophenol	11	R
1,2,4-Trichlorobenzene	11	U
Naphthalene	11	U
4-chloroaniline	11	U
Hexachlorobutadiene	11	U
4-Chloro-3-methylphenol	11	R
2-Methylnaphthalene	11	U
Hexachlorocyclopentadiene	11	U
2,4,6-Trichlorophenol	11	R
2,4,5-Trichlorophenol	11	R
2-chloronapthalene	11	U
2-Nitroaniline	11	U
Dimethylphthalate	11	U
Acenaphthylene	11	U
2,6-Dinitrotoluene	11	U
3-Nitroaniline	11	U
Acenapthene	11	U
2,4-Dinitrophenol	53	R

FREQUENCY OF DETECTION
FIELD BLANKS
SITE SCREENING AREA 1
SEMIVOLATILE COMPOUNDS
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	OHMFB-01	
Sample Date		
Units	ug/L	
4-Nitrophenol	53	R
SEMIVOLATILES cont.		
Dibenzofuran	11	U
2,4-Dinitrotoluene	11	U
Diethylphthalate	11	U
4-Chlorophenyl-phenylether	11	U
Fluorene	11	U
4-Nitroaniline	11	U
4,6-Dinitro-2-methylphenol	26	R
4-bromophenyl-phenylether	11	U
N-Nitrosodiphenylamine	11	U
Hexachlorobenzene	11	U
Pentachlorophenol	11	R
Phenanthrene	11	U
Anthracene	11	U
Carbazole	11	U
Di-n-butylphthalate	11	U
Fluoranthene	11	U
Pyrene	11	U
Butylbenzylphthalate	11	U
3,3-Dichlorobenzidine	11	U
Benzo(a)anthracene	11	U
Chrysene	11	U
Bis(2-ethylhexyl)-phthalate	11	U
Di-n-octylphthalate	11	UJ
Benzo(b)fluoranthene	11	UJ
Benzo(k)fluoranthene	11	UJ
Benzo(a)pyrene	11	UJ
Indeno(1,2,3-cd)pyrene	11	UJ
Dibenzo(a,h)anthracene	11	UJ
Benzo(g,h,i)perylene	11	UJ

FREQUENCY OF DETECTION
RINSATE BLANKS
SITE SCREENING AREA 1
INORGANICS AND CYANIDE
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	OHMRIN-02	OHMRIN-3	OHMRIN-08	OHMRIN-07	OHMRIN-04
Sample Date	11/03/94	11/04/94	12/06/94	11/12/94	
Units	ug/L	ug/L	ug/L	ug/L	ug/L
Aluminum	59.9 U	59.9 U	1350	59.9 U	59 U
Antimony	29.8 U	29.8 U	29.8 U	29.8 U	30 U
Arsenic	2 U	2 U	2 U	2 U	2 UL
Barium	1.3 U	1.3 U	11.5	0.8 L	1 U
Beryllium	0.5 U	0.5 U	0.5 U	0.5 U	3
Cadmium	1.1 U	1.1 U	1.1 U	1.1 U	4
Calcium	48.1	40.6	509	39	92
Chromium	5.9 U	5.9 U	8.46	5.9 U	17
Cobalt	3.7 U	3.7 U	3.7 U	3.7 U	4 U
Copper	5.5 U	5.5 U	12.1	5.5 U	17
Iron	13.9 U	13.9 U	2450	18	19
Lead	2 U	2 U	2 U	1.1 U	3 U
Magnesium	33.5 U	33.5 U	235	20	34 U
Manganese	1.2 U	1.2 U	35.7	1.2 U	12
Mercury	0.14 U	0.14 U	0.14 U	0.2 U	0.2 U
Nickel	9.5 U	9.5 U	39.6	9.5 U	13
Potassium	1490 U	1490 U	1490 U	1490 U	1490 U
Selenium	1.3 U	1.3 U	9.75	1.1 U	1.3 U
Silver	5.8 U	5.8 U	5.8 U	5.8 U	6 U
Sodium	97.3	97.3	53.6	63	131
Thallium	2 U	2 U	2 U	1.1 U	2 U
Vanadium	4.2 U	4.2 U	4.2 U	4.2 U	4 U
Zinc	6	6.44	33	4.1 U	20
TAL Cyanide	10	10	1.16	10 U	10 U

FREQUENCY OF DETECTION
RINSATE BLANKS
SITE SCREENING AREA 1
INORGANICS AND CYANIDE
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sample Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	59 U	59.9 U	1350	1350	OHMRIN-08	1/5
Antimony	29.8 U	30 U	ND	ND		0/5
Arsenic	2 U	2 U	ND	ND		0/5
Barium	1 U	1.3 U	0.8 L	11.5	OHMRIN-08	2/5
Beryllium	0.5 U	0.5 U	3	3	OHMRIN-04	1/5
Cadmium	1.1 U	1.1 U	4	4	OHMRIN-04	1/5
Calcium	NA	NA	39	509	OHMRIN-08	5/5
Chromium	5.9 U	5.9 U	8.46	17	OHMRIN-04	2/5
Cobalt	3.7 U	4 U	ND	ND		0/5
Copper	5.5 U	5.5 U	12.1	17	OHMRIN-04	2/5
Iron	13.9 U	13.9 U	18	2450	OHMRIN-08	3/5
Lead	1.1 U	3 U	ND	ND		0/5
Magnesium	33.5 U	34 U	20	235	OHMRIN-08	2/5
Manganese	1.2 U	1.2 U	12	35.7	OHMRIN-08	2/5
Mercury	0.14 U	0.2 U	ND	ND		0/5
Nickel	9.5 U	9.5 U	13	39.6	OHMRIN-08	2/5
Potassium	1490 U	1490 U	ND	ND		0/5
Selenium	1.1 U	1.3 U	9.75	9.75	OHMRIN-08	1/5
Silver	5.8 U	6 U	ND	ND		0/5
Sodium	NA	NA	53.6	131	OHMRIN-04	5/5
Thallium	1.1 U	2 U	ND	ND		0/5
Vanadium	4 U	4.2 U	ND	ND		0/5
Zinc	4.1 U	4.1 U	6	33	OHMRIN-08	4/5
TAL Cyanide	10 U	10 U	1.16	10	OHMRIN-3	3/5

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
EXPLOSIVE COMPOUNDS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A15RB-01	A15RB-02	A15RB-03	A15/01RB-23
Sampling Date	11/01/94	11/02/94	11/04/94	12/03/94
Units	UG/L	UG/L	UG/L	UG/L
HMX	0.61 U	0.61 U	0.61 U	0.61 U
RDX	0.59 U	0.94 U	0.59 U	0.59 U
1,3,5-Trinitrobenzene	0.66 U	0.66 U	0.66 U	0.66 U
1,3-Dinitrobenzene	1.1 U	1.1 U	1.1 U	1.1 U
Tertyl	1 U	1 U	1 U	1 U
Nitrobenzene	0.73 U	0.73 U	0.73 U	0.73 U
2,4,6-Trinitrotoluene	0.84	0.62 U	0.62 U	0.62 U
4-Amino-2,6-Dinitrotoluene	1 U	1 U	1 U	1 U
2,6-Dinitrotoluene	1 U	1 U	1 U	1 U
2,4-Dinitrotoluene	1 U	1 U	1 U	1 U
2-Nitrotoluene	0.75 U	0.75 U	0.75 U	0.75 U
3-Nitrotoluene	0.91 U	0.91 U	0.91 U	0.91 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
EXPLOSIVE COMPOUNDS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
HMX	0.61 U	0.61 U	ND	ND		0/4
RDX	0.59 U	0.94 U	ND	ND		0/4
1,3,5-Trinitrobenzene	0.66 U	0.66 U	ND	ND		0/4
1,3-Dinitrobenzene	1.1 U	1.1 U	ND	ND		0/4
Tertyl	1 U	1 U	ND	ND		0/4
Nitrobenzene	0.73 U	0.73 U	ND	ND		0/4
2,4,6-Trinitrotoluene	0.62 U	0.62 U	0.84	0.84	A15RB-01	1/4
4-Amino-2,6-Dinitrotoluene	1 U	1 U	ND	ND		0/4
2,6-Dinitrotoluene	1 U	1 U	ND	ND		0/4
2,4-Dinitrotoluene	1 U	1 U	ND	ND		0/4
2-Nitrotoluene	0.75 U	0.75 U	ND	ND		0/4
3-Nitrotoluene	0.91 U	0.91 U	ND	ND		0/4

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
PESTICIDE/PCB COMPOUNDS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A15RB-01	A15RB-02	A15RB-03	A15/01RB-23
Sampling Date	11/01/94	11/02/94	11/04/94	12/03/94
Units	UG/L	UG/L	UG/L	UG/L
alpha-BHC	0.05 U	0.05 U	0.05 U	0.05 U
beta-BHC	0.05 U	0.05 U	0.05 U	0.05 U
delta-BHC	0.05 U	0.05 U	0.05 U	0.05 U
gamma-BHC (Lindane)	0.05 U	0.05 U	0.05 U	0.05 U
Heptachlor	0.05 U	0.05 U	0.05 U	0.05 U
Aldrin	0.05 U	0.05 U	0.05 U	0.05 U
Heptachlor Epoxide	0.05 U	0.05 U	0.05 U	0.05 U
Endosulfan I	0.05 U	0.05 U	0.05 U	0.05 U
Dieldrin	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDE	0.1 U	0.1 U	0.1 U	0.1 U
Endrin	0.1 U	0.1 U	0.1 U	0.1 U
Endosulfan II	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDD	0.1 U	0.1 U	0.1 U	0.1 U
Endosulfan Sulfate	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDT	0.1 U	0.1 U	0.1 U	0.1 U
Methoxychlor	0.5 U	0.5 U	0.5 U	0.5 U
Endrin Ketone	0.1 U	0.1 U	0.1 U	0.1 U
Endrin Aldehyde	0.1 U	0.1 U	0.1 U	0.1 U
alpha-Chlordane	0.05 U	0.05 U	0.05 U	0.05 U
gamma-Chlordane	0.05 U	0.05 U	0.05 U	0.05 U
Toxaphene	5 U	5 U	5 U	5 U
Aroclor 1016	1 U	1 U	1 U	1 U
Aroclor 1221	2 U	2 U	2 U	2 U
Aroclor 1232	1 U	1 U	1 U	1 U
Aroclor 1242	1 U	1 U	1 U	1 U
Aroclor-1248	1 U	1 U	1 U	1 U
Aroclor-1254	1 U	1 U	1 U	1 U
Aroclor-1260	1 U	1 U	1 U	1 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
PESTICIDE/PCB COMPOUNDS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
alpha-BHC	0.05 U	0.05 U	ND	ND		0/4
beta-BHC	0.05 U	0.05 U	ND	ND		0/4
delta-BHC	0.05 U	0.05 U	ND	ND		0/4
gamma-BHC (Lindane)	0.05 U	0.05 U	ND	ND		0/4
Heptachlor	0.05 U	0.05 U	ND	ND		0/4
Aldrin	0.05 U	0.05 U	ND	ND		0/4
Heptachlor Epoxide	0.05 U	0.05 U	ND	ND		0/4
Endosulfan I	0.05 U	0.05 U	ND	ND		0/4
Dieldrin	0.1 U	0.1 U	ND	ND		0/4
4,4'-DDE	0.1 U	0.1 U	ND	ND		0/4
Endrin	0.1 U	0.1 U	ND	ND		0/4
Endosulfan II	0.1 U	0.1 U	ND	ND		0/4
4,4'-DDD	0.1 U	0.1 U	ND	ND		0/4
Endosulfan Sulfate	0.1 U	0.1 U	ND	ND		0/4
4,4'-DDT	0.1 U	0.1 U	ND	ND		0/4
Methoxychlor	0.5 U	0.5 U	ND	ND		0/4
Endrin Ketone	0.1 U	0.1 U	ND	ND		0/4
Endrin Aldehyde	0.1 U	0.1 U	ND	ND		0/4
alpha-Chlordane	0.05 U	0.05 U	ND	ND		0/4
gamma-Chlordane	0.05 U	0.05 U	ND	ND		0/4
Toxaphene	5 U	5 U	ND	ND		0/4
Aroclor 1016	1 U	1 U	ND	ND		0/4
Aroclor 1221	2 U	2 U	ND	ND		0/4
Aroclor 1232	1 U	1 U	ND	ND		0/4
Aroclor 1242	1 U	1 U	ND	ND		0/4
Aroclor-1248	1 U	1 U	ND	ND		0/4
Aroclor-1254	1 U	1 U	ND	ND		0/4
Aroclor-1260	1 U	1 U	ND	ND		0/4

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A15RB-01	A15RB-02	A15RB-03	A15/01RB-23
Sampling Date	11/01/94	11/02/94	11/04/94	12/03/94
Units	UG/L	UG/L	UG/L	UG/L
Phenol	10 U	10 U	10 U	10 U
bis(2-Chloroethyl) Ether	10 U	10 U	10 U	10 U
2-Chlorophenol	10 U	10 U	10 U	10 U
1,3-Dichlorobenzene	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	10 U	10 U	10 U	10 U
1,2-Dichlorobenzene	10 U	10 U	10 U	10 U
2-Methylphenol	10 U	10 U	10 U	10 U
bis(2-Chloroisopropyl)Ether	10 U	10 U	10 U	10 U
4-Methylphenol	10 U	10 U	10 U	10 U
N-Nitrosodipropylamine	10 U	10 U	10 U	10 U
Hexachloroethane	10 U	10 U	10 U	10 U
Nitrobenzene	10 U	10 U	10 U	10 U
Isophorone	10 U	10 U	10 U	10 U
2-Nitrophenol	10 U	10 U	10 U	10 U
2,4-Dimethylphenol	10 U	10 U	10 U	10 U
bis(2-Chloroethoxy)Methane	10 U	10 U	10 U	10 U
2,4-Dichlorophenol	10 U	10 U	10 U	10 U
1,2,4-Trichlorobenzene	10 U	10 U	10 U	10 U
Naphthalene	10 U	10 U	10 U	10 UJ
4-Chloroaniline	10 U	10 U	10 U	10 U
Hexachlorobutadiene	10 U	10 U	10 U	10 U
4-Chloro-3-methylphenol	10 U	10 U	10 U	10 U
2-Methylnaphthalene	10 U	10 U	10 U	10 U
Hexachlorocyclopentadiene	10 U	10 U	10 U	10 U
2,4,6-Trichlorophenol	10 U	10 U	10 U	10 U
2,4,5-Trichlorophenol	25 U	25 U	25 U	25 U
2-Chloronaphthalene	10 U	10 U	10 U	10 U
2-Nitroaniline	25 U	25 U	25 U	25 U
Dimethylphthalate	10 U	10 U	10 U	10 U
Acenaphthylene	10 U	10 U	10 U	10 U
2,6-Dinitrotoluene	10 U	10 U	10 U	10 U
3-Nitroaniline	25 U	25 U	25 U	25 U
Acenaphthene	10 U	10 U	10 U	10 U
2,4-Dinitrophenol	25 U	25 U	25 U	25 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A15RB-01	A15RB-02	A15RB-03	A15/01RB-23
Sampling Date	11/01/94	11/02/94	11/04/94	12/03/94
Units	UG/L	UG/L	UG/L	UG/L
4-Nitrophenol	25 U	25 U	25 U	25 U
Dibenzofuran	10 U	10 U	10 U	10 U
2,4-Dinitrotoluene	10 U	10 U	10 U	10 U
Diethylphthalate	10 U	10 U	10 U	10 U
4-Chlorophenylphenyl Ether	10 U	10 U	10 U	10 U
Fluorene	10 U	10 U	10 U	10 U
4-Nitroaniline	25 U	25 U	25 U	25 U
4,6-Dinitro-2-Methylphenol	25 U	25 U	25 U	25 U
N-nitrosodiphenylamine	10 U	10 U	10 U	10 U
4-Bromophenylphenyl Ether	10 U	10 U	10 U	10 U
Hexachlorobenzene	10 U	10 U	10 U	10 U
Pentachlorophenol	25 U	25 U	25 U	25 U
Phenanthrene	10 U	10 U	10 U	10 U
Anthracene	10 U	10 U	10 U	10 U
Carbazole	10 U	10 U	10 U	10 U
Di-n-Butyl Phthalate	8 J	9 J	11	9 J
Fluoranthene	10 U	10 U	10 U	10 U
Pyrene	10 U	10 U	10 U	10 U
Butyl Benzyl Phthalate	10 U	10 U	10 U	10 U
3,3'-Dichlorobenzidine	10 U	10 U	10 U	10 U
Benzo(a)anthracene	10 U	10 U	10 U	10 U
Chrysene	10 U	10 U	10 U	10 U
bis(2-Ethylhexyl)Phthalate	2 J	10 U	10 U	10 U
Di-n-Octylphthalate	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	10 U	10 U	10 U	10 U
Benzo(a)Pyrene	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	10 U	10 U	10 U	10 U
Dibenzo(a,h)anthracene	10 U	10 U	10 U	10 U
Benzo(g,h,i)Perylene	10 U	10 U	10 U	10 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Phenol	10 U	10 U	ND	ND		0/4
bis(2-Chloroethyl) Ether	10 U	10 U	ND	ND		0/4
2-Chlorophenol	10 U	10 U	ND	ND		0/4
1,3-Dichlorobenzene	10 U	10 U	ND	ND		0/4
1,4-Dichlorobenzene	10 U	10 U	ND	ND		0/4
1,2-Dichlorobenzene	10 U	10 U	ND	ND		0/4
2-Methylphenol	10 U	10 U	ND	ND		0/4
bis(2-Chloroisopropyl)Ether	10 U	10 U	ND	ND		0/4
4-Methylphenol	10 U	10 U	ND	ND		0/4
N-Nitrosodipropylamine	10 U	10 U	ND	ND		0/4
Hexachloroethane	10 U	10 U	ND	ND		0/4
Nitrobenzene	10 U	10 U	ND	ND		0/4
Isophorone	10 U	10 U	ND	ND		0/4
2-Nitrophenol	10 U	10 U	ND	ND		0/4
2,4-Dimethylphenol	10 U	10 U	ND	ND		0/4
bis(2-Chloroethoxy)Methane	10 U	10 U	ND	ND		0/4
2,4-Dichlorophenol	10 U	10 U	ND	ND		0/4
1,2,4-Trichlorobenzene	10 U	10 U	ND	ND		0/4
Naphthalene	10 U	10 U	ND	ND		0/4
4-Chloroaniline	10 U	10 U	ND	ND		0/4
Hexachlorobutadiene	10 U	10 U	ND	ND		0/4
4-Chloro-3-methylphenol	10 U	10 U	ND	ND		0/4
2-Methylnaphthalene	10 U	10 U	ND	ND		0/4
Hexachlorocyclopentadiene	10 U	10 U	ND	ND		0/4
2,4,6-Trichlorophenol	10 U	10 U	ND	ND		0/4
2,4,5-Trichlorophenol	25 U	25 U	ND	ND		0/4
2-Chloronaphthalene	10 U	10 U	ND	ND		0/4
2-Nitroaniline	25 U	25 U	ND	ND		0/4
Dimethylphthalate	10 U	10 U	ND	ND		0/4
Acenaphthylene	10 U	10 U	ND	ND		0/4
2,6-Dinitrotoluene	10 U	10 U	ND	ND		0/4
3-Nitroaniline	25 U	25 U	ND	ND		0/4
Acenaphthene	10 U	10 U	ND	ND		0/4
2,4-Dinitrophenol	25 U	25 U	ND	ND		0/4

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
4-Nitrophenol	25 U	25 U	ND	ND		0/4
Dibenzofuran	10 U	10 U	ND	ND		0/4
2,4-Dinitrotoluene	10 U	10 U	ND	ND		0/4
Diethylphthalate	10 U	10 U	ND	ND		0/4
4-Chlorophenylphenyl Ether	10 U	10 U	ND	ND		0/4
Fluorene	10 U	10 U	ND	ND		0/4
4-Nitroaniline	25 U	25 U	ND	ND		0/4
4,6-Dinitro-2-Methylphenol	25 U	25 U	ND	ND		0/4
N-nitrosodiphenylamine	10 U	10 U	ND	ND		0/4
4-Bromophenylphenyl Ether	10 U	10 U	ND	ND		0/4
Hexachlorobenzene	10 U	10 U	ND	ND		0/4
Pentachlorophenol	25 U	25 U	ND	ND		0/4
Phenanthrene	10 U	10 U	ND	ND		0/4
Anthracene	10 U	10 U	ND	ND		0/4
Carbazole	10 U	10 U	ND	ND		0/4
Di-n-Butyl Phthalate	NA	NA	8 J	11	A15RB-03	4/4
Fluoranthene	10 U	10 U	ND	ND		0/4
Pyrene	10 U	10 U	ND	ND		0/4
Butyl Benzyl Phthalate	10 U	10 U	ND	ND		0/4
3,3'-Dichlorobenzidine	10 U	10 U	ND	ND		0/4
Benzo(a)anthracene	10 U	10 U	ND	ND		0/4
Chrysene	10 U	10 U	ND	ND		0/4
bis(2-Ethylhexyl)Phthalate	10 U	10 U	2 J	2 J	A15RB-01	1/4
Di-n-Octylphthalate	10 U	10 U	ND	ND		0/4
Benzo(b)fluoranthene	10 U	10 U	ND	ND		0/4
Benzo(k)fluoranthene	10 U	10 U	ND	ND		0/4
Benzo(a)Pyrene	10 U	10 U	ND	ND		0/4
Indeno(1,2,3-cd)pyrene	10 U	10 U	ND	ND		0/4
Dibenzo(a,h)anthracene	10 U	10 U	ND	ND		0/4
Benzo(g,h,i)Perylene	10 U	10 U	ND	ND		0/4

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A15RB-01	A15RB-02	A15RB-03	A15/01RB23
Sampling Date	11/01/94	11/02/94	11/04/94	12/03/94
Units	UG/L	UG/L	UG/L	UG/L
Chloromethane	1 UJ	1 UJ	1 UJ	1 U
Bromomethane	1 U	1 U	1 U	1 U
Vinyl chloride	1 U	1 U	1 U	1 U
Chloroethane	1 U	1 U	1 U	1 U
Methylene chloride	3	2	2	3
Acetone	5 R	5 R	5 R	5 R
Carbon disulfide	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	1 U	1 U
Chloroform	3	3	3	6
1,2-Dichloroethane	1 U	1 U	1 U	1 U
Bromochloromethane	1 U	1 U	1 U	1 U
2-Butanone	5 R	5 R	5 R	5 R
1,1,1-Trichloroethane	1 U	1 U	1 U	1 U
Carbon Tetrachloride	1 U	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	1 U	1 U	1 U	1 U
Trichloroethene	1 U	1 U	1 U	1 U
Dibromochloromethane	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U
Benzene	1 U	1 U	1 U	1 U
trans-1,3-Dichloropropene	1 U	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U	1 U
4-Methyl-2-pentanone	5 U	5 U	5 U	5 U
2-Hexanone	5 R	5 R	5 R	5 U
Tetrachloroethene	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U
Toluene	1 U	1 U	1 U	1 U
Chlorobenzene	1 U	1 U	1 U	1 U
Ethylbenzene	1 U	1 U	1 U	1 U
Styrene	1 U	1 U	1 U	1 U
Total Xylenes	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	1 U	1 U	1 U	1 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A15RB-01	A15RB-02	A15RB-03	A15/01RB23
Sampling Date	11/01/94	11/02/94	11/04/94	12/03/94
Units	UG/L	UG/L	UG/L	UG/L
1,4-Dichlorobenzene	1 U	1 U	1 U	1 U
1,3-Dichlorobenzene	1 U	1 U	1 U	1 U
1,2-Dibromo-3-chloropropane	1 R	1 R	1 R	1 R
1,2-Dibromoethane	1 U	1 U	1 U	1 U
TRANS 1,2-Dichloroethene	1 U	1 U	1 U	1 U
CIS 1,2-Dichloroethene	1 U	1 U	1 U	1 U
1,2-Dichloroethene (total)				

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Chloromethane	1 UJ	1 UJ	ND	ND		0/4
Bromomethane	1 U	1 U	ND	ND		0/4
Vinyl chloride	1 U	1 U	ND	ND		0/4
Chloroethane	1 U	1 U	ND	ND		0/4
Methylene chloride	NA	NA	2	3	A151RB23	4/4
Acetone	NA	NA	ND	ND		0/0
Carbon disulfide	1 U	1 U	ND	ND		0/4
1,1-Dichloroethene	1 U	1 U	ND	ND		0/4
1,1-Dichloroethane	1 U	1 U	ND	ND		0/4
Chloroform	NA	NA	3	6	A151RB23	4/4
1,2-Dichloroethane	1 U	1 U	ND	ND		0/4
Bromochloromethane	1 U	1 U	ND	ND		0/4
2-Butanone	NA	NA	ND	ND		0/0
1,1,1-Trichloroethane	1 U	1 U	ND	ND		0/4
Carbon Tetrachloride	1 U	1 U	ND	ND		0/4
Bromodichloromethane	1 U	1 U	ND	ND		0/4
1,2-Dichloropropane	1 U	1 U	ND	ND		0/4
cis-1,3-Dichloropropene	1 U	1 U	ND	ND		0/4
Trichloroethene	1 U	1 U	ND	ND		0/4
Dibromochloromethane	1 U	1 U	ND	ND		0/4
1,1,2-Trichloroethane	1 U	1 U	ND	ND		0/4
Benzene	1 U	1 U	ND	ND		0/4
trans-1,3-Dichloropropene	1 U	1 U	ND	ND		0/4
Bromoform	1 U	1 U	ND	ND		0/4
4-Methyl-2-pentanone	5 U	5 U	ND	ND		0/4
2-Hexanone	5 U	5 U	ND	ND		0/1
Tetrachloroethene	1 U	1 U	ND	ND		0/4
1,1,2,2-Tetrachloroethane	1 U	1 U	ND	ND		0/4
Toluene	1 U	1 U	ND	ND		0/4
Chlorobenzene	1 U	1 U	ND	ND		0/4
Ethylbenzene	1 U	1 U	ND	ND		0/4
Styrene	1 U	1 U	ND	ND		0/4
Total Xylenes	1 U	1 U	ND	ND		0/4
1,2-Dichlorobenzene	1 U	1 U	ND	ND		0/4

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
1,4-Dichlorobenzene	1 U	1 U	ND	ND		0/4
1,3-Dichlorobenzene	1 U	1 U	ND	ND		0/4
1,2-Dibromo-3-chloropropane	NA	NA	ND	ND		0/0
1,2-Dibromoethane	1 U	1 U	ND	ND		0/4
TRANS 1,2-Dichloroethene	1 U	1 U	ND	ND		0/4
CIS 1,2-Dichloroethene	1 U	1 U	ND	ND		0/4
1,2-Dichloroethene (total)						

FREQUENCY OF DETECTION SUMMARY
TRIP BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	15TB-01	15TB-02	15TB-05	15TB-33	A15/01TB-35
Sampling Date	11/01/94	11/02/94	11/04/94	12/02/94	12/03/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L
Chloromethane	1 UJ	1 UJ	1 UJ	1 U	1 U
Bromomethane	1 U	1 U	1 U	1 U	1 U
Vinyl chloride	1 U	1 U	1 U	1 U	1 U
Chloroethane	1 U	1 U	1 U	1 U	1 U
Methylene chloride	2 U	2 U	2 U	2 U	2 U
Acetone	5 R	5 R	5 R	5 R	5 R
Carbon disulfide	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	1 U	1 U	1 U
Chloroform	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U
Bromochloromethane	1 U	1 U	1 U	1 U	1 U
2-Butanone	5 R	5 R	5 R	5 R	5 R
1,1,1-Trichloroethane	1 U	1 U	1 U	1 U	1 U
Carbon Tetrachloride	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U
Trichloroethene	1 U	1 U	1 U	1 U	1 U
Dibromochloromethane	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	1 U
Benzene	1 U	1 U	1 U	1 U	1 U
trans-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U	1 U	1 U
4-Methyl-2-pentanone	5 U	5 U	5 U	5 U	5 U
2-Hexanone	5 R	5 R	5 R	5 U	5 U
Tetrachloroethene	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U	1 U
Toluene	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	1 U	1 U	1 U	1 U	1 U
Styrene	1 U	1 U	1 U	1 U	1 U
Total Xylenes	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U

FREQUENCY OF DETECTION SUMMARY
TRIP BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	15TB-01	15TB-02	15TB-05	15TB-33	A15/01TB-35
Sampling Date	11/01/94	11/02/94	11/04/94	12/02/94	12/03/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L
1,4-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U
1,3-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U
1,2-Dibromo-3-chloropropane	1 R	1 R	1 R	1 R	1 R
1,2-Dibromoethane	1 U	1 U	1 U	1 U	1 U
TRANS 1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U
CIS 1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethene (total)	1 U	1 U	1 U	1 U	1 U

FREQUENCY OF DETECTION SUMMARY
TRIP BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Chloromethane	1 UJ	1 UJ	ND	ND		0/5
Bromomethane	1 U	1 U	ND	ND		0/5
Vinyl chloride	1 U	1 U	ND	ND		0/5
Chloroethane	1 U	1 U	ND	ND		0/5
Methylene chloride	2 U	2 U	ND	ND		0/5
Acetone	NA	NA	ND	ND		0/0
Carbon disulfide	1 U	1 U	ND	ND		0/5
1,1-Dichloroethene	1 U	1 U	ND	ND		0/5
1,1-Dichloroethane	1 U	1 U	ND	ND		0/5
Chloroform	1 U	1 U	ND	ND		0/5
1,2-Dichloroethane	1 U	1 U	ND	ND		0/5
Bromochloromethane	1 U	1 U	ND	ND		0/5
2-Butanone	NA	NA	ND	ND		0/0
1,1,1-Trichloroethane	1 U	1 U	ND	ND		0/5
Carbon Tetrachloride	1 U	1 U	ND	ND		0/5
Bromodichloromethane	1 U	1 U	ND	ND		0/5
1,2-Dichloropropane	1 U	1 U	ND	ND		0/5
cis-1,3-Dichloropropene	1 U	1 U	ND	ND		0/5
Trichloroethene	1 U	1 U	ND	ND		0/5
Dibromochloromethane	1 U	1 U	ND	ND		0/5
1,1,2-Trichloroethane	1 U	1 U	ND	ND		0/5
Benzene	1 U	1 U	ND	ND		0/5
trans-1,3-Dichloropropene	1 U	1 U	ND	ND		0/5
Bromoform	1 U	1 U	ND	ND		0/5
4-Methyl-2-pentanone	5 U	5 U	ND	ND		0/5
2-Hexanone	5 U	5 U	ND	ND		0/2
Tetrachloroethene	1 U	1 U	ND	ND		0/5
1,1,2,2-Tetrachloroethane	1 U	1 U	ND	ND		0/5
Toluene	1 U	1 U	ND	ND		0/5
Chlorobenzene	1 U	1 U	ND	ND		0/5
Ethylbenzene	1 U	1 U	ND	ND		0/5
Styrene	1 U	1 U	ND	ND		0/5
Total Xylenes	1 U	1 U	ND	ND		0/5
1,2-Dichlorobenzene	1 U	1 U	ND	ND		0/5

FREQUENCY OF DETECTION SUMMARY
TRIP BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
1,4-Dichlorobenzene	1 U	1 U	ND	ND		0/5
1,3-Dichlorobenzene	1 U	1 U	ND	ND		0/5
1,2-Dibromo-3-chloropropane	NA	NA	ND	ND		0/0
1,2-Dibromoethane	1 U	1 U	ND	ND		0/5
TRANS 1,2-Dichloroethene	1 U	1 U	ND	ND		0/5
CIS 1,2-Dichloroethene	1 U	1 U	ND	ND		0/5
1,2-Dichloroethene (total)	1 U	1 U	ND	ND		0/5

FREQUENCY OF DETECTION SUMMARY
TRIP BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 1
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	1/7TB-18	1TB20	1TB21	01TB26	01TB34	A07/01TB-36
Sampling Date	11/18/94	11/19/94	11/20/94	11/02/94	12/03/94	12/04/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
Chloromethane	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl chloride	1 U	1 U	1 U	1 U	1 U	1 U
Chloroethane	1 U	1 U	1 U	1 U	1 U	1 U
Methylene chloride	2 U	2 U	2 U	2 U	2 U	2 U
Acetone	5 R	5 R	5 R	5 R	5 R	5 R
Carbon disulfide	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	1 U	0.5 J	1 U	1 U
Bromochloromethane	1 U	1 U	1 U	1 U	1 U	1 U
2-Butanone	5 R	5 R	5 R	5 R	5 R	5 R
1,1,1-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U
Carbon Tetrachloride	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	1 U	1 U	1 U	1 U	1 U	1 U
Dibromochloromethane	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U
Benzene	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U	1 U	1 U	1 U
4-Methyl-2-pentanone	5 U	5 U	5 U	5 U	5 U	5 U
2-Hexanone	5 R	5 R	5 R	5 R	5 U	5 U
Tetrachloroethene	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	1 U	1 U	1 U	1 U	1 U	1 U
Styrene	1 U	1 U	1 U	1 U	1 U	1 U
Total Xylenes	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U

FREQUENCY OF DETECTION SUMMARY
TRIP BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 1
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	1/7TB-18	1TB20	1TB21	01TB26	01TB34	A07/01TB-36
Sampling Date	11/18/94	11/19/94	11/20/94	11/02/94	12/03/94	12/04/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
1,4-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U
1,3-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dibromo-3-chloropropane	1 R	1 R	1 R	1 R	1 R	1 R
1,2-Dibromoethane	1 U	1 U	1 U	1 U	1 U	1 U
TRANS 1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U
CIS 1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethene (total)						

FREQUENCY OF DETECTION SUMMARY
TRIP BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 1
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A15/1TB-35
Sampling Date	12/03/94
Units	UG/L
Chloromethane	1 U
Bromomethane	1 U
Vinyl chloride	1 U
Chloroethane	1 U
Methylene chloride	2 U
Acetone	5 R
Carbon disulfide	1 U
1,1-Dichloroethene	1 U
1,1-Dichloroethane	1 U
Chloroform	1 U
1,2-Dichloroethane	1 U
Bromochloromethane	1 U
2-Butanone	5 R
1,1,1-Trichloroethane	1 U
Carbon Tetrachloride	1 U
Bromodichloromethane	1 U
1,2-Dichloropropane	1 U
cis-1,3-Dichloropropene	1 U
Trichloroethene	1 U
Dibromochloromethane	1 U
1,1,2-Trichloroethane	1 U
Benzene	1 U
trans-1,3-Dichloropropene	1 U
Bromoform	1 U
4-Methyl-2-pentanone	5 U
2-Hexanone	5 U
Tetrachloroethene	1 U
1,1,2,2-Tetrachloroethane	1 U
Toluene	1 U
Chlorobenzene	1 U
Ethylbenzene	1 U
Styrene	1 U
Total Xylenes	1 U
1,2-Dichlorobenzene	1 U

FREQUENCY OF DETECTION SUMMARY
TRIP BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 1
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A15/1TB-35
Sampling Date	12/03/94
Units	UG/L
1,4-Dichlorobenzene	1 U
1,3-Dichlorobenzene	1 U
1,2-Dibromo-3-chloropropane	1 R
1,2-Dibromoethane	1 U
TRANS 1,2-Dichloroethene	1 U
CIS 1,2-Dichloroethene	1 U
1,2-Dichloroethene (total)	

FREQUENCY OF DETECTION SUMMARY
TRIP BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 1
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Chloromethane	1 U	1 U	ND	ND		0/7
Bromomethane	1 U	1 U	ND	ND		0/7
Vinyl chloride	1 U	1 U	ND	ND		0/7
Chloroethane	1 U	1 U	ND	ND		0/7
Methylene chloride	2 U	2 U	ND	ND		0/7
Acetone	NA	NA	ND	ND		0/0
Carbon disulfide	1 U	1 U	ND	ND		0/7
1,1-Dichloroethene	1 U	1 U	ND	ND		0/7
1,1-Dichloroethane	1 U	1 U	ND	ND		0/7
Chloroform	1 U	1 U	ND	ND		0/7
1,2-Dichloroethane	1 U	1 U	0.5 J	0.5 J	01TB26	1/7
Bromochloromethane	1 U	1 U	ND	ND		0/7
2-Butanone	NA	NA	ND	ND		0/0
1,1,1-Trichloroethane	1 U	1 U	ND	ND		0/7
Carbon Tetrachloride	1 U	1 U	ND	ND		0/7
Bromodichloromethane	1 U	1 U	ND	ND		0/7
1,2-Dichloropropane	1 U	1 U	ND	ND		0/7
cis-1,3-Dichloropropene	1 U	1 U	ND	ND		0/7
Trichloroethene	1 U	1 U	ND	ND		0/7
Dibromochloromethane	1 U	1 U	ND	ND		0/7
1,1,2-Trichloroethane	1 U	1 U	ND	ND		0/7
Benzene	1 U	1 U	ND	ND		0/7
trans-1,3-Dichloropropene	1 U	1 U	ND	ND		0/7
Bromoform	1 U	1 U	ND	ND		0/7
4-Methyl-2-pentanone	5 U	5 U	ND	ND		0/7
2-Hexanone	5 U	5 U	ND	ND		0/3
Tetrachloroethene	1 U	1 U	ND	ND		0/7
1,1,2,2-Tetrachloroethane	1 U	1 U	ND	ND		0/7
Toluene	1 U	1 U	ND	ND		0/7
Chlorobenzene	1 U	1 U	ND	ND		0/7
Ethylbenzene	1 U	1 U	ND	ND		0/7
Styrene	1 U	1 U	ND	ND		0/7
Total Xylenes	1 U	1 U	ND	ND		0/7
1,2-Dichlorobenzene	1 U	1 U	ND	ND		0/7

FREQUENCY OF DETECTION SUMMARY
TRIP BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 1
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
1,4-Dichlorobenzene	1 U	1 U	ND	ND		0/7
1,3-Dichlorobenzene	1 U	1 U	ND	ND		0/7
1,2-Dibromo-3-chloropropane	NA	NA	ND	ND		0/0
1,2-Dibromoethane	1 U	1 U	ND	ND		0/7
TRANS 1,2-Dichloroethene	1 U	1 U	ND	ND		0/7
CIS 1,2-Dichloroethene	1 U	1 U	ND	ND		0/7
1,2-Dichloroethene (total)						

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
EXPLOSIVE COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A06RB-05	A06RB-06	A06RB-07	A06RB-08	A06RB-09	A06RB-10
Sample Date	11/05/94	11/06/94	11/07/94	11/08/94	11/15/94	11/16/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
HMX	0.61 U	0.61 U	0.61 U	0.61 U	0.61 U	0.61 U
RDX	0.59 U	0.59 U	12 U	11 U	0.59 U	0.59 U
1,3,5-Trinitrobenzene	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U
1,3-Dinitrobenzene	1.1 U	1.1 U	7.2 U	11 U	1.1 U	1.1 U
Tertyl	1 U	1 U	1.7 U	1.5 U	1 U	1 U
Nitrobenzene	0.73 U	0.73 U	0.73 U	0.73 U	0.73 U	0.73 U
2,4,6-Trinitrotoluene	0.62 U	0.62 U	0.62 U	0.62 U	0.62 U	0.62 U
4-Amino-2,6-Dinitrotoluene	1 U	1 U	1 U	1 U	1 U	1 U
2,6-Dinitrotoluene	1 U	1 U	1 U	1 U	1 U	1 U
2,4-Dinitrotoluene	1 U	1 U	1 U	1 U	1 U	1 U
2-Nitrotoluene	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U
3-Nitrotoluene	0.91 U	0.91 U	0.91 U	0.91 U	0.91 U	0.91 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
EXPLOSIVE COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A06RB-11	A06RB-14
Sample Date	11/17/94	11/18/94
Units	UG/L	UG/L
HMX	0.61 U	0.61 U
RDX	0.59 U	0.59 U
1,3,5-Trinitrobenzene	0.66 U	0.66 U
1,3-Dinitrobenzene	1.1 U	1.1 U
Tertyl	1 U	1 U
Nitrobenzene	0.73 U	0.73 U
2,4,6-Trinitrotoluene	0.62 U	0.62 U
4-Amino-2,6-Dinitrotoluene	1 U	1 U
2,6-Dinitrotoluene	1 U	1 U
2,4-Dinitrotoluene	1 U	1 U
2-Nitrotoluene	0.75 U	0.75 U
3-Nitrotoluene	0.91 U	0.91 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
EXPLOSIVE COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sample Date Units	MINIMUM	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
HMX	0.61 U	0.61 U	ND	ND		0/8
RDX	0.59 U	12 U	ND	ND		0/8
1,3,5-Trinitrobenzene	0.66 U	0.66 U	ND	ND		0/8
1,3-Dinitrobenzene	1.1 U	11 U	ND	ND		0/8
Tertyl	1 U	1.7 U	ND	ND		0/8
Nitrobenzene	0.73 U	0.73 U	ND	ND		0/8
2,4,6-Trinitrotoluene	0.62 U	0.62 U	ND	ND		0/8
4-Amino-2,6-Dinitrotoluene	1 U	1 U	ND	ND		0/8
2,6-Dinitrotoluene	1 U	1 U	ND	ND		0/8
2,4-Dinitrotoluene	1 U	1 U	ND	ND		0/8
2-Nitrotoluene	0.75 U	0.75 U	ND	ND		0/8
3-Nitrotoluene	0.91 U	0.91 U	ND	ND		0/8

RINSATE BLANKS
DISSOLVED INORGANICS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A06RB-06F	A06RB-09F	A06RB-10F
Sampling Date	11/06/94	11/15/94	11/16/94
Units	UG/L	UG/L	UG/L
Aluminum	11 U	11 U	11 U
Antimony	14.2 J	12.2 U	12.2 U
Arsenic	2.3 U	2.3 U	2.3 U
Barium	0.5 U	0.5 U	0.5 U
Beryllium	0.1 U	0.11 J	0.1 U
Cadmium	1.5 U	1.5 U	1.5 U
Calcium	42.5 J	58.4 J	76.5 J
Chromium	1.8 U	1.8 U	1.8 U
Cobalt	1.9 U	1.9 U	1.9 U
Copper	1.4 U	2.4 J	6.8 J
Iron	5.6 J	1.5 U	29.8 J
Lead	1.4 U	1.4 U	1.4 U
Magnesium	11.1 U	17 J	18.5 J
Manganese	1.2 J	1.7 J	1.2 J
Mercury	0.2 U	0.2 U	0.2 U
Nickel	4.3 U	4.3 U	4.3 U
Potassium	381 U	381 U	381 U
Selenium	2.6 U	2.6 U	2.6 UL
Silver	2 U	2 U	2 U
Sodium	57.7 J	55.5 J	52.8 J
Thallium	4 U	4 U	4 U
Vanadium	1.4 U	1.4 U	1.4 U
Zinc	4 J	4.6 J	8.7 J

RINSATE BLANKS
DISSOLVED INORGANICS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	11 U	11 U	ND	ND		0/3
Antimony	12.2 U	12.2 U	14.2 J	14.2 J	A06RB-06F	1/3
Arsenic	2.3 U	2.3 U	ND	ND		0/3
Barium	0.5 U	0.5 U	ND	ND		0/3
Beryllium	0.1 U	0.1 U	0.11 J	0.11 J	A06RB-09F	1/3
Cadmium	1.5 U	1.5 U	ND	ND		0/3
Calcium	NA	NA	42.5 J	76.5 J	A06RB-10F	3/3
Chromium	1.8 U	1.8 U	ND	ND		0/3
Cobalt	1.9 U	1.9 U	ND	ND		0/3
Copper	1.4 U	1.4 U	2.4 J	6.8 J	A06RB-10F	2/3
Iron	1.5 U	1.5 U	5.6 J	29.8 J	A06RB-10F	2/3
Lead	1.4 U	1.4 U	ND	ND		0/3
Magnesium	11.1 U	11.1 U	17 J	18.5 J	A06RB-10F	2/3
Manganese	NA	NA	1.2 J	1.7 J	A06RB-09F	3/3
Mercury	0.2 U	0.2 U	ND	ND		0/3
Nickel	4.3 U	4.3 U	ND	ND		0/3
Potassium	381 U	381 U	ND	ND		0/3
Selenium	2.6 U	2.6 U	ND	ND		0/3
Silver	2 U	2 U	ND	ND		0/3
Sodium	NA	NA	52.8 J	57.7 J	A06RB-06F	3/3
Thallium	4 U	4 U	ND	ND		0/3
Vanadium	1.4 U	1.4 U	ND	ND		0/3
Zinc	NA	NA	4 J	8.7 J	A06RB-10F	3/3

RINSATE BLANKS
TOTAL INORGANICS AND CYANIDE
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A06RB-05	A06RB-06	A06RB-07	A06RB-08	A06RB09	A06RB-10
Sampling Date	11/05/94	11/06/94	11/07/94	11/08/94	11/15/94	11/16/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
Aluminum	11.3 J	12.7 J	11 U	11 U	11 U	11 U
Antimony	12.2 UL	12.2 UL	12.2 UL	12.2 UL	12.2 UL	12.2 R
Arsenic	2.3 U	2.3 U	2.3 U	2.3 U	2.3 U	2.3 U
Barium	0.5 U	0.5 U	1 U	0.5 U	0.5 U	0.5 U
Beryllium	0.1 J	0.1 J	1 U	0.1 U	0.1 U	0.32 J
Cadmium	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
Calcium	25.5 J	18.8 J	14.8 J	16.9 J	27.9 J	11.6 J
Chromium	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U
Cobalt	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U
Copper	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.5 J
Iron	18.7 J	132 J	1.5 U	3.4 J	10.8 J	1.5 U
Lead	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U
Magnesium	11.1 U	11.1 U	11.1 U	11.1 U	11.1 U	11.1 U
Manganese	1.1 J	0.4 J	1 U	0.4 U	0.4 U	0.4 U
Mercury	0.2 U	0.2 U	0.2 UL	0.2 U	0.2 U	0.2 U
Nickel	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U
Potassium	381 U	381 U	381 U	381 U	381 U	381 U
Selenium	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 UL
Silver	2 U	2 U	2 U	2 U	2 U	2 UL
Sodium	31.8 J	32.1 J	14.1 J	257 J	18.6 J	33.4 J
Thallium	4.2 J	4 U	4 UL	4 U	4.4 J	4 U
Vanadium	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 UL
Zinc	4.6 J	5.4 J	4.7 JJ	4.6 J	6.1 J	7 J
CN	5 U	5 U	5 U	5 U	5 U	5 U

RINSATE BLANKS
TOTAL INORGANICS AND CYANIDE
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A06RB-11	A06RB-14
Sampling Date	11/17/94	11/18/94
Units	UG/L	UG/L
Aluminum	14 J	20.4 J
Antimony	12.2 R	12.2 R
Arsenic	2.3 U	2.3 U
Barium	0.5 U	0.5 U
Beryllium	0.23 J	0.29 J
Cadmium	1.5 U	1.5 U
Calcium	13.7 J	9.7 J
Chromium	1.8 U	1.8 U
Cobalt	1.9 U	1.9 U
Copper	1.5 J	1.4 U
Iron	2.3 J	5.3 J
Lead	1.4 U	1.4 U
Magnesium	11.1 U	11.1 U
Manganese	0.4 U	0.4 U
Mercury	0.2 U	0.2 U
Nickel	4.3 U	4.3 U
Potassium	381 U	381 U
Selenium	2.6 UL	2.6 UL
Silver	2 UL	2 UL
Sodium	25.7 J	34.4 J
Thallium	4 U	4 U
Vanadium	1.4 UL	1.4 UL
Zinc	3.8 J	5 J
CN	5 U	5 U

RINSATE BLANKS
TOTAL INORGANICS AND CYANIDE
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	11 U	11 U	11.3 J	20.4 J	A06RB-14	4/8
Antimony	12.2 UL	12.2 UL	ND	ND		0/5
Arsenic	2.3 U	2.3 U	ND	ND		0/8
Barium	0.5 U	1 U	ND	ND		0/8
Beryllium	0.1 U	1 U	0.1 J	0.32 J	A06RB-10	5/8
Cadmium	1.5 U	1.5 U	ND	ND		0/8
Calcium	NA	NA	9.7 J	27.9 J	A06RB09	8/8
Chromium	1.8 U	1.8 U	ND	ND		0/8
Cobalt	1.9 U	1.9 U	ND	ND		0/8
Copper	1.4 U	1.4 U	1.5 J	1.5 J	A06RB-11	2/8
Iron	1.5 U	1.5 U	2.3 J	132 J	A06RB-06	6/8
Lead	1.4 U	1.4 U	ND	ND		0/8
Magnesium	11.1 U	11.1 U	ND	ND		0/8
Manganese	0.4 U	1 U	0.4 J	1.1 J	A06RB-05	2/8
Mercury	0.2 U	0.2 U	ND	ND		0/8
Nickel	4.3 U	4.3 U	ND	ND		0/8
Potassium	381 U	381 U	ND	ND		0/8
Selenium	2.6 U	2.6 U	ND	ND		0/8
Silver	2 U	2 U	ND	ND		0/8
Sodium	NA	NA	14.1 J	257 J	A06RB-08	8/8
Thallium	4 U	4 U	4.2 J	4.4 J	A06RB09	2/8
Vanadium	1.4 U	1.4 U	ND	ND		0/8
Zinc	NA	NA	3.8 J	7 J	A06RB-10	8/8
CN	5 U	5 U	ND	ND		0/8

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
PESTICIDE/PCB COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A06RB-05	A06RB-06	A06RB-07	A06RB-08	A06RB09	A06RB-10
Sampling Date	11/05/94	11/06/94	11/07/94	11/08/94	11/15/94	11/16/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
alpha-BHC	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
beta-BHC	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
delta-BHC	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
gamma-BHC (Lindane)	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Heptachlor	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Aldrin	0.05 U	0.05 U	0.05 U	0.022 J	0.05 U	0.05 U
Heptachlor Epoxide	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Endosulfan I	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Dieldrin	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDE	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Endrin	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Endosulfan II	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDD	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Endosulfan Sulfate	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDT	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Methoxychlor	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Endrin Ketone	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Endrin Aldehyde	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
alpha-Chlordane	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
gamma-Chlordane	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Toxaphene	5 U	5 U	5 U	5 U	5 U	5 U
Aroclor 1016	1 U	1 U	1 U	1 U	1 U	1 U
Aroclor 1221	2 U	2 U	2 U	2 U	2 U	2 U
Aroclor 1232	1 U	1 U	1 U	1 U	1 U	1 U
Aroclor 1242	1 U	1 U	1 U	1 U	1 U	1 U
Aroclor-1248	1 U	1 U	1 U	1 U	1 U	1 U
Aroclor-1254	1 U	1 U	1 U	1 U	1 U	1 U
Aroclor-1260	1 U	1 U	1 U	1 U	1 U	1 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
PESTICIDE/PCB COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A06RB-11	A06RB-14
Sampling Date	11/17/94	11/18/94
Units	UG/L	UG/L
alpha-BHC	0.05 U	0.05 U
beta-BHC	0.05 U	0.05 U
delta-BHC	0.05 U	0.05 U
gamma-BHC (Lindane)	0.05 U	0.05 U
Heptachlor	0.05 U	0.05 U
Aldrin	0.05 U	0.05 U
Heptachlor Epoxide	0.05 U	0.05 U
Endosulfan I	0.05 U	0.05 U
Dieldrin	0.1 U	0.1 U
4,4'-DDE	0.1 U	0.1 U
Endrin	0.1 U	0.1 U
Endosulfan II	0.1 U	0.1 U
4,4'-DDD	0.1 U	0.1 U
Endosulfan Sulfate	0.1 U	0.1 U
4,4'-DDT	0.1 U	0.1 U
Methoxychlor	0.5 U	0.5 U
Endrin Ketone	0.1 U	0.1 U
Endrin Aldehyde	0.1 U	0.1 U
alpha-Chlordane	0.05 U	0.05 U
gamma-Chlordane	0.05 U	0.05 U
Toxaphene	5 U	5 U
Aroclor 1016	1 U	1 U
Aroclor 1221	2 U	2 U
Aroclor 1232	1 U	1 U
Aroclor 1242	1 U	1 U
Aroclor-1248	1 U	1 U
Aroclor-1254	1 U	1 U
Aroclor-1260	1 U	1 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
PESTICIDE/PCB COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
alpha-BHC	0.05 U	0.05 U	ND	ND		0/8
beta-BHC	0.05 U	0.05 U	ND	ND		0/8
delta-BHC	0.05 U	0.05 U	ND	ND		0/8
gamma-BHC (Lindane)	0.05 U	0.05 U	ND	ND		0/8
Heptachlor	0.05 U	0.05 U	ND	ND		0/8
Aldrin	0.05 U	0.05 U	0.022 J	0.022 J	A06RB-08	1/8
Heptachlor Epoxide	0.05 U	0.05 U	ND	ND		0/8
Endosulfan I	0.05 U	0.05 U	ND	ND		0/8
Dieldrin	0.1 U	0.1 U	ND	ND		0/8
4,4'-DDE	0.1 U	0.1 U	ND	ND		0/8
Endrin	0.1 U	0.1 U	ND	ND		0/8
Endosulfan II	0.1 U	0.1 U	ND	ND		0/8
4,4'-DDD	0.1 U	0.1 U	ND	ND		0/8
Endosulfan Sulfate	0.1 U	0.1 U	ND	ND		0/8
4,4'-DDT	0.1 U	0.1 U	ND	ND		0/8
Methoxychlor	0.5 U	0.5 U	ND	ND		0/8
Endrin Ketone	0.1 U	0.1 U	ND	ND		0/8
Endrin Aldehyde	0.1 U	0.1 U	ND	ND		0/8
alpha-Chlordane	0.05 U	0.05 U	ND	ND		0/8
gamma-Chlordane	0.05 U	0.05 U	ND	ND		0/8
Toxaphene	5 U	5 U	ND	ND		0/8
Aroclor 1016	1 U	1 U	ND	ND		0/8
Aroclor 1221	2 U	2 U	ND	ND		0/8
Aroclor 1232	1 U	1 U	ND	ND		0/8
Aroclor 1242	1 U	1 U	ND	ND		0/8
Aroclor-1248	1 U	1 U	ND	ND		0/8
Aroclor-1254	1 U	1 U	ND	ND		0/8
Aroclor-1260	1 U	1 U	ND	ND		0/8

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A06RB-05	A06RB-06	A06RB-07	A06RB-08	A06RB09	A06RB-10
Sampling Date	11/05/94	11/06/94	11/07/94	11/08/94	11/15/94	11/16/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
Phenol	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroethyl) Ether	10 U	10 U	10 U	10 U	10 U	10 U
2-Chlorophenol	10 U	10 U	10 U	10 U	10 U	10 U
1,3-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylphenol	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroisopropyl)Ether	10 U	10 U	10 U	10 U	10 U	10 U
4-Methylphenol	10 U	10 U	10 U	10 U	10 U	10 U
N-Nitrosodipropylamine	10 U	10 U	10 U	10 U	10 U	10 U
Hexachloroethane	10 U	10 U	10 U	10 U	10 U	10 U
Nitrobenzene	10 U	10 U	10 U	10 U	10 U	10 U
Isophorone	10 U	10 U	10 U	10 U	10 U	10 U
2-Nitrophenol	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dimethylphenol	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroethoxy)Methane	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dichlorophenol	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4-Trichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
Naphthalene	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloroaniline	10 UJ	10 UJ	10 UJ	10 U	10 UJ	10 UJ
Hexachlorobutadiene	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloro-3-methylphenol	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylnaphthalene	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorocyclopentadiene	10 U	10 U	10 U	10 U	10 U	10 U
2,4,6-Trichlorophenol	10 U	10 U	10 U	10 U	10 U	10 U
2,4,5-Trichlorophenol	25 U	25 U	25 U	25 U	25 U	25 U
2-Chloronaphthalene	10 U	10 U	10 U	10 U	10 U	10 U
2-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U
Dimethylphthalate	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthylene	10 U	10 U	10 U	10 U	10 U	10 U
2,6-Dinitrotoluene	10 U	10 U	10 U	10 U	10 U	10 U
3-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U
Acenaphthene	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dinitrophenol	25 U	25 U	25 UJ	25 U	25 U	25 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A06RB-05	A06RB-06	A06RB-07	A06RB-08	A06RB09	A06RB-10
Sampling Date	11/05/94	11/06/94	11/07/94	11/08/94	11/15/94	11/16/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
4-Nitrophenol	25 U	25 U	25 U	25 U	25 U	25 U
Dibenzofuran	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dinitrotoluene	10 U	10 U	10 U	10 U	10 U	10 U
Diethylphthalate	10 U	10 U	9 J	8 J	10 U	10 U
4-Chlorophenylphenyl Ether	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene	10 U	10 U	10 U	10 U	10 U	10 U
4-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U
4,6-Dinitro-2-Methylphenol	25 U	25 U	25 U	25 U	25 U	25 U
N-nitrosodiphenylamine	10 U	10 U	10 U	10 U	10 U	10 U
4-Bromophenylphenyl Ether	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
Pentachlorophenol	25 U	25 U	25 U	25 U	25 U	25 U
Phenanthrene	10 U	10 U	10 U	10 U	10 U	10 U
Anthracene	10 U	10 U	10 U	10 U	10 U	10 U
Carbazole	10 U	10 U	10 U	10 U	10 U	10 U
Di-n-Butyl Phthalate	7 J	6 J	10 U	10 U	7 J	10 U
Fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U
Pyrene	10 U	10 U	10 U	10 U	10 U	10 U
Butyl Benzyl Phthalate	10 U	10 U	10 U	10 U	10 U	10 U
3,3'-Dichlorobenzidine	10 U	10 U	10 U	10 U	10 UJ	10 U
Benzo(a)anthracene	10 U	10 U	10 U	10 U	10 U	10 U
Chrysene	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Ethylhexyl)Phthalate	10 U	10 U	10 U	1 J	10 U	10 U
Di-n-Octylphthalate	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)Pyrene	10 U	10 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	10 U	10 U	10 U	10 U	10 U	10 U
Dibenzo(a,h)anthracene	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)Perylene	10 U	10 U	10 U	10 U	10 U	10 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A06RB-11	A06RB-14
Sampling Date	11/17/94	11/18/94
Units	UG/L	UG/L
Phenol	10 U	10 U
bis(2-Chloroethyl) Ether	10 U	10 U
2-Chlorophenol	10 U	10 U
1,3-Dichlorobenzene	10 U	10 U
1,4-Dichlorobenzene	10 U	10 U
1,2-Dichlorobenzene	10 U	10 U
2-Methylphenol	10 U	10 U
bis(2-Chloroisopropyl)Ether	10 U	10 U
4-Methylphenol	10 U	10 U
N-Nitrosodipropylamine	10 U	10 U
Hexachloroethane	10 U	10 U
Nitrobenzene	10 U	10 U
Isophorone	10 U	10 U
2-Nitrophenol	10 U	10 U
2,4-Dimethylphenol	10 U	10 U
bis(2-Chloroethoxy)Methane	10 U	10 U
2,4-Dichlorophenol	10 U	10 U
1,2,4-Trichlorobenzene	10 U	10 U
Naphthalene	10 U	10 U
4-Chloroaniline	10 UJ	10 U
Hexachlorobutadiene	10 U	10 U
4-Chloro-3-methylphenol	10 U	10 U
2-Methylnaphthalene	10 U	10 U
Hexachlorocyclopentadiene	10 U	10 U
2,4,6-Trichlorophenol	10 U	10 U
2,4,5-Trichlorophenol	25 U	25 U
2-Chloronaphthalene	10 U	10 U
2-Nitroaniline	25 U	25 U
Dimethylphthalate	10 U	10 U
Acenaphthylene	10 U	10 U
2,6-Dinitrotoluene	10 U	10 U
3-Nitroaniline	25 U	25 U
Acenaphthene	10 U	10 U
2,4-Dinitrophenol	25 U	25 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A06RB-11	A06RB-14
Sampling Date	11/17/94	11/18/94
Units	UG/L	UG/L
4-Nitrophenol	25 U	25 U
Dibenzofuran	10 U	10 U
2,4-Dinitrotoluene	10 U	10 U
Diethylphthalate	10 U	10 U
4-Chlorophenylphenyl Ether	10 U	10 U
Fluorene	10 U	10 U
4-Nitroaniline	25 U	25 U
4,6-Dinitro-2-Methylphenol	25 U	25 U
N-nitrosodiphenylamine	10 U	10 U
4-Bromophenylphenyl Ether	10 U	10 U
Hexachlorobenzene	10 U	10 U
Pentachlorophenol	25 U	25 U
Phenanthrene	10 U	10 U
Anthracene	10 U	10 U
Carbazole	10 U	10 U
Di-n-Butyl Phthalate	10 U	1 J
Fluoranthene	10 U	10 U
Pyrene	10 U	10 U
Butyl Benzyl Phthalate	10 U	10 U
3,3'-Dichlorobenzidine	10 U	10 U
Benzo(a)anthracene	10 U	10 U
Chrysene	10 U	10 U
bis(2-Ethylhexyl)Phthalate	10 U	10 U
Di-n-Octylphthalate	10 U	10 U
Benzo(b)fluoranthene	10 U	10 U
Benzo(k)fluoranthene	10 U	10 U
Benzo(a)Pyrene	10 U	10 U
Indeno(1,2,3-cd)pyrene	10 U	10 U
Dibenzo(a,h)anthracene	10 U	10 U
Benzo(g,h,i)Perylene	10 U	10 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Phenol	10 U	10 U	ND	ND		0/8
bis(2-Chloroethyl) Ether	10 U	10 U	ND	ND		0/8
2-Chlorophenol	10 U	10 U	ND	ND		0/8
1,3-Dichlorobenzene	10 U	10 U	ND	ND		0/8
1,4-Dichlorobenzene	10 U	10 U	ND	ND		0/8
1,2-Dichlorobenzene	10 U	10 U	ND	ND		0/8
2-Methylphenol	10 U	10 U	ND	ND		0/8
bis(2-Chloroisopropyl)Ether	10 U	10 U	ND	ND		0/8
4-Methylphenol	10 U	10 U	ND	ND		0/8
N-Nitrosodipropylamine	10 U	10 U	ND	ND		0/8
Hexachloroethane	10 U	10 U	ND	ND		0/8
Nitrobenzene	10 U	10 U	ND	ND		0/8
Isophorone	10 U	10 U	ND	ND		0/8
2-Nitrophenol	10 U	10 U	ND	ND		0/8
2,4-Dimethylphenol	10 U	10 U	ND	ND		0/8
bis(2-Chloroethoxy)Methane	10 U	10 U	ND	ND		0/8
2,4-Dichlorophenol	10 U	10 U	ND	ND		0/8
1,2,4-Trichlorobenzene	10 U	10 U	ND	ND		0/8
Naphthalene	10 U	10 U	ND	ND		0/8
4-Chloroaniline	10 UJ	10 UJ	ND	ND		0/8
Hexachlorobutadiene	10 U	10 U	ND	ND		0/8
4-Chloro-3-methylphenol	10 U	10 U	ND	ND		0/8
2-Methylnaphthalene	10 U	10 U	ND	ND		0/8
Hexachlorocyclopentadiene	10 U	10 U	ND	ND		0/8
2,4,6-Trichlorophenol	10 U	10 U	ND	ND		0/8
2,4,5-Trichlorophenol	25 U	25 U	ND	ND		0/8
2-Chloronaphthalene	10 U	10 U	ND	ND		0/8
2-Nitroaniline	25 U	25 U	ND	ND		0/8
Dimethylphthalate	10 U	10 U	ND	ND		0/8
Acenaphthylene	10 U	10 U	ND	ND		0/8
2,6-Dinitrotoluene	10 U	10 U	ND	ND		0/8
3-Nitroaniline	25 U	25 U	ND	ND		0/8
Acenaphthene	10 U	10 U	ND	ND		0/8
2,4-Dinitrophenol	25 U	25 U	ND	ND		0/8

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
4-Nitrophenol	25 U	25 U	ND	ND		0/8
Dibenzofuran	10 U	10 U	ND	ND		0/8
2,4-Dinitrotoluene	10 U	10 U	ND	ND		0/8
Diethylphthalate	10 U	10 U	8 J	9 J	A06RB-07	2/8
4-Chlorophenylphenyl Ether	10 U	10 U	ND	ND		0/8
Fluorene	10 U	10 U	ND	ND		0/8
4-Nitroaniline	25 U	25 U	ND	ND		0/8
4,6-Dinitro-2-Methylphenol	25 U	25 U	ND	ND		0/8
N-nitrosodiphenylamine	10 U	10 U	ND	ND		0/8
4-Bromophenylphenyl Ether	10 U	10 U	ND	ND		0/8
Hexachlorobenzene	10 U	10 U	ND	ND		0/8
Pentachlorophenol	25 U	25 U	ND	ND		0/8
Phenanthrene	10 U	10 U	ND	ND		0/8
Anthracene	10 U	10 U	ND	ND		0/8
Carbazole	10 U	10 U	ND	ND		0/8
Di-n-Butyl Phthalate	10 U	10 U	1 J	7 J	A06RB09	4/8
Fluoranthene	10 U	10 U	ND	ND		0/8
Pyrene	10 U	10 U	ND	ND		0/8
Butyl Benzyl Phthalate	10 U	10 U	ND	ND		0/8
3,3'-Dichlorobenzidine	10 U	10 U	ND	ND		0/8
Benzo(a)anthracene	10 U	10 U	ND	ND		0/8
Chrysene	10 U	10 U	ND	ND		0/8
bis(2-Ethylhexyl)Phthalate	10 U	10 U	1 J	1 J	A06RB-08	1/8
Di-n-Octylphthalate	10 U	10 U	ND	ND		0/8
Benzo(b)fluoranthene	10 U	10 U	ND	ND		0/8
Benzo(k)fluoranthene	10 U	10 U	ND	ND		0/8
Benzo(a)Pyrene	10 U	10 U	ND	ND		0/8
Indeno(1,2,3-cd)pyrene	10 U	10 U	ND	ND		0/8
Dibenzo(a,h)anthracene	10 U	10 U	ND	ND		0/8
Benzo(g,h,i)Perylene	10 U	10 U	ND	ND		0/8

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A06RB-05	A06RB-06	A06RB-07	A06RB-08	A06RB-09	A06RB-10
Sampling Date	11/05/94	11/06/94	11/07/94	11/08/94	11/15/94	11/16/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
Chloromethane	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 U
Bromomethane	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl chloride	1 U	1 U	1 U	1 U	1 U	1 U
Chloroethane	1 U	1 U	1 U	1 U	1 U	1 U
Methylene chloride	2 U	2	2 U	2 U	3	35 D
Acetone	5 R	5 R	9 J	9 J	5 R	5 R
Carbon disulfide	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	4	3	1 U	1 U	7	4
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U
Bromochloromethane	1 U	1 U	1 U	1 U	1 U	1 U
2-Butanone	5 R	5 R	5 R	5 R	5 R	5 R
1,1,1-Trichloroethane	1 U	1 U	17	18	1 U	1 U
Carbon Tetrachloride	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	1 U	1 U	1 U	1 U	1 U	1 U
Dibromochloromethane	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U
Benzene	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U	1 U	1 U	1 U
4-Methyl-2-pentanone	5 U	5 U	5 U	5 U	5 U	5 U
2-Hexanone	5 R	5 R	5 R	5 R	5 R	5 R
Tetrachloroethene	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	1 U	1 U	1 U	1 U	1 U	1 U
Styrene	1 U	1 U	1 U	1 U	1 U	1 U
Total Xylenes	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A06RB-05	A06RB-06	A06RB-07	A06RB-08	A06RB-09	A06RB-10
Sampling Date	11/05/94	11/06/94	11/07/94	11/08/94	11/15/94	11/16/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
1,4-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U
1,3-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dibromo-3-chloropropane	1 R	1 R	1 R	1 R	1 R	1 R
1,2-Dibromoethane	1 U	1 U	1 U	1 U	1 U	1 U
TRANS 1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U
CIS 1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethene (total)						

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A06RB-11	A06RB-14
Sampling Date	11/17/94	11/18/94
Units	UG/L	UG/L
Chloromethane	1 U	2 U
Bromomethane	1 U	2 U
Vinyl chloride	1 U	2 U
Chloroethane	1 U	2 U
Methylene chloride	38 D	33
Acetone	5 R	10 R
Carbon disulfide	1 U	2 U
1,1-Dichloroethene	1 U	2 U
1,1-Dichloroethane	1 U	2 U
Chloroform	4	4
1,2-Dichloroethane	1 U	2 U
Bromochloromethane	1 U	2 U
2-Butanone	5 R	10 R
1,1,1-Trichloroethane	1 U	2 U
Carbon Tetrachloride	1 U	2 U
Bromodichloromethane	1 U	2 U
1,2-Dichloropropane	1 U	2 U
cis-1,3-Dichloropropene	1 U	2 U
Trichloroethene	1 U	2 U
Dibromochloromethane	1 U	2 U
1,1,2-Trichloroethane	1 U	2 U
Benzene	1 U	2 U
trans-1,3-Dichloropropene	1 U	2 U
Bromoform	1 U	2 U
4-Methyl-2-pentanone	5 U	10 U
2-Hexanone	5 R	10 U
Tetrachloroethene	1 U	2 U
1,1,2,2-Tetrachloroethane	1 U	2 U
Toluene	1 U	2 U
Chlorobenzene	1 U	2 U
Ethylbenzene	1 U	2 U
Styrene	1 U	2 U
Total Xylenes	1 U	2 U
1,2-Dichlorobenzene	1 U	2 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A06RB-11	A06RB-14
Sampling Date	11/17/94	11/18/94
Units	UG/L	UG/L
1,4-Dichlorobenzene	1 U	2 U
1,3-Dichlorobenzene	1 U	2 U
1,2-Dibromo-3-chloropropane	1 R	2 R
1,2-Dibromoethane	1 U	2 U
TRANS 1,2-Dichloroethene	1 U	2 U
CIS 1,2-Dichloroethene	1 U	2 U
1,2-Dichloroethene (total)		

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Chloromethane	1 UJ	2 U	ND	ND		0/8
Bromomethane	1 U	2 U	ND	ND		0/8
Vinyl chloride	1 U	2 U	ND	ND		0/8
Chloroethane	1 U	2 U	ND	ND		0/8
Methylene chloride	2 U	2 U	2	38 D	A06RB-11	5/8
Acetone	NA	NA	9 J	9 J	A06RB-08	2/2
Carbon disulfide	1 U	2 U	ND	ND		0/8
1,1-Dichloroethene	1 U	2 U	ND	ND		0/8
1,1-Dichloroethane	1 U	2 U	ND	ND		0/8
Chloroform	1 U	1 U	3	7	A06RB-09	6/8
1,2-Dichloroethane	1 U	2 U	ND	ND		0/8
Bromochloromethane	1 U	2 U	ND	ND		0/8
2-Butanone	NA	NA	ND	ND		0/0
1,1,1-Trichloroethane	1 U	2 U	17	18	A06RB-08	2/8
Carbon Tetrachloride	1 U	2 U	ND	ND		0/8
Bromodichloromethane	1 U	2 U	ND	ND		0/8
1,2-Dichloropropane	1 U	2 U	ND	ND		0/8
cis-1,3-Dichloropropene	1 U	2 U	ND	ND		0/8
Trichloroethene	1 U	2 U	ND	ND		0/8
Dibromochloromethane	1 U	2 U	ND	ND		0/8
1,1,2-Trichloroethane	1 U	2 U	ND	ND		0/8
Benzene	1 U	2 U	ND	ND		0/8
trans-1,3-Dichloropropene	1 U	2 U	ND	ND		0/8
Bromoform	1 U	2 U	ND	ND		0/8
4-Methyl-2-pentanone	5 U	10 U	ND	ND		0/8
2-Hexanone	10 U	10 U	ND	ND		0/1
Tetrachloroethene	1 U	2 U	ND	ND		0/8
1,1,2,2-Tetrachloroethane	1 U	2 U	ND	ND		0/8
Toluene	1 U	2 U	ND	ND		0/8
Chlorobenzene	1 U	2 U	ND	ND		0/8
Ethylbenzene	1 U	2 U	ND	ND		0/8
Styrene	1 U	2 U	ND	ND		0/8
Total Xylenes	1 U	2 U	ND	ND		0/8
1,2-Dichlorobenzene	1 U	2 U	ND	ND		0/8

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
1,4-Dichlorobenzene	1 U	2 U	ND	ND		0/8
1,3-Dichlorobenzene	1 U	2 U	ND	ND		0/8
1,2-Dibromo-3-chloropropane	NA	NA	ND	ND		0/0
1,2-Dibromoethane	1 U	2 U	ND	ND		0/8
TRANS 1,2-Dichloroethene	1 U	2 U	ND	ND		0/8
CIS 1,2-Dichloroethene	1 U	2 U	ND	ND		0/8
1,2-Dichloroethene (total)						

FREQUENCY OF DETECTION SUMMARY
TRIP BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	06TB-07	06TB-08	06TB-09	A06TB10	06TB-11	6TB-13
Sampling Date	11/05/94	11/06/94	11/06/94	11/07/94	11/08/94	11/15/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
Chloromethane	1 UJ	1 UJ	1 UJ	1 UJ	1 U	1 UJ
Bromomethane	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl chloride	1 U	1 U	1 U	1 U	1 U	1 U
Chloroethane	1 U	1 U	1 U	1 U	1 U	1 U
Methylene chloride	2 U	2 U	2 U	2 U	2 U	2 U
Acetone	5 R	5 R	5 R	5 R	5 R	5 R
Carbon disulfide	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U	0.6 J
Bromochloromethane	1 U	1 U	1 U	1 U	1 U	1 U
2-Butanone	5 R	5 R	5 R	5 R	5 R	5 R
1,1,1-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U
Carbon Tetrachloride	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	1 U	1 U	1 U	1 U	1 U	1 U
Dibromochloromethane	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U
Benzene	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U	1 U	1 U	1 U
4-Methyl-2-pentanone	5 U	5 U	5 U	5 U	5 U	5 U
2-Hexanone	5 R	5 R	5 R	5 R	5 U	5 R
Tetrachloroethene	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	1 U	1 U	1 U	1 U	1 U	1 U
Styrene	1 U	1 U	1 U	1 U	1 U	1 U
Total.Xylenes	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U

FREQUENCY OF DETECTION SUMMARY
TRIP BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	06TB-07	06TB-08	06TB-09	A06TB10	06TB-11	6TB-13
Sampling Date	11/05/94	11/06/94	11/06/94	11/07/94	11/08/94	11/15/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
1,4-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U
1,3-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dibromo-3-chloropropane	1 R	1 R	1 R	1 R	1 U	1 R
1,2-Dibromoethane	1 U	1 U	1 U	1 U	1 U	1 U
TRANS 1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U
CIS 1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U

FREQUENCY OF DETECTION SUMMARY
TRIP BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	6TB-14	6TB-15	6TB-16	A6/7TB-17	6/7 TB-19
Sampling Date	11/15/94	11/16/94	11/17/94	11/17/94	11/18/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L
Chloromethane	1 U	1 U	1 U	1 U	1 U
Bromomethane	1 U	1 U	1 U	1 U	1 U
Vinyl chloride	1 U	1 U	1 U	1 U	1 U
Chloroethane	1 U	1 U	1 U	1 U	1 U
Methylene chloride	2 U	2 U	2 U	2 U	2 U
Acetone	5 U	5 R	5 R	5 R	5 R
Carbon disulfide	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	1 U	1 U	1 U
Chloroform	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U
Bromochloromethane	1 U	1 U	1 U	1 U	1 U
2-Butanone	5 U	5 R	5 R	5 R	5 R
1,1,1-Trichloroethane	1 U	1 U	1 U	1 U	1 U
Carbon Tetrachloride	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U
Trichloroethene	1 U	1 U	1 U	1 U	1 U
Dibromochloromethane	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	1 U
Benzene	1 U	1 U	1 U	1 U	1 U
trans-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U	1 U	1 U
4-Methyl-2-pentanone	5 U	5 U	5 U	5 U	5 U
2-Hexanone	5 U	5 R	5 R	5 R	5 R
Tetrachloroethene	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U	1 U
Toluene	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	1 U	1 U	1 U	1 U	1 U
Styrene	1 U	1 U	1 U	1 U	1 U
Total Xylenes	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U

FREQUENCY OF DETECTION SUMMARY
TRIP BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	6TB-14	6TB-15	6TB-16	A6/7TB-17	6/7 TB-19
Sampling Date	11/15/94	11/16/94	11/17/94	11/17/94	11/18/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L
1,4-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U
1,3-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U
1,2-Dibromo-3-chloropropane	1 U	1 R	1 R	1 R	1 R
1,2-Dibromoethane	1 U	1 U	1 U	1 U	1 U
TRANS 1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U
CIS 1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U

FREQUENCY OF DETECTION SUMMARY
TRIP BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Chloromethane	1 UJ	1 UJ	ND	ND		0/11
Bromomethane	1 U	1 U	ND	ND		0/11
Vinyl chloride	1 U	1 U	ND	ND		0/11
Chloroethane	1 U	1 U	ND	ND		0/11
Methylene chloride	2 U	2 U	ND	ND		0/11
Acetone	5 U	5 U	ND	ND		0/1
Carbon disulfide	1 U	1 U	ND	ND		0/11
1,1-Dichloroethene	1 U	1 U	ND	ND		0/11
1,1-Dichloroethane	1 U	1 U	ND	ND		0/11
Chloroform	1 U	1 U	ND	ND		0/11
1,2-Dichloroethane	1 U	1 U	0.6 J	0.6 J	6TB-13	1/11
Bromochloromethane	1 U	1 U	ND	ND		0/11
2-Butanone	5 U	5 U	ND	ND		0/1
1,1,1-Trichloroethane	1 U	1 U	ND	ND		0/11
Carbon Tetrachloride	1 U	1 U	ND	ND		0/11
Bromodichloromethane	1 U	1 U	ND	ND		0/11
1,2-Dichloropropane	1 U	1 U	ND	ND		0/11
cis-1,3-Dichloropropene	1 U	1 U	ND	ND		0/11
Trichloroethene	1 U	1 U	ND	ND		0/11
Dibromochloromethane	1 U	1 U	ND	ND		0/11
1,1,2-Trichloroethane	1 U	1 U	ND	ND		0/11
Benzene	1 U	1 U	ND	ND		0/11
trans-1,3-Dichloropropene	1 U	1 U	ND	ND		0/11
Bromoform	1 U	1 U	ND	ND		0/11
4-Methyl-2-pentanone	5 U	5 U	ND	ND		0/11
2-Hexanone	5 U	5 U	ND	ND		0/2
Tetrachloroethene	1 U	1 U	ND	ND		0/11
1,1,2,2-Tetrachloroethane	1 U	1 U	ND	ND		0/11
Toluene	1 U	1 U	ND	ND		0/11
Chlorobenzene	1 U	1 U	ND	ND		0/11
Ethylbenzene	1 U	1 U	ND	ND		0/11
Styrene	1 U	1 U	ND	ND		0/11
Total Xylenes	1 U	1 U	ND	ND		0/11
1,2-Dichlorobenzene	1 U	1 U	ND	ND		0/11

FREQUENCY OF DETECTION SUMMARY
TRIP BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
1,4-Dichlorobenzene	1 U	1 U	ND	ND		0/11
1,3-Dichlorobenzene	1 U	1 U	ND	ND		0/11
1,2-Dibromo-3-chloropropane	1 U	1 U	ND	ND		0/2
1,2-Dibromoethane	1 U	1 U	ND	ND		0/11
TRANS 1,2-Dichloroethene	1 U	1 U	ND	ND		0/11
CIS 1,2-Dichloroethene	1 U	1 U	ND	ND		0/11

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
EXPLOSIVE COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A07RB-04	A07RB-12	A07RB-17	A07RB-18A	A07RB-20	A07RB-21
Sampling date	11/04/94	11/17/94	11/21/94	11/28/94	11/29/94	11/30/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
HMX	0.61 U	0.61 U	0.61 U	0.61 U	0.61 U	0.61 U
RDX	0.59 U	0.59 U	0.59 U	0.59 U	0.59 U	0.59 U
1,3,5-TRINITROBENZENE	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U
1,3-DINITROBENZENE	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U
TERTYL	1 U	1 U	1 U	1 U	1 U	1 U
NITROBENZENE	0.73 U	0.73 U	0.73 U	0.73 U	0.73 U	0.73 U
2,4,6-TRINITROTOLUENE	0.62 U	0.62 U	0.62 U	0.62 U	0.62 U	0.62 U
4-AMINO-2,6-DINITROTOLUEN	1 U	1 U	1 U	1 U	1 U	1 U
2,6-DINITROTOLUENE	1 U	1 U	1 U	1 U	1 U	1 U
2,4-DINITROTOLUENE	1 U	1 U	1 U	1 U	1 U	1 U
2-NITROTOLUENE	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U
3-NITROTOLUENE	0.91 U	0.91 U	0.91 U	0.91 U	0.91 U	0.91 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
EXPLOSIVE COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A07RB-22	A01/07RB-24
Sampling date	12/01/94	12/04/94
Units	UG/L	UG/L
HMX	0.61 U	0.61 U
RDX	0.59 U	0.59 U
1,3,5-TRINITROBENZENE	0.66 U	0.66 U
1,3-DINITROBENZENE	1.1 U	1.1 U
TERTYL	1 U	1 U
NITROBENZENE	0.73 U	0.73 U
2,4,6-TRINITROTOLUENE	0.62 U	0.62 U
4-AMINO-2,6-DINITROTOLUEN	1 U	1 U
2,6-DINITROTOLUENE	1 U	1 U
2,4-DINITROTOLUENE	1 U	1 U
2-NITROTOLUENE	0.75 U	0.75 U
3-NITROTOLUENE	0.91 U	0.91 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
EXPLOSIVE COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
HMX	0.61 U	0.61 U	ND	ND		0/8
RDX	0.59 U	0.59 U	ND	ND		0/8
1,3,5-TRINITROBENZENE	0.66 U	0.66 U	ND	ND		0/8
1,3-DINITROBENZENE	1.1 U	1.1 U	ND	ND		0/8
TERTYL	1 U	1 U	ND	ND		0/8
NITROBENZENE	0.73 U	0.73 U	ND	ND		0/8
2,4,6-TRINITROTOLUENE	0.62 U	0.62 U	ND	ND		0/8
4-AMINO-2,6-DINITROTOLUEN	1 U	1 U	ND	ND		0/8
2,6-DINITROTOLUENE	1 U	1 U	ND	ND		0/8
2,4-DINITROTOLUENE	1 U	1 U	ND	ND		0/8
2-NITROTOLUENE	0.75 U	0.75 U	ND	ND		0/8
3-NITROTOLUENE	0.91 U	0.91 U	ND	ND		0/8

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
PESTICIDE/PCB COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A07RB-04	A07RB-12	A07RB-17	A07RB-18 1122	A07RB-18 1128	A07RB-20
Sampling date	11/04/94	11/17/94	11/21/94	11/22/94	11/28/94	11/29/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
alpha-BHC	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
beta-BHC	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
delta-BHC	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
gamma-BHC (Lindane)	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Heptachlor	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Aldrin	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Heptachlor Epoxide	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Endosulfan I	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Dieldrin	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDE	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Endrin	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Endosulfan II	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDD	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Endosulfan Sulfate	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDT	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Methoxychlor	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Endrin Ketone	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Endrin Aldehyde	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
alpha-Chlordane	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
gamma-Chlordane	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Toxaphene	5 U	5 U	5 U	5 U	5 U	5 U
Aroclor 1016	1 U	1 U	1 U	1 U	1 U	1 U
Aroclor 1221	2 U	2 U	2 U	2 U	2 U	2 U
Aroclor 1232	1 U	1 U	1 U	1 U	1 U	1 U
Aroclor 1242	1 U	1 U	1 U	1 U	1 U	1 U
Aroclor-1248	1 U	1 U	1 U	1 U	1 U	1 U
Aroclor-1254	1 U	1 U	1 U	1 U	1 U	1 U
Aroclor-1260	1 U	1 U	1 U	1 U	1 U	1 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
PESTICIDE/PCB COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A07RB-21	A07RB-22	A01/07RB-24
Sampling date	11/30/94	12/01/94	12/04/94
Units	UG/L	UG/L	UG/L
alpha-BHC	0.05 U	0.05 UL	0.05 U
beta-BHC	0.05 U	0.05 UL	0.05 U
delta-BHC	0.05 U	0.05 UL	0.05 U
gamma-BHC (Lindane)	0.05 U	0.05 UL	0.05 U
Heptachlor	0.05 U	0.05 UL	0.05 U
Aldrin	0.05 U	0.05 UL	0.05 U
Heptachlor Epoxide	0.05 U	0.05 UL	0.05 U
Endosulfan I	0.05 U	0.05 UL	0.05 U
Dieldrin	0.1 U	0.1 UL	0.1 U
4,4'-DDE	0.1 U	0.1 UL	0.1 U
Endrin	0.1 U	0.1 UL	0.1 U
Endosulfan II	0.1 U	0.1 UL	0.1 U
4,4'-DDD	0.1 U	0.1 UL	0.1 U
Endosulfan Sulfate	0.1 U	0.1 UL	0.1 U
4,4'-DDT	0.1 U	0.1 UL	0.1 U
Methoxychlor	0.5 U	0.5 UL	0.5 U
Endrin Ketone	0.1 U	0.1 UL	0.1 U
Endrin Aldehyde	0.1 U	0.1 UL	0.1 U
alpha-Chlordane	0.05 U	0.05 UL	0.05 U
gamma-Chlordane	0.05 U	0.05 UL	0.05 U
Toxaphene	5 U	5 UL	5 U
Aroclor 1016	1 U	1 UL	1 U
Aroclor 1221	2 U	2 UL	2 U
Aroclor 1232	1 U	1 UL	1 U
Aroclor 1242	1 U	1 UL	1 U
Aroclor-1248	1 U	1 UL	1 U
Aroclor-1254	1 U	1 UL	1 U
Aroclor-1260	1 U	1 UL	1 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
PESTICIDE/PCB COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
alpha-BHC	0.05 U	0.05 U	ND	ND		0/9
beta-BHC	0.05 U	0.05 U	ND	ND		0/9
delta-BHC	0.05 U	0.05 U	ND	ND		0/9
gamma-BHC (Lindane)	0.05 U	0.05 U	ND	ND		0/9
Heptachlor	0.05 U	0.05 U	ND	ND		0/9
Aldrin	0.05 U	0.05 U	ND	ND		0/9
Heptachlor Epoxide	0.05 U	0.05 U	ND	ND		0/9
Endosulfan I	0.05 U	0.05 U	ND	ND		0/9
Dieldrin	0.1 U	0.1 U	ND	ND		0/9
4,4'-DDE	0.1 U	0.1 U	ND	ND		0/9
Endrin	0.1 U	0.1 U	ND	ND		0/9
Endosulfan II	0.1 U	0.1 U	ND	ND		0/9
4,4'-DDD	0.1 U	0.1 U	ND	ND		0/9
Endosulfan Sulfate	0.1 U	0.1 U	ND	ND		0/9
4,4'-DDT	0.1 U	0.1 U	ND	ND		0/9
Methoxychlor	0.5 U	0.5 U	ND	ND		0/9
Endrin Ketone	0.1 U	0.1 U	ND	ND		0/9
Endrin Aldehyde	0.1 U	0.1 U	ND	ND		0/9
alpha-Chlordane	0.05 U	0.05 U	ND	ND		0/9
gamma-Chlordane	0.05 U	0.05 U	ND	ND		0/9
Toxaphene	5 U	5 U	ND	ND		0/9
Aroclor 1016	1 U	1 U	ND	ND		0/9
Aroclor 1221	2 U	2 U	ND	ND		0/9
Aroclor 1232	1 U	1 U	ND	ND		0/9
Aroclor 1242	1 U	1 U	ND	ND		0/9
Aroclor-1248	1 U	1 U	ND	ND		0/9
Aroclor-1254	1 U	1 U	ND	ND		0/9
Aroclor-1260	1 U	1 U	ND	ND		0/9

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A07RB-04	A07RB-12	A07RB-17	A07RB-18 1122	A07RB-18 1128	A07RB-20
Sampling date	11/04/94	11/17/94	11/21/94	11/22/94	11/30/94	11/29/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
Phenol	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroethyl) Ether	10 U	10 U	10 U	10 U	10 U	10 U
2-Chlorophenol	10 U	10 U	10 U	10 U	10 U	10 U
1,3-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylphenol	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroisopropyl)Ether	10 U	10 U	10 U	10 U	10 U	10 U
4-Methylphenol	10 U	10 U	10 U	10 U	10 U	10 U
N-Nitrosodipropylamine	10 U	10 U	10 U	10 U	10 U	10 U
Hexachloroethane	10 U	10 U	10 U	10 U	10 U	10 U
Nitrobenzene	10 U	10 U	10 U	10 U	10 U	10 U
Isophorone	10 U	10 U	10 U	10 U	10 U	10 U
2-Nitrophenol	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dimethylphenol	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroethoxy)Methane	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dichlorophenol	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4-Trichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
Naphthalene	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloroaniline	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ
Hexachlorobutadiene	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloro-3-methylphenol	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylnaphthalene	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorocyclopentadiene	10 U	10 U	10 U	10 U	10 U	10 U
2,4,6-Trichlorophenol	10 U	10 U	10 U	10 U	10 U	10 U
2,4,5-Trichlorophenol	25 U	25 U	25 U	25 U	25 U	25 U
2-Chloronaphthalene	10 U	10 U	10 U	10 U	10 U	10 U
2-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U
Dimethylphthalate	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthylene	10 U	10 U	10 U	10 U	10 U	10 U
2,6-Dinitrotoluene	10 U	10 U	10 U	10 U	10 U	10 U
3-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U
Acenaphthene	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dinitrophenol	25 U	25 U	25 U	25 U	25 U	25 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A07RB-04	A07RB-12	A07RB-17	A07RB-18 1122	A07RB-18 1128	A07RB-20
Sampling date	11/04/94	11/17/94	11/21/94	11/22/94	11/30/94	11/29/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
4-Nitrophenol	25 U	25 U	25 U	25 U	25 U	25 U
Dibenzofuran	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dinitrotoluene	10 U	10 U	10 U	10 U	10 U	10 U
Diethylphthalate	10 U	10 U	10 U	10 U	10 U	10 U
4-Chlorophenylphenyl Ether	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene	10 U	10 U	10 U	10 U	10 U	10 U
4-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U
4,6-Dinitro-2-Methylphenol	25 U	25 U	25 U	25 U	25 U	25 U
N-nitrosodiphenylamine	10 U	10 U	10 U	10 U	10 U	10 U
4-Bromophenylphenyl Ether	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
Pentachlorophenol	25 U	25 U	25 U	25 U	25 U	25 U
Phenanthrene	10 U	10 U	10 U	10 U	10 U	10 U
Anthracene	10 U	10 U	10 U	10 U	10 U	10 U
Carbazole	10 U	10 U	10 U	10 U	10 U	10 U
Di-n-Butyl Phthalate	9 J	5 J	1 J	1 J	10 U	2 B
Fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U
Pyrene	10 U	10 U	10 U	10 U	10 U	10 U
Butyl Benzyl Phthalate	10 U	10 U	10 U	10 U	10 U	10 U
3,3'-Dichlorobenzidine	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	10 U	10 U	10 U	10 U	10 U	10 U
Chrysene	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Ethylhexyl)Phthalate	10 U	10 U	10 U	10 U	25 B	4 B
Di-n-Octylphthalate	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)Pyrene	10 U	10 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	10 U	10 U	10 U	10 U	10 U	10 U
Dibenzo(a,h)anthracene	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)Perylene	10 U	10 U	10 U	10 U	10 U	10 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A07RB-21	A07RB-22	A01/07RB-24
Sampling date	11/30/94	12/01/94	12/04/94
Units	UG/L	UG/L	UG/L
Phenol	10 U	10 U	10 U
bis(2-Chloroethyl) Ether	10 U	10 U	10 U
2-Chlorophenol	10 U	10 U	10 U
1,3-Dichlorobenzene	10 U	10 U	10 U
1,4-Dichlorobenzene	10 U	10 U	10 U
1,2-Dichlorobenzene	10 U	10 U	10 U
2-Methylphenol	10 U	10 U	10 U
bis(2-Chloroisopropyl)Ether	10 U	10 U	10 U
4-Methylphenol	10 U	10 U	10 U
N-Nitrosodipropylamine	10 U	10 U	10 U
Hexachloroethane	10 U	10 U	10 U
Nitrobenzene	10 U	10 U	10 U
Isophorone	10 U	10 U	10 U
2-Nitrophenol	10 U	10 U	10 U
2,4-Dimethylphenol	10 U	10 U	10 U
bis(2-Chloroethoxy)Methane	10 U	10 U	10 U
2,4-Dichlorophenol	10 U	10 U	10 U
1,2,4-Trichlorobenzene	10 U	10 U	10 U
Naphthalene	10 U	10 U	10 U
4-Chloroaniline	10 UJ	10 UJ	10 UJ
Hexachlorobutadiene	10 U	10 U	10 U
4-Chloro-3-methylphenol	10 U	10 U	10 U
2-Methylnaphthalene	10 U	10 U	10 U
Hexachlorocyclopentadiene	10 U	10 U	10 U
2,4,6-Trichlorophenol	10 U	10 U	10 U
2,4,5-Trichlorophenol	25 U	25 U	25 U
2-Chloronaphthalene	10 U	10 U	10 U
2-Nitroaniline	25 U	25 U	25 U
Dimethylphthalate	10 U	10 U	10 U
Acenaphthylene	10 U	10 U	10 U
2,6-Dinitrotoluene	10 U	10 U	10 U
3-Nitroaniline	25 U	25 U	25 U
Acenaphthene	10 U	10 U	10 U
2,4-Dinitrophenol	25 U	25 U	25 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A07RB-21	A07RB-22	A01/07RB-24
Sampling date	11/30/94	12/01/94	12/04/94
Units	UG/L	UG/L	UG/L
4-Nitrophenol	25 U	25 U	25 U
Dibenzofuran	10 U	10 U	10 U
2,4-Dinitrotoluene	10 U	10 U	10 U
Diethylphthalate	10 U	10 U	10 U
4-Chlorophenylphenyl Ether	10 U	10 U	10 U
Fluorene	10 U	10 U	10 U
4-Nitroaniline	25 U	25 U	25 U
4,6-Dinitro-2-Methylphenol	25 U	25 U	25 U
N-nitrosodiphenylamine	10 U	10 U	10 U
4-Bromophenylphenyl Ether	10 U	10 U	10 U
Hexachlorobenzene	10 U	10 U	10 U
Pentachlorophenol	25 U	25 U	25 U
Phenanthrene	10 U	10 U	10 U
Anthracene	10 U	10 U	10 U
Carbazole	10 U	10 U	10 U
Di-n-Butyl Phthalate	2 B	2 B	9 J
Fluoranthene	10 U	10 U	10 U
Pyrene	10 U	10 U	10 U
Butyl Benzyl Phthalate	10 U	10 U	10 U
3,3'-Dichlorobenzidine	10 U	10 U	10 U
Benzo(a)anthracene	10 U	10 U	10 U
Chrysene	10 U	10 U	10 U
bis(2-Ethylhexyl)Phthalate	1 B	9 B	1 B
Di-n-Octylphthalate	10 U	10 U	10 U
Benzo(b)fluoranthene	10 U	10 U	10 U
Benzo(k)fluoranthene	10 U	10 U	10 U
Benzo(a)Pyrene	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	10 U	10 U	10 U
Dibenzo(a,h)anthracene	10 U	10 U	10 U
Benzo(g,h,i)Perylene	10 U	10 U	10 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Phenol	10 U	10 U	ND	ND		0/9
bis(2-Chloroethyl) Ether	10 U	10 U	ND	ND		0/9
2-Chlorophenol	10 U	10 U	ND	ND		0/9
1,3-Dichlorobenzene	10 U	10 U	ND	ND		0/9
1,4-Dichlorobenzene	10 U	10 U	ND	ND		0/9
1,2-Dichlorobenzene	10 U	10 U	ND	ND		0/9
2-Methylphenol	10 U	10 U	ND	ND		0/9
bis(2-Chloroisopropyl)Ether	10 U	10 U	ND	ND		0/9
4-Methylphenol	10 U	10 U	ND	ND		0/9
N-Nitrosodipropylamine	10 U	10 U	ND	ND		0/9
Hexachloroethane	10 U	10 U	ND	ND		0/9
Nitrobenzene	10 U	10 U	ND	ND		0/9
Isophorone	10 U	10 U	ND	ND		0/9
2-Nitrophenol	10 U	10 U	ND	ND		0/9
2,4-Dimethylphenol	10 U	10 U	ND	ND		0/9
bis(2-Chloroethoxy)Methane	10 U	10 U	ND	ND		0/9
2,4-Dichlorophenol	10 U	10 U	ND	ND		0/9
1,2,4-Trichlorobenzene	10 U	10 U	ND	ND		0/9
Naphthalene	10 U	10 U	ND	ND		0/9
4-Chloroaniline	10 U	10 U	ND	ND		0/9
Hexachlorobutadiene	10 U	10 U	ND	ND		0/9
4-Chloro-3-methylphenol	10 U	10 U	ND	ND		0/9
2-Methylnaphthalene	10 U	10 U	ND	ND		0/9
Hexachlorocyclopentadiene	10 U	10 U	ND	ND		0/9
2,4,6-Trichlorophenol	10 U	10 U	ND	ND		0/9
2,4,5-Trichlorophenol	25 U	25 U	ND	ND		0/9
2-Chloronaphthalene	10 U	10 U	ND	ND		0/9
2-Nitroaniline	25 U	25 U	ND	ND		0/9
Dimethylphthalate	10 U	10 U	ND	ND		0/9
Acenaphthylene	10 U	10 U	ND	ND		0/9
2,6-Dinitrotoluene	10 U	10 U	ND	ND		0/9
3-Nitroaniline	25 U	25 U	ND	ND		0/9
Acenaphthene	10 U	10 U	ND	ND		0/9
2,4-Dinitrophenol	25 U	25 U	ND	ND		0/9

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
4-Nitrophenol	25 U	25 U	ND	ND		0/9
Dibenzofuran	10 U	10 U	ND	ND		0/9
2,4-Dinitrotoluene	10 U	10 U	ND	ND		0/9
Diethylphthalate	10 U	10 U	ND	ND		0/9
4-Chlorophenylphenyl Ether	10 U	10 U	ND	ND		0/9
Fluorene	10 U	10 U	ND	ND		0/9
4-Nitroaniline	25 U	25 U	ND	ND		0/9
4,6-Dinitro-2-Methylphenol	25 U	25 U	ND	ND		0/9
N-nitrosodiphenylamine	10 U	10 U	ND	ND		0/9
4-Bromophenylphenyl Ether	10 U	10 U	ND	ND		0/9
Hexachlorobenzene	10 U	10 U	ND	ND		0/9
Pentachlorophenol	25 U	25 U	ND	ND		0/9
Phenanthrene	10 U	10 U	ND	ND		0/9
Anthracene	10 U	10 U	ND	ND		0/9
Carbazole	10 U	10 U	ND	ND		0/9
Di-n-Butyl Phthalate	2 B	10 U	1 J	9 J	A17RB-24	5/9
Fluoranthene	10 U	10 U	ND	ND		0/9
Pyrene	10 U	10 U	ND	ND		0/9
Butyl Benzyl Phthalate	10 U	10 U	ND	ND		0/9
3,3'-Dichlorobenzidine	10 U	10 U	ND	ND		0/9
Benzo(a)anthracene	10 U	10 U	ND	ND		0/9
Chrysene	10 U	10 U	ND	ND		0/9
bis(2-Ethylhexyl)Phthalate	1 B	25 B	ND	ND		0/9
Di-n-Octylphthalate	10 U	10 U	ND	ND		0/9
Benzo(b)fluoranthene	10 U	10 U	ND	ND		0/9
Benzo(k)fluoranthene	10 U	10 U	ND	ND		0/9
Benzo(a)Pyrene	10 U	10 U	ND	ND		0/9
Indeno(1,2,3-cd)pyrene	10 U	10 U	ND	ND		0/9
Dibenzo(a,h)anthracene	10 U	10 U	ND	ND		0/9
Benzo(g,h,i)Perylene	10 U	10 U	ND	ND		0/9

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A07RB-04	A07RB-12	A07RB-17	A07RB-18	A07RB-18A	A07RB-20
Sampling Date	11/04/94	11/17/94	11/21/94	11/22/94	11/28/94	11/29/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
Chloromethane	1 UJ	1 U	1 U	1 U	1 U	2 U
Bromomethane	1 U	1 U	1 U	1 U	1 U	2 U
Vinyl chloride	1 U	1 U	1 U	1 U	1 U	2 U
Chloroethane	1 U	1 U	1 U	1 U	1 U	2 U
Methylene chloride	2	4	27 R	32 R	20	30
Acetone	5 R	5 R	5 R	5 R	5 U	10 R
Carbon disulfide	1 U	1 U	1 U	1 U	1 U	2 U
1,1-Dichloroethene	1 U	1 U	1 U	1 U	1 U	2 U
1,1-Dichloroethane	1 U	1 U	1 U	1 U	1 U	2 U
Chloroform	3	4	3	4	2	4
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U	2 U
Bromochloromethane	1 U	1 U	1 U	1 U	1 U	2 U
2-Butanone	5 R	5 R	5 R	5 R	5 U	10 R
1,1,1-Trichloroethane	1 U	1 U	1 U	1 U	1 U	2 U
Carbon Tetrachloride	1 U	1 U	1 U	1 U	1 U	2 U
Bromodichloromethane	1 U	1 U	1 U	1 U	1 U	2 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U	2 U
cis-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	2 U
Trichloroethene	1 U	1 U	1 U	1 U	1 U	2 U
Dibromochloromethane	1 U	1 U	1 U	1 U	1 U	2 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	1 U	2 U
Benzene	1 U	1 U	1 U	1 U	1 U	2 U
trans-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	2 U
Bromoform	1 U	1 U	1 U	1 U	1 U	2 U
4-Methyl-2-pentanone	5 U	5 U	5 U	5 U	5 U	10 U
2-Hexanone	5 R	5 R	5 U	5 R	5 U	10 U
Tetrachloroethene	1 U	1 U	1 U	1 U	1 U	2 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U	1 U	2 U
Toluene	1 U	1 U	1	1 U	1 U	2 U
Chlorobenzene	1 U	1 U	1 U	1 U	1 U	2 U
Ethylbenzene	1 U	1 U	1 U	1 U	1 U	2 U
Styrene	1 U	1 U	1 U	1 U	1 U	2 U
Total Xylenes	1 U	1 U	1 U	1 U	1 U	2 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A07RB-04	A07RB-12	A07RB-17	A07RB-18	A07RB-18A	A07RB-20
Sampling Date	11/04/94	11/17/94	11/21/94	11/22/94	11/28/94	11/29/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
1,2-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	2 U
1,4-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	2 U
1,3-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	2 U
1,2-Dibromo-3-chloropropa	1 R	1 R	1 R	1 R	1 U	2 R
1,2-Dibromoethane	1 U	1 U	1 U	1 U	1 U	2 U
TRANS 1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	2 U
CIS 1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	2 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A07RB-21	A07RB-22	A01/07RB-24
Sampling Date	11/30/94	12/01/94	12/04/94
Units	UG/L	UG/L	UG/L
Chloromethane	2 U	1 U	1 U
Bromomethane	2 U	1 U	1 U
Vinyl chloride	2 U	1 U	1 U
Chloroethane	2 U	1 U	1 U
Methylene chloride	28	7	4
Acetone	10 R	5 R	5 R
Carbon disulfide	2 U	1 U	1 U
1,1-Dichloroethene	2 U	1 U	1 U
1,1-Dichloroethane	2 U	1 U	1 U
Chloroform	2 U	6	6
1,2-Dichloroethane	2 U	1 U	1 U
Bromochloromethane	2 U	1 U	1 U
2-Butanone	10 R	5 R	5 R
1,1,1-Trichloroethane	2 U	1 U	1 U
Carbon Tetrachloride	2 U	1 U	1 U
Bromodichloromethane	2 U	1 U	1 U
1,2-Dichloropropane	2 U	1 U	1 U
cis-1,3-Dichloropropene	2 U	1 U	1 U
Trichloroethene	2 U	1 U	1 U
Dibromochloromethane	2 U	1 U	1 U
1,1,2-Trichloroethane	2 U	1 U	1 U
Benzene	2 U	1 U	1 U
trans-1,3-Dichloropropene	2 U	1 U	1 U
Bromoform	2 U	1 U	1 U
4-Methyl-2-pentanone	10 U	5 U	5 U
2-Hexanone	10 R	5 R	5 U
Tetrachloroethene	2 U	1 U	1 U
1,1,2,2-Tetrachloroethane	2 U	1 U	1 U
Toluene	2 U	1 U	1 U
Chlorobenzene	2 U	1 U	1 U
Ethylbenzene	2 U	1 U	1 U
Styrene	2 U	1 U	1 U
Total Xylenes	2 U	1 U	1 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A07RB-21	A07RB-22	A01/07RB-24
Sampling Date	11/30/94	12/01/94	12/04/94
Units	UG/L	UG/L	UG/L
1,2-Dichlorobenzene	2 U	1 U	1 U
1,4-Dichlorobenzene	2 U	1 U	1 U
1,3-Dichlorobenzene	2 U	1 U	1 U
1,2-Dibromo-3-chloropropa	2 R	1 R	1 R
1,2-Dibromoethane	2 U	1 U	1 U
TRANS 1,2-Dichloroethene	2 U	1 U	1 U
CIS 1,2-Dichloroethene	2 U	1 U	1 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Chloromethane	1 UJ	2 U	ND	ND		0/9
Bromomethane	1 U	2 U	ND	ND		0/9
Vinyl chloride	1 U	2 U	ND	ND		0/9
Chloroethane	1 U	2 U	ND	ND		0/9
Methylene chloride	NA	NA	2	30	A07RB-20	7/7
Acetone	5 U	5 U	ND	ND		0/1
Carbon disulfide	1 U	2 U	ND	ND		0/9
1,1-Dichloroethene	1 U	2 U	ND	ND		0/9
1,1-Dichloroethane	1 U	2 U	ND	ND		0/9
Chloroform	2 U	2 U	2	6	A17RB-24	8/9
1,2-Dichloroethane	1 U	2 U	ND	ND		0/9
Bromochloromethane	1 U	2 U	ND	ND		0/9
2-Butanone	5 U	5 U	ND	ND		0/1
1,1,1-Trichloroethane	1 U	2 U	ND	ND		0/9
Carbon Tetrachloride	1 U	2 U	ND	ND		0/9
Bromodichloromethane	1 U	2 U	ND	ND		0/9
1,2-Dichloropropane	1 U	2 U	ND	ND		0/9
cis-1,3-Dichloropropene	1 U	2 U	ND	ND		0/9
Trichloroethene	1 U	2 U	ND	ND		0/9
Dibromochloromethane	1 U	2 U	ND	ND		0/9
1,1,2-Trichloroethane	1 U	2 U	ND	ND		0/9
Benzene	1 U	2 U	ND	ND		0/9
trans-1,3-Dichloropropene	1 U	2 U	ND	ND		0/9
Bromoform	1 U	2 U	ND	ND		0/9
4-Methyl-2-pentanone	5 U	10 U	ND	ND		0/9
2-Hexanone	5 U	10 U	ND	ND		0/4
Tetrachloroethene	1 U	2 U	ND	ND		0/9
1,1,2,2-Tetrachloroethane	1 U	2 U	ND	ND		0/9
Toluene	1 U	2 U	1	1	A07RB-17	1/9
Chlorobenzene	1 U	2 U	ND	ND		0/9
Ethylbenzene	1 U	2 U	ND	ND		0/9
Styrene	1 U	2 U	ND	ND		0/9
Total Xylenes	1 U	2 U	ND	ND		0/9

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
1,2-Dichlorobenzene	1 U	2 U	ND	ND		0/9
1,4-Dichlorobenzene	1 U	2 U	ND	ND		0/9
1,3-Dichlorobenzene	1 U	2 U	ND	ND		0/9
1,2-Dibromo-3-chloropropa	1 U	1 U	ND	ND		0/1
1,2-Dibromoethane	1 U	2 U	ND	ND		0/9
TRANS 1,2-Dichloroethene	1 U	2 U	ND	ND		0/9
CIS 1,2-Dichloroethene	1 U	2 U	ND	ND		0/9

RINSATE BLANKS
DISSOLVED INORGANICS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A15RB-02F
Sampling Date	11/02/94
Units	UG/L
Aluminum	11 U
Antimony	12.2 U
Arsenic	2.3 U
Barium	1 U
Beryllium	1 U
Cadmium	1.5 U
Calcium	50.7
Chromium	1.8 U
Cobalt	1.9 U
Copper	2.4
Iron	1.5 U
Lead	1.4 U
Magnesium	13
Manganese	1 U
Mercury	0.2 UL
Nickel	4.3 U
Potassium	381 U
Selenium	2.6 U
Silver	2 U
Sodium	47.7
Thallium	4 U
Vanadium	1.4 U
Zinc	5.7 B
CN	NA

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
DISSOLVED INORGANICS AND CYANIDE
SITE SCREENING AREA 1
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A01RB-15F	A01RB-19F
Sampling Date	11/19/94	11/29/94
Units	UG/L	UG/L
Aluminum	11 U	11 U
Antimony	12.2 U	12.2 U
Arsenic	2.3 U	2.3 U
Barium	0.5 U	0.5 U
Beryllium	0.1 U	0.1 U
Cadmium	1.5 U	1.5 U
Calcium	26.8	23.4
Chromium	1.8 UL	1.8 UL
Cobalt	1.9 U	1.9 U
Copper	1.4 U	1.4 U
Iron	55.6 B	4.6 B
Lead	1.4 U	1.4 U
Magnesium	11.1 U	11.1 U
Manganese	1	0.88 J
Mercury	0.2 U	0.2 U
Nickel	4.3 U	4.3 U
Potassium	381 U	381 U
Selenium	2.6 U	2.6 U
Silver	2 U	2 U
Sodium	42.9 B	54.3 B
Thallium	4 U	4 U
Vanadium	1.4 U	1.4 U
Zinc	4.7 B	3.4 B

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
DISSOLVED INORGANICS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A07RB-12F	A07RB-22F
Sampling date	11/17/94	12/01/94
Units	UG/L	UG/L
Aluminum	11 U	11 U
Antimony	12.2 U	12.4
Arsenic	2.3 U	2.3 UL
Barium	0.5 U	0.5 U
Beryllium	0.1 U	0.1 U
Cadmium	1.5 U	1.5 U
Calcium	34.6 B	63.7
Chromium	1.8 U	1.8 U
Cobalt	1.9 U	1.9 U
Copper	1.4 U	1.4 U
Iron	10.2 B	18.5 B
Lead	1.4 U	1.4 U
Magnesium	11.1 U	11.1 U
Manganese	1.2 B	1.1
Mercury	0.2 U	0.2 UL
Nickel	4.3 U	4.3 U
Potassium	381 U	381 U
Selenium	2.6 UL	2.6 U
Silver	2 U	2 U
Sodium	59.1 B	275
Thallium	4 U	4 U
Vanadium	1.4 U	1.4 U
Zinc	7.1 B	3.4 B
CN	NA	NA

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
DISSOLVED INORGANICS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A06RB-06F	A06RB-09F	A06RB-10F
Sampling Date	11/06/94	11/15/94	11/16/94
Units	UG/L	UG/L	UG/L
Aluminum	11 U	11 U	11 U
Antimony	14.2 J	12.2 U	12.2 U
Arsenic	2.3 U	2.3 U	2.3 U
Barium	0.5 U	0.5 U	0.5 U
Beryllium	0.1 U	0.11 J	0.1 U
Cadmium	1.5 U	1.5 U	1.5 U
Calcium	42.5 J	58.4 J	76.5 J
Chromium	1.8 U	1.8 U	1.8 U
Cobalt	1.9 U	1.9 U	1.9 U
Copper	1.4 U	2.4 J	6.8 J
Iron	5.6 J	1.5 U	29.8 J
Lead	1.4 U	1.4 U	1.4 U
Magnesium	11.1 U	17 J	18.5 J
Manganese	1.2 J	1.7 J	1.2 J
Mercury	0.2 U	0.2 U	0.2 U
Nickel	4.3 U	4.3 U	4.3 U
Potassium	381 U	381 U	381 U
Selenium	2.6 U	2.6 U	2.6 UL
Silver	2 U	2 U	2 U
Sodium	57.7 J	55.5 J	52.8 J
Thallium	4 U	4 U	4 U
Vanadium	1.4 U	1.4 U	1.4 U
Zinc	4 J	4.6 J	8.7 J

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
DISSOLVED INORGANICS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	11 U	11 U	ND	ND		0/3
Antimony	12.2 U	12.2 U	14.2 J	14.2 J	A06RB-06F	1/3
Arsenic	2.3 U	2.3 U	ND	ND		0/3
Barium	0.5 U	0.5 U	ND	ND		0/3
Beryllium	0.1 U	0.1 U	0.11 J	0.11 J	A06RB-09F	1/3
Cadmium	1.5 U	1.5 U	ND	ND		0/3
Calcium	NA	NA	42.5 J	76.5 J	A06RB-10F	3/3
Chromium	1.8 U	1.8 U	ND	ND		0/3
Cobalt	1.9 U	1.9 U	ND	ND		0/3
Copper	1.4 U	1.4 U	2.4 J	6.8 J	A06RB-10F	2/3
Iron	1.5 U	1.5 U	5.6 J	29.8 J	A06RB-10F	2/3
Lead	1.4 U	1.4 U	ND	ND		0/3
Magnesium	11.1 U	11.1 U	17 J	18.5 J	A06RB-10F	2/3
Manganese	NA	NA	1.2 J	1.7 J	A06RB-09F	3/3
Mercury	0.2 U	0.2 U	ND	ND		0/3
Nickel	4.3 U	4.3 U	ND	ND		0/3
Potassium	381 U	381 U	ND	ND		0/3
Selenium	2.6 U	2.6 U	ND	ND		0/3
Silver	2 U	2 U	ND	ND		0/3
Sodium	NA	NA	52.8 J	57.7 J	A06RB-06F	3/3
Thallium	4 U	4 U	ND	ND		0/3
Vanadium	1.4 U	1.4 U	ND	ND		0/3
Zinc	NA	NA	4 J	8.7 J	A06RB-10F	3/3

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
TOTAL INORGANICS AND CYANIDE
SITE SCREENING AREA 1
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A01RB-13	A01RB-15	A01RB-16	A01RB-19	A1/7RB-24
Sampling Date	11/18/94	11/19/94	11/20/94	11/29/94	12/04/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L
Aluminum	25.4 B	11 U	18.7 B	11 U	11 U
Antimony	12.2 R	12.2 UL	12.2 R	12.2 UL	12.2 U
Arsenic	2.3 U	2.3 U	2.3 U	2.3 U	2.3 U
Barium	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Beryllium	0.27 B	0.1 U	0.2 B	0.1 U	0.1 U
Cadmium	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
Calcium	15.6 B	17 B	67.2 B	15.2 B	6.3 U
Chromium	1.8 U	1.8 U	1.8 U	1.8 U	1.8 UL
Cobalt	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U
Copper	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U
Iron	8 B	14.7 B	32.1 B	13.9 B	1.5 U
Lead	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U
Magnesium	11.1 U	1.1 U	11.1 U	11.1 U	11.1 U
Manganese	0.4 U	0.4 B	1 B	0.4 U	0.4 U
Mercury	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U
Potassium	381 U	381 U	381 U	381 U	381 U
Selenium	2.6 UL	2.6 U	2.6 UL	2.6 U	2.6 U
Silver	2 UL	2 U	2 UL	2 U	2 UL
Sodium	42.9 B	41.8 B	37 B	24.6 B	9.2 U
Thallium	4 U	4 U	4 U	4 U	4.1 K
Vanadium	1.4 UL	1.4 U	1.4 UL	1.4 U	1.4 U
Zinc	3.8 B	8.9 J	4.7 B	10.9 J	1 U
CN	5 U	5 U	5 U	5 U	5 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
TOTAL INORGANICS AND CYANIDE
SITE SCREENING AREA 1
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	11 U	25.4 B	ND	ND		0/5
Antimony	12.2 UL	12.2 UL	ND	ND		0/3
Arsenic	2.3 U	2.3 U	ND	ND		0/5
Barium	0.5 U	0.5 U	ND	ND		0/5
Beryllium	0.1 U	0.27 B	ND	ND		0/5
Cadmium	1.5 U	1.5 U	ND	ND		0/5
Calcium	6.3 U	67.2 B	ND	ND		0/5
Chromium	1.8 U	1.8 U	ND	ND		0/5
Cobalt	1.9 U	1.9 U	ND	ND		0/5
Copper	1.4 U	1.4 U	ND	ND		0/5
Iron	1.5 U	32.1 B	ND	ND		0/5
Lead	1.4 U	1.4 U	ND	ND		0/5
Magnesium	1.1 U	11.1 U	ND	ND		0/5
Manganese	0.4 U	1 B	ND	ND		0/5
Mercury	0.2 U	0.2 U	ND	ND		0/5
Nickel	4.3 U	4.3 U	ND	ND		0/5
Potassium	381 U	381 U	ND	ND		0/5
Selenium	2.6 UL	2.6 UL	ND	ND		0/5
Silver	2 UL	2 UL	ND	ND		0/5
Sodium	9.2 U	42.9 B	ND	ND		0/5
Thallium	4 U	4 U	4.1 K	4.1 K	A1/7RB-24	1/5
Vanadium	1.4 UL	1.4 UL	ND	ND		0/5
Zinc	1 U	4.7 B	8.9 J	10.9 J	A01RB-19	2/5
CN	5 U	5 U	ND	ND		0/5

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
TOTAL INORGANICS AND CYANIDE
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A15RB-01	A15RB-02	A15RB-03	A15/01RB-23
Sampling Date	11/01/94	11/02/94	11/04/94	12/03/94
Units	UG/L	UG/L	UG/L	UG/L
Aluminum	11 U	11 U	11 U	11 U
Antimony	12.2 UL	12.2 UL	12.2 UL	12.2 UL
Arsenic	2.3 U	2.3 U	2.3 U	2.3 U
Barium	1 U	1 U	1 U	0.5 U
Beryllium	1 U	1 U	1 U	0.1 U
Cadmium	1.5 U	1.5 U	1.5 U	1.5 U
Calcium	39.5	30.5	30.1	6.3 U
Chromium	1.8 U	1.8 U	1.8 U	1.8 UL
Cobalt	1.9 U	1.9 U	1.9 U	1.9 U
Copper	1.4 U	1.4 U	1.4 U	1.4 U
Iron	36.2	1.7	16.5	1.5 U
Lead	1.4 U	1.4 U	1.4 U	1.4 U
Magnesium	11.1 U	12.8	11.1 U	11.1 U
Manganese	1 U	1 U	1 U	0.4 U
Mercury	0.2 UL	0.2 UL	0.2 UL	0.2 U
Nickel	4.3 U	4.3 U	4.3 U	4.3 U
Potassium	381 U	381 U	381 U	381 U
Selenium	2.6 U	2.6 U	2.6 U	2.6 U
Silver	2 U	2 U	2 U	2 UL
Sodium	27.3	45.8	35.1	191
Thallium	4 UL	4 UL	4 UL	4 U
Vanadium	1.4 U	1.4 U	1.4 U	1.4 U
Zinc	6 BJ	5.7 BJ	4.4 BJ	1 U
CN	5 U	5 U	5 U	5 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
TOTAL INORGANICS AND CYANIDE
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	11 U	11 U	ND	ND		0/4
Antimony	12.2 UL	12.2 UL	ND	ND		0/4
Arsenic	2.3 U	2.3 U	ND	ND		0/4
Barium	0.5 U	1 U	ND	ND		0/4
Beryllium	0.1 U	1 U	ND	ND		0/4
Cadmium	1.5 U	1.5 U	ND	ND		0/4
Calcium	6.3 U	6.3 U	30.1	39.5	A15RB-01	3/4
Chromium	1.8 U	1.8 U	ND	ND		0/4
Cobalt	1.9 U	1.9 U	ND	ND		0/4
Copper	1.4 U	1.4 U	ND	ND		0/4
Iron	1.5 U	1.5 U	1.7	36.2	A15RB-01	3/4
Lead	1.4 U	1.4 U	ND	ND		0/4
Magnesium	11.1 U	11.1 U	12.8	12.8	A15RB-02	1/4
Manganese	0.4 U	1 U	ND	ND		0/4
Mercury	0.2 UL	0.2 UL	ND	ND		0/4
Nickel	4.3 U	4.3 U	ND	ND		0/4
Potassium	381 U	381 U	ND	ND		0/4
Selenium	2.6 U	2.6 U	ND	ND		0/4
Silver	2 U	2 U	ND	ND		0/4
Sodium	NA	NA	27.3	191	A15/01RB-23	4/4
Thallium	4 UL	4 UL	ND	ND		0/4
Vanadium	1.4 U	1.4 U	ND	ND		0/4
Zinc	1 U	6 BJ	ND	ND		0/4
CN	5 U	5 U	ND	ND		0/4

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
TOTAL INORGANICS AND CYANIDE
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A06RB-05	A06RB-06	A06RB-07	A06RB-08	A06RB09	A06RB-10
Sampling Date	11/05/94	11/06/94	11/07/94	11/08/94	11/15/94	11/16/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
Aluminum	11.3 J	12.7 J	11 U	11 U	11 U	11 U
Antimony	12.2 UL	12.2 UL	12.2 UL	12.2 UL	12.2 UL	12.2 R
Arsenic	2.3 U	2.3 U	2.3 U	2.3 U	2.3 U	2.3 U
Barium	0.5 U	0.5 U	1 U	0.5 U	0.5 U	0.5 U
Beryllium	0.1 J	0.1 J	1 U	0.1 U	0.1 U	0.32 J
Cadmium	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
Calcium	25.5 J	18.8 J	14.8 J	16.9 J	27.9 J	11.6 J
Chromium	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U
Cobalt	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U
Copper	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.5 J
Iron	18.7 J	132 J	1.5 U	3.4 J	10.8 J	1.5 U
Lead	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U
Magnesium	11.1 U	11.1 U	11.1 U	11.1 U	11.1 U	11.1 U
Manganese	1.1 J	0.4 J	1 U	0.4 U	0.4 U	0.4 U
Mercury	0.2 U	0.2 U	0.2 UL	0.2 U	0.2 U	0.2 U
Nickel	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U
Potassium	381 U	381 U	381 U	381 U	381 U	381 U
Selenium	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 UL
Silver	2 U	2 U	2 U	2 U	2 U	2 UL
Sodium	31.8 J	32.1 J	14.1 J	257 J	18.6 J	33.4 J
Thallium	4.2 J	4 U	4 UL	4 U	4.4 J	4 U
Vanadium	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 UL
Zinc	4.6 J	5.4 J	4.7 JJ	4.6 J	6.1 J	7 J
CN	5 U	5 U	5 U	5 U	5 U	5 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
TOTAL INORGANICS AND CYANIDE
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A06RB-11	A06RB-14
Sampling Date	11/17/94	11/18/94
Units	UG/L	UG/L
Aluminum	14 J	20.4 J
Antimony	12.2 R	12.2 R
Arsenic	2.3 U	2.3 U
Barium	0.5 U	0.5 U
Beryllium	0.23 J	0.29 J
Cadmium	1.5 U	1.5 U
Calcium	13.7 J	9.7 J
Chromium	1.8 U	1.8 U
Cobalt	1.9 U	1.9 U
Copper	1.5 J	1.4 U
Iron	2.3 J	5.3 J
Lead	1.4 U	1.4 U
Magnesium	11.1 U	11.1 U
Manganese	0.4 U	0.4 U
Mercury	0.2 U	0.2 U
Nickel	4.3 U	4.3 U
Potassium	381 U	381 U
Selenium	2.6 UL	2.6 UL
Silver	2 UL	2 UL
Sodium	25.7 J	34.4 J
Thallium	4 U	4 U
Vanadium	1.4 UL	1.4 UL
Zinc	3.8 J	5 J
CN	5 U	5 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
TOTAL INORGANICS AND CYANIDE
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	11 U	11 U	11.3 J	20.4 J	A06RB-14	4/8
Antimony	12.2 UL	12.2 UL	ND	ND		0/5
Arsenic	2.3 U	2.3 U	ND	ND		0/8
Barium	0.5 U	1 U	ND	ND		0/8
Beryllium	0.1 U	1 U	0.1 J	0.32 J	A06RB-10	5/8
Cadmium	1.5 U	1.5 U	ND	ND		0/8
Calcium	NA	NA	9.7 J	27.9 J	A06RB09	8/8
Chromium	1.8 U	1.8 U	ND	ND		0/8
Cobalt	1.9 U	1.9 U	ND	ND		0/8
Copper	1.4 U	1.4 U	1.5 J	1.5 J	A06RB-11	2/8
Iron	1.5 U	1.5 U	2.3 J	132 J	A06RB-06	6/8
Lead	1.4 U	1.4 U	ND	ND		0/8
Magnesium	11.1 U	11.1 U	ND	ND		0/8
Manganese	0.4 U	1 U	0.4 J	1.1 J	A06RB-05	2/8
Mercury	0.2 U	0.2 U	ND	ND		0/8
Nickel	4.3 U	4.3 U	ND	ND		0/8
Potassium	381 U	381 U	ND	ND		0/8
Selenium	2.6 U	2.6 U	ND	ND		0/8
Silver	2 U	2 U	ND	ND		0/8
Sodium	NA	NA	14.1 J	257 J	A06RB-08	8/8
Thallium	4 U	4 U	4.2 J	4.4 J	A06RB09	2/8
Vanadium	1.4 U	1.4 U	ND	ND		0/8
Zinc	NA	NA	3.8 J	7 J	A06RB-10	8/8
CN	5 U	5 U	ND	ND		0/8

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
TOTAL INORGANICS AND CYANIDE
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A07RB-04	A07RB-12	A07RB-17	A07RB-18	A07RB-18A	A07RB-20
Sampling date	11/04/94	11/17/94	11/21/94	11/22/94	11/28/94	11/29/94
Units	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
Aluminum	11.00 U	14 J	16.4 B	11 U	11 U	11 U
Antimony	12.20 UL	12.2 R	12.2 R	12.2 UL	12.2 UL	12.2 UL
Arsenic	2.30 U	2.3 U	2.3 U	2.3 U	2.3 U	2.3 U
Barium	1.00 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Beryllium	1.00 U	0.16 J	0.25 B	0.1 U	0.1 U	0.1 U
Cadmium	1.50 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
Calcium	17.30 J	21.3 J	10.8 B	11.5 B	10.4 B	54.5 B
Chromium	1.80 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U
Cobalt	1.90 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U
Copper	1.40 U	1.4 U	1.4 U	1.4 U	1.4 U	1.7 J
Iron	1.50 U	1.5 U	4.4 B	6.9 B	4.3 B	16.7 B
Lead	1.40 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U
Magnesium	11.10 U	11.1 U	11.1 U	11.1 U	11.1 U	25.1
Manganese	1.00 U	0.4 U	0.4 U	0.53 B	0.4 U	0.67 B
Mercury	0.20 UL	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	4.30 U	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U
Potassium	381.00 U	381 U	381 U	381 U	381 U	381 U
Selenium	2.60 U	2.6 UL	2.6 UL	2.6 U	2.6 U	2.6 U
Silver	2.00 U	2 UL	2 UL	2 U	2 U	2 U
Sodium	27.50 J	29.7 J	19.5 B	18.7 B	28.6 B	80.2 B
Thallium	4.00 UL	5.6 J	4 U	4 U	4 U	4 U
Vanadium	1.40 U	1.4 UL	1.4 UL	1.4 U	1.4 U	1.4 U
Zinc	5.90 JJ	5.9 J	5.6 B	8.3 J	9.6 J	15.1 J
CN	5.00 U	5 U	5 U	5 U	5 U	5 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
TOTAL INORGANICS AND CYANIDE
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	A07RB-21	A07RB-22	A01/07RB-24
Sampling date	11/30/94	12/01/94	12/14/94
Units	UG/L	UG/L	UG/L
Aluminum	11.00 U	15.10 B	11.00 U
Antimony	12.20 UL	12.20 R	12.20 U
Arsenic	2.30 U	2.30 U	2.30 U
Barium	0.50 U	0.50 UL	0.50 U
Beryllium	0.10 U	0.10 UL	0.10 U
Cadmium	1.50 U	1.50 U	1.50 U
Calcium	18.00 B	12.20 B	6.30 U
Chromium	1.80 U	1.80 U	1.80 UL
Cobalt	1.90 U	1.90 U	1.90 U
Copper	1.40 U	1.40 U	1.40 U
Iron	21.30 B	3.90 L	1.50 U
Lead	1.40 U	1.40 U	1.40 U
Magnesium	11.10 U	11.10 U	11.10 U
Manganese	0.40 B	0.47 B	0.40 U
Mercury	0.20 U	0.20 UL	0.20 U
Nickel	4.30 U	5.40 L	4.30 U
Potassium	381.00 U	381.00 U	381.00 U
Selenium	2.60 U	2.60 U	2.60 U
Silver	2.00 U	2.00 UL	2.00 UL
Sodium	26.10 B	343.00 B	9.20 U
Thallium	4.00 U	6.00 K	4.10 K
Vanadium	1.40 U	1.40 UL	1.40 U
Zinc	10.10 J	1.00 U	1.00 U
CN	5.00 U	5 R	5.00 U

FREQUENCY OF DETECTION SUMMARY
RINSATE BLANKS
TOTAL INORGANICS AND CYANIDE
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	11 U	16.4 B	14 J	14 J	A07RB-12	1/9
Antimony	12.2 UL	12.2 UL	ND	ND		0/6
Arsenic	2.3 U	2.3 U	ND	ND		0/9
Barium	0.5 U	1 U	ND	ND		0/9
Beryllium	0.1 U	1 U	0.16 J	0.16 J	A07RB-12	1/9
Cadmium	1.5 U	1.5 U	ND	ND		0/9
Calcium	6.3 U	54.5 B	17.3 J	21.3 J	A07RB-12	2/9
Chromium	1.8 U	1.8 U	ND	ND		0/9
Cobalt	1.9 U	1.9 U	ND	ND		0/9
Copper	1.4 U	1.4 U	1.7 J	1.7 J	A07RB-20	1/9
Iron	1.5 U	21.3 B	3.9 L	3.9 L	A07RB-22	1/9
Lead	1.4 U	1.4 U	ND	ND		0/9
Magnesium	11.1 U	11.1 U	25.1	25.1	A07RB-20	1/9
Manganese	0.4 U	1 U	ND	ND		0/9
Mercury	0.2 U	0.2 UL	ND	ND		0/9
Nickel	4.3 U	4.3 U	5.4 L	5.4 L	A07RB-22	1/9
Potassium	381 U	381 U	ND	ND		0/9
Selenium	2.6 UL	2.6 U	ND	ND		0/9
Silver	2 U	2 U	ND	ND		0/9
Sodium	9.2 U	343 B	27.5 J	29.7 J	A07RB-12	2/9
Thallium	4 UL	4 UL	4.1 K	6 K	A07RB-22	3/9
Vanadium	1.4 U	1.4 UL	ND	ND		0/9
Zinc	1 U	5.6 B	5.9 J	15.1 J	A07RB-20	6/9
CN	5 U	5 U	ND	ND		0/8

FREQUENCY OF DETECTION SUMMARY
FIELD BLANKS
DISSOLVED INORGANICS
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	FB-R16F	FB-DSF	FB-DIF
Sampling Date	11/22/94	11/22/94	11/22/94
Units	UG/L	UG/L	UG/L
Aluminum	15.7 B	11 U	11 U
Antimony	12.2 U	12.2 U	12.2 U
Arsenic	2.3 U	2.3 U	2.3 U
Barium	12.80	0.50 U	0.50 U
Beryllium	0.11 B	0.10 U	0.10 U
Cadmium	1.5 U	1.5 U	1.5 U
Calcium	21300	54.5 B	50.1 B
Chromium	1.8 U	1.8 U	1.8 U
Cobalt	1.9 U	1.9 U	1.9 U
Copper	7.0	2.1	2.3
Iron	21.4 B	14.1 B	6.9 B
Lead	1.4 U	1.4 U	1.4 U
Magnesium	1330	25.2	11.8 B
Manganese	25.2	1.4 B	1.4 B
Mercury	0.20 U	0.20 U	0.20 U
Nickel	4.3 U	4.3 U	4.3 U
Potassium	1550	381 U	381 U
Selenium	2.6 UL	2.6 U	2.6 UL
Silver	2.0 U	2.0 U	2.0 U
Sodium	7220	57.8 B	59.5 B
Thallium	4.0 U	4.0 U	4.0 U
Vanadium	1.4 U	1.4 U	1.4 U
Zinc	89.5	6.3 B	10.3 B

FREQUENCY OF DETECTION SUMMARY
FIELD BLANKS
DISSOLVED INORGANICS
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	11 U	15.7 B	ND	ND		0/3
Antimony	12.2 U	12.2 U	ND	ND		0/3
Arsenic	2.3 U	2.3 U	ND	ND		0/3
Barium	0.50 U	0.50 U	12.80	12.80	FB-R16F	1/3
Beryllium	0.10 U	0.11 B	ND	ND		0/3
Cadmium	1.5 U	1.5 U	ND	ND		0/3
Calcium	50.1 B	54.5 B	21300	21300	FB-R16F	1/3
Chromium	1.8 U	1.8 U	ND	ND		0/3
Cobalt	1.9 U	1.9 U	ND	ND		0/3
Copper	NA	NA	2.1	7.0	FB-R16F	3/3
Iron	6.9 B	21.4 B	ND	ND		0/3
Lead	1.4 U	1.4 U	ND	ND		0/3
Magnesium	11.8 B	11.8 B	25.2	1330	FB-R16F	2/3
Manganese	1.4 B	1.4 B	25.2	25.2	FB-R16F	1/3
Mercury	0.20 U	0.20 U	ND	ND		0/3
Nickel	4.3 U	4.3 U	ND	ND		0/3
Potassium	381 U	381 U	1550	1550	FB-R16F	1/3
Selenium	2.6 UL	2.6 UL	ND	ND		0/3
Silver	2.0 U	2.0 U	ND	ND		0/3
Sodium	57.8 B	59.5 B	7220	7220	FB-R16F	1/3
Thallium	4.0 U	4.0 U	ND	ND		0/3
Vanadium	1.4 U	1.4 U	ND	ND		0/3
Zinc	6.3 B	10.3 B	89.5	89.5	FB-R16F	1/3

FREQUENCY OF DETECTION SUMMARY
FIELD BLANKS
TOTAL INORGANICS AND CYANIDE
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location	FB-B16	FB-DS	FB-DI
Sampling Date	11/22/94	11/22/94	11/22/94
Units	UG/L	UG/L	UG/L
Aluminum	41.8 B	17.7 B	21.0 B
Antimony	12.2 R	12.2 R	12.2 R
Arsenic	2.3 U	2.3 U	2.3 U
Barium	14.8	0.5 U	0.5 U
Beryllium	0.29 B	0.20 B	0.23 B
Cadmium	1.5 U	1.5 U	1.5 U
Calcium	21400	32 B	32.9 B
Chromium	1.8 U	1.8 U	1.8 U
Cobalt	1.9 U	1.9 U	1.9 U
Copper	7.4	1.7	1.4 U
Iron	1180	12.8 B	4.3 B
Lead	1.4 U	1.4 U	1.4 U
Magnesium	1330	11.1 U	11.1 U
Manganese	28.5	0.4 U	1.0 B
Mercury	0.20 U	0.20 U	0.20 U
Nickel	4.3 U	4.3 U	4.3 U
Potassium	1610	381 U	381 U
Selenium	2.6 UL	2.6 UL	2.6 UL
Silver	2.0 UL	2.0 UL	2.0 UL
Sodium	7240	29.9	51 B
Thallium	4.0	4.0 U	4.0 U
Vanadium	1.4 UL	1.4 UL	1.4 UL
Zinc	153	6.1 B	7.2 B
Cyanide	5.0 U	5.0 U	5.0 U

FREQUENCY OF DETECTION SUMMARY
FIELD BLANKS
TOTAL INORGANICS AND CYANIDE
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Location Sampling Date Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	17.7 B	41.8 B	ND	ND		0/3
Antimony	NA	NA	ND	ND		0/0
Arsenic	2.3 U	2.3 U	ND	ND		0/3
Barium	0.5 U	0.5 U	14.8	14.8	FB-B16	1/3
Beryllium	0.20 B	0.29 B	ND	ND		0/3
Cadmium	1.5 U	1.5 U	ND	ND		0/3
Calcium	32 B	32.9 B	21400	21400	FB-B16	1/3
Chromium	1.8 U	1.8 U	ND	ND		0/3
Cobalt	1.9 U	1.9 U	ND	ND		0/3
Copper	1.4 U	1.4 U	1.7	7.4	FB-B16	2/3
Iron	4.3 B	12.8 B	1180	1180	FB-B16	1/3
Lead	1.4 U	1.4 U	ND	ND		0/3
Magnesium	11.1 U	11.1 U	1330	1330	FB-B16	1/3
Manganese	0.4 U	1.0 B	28.5	28.5	FB-B16	1/3
Mercury	0.20 U	0.20 U	ND	ND		0/3
Nickel	4.3 U	4.3 U	ND	ND		0/3
Potassium	381 U	381 U	1610	1610	FB-B16	1/3
Selenium	2.6 UL	2.6 UL	ND	ND		0/3
Silver	2.0 UL	2.0 UL	ND	ND		0/3
Sodium	51 B	51 B	29.9	7240	FB-B16	2/3
Thallium	4.0 U	4.0 U	4.0	4.0	FB-B16	1/3
Vanadium	1.4 UL	1.4 UL	ND	ND		0/3
Zinc	6.1 B	7.2 B	153	153	FB-B16	1/3
Cyanide	5.0 U	5.0 U	ND	ND		0/3

APPENDIX H
BACKGROUND ANALYTICAL RESULTS AND STATISTICS

TABLE 5 - 4
FREQUENCY OF DETECTION SUMMARY
SOIL ASSOCIATION 2
SURFACE SOIL
TOTAL INORGANICS AND CYANIDE
BACKGROUND INVESTIGATION
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Sample ID Date sampled Depth Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	NA	NA	2850	8440	BGS33	12/12
Arsenic	NA	NA	0.68 J	4.2	BGS19	12/12
Barium	NA	NA	11.8 J	76.3	BGS38	12/12
Beryllium	0.22 U	0.22 U	0.27 J	0.93 J	BGS38	11/12
Cadmium	1.1 UL	1.3 U	1.3 K	1.3 K	BGS36	1/12
Calcium	NA	NA	135 J	1740	BGS34D	12/12
Chromium	NA	NA	2.6	18.3	BGS34D	12/12
Cobalt	NA	NA	1.1 J	6.7 J	BGS18D	12/12
Copper	1.1 U	1.1 U	1.5 J	5 J	BGS38	11/12
Iron	NA	NA	1910	17200	BGS19	12/12
Lead	NA	NA	6.8 L	16.5	BGS36	12/12
Magnesium	NA	NA	161 J	1610	BGS34D	12/12
Manganese	NA	NA	20.3	413	BGS38	12/12
Nickel	3.7 U	4 U	3.8 J	8.8 K	BGS33	10/12
Potassium	338 U	400 U	429 J	1640 J	BGS34D	7/12
Selenium	0.22 UL	0.25 U	0.26 L	0.27 L	BGS39D	3/12
Sodium	NA	NA	17.4 J	69.3 J	BGS39	12/12
Vanadium	NA	NA	6.1 J	20.8	BGS19	12/12
Zinc	NA	NA	5.9 J	24.1	BGS34D	12/12

TABLE 5 - 6
FREQUENCY OF DETECTION SUMMARY
SOIL ASSOCIATION 4
SURFACE SOIL
TOTAL INORGANICS AND CYANIDE
BACKGROUND INVESTIGATION
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Sample ID Date sampled Depth Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	NA	NA	4370	19200	BGS28	11/11
Arsenic	NA	NA	0.75 L	63.9	BGS21	11/11
Barium	NA	NA	15.8 J	80.2	BGS28	11/11
Beryllium	0.23 U	0.25 U	0.32 J	0.63 J	BGS28	6/11
Cadmium	1.2 U	1.4 U	1.5	1.5	BGS30	1/11
Calcium	NA	NA	97 J	1610 J	BGS11	11/11
Chromium	NA	NA	5.3	17.5	BGS28	11/11
Cobalt	NA	NA	1 J	6 J	BGS10	11/11
Copper	1.2 UL	1.2 UL	1.5 J	5.3 J	BGS28	10/11
Iron	NA	NA	3580	19900	BGS27	11/11
Lead	NA	NA	10.4 L	38.7 L	BGS28	11/11
Magnesium	NA	NA	229 J	1070 J	BGS28	11/11
Manganese	NA	NA	9.5	491	BGS03	11/11
Nickel	4 U	4.1 U	4.6 J	10.7	BGS28	9/11
Potassium	367 U	449 U	416 J	515 J	BGS11	3/11
Selenium	0.23 U	0.25 U	0.27 J	0.55 L	BGS08	8/11
Silver	0.92 U	1.1 U	1 J	2.1 J	BGS21	2/11
Sodium	NA	NA	24 J	51 J	BGS21	11/11
Vanadium	NA	NA	10.7 J	34.7	BGS28	11/11
Zinc	NA	NA	8.2	48.4	BGS28	11/11

TABLE 5 - 8
FREQUENCY OF DETECTION SUMMARY
SUBSURFACE SOIL
TOTAL INORGANICS AND CYANIDE
BACKGROUND INVESTIGATION
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Sample ID Date sampled Depth Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	NA	NA	2710	28200	BGSB06-05D	16/16
Antimony	8.2 UL	9.6 UL	8.5 L	31.3 L	BGSB07-11	2/13
Arsenic	NA	NA	0.23 J	42.7	BGSB07-11	16/16
Barium	NA	NA	10.6 J	66.9	BGSB06-05D	16/16
Beryllium	0.22 UL	0.24 U	0.3 J	9.8	BGSB07-11	13/16
Calcium	NA	NA	28.9 J	233000	BGSB07-16	16/16
Chromium	NA	NA	5.2 L	33.5	BGSB04-09	16/16
Cobalt	0.91 U	1 U	0.97 J	156	BGSB07-11	12/16
Copper	NA	NA	2 J	15	BGSB06-05D	16/16
Iron	NA	NA	0	51100 J	BGSB04-09	16/16
Lead	NA	NA	3.6 L	25.5 L	BGSB06-05	16/16
Magnesium	NA	NA	136 J	2870	BGSB04-09	16/16
Manganese	NA	NA	3.5 J	2940	BGSB07-11	16/16
Nickel	3.6 U	3.8 U	4.2 J	145	BGSB07-11	13/16
Potassium	344 U	356 U	392 J	2560	BGSB06-11	13/16
Selenium	0.22 UL	0.26 UL	0.26 L	0.75 L	BGSB05-02	10/16
Silver	0.87 U	1.1 U	1.1 J	2.4 J	BGSB07-11	5/16
Sodium	10.8 U	10.8 U	17.2 J	2180	BGSB07-16	15/16
Thallium	0.22 U	2.6 UL	0.44 K	0.44 K	BGSB06-05D	1/16
Vanadium	1.2 U	1.2 U	7.8 J	70.3 L	BGSB08-07	15/16
Zinc	NA	NA	3.6 J	330	BGSB07-11	16/16

TABLE 5 - 10
FREQUENCY OF DETECTION SUMMARY
GROUNDWATER
TOTAL INORGANICS AND CYANIDE
BACKGROUND INVESTIGATION
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Sample ID Date sampled Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	NA	NA	44.9 J	14600 L	BGGW08A-01	18/18
Antimony	12.4 U	12.4 U	16.4 K	16.4 K	BGGW08A-01	1/18
Arsenic	2.3 U	2.6 UL	3.5 J	36.4	BGGW08A-01	6/18
Barium	NA	NA	13 J	97.5 J	BGGW08A-01	18/18
Beryllium	0.2 U	0.2 U	0.22 J	1.5 J	BGGW08A-01	8/18
Calcium	2.3 U	2.3 U	768 J	530000	BGGW08A-01	17/18
Chromium	1.5 UL	1.5 UL	1.6 J	49.6	BGGW08A-01	14/18
Cobalt	2.1 U	2.1 U	2.5 J	22.4 J	BGGW08A-01	8/18
Copper	1.1 U	1.1 U	1.3 J	14.6 J	BGGW08A-01	17/18
Iron	NA	NA	483	48200	BGGW08A-01	18/18
Lead	1.5 U	1.5 U	1.8 L	12.8	BGGW08A-01	5/18
Magnesium	NA	NA	489 J	9770	BGGW04-01	18/18
Manganese	NA	NA	4.5 J	413	BGGW08A-01	18/18
Nickel	5.2 U	5.2 U	7.9 J	27.6 J	BGGW08A-01	2/18
Potassium	NA	NA	557 J	17000	BGGW07A-01	18/18
Selenium	2.4 UL	2.4 UL	2.9 J	2.9 J	BGGW01A-01	1/18
Sodium	NA	NA	3670 J	27200	BGGW07A-01	18/18
Vanadium	1.8 U	1.8 U	2.9 J	66.6	BGGW08A-01	17/18
Zinc	NA	NA	5.9 J	99.1 J	BGGW08A-01	18/18

TABLE 5 - 10
FREQUENCY OF DETECTION SUMMARY
GROUNDWATER
DISSOLVED INORGANICS
BACKGROUND INVESTIGATION
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Sample ID Date sampled Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	11.5 U	11.5 U	12.9 J	212	BGGW06ADS-01	6/18
Antimony	12.4 U	12.4 U	16.7 J	21.1 J	BGGW06ADS-01	5/18
Arsenic	2.3 UL	2.6 UL	3 L	5.5 L	BGGW04DS-01	2/18
Barium	NA	NA	5.9 J	73.4 J	BGGW07ADS-01	18/18
Calcium	NA	NA	611 J	129000	BGGW07DS-01	18/18
Cobalt	2.1 U	2.1 U	3.2 J	4.6 J	BGGW08DS-01	2/18
Copper	1.1 U	1.5 U	1.1 J	4 J	BGGW01ADS-01	12/18
Iron	1.9 U	1.9 U	2.4 J	347	BGGW03ADS-01	15/18
Magnesium	NA	NA	70.2 J	9810	BGGW04DS-01	18/18
Manganese	0.6 U	0.6 U	1.1 J	54.4	BGGW04DS-01	15/18
Potassium	NA	NA	430 J	17900	BGGW07ADS-01	18/18
Selenium	2.4 U	2.6 U	3.3 K	3.9 K	BGGW02ADS-01	2/18
Sodium	NA	NA	3690 J	27800	BGGW07ADS-01	18/18
Vanadium	1.8 U	1.8 U	1.8 J	10.2 J	BGGW06ADS-01	10/18
Zinc	NA	NA	2.9 J	15.6 J	BGGW07DS-01	18/18

TABLE 5 - 15
FREQUENCY OF DETECTION SUMMARY
FRESHWATER STREAMS
SURFACE WATER
TOTAL INORGANICS AND CYANIDE
BACKGROUND INVESTIGATION
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Sample ID Date sampled Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	NA	NA	94.4 J	1050	BGCPSW03-01D	7/7
Antimony	37 UL	37 UL	37.2 L	45.7 L	BGCPSW02-01	3/7
Barium	NA	NA	30.4 J	41.5 J	BGCPSW03-01D	7/7
Calcium	NA	NA	13000 J	97300	BGCPSW05-01	7/7
Chromium	3 U	3 U	9.8 J	9.8 J	BGCPSW02-01	1/7
Copper	5 U	5 U	5 J	5 J	BGCPSW04-01	1/7
Iron	NA	NA	630	2500 J	BGTNSW06-01	7/7
Lead	1 UL	1 UL	1.6 J	15.9	BGCPSW01-01	4/7
Magnesium	NA	NA	1380 J	2460 J	BGCPSW01-01	7/7
Manganese	NA	NA	15.4	85.9 J	BGTNSW06-01	7/7
Potassium	1570 U	1570 U	1740 J	3210 J	BGCPSW03-01	6/7
Sodium	NA	NA	5230	9390	BGCPSW03-01D	7/7
Vanadium	4 U	4 U	4.5 J	4.5 J	BGCPSW03-01	1/7
Zinc	3 U	3 U	11.9 J	59.3	BGCPSW05-01	6/7

TABLE 5 - 16
FREQUENCY OF DETECTION SUMMARY
TIDAL FRESHWATER STREAMS
SURFACE WATER
TOTAL INORGANICS AND CYANIDE
BACKGROUND INVESTIGATION
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Sample ID Date sampled Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	NA	NA	171 J	5600	BGTCSW02-01	17/17
Arsenic	1 UL	1 UL	1.2 L	3.5 L	BGTNSW01-01	14/17
Barium	NA	NA	26.6 J	49.9 J	BGTNSW04-01D	17/17
Cadmium	5 U	5 U	5.1 K	7.8 K	BGTNSW02-02	4/17
Calcium	NA	NA	29200 J	198000 J	BGTNSW01-02	17/17
Cobalt	4 U	4 U	5.3 J	8.5 J	BGTCSW03-02	4/17
Copper	5 U	5 U	5.6 J	6.7 J	BGTCSW03-02	4/17
Iron	NA	NA	289 J	6650	BGTCSW03-02	17/17
Lead	1 U	5 UL	1.2 L	5.4 L	BGTCSW01-01	7/17
Magnesium	NA	NA	23000	656000 J	BGTNSW01-02	17/17
Manganese	NA	NA	33.1	379	BGTCSW03-02	17/17
Nickel	16 U	16 U	19.8 K	55.5 K	BGTNSW03-01	10/17
Potassium	NA	NA	8210	220000 J	BGTNSW01-02	17/17
Selenium	1 U	10 UL	1.8 L	1.8 L	BGTNSW04-01D	1/17
Sodium	45 U	45 U	180000	5760000 J	BGTNSW01-02	16/17
Vanadium	4 U	4 U	5 J	14.4 J	BGTNSW04-01D	11/17
Zinc	3 U	3 U	7.9 J	20.2	BGTCSW03-02	9/17
Cyanide	10 U	10 U	16.9	16.9	BGTCSW03-01	1/17

TABLE 5 - 19
FREQUENCY OF DETECTION SUMMARY
FRESHWATER STREAMS
SEDIMENT
TOTAL INORGANICS AND CYANIDE
BACKGROUND INVESTIGATION
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Sample ID Date sampled Depth Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	NA	NA	482 K	17700 J	BGCPSD01-02	13/13
Antimony	9.4 UL	22 UL	14.4 L	29.1 L	BGCPSD01-01	2/4
Arsenic	0.24 UL	0.3 UL	0.27 L	5.4 L	BGCPSD01-02	8/13
Barium	NA	NA	2.3 J	84.8	BGCPSD03-02	13/13
Beryllium	0.25 U	0.3 U	0.28 J	0.99 J	BGCPSD01-02	5/13
Calcium	NA	NA	74.9 J	44000 J	BGCPSD01-01	13/13
Chromium	NA	NA	2.8	32.8	BGCPSD01-02	13/13
Cobalt	1 U	1.1 U	1.1 J	7.9 J	BGTNSD06-01	11/13
Copper	1 U	1.3 U	1 J	6.3 J	BGCPSD01-01	5/13
Iron	NA	NA	329	27700 J	BGCPSD01-02	13/13
Lead	NA	NA	1.8 L	381 L	BGCPSD01-01	13/13
Magnesium	NA	NA	37.8 J	2060	BGCPSD01-02	13/13
Manganese	NA	NA	8.7	93.1	BGTNSD06-01	13/13
Mercury	0.06 UL	0.14 UL	0.06 L	0.09 L	BGCPSD03-02	2/13
Nickel	4.1 U	4.7 U	4.6 K	17.5 K	BGTNSD06-01	7/13
Potassium	370 U	933 U	503 J	1910	BGCPSD01-02	3/13
Selenium	0.24 UL	0.44 UL	0.86 L	0.86 L	BGTNSD06-01	1/13
Sodium	NA	NA	12.2 J	323 J	BGCPSD04-01	13/13
Vanadium	NA	NA	1.9 J	38.9	BGCPSD01-02	13/13
Zinc	NA	NA	3.2 J	143	BGCPSD01-01	13/13

TABLE 5 - 20
FREQUENCY OF DETECTION SUMMARY
TIDAL FRESHWATER STREAMS
SEDIMENT
TOTAL INORGANICS AND CYANIDE
BACKGROUND INVESTIGATION
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Sample ID Date sampled Depth Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	NA	NA	1510	40500	BGTNSD03-01	25/25
Antimony	8.6 U	35.2 UL	18.9 L	18.9 L	BGTCSD05-01	1/25
Arsenic	NA	NA	1.4 J	13.1	BGTCSD06-02	25/25
Barium	NA	NA	3.6 J	93.2 J	BGTCSD06-02	25/25
Beryllium	0.23 U	0.5 U	0.55 J	1.6 J	BGTNSD03-01	23/25
Calcium	NA	NA	217 J	4220	BGTCSD05-01	25/25
Chromium	NA	NA	3.8	66.1	BGTNSD03-01	25/25
Cobalt	0.93 U	0.93 U	3.8 J	15 J	BGTNSD03-01	24/25
Copper	1.2 U	1.2 U	3.7 J	43.1	BGTNSD03-01	24/25
Iron	NA	NA	3060	46000	BGTCSD06-02	25/25
Lead	NA	NA	3.4	51.6	BGTNSD03-01	25/25
Magnesium	NA	NA	292 J	9720 K	BGTNSD03-01	25/25
Manganese	NA	NA	7.4	1980	BGTCSD01-01	25/25
Mercury	0.05 U	0.23 U	0.18 L	0.29 L	BGTNSD03-01	4/25
Nickel	3.7 U	8 U	9.3 K	55.2	BGTNSD03-01	23/25
Potassium	366 U	780 U	1200 J	6080	BGTCSD01-01	23/25
Selenium	0.23 U	0.88 U	0.46 L	1.5 L	BGTCSD04-02	17/25
Silver	0.93 U	3.8 U	2.2 J	2.2 J	BGTCSD05-02	1/25
Sodium	NA	NA	177 J	16700	BGTCSD01-01	25/25
Vanadium	NA	NA	4.8 J	67.6	BGTNSD03-01	25/25
Zinc	NA	NA	4 J	202 J	BGTNSD03-01	25/25

TABLE 6 - 3
STATISTICAL SUMMARY
SOIL ASSOCIATION 2
SURFACE SOIL SAMPLES
INORGANICS AND CYANIDE
BACKGROUND INVESTIGATION
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG UPPER 95% CONFIDENCE INTERVAL
Aluminum	5669.17	1651.14	6525.22	6869.55
Arsenic	2.23	1.34	2.92	3.71
Barium	29.53	16.64	38.15	40.30
Beryllium	0.44	0.21	0.55	0.65
Cadmium	0.65	0.21	0.76	0.74
Calcium	858.00	580.81	1159.13	1845.33
Chromium	8.74	4.06	10.85	12.25
Cobalt	3.28	1.83	4.23	4.99
Copper	2.45	1.22	3.08	3.72
Iron	7124.17	4290.22	9348.48	11720.17
Lead	10.28	2.96	11.81	12.09
Magnesium	540.92	377.51	736.64	800.48
Manganese	144.94	122.35	208.38	323.66
Nickel	5.41	2.23	6.57	7.83
Potassium	497.71	415.59	713.18	898.91
Selenium	0.15	0.07	0.19	0.19
Sodium	41.56	15.55	49.62	54.56
Vanadium	14.05	4.44	16.35	17.74
Zinc	15.72	5.08	18.35	19.99

TABLE 6 - 5
STATISTICAL SUMMARY
SOIL ASSOCIATION 4
SURFACE SOIL SAMPLES
INORGANICS AND CYANIDE
BACKGROUND INVESTIGATION
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG UPPER 95% CONFIDENCE INTERVAL
Aluminum	8611.82	4939.40	11310.40	12486.33
Arsenic	7.42	18.75	17.66	17.95
Barium	31.11	19.42	41.72	43.48
Beryllium	0.29	0.19	0.39	0.52
Cadmium	0.70	0.27	0.85	0.83
Calcium	517.64	465.12	771.75	1288.36
Chromium	9.05	4.19	11.35	12.27
Cobalt	2.40	1.47	3.20	3.57
Copper	2.50	1.31	3.21	3.94
Iron	7450.91	4895.81	10125.68	10866.15
Lead	15.86	7.72	20.08	19.60
Magnesium	409.64	234.50	537.75	546.57
Manganese	113.35	141.26	190.53	660.55
Nickel	5.63	2.42	6.96	8.40
Potassium	267.95	127.51	337.62	354.97
Selenium	0.31	0.14	0.39	0.48
Silver	0.69	0.49	0.96	0.93
Sodium	38.44	7.76	42.67	43.95
Vanadium	18.09	8.42	22.69	24.35
Zinc	16.25	11.14	22.33	22.26

TABLE 6 - 8
STATISTICAL SUMMARY
SUBSURFACE SOIL SAMPLES
INORGANICS
BACKGROUND INVESTIGATION
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG UPPER 95% CONFIDENCE INTERVAL
Aluminum	10195.63	6772.98	13163.88	14673.48
Antimony	6.90	7.42	10.56	9.18
Arsenic	8.36	11.52	13.41	46.92
Barium	31.15	15.93	38.13	42.12
Beryllium	1.05	2.36	2.08	1.82
Calcium	16905.16	57925.27	42290.91	226749.41
Chromium	17.51	10.40	22.07	27.75
Cobalt	12.33	38.45	29.18	24.26
Copper	5.98	3.82	7.66	8.69
Iron	17064.67	14083.98	23468.49	35244.98
Lead	12.44	7.35	15.66	18.24
Magnesium	894.69	783.98	1238.27	1595.44
Manganese	266.34	721.45	582.51	1687.15
Nickel	15.75	34.93	31.06	27.60
Potassium	1163.00	770.64	1500.73	2483.43
Selenium	0.32	0.20	0.41	0.48
Silver	0.84	0.63	1.12	1.14
Sodium	202.54	529.67	434.67	446.86
Thallium	0.22	0.30	0.35	0.28
Vanadium	27.31	21.19	36.59	86.12
Zinc	37.71	79.07	72.36	65.38

TABLE 5
FREQUENCY OF POSITIVE DETECTIONS SUMMARY
GROUNDWATER (ug/l)
DISSOLVED INORGANICS
BACKGROUND INVESTIGATION
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Sample ID Date sampled Units	MINIMUM NONDETECTED	MAXIMUM NONDETECTED	MINIMUM DETECTED	MAXIMUM DETECTED	LOCATION OF MAXIMUM DETECTED	FREQUENCY OF DETECTION
Aluminum	11.5 U	11.5 U	12.9 J	212	BGGW06ADS-01	6/18
Antimony	12.4 U	12.4 U	16.7 J	21.1 J	BGGW06ADS-01	5/18
Arsenic	2.3 UL	2.6 UL	3 L	5.5 L	BGGW04DS-01	2/18
Barium	NA	NA	5.9 J	73.4 J	BGGW07ADS-01	18/18
Calcium	NA	NA	611 J	129000	BGGW07DS-01	18/18
Cobalt	2.1 U	2.1 U	3.2 J	4.6 J	BGGW08DS-01	2/18
Copper	1.1 U	1.5 U	1.1 J	4 J	BGGW01ADS-01	12/18
Iron	1.9 U	1.9 U	2.4 J	347	BGGW03ADS-01	15/18
Magnesium	NA	NA	70.2 J	9810	BGGW04DS-01	18/18
Manganese	0.6 U	0.6 U	1.1 J	54.4	BGGW04DS-01	15/18
Potassium	NA	NA	430 J	17900	BGGW07ADS-01	18/18
Selenium	2.4 U	2.6 U	3.3 K	3.9 K	BGGW02ADS-01	2/18
Sodium	NA	NA	3690 J	27800	BGGW07ADS-01	18/18
Vanadium	1.8 U	1.8 U	1.8 J	10.2 J	BGGW06ADS-01	10/18
Zinc	NA	NA	2.9 J	15.6 J	BGGW07DS-01	18/18

APPENDIX I
STATISTICAL SUMMARY

STATISTICAL SUMMARY
SUBSURFACE SOIL - SOIL BORINGS
VOLATILE ORGANIC COMPOUNDS
SSA 1
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
VOLATILES (ug/kg)						
Methylene chloride	6.05	2.96	6.87	1.69	0.50	7.18
2-Butanone	5.71	1.65	6.17	1.69	0.33	6.36
Trichloroethene	5.32	1.58	5.75	1.61	0.41	6.18
Tetrachloroethene	5.93	2.61	6.65	1.71	0.38	6.68
Toluene	6.16	4.78	7.47	1.67	0.54	7.31
Ethylbenzene	5.26	1.59	5.70	1.60	0.41	6.11
Total Xylenes	5.61	2.80	6.38	1.60	0.57	7.01

STATISTICAL SUMMARY
SUBSURFACE SOIL - SOIL BORINGS
PESTICIDE/PCB COMPOUNDS
SSA 1
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
PESTICIDE/PCBS (ug/kg)						
Heptachlor Epoxide	3.43	4.17	4.56	0.61	1.03	4.97
4,4'-DDE	4.13	3.77	5.15	1.10	0.75	5.16
Endosulfan Sulfate	4.14	3.75	5.16	1.11	0.74	5.17
4,4'-DDT	4.24	3.71	5.25	1.15	0.73	5.31
Methoxychlor	10.92	3.38	11.84	2.36	0.23	11.63
Endrin Ketone	4.44	3.79	5.47	1.18	0.76	5.66
Aroclor-1260	41.37	37.59	51.59	3.40	0.75	51.83

STATISTICAL SUMMARY
SUBSURFACE SOIL - SOIL BORINGS
TOTAL INORGANICS AND CYANIDE
SSA 1
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
ANALYTES (mg/kg)						
Aluminum	4730.05	1864.98	5236.84	8.35	0.60	6120.58
Arsenic	5.53	5.33	6.98	1.22	1.13	10.55
Barium	22.80	11.59	25.95	2.97	0.69	31.23
Beryllium	0.50	0.62	0.67	-1.16	1.06	0.89
Cadmium	0.24	0.13	0.27	-1.55	0.42	0.27
Calcium	24006.89	46373.56	36608.32	8.16	2.07	140601.26
Chromium	13.01	8.28	15.26	2.25	0.96	21.89
Cobalt	3.49	2.54	4.18	0.97	0.84	5.14
Copper	3.40	2.63	4.12	0.99	0.76	4.71
Iron	11735.21	7438.54	13756.54	9.10	0.88	18359.96
Lead	7.54	6.69	9.36	1.80	0.66	9.49
Magnesium	1040.18	750.03	1243.99	6.56	1.08	2029.39
Manganese	82.74	66.64	100.85	4.09	0.93	133.61
Mercury	0.06	0.04	0.07	-2.90	0.50	0.07
Nickel	5.22	3.40	6.14	1.39	0.83	7.72
Potassium	1023.03	753.82	1227.87	6.45	1.20	2235.16
Sodium	164.76	277.81	240.26	4.04	1.42	313.96
Thallium	0.49	0.36	0.59	-0.98	0.78	0.67
Vanadium	11.59	5.04	12.96	2.30	0.70	16.13
Zinc	32.63	49.02	45.95	3.05	0.90	44.32
Cyanide	1.12	0.61	1.31	-0.13	0.80	1.74

STATISTICAL SUMMARY
SURFACE SOILS
SEMIVOLATILE ORGANIC COMPOUNDS
SSA-1
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

SEMIVOLATILES (ug/kg)	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
Phenol	562.63	972.26	765.71	5.62	0.97	587.88
1,4-Dichlorobenzene	525.00	927.61	718.76	5.62	0.89	529.38
2-Methylphenol	544.25	947.93	742.25	5.62	0.95	568.75
2,2'-oxybis(1-chloropropene)	505.16	813.08	674.99	5.63	0.89	527.11
4-Methylphenol	566.31	951.87	765.13	5.65	0.99	618.59
Naphthalene	484.17	801.67	651.62	5.58	0.89	505.80
2-Methylnaphthalene	497.66	803.43	665.47	5.62	0.88	520.14
Acenaphthylene	512.53	926.77	706.11	5.53	0.98	541.97
Acenapthene	472.27	814.56	642.41	5.58	0.85	483.97
Dibenzofuran	489.03	818.00	659.89	5.57	0.91	515.12
2,4-Dinitrotoluene	548.27	946.83	746.03	5.64	0.94	572.35
Fluorene	482.59	899.41	670.46	5.56	0.86	478.06
Phenanthrene	1446.86	5674.48	2632.12	5.67	1.33	1132.96
Anthracene	2490.44	16214.64	5877.27	5.47	1.38	1015.74
Carbazole	479.41	1304.02	751.78	5.43	0.90	438.58
Fluoranthene	3271.55	11672.51	5709.64	6.10	1.71	3810.65
Pyrene	4634.47	12839.11	7316.24	6.35	1.88	7745.95
3,3-Dichlorobenzidine	544.28	947.93	742.28	5.62	0.95	569.69
Benzo(a)anthracene	1728.03	4530.03	2674.24	5.97	1.44	1849.44
Chrysene	3292.59	9414.52	5259.05	6.18	1.69	3960.28
Bis(2-ethylhexyl)-phthalate	628.47	1648.04	972.70	5.36	1.26	748.30
Benzo(b)fluoranthene	3798.67	9209.88	5722.39	6.24	1.85	6508.23
Benzo(k)fluoranthene	2586.66	6771.45	4001.04	6.13	1.64	3393.16
Benzo(a)pyrene	2061.14	5040.99	3114.08	6.05	1.53	2561.90
Indeno(1,2,3-cd)pyrene	2308.14	13721.37	5174.19	5.76	1.21	973.92
Dibenzo(a,h)anthracene	1250.31	6609.93	2630.96	5.62	1.04	665.08
Benzo(g,h,i)perylene	2909.06	13994.33	5832.13	5.81	1.33	1299.85

STATISTICAL SUMMARY
SURFACE SOILS
NITRAMINE COMPOUNDS
SSA-1
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

NITRAMINE (ug/kg)	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
1,3,5-Trinitrobenzene	145.08	123.96	170.97	4.89	0.32	149.47
1,3,5-Trinitrobenzene	145.08	123.96	170.97	4.89	0.32	149.47
1,3-Dinitrobenzene	154.30	21.29	158.74	5.03	0.13	158.76
2,4,6-Trinitrotoluene	349.69	788.77	514.44	5.37	0.67	316.59
2,4-Dinitrotoluene	139.38	91.92	158.57	4.87	0.27	144.14

STATISTICAL SUMMARY
SURFACE SOILS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
Chloromethane	5.63	0.34	5.73	1.73	0.06	5.74
Bromomethane	5.63	0.34	5.73	1.73	0.06	5.74
Vinyl chloride	5.63	0.34	5.73	1.73	0.06	5.74
Chloroethane	5.63	0.34	5.73	1.73	0.06	5.74
Methylene chloride	5.19	1.11	5.53	1.62	0.28	5.74
Acetone	4.94	1.51	5.40	1.50	0.54	6.38
Carbon disulfide	5.63	0.34	5.73	1.73	0.06	5.74
1,1-Dichloroethene	5.63	0.34	5.73	1.73	0.06	5.74
1,1-Dichloroethane	5.63	0.34	5.73	1.73	0.06	5.74
1,2-Dichloroethene (total	5.63	0.34	5.73	1.73	0.06	5.74
Chloroform	5.63	0.34	5.73	1.73	0.06	5.74
1,2-Dichloroethane	5.63	0.34	5.73	1.73	0.06	5.74
2-Butanone	5.73	1.32	6.21	1.73	0.19	6.17
1,1,1-Trichloroethane	5.63	0.34	5.73	1.73	0.06	5.74
Carbon Tetrachloride	5.63	0.34	5.73	1.73	0.06	5.74
Bromodichloromethane	5.63	0.34	5.73	1.73	0.06	5.74
1,2-Dichloropropane	5.63	0.34	5.73	1.73	0.06	5.74
cis-1,3-Dichloropropene	5.63	0.34	5.73	1.73	0.06	5.74
Trichloroethene	5.63	0.34	5.73	1.73	0.06	5.74
Dibromochloromethane	5.63	0.34	5.73	1.73	0.06	5.74
1,1,2-Trichloroethane	5.63	0.34	5.73	1.73	0.06	5.74
Benzene	5.63	0.34	5.73	1.73	0.06	5.74
trans-1,3-Dichloropropene	5.63	0.34	5.73	1.73	0.06	5.74
Bromoform	5.63	0.34	5.73	1.73	0.06	5.74
4-Methyl-2-pentanone	7.81	2.81	8.66	1.99	0.35	8.82
2-Hexanone	7.81	2.81	8.66	1.99	0.35	8.82
Tetrachloroethene	5.50	0.73	5.72	1.69	0.19	5.89
1,1,2,2-Tetrachloroethane	5.63	0.34	5.73	1.73	0.06	5.74
Toluene	5.32	1.20	5.69	1.61	0.43	6.46
Chlorobenzene	5.48	0.90	5.76	1.67	0.32	6.24
Ethylbenzene	5.63	0.34	5.73	1.73	0.06	5.74
Styrene	5.63	0.34	5.73	1.73	0.06	5.74
Total Xylenes	5.63	0.34	5.73	1.73	0.06	5.74

STATISTICAL SUMMARY
SURFACE SOILS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
2,4-Dinitrophenol	448.39	13.13	452.39	6.11	0.03	452.50
4-Nitrophenol	448.39	13.13	452.39	6.11	0.03	452.50
Dibenzofuran	184.19	5.79	185.96	5.22	0.03	186.00
2,4-Dinitrotoluene	184.19	5.79	185.96	5.22	0.03	186.00
Diethylphthalate	184.19	5.79	185.96	5.22	0.03	186.00
4-Chlorophenylphenyl Ethe	184.19	5.79	185.96	5.22	0.03	186.00
Fluorene	184.19	5.79	185.96	5.22	0.03	186.00
4-Nitroaniline	448.39	13.13	452.39	6.11	0.03	452.50
4,6-Dinitro-2-Methylpheno	448.39	13.13	452.39	6.11	0.03	452.50
N-nitrosodiphenylamine	184.19	5.79	185.96	5.22	0.03	186.00
4-Bromophenylphenyl Ether	184.19	5.79	185.96	5.22	0.03	186.00
Hexachlorobenzene	184.19	5.79	185.96	5.22	0.03	186.00
Pentachlorophenol	448.39	13.13	452.39	6.11	0.03	452.50
Phenanthrene	172.97	32.84	182.98	5.13	0.27	191.10
Anthracene	184.19	5.79	185.96	5.22	0.03	186.00
Carbazole	184.19	5.79	185.96	5.22	0.03	186.00
Di-n-Butyl Phthalate	836.84	1044.43	1155.17	6.02	1.27	1985.52
Fluoranthene	180.10	25.36	187.83	5.18	0.18	191.42
Pyrene	173.94	34.02	184.30	5.13	0.27	191.91
Butyl Benzyl Phthalate	203.71	108.66	236.83	5.26	0.28	219.39
3,3'-Dichlorobenzidine	225.00	75.14	247.90	5.37	0.29	246.79
Benzo(a)anthracene	167.55	43.38	180.77	5.06	0.43	201.74
Chrysene	172.84	32.46	182.73	5.12	0.27	191.10
bis(2-Ethylhexyl)Phthalat	304.16	627.17	495.32	5.19	0.82	361.28
Di-n-Octylphthalate	181.23	16.46	186.24	5.19	0.12	188.46
Benzo(b)fluoranthene	182.29	31.37	191.85	5.18	0.27	201.48
Benzo(k)fluoranthene	174.35	29.06	183.21	5.14	0.26	191.89
Benzo(a)Pyrene	171.29	32.89	181.31	5.11	0.31	193.33
Indeno(1,2,3-cd)pyrene	174.16	30.80	183.55	5.14	0.25	190.97
Dibenzo(a,h)anthracene	184.19	5.79	185.96	5.22	0.03	186.00
Benzo(g,h,i)Perylene	187.03	133.49	227.72	5.10	0.48	220.04

STATISTICAL SUMMARY
SURFACE SOILS
EXPLOSIVE COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
HMX	0.25	0.00	0.25	-1.39	0.00	0.25
RDX	0.25	0.00	0.25	-1.39	0.00	0.25
1,3,5-Trinitrobenzene	0.13	0.00	0.13	-2.08	0.00	0.13
1,3-Dinitrobenzene	0.13	0.00	0.13	-2.08	0.00	0.13
Tertyl	0.32	0.00	0.33	-1.12	0.00	0.33
Nitrobenzene	0.13	0.00	0.13	-2.04	0.00	0.13
2,4,6-Trinitrotoluene	0.13	0.00	0.13	-2.08	0.00	0.13
4-Amino-2,6-Dinitrotoluen	0.13	0.00	0.13	-2.08	0.00	0.13
2,6-Dinitrotoluene	0.13	0.00	0.13	-2.08	0.00	0.13
2,4-Dinitrotoluene	0.13	0.00	0.13	-2.04	0.00	0.13
2-Nitrotoluene	0.13	0.00	0.13	-2.08	0.00	0.13
3-Nitrotoluene	0.11	0.00	0.11	-2.21	0.00	0.11

STATISTICAL SUMMARY
SUBSURFACE SOILS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
Chloromethane	6.11	0.72	6.29	1.80	0.11	6.30
Bromomethane	6.11	0.72	6.29	1.80	0.11	6.30
Vinyl chloride	6.11	0.72	6.29	1.80	0.11	6.30
Chloroethane	6.11	0.72	6.29	1.80	0.11	6.30
Methylene chloride	13.11	23.88	19.31	2.01	0.87	14.93
Acetone	7.26	4.14	8.34	1.86	0.50	8.47
Carbon disulfide	5.86	1.09	6.14	1.74	0.26	6.35
1,1-Dichloroethene	6.11	0.72	6.29	1.80	0.11	6.30
1,1-Dichloroethane	6.11	0.72	6.29	1.80	0.11	6.30
1,2-Dichloroethene (total	6.08	0.75	6.29	1.80	0.12	6.29
Chloroform	6.11	0.72	6.29	1.80	0.11	6.30
1,2-Dichloroethane	6.11	0.72	6.29	1.80	0.11	6.30
2-Butanone	6.32	1.44	6.74	1.82	0.21	6.75
1,1,1-Trichloroethane	6.11	0.72	6.29	1.80	0.11	6.30
Carbon Tetrachloride	6.11	0.72	6.29	1.80	0.11	6.30
Bromodichloromethane	6.11	0.72	6.29	1.80	0.11	6.30
1,2-Dichloropropane	6.11	0.72	6.29	1.80	0.11	6.30
cis-1,3-Dichloropropene	6.11	0.72	6.29	1.80	0.11	6.30
Trichloroethene	6.11	0.72	6.29	1.80	0.11	6.30
Dibromochloromethane	6.11	0.72	6.29	1.80	0.11	6.30
1,1,2-Trichloroethane	6.11	0.72	6.29	1.80	0.11	6.30
Benzene	6.11	0.72	6.29	1.80	0.11	6.30
trans-1,3-Dichloropropene	6.11	0.72	6.29	1.80	0.11	6.30
Bromoform	6.11	0.72	6.29	1.80	0.11	6.30
4-Methyl-2-pentanone	6.51	1.53	6.91	1.85	0.20	6.85
2-Hexanone	6.26	1.77	6.72	1.79	0.31	6.91
Tetrachloroethene	6.11	0.72	6.29	1.80	0.11	6.30
1,1,2,2-Tetrachloroethane	5.96	0.91	6.20	1.77	0.20	6.32
Toluene	6.11	0.72	6.29	1.80	0.11	6.30
Chlorobenzene	6.11	0.72	6.29	1.80	0.11	6.30
Ethylbenzene	6.11	0.72	6.29	1.80	0.11	6.30
Styrene	6.11	0.72	6.29	1.80	0.11	6.30
Total Xylenes	5.96	0.91	6.20	1.77	0.20	6.32

STATISTICAL SUMMARY
SUBSURFACE SOILS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
Acenaphthene	202.74	21.36	208.29	5.31	0.10	208.16
2,4-Dinitrophenol	492.74	52.08	506.27	6.19	0.10	505.96
4-Nitrophenol	492.74	52.08	506.27	6.19	0.10	505.96
Dibenzofuran	202.74	21.36	208.29	5.31	0.10	208.16
2,4-Dinitrotoluene	197.74	28.95	205.26	5.28	0.16	206.98
Diethylphthalate	202.74	21.36	208.29	5.31	0.10	208.16
4-Chlorophenylphenyl Ethe	202.74	21.36	208.29	5.31	0.10	208.16
Fluorene	202.74	21.36	208.29	5.31	0.10	208.16
4-Nitroaniline	492.74	52.08	506.27	6.19	0.10	505.96
4,6-Dinitro-2-Methylpheno	492.74	52.08	506.27	6.19	0.10	505.96
N-nitrosodiphenylamine	202.74	21.36	208.29	5.31	0.10	208.16
4-Bromophenylphenyl Ether	202.74	21.36	208.29	5.31	0.10	208.16
Hexachlorobenzene	202.74	21.36	208.29	5.31	0.10	208.16
Pentachlorophenol	492.74	52.08	506.27	6.19	0.10	505.96
Phenanthrene	202.74	21.36	208.29	5.31	0.10	208.16
Anthracene	202.74	21.36	208.29	5.31	0.10	208.16
Carbazole	202.74	21.36	208.29	5.31	0.10	208.16
Di-n-Butyl Phthalate	928.79	1670.77	1362.93	5.54	1.55	1959.97
Fluoranthene	202.74	21.36	208.29	5.31	0.10	208.16
Pyrene	202.74	21.36	208.29	5.31	0.10	208.16
Butyl Benzyl Phthalate	238.21	167.53	281.75	5.38	0.35	254.97
3,3'-Dichlorobenzidine	265.83	99.86	291.78	5.52	0.34	293.01
Benzo(a)anthracene	202.74	21.36	208.29	5.31	0.10	208.16
Chrysene	202.74	21.36	208.29	5.31	0.10	208.16
bis(2-Ethylhexyl)Phthalat	152.83	94.09	177.28	4.83	0.65	192.79
Di-n-Octylphthalate	202.74	21.36	208.29	5.31	0.10	208.16
Benzo(b)fluoranthene	202.74	21.36	208.29	5.31	0.10	208.16
Benzo(k)fluoranthene	202.74	21.36	208.29	5.31	0.10	208.16
Benzo(a)Pyrene	202.74	21.36	208.29	5.31	0.10	208.16
Indeno(1,2,3-cd)pyrene	202.74	21.36	208.29	5.31	0.10	208.16
Dibenzo(a,h)anthracene	202.74	21.36	208.29	5.31	0.10	208.16
Benzo(g,h,i)Perylene	202.74	21.36	208.29	5.31	0.10	208.16

STATISTICAL SUMMARY
SUBSURFACE SOILS
EXPLOSIVE COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
HMX	0.25	0.00	0.25	-1.39	0.00	0.25
RDX	0.25	0.00	0.25	-1.39	0.00	0.25
1,3,5-Trinitrobenzene	0.16	0.18	0.21	-1.99	0.43	0.17
1,3-Dinitrobenzene	0.13	0.00	0.13	-2.08	0.00	0.13
Tertyl	0.32	0.00	0.32	-1.12	0.00	0.32
Nitrobenzene	0.13	0.00	0.13	-2.04	0.00	0.13
2,4,6-Trinitrotoluene	0.26	0.56	0.41	-1.89	0.71	0.25
4-Amino-2,6-Dinitrotoluen	0.13	0.01	0.13	-2.07	0.06	0.13
2,6-Dinitrotoluene	0.14	0.07	0.16	-2.02	0.27	0.15
2,4-Dinitrotoluene	0.15	0.06	0.16	-1.96	0.27	0.16
2-Nitrotoluene	0.13	0.00	0.13	-2.08	0.00	0.13
3-Nitrotoluene	0.11	0.00	0.11	-2.21	0.00	0.11

STATISTICAL SUMMARY
GROUNDWATER-TEMPORARY PIEZOMETER
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
Chloromethane	0.82	0.25	0.96	-0.25	0.35	1.04
Bromomethane	0.50	0.00	0.50	-0.69	0.00	0.50
Vinyl chloride	0.50	0.00	0.50	-0.69	0.00	0.50
Chloroethane	0.50	0.00	0.50	-0.69	0.00	0.50
Methylene chloride	0.95	0.15	1.04	-0.06	0.21	1.09
Acetone	11.17	11.26	18.15	1.89	1.16	63.99
Carbon disulfide	0.50	0.00	0.50	-0.69	0.00	0.50
1,1-Dichloroethene	0.50	0.00	0.50	-0.69	0.00	0.50
1,1-Dichloroethane	0.50	0.00	0.50	-0.69	0.00	0.50
Chloroform	0.50	0.00	0.50	-0.69	0.00	0.50
1,2-Dichloroethane	0.50	0.00	0.50	-0.69	0.00	0.50
Bromochloromethane	0.50	0.00	0.50	-0.69	0.00	0.50
2-Butanone	2.50	NA	NA	0.92	NA	NA
1,1,1-Trichloroethane	0.50	0.00	0.50	-0.69	0.00	0.50
Carbon Tetrachloride	0.50	0.00	0.50	-0.69	0.00	0.50
Bromodichloromethane	0.50	0.00	0.50	-0.69	0.00	0.50
1,2-Dichloropropane	0.50	0.00	0.50	-0.69	0.00	0.50
cis-1,3-Dichloropropene	0.50	0.00	0.50	-0.69	0.00	0.50
Trichloroethene	0.55	0.15	0.63	-0.63	0.21	0.62
Dibromochloromethane	0.50	0.00	0.50	-0.69	0.00	0.50
1,1,2-Trichloroethane	0.50	0.00	0.50	-0.69	0.00	0.50
Benzene	0.50	0.00	0.50	-0.69	0.00	0.50
trans-1,3-Dichloropropene	0.50	0.00	0.50	-0.69	0.00	0.50
Bromoform	0.50	0.00	0.50	-0.69	0.00	0.50
4-Methyl-2-pentanone	2.50	0.00	2.50	0.92	0.00	2.50
2-Hexanone	2.50	NA	NA	0.92	NA	NA
Tetrachloroethene	0.50	0.00	0.50	-0.69	0.00	0.50
1,1,2,2-Tetrachloroethane	0.50	0.00	0.50	-0.69	0.00	0.50
Toluene	0.50	0.00	0.50	-0.69	0.00	0.50
Chlorobenzene	0.50	0.00	0.50	-0.69	0.00	0.50
Ethylbenzene	0.53	0.09	0.58	-0.65	0.14	0.57
Styrene	0.50	0.00	0.50	-0.69	0.00	0.50
Total Xylenes	0.50	0.00	0.50	-0.69	0.00	0.50

STATISTICAL SUMMARY
GROUNDWATER-TEMPORARY PIEZOMETER
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
Phenol	5.00	0.00	5.00	1.61	0.00	5.00
bis(2-Chloroethyl) Ether	5.00	0.00	5.00	1.61	0.00	5.00
2-Chlorophenol	5.00	0.00	5.00	1.61	0.00	5.00
1,3-Dichlorobenzene	5.00	0.00	5.00	1.61	0.00	5.00
1,4-Dichlorobenzene	5.00	0.00	5.00	1.61	0.00	5.00
1,2-Dichlorobenzene	5.00	0.00	5.00	1.61	0.00	5.00
2-Methylphenol	5.00	0.00	5.00	1.61	0.00	5.00
bis(2-Chloroisopropyl)Eth	5.00	0.00	5.00	1.61	0.00	5.00
4-Methylphenol	5.00	0.00	5.00	1.61	0.00	5.00
N-Nitrosodipropylamine	5.00	0.00	5.00	1.61	0.00	5.00
Hexachloroethane	5.00	0.00	5.00	1.61	0.00	5.00
Nitrobenzene	5.00	0.00	5.00	1.61	0.00	5.00
Isophorone	5.00	0.00	5.00	1.61	0.00	5.00
2-Nitrophenol	5.00	0.00	5.00	1.61	0.00	5.00
2,4-Dimethylphenol	5.00	0.00	5.00	1.61	0.00	5.00
bis(2-Chloroethoxy)Methan	5.00	0.00	5.00	1.61	0.00	5.00
2,4-Dichlorophenol	5.00	0.00	5.00	1.61	0.00	5.00
1,2,4-Trichlorobenzene	5.00	0.00	5.00	1.61	0.00	5.00
Naphthalene	5.00	0.00	5.00	1.61	0.00	5.00
4-Chloroaniline	9.55	1.51	10.37	2.24	0.21	10.92
Hexachlorobutadiene	5.00	0.00	5.00	1.61	0.00	5.00
4-Chloro-3-methylphenol	5.00	0.00	5.00	1.61	0.00	5.00
2-Methylnaphthalene	5.00	0.00	5.00	1.61	0.00	5.00
Hexachlorocyclopentadiene	5.00	0.00	5.00	1.61	0.00	5.00
2,4,6-Trichlorophenol	5.00	0.00	5.00	1.61	0.00	5.00
2,4,5-Trichlorophenol	12.50	0.00	12.50	2.53	0.00	12.50
2-Chloronaphthalene	5.00	0.00	5.00	1.61	0.00	5.00
2-Nitroaniline	12.50	0.00	12.50	2.53	0.00	12.50
Dimethylphthalate	5.00	0.00	5.00	1.61	0.00	5.00
Acenaphthylene	5.00	0.00	5.00	1.61	0.00	5.00
2,6-Dinitrotoluene	5.00	0.00	5.00	1.61	0.00	5.00
3-Nitroaniline	12.50	0.00	12.50	2.53	0.00	12.50
Acenaphthene	5.00	0.00	5.00	1.61	0.00	5.00

STATISTICAL SUMMARY
GROUNDWATER-TEMPORARY PIEZOMETER
PESTICIDE/PCB COMPOUNDS
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
alpha-BHC	0.04	0.01	0.05	-3.18	0.32	0.05
beta-BHC	0.04	0.01	0.05	-3.24	0.34	0.05
delta-BHC	0.04	0.01	0.05	-3.28	0.33	0.05
gamma-BHC (Lindane)	0.04	0.01	0.05	-3.18	0.32	0.05
Heptachlor	0.04	0.01	0.05	-3.18	0.32	0.05
Aldrin	0.04	0.01	0.05	-3.18	0.32	0.05
Heptachlor Epoxide	0.04	0.01	0.05	-3.18	0.32	0.05
Endosulfan I	0.04	0.01	0.05	-3.18	0.32	0.05
Dieldrin	0.09	0.02	0.10	-2.49	0.32	0.11
4,4'-DDE	0.09	0.02	0.10	-2.49	0.32	0.11
Endrin	0.09	0.02	0.10	-2.49	0.32	0.11
Endosulfan II	0.09	0.02	0.10	-2.49	0.32	0.11
4,4'-DDD	0.09	0.02	0.10	-2.49	0.32	0.11
Endosulfan Sulfate	0.09	0.02	0.10	-2.49	0.32	0.11
4,4'-DDT	0.09	0.02	0.10	-2.49	0.32	0.11
Methoxychlor	0.43	0.12	0.50	-0.88	0.32	0.54
Endrin Ketone	0.09	0.02	0.10	-2.49	0.32	0.11
Endrin Aldehyde	0.09	0.02	0.10	-2.49	0.32	0.11
alpha-Chlordane	0.04	0.01	0.05	-3.18	0.32	0.05
gamma-Chlordane	0.04	0.01	0.05	-3.18	0.32	0.05
Toxaphene	4.32	1.17	4.96	1.42	0.32	5.38
Aroclor 1016	0.86	0.23	0.99	-0.19	0.32	1.08
Aroclor 1221	1.73	0.47	1.98	0.50	0.32	2.15
Aroclor 1232	0.86	0.23	0.99	-0.19	0.32	1.08
Aroclor 1242	0.86	0.23	0.99	-0.19	0.32	1.08
Aroclor-1248	0.86	0.23	0.99	-0.19	0.32	1.08
Aroclor-1254	0.86	0.23	0.99	-0.19	0.32	1.08
Aroclor-1260	0.86	0.23	0.99	-0.19	0.32	1.08

STATISTICAL SUMMARY
GROUNDWATER-TEMPORARY PIEZOMETER
TOTAL INORGANICS AND CYANIDE
SITE SCREENING AREA 6
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
Aluminum	34820.00	30332.33	51391.72	10.10	0.93	90403.38
Antimony	13.72	7.98	18.35	2.46	0.61	23.46
Arsenic	67.61	124.28	135.51	3.40	1.19	228.37
Barium	154.76	124.59	222.83	4.80	0.72	287.32
Beryllium	2.54	2.14	3.71	0.65	0.79	5.00
Cadmium	3.62	7.82	7.89	0.40	1.08	8.93
Calcium	943876.36	751747.18	1354584.83	13.19	1.56	17777508.92
Chromium	127.12	140.58	203.92	4.39	1.00	403.15
Cobalt	27.26	23.44	40.07	3.04	0.74	50.56
Copper	35.75	30.03	52.15	3.27	0.82	77.30
Iron	90281.82	80974.57	134521.35	11.05	0.91	225886.52
Lead	34.32	31.87	51.73	3.15	0.96	92.11
Magnesium	24722.73	22137.18	36817.12	9.81	0.82	52355.41
Manganese	551.91	480.94	814.66	6.00	0.82	1178.02
Mercury	0.10	0.00	0.10	-2.30	0.00	0.10
Nickel	58.07	66.23	94.26	3.61	0.96	145.90
Potassium	13072.73	11320.01	19257.29	9.21	0.73	24132.04
Selenium	4.84	7.99	9.20	0.96	0.99	10.85
Silver	1.00	0.00	1.00	0.00	0.00	1.00
Sodium	9297.27	3796.38	11371.38	9.07	0.38	11957.26
Thallium	4.49	2.66	5.94	1.33	0.63	7.54
Vanadium	129.68	167.83	221.37	4.33	1.05	427.71
Zinc	187.12	173.64	281.98	4.88	0.88	424.36
CN	4.76	3.01	6.41	1.40	0.59	7.38

STATISTICAL SUMMARY
SUBSURFACE SOILS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
Chloromethane	5.98	0.40	6.11	1.79	0.07	6.12
Bromomethane	5.98	0.40	6.11	1.79	0.07	6.12
Vinyl chloride	5.98	0.40	6.11	1.79	0.07	6.12
Chloroethane	5.98	0.40	6.11	1.79	0.07	6.12
Methylene chloride	6.98	4.51	8.46	1.80	0.53	8.68
Acetone	7.91	2.68	8.79	2.02	0.31	8.89
Carbon disulfide	5.98	0.40	6.11	1.79	0.07	6.12
1,1-Dichloroethene	5.98	0.40	6.11	1.79	0.07	6.12
1,1-Dichloroethane	5.98	0.40	6.11	1.79	0.07	6.12
1,2-Dichloroethene (total	5.98	0.40	6.11	1.79	0.07	6.12
Chloroform	5.98	0.40	6.11	1.79	0.07	6.12
1,2-Dichloroethane	5.98	0.40	6.11	1.79	0.07	6.12
2-Butanone	7.91	2.68	8.79	2.02	0.31	8.89
1,1,1-Trichloroethane	5.98	0.40	6.11	1.79	0.07	6.12
Carbon Tetrachloride	5.98	0.40	6.11	1.79	0.07	6.12
Bromodichloromethane	5.98	0.40	6.11	1.79	0.07	6.12
1,2-Dichloropropane	5.98	0.40	6.11	1.79	0.07	6.12
cis-1,3-Dichloropropene	5.98	0.40	6.11	1.79	0.07	6.12
Trichloroethene	5.98	0.40	6.11	1.79	0.07	6.12
Dibromochloromethane	5.98	0.40	6.11	1.79	0.07	6.12
1,1,2-Trichloroethane	5.98	0.40	6.11	1.79	0.07	6.12
Benzene	5.98	0.40	6.11	1.79	0.07	6.12
trans-1,3-Dichloropropene	5.98	0.40	6.11	1.79	0.07	6.12
Bromoform	5.98	0.40	6.11	1.79	0.07	6.12
4-Methyl-2-pentanone	5.98	0.40	6.11	1.79	0.07	6.12
2-Hexanone	6.65	1.97	7.29	1.86	0.23	7.21
Tetrachloroethene	5.98	0.40	6.11	1.79	0.07	6.12
1,1,2,2-Tetrachloroethane	5.98	0.40	6.11	1.79	0.07	6.12
Toluene	5.98	0.40	6.11	1.79	0.07	6.12
Chlorobenzene	5.98	0.40	6.11	1.79	0.07	6.12
Ethylbenzene	5.98	0.40	6.11	1.79	0.07	6.12
Styrene	5.98	0.40	6.11	1.79	0.07	6.12
Total Xylenes	5.98	0.40	6.11	1.79	0.07	6.12

STATISTICAL SUMMARY
SUBSURFACE SOILS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
Acenaphthene	195.00	9.61	198.15	5.27	0.05	198.27
2,4-Dinitrophenol	471.85	20.81	478.68	6.16	0.04	478.99
4-Nitrophenol	471.85	20.81	478.68	6.16	0.04	478.99
Dibenzofuran	195.00	9.61	198.15	5.27	0.05	198.27
2,4-Dinitrotoluene	195.00	9.61	198.15	5.27	0.05	198.27
Diethylphthalate	195.00	9.61	198.15	5.27	0.05	198.27
4-Chlorophenylphenyl Ethe	195.00	9.61	198.15	5.27	0.05	198.27
Fluorene	195.00	9.61	198.15	5.27	0.05	198.27
4-Nitroaniline	471.85	20.81	478.68	6.16	0.04	478.99
4,6-Dinitro-2-Methylpheno	471.85	20.81	478.68	6.16	0.04	478.99
N-nitrosodiphenylamine	195.00	9.61	198.15	5.27	0.05	198.27
4-Bromophenylphenyl Ether	195.00	9.61	198.15	5.27	0.05	198.27
Hexachlorobenzene	195.00	9.61	198.15	5.27	0.05	198.27
Pentachlorophenol	471.85	20.81	478.68	6.16	0.04	478.99
Phenanthrene	283.89	462.98	435.89	5.37	0.50	298.11
Anthracene	195.00	9.61	198.15	5.27	0.05	198.27
Carbazole	195.00	9.61	198.15	5.27	0.05	198.27
Di-n-Butyl Phthalate	247.59	211.57	317.05	5.30	0.62	318.48
Fluoranthene	195.00	9.61	198.15	5.27	0.05	198.27
Pyrene	193.89	10.68	197.40	5.27	0.06	197.56
Butyl Benzyl Phthalate	202.04	36.83	214.13	5.30	0.14	211.60
3,3'-Dichlorobenzidine	195.00	9.61	198.15	5.27	0.05	198.27
Benzo(a)anthracene	195.00	9.61	198.15	5.27	0.05	198.27
Chrysene	195.00	9.61	198.15	5.27	0.05	198.27
bis(2-Ethylhexyl)Phthalat	180.81	71.83	204.40	5.12	0.42	215.28
Di-n-Octylphthalate	193.15	14.29	197.84	5.26	0.08	198.52
Benzo(b)fluoranthene	195.00	9.61	198.15	5.27	0.05	198.27
Benzo(k)fluoranthene	195.00	9.61	198.15	5.27	0.05	198.27
Benzo(a)Pyrene	195.00	9.61	198.15	5.27	0.05	198.27
Indeno(1,2,3-cd)pyrene	195.00	9.61	198.15	5.27	0.05	198.27
Dibenzo(a,h)anthracene	195.00	9.61	198.15	5.27	0.05	198.27
Benzo(g,h,i)Perylene	195.00	9.61	198.15	5.27	0.05	198.27

STATISTICAL SUMMARY
SUBSURFACE SOILS
EXPLOSIVE COMPOUNDS
SITE SCREENING AREA 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
HMX	1.38	5.72	3.26	-1.15	0.94	0.79
RDX	0.26	0.06	0.28	-1.36	0.16	0.28
1,3,5-Trinitrobenzene	0.13	0.00	0.13	-2.08	0.00	0.13
1,3-Dinitrobenzene	0.13	0.00	0.13	-2.08	0.00	0.13
Tertyl	0.34	0.05	0.36	-1.09	0.13	0.36
Nitrobenzene	0.13	0.00	0.13	-2.04	0.00	0.13
2,4,6-Trinitrotoluene	0.13	0.00	0.13	-2.08	0.00	0.13
4-Amino-2,6-Dinitrotoluen	0.13	0.00	0.13	-2.08	0.00	0.13
2,6-Dinitrotoluene	0.13	0.00	0.13	-2.08	0.00	0.13
2,4-Dinitrotoluene	0.13	0.00	0.13	-2.04	0.00	0.13
2-Nitrotoluene	0.13	0.00	0.13	-2.08	0.00	0.13
3-Nitrotoluene	0.11	0.00	0.11	-2.21	0.00	0.11

STATISTICAL SUMMARY
SUBSURFACE SOILS
VOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
Chloromethane	6.04	0.69	6.36	1.79	0.11	6.39
Bromomethane	6.04	0.69	6.36	1.79	0.11	6.39
Vinyl chloride	6.04	0.69	6.36	1.79	0.11	6.39
Chloroethane	6.04	0.69	6.36	1.79	0.11	6.39
Methylene chloride	5.32	1.51	6.04	1.60	0.48	7.36
Acetone	7.46	4.43	9.56	1.92	0.39	9.08
Carbon disulfide	6.04	0.69	6.36	1.79	0.11	6.39
1,1-Dichloroethene	6.04	0.69	6.36	1.79	0.11	6.39
1,1-Dichloroethane	6.04	0.69	6.36	1.79	0.11	6.39
1,2-Dichloroethene (total	6.04	0.69	6.36	1.79	0.11	6.39
Chloroform	6.04	0.69	6.36	1.79	0.11	6.39
1,2-Dichloroethane	6.04	0.69	6.36	1.79	0.11	6.39
2-Butanone	6.43	1.48	7.13	1.84	0.19	7.09
1,1,1-Trichloroethane	6.04	0.69	6.36	1.79	0.11	6.39
Carbon Tetrachloride	6.04	0.69	6.36	1.79	0.11	6.39
Bromodichloromethane	6.04	0.69	6.36	1.79	0.11	6.39
1,2-Dichloropropane	6.04	0.69	6.36	1.79	0.11	6.39
cis-1,3-Dichloropropene	6.04	0.69	6.36	1.79	0.11	6.39
Trichloroethene	6.04	0.69	6.36	1.79	0.11	6.39
Dibromochloromethane	6.04	0.69	6.36	1.79	0.11	6.39
1,1,2-Trichloroethane	6.04	0.69	6.36	1.79	0.11	6.39
Benzene	6.04	0.69	6.36	1.79	0.11	6.39
trans-1,3-Dichloropropene	6.04	0.69	6.36	1.79	0.11	6.39
Bromoform	6.04	0.69	6.36	1.79	0.11	6.39
4-Methyl-2-pentanone	6.04	0.69	6.36	1.79	0.11	6.39
2-Hexanone	6.04	0.69	6.36	1.79	0.11	6.39
Tetrachloroethene	6.04	0.69	6.36	1.79	0.11	6.39
1,1,2,2-Tetrachloroethane	6.04	0.69	6.36	1.79	0.11	6.39
Toluene	6.04	0.69	6.36	1.79	0.11	6.39
Chlorobenzene	6.04	0.69	6.36	1.79	0.11	6.39
Ethylbenzene	6.04	0.69	6.36	1.79	0.11	6.39
Styrene	6.04	0.69	6.36	1.79	0.11	6.39
Total Xylenes	6.04	0.69	6.36	1.79	0.11	6.39

STATISTICAL SUMMARY
SUBSURFACE SOILS
SEMIVOLATILE ORGANIC COMPOUNDS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
2,4-Dinitrophenol	472.69	33.27	489.13	6.16	0.07	489.71
4-Nitrophenol	472.69	33.27	489.13	6.16	0.07	489.71
Dibenzofuran	194.62	13.30	201.19	5.27	0.07	201.54
2,4-Dinitrotoluene	194.62	13.30	201.19	5.27	0.07	201.54
Diethylphthalate	194.62	13.30	201.19	5.27	0.07	201.54
4-Chlorophenylphenyl Ethe	194.62	13.30	201.19	5.27	0.07	201.54
Fluorene	194.62	13.30	201.19	5.27	0.07	201.54
4-Nitroaniline	472.69	33.27	489.13	6.16	0.07	489.71
4,6-Dinitro-2-Methylpheno	472.69	33.27	489.13	6.16	0.07	489.71
N-nitrosodiphenylamine	194.62	13.30	201.19	5.27	0.07	201.54
4-Bromophenylphenyl Ether	194.62	13.30	201.19	5.27	0.07	201.54
Hexachlorobenzene	194.62	13.30	201.19	5.27	0.07	201.54
Pentachlorophenol	472.69	33.27	489.13	6.16	0.07	489.71
Phenanthrene	186.69	32.74	202.88	5.21	0.23	213.74
Anthracene	194.62	13.30	201.19	5.27	0.07	201.54
Carbazole	194.62	13.30	201.19	5.27	0.07	201.54
Di-n-Butyl Phthalate	1651.83	2197.55	2791.18	6.26	1.74	23804.66
Fluoranthene	187.31	30.73	202.49	5.22	0.21	211.36
Pyrene	188.46	27.03	201.82	5.23	0.17	206.98
Butyl Benzyl Phthalate	194.62	13.30	201.19	5.27	0.07	201.54
3,3'-Dichlorobenzidine	194.62	13.30	201.19	5.27	0.07	201.54
Benzo(a)anthracene	183.31	44.18	205.15	5.15	0.42	245.59
Chrysene	183.15	44.71	205.25	5.15	0.44	248.04
bis(2-Ethylhexyl)Phthalat	130.15	68.58	164.05	4.68	0.70	222.57
Di-n-Octylphthalate	194.62	13.30	201.19	5.27	0.07	201.54
Benzo(b)fluoranthene	194.62	13.30	201.19	5.27	0.07	201.54
Benzo(k)fluoranthene	194.62	13.30	201.19	5.27	0.07	201.54
Benzo(a)Pyrene	194.62	13.30	201.19	5.27	0.07	201.54
Indeno(1,2,3-cd)pyrene	194.62	13.30	201.19	5.27	0.07	201.54
Dibenzo(a,h)anthracene	194.62	13.30	201.19	5.27	0.07	201.54
Benzo(g,h,i)Perylene	194.62	13.30	201.19	5.27	0.07	201.54

STATISTICAL SUMMARY
SUBSURFACE SOILS
EXPLOSIVE COMPOUNDS
SITE SCREENING AREA 15
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	NORMAL ARITHMETIC MEAN	NORMAL STANDARD DEVIATION	NORMAL UPPER 95% CONFIDENCE INTERVAL	LOG ARITHMETIC MEAN	LOG STANDARD DEVIATION	LOG UPPER 95% CONFIDENCE INTERVAL
HMX	0.25	0.00	0.25	-1.39	0.00	0.25
RDX	0.25	0.00	0.25	-1.39	0.00	0.25
1,3,5-Trinitrobenzene	0.13	0.00	0.13	-2.08	0.00	0.13
1,3-Dinitrobenzene	0.13	0.00	0.13	-2.08	0.00	0.13
Tertyl	0.33	0.00	0.33	-1.12	0.00	0.33
Nitrobenzene	0.13	0.00	0.13	-2.04	0.00	0.13
2,4,6-Trinitrotoluene	0.13	0.00	0.13	-2.08	0.00	0.13
4-Amino-2,6-Dinitrotoluen	0.13	0.00	0.13	-2.08	0.00	0.13
2,6-Dinitrotoluene	0.13	0.00	0.13	-2.08	0.00	0.13
2,4-Dinitrotoluene	0.13	0.00	0.13	-2.04	0.00	0.13
2-Nitrotoluene	0.13	0.00	0.13	-2.08	0.00	0.13
3-Nitrotoluene	0.11	0.00	0.11	-2.21	0.00	0.11

APPENDIX J
RISK-BASED CONCENTRATION TABLE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region III
841 Chestnut Street
Philadelphia, Pennsylvania 19107

March 7, 1995

SUBJECT: Risk-Based Concentration Table, January - June 1995

FROM: Roy L. Smith, Ph.D., Senior Toxicologist
Technical Support Section (3HW13)

TO: RBC Table Mailing List

Attached is the EPA Region III Risk-Based Concentration (RBC) table, which we have distributed quarterly to all interested parties since 1991. Please see below for some important announcements concerning changes in the Table and administrative issues with our mailing list.

Major Changes in this Issue of the RBC

1. IRIS and HEAST have matured, and EPA has revised them at a decreasing rate over the last few years. Lately, each quarterly RBC update has been virtually the same as its predecessor. Meanwhile, the mailing list for the RBC table has expanded exponentially and the quarterly mailings have become a substantial burden to the Region. Upon reflection, we've decided to change to semi-annual distribution. We think this change will extend our ability to keep producing the RBC table, while having little effect on the table's usefulness. (For example, there have been *no* changes to toxicity constants in IRIS or HEAST in the three months since the 4th quarter table was published.)

2. The RBC table now includes soil screening levels (SSLs) for protection of groundwater and air. Most of the new entries were taken directly from EPA/OSWER's newly proposed SSL guidance document. We've added some additional SSLs based on the same proposed methodology. Sources of SSLs are noted in the table. SSLs incorporate all the same exposure assumptions as RBCs, plus many additional assumptions needed for inter-media extrapolation. SSLs are therefore distinct from RBCs, and should be used only in the framework proposed in the OSWER document. If you have not yet seen this proposal, you can obtain it from NTIS (703-487-4650, as document numbers 93554-1, PB95-963530, or EPA540/R-94/105).

Administrative Issues

Our situation on the administrative front can be summarized in one word--"HELP"!! The RBC mailing list now includes more than 1300 recipients and we are experiencing significant problems with our current delivery system. We would appreciate your suggestions for making our future mailings more efficient. We are also exploring the possibility of providing access to the RBC through an electronic bulletin board and would like your feedback on that idea. In the meantime, we will be examining our current mailing list and limiting future mailings to one individual per organization; we need your help in distributing the RBC within your organization if there are others who would like copies.

2. A single contaminant contributes nearly all of the health risk;

3. Volatilization or leaching of that contaminant from soil is expected not to be significant;

4. The exposure scenarios used in the RBC table are appropriate for the site;

5. The fixed risk levels used in the RBC table are appropriate for the site; and

6. Risk to ecological receptors is expected not to be significant;

the risk-based concentrations would probably be protective as no-action levels or cleanup goals. However, to the extent that a site deviates from this description, as most do, the RBCs would not necessarily be appropriate.

To summarize, the table should generally not be used to (1) set cleanup or no-action levels at CERCLA or RCRA Corrective Action sites, (2) substitute for EPA guidance for preparing baseline risk assessments, or (3) determine if a waste is hazardous under RCRA.

Attachment

EPA Region III Risk-Based Concentration Table

Background Information

Roy L. Smith, Ph.D.
Senior Toxicologist
February 9, 1995

Development of Risk-Based Concentrations

General

Separate carcinogenic and non-carcinogenic risk-based concentrations were calculated for each compound for each pathway. The concentration in the table is the lower of the two, rounded to two significant figures. The following terms and values were used in the calculations:

Exposure variables	Value	Symbol
General:		
Carcinogenic potency slope oral (risk per mg/kg/d):	*	CPSo
Carcinogenic potency slope inhaled (risk per mg/kg/d):	*	CPSi
Reference dose oral (mg/kg/d):	*	RfDo
Reference dose inhaled (mg/kg/d):	*	RfDi
Target cancer risk:	1e-06	TR
Target hazard quotient:	1	THQ
Body weight, adult (kg):	70	BWa
Body weight, age 1-6 (kg):	15	BWc
Averaging time carcinogens (d):	25550	ATc
Averaging time non-carcinogens (d):	ED*365	ATn
Inhalation, adult (m3/d):	20	IRAa
Inhalation, child (m3/d):	12	IRAc
Inhalation factor, age-adjusted (m3-y/kg-d):	11.66	IFAadj
Tap water ingestion, adult (L/d):	2	IRWa
Tap water ingestion, age 1-6 (L/d):	1	IRWc
Tap water ingestion factor, age-adjusted (L-y/kg-d):	1.09	IFWadj
Fish ingestion (g/d):	54	IRF
Soil ingestion, adult (mg/d):	100	IRSa
Soil ingestion, age 1-6 (mg/d):	200	IRSc
Soil ingestion factor, age adjusted (mg-y/kg-d):	114.29	IFSadj
Residential:		
Exposure frequency (d/y):	350	EFr
Exposure duration, total (y):	30	EDtot
Exposure duration, age 1-6 (y):	6	EDc
Volatilization factor (L/m3):	0.5	K

Exposure variables	Value	Symbol
Occupational:		
Exposure frequency (d/y):	250	EFo
Exposure duration (y):	25	EDo
Fraction of contaminated soil ingested (unitless)	0.5	FC

*: Contaminant-specific toxicological constants. The priority among sources of toxicological constants was as follows: (1) IRIS, (2) HEAST, (3) HEAST alternative method, (4) EPA Superfund Health Risk Technical Support Center, (5) withdrawn from IRIS or HEAST, and (6) other EPA documents. Each source was used only if numbers from higher-priority sources were unavailable. The EPA Superfund Health Risk Technical Support Center, part of the Chemical Mixtures Branch of ECAO-Cincinnati, develops provisional RfDs and CPSs on request for contaminants not in IRIS or HEAST. These provisional values are labeled "E = EPA-ECAO provisional" in the table. It is possible they may be obsolete. If one of the "E" constants is important to a Superfund risk assessment, consider requesting, through a Regional risk assessor, a new provisional value.

Age-adjusted factors

Because contact rates with tap water, ambient air, and residential soil are different for children and adults, carcinogenic risks during the first 30 years of life were calculated using age-adjusted factors. These factors approximated the integrated exposure from birth until age 30 by combining contact rates, body weights, and exposure durations for two age groups - small children and adults. The age-adjusted factor for soil was obtained from RAGS IB; the others were developed by analogy.

Air inhalation

$$IFAadj \ \frac{m^3 \cdot y}{kg \cdot d} = \frac{EDc \cdot IRAc}{BWc} + \frac{(EDtot - EDc) \cdot IRAa}{BWa}$$

Tap water ingestion

$$IFWadj \ \frac{L \cdot y}{kg \cdot d} = \frac{EDc \cdot IRWc}{BWc} + \frac{(EDtot - EDc) \cdot IRWa}{BWa}$$

Soil ingestion

$$IFSadj \ \frac{mg \cdot y}{kg \cdot d} = \frac{EDc \cdot IRSc}{BWc} + \frac{(EDtot - EDc) \cdot IRSa}{BWa}$$

Residential water

Volatilization terms were calculated only for compounds with a mark in the "VOC" column. Compounds having a Henry's Law constant greater than 10^{-5} were considered volatile. The list may be incomplete, but is unlikely to include false positives. The equations and the volatilization factor (K, above) were obtained from RAGS IB. Oral potency slopes and reference doses were used for both oral and inhaled exposures for volatile compounds lacking inhalation values. Inhaled potency slopes were substituted for unavailable oral potency slopes only for volatile compounds; inhaled RfDs were substituted for unavailable

oral RfDs for both volatile and non-volatile compounds. RBCs for carcinogens were based on combined childhood and adult exposure; for non-carcinogens RBCs were based on adult exposure.

Carcinogens

$$RBC\ \frac{\mu g}{L} = \frac{TR \cdot ATc \cdot 1000\ \frac{\mu g}{mg}}{EFr \cdot ([K \cdot IFAadj \cdot CPSi] + [IFWadj \cdot CPSo])}$$

Non-carcinogens

$$RBC\ \frac{\mu g}{L} = \frac{THQ \cdot BWa \cdot ATn \cdot 1000\ \frac{\mu g}{mg}}{EFr \cdot EDtot \cdot \left(\frac{K \cdot IRAa}{RfDi} + \frac{IRWa}{RfDo}\right)}$$

Ambient air

Oral potency slopes and references were used where inhalation values were not available. RBCs for carcinogens were based on combined childhood and adult exposure; for non-carcinogens RBCs were based on adult exposure.

Carcinogens

$$RBC\ \frac{\mu g}{m^3} = \frac{TR \cdot ATc \cdot 1000\ \frac{\mu g}{mg}}{EFr \cdot IFAadj \cdot CPSi}$$

Non-carcinogens

$$RBC\ \frac{\mu g}{m^3} = \frac{THQ \cdot RfDi \cdot BWa \cdot ATn \cdot 1000\ \frac{\mu g}{mg}}{EFr \cdot EDtot \cdot IRAa}$$

Edible fish

All RBCs were based on adult exposure.

Carcinogens

$$RBC\ \frac{mg}{kg} = \frac{TR \cdot BWa \cdot ATc}{EFr \cdot EDtot \cdot \frac{IRF}{1000\ \frac{g}{kg}} \cdot CPSo}$$

Non-carcinogens

$$RBC\ \frac{mg}{kg} = \frac{THQ \cdot RfDo \cdot BWa \cdot ATn}{EFr \cdot EDtot \cdot \frac{IRF}{1000\ \frac{g}{kg}}}$$

Commercial/industrial soil ingestion

RBCs were based on adult occupational exposure, including an assumption that only 50% of total soil ingestion is work-related.

Carcinogens

$$RBC\ \frac{mg}{kg} = \frac{TR\ BWa\ ATc}{EFo\ EDo \cdot \frac{IRSa}{10^6\ \frac{mg}{kg}} \cdot FC \cdot CPSo}$$

Non-carcinogens

$$RBC\ \frac{mg}{kg} = \frac{THQ\ RfDo \cdot BWa \cdot ATn}{EFo \cdot EDo \cdot \frac{IRSa}{10^6\ \frac{mg}{kg}} \cdot FC}$$

Residential soil ingestion

RBCs for carcinogens were based on combined childhood and adult exposure; RBCs for non-carcinogens were based on childhood exposure only.

Carcinogens

$$RBC\ \frac{mg}{kg} = \frac{TR \cdot ATc}{EFr \cdot \frac{IFSadj}{10^6\ \frac{mg}{kg}} \cdot CPSo}$$

Non-carcinogens

$$RBC\ \frac{mg}{kg} = \frac{THQ\ RfDo \cdot BWc \cdot ATn}{EFr \cdot EDc \cdot \frac{IRSc}{10^6\ \frac{mg}{kg}}}$$

Development of Soil Screening Levels

General

In December 1994 the EPA Office of Solid Waste and Emergency Response proposed Soil Screening Guidance (Document 9355.4-1, PB95-963530, EPA540/R-94/101, available through NTIS at 703-487-4650). This draft document provides (1) a framework in which soil screening levels are to be used, (2) a detailed methodology for calculating soil screening levels, and (3) soil screening levels for 107 substances.

Consistent with this new guidance, the risk-based concentration table now includes two columns of generic soil screening levels (SSLs). OSWER's 107 proposed soil screening levels have been added verbatim. In addition, the proposed SSL methodology has been used to calculate soil screening levels for more substances, which are also included in the

new table. The table clearly distinguishes the OSWER SSLs from the "unofficial" ones.

These SSLs provide reasonable maximum estimates of transfers of contaminants from soil to other media. One column contains soil concentrations protective of groundwater quality; the other contains soil concentrations protective of air quality. "Protective" is defined in the same terms as the risk-based concentrations for tap water and air -- that residential contact scenarios will yield a fixed upper bound risk of 10^{-6} or a fixed hazard quotient of 1 (whichever occurs at the lower concentration).

OSWER's SSLs should be used only within the framework proposed in the guidance document. The additional SSLs included in the RBC table are intended for the same uses (although they obviously carry less weight than the formally proposed numbers).

The SSLs are based on the following assumptions:

Input variables	Value	Symbol*
Surface soil moisture content (g/g)	0.1	W_s
Vadose zone soil moisture content (kg/kg)	0.2	W_v
Surface soil bulk density (g/cm^3)	1.5	ρ_{bs}
Vadose zone soil bulk density (kg/L)	1.5	ρ_{bv}
Surface soil particle density (g/cm^3)	2.65	ρ_{ss}
Vadose zone soil particle density (g/cm^3)	2.65	ρ_{sv}
Total surface soil porosity (L pore /L soil)	0.43	N_s
Total vadose zone soil porosity (L pore/L soil)	0.43	N_v
Air-filled surface soil porosity (L air/L soil)	0.28	θ_{as}
Water-filled surface soil porosity (L water/L soil)	0.15	θ_{ws}
Air-filled vadose zone soil porosity (L air/L soil)	0.13	θ_{av}
Water-filled vadose zone soil porosity (L water/L soil)	0.30	θ_{wv}
Organic carbon fraction of surface soil (g/g)	0.006	FOC_s
Organic carbon fraction of vadose zone soil (g/g)	0.002	FOC_v
Dispersion factor for 0.5 acres (g/m^{2}s per kg/m^3)	35.1	Q/C
Particulate emission factor (m^3/kg)	6.79e+08	PEF
Exposure interval (s)	9.50e+08	T
Dilution-attenuation factor (unitless)	10	DAF

*: Symbols were adjusted, variables were rearranged, and derived and chemical-specific variables were omitted for simplicity and clarity. Presentation of the input variables in a single table using the same terms as in the OSWER SSL document would have been confusing. The terms used here are generally similar to OSWER's, and can easily be compared with the SSL guidance document.

With two exceptions described in the following section, SSL calculations were based on the same algorithms presented in the OSWER draft SSL guidance document. For details of the calculations (and for general background information on SSLs), I strongly recommend

consulting that document. The "unofficial" SSLs were developed under the following conditions:

Soil Screening Levels for Inhalation

Inhaled reference doses and potency slopes were used if available. If inhalation values were not available, oral RfDs and potency slopes were substituted. SSLs were calculated only for substances for which aqueous solubility, Koc, Henry's Law constant, and diffusivity in air were available. SSLs were calculated only for substances for which a volatilization factor could be calculated. This was done because OSWER's large proposed particulate emission factor rendered it pointless to estimate SSLs for particulate emissions alone. The final calculated SSL shown in the RBC table is the smaller of the risk-based SSL and the soil saturation concentration. All calculated SSLs were rounded to 2 significant figures.

The OSWER risk algorithms for inhalation were revised in order to be consistent with the rest of the RBC table. Only calculated SSLs were affected by this; SSLs proposed by OSWER are presented verbatim. Calculated SSLs for inhalation of carcinogens were based on an integrated lifetime exposure rather than adult exposure. SSLs for inhalation of noncarcinogens were based on adult exposure for 350 days per year rather than 365 days per year. The following algorithms were used to calculate inhalation SSLs:

Carcinogens

$$SSL \ \frac{mg}{kg} = \frac{TR \cdot ATc}{EFr \cdot IFAadj \cdot \left(\frac{1}{VF} + \frac{1}{PEF}\right) \cdot CPSi}$$

Non-carcinogens

$$SSL \ \frac{mg}{kg} = \frac{THQ \cdot BWa \cdot ATn \cdot RfDi}{EFr \cdot EDtot \cdot IRAa \cdot \left(\frac{1}{VF} + \frac{1}{PEF}\right)}$$

Soil Screening Levels for Groundwater Use

All algorithms were as proposed by OSWER. MCLs were used as target groundwater concentrations if available. If MCLs were unavailable the risk-based concentration in the "tap water" column of the RBC table was used as the target groundwater concentration. All SSLs for groundwater are based on a dilution-attenuation factor (DAF) of 10. Since these SSLs scale linearly with DAF, the SSLs for DAF=1 would be ten times lower. They were omitted to conserve space. All groundwater SSLs were rounded to 2 significant figures and capped at unity.

Sources: I=IRIS H=HEAST A=HEAST alternate W=Withdrawn from IRIS or HEAST E=EPA-ECAO Regional Support provisional value O=Other EPA documents.

Basis: C=carcinogenic effects N=noncarcinogenic effects E=EPA draft Soil Screening Level S=soil saturation concentration.

Contaminant	CAS	RfDo mg/kg/d	RfDi mg/kg/d	CPSo kg d/mg	CPSi kg d/mg	VOC	Risk-Based Concentrations: Tap Water µg/L	Ambient Air µg/m3	Fish mg/kg	Soil Ingestion: Industrial mg/kg	Soil Ingestion: Residential mg/kg	Soil Screening Levels-Transfers from Soil to: Air mg/kg	Groundwater mg/kg
Acephate	30560191	4.00E-03 I		8.70E-03 I			7.7 C	0.72 C	0.36 C	660 C	73 C		
Acetaldehyde	75070		2.57E-03 I		7.70E-03 I		94 N	0.81 C					
Acetochlor	34256821	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Acetone	67641	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N	62000 E	8 E
Acetone cyanohydrin	75865	7.00E-02 H	4.00E-02 A				2600 N	150 N	95 N	140000 N	5500 N		
Acetonitrile	75078	6.00E-03 I	1.43E-02 A				220 N	52 N	8.1 N	12000 N	470 N		
Acetophenone	98862	1.00E-01 I	5.71E-06 W			☒	0.042 N	0.021 N	140 N	200000 N	7800 N		
Acifluorfen	62476599	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
Acrolein	107028	2.00E-02 H	5.71E-06 I				730 N	0.021 N	27 N	41000 N	1600 N		
Acrylamide	79061	2.00E-04 I		4.50E+00 I	4.55E+00 I		0.015 C	0.0014 C	0.0007 C	1.3 C	0.14 C		
Acrylic acid	79107	5.00E-01 I	1.00E-03 I				18000 N	3.7 N	680 N	1E+06 N	39000 N		
Acrylonitrile	107131	1.00E-03 H	5.71E-04 I	5.40E-01 I	2.38E-01 I		0.12 C	0.026 C	0.0058 C	11 C	1.2 C		
Alachlor	15972608	1.00E-02 I		8.00E-02 H			0.84 C	0.078 C	0.039 C	72 C	8 C		
Alar	1596845	1.50E-01 I					5500 N	550 N	200 N	310000 N	12000 N		
Aldicarb	116063	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N	570 S	0.036 N
Aldicarb sulfone	1646884	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N		
Aldrin	309002	3.00E-05 I		1.70E+01 I	1.71E+01 I		0.004 C	0.00037 C	0.00019 C	0.34 C	0.038 C	0.5 E	0.005 E
Ally	74223646	2.50E-01 I					9100 N	910 N	340 N	510000 N	20000 N		
Allyl alcohol	107186	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Allyl chloride	107051	5.00E-02 W	2.86E-04 I				1800 N	1 N	68 N	100000 N	3900 N		
Aluminum	7429905	1.00E+00 E					37000 N	3700 N	1400 N	1E+06 N	78000 N		
Aluminum phosphide	20859738	4.00E-04 I					15 N	1.5 N	0.54 N	820 N	31 N		
Amdro	67485294	3.00E-04 I					11 N	1.1 N	0.41 N	610 N	23 N		
Ametryn	834128	9.00E-03 I					330 N	33 N	12 N	18000 N	700 N		
m-Aminophenol	591275	7.00E-02 H					2600 N	260 N	95 N	140000 N	5500 N		
4-Aminopyridine	504245	2.00E-05 H					0.73 N	0.073 N	0.027 N	41 N	1.6 N		
Amitraz	33089611	2.50E-03 I					91 N	9.1 N	3.4 N	5100 N	200 N		
Ammonia	7664417		2.86E-02 I				1000 N	100 N					
Ammonium sulfamate	7773060	2.00E-01 I					7300 N	730 N	270 N	410000 N	16000 N		
Aniline	62533		2.86E-04 I	5.70E-03 I			10 N	1 N	0.55 C	1000 C	110 C	45 N	0.031 N
Antimony and compounds	7440360	4.00E-04 I					15 N	1.5 N	0.54 N	820 N	31 N		
Antimony pentoxide	1314609	5.00E-04 H					18 N	1.8 N	0.68 N	1000 N	39 N		
Antimony potassium tartrate	304610	9.00E-04 H					33 N	3.3 N	1.2 N	1800 N	70 N		
Antimony tetroxide	1332316	4.00E-04 H					15 N	1.5 N	0.54 N	820 N	31 N		
Antimony trioxide	1309644	4.00E-04 H					15 N	1.5 N	0.54 N	820 N	31 N		
Apollo	74115245	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
Aramite	140578	5.00E-02 H		2.50E-02 I	2.49E-02 I		2.7 C	0.25 C	0.13 C	230 C	26 C		
Arsenic	7440382	3.00E-04 I					11 N	1.1 N	0.41 N	610 N	23 N	380 E	15 E
Arsenic (as carcinogen)	7440382			1.75E+00 I	1.51E+01 I		0.038 C	0.00041 C	0.0018 C	3.3 C	0.37 C	380 E	15 E
Arsine	7784421		1.43E-05 I				0.52 N	0.052 N					
Assure	76578148	9.00E-03 I					330 N	33 N	12 N	18000 N	700 N		
Asulam	3337711	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		

Sources: I=IRIS H=HEAST A=HEAST alternate W=Withdrawn from IRIS or HEAST E=EPA-ECAO Regional Support provisional value O=Other EPA documents.

Basis: C=carcinogenic effects N=noncarcinogenic effects E=EPA draft Soil Screening Level S=soil saturation concentration.

Contaminant	CAS	RfDo mg/kg/d	RfDi mg/kg/d	CPSo kg d/mg	CPSi kg d/mg	VOC	Risk-Based Concentrations: Tap Water µg/L	Ambient Air µg/m3	Fish mg/kg	Soil Ingestion: Industrial mg/kg	Soil Ingestion: Residential mg/kg	Soil Screening Levels-Transfers from Soil to: Air mg/kg	Groundwater mg/kg
Atrazine	1912249	3.50E-02 I		2.22E-01 H			0.3 C	0.028 C	0.014 C	26 C	2.9 C		
Avermectin B1	65195553	4.00E-04 I					15 N	1.5 N	0.54 N	820 N	31 N		
Azobenzene	103333			1.10E-01 I	1.08E-01 I		0.61 C	0.058 C	0.029 C	52 C	5.8 C		
Barium and compounds	7440393	7.00E-02 I	1.43E-04 A				2600 N	0.52 N	95 N	140000 N	5500 N	350000 E	32 E
Baygon	114261	4.00E-03 I					150 N	15 N	5.4 N	8200 N	310 N		
Bayleton	43121433	3.00E-02 I					1100 N	110 N	41 N	61000 N	2300 N		
Baythroid	68359375	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
Benefin	1861401	3.00E-01 I					11000 N	1100 N	410 N	610000 N	23000 N		
Benomyl	17804352	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Bentazon	25057890	2.50E-03 I					91 N	9.1 N	3.4 N	5100 N	200 N		
Benzaldehyde	100527	1.00E-01 I				☒	610 N	370 N	140 N	200000 N	7800 N		
Benzene	71432		1.71E-03 E	2.90E-02 I	2.90E-02 I	☒	0.36 C	0.22 C	0.11 C	200 C	22 C	0.5 E	0.02 E
Benzenethiol	108985	1.00E-05 H					0.37 N	0.037 N	0.014 N	20 N	0.78 N		
Benzidine	92875	3.00E-03 I		2.30E+02 I	2.35E+02 I		0.00029 C	0.00003 C	0.00001 C	0.025 C	0.0028 C	1.3 C	1.100E-06 C
Benzoic acid	65850	4.00E+00 I					150000 N	15000 N	5400 N	1E+06 N	310000 N	320 S	280 E
Benzotrichloride	98077			1.30E+01 I			0.0052 C	0.00048 C	0.00024 C	0.44 C	0.049 C	0.012 C	0.000073 C
Benzyl alcohol	100516	3.00E-01 H					11000 N	1100 N	410 N	610000 N	23000 N		
Benzyl chloride	100447			1.70E-01 I		☒	0.062 C	0.037 C	0.019 C	34 C	3.8 C	0.5 C	0.00036 C
Beryllium and compounds	7440417	5.00E-03 I		4.30E+00 I	8.40E+00 I		0.016 C	0.00075 C	0.00073 C	1.3 C	0.15 C	690 E	180 E
Bidrin	141662	1.00E-04 I					3.7 N	0.37 N	0.14 N	200 N	7.8 N		
Biphenthrin (Talstar)	82657043	1.50E-02 I					550 N	55 N	20 N	31000 N	1200 N		
1,1-Biphenyl	92524	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N	9000 S	110 N
Bis(2-chloroethyl)ether	111444			1.10E+00 I	1.16E+00 I	☒	0.0092 C	0.0054 C	0.0029 C	5.2 C	0.58 C	0.3 E	0.0003 E
Bis(2-chloroisopropyl)ether	39638329	4.00E-02 I		7.00E-02 H	3.50E-02 H	☒	0.26 C	0.18 C	0.045 C	82 C	9.1 C		
Bis(chloromethyl)ether	542881			2.20E+02 I	2.17E+02 I	☒	0.00005 C	0.00003 C	0.00001 C	0.026 C	0.0029 C	0.00004 C	1.000E-07 C
Bis(2-chloro-1-methylethyl)ether				7.00E-02 W	7.00E-02 W		0.96 C	0.089 C	0.045 C	82 C	9.1 C		
Bis(2-ethylhexyl)phthalate (DEHP)	117817	2.00E-02 I		1.40E-02 I			4.8 C	0.45 C	0.23 C	410 C	46 C	210 E	11 E
Bisphenol A	80057	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Boron (and borates)	7440428	9.00E-02 I	5.71E-03 H				3300 N	21 N	120 N	180000 N	7000 N		
Boron trifluoride	7637072		2.00E-04 H				7.3 N	0.73 N					
Bromodichloromethane	75274	2.00E-02 I		6.20E-02 I		☒	0.17 C	0.1 C	0.051 C	92 C	10 C	1800 E	0.3 E
Bromoethene	593602				1.10E-01 H	☒	0.096 C	0.057 C					
Bromoform (tribromomethane)	75252	2.00E-02 I		7.90E-03 I	3.85E-03 I	☒	2.4 C	1.6 C	0.4 C	720 C	81 C	46 E	0.5 E
Bromomethane	74839	1.40E-03 I	1.43E-03 I			☒	8.7 N	5.2 N	1.9 N	2900 N	110 N	2 E	0.1 E
4-Bromophenyl phenyl ether	101553	5.80E-02 O					2100 N	210 N	78 N	120000 N	4500 N		
Bromophos	2104963	5.00E-03 H					180 N	18 N	6.8 N	10000 N	390 N		
Bromoxynil	1689845	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Bromoxynil octanoate	1689992	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
1,3-Butadiene	106990				9.80E-01 I	☒	0.011 C	0.0064 C				0.0013 C	0.000072 C
1-Butanol	71363	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N	9700 E	8 E
Butyl b[illegible]yl phthalate	85687	2.00E-01 I					7300 N	730 N	270 N	410000 N	16000 N	530 E	68 E
Butyla[illegible]	2008415	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		

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sec-Butylbenzene	135988	1.00E-02 E				☒	61 N	37 N	14 N	20000 N	780 N	80 S	0.27 N
tert-Butylbenzene	104518	1.00E-02 E				☒	61 N	37 N	14 N	20000 N	780 N		
Butylphthalyl butylglycolate	85701	1.00E+00 I					37000 N	3700 N	1400 N	1E+06 N	78000 N		
Cacodylic acid	75605	3.00E-03 H					110 N	11 N	4.1 N	6100 N	230 N		
Cadmium and compounds	7440439	5.00E-04 I			6.30E+00 I		18 N	0.00099 C	0.68 N	1000 N	39 N	920 E	6 E
Caprolactam	105602	5.00E-01 I					18000 N	1800 N	680 N	1E+06 N	39000 N		
Captafol	2425061	2.00E-03 I		8.60E-03 H			7.8 C	0.73 C	0.37 C	670 C	74 C		
Captan	133062	1.30E-01 I		3.50E-03 H			19 C	1.8 C	0.9 C	1600 C	180 C		
Carbaryl	63252	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N	0.34 S	23 N
Carbofuran	1563662	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Carbon disulfide	75150	1.00E-01 I	2.86E-03 H			☒	21 N	10 N	140 N	200000 N	7800 N	11 E	14 E
Carbon tetrachloride	56235	7.00E-04 I	5.71E-04 E	1.30E-01 I	5.25E-02 I	☒	0.16 C	0.12 C	0.024 C	44 C	4.9 C	0.2 E	0.03 E
Carbosulfan	55285148	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
Carboxin	5234684	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
Chloral	75876	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
Chloramben	133904	1.50E-02 I					550 N	55 N	20 N	31000 N	1200 N		
Chloranil	118752			4.03E-01 H			0.17 C	0.016 C	0.0078 C	14 C	1.6 C		
Chlordane	57749	6.00E-05 I		1.30E+00 I	1.29E+00 I		0.052 C	0.0049 C	0.0024 C	4.4 C	0.49 C	10 E	2 E
Chlorimuron-ethyl	90982324	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Chlorine	7782505	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
Chlorine dioxide	10049044		5.71E-05 I				2.1 N	0.21 N					
Chloroacetaldehyde	107200	6.90E-03 O					250 N	25 N	9.3 N	14000 N	540 N		
Chloroacetic acid	79118	2.00E-03 H					73 N	7.3 N	2.7 N	4100 N	160 N		
2-Chloroacetophenone	532274		8.57E-06 I				0.31 N	0.031 N					
4-Chloroaniline	106478	4.00E-03 I					150 N	15 N	5.4 N	8200 N	310 N	1200 S	0.3 E
Chlorobenzene	108907	2.00E-02 I	5.71E-03 A			☒	39 N	21 N	27 N	41000 N	1600 N	94 E	0.6 E
Chlorobenzilate	510156	2.00E-02 I		2.70E-01 H	2.70E-01 H		0.25 C	0.023 C	0.012 C	21 C	2.4 C		
p-Chlorobenzoic acid	74113	2.00E-01 H					7300 N	730 N	270 N	410000 N	16000 N		
4-Chlorobenzotrifluoride	98566	2.00E-02 H					730 N	73 N	27 N	41000 N	1600 N	86 N	7.5 N
2-Chloro-1,3-butadiene	126998	2.00E-02 A	2.00E-03 H			☒	14 N	7.3 N	27 N	41000 N	1600 N		
1-Chlorobutane	109693	4.00E-01 H				☒	2400 N	1500 N	540 N	820000 N	31000 N		
Chlorodibromomethane	124481	2.00E-02 I		8.40E-02 I		☒	0.13 C	0.075 C	0.038 C	68 C	7.6 C	1900 E	0.2 E
Chlorodifluoromethane	75456		1.43e+01 I			☒	87000 N	52000 N					
Chloroethane	75003	4.00E-01 E	2.86E+00 I			☒	8600 N	10000 N	540 N	820000 N	31000 N	2600 S	33 N
2-Chloroethyl vinyl ether	110758	2.50E-02 O				☒	150 N	91 N	34 N	51000 N	2000 N		
Chloroform	67663	1.00E-02 I		6.10E-03 I	8.05E-02 I	☒	0.15 C	0.078 C	0.52 C	940 C	100 C	0.2 E	0.3 E
Chloromethane	74873			1.30E-02 H	6.30E-03 H	☒	1.4 C	0.99 C	0.24 C	440 C	49 C	0.063 C	0.0066 C
4-Chloro-2,2-methylaniline hydrochloride	3165933			4.60E-01 H			0.15 C	0.014 C	0.0069 C	12 C	1.4 C		
4-Chloro-2-methylaniline	95692			5.80E-01 H			0.12 C	0.011 C	0.0054 C	9.9 C	1.1 C		
beta-Chloronaphthalene	91587	8.00E-02 I					2900 N	290 N	110 N	160000 N	6300 N	2.8 S	140 N
o-Chloronitrobenzene	88733			2.50E-02 H		☒	0.42 C	0.25 C	0.13 C	230 C	26 C		
p-Chloronitrobenzene	100005			1.80E-02 H		☒	0.59 C	0.35 C	0.18 C	320 C	35 C		

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2-Chlorophenol	95578	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N	53000 E	2 E
2-Chloropropane	75296		2.86E-02 H			X	170 N	100 N				22 N	0.64 N
Chlorothalonil	1897456	1.50E-02 I		1.10E-02 H			6.1 C	0.57 C	0.29 C	520 C	58 C		
o-Chlorotoluene	95498	2.00E-02 I				X	120 N	73 N	27 N	41000 N	1600 N	1200 N	5.6 N
Chlorpropham	101213	2.00E-01 I					7300 N	730 N	270 N	410000 N	16000 N		
Chlorpyrifos	2921882	3.00E-03 I					110 N	11 N	4.1 N	6100 N	230 N		
Chlorpyrifos-methyl	5598130	1.00E-02 H					370 N	37 N	14 N	20000 N	780 N		
Chlorsulfuron	64902723	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Chlorthiophos	60238564	8.00E-04 H					29 N	2.9 N	1.1 N	1600 N	63 N		
Chromium III and compounds	16065831	1.00E+00 I	5.71E-07 W				37000 N	0.0021 N	1400 N	1E+06 N	78000 N		
Chromium VI and compounds	7440473	5.00E-03 I			4.20E+01 I		180 N	0.00015 C	6.8 N	10000 N	390 N	140 E	19 E
Coal tar	8001589				2.20E+00 W			0.0028 C					
Cobalt	7440484	6.00E-02 E					2200 N	220 N	81 N	120000 N	4700 N		
Coke Oven Emissions	8007452				2.17E+00 I			0.0029 C					
Copper and compounds	7440508	3.71E-02 H					1400 N	140 N	50 N	76000 N	2900 N		
Crotonaldehyde	123739	1.00E-02 W		1.90E+00 H	1.90E+00 W		0.035 C	0.0033 C	0.0017 C	3 C	0.34 C		
Cumene	98828	4.00E-02 I	2.57E-03 H				1500 N	9.4 N	54 N	82000 N	3100 N	81 N	65 N
Cyanides:													
Barium cyanide	542621	1.00E-01 W					3700 N	370 N	140 N	200000 N	7800 N		
Calcium cyanide	592018	4.00E-02 I					1500 N	150 N	54 N	82000 N	3100 N		
Copper cyanide	544923	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Cyanazine	21725462	2.00E-03 H		8.40E-01 H			0.08 C	0.0075 C	0.0038 C	6.8 C	0.76 C		
Cyanogen	460195	4.00E-02 I					1500 N	150 N	54 N	82000 N	3100 N		
Cyanogen bromide	506683	9.00E-02 I					3300 N	330 N	120 N	180000 N	7000 N		
Cyanogen chloride	506774	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Free cyanide	57125	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Hydrogen cyanide	74908	2.00E-02 I	8.57E-04 I				730 N	3.1 N	27 N	41000 N	1600 N		
Potassium cyanide	151508	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Potassium silver cyanide	506616	2.00E-01 I					7300 N	730 N	270 N	410000 N	16000 N		
Silver cyanide	506649	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
Sodium cyanide	143339	4.00E-02 I					1500 N	150 N	54 N	82000 N	3100 N		
Zinc cyanide	557211	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Cyclohexanone	108941	5.00E+00 I				X	30000 N	18000 N	6800 N	1E+06 N	390000 N		
Cyclohexlamine	108918	2.00E-01 I					7300 N	730 N	270 N	410000 N	16000 N		
Cyhalothrin/Karate	68085858	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Cypermethrin	52315078	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
Cyromazine	66215278	7.50E-03 I					270 N	27 N	10 N	15000 N	590 N		
Dacthal	1861321	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
Dalapon	75990	3.00E-02 I					1100 N	110 N	41 N	61000 N	2300 N		
Danitol	39515418	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
DDD	72548			2.40E-01 I			0.28 C	0.026 C	0.013 C	24 C	2.7 C	37 S	0.7 E
DDE	72559			3.40E-01			0.2 C	0.018 C	0.0093 C	17 C	1.9 C		0.5 E

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DDT	50293	5.00E-04 I		3.40E-01 I	3.40E-01 I		0.2 C	0.018 C	0.0093 C	17 C	1.9 C	80 E	1 E
Decabromodiphenyl ether	1163195	1.00E-02 I				☒	61 N	37 N	14 N	20000 N	780 N		
Demeton	8065483	4.00E-05 I					1.5 N	0.15 N	0.054 N	82 N	3.1 N		
Diallate	2303164			6.10E-02 H		☒	0.17 C	0.1 C	0.052 C	94 C	10 C		
Diazinon	333415	9.00E-04 H					33 N	3.3 N	1.2 N	1800 N	70 N	5400 S	2.8 N
Dibenzofuran	132649	4.00E-03 E					150 N	15 N	5.4 N	8200 N	310 N	120 S	120 N
1,4-Dibromobenzene	106376	1.00E-02 I				☒	61 N	37 N	14 N	20000 N	780 N		
1,2-Dibromo-3-chloropropane	96128		5.71E-05 I	1.40E+00 H	2.42E-03 H	☒	0.048 C	0.21 N	0.0023 C	4.1 C	0.46 C	1.9 N	0.00061 M
1,2-Dibromoethane	106934		5.71E-05 H	8.50E+01 I	7.70E-01 I	☒	0.00075 C	0.0081 C	0.00004 C	0.067 C	0.0075 C	0.0058 C	0.00018 M
Dibutyl phthalate	84742	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N	100 E	120 E
Dicamba	1918009	3.00E-02 I					1100 N	110 N	41 N	61000 N	2300 N		
1,2-Dichlorobenzene	95501	9.00E-02 I	4.00E-02 A			☒	270 N	150 N	120 N	180000 N	7000 N	300 E	6 E
1,3-Dichlorobenzene	541731	8.90E-02 O				☒	540 N	320 N	120 N	180000 N	7000 N		
1,4-Dichlorobenzene	106467		2.29E-01 I	2.40E-02 H		☒	0.44 C	0.26 C	0.13 C	240 C	27 C	7700 E	1 E
3,3'-Dichlorobenzidine	91941			4.50E-01 I			0.15 C	0.014 C	0.007 C	13 C	1.4 C	52 S	0.01 E
1,4-Dichloro-2-butene	764410				9.30E+00 H	☒	0.0011 C	0.00067 C					
Dichlorodifluoromethane	75718	2.00E-01 I	5.71E-02 A			☒	390 N	210 N	270 N	410000 N	16000 N	37 N	7.5 N
1,1-Dichloroethane	75343	1.00E-01 H	1.43E-01 A			☒	810 N	520 N	140 N	200000 N	7800 N	980 E	11 E
1,2-Dichloroethane (EDC)	107062		2.86E-03 E	9.10E-02 I	9.10E-02 I	☒	0.12 C	0.069 C	0.035 C	63 C	7 C	0.3 E	0.01 E
1,1-Dichloroethylene	75354	9.00E-03 I		6.00E-01 I	1.75E-01 I	☒	0.044 C	0.036 C	0.0053 C	9.5 C	1.1 C	0.04 E	0.03 E
1,2-Dichloroethylene (cis)	156592	1.00E-02 H				☒	61 N	37 N	14 N	20000 N	780 N	1500 E	0.2 E
1,2-Dichloroethylene (trans)	156605	2.00E-02 I				☒	120 N	73 N	27 N	41000 N	1600 N	3600 E	0.3 E
1,2-Dichloroethylene (mixture)	540590	9.00E-03 H				☒	55 N	33 N	12 N	18000 N	700 N		
2,4-Dichlorophenol	120832	3.00E-03 I					110 N	11 N	4.1 N	6100 N	230 N	4800 S	0.5 E
2,4-Dichlorophenoxyacetic Acid (2,4-D)	94757	1.00E-02 I				☒	61 N	37 N	14 N	20000 N	780 N	7000 S	1.7 M
4-(2,4-Dichlorophenoxy)butyric Acid	94826	8.00E-03 I					290 N	29 N	11 N	16000 N	630 N		
1,2-Dichloropropane	78875		1.14E-03 I	6.80E-02 H		☒	0.16 C	0.092 C	0.046 C	84 C	9.4 C	11 E	0.02 E
2,3-Dichloropropanol	616239	3.00E-03 I					110 N	11 N	4.1 N	6100 N	230 N		
1,3-Dichloropropene	542756	3.00E-04 I	5.71E-03 I	1.75E-01 H	1.30E-01 H	☒	0.077 C	0.048 C	0.018 C	33 C	3.7 C	0.1 E	0.001 E
Dichlorvos	62737	5.00e-04 I	1.43E-04 I	2.90E-01 I			0.23 C	0.022 C	0.011 C	20 C	2.2 C	3.5 C	0.00072 C
Dicofol	115322			4.40E-01 W			0.15 C	0.014 C	0.0072 C	13 C	1.5 C		
Dicyclopentadiene	77736	3.00E-02 H	5.71E-05 A			☒	0.42 N	0.21 N	41 N	61000 N	2300 N		
Dieldrin	60571	5.00E-05 I		1.60E+01 I	1.61E+01 I		0.0042 C	0.00039 C	0.0002 C	0.36 C	0.04 C	2 E	0.001 E
Diesel emissions			1.43E-03 I				52 N	5.2 N					
Diethyl phthalate	84662	8.00E-01 I					29000 N	2900 N	1100 N	1E+06 N	63000 N	520 E	110 E
Diethylene glycol, monobutyl ether	112345		5.71E-03 H				210 N	21 N					
Diethylene glycol, monoethyl ether	111900	2.00E+00 H					73000 N	7300 N	2700 N	1E+06 N	160000 N		
Diethylforamide	617845	1.10E-02 H					400 N	40 N	15 N	22000 N	860 N		
Di(2-ethylhexyl)adipate	103231	6.00E-01 I		1.20E-03 I			56 C	5.2 C	2.6 C	4800 C	530 C		
Diethylstilbestrol	56531			4.70E+03 H			0.00001 C	1E-06 C	7E-07 C	0.0012 C	0.00014 C		
Difenzoquat (Avenge)	43222486	8.00E-02 I					2900 N	290 N	110 N	160000 N	6300 N		
Diflubenzuron	35367385	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		

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Contaminant	CAS	RfDo mg/kg/d	RfDi mg/kg/d	CPSo kg·d/mg	CPSi kg·d/mg	VOC	Risk-Based Concentrations: Tap Water µg/L	Ambient Air µg/m3	Fish mg/kg	Soil Ingestion: Industrial mg/kg	Soil Ingestion: Residential mg/kg	Soil Screening Levels-Transfers from Soil to: Air mg/kg	Groundwater mg/kg
1,1-Difluoroethane	75376		1.14E+01 I			☒	69000 N	42000 N					
Diisopropyl methylphosphonate (DIMP)	1445756	8.00E-02 I					2900 N	290 N	110 N	160000 N	6300 N		
Dimethipin	55290647	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Dimethoate	60515	2.00E-04 I					7.3 N	0.73 N	0.27 N	410 N	16 N		
3,3'-Dimethoxybenzidine	119904			1.40E-02 H			4.8 C	0.45 C	0.23 C	410 C	46 C		
Dimethylamine	124403		5.71E-06 W				0.21 N	0.021 N					
2,4-Dimethylaniline hydrochloride	21436964			5.80E-01 H			0.12 C	0.011 C	0.0054 C	9.9 C	1.1 C		
2,4-Dimethylaniline	95681			7.50E-01 H			0.09 C	0.0083 C	0.0042 C	7.6 C	0.85 C		
N-N-Dimethylaniline	121697	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
3,3'-Dimethylbenzidine	119937			9.20E+00 H			0.0073 C	0.00068 C	0.00034 C	0.62 C	0.069 C	29 C	0.00039 C
N,N-Dimethylformamide	68122	1.00E-01 H	8.57E-03 I				3700 N	31 N	140 N	200000 N	7800 N		
1,1-Dimethylhydrazine	57147			2.60E+00 W	3.50E+00 W		0.026 C	0.0018 C	0.0012 C	2.2 C	0.25 C		
1,2-Dimethylhydrazine	540738			3.70E+01 W	3.70E+01 W		0.0018 C	0.00017 C	0.00009 C	0.15 C	0.017 C		
2,4-Dimethylphenol	105679	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N	5400 S	3 E
2,6-Dimethylphenol	576261	6.00E-04 I					22 N	2.2 N	0.81 N	1200 N	47 N		
3,4-Dimethylphenol	95658	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N		
Dimethyl phthalate	131113	1.00E+01 H					370000 N	37000 N	14000 N	1E+06 N	780000 N	1600 E	1200 E
Dimethyl terephthalate	120616	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
1,2-Dinitrobenzene	528290	4.00E-04 H					15 N	1.5 N	0.54 N	820 N	31 N		
1,3-Dinitrobenzene	99650	1.00E-04 I					3.7 N	0.37 N	0.14 N	200 N	7.8 N		
1,4-Dinitrobenzene	100254	4.00E-04 H					15 N	1.5 N	0.54 N	820 N	31 N		
4,6-Dinitro-o-cyclohexyl phenol	131895	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
2,4-Dinitrophenol	51285	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N	360 N	0.1 E
Dinitrotoluene mixture				6.80E-01 I			0.099 C	0.0092 C	0.0046 C	8.4 C	0.94 C		
2,4-Dinitrotoluene	121142	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N	120 S	0.2 E
2,6-Dinitrotoluene	606202	1.00E-03 H					37 N	3.7 N	1.4 N	2000 N	78 N	370 S	0.1 E
Dinoseb	88857	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N		
di-n-Octyl phthalate	117840	2.00E-02 H					730 N	73 N	27 N	41000 N	1600 N	1000000 S	1000000 E
1,4-Dioxane	123911			1.10E-02 I			6.1 C	0.57 C	0.29 C	520 C	58 C		
Diphenamid	957517	3.00E-02 I					1100 N	110 N	41 N	61000 N	2300 N		
Diphenylamine	122394	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
1,2-Diphenylhydrazine	122667			8.00E-01 I	7.70E-01 I		0.084 C	0.0081 C	0.0039 C	7.2 C	0.8 C		
Diquat	85007	2.20E-03 I					80 N	8 N	3 N	4500 N	170 N		
Direct black 38	1937377			8.60E+00 H			0.0078 C	0.00073 C	0.00037 C	0.67 C	0.074 C		
Direct blue 6	2602462			8.10E+00 H			0.0083 C	0.00077 C	0.00039 C	0.71 C	0.079 C		
Direct brown 95	16071866			9.30E+00 H			0.0072 C	0.00067 C	0.00034 C	0.62 C	0.069 C		
Disulfoton	298044	4.00E-05 I					1.5 N	0.15 N	0.054 N	82 N	3.1 N		
1,4-Dithiane	505293	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
Diuron	330541	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
Dodine	2439103	4.00E-03 I					150 N	15 N	5.4 N	8200 N	310 N		
Endosu[illegible]	115297	6.00E-03 I					220 N	22 N	8.1 N	12000 N	470 N	1 S	3 E
Endoth[illegible]	145733	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		

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Endrin	72208	3.00E-04 I					11 N	1.1 N	0.41 N	610 N	23 N	16 S	0.4 E
Epichlorohydrin	106898	2.00E-03 H	2.86E-04 I	9.90E-03 I	4.20E-03 I		6.8 C	1 N	0.32 C	580 C	65 C		
1,2-Epoxybutane	106887		5.71E-03 I				210 N	21 N					
Ethephon (2-chloroethyl phosphonic acid)	16672870	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Ethion	563122	5.00E-04 I					18 N	1.8 N	0.68 N	1000 N	39 N		
2-Ethoxyethanol acetate	111159	3.00E-01 A					11000 N	1100 N	410 N	610000 N	23000 N		
2-Ethoxyethanol	110805	4.00E-01 H	5.71E-02 I				15000 N	210 N	540 N	820000 N	31000 N		
Ethyl acrylate	140885			4.80E-02 H			1.4 C	0.13 C	0.066 C	120 C	13 C		
EPTC (S-Ethyl dipropylthiocarbamate)	759944	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
Ethyl ether	60297	2.00E-01 I				☒	1200 N	730 N	270 N	410000 N	16000 N		
Ethyl methacrylate	97632	9.00E-02 H					3300 N	330 N	120 N	180000 N	7000 N		
Ethyl acetate	141786	9.00E-01 I					33000 N	3300 N	1200 N	1E+06 N	70000 N		
Ethylbenzene	100414	1.00E-01 I	2.86E-01 I			☒	1300 N	1000 N	140 N	200000 N	7800 N	260 E	5 E
Ethylene cyanohydrin	109784	3.00E-01 H					11000 N	1100 N	410 N	610000 N	23000 N		
Ethylene diamine	107153	2.00E-02 H					730 N	73 N	27 N	41000 N	1600 N		
Ethylene glycol	107211	2.00E+00 I					73000 N	7300 N	2700 N	1E+06 N	160000 N		
Ethylene glycol, monobutyl ether	111762		5.71E-03 H				210 N	21 N					
Ethylene oxide	75218			1.02E+00 H	3.50E-01 H		0.066 C	0.018 C	0.0031 C	5.6 C	0.63 C		
Ethylene thiourea (ETU)	96457	8.00E-05 I		1.19E-01 H			0.57 C	0.053 C	0.027 C	48 C	5.4 C		
Ethyl p-nitrophenyl phenylphosphorothioate	2104645	1.00E-05 I					0.37 N	0.037 N	0.014 N	20 N	0.78 N		
Ethylnitrosourea	759739			1.40E+02 W			0.00048 C	0.00005 C	0.00002 C	0.041 C	0.0046 C		
Ethylphthalyl ethyl glycolate	84720	3.00E+00 I					110000 N	11000 N	4100 N	1E+06 N	230000 N		
Express	10120	8.00E-03 I					290 N	29 N	11 N	16000 N	630 N		
Fenamiphos	22224926	2.50E-04 I					9.1 N	0.91 N	0.34 N	510 N	20 N		
Fluometuron	2164172	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
Fluoride	7782414	6.00E-02 I					2200 N	220 N	81 N	120000 N	4700 N		
Fluoridone	59756604	8.00E-02 I					2900 N	290 N	110 N	160000 N	6300 N		
Flurprimidol	56425913	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Flutolanil	66332965	6.00E-02 I					2200 N	220 N	81 N	120000 N	4700 N		
Fluvalinate	69409945	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
Folpet	133073	1.00E-01 I		3.50E-03 I			19 C	1.8 C	0.9 C	1600 C	180 C		
Fomesafen	72178020			1.90E-01 I			0.35 C	0.033 C	0.017 C	30 C	3.4 C		
Fonofos	944229	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
Formaldehyde	50000	2.00E-01 I			4.55E-02 I		7300 N	0.14 C	270 N	410000 N	16000 N		
Formic Acid	64186	2.00E+00 H					73000 N	7300 N	2700 N	1E+06 N	160000 N		
Fosetyl-al	39148248	3.00E+00 I					110000 N	11000 N	4100 N	1E+06 N	230000 N		
Furan	110009	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N		
Furazolidone	67458			3.80E+00 H			0.018 C	0.0016 C	0.00083 C	1.5 C	0.17 C		
Furfural	98011	3.00E-03 I	1.43E-02 A				110 N	52 N	4.1 N	6100 N	230 N		
Furium	531828			5.00E+01 H			0.0013 C	0.00013 C	0.00006 C	0.11 C	0.013 C		
Furmecyclox	60568050			3.00E-02 I			2.2 C	0.21 C	0.11 C	190 C	21 C		
Glufosinate-ammonium	77182822	4.00E-04 I					15 N	1.5 N	0.54 N	820 N	31 N		

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Glycidaldehyde	765344	4.00E-04 I	2.86E-04 H				15 N	1 N	0.54 N	820 N	31 N		
Glyphosate	1071836	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
Haloxyfop-methyl	69806402	5.00E-05 I					1.8 N	0.18 N	0.068 N	100 N	3.9 N		
Harmony	79277273	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
HCH (alpha)	319846			6.30E+00 I	6.30E+00 I		0.011 C	0.00099 C	0.0005 C	0.91 C	0.1 C	0.9 E	0.0004 E
HCH (beta)	319857			1.80E+00 I	1.80E+00 I		0.037 C	0.0035 C	0.0018 C	3.2 C	0.35 C	16 E	0.002 E
HCH (gamma) Lindane	58899	3.00E-04 I		1.30E+00 H			0.052 C	0.0048 C	0.0024 C	4.4 C	0.49 C	4.2 C	0.006 E
HCH-technical	608731			1.80E+00 I	1.79E+00 I		0.037 C	0.0035 C	0.0018 C	3.2 C	0.35 C		
Heptachlor	76448	5.00E-04 I		4.50E+00 I	4.55E+00 I	☒	0.0023 C	0.0014 C	0.0007 C	1.3 C	0.14 C	0.3 E	0.06 E
Heptachlor epoxide	1024573	1.30E-05 I		9.10E+00 I	9.10E+00 I	☒	0.0012 C	0.00069 C	0.00035 C	0.63 C	0.07 C	1 E	0.03 E
Hexabromobenzene	87821	2.00E-03 I				☒	12 N	7.3 N	2.7 N	4100 N	160 N		
Hexachlorobenzene	118741	8.00E-04 I		1.60E+00 I	1.61E+00 I	☒	0.0066 C	0.0039 C	0.002 C	3.6 C	0.4 C	1 E	0.8 E
Hexachlorobutadiene	87683	2.00E-04 H		7.80E-02 I	7.70E-02 I	☒	0.14 C	0.081 C	0.04 C	73 C	8.2 C	1 E	0.1 E
Hexachlorocyclopentadiene	77474	7.00E-03 I	2.00E-05 H			☒	0.15 N	0.073 N	9.5 N	14000 N	550 N	2 E	10 E
Hexachlorodibenzo-p-dioxin mixture	19408743			6.20E+03 I	4.55E+03 I		0.00001 C	1E-06 C	5E-07 C	0.0009 C	0.0001 C		
Hexachloroethane	67721	1.00E-03 I		1.40E-02 I	1.40E-02 I	☒	0.75 C	0.45 C	0.23 C	410 C	46 C	49 E	0.2 E
Hexachlorophene	70304	3.00E-04 I					11 N	1.1 N	0.41 N	610 N	23 N		
Hexahydro-1,3,5-trinitro-1,3,5-triazine	121824	3.00E-03 I		1.10E-01 I			0.61 C	0.057 C	0.029 C	52 C	5.8 C		
1,6-Hexamethylene diisocyanate	822060		2.86E-06 I				0.1 N	0.01 N					
n-Hexane	110543	6.00E-02 H	5.71E-02 I			☒	350 N	210 N	81 N	120000 N	4700 N	32 N	13 N
Hexazinone	51235042	3.30E-02 I					1200 N	120 N	45 N	67000 N	2600 N		
Hydrazine, hydrazine sulfate	302012			3.00E+00 I	1.71E+01 I		0.022 C	0.00037 C	0.0011 C	1.9 C	0.21 C		
Hydrogen chloride	7647010		2.00E-03 I				73 N	7.3 N					
Hydrogen sulfide	7783064	3.00E-03 I	2.57E-04 I				110 N	0.94 N	4.1 N	6100 N	230 N		
Hydroquinone	123319	4.00E-02 H					1500 N	150 N	54 N	82000 N	3100 N		
Imazalil	35554440	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
Imazaquin	81335377	2.50E-01 I					9100 N	910 N	340 N	510000 N	20000 N		
Iprodione	36734197	4.00E-02 I					1500 N	150 N	54 N	82000 N	3100 N		
Isobutanol	78831	3.00E-01 I				☒	1800 N	1100 N	410 N	610000 N	23000 N		
Isophorone	78591	2.00E-01 I		9.50E-04 I			71 C	6.6 C	3.3 C	6000 C	670 C	3400 E	0.2 E
Isopropalin	33820530	1.50E-02 I					550 N	55 N	20 N	31000 N	1200 N		
Isopropyl methyl phosphonic acid	1832548	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
Isoxaben	82558507	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Kepone	143500			1.80E+01 E			0.0037 C	0.00035 C	0.00018 C	0.32 C	0.035 C		
Lactofen	77501634	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
Linuron	330552	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
Lithium	7439932	2.00E-02 E					730 N	73 N	27 N	41000 N	1600 N		
Londax	83056996	2.00E-01 I					7300 N	730 N	270 N	410000 N	16000 N		
Malathion	121755	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Maleic anhydride	108316	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
Maleic hydrazide	123331	5.00E-01 I					18000 N	1800 N	680 N	1E+06 N	39000 N		
Malonc[illegible]e	109773	2.00E-05 H					0.73 N	0.073 N	0.027 N	41 N	1.6 N		

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Mancozeb	8018017	3.00E-02 H					1100 N	110 N	41 N	61000 N	2300 N		
Maneb	12427382	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Manganese and compounds	7439965	5.00E-03 I	1.43e-05 I				180 N	0.052 N	6.8 N	10000 N	390 N		
Mephosfolan	950107	9.00E-05 H					3.3 N	0.33 N	0.12 N	180 N	7 N		
Mepiquat chloride	24307264	3.00E-02 I					1100 N	110 N	41 N	61000 N	2300 N		
Mercury (inorganic)	7439976	3.00E-04 H	8.57E-05 H				11 N	0.31 N	0.41 N	610 N	23 N	7 E	3 E
Mercury (methyl)	22967926	3.00E-04 I					11 N	1.1 N	0.41 N	610 N	23 N		
Merphos	150505	3.00E-05 I					1.1 N	0.11 N	0.041 N	61 N	2.3 N		
Merphos oxide	78488	3.00E-05 I					1.1 N	0.11 N	0.041 N	61 N	2.3 N		
Metalaxyl	57837191	6.00E-02 I					2200 N	220 N	81 N	120000 N	4700 N		
Methacrylonitrile	126987	1.00E-04 I	2.00E-04 A				3.7 N	0.73 N	0.14 N	200 N	7.8 N		
Methamidophos	10265926	5.00E-05 I					1.8 N	0.18 N	0.068 N	100 N	3.9 N		
Methanol	67561	5.00E-01 I					18000 N	1800 N	680 N	1E+06 N	39000 N		
Methidathion	950378	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N		
Methomyl	16752775	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
Methoxychlor	72435	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N	41 S	62 E
2-Methoxyethanol acetate	110496	2.00E-03 A					73 N	7.3 N	2.7 N	4100 N	160 N		
2-Methoxyethanol	109864	1.00E-03 H	5.71E-03 I				37 N	21 N	1.4 N	2000 N	78 N		
2-Methoxy-5-nitroaniline	99592			4.60E-02 H			1.5 C	0.14 C	0.069 C	120 C	14 C		
Methyl acetate	79209	1.00E+00 H					37000 N	3700 N	1400 N	1E+06 N	78000 N		
Methyl acrylate	96333	3.00E-02 A					1100 N	110 N	41 N	61000 N	2300 N		
2-Methylaniline hydrochloride	636215			1.80E-01 H			0.37 C	0.035 C	0.018 C	32 C	3.5 C		
2-Methylaniline	95534			2.40E-01 H			0.28 C	0.026 C	0.013 C	24 C	2.7 C		
Methyl chlorocarbonate	79221	1.00E+00 W					37000 N	3700 N	1400 N	1E+06 N	78000 N		
4-(2-Methyl-4-chlorophenoxy) butyric acid	94815	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
2-Methyl-4-chlorophenoxyacetic acid	94746	5.00E-04 I					18 N	1.8 N	0.68 N	1000 N	39 N		
2-(2-Methyl-14-chlorophenoxy)propionic aci	93652	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N		
Methylcyclohexane	108872		8.57E-01 H				31000 N	3100 N				60 S	1500 N
Methylene bromide	74953	1.00E-02 A				☒	61 N	37 N	14 N	20000 N	780 N		
Methylene chloride	75092	6.00E-02 I	8.57E-01 H	7.50E-03 I	1.64E-03 I	☒	4.1 C	3.8 C	0.42 C	760 C	85 C	7 E	0.01 E
4,4'-Methylene bis(2-chloroaniline)	101144	7.00E-04 H		1.30E-01 H	1.30E-01 H		0.52 C	0.048 C	0.024 C	44 C	4.9 C		
4,4'-Methylenebisbenzéneamine	101779			2.50E-01 W			0.27 C	0.025 C	0.013 C	23 C	2.6 C		
4,4'-Methylene bis(N,N'-dimethyl)aniline	101611			4.60E-02 I			1.5 C	0.14 C	0.069 C	120 C	14 C		
4,4'-Methylenediphenyl isocyanate	101688		5.71E-06 I			☒	0.035 N	0.021 N					
Methyl ethyl ketone	78933	6.00E-01 I	2.86E-01 I			☒	1900 N	1000 N	810 N	1E+06 N	47000 N		
Methyl hydrazine	60344			1.10E+00 W			0.061 C	0.0057 C	0.0029 C	5.2 C	0.58 C		
Methyl isobutyl ketone	108101	8.00E-02 H	2.29E-02 A				2900 N	84 N	110 N	160000 N	6300 N		
Methyl methacrylate	80626	8.00E-02 H					2900 N	290 N	110 N	160000 N	6300 N		
2-Methyl-5-nitroaniline	99558			3.30E-02 H			2 C	0.19 C	0.096 C	170 C	19 C		
Methyl parathion	298000	2.50E-04 I					9.1 N	0.91 N	0.34 N	510 N	20 N	28 S	0.041 N
2-Methylphenol (o-cresol)	95487	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N	12000 S	6 E
3-Methylphenol (m-cresol)	103394	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		

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4-Methylphenol (p-cresol)	106445	5.00E-03 H					180 N	18 N	6.8 N	10000 N	390 N		
Methyl styrene (mixture)	25013154	6.00E-03 A	1.14E-02 A			☒	60 N	42 N	8.1 N	12000 N	470 N		
Methyl styrene (alpha)	98839	7.00E-02 A				☒	430 N	260 N	95 N	140000 N	5500 N	8.8 S	7.5 N
Methyl tertbutyl ether (MTBE)	1634044	5.00E-03 E	8.57E-01 I			☒	180 N	3100 N	6.8 N	10000 N	390 N		
Metolaclor (Dual)	51218452	1.50E-01 H					5500 N	550 N	200 N	310000 N	12000 N		
Metribuzin	21807649	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
Mirex	2385855	2.00E-04 I		1.80E+00 W			0.037 C	0.0035 C	0.0018 C	3.2 C	0.35 C		
Molinate	2212671	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
Molybdenum	7439987	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Monochloramine	10599903	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
Naled	300765	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
2-Naphthylamine	91598			1.30e+02 E			0.00052 C	0.00005 C	0.00002 C	0.044 C	0.0049 C		
Napropamide	15299997	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
Nickel refinery dust					8.40E-01 I			0.0075 C					
Nickel and compounds	7440020	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N	6900 E	21 E
Nickel subsulfide	12035722				1.70E+00 I			0.0037 C					
Nitrapyrin	1929824	1.50E-03 W					55 N	5.5 N	2 N	3100 N	120 N		
Nitrate	14797558	1.60E+00 I					58000 N	5800 N	2200 N	1E+06 N	130000 N		
Nitric Oxide	10102439	1.00E-01 W					3700 N	370 N	140 N	200000 N	7800 N		
Nitrite	14797650	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
2-Nitroaniline	88744	6.00E-05 W	5.71E-05 H				2.2 N	0.21 N	0.081 N	120 N	4.7 N		
3-Nitroaniline	99092	3.00E-03 O					110 N	11 N	4.1 N	6100 N	230 N		
4-Nitroaniline	100016	3.00E-03 O					110 N	11 N	4.1 N	6100 N	230 N		
Nitrobenzene	98953	5.00E-04 I	5.71E-04 A			☒	3.4 N	2.1 N	0.68 N	1000 N	39 N	110 E	0.09 E
Nitrofurantoin	67209	7.00E-02 H					2600 N	260 N	95 N	140000 N	5500 N		
Nitrofurazone	59870			1.50E+00 H	9.40E+00 H		0.045 C	0.00067 C	0.0021 C	3.8 C	0.43 C		
Nitrogen dioxide	10102440	1.00E+00 W					37000 N	3700 N	1400 N	1E+06 N	78000 N		
Nitroguanidine	556887	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
4-Nitrophenol	100027	6.20E-02 O					2300 N	230 N	84 N	130000 N	4800 N		
2-Nitropropane	79469		5.71E-03 I		9.40E+00 H		210 N	0.00067 C					
N-Nitrosodi-n-butylamine	924163			5.40E+00 I	5.60E+00 I		0.012 C	0.0011 C	0.00058 C	1.1 C	0.12 C		
N-Nitrosodiethanolamine	1116547			2.80E+00 I			0.024 C	0.0022 C	0.0011 C	2 C	0.23 C		
N-Nitrosodiethylamine	55185			1.50E+02 I	1.51E+02 I		0.00045 C	0.00004 C	0.00002 C	0.038 C	0.0043 C		
N-Nitrosodimethylamine	62759			5.10E+01 I	4.90E+01 I		0.0013 C	0.00013 C	0.00006 C	0.11 C	0.013 C		
N-Nitrosodiphenylamine	86306			4.90E-03 I			14 C	1.3 C	0.64 C	1200 C	130 C	29 C	0.2 E
N-Nitroso di-n-propylamine	621647			7.00E+00 I			0.0096 C	0.00089 C	0.00045 C	0.82 C	0.091 C	0.014 C	0.00002 E
N-Nitroso-N-methylethylamine	10595956			2.20E+01 I			0.0031 C	0.00028 C	0.00014 C	0.26 C	0.029 C		
N-Nitrosopyrrolidine	930552			2.10E+00 I	2.13E+00 I		0.032 C	0.0029 C	0.0015 C	2.7 C	0.3 C		
m-Nitrotoluene	99081	1.00E-02 H				☒	61 N	37 N	14 N	20000 N	780 N	460 S	0.42 N
o-Nitrotoluene	88722	1.00E-02 H				☒	61 N	37 N	14 N	20000 N	780 N	460 S	0.42 N
p-Nitrotoluene	99990	1.00E-02 H				☒	61 N	37 N	14 N	20000 N	780 N	460 S	0.42 N
Norflu	27314132	4.00E-02 I					1500 N	150 N	54 N	82000 N	3100 N		

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NuStar	85509199	7.00E-04 I					26 N	2.6 N	0.95 N	1400 N	55 N		
Octabromodiphenyl ether	32536520	3.00E-03 I					110 N	11 N	4.1 N	6100 N	230 N		
Octahydro-1357-tetranitro-1357-tetrazocine	2691410	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Octamethylpyrophosphoramide	152169	2.00E-03 H					73 N	7.3 N	2.7 N	4100 N	160 N		
Oryzalin	19044883	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Oxadiazon	19666309	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Oxamyl	23135220	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
Oxyfluorfen	42874033	3.00E-03 I					110 N	11 N	4.1 N	6100 N	230 N		
Paclobutrazol	76738620	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
Paraquat	1910425	4.50E-03 I					160 N	16 N	6.1 N	9200 N	350 N		
Parathion	56382	6.00E-03 H					220 N	22 N	8.1 N	12000 N	470 N	110 S	3.9 N
Pebulate	1114712	5.00E-02 H					1800 N	180 N	68 N	100000 N	3900 N		
Pendimethalin	40487421	4.00E-02 I					1500 N	150 N	54 N	82000 N	3100 N		
Pentabromo-6-chloro cyclohexane	87843			2.30E-02 H			2.9 C	0.27 C	0.14 C	250 C	28 C		
Pentabromodiphenyl ether	32534819	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
Pentachlorobenzene	608935	8.00E-04 I				☒	4.9 N	2.9 N	1.1 N	1600 N	63 N	570 N	48 N
Pentachloronitrobenzene	82688	3.00E-03 I		2.60E-01 H		☒	0.041 C	0.024 C	0.012 C	22 C	2.5 C		
Pentachlorophenol	87865	3.00E-02 I		1.20E-01 I			0.56 C	0.052 C	0.026 C	48 C	5.3 C	7.9 C	0.2 E
Permethrin	52645531	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Phenmedipham	13684634	2.50E-01 I					9100 N	910 N	340 N	510000 N	20000 N		
Phenol	108952	6.00E-01 I					22000 N	2200 N	810 N	1E+06 N	47000 N	21000 S	49 E
m-Phenylenediamine	108452	6.00E-03 I					220 N	22 N	8.1 N	12000 N	470 N		
p-Phenylenediamine	106503	1.90E-01 H					6900 N	690 N	260 N	390000 N	15000 N		
Phenylmercuric acetate	62384	8.00E-05 I					2.9 N	0.29 N	0.11 N	160 N	6.3 N		
2-Phenylphenol	90437			1.94E-03 H			35 C	3.2 C	1.6 C	3000 C	330 C		
Phorate	298022	2.00E-04 H					7.3 N	0.73 N	0.27 N	410 N	16 N		
Phosmet	732116	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Phosphine	7803512	3.00E-04 I	8.57E-06 H				11 N	0.031 N	0.41 N	610 N	23 N		
Phosphorus (white)	7723140	2.00E-05 I					0.73 N	0.073 N	0.027 N	41 N	1.6 N		
p-Phthalic acid	100210	1.00E+00 H					37000 N	3700 N	1400 N	1E+06 N	78000 N		
Phthalic anhydride	85449	2.00E+00 I	3.43E-02 H				73000 N	130 N	2700 N	1E+06 N	160000 N		
Picloram	1918021	7.00E-02 I					2600 N	260 N	95 N	140000 N	5500 N		
Pirimiphos-methyl	29232937	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
Polybrominated biphenyls		7.00E-06 H		8.90E+00 H			0.0076 C	0.0007 C	0.00035 C	0.64 C	0.072 C		
Polychlorinated biphenyls (PCBs)	1336363			7.70E+00 I			0.0087 C	0.00081 C	0.00041 C	0.74 C	0.083 C		8.2 E
Aroclor 1016	12674112	7.00E-05 I					2.6 N	0.26 N	0.095 N	140 N	5.5 N		
Aroclor 1254	11097691	2.00E-05 I					0.73 N	0.073 N	0.027 N	41 N	1.6 N		
Polychlorinated terphenyls (PCTs)				4.50E+00 E			0.015 C	0.0014 C	0.0007 C	1.3 C	0.14 C		
Polynuclear aromatic hydrocarbons													
Acenaphthene	83329	6.00E-02 I					2200 N	220 N	81 N	120000 N	4700 N	120 S	200 E
Anthracene	120127	3.00E-01 I					11000 N	1100 N	410 N	610000 N	23000 N	6.8 S	4300 E
Benz[a]anthracene	56553			7.30E-01 E	6.10E-01 E		0.092 C	0.01 C	0.0043 C	7.8 C	0.88 C	27 S	0.7 E

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Benzo[b]fluoranthene	205992			7.30E-01 E	6.10E-01 E		0.092 c	0.01 c	0.0043 c	7.8 c	0.88 c	23 s	4 E
Benzo[k]fluoranthene	207089			7.30E-02 E	6.10E-02 E		0.92 c	0.1 c	0.043 c	78 c	8.8 c		4 E
Benzo[a]pyrene	50328			7.30E+00 I	6.10E+00 W		0.0092 c	0.001 c	0.00043 c	0.78 c	0.088 c	11 s	4 E
Carbazole	86748			2.00E-02 H			3.4 c	0.31 c	0.16 c	290 c	32 c	11 s	0.5 E
Chrysene	218019			7.30E-03 E	6.10E-03 E		9.2 c	1 c	0.43 c	780 c	88 c	3.6 s	1 E
Dibenz[ah]anthracene	53703			7.30E+00 E	6.10E+00 E		0.0092 c	0.001 c	0.00043 c	0.78 c	0.088 c	7.2 s	11 E
Fluoranthene	206440	4.00E-02 I					1500 N	150 N	54 N	82000 N	3100 N	68 s	980 E
Fluorene	86737	4.00E-02 I					1500 N	150 N	54 N	82000 N	3100 N	89 s	160 E
Indeno[1,2,3-cd]pyrene	193395			7.30E-01 E	6.10E-01 E		0.092 c	0.01 c	0.0043 c	7.8 c	0.88 c	280 s	35 E
Naphthalene	91203	4.00E-02 W					1500 N	150 N	54 N	82000 N	3100 N	180 s	30 E
Pyrene	129000	3.00E-02 I					1100 N	110 N	41 N	61000 N	2300 N	56 s	1400 E
Prochloraz	67747095	9.00E-03 I		1.50E-01 I			0.45 c	0.042 c	0.021 c	38 c	4.3 c		
Profluralin	26399360	6.00E-03 H					220 N	22 N	8.1 N	12000 N	470 N		
Prometon	1610180	1.50E-02 I					550 N	55 N	20 N	31000 N	1200 N		
Prometryn	7287196	4.00E-03 I					150 N	15 N	5.4 N	8200 N	310 N		
Pronamide	23950585	7.50E-02 I					2700 N	270 N	100 N	150000 N	5900 N		
Propachlor	1918167	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
Propanil	709988	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Propargite	2312358	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Propargyl alcohol	107197	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
Propazine	139402	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Propham	122429	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Propiconazole	60207901	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
Propylene glycol	57556	2.00E+01 H					730000 N	73000 N	27000 N	1E+06 N	1000000 N		
Propylene glycol, monoethyl ether	52125538	7.00E-01 H					26000 N	2600 N	950 N	1E+06 N	55000 N		
Propylene glycol, monomethyl ether	107982	7.00E-01 H	5.71E-01 I				26000 N	2100 N	950 N	1E+06 N	55000 N		
Propylene oxide	75569		8.57E-03 I	2.40E-01 I	1.29E-02 I		0.28 c	0.49 c	0.013 c	24 c	2.7 c		
Pursuit	81335775	2.50E-01 I					9100 N	910 N	340 N	510000 N	20000 N		
Pydrin	51630581	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
Pyridine	110861	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N		
Quinalphos	13593038	5.00E-04 I					18 N	1.8 N	0.68 N	1000 N	39 N		
Quinoline	91225			1.20E+01 H			0.0056 c	0.00052 c	0.00026 c	0.48 c	0.053 c		
Resmethrin	10463868	3.00E-02 I					1100 N	110 N	41 N	61000 N	2300 N		
Ronnel	299843	5.00E-02 H					1800 N	180 N	68 N	100000 N	3900 N		
Rotenone	83794	4.00E-03 I					150 N	15 N	5.4 N	8200 N	310 N		
Savey	78587050	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
Selenious Acid	7783008	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Selenium	7782492	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		3 E
Selenourea	630104	5.00E-03 H					180 N	18 N	6.8 N	10000 N	390 N		
Sethoxydim	74051802	9.00E-02 I					3300 N	330 N	120 N	180000 N	7000 N		
Silver and compounds	7440224	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Simaz	122349	5.00E-03 I		1.20E-0			0.56 c	0.052 c	0.026 c	48 c	5.3 c		

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Sodium azide	26628228	4.00E-03 I					150 N	15 N	5.4 N	8200 N	310 N		
Sodium diethyldithiocarbamate	148185	3.00E-02 I		2.70E-01 H			0.25 C	0.023 C	0.012 C	21 C	2.4 C		
Sodium fluoroacetate	62748	2.00E-05 I					0.73 N	0.073 N	0.027 N	41 N	1.6 N		
Sodium metavanadate	13718268	1.00E-03 H					37 N	3.7 N	1.4 N	2000 N	78 N		
Strontium, stable	7440246	6.00E-01 I					22000 N	2200 N	810 N	1E+06 N	47000 N		
Strychnine	57249	3.00E-04 I					11 N	1.1 N	0.41 N	610 N	23 N		
Styrene	100425	2.00E-01 I	2.86E-01 I			☒	1600 N	1000 N	270 N	410000 N	16000 N	1400 E	2 E
Systhane	88671890	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
2,3,7,8-TCDD (dioxin)	1746016			1.56E+05 H	1.16E+05 H		4E-07 C	5E-08 C	C	4E-05 C	4E-06 C		
Tebuthiuron	34014181	7.00E-02 I					2600 N	260 N	95 N	140000 N	5500 N		
Temephos	3383968	2.00E-02 H					730 N	73 N	27 N	41000 N	1600 N		
Terbacil	5902512	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
Terbufos	13071799	2.50E-05 H					0.91 N	0.091 N	0.034 N	51 N	2 N		
Terbutryn	886500	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N		
1,2,4,5-Tetrachlorobenzene	95943	3.00E-04 I				☒	1.8 N	1.1 N	0.41 N	610 N	23 N	91 N	0.69 N
1,1,1,2-Tetrachloroethane	630206	3.00E-02 I		2.60E-02 I	2.59E-02 I	☒	0.41 C	0.24 C	0.12 C	220 C	25 C		
1,1,2,2-Tetrachloroethane	79345			2.00E-01 I	2.03E-01 I	☒	0.052 C	0.031 C	0.016 C	29 C	3.2 C	0.4 E	0.001 E
Tetrachloroethylene (PCE)	127184	1.00E-02 I		5.20E-02 E	2.03E-03 E	☒	1.1 C	3.1 C	0.061 C	110 C	12 C	11 E	0.04 E
2,3,4,6-Tetrachlorophenol	58902	3.00E-02 I					1100 N	110 N	41 N	61000 N	2300 N		
p,a,a,a-Tetrachlorotoluene	5216251			2.00E+01 H		☒	0.00053 C	0.00031 C	0.00016 C	0.29 C	0.032 C		
Tetrachlorovinphos	961115	3.00E-02 I		2.40E-02 H			2.8 C	0.26 C	0.13 C	240 C	27 C		
Tetraethyldithiopyrophosphate	3689245	5.00E-04 I					18 N	1.8 N	0.68 N	1000 N	39 N		
Lead (tetraethyl)	78002	1.00E-07 I					0.0037 N	0.00037 N	0.00014 N	0.2 N	0.0078 N	0.00068 N	0.000034 N
Thallic oxide	1314325	7.00E-05 W					2.6 N	0.26 N	0.095 N	140 N	5.5 N		
Thallium													0.4 E
Thallium acetate	563688	9.00E-05 I					3.3 N	0.33 N	0.12 N	180 N	7 N		
Thallium carbonate	6533739	8.00E-05 I					2.9 N	0.29 N	0.11 N	160 N	6.3 N		
Thallium chloride	7791120	8.00E-05 I					2.9 N	0.29 N	0.11 N	160 N	6.3 N		
Thallium nitrate	10102451	9.00E-05 I					3.3 N	0.33 N	0.12 N	180 N	7 N		
Thallium selenite	12039520	9.00E-05 W					3.3 N	0.33 N	0.12 N	180 N	7 N		
Thallium sulfate	7446186	8.00E-05 I					2.9 N	0.29 N	0.11 N	160 N	6.3 N		
Thiobencarb	28249776	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
2-(Thiocyanomethylthio)-benzothiazole	21564170	3.00E-02 H					1100 N	110 N	41 N	61000 N	2300 N		
Thiofanox	39196184	3.00E-04 H					11 N	1.1 N	0.41 N	610 N	23 N		
Thiophanate-methyl	23564058	8.00E-02 I					2900 N	290 N	110 N	160000 N	6300 N		
Thiram	137268	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Tin and compounds		6.00E-01 H					22000 N	2200 N	810 N	1E+06 N	47000 N		
Toluene	108883	2.00E-01 I	1.14E-01 I			☒	750 N	420 N	270 N	410000 N	16000 N	520 E	5 E
Toluene-2,4-diamine	95807			3.20E+00 H			0.021 C	0.002 C	0.00099 C	1.8 C	0.2 C		
Toluene-2,5-diamine	95705	6.00E-01 H					22000 N	2200 N	810 N	1E+06 N	47000 N		
Toluene-2,6-diamine	823405	2.00E-01 H					7300 N	730 N	270 N	410000 N	16000 N		
p-Toluidine	106490			1.90E-01 H			0.35 C	0.033 C	0.017 C	30 C	3.4 C		

Sources: I=IRIS H=HEAST A=HEAST alternate W=Withdrawn from IRIS or HEAST E=EPA-ECAO Regional Support provisional value O=Other EPA documents.

Basis: C=carcinogenic effects N=noncarcinogenic effects E=EPA draft Soil Screening Level S=soil saturation concentration.

Contaminant	CAS	RfDo mg/kg/d	RfDi mg/kg/d	CPSo kg·d/mg	CPSi kg·d/mg	VOC	Risk-Based Concentrations: Tap Water µg/L	Ambient Air µg/m3	Fish mg/kg	Soil Ingestion: Industrial mg/kg	Soil Ingestion: Residential mg/kg	Soil Screening Levels-Transfers from Soil to: Air mg/kg	Groundwater mg/kg
Toxaphene	8001352			1.10E+00 I	1.12E+00 I		0.061 C	0.0056 C	0.0029 C	5.2 C	0.58 C	5 E	0.04 E
Tralomethrin	66841256	7.50E-03 I					270 N	27 N	10 N	15000 N	590 N		
Triallate	2303175	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
Triasulfuron	82097505	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
1,2,4-Tribromobenzene	615543	5.00E-03 I				X	30 N	18 N	6.8 N	10000 N	390 N		
Tributyltin oxide (TBTO)	56359	3.00E-05 I					1.1 N	0.11 N	0.041 N	61 N	2.3 N		
2,4,6-Trichloroaniline hydrochloride	33663502			2.90E-02 H			2.3 C	0.22 C	0.11 C	200 C	22 C		
2,4,6-Trichloroaniline	634935			3.40E-02 H			2 C	0.18 C	0.093 C	170 C	19 C		
1,2,4-Trichlorobenzene	120821	1.00E-02 I	5.71e-02 H			X	190 N	210 N	14 N	20000 N	780 N	240 E	2 E
1,1,1-Trichloroethane	71556	9.00E-02 W	2.86E-01 W			X	1300 N	1000 N	120 N	180000 N	7000 N	980 E	0.9 E
1,1,2-Trichloroethane	79005	4.00E-03 I		5.70E-02 I	5.60E-02 I	X	0.19 C	0.11 C	0.055 C	100 C	11 C	0.8 E	0.01 E
Trichloroethylene (TCE)	79016	6.00E-03 E		1.10E-02 W	6.00E-03 E	X	1.6 C	1 C	0.29 C	520 C	58 C	3 E	0.02 E
Trichlorofluoromethane	75694	3.00E-01 I	2.00E-01 A			X	1300 N	730 N	410 N	610000 N	23000 N	790 N	13 N
2,4,5-Trichlorophenol	95954	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N	8200 S	120 E
2,4,6-Trichlorophenol	88062			1.10E-02 I	1.09E-02 I		6.1 C	0.57 C	0.29 C	520 O	58 C	150 C	0.05 E
2,4,5-Trichlorophenoxyacetic acid	93765	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
2-(2,4,5-Trichlorophenoxy)propionic acid	93721	8.00E-03 I					290 N	29 N	11 N	16000 N	630 N		
1,1,2-Trichloropropane	598776	5.00E-03 I				X	30 N	18 N	6.8 N	10000 N	390 N	13 N	0.14 N
1,2,3-Trichloropropane	96184	6.00E-03 I		7.00e+00 I		X	0.0015 C	0.00089 C	0.00045 C	0.82 C	0.091 C	0.00003 C	6.000E-06 C
1,2,3-Trichloropropene	96195	5.00E-03 H				X	30 N	18 N	6.8 N	10000 N	390 N		
1,1,2-Trichloro-1,2,2- trifluoroethane	76131	3.00E+01 I	8.57E+00 H			X	59000 N	31000 N	41000 N	1E+06 N	1000000 N	2400 S	3100 N
Tridiphane	58138082	3.00E-03 I					110 N	11 N	4.1 N	6100 N	230 N		
Triethylamine	121448		2.00E-03 I				73 N	7.3 N					
Trifluralin	1582098	7.50E-03 I		7.70E-03 I			8.7 C	0.81 C	0.41 C	740 C	83 C		
1,2,4-Trimethylbenzene	95636	5.00e-04 E				X	3 N	1.8 N	0.68 N	1000 N	39 N		
1,3,5-Trimethylbenzene	108678	4.00e-04 E				X	2.4 N	1.5 N	0.54 N	820 N	31 N	6.8 N	0.26 N
Trimethyl phosphate	512561			3.70E-02 H			1.8 C	0.17 C	0.085 C	150 C	17 C		
1,3,5-Trinitrobenzene	99354	5.00E-05 I					1.8 N	0.18 N	0.068 N	100 N	3.9 N		
Trinitrophenylmethylnitramine	479458	1.00E-02 H					370 N	37 N	14 N	20000 N	780 N		
2,4,6-Trinitrotoluene	118967	5.00E-04 I		3.00E-02 I			2.2 C	0.21 C	0.11 C	190 C	21 C		
Uranium (soluble salts)	7440611	3.00E-03 I					110 N	11 N	4.1 N	6100 N	230 N		
Vanadium	7440622	7.00E-03 H					260 N	26 N	9.5 N	14000 N	550 N		
Vanadium pentoxide	1314621	9.00E-03 I					330 N	33 N	12 N	18000 N	700 N		
Vanadium sulfate	36907423	2.00E-02 H					730 N	73 N	27 N	41000 N	1600 N		
Vernam	1929777	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N		
Vinclozolin	50471448	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
Vinyl acetate	108054	1.00E+00 H	5.71E-02 I				37000 N	210 N	1400 N	1E+06 N	78000 N	370 E	84 E
Vinyl bromide	593602		8.57E-04 I			X	5.2 N	3.1 N				2 N	0.018 N
Vinyl chloride	75014			1.90E+00 H	3.00E-01 H	X	0.019 C	0.021 C	0.0017 C	3 C	0.34 C	0.002 E	0.01 E
Warfarin	81812	3.00E-04 I					11 N	1.1 N	0.41 N	610 N	23 N		
m-Xylene	108323	2.00E+00 H	2.00E-01 W			X	1400 N	730 N	2700 N	1E+06 N	160000 N	950 S	240 N
o-Xyle	95476	2.00E+00 H	2.00E-01 W			X	1400 N	730 N	2700 N	1E+06 N	160000 N	7?	150 N

Sources: I=IRIS H=HEAST A=HEAST alternate W=Withdrawn from IRIS or HEAST E=EPA-ECAO Regional Support provisional value O=Other EPA documents.

Basis: C=carcinogenic effects N=noncarcinogenic effects E=EPA draft Soil Screening Level S=soil saturation concentration.

Contaminant	CAS	RfDo mg/kg/d	RfDi mg/kg/d	CPSo kg·d/mg	CPSi kg·d/mg	VOC	Risk-Based Concentrations: Tap Water µg/L	Ambient Air µg/m3	Fish mg/kg	Soil Ingestion: Industrial mg/kg	Soil Ingestion: Residential mg/kg	Soil Screening Levels-Transfers from Soil to: Air mg/kg	Groundwater mg/kg
p-Xylene	106423		8.57E-02 w			☒	520 N	310 N				1000 S	220 N
Xylene (mixed)	1330207	2.00E+00 I				☒	12000 N	7300 N	2700 N	1E+06 N	160000 N	320 E	74 E
Zinc	7440666	3.00E-01 I					11000 N	1100 N	410 N	610000 N	23000 N		42000 E
Zinc phosphide	1314847	3.00E-04 I					11 N	1.1 N	0.41 N	610 N	23 N		
Zineb	12122677	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		

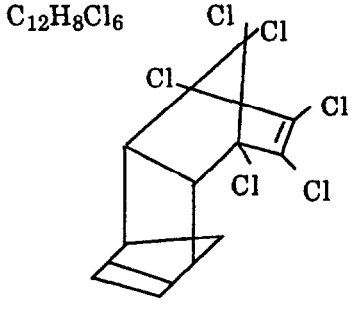
APPENDIX K
HUMAN HEALTH TOXICOLOGICAL PROFILES

Date of Last Revision: 11/10/94
Revisor: Patrick B. Moroney

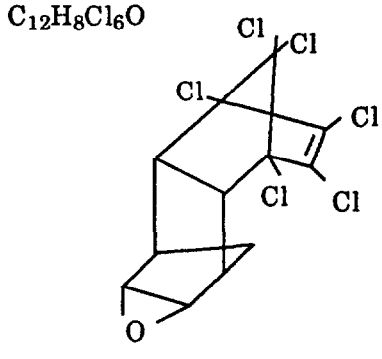
ALDRIN/DIELDRIN

INTRODUCTION

Chemical Name: Aldrin
Synonyms: Aldrex, Aldrite
CAS Number: 309-00-2;
Molecular Formula: $C_{12}H_8Cl_6$
Molecular Weight: 364.90 g/mole
Chemical Structure:



Chemical Name: Dieldrin
Synonyms: Alvit, Dieldrix
CAS Number: 60-57-1
Molecular Formula: $C_{12}H_8Cl_6O$
Molecular Weight: 308.93 g/mole
Chemical Structure:



Aldrin is an insecticide formerly used against termites and soil-dwelling pests such as ants, wireworms, whitegrubs, etc. It is a white crysalline powder in its pure form. The technical grade color is tan. Aldrin readily degrades to dieldrin upon entry into the environment or a

human receptor. Aldrin and dieldrin are structurally similar compounds. Hence, both compounds will be discussed simultaneously. Aldrin is not known to occur naturally (1,2).

Initially in 1970, the U.S. Department of Aqriculture cancelled all uses of aldrin based on the potentially carcinogenic nature of the compounds and the concern that these chemicals could cause severe aquatic environmental change. Aldrin has not been produced or used in the U.S. since 1987. Any past releases have probably been converted to its degradation product, dieldrin, which has also been cancelled for use (1,2).

FATE AND TRANSPORT

Aldrin

Log Koc: 4.69 (1)
Log Kow: 3.01 (1); 6.5 (2)
Half-life: see text
Henry's Law Constant: 3.2×10^{-4} atm-m^3/mole (1); 4.96×10^{-3} atm-m^3/mole (2)
BCF: 4,571 (molluscs) (2)
3,890 (golden orfe)
12,260 (algae)
Degradation Products: Dieldrin (1,2,3)
Solubility:
Water: 0.20 mg/L @ 25°C (1); 0.02 mg/L @ 20°C (2); 0.027 mg/L (3)
Organic Solvents: Very soluble in most organic solvents (1)
Vapor Pressure: 7.5×10^{-5} mm Hg @ 20°C; 1.4×10^{-4} mm Hg @ 25°C (1); 3.75×10^{-5} mm Hg @ 20°C (2); 6×10^{-6} mm Hg @ 25°C (3) Density: 1.7 @ 20°C (3)

Dieldrin

Log Koc: 3.87 (1); 3.87-4.08 (2)
Log Kow: 4.55 (1)
Half-life: 723 days (evaporation at 25°C)(1)
Henry's Law Constant: 1.51×10^{-5} atm-m^3/mole @ 25°C (1)
BCF: 100-10,000 (various aqueous species) (2) 3-6,000 (fish) (2)
Degradation Products: Photodieldrin (1)
Solubility:
Water: 0.18 mg/L @ 25°C (1); 0.2 mg/L @ 25°C (4)
Organic Solvents: Very soluble in benzene; slightly soluble in acetone, alcohol and ether (1)
Vapor Pressure: 1.78×10^{-7} mm Hg @ 20°C; 7.78×10^{-7} mm Hg @ 25°C (1); 2.8×10^{-6} mm Hg @ 20°C (4)
Density: 1.7 @ 20°C (1)

As stated previously, aldrin quickly degrades to dieldrin upon entry into the environment. Aldrin undergoes photolysis to dieldrin, which further degrades by ultraviolet radiation or microbial action into the more persistent photodieldrin (1).

Dieldrin is ubiquitous in the environment and very persistent. This is due to its higher resistance to biotransformation and abiotic degradation than aldrin. Consequently, dieldrin is found in low levels in all media. Dieldrin has a strong affinity for organic matter such as animal fat and plant waxes. Consequently, it bioconcentrates and biomagnifies through the terrestrial and aquatic food chains. This degradation product strongly adheres to soil and sediment, which minimizes mobility in this medium. However, aldrin and dieldrin can

volatilize from soil. Dieldrin is not water soluble. The presence of these compounds in surface water is attributed to runoff from contaminated soil (1).

Aldrin can enter the environment from accidental spills or leaks from storage containers at waste sites. In the past, aldrin entered the environment as a result of pesticide use on crops and use as termite control. Due to use on crops, aldrin and dieldrin have persisted as residue in soil and resulted in crop uptake. Because of the persistence and bioaccumulation of dieldrin, exposure can occur through the ingestion of contaminated water or food. The potential for exposure also exists in homes treated for termites. In this case, exposure via inhalation is significant (1).

PHARMACOKINETICS

Exposure to aldrin and dieldrin can occur via ingestion, dermal contact and inhalation. Inhalation and dermal contact exposure in air is possible due to the volatilization of these aldrin from contaminated surfaces. Hence, these compounds can enter the bloodstream via the stomach, skin, and lungs. As stated previously, aldrin quickly breaks down to dieldrin upon entry into the body. The dieldrin is very persistent in the fatty tissue. It can take a period of weeks to years for the compound to leave the body (1).

A study of the body burden of dieldrin showed that the bioconcentration and rate of elimination of dieldrin were related to the lipid content of the person. The highest levels of dieldrin in adipose tissue were found in the leanest individuals. These individuals also exhibited the lowest total body burden. However, the proportion of the total exposure dose retained in the adipose tissue was highest in those subjects with the greatest total body fat (1).

Placental transfer of dieldrin occurs. A study showed that the level of this pesticide was higher in fetal blood than the mother's blood (1). Aldrin and dieldrin are both toxic to the reproductive system and teratogenic. Reproductive effects include decreased fertility, increased fetal death and effects on gestation. Teratogenic effects include cleft palate, webbed foot and skeletal anomalies (4).

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

Aldrin and dieldrin cause similar adverse health effects. Short-term exposure to elevated levels of these compounds causes central nervous system excitation resulting in convulsions. Acute exposure can also damage the kidneys. Chronic exposure from an occupational setting also produces convulsions. Exposure to moderate levels of aldrin or dieldrin can cause headaches, dizziness or uncontrolled muscle movements. Animal studies support these health effect observations in humans (1).

It is unlikely that sufficient quantities of these pesticides could be ingested by persons living within vicinity of a hazardous waste site to result in death. Additionally, low levels of these compounds likely to be in air near such a site are significantly lower than the levels necessary to cause death (1).

The USEPA reference dose for chronic oral exposure to aldrin is $3x10^{-5}$ mg/kg/day. The reference concentration for chronic inhalation exposure is not available (2). The oral reference dose for chronic exposure to dieldrin is $5x10^{-5}$ mg/kg/day. The reference concentration for chronic inhalation exposure to dieldrin is not available (3).

Carcinogenic Effects

Epidemiological studies have been inadequate to determine whether aldrin and dieldrin cause cancer in exposed populations because of small sample size and the exposure of subjects to other chemicals in addition to aldrin and dieldrin. However, several studies conducted on mice indicate that aldrin and/or dieldrin may induce carcinoma in the liver. In addition, another study showed an increase in pulmonary, lymphoid and other tumors upon exposure to these pesticides. Most recent data indicates that aldrin and dieldrin may act primarily as tumor promoters (1).

An upper bound cancer slope factor (CSF) of 17 $(mg/kg/day)^{-1}$ for oral exposure to aldrin was estimated by USEPA. The inhalation CSF was 17 (mg/kg/day) (3). The oral CSF for dieldrin is 16 $(mg/kg/day)^{-1}$. The inhalation CSF is 16.1 $(mg/kg/day)^{-1}$ (3). The USEPA weight-of-evidence for aldrin and dieldrin is B2-Probable human carcinogen (2).

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

Aldrin and dieldrin are both acutely toxic to freshwater species at low concentrations. The LC_{50} values range from 1 to 46 µg/L for different fish species. Saltwater species are also sensitive to these pesticides. The range of LC_{50} values are similar to the freshwater range. The range for aldrin is 2 to 100 µg/L and 1 to 34 µg/L for dieldrin (4).

Terrestrial and Avian

These pesticides, particularly dieldrin, have been associated with large-scale bird and mammal kills in treated areas. Experimental feeding studies have shown that the chemicals are quite toxic to terrestrial wildlife and domestic animals at low levels (4).

REGULATORY LEVELS AND CRITERIA

National aldrin and dieldrin regulatory levels and criteria relative to a risk assessment are established under the Safe Drinking Water Act (SDWA), and the Ambient Water Quality Criteria (WQC).

SUMMARY OF CRITERIA

	Aldrin
Chronic Oral RfD:	$3x10^{-5}$ mg/kg/day (2)
Chronic Inhalation (RfC):	Not Available (2)
USEPA Weight-of-Evidence:	B2-Probable human carcinogen (2)
Oral Slope Factor:	17 $(mg/kg/day)^{-1}$
Inhalation Slope Factor:	17.1 $(mg/kg/day)^{-1}$
SDWA MCLG MCL:	Aldrin in an unregulated contaminant for which USEPA establishes a monitoring requirement, but which does not have an associated final MCLG or MCL (2)
Ambient Water Quality Criteria	
Human Health	
- Water and Fish Consumption	$7.4x10^{-5}$ µg/L (2)
- Fish Consumption Only	$7.9x10^{-5}$ µg/L (2)

Aquatic Organisms	
- Freshwater, Acute	3 µg/L (2,4)
- Freshwater, Chronic	None
- Marine, Acute	1.3 µg/L (2)
- Marine, Chronic	None
ACGIH TLV-TWA:	0.25 mg/m^3 (4)
OSHA PEL-TWA:	0.25 mg/m^3 (4)

Dieldrin

Chronic Oral Exposure (RfD):	5x10^{-5} mg/kg/day (3)
Chronic Inhalation (RfD):	Not Available (3)
USEPA Weight-of-Evidence:	B2-Probable human carcinogen (2)
Oral Slope Factor:	16 (mg/kg/day)$^{-1}$ (3)
Inhalation Slope Factor:	16.1 (mg/kg/day)$^{-1}$ (3)
SDWA MCLG, MCL:	Dieldrin in an unregulated contaminant for which USEPA establishes a monitoring requirement, but which does not have an associated final MCLG or MCL (2)
Ambient Water Quality Criteria	
Human Health	
- Water and Fish Consumption	0.00014 µg/L (5)
- Fish Consumption Only	0.00014 µg/L (5)
Aquatic Organisms	
- Freshwater, Acute	2.5 µg/L (4)
- Freshwater, Chronic	0.0019 µg/L (4)
- Marine, Acute	0.71 µg/L (4)
- Marine, Chronic	0.0019 µg/L (4)
ACGIH TLV-TWA:	0.25 mg/m^3 (4)
OSHA PEL-TWA:	0.25 mg/m^3 (4)

REFERENCES

1 Toxicological Profile for Aldrin/Dieldrin (Draft For Public Comment). U.S. Department of Human and Health Services. Public Health Service. Agency for Toxic Substances and Disease Registry. Atlanta, Georgia. February 18, 1992.

2. Integrated Risk Information System (IRIS). Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. 1994.

3. Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Volume II Pesticides Philip H. Howard. Lewis Publishers, Inc. 1991.

4. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. September 1985.

5. Federal Register. Rules and Regulation. Volume 57. Number 246. December 22, 1992.

Date of Last Revision: 12/14/94
Revisor: Patrick B. Moroney

ALUMINUM

INTRODUCTION

Chemical Name: Aluminum
Synonyms (1): Alaun; Alumina Fibre; Aluminum Dehydrated; Aluminium Flake
CAS Number (1): 7429-90-5
Molecular Formula (1): Al
Molecular Weight (1): 26.98 g/mole

Aluminum is a silvery white, crystalline solid which is the most abundant component of the earth's crust. It is the third most abundant of all chemicals and does not occur free in nature. Fine powder forms of aluminum are flammable and form explosive mixtures in the air.

HUMAN HEALTH EFFECTS

Aluminum compounds can affect absorption of other elements in the gastrointestinal tract and thereby alter intestinal function. Aluminum inhibits fluoride absorption and may decrease the absorption of calcium and iron compounds and possibly the absorption of cholesterol. It may alter gastrointestinal tract motility through inhibition of acetylcholine-induced contractions which may explain why aluminum-containing antacids often produce constipation.

A progressively fatal neurologic syndrome also has been reported in patients on long-term intermittent hemodialysis treatment for chronic renal failure. The disorder, which typically arises after three to seven years of dialysis treatment, may be due to aluminum intoxication. Sources of excess aluminum may be from oral aluminum hydroxide commonly given to these patients or from aluminum in dialysis fluid derived from tap water used to prepare the dialysis fluid.

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

The chemistry of aluminum in surface water is complex due to the following five properties:

- aluminum is amphoteric; it is more soluble in acidic solutions than basic solutions;
- ions such as chloride and sulfate form soluble complexes with aluminum;
- aluminum can form strong complexes with fulvic and humic acids;
- hydroxide ions can connect aluminum ions to form soluble and insoluble polymers; and,
- under some environmental conditions, aluminum solutions slowly reach equilibrium (4).

Acute tests have been conducted on aluminum at pH values ranging between 6.5 and 9.0 with freshwater species in fourteen genera. In many tests, less than 50% were affected at the highest concentration tested. Some studies found that the acute toxicity of aluminum increased with pH, whereas others found the opposite to be true. Three studies have been conducted on the chronic toxicity of aluminum to aquatic animals. The chronic values of Daphnia magna, Ceriodaphnia dubia, and the fathead minnow were 742.2, 1,908, and 3,288 µg/L, respectively. The diatom, Cyclotella meneghiniana, and the green alga, Selenastrum capricornutum were affected by concentrations of aluminum in the range of 400 to 900 µg/L. Bioconcentration factors from 50 to 231 were obtained in tests with young brook trout and striped bass. At a pH of 6.5 to 6.6, 169 µg/L caused a 24% reduction in the growth of young brook trout, and 174 µg/L killed 58% of the exposed striped bass.

The Ambient Water Quality Criteria indicates that, except possibly where a locally important species is very sensitive, freshwater aquatic organisms and their uses should not be affected adversely, when pH is between 6.5 to 9.0 if the four-day average concentration of aluminum does not exceed 87 µg/L more than once every three years on the average, and if the one-hour average concentration does not exceed 750 µg/L more than once every three years on average.

Terrestrial and Avian

Information regarding the toxicity of aluminum to terrestrial and avian wildlife or domestic animals was not available.

REGULATORY LEVELS AND CRITERIA

ACGIH TLV-TWA (5):

2 mg/m^3 (soluble salts)
2 mg/m^3 (alkyls)
5 mg/m^3 (welding fumes)

OSHA PEL-TWA (6):

15 mg/m^3 (total dust)
5 mg/m^3 (respirable fraction)

Chronic Oral RfD: 1.0 mg/kg/day (7)

REFERENCES

1. Sax, Irving N. and Richard J. Lewis, Sr. Hazardous Chemicals Desk Reference. Van Nostrand Reinhold Company, Inc., New York, New York. 1987.

2. Hawley, G.G. The Condensed Chemical Dictionary-Eleventh Edition. Van Nostrand Reinhold Company, Inc., New York, New York. 1987.

3. Klaasen, C.D., M.O. Andur, and J. Doull, Eds. Casarett and Doull's Toxicology, The Basic Science of Poisons, Third Edition. Macmillian Publishing Company. New York, New York. 1986.

4. Environmental Protection Agency. Ambient Water Quality Criteria for Aluminum. Office of Water Regulations and Standards. Washington, D.C. September, 1988.

5. American Conference of Governmental Industrial Hygienists (ACGIH). Threshold Limit Values and Biological Exposure Indices. 1993-1994.

6. 29 Code of Federal Regulations, Part 1910.1000, Table Z-1. 1993.

7. United States Environmental Potection Agency. 1994. "Risk-Based Concentration Tables, Fourth Quarter 1994." Region III, Philadelphia, Pennsylvania.

Date of Last Revision: 12/14/94
Revisor: Patrick B. Moroney

ANTIMONY

INTRODUCTION

Chemical Name:	Antimony
CAS Number (1):	7440-36-0
Molecular Formula (1):	Sb
Molecular Weight (1):	151.18 g/mole

Antimony is a silvery or gray lustrous metal that comes from the ores stibnite, dermasite, tetrahedrite, livingstonite, and jamisonite (1). Stibnite is the most common naturally occurring form of antimony. Antimony is used as a hardening alloy for lead, solder, sheet and pipe, semiconductor technology, production of fireproofing chemicals, ceramics, glassware, and pigments, and pyrotechnics (2,3). Antimony exists in four valence states (-3, 0, +3, and +5) (4). Antimony is a common air pollutant from industrial emissions but exposure in the general population is largely from food (3).

FATE AND TRANSPORT

Antimony occurs as a soluble oxide or as antinomite (+3) salt in most natural water systems. It may change to volatile stibine in a reducing environment. Stibine is very soluble in water, but it is not stable in under aerobic conditions. Sediment beds offer a reducing environment allowing for remobilization of antimony previously removed from solution. Sorption to clays and minerals is the most important mechanism resulting in the removal of antimony from solution. Insoluble forms of antimony compounds may be formed when heavy metals in solution react with antimonite or antimonate. Bioaccumulation represents a minor fate process for antimony. (4)

PHARMACOKINETICS

Antimony is slowly absorbed from the gastrointestinal tract. The metal accumulates in lung tissue when humans are exposed to antimony dust in an occupational setting. Trivalent antimony is concentrated in red blood cells and the liver. Pentavalent antimony is mostly found in plasma. Both trivalent and pentavalent antimony are excreted in feces and urine. More trivalent antimony is excreted in the urine, where more pentavalent antimony is excreted in the feces (3).

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

Studies have reported that antimony trioxide, antimony trichloride, and antimony pentachloride may be mutagenic. Reproductive studies have indicated that female workers exposed to metallic antimony dust, antimony trioxide, and pentoxide had an increase in incident of gynecological disorders and late spontaneous abortions. Antimony was found in the breast milk, placental tissue,

amniotic tissue, and blood of the umbilical cord in exposed workers. Intraperitoneal administration of antimony in rats supported the findings of the human reproductive effects (4).

Cardiovascular effects in humans consist of changes in electrocardiograms, cardiac edema, myocardial fibrosis, and other signs of myocardial structural damage when exposed to either trivalent or pentavalent antimonial compounds. Animal studies have supported these findings (4).

Antimony and/or its compounds are known to cause pneumoconiosis upon inhalation exposure. Chronic exposure by inhalation causes rhinitis, pharyngitis, tracheitis, and bronchitis. Dermatitis may occur in humans dermally exposed to antimony (4). Also transient skin eruptions, termed "antimony spots", may occur in workers with chronic exposure to antimony (3). An oral RfD of 4.0×10^{-4} has been established by EPA.

Carcinogenic Effects

Antimony production workers have demonstrated higher incidences of lung cancer. Also, animal studies involving rats have indicated that antimony trioxide may produce lung and liver tumors (4).

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

Although criteria have not been established for antimony, the lowest values known to be toxic in aquatic organisms have been reported. These values are as follows (5):

Freshwater:

Acute toxicity:	88 µg/L (proposed criteria)
Chronic toxicity:	30 µg/L (proposed criteria)

Marine:

Acute toxicity:	1,500 µg/L (proposed criteria)
Chronic toxicity:	500 µg/L (proposed criteria)

These values were established from a study involving the exposure of antimony potassium tartrate and antimony trichloride to Daphnia magna. The LC_{50} and EC_{50} values for Daphnia magna and the fathead minnow ranged from 9,000 to 21,900 µg/L. The chronic value for the fathead minnow and Daphnia magna are 1,600 and 5,400 µg/L, respectively. No detectable bioconcentration of antimony by the bluegill was observed (4).

Terrestrial and Avian

Studies regarding the toxicity of antimony to wildlife and domestic animals were not located in the available literature (4).

REGULATORY LEVELS AND CRITERIA

Oral RfD (7):	$4x10^{-4}$ mg/kg/day
EPA Carcinogenic Classification (7):	Group D - not classified as a carcinogen
Ambient Water Quality Criteria (5):	
Water and Organisms	146 µg/L
Organisms Only	45,000 µg/L
MCL	0.006 mg/L
MCLG	0.006 mg/L
OSHA PEL-TWA:	0.5 mg/m^3 (antimony and its compounds as Sb)
ACGIH TLV-TWA:	0.5 mg/m^3 (antimony and its compounds as Sb)

SUMMARY OF CRITERIA

The Oral RfD for antimony was reported as $4.0x10^{-04}$. The study supporting this value involved the exposure of 5 ppm of antimony potassium tartrate in drinking water to rats (7).

REFERENCES

1. Sax, Irving N. and Richard J. Lewis, Sr. Hazardous Chemicals Desk Reference. Van Nostrand Reinhold Company, Inc., New York, New York. 1987.

2. Hawley, G.G. The Condensed Chemical Dictionary-Eleventh Edition. Van Nostrand Reinhold Company, Inc., New York, New York. 1987.

3. Klaasen, C.D., M.O. Andur, and J. Doull, Eds. Casarett and Doull's Toxicology, The Basic Science of Poisons, Third Edition, Macmillian Publishing Company. New York, New York. 1987.

4. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. September 1985.

5. Ambient Water Quality Criteria. Office of Water, U.S. Environmental Protection Agency, Washington D.C. May 1986.

6. HEAST. Health Effects Assessment Summary Tables. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. March 1994.

7. IRIS. Integrated Risk Information System. Office of Research and Development, USEPA, Washington, D.C. 1994.

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ARSENIC

INTRODUCTION

Chemical Name:	Arsenic
CAS Number:	7440-38-2
Molecular Formula:	As
Molecular Weight:	74.92 g/mole
Chemical Structure:	As

Arsenic (elemental) exists as a silvery to black, brittle, crystalline and amorphous metalloid. Arsenic is used in the production of glass, enamels, ceramics, oil, cloth, linoleum, electrical semiconductors, pigments, fireworks, pesticides, fungicides, veterinary pharmaceuticals and wood preservatives. Arsenic also has been shown to occur in municipal sewage (7).

FATE AND TRANSPORT

BCF (1):	Accumulates to toxic levels in food chain organisms
Degradation Products:	None
Solubility:	
In Water (5):	Insoluble
In Organics (6):	Unknown (5); soluble in nitric acid
Vapor Pressure (6):	1 mm Hg @ 372° C (sublimes)
Specific Gravity (5):	5.727

Arsenic can occur in soil, water, or air. Since it is an element, it cannot be degraded by environmental processes. However, transformation from one arsenic compound to another is possible.

In the environment, arsenic can occur in four different oxidation states (-3, 0, +3, +5). The particular chemical speciation is important in determining mobility. Interconversions between the +3 and +5 states, as well as organic complexation, are most important (8).

In the soil, the concentration and chemical form in which arsenic occurs is affected by pH, soil type and iron and aluminum content of the soil. Lowered pH and reducing conditions tend to favor the development of arsine, a toxic gas comprised of arsenic and oxygen (7).

In the aquatic environment, volatilization is an important mechanism when biological activity or highly reducing conditions favor the production of arsine or methylarsenics. Sorption of arsenic onto sediments is also an important process in aquatic transport processes. While arsenic may cycle considerably in the environment given its mobility, the deep ocean probably serves as a sink for most inorganic arsenic (7).

PHARMACOKINETICS

Human and animal studies have shown that gastrointestinal absorption of arsenic is very high (>90 to 95 percent). Absorption of arsenic via the inhalation and dermal routes is limited in both animal and human studies. In terms of the developing fetus, inorganic arsenic has been shown to rapidly cross the transplacental barrier after oral administration to mice and rats (5).

Most animals and humans tend to clear arsenic rapidly from the blood and other tissues (including the liver, kidneys, and lungs). Arsenic has been shown to be retained in the brain of experimental animals (5). Arsenic has a tendency to accumulate in the skin and desquamous tissues, such as hair and nails of animals (2).

The main route of excretion for absorbed arsenic is via the urine. Studies demonstrate that only six to nine percent of ingested arsenic appears in the feces, indicating nearly complete gastrointestinal absorption of the metal. The biological half-life is on the order of ten hours, with 50 to 80 percent excreted in about three days (2).

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

Trivalent compounds of arsenic are the principal toxic forms. Arsenic's principal mode of toxic action is at the cellular level, where it affects mitochondrial enzymes that are critical in tissue respiration (2).

Ingestion of large doses of arsenic can be acutely fatal. Symptoms include fever, anorexia, cardiac arrhythmia and eventual cardiovascular failure. Additionally, central nervous system (CNS) effects, including peripheral neuropathy and sensory loss, are usually noted (2).

Chronic long-term exposure is characterized by liver injury. This is usually reflected as jaundice, and may progress to cirrhosis. Also, peripheral vascular disease has been observed in persons chronically exposed to arsenic (2).

USEPA has established an oral RfD of 3×10^{-4} mg/kg/day for arsenic. This is based on keratosis and hyperpigmentation (1).

Carcinogenic Effects

Arsenic has been implicated as a carcinogen by the inhalation route in both animal and human studies.

Studies of populations living near arsenic-using pesticide manufacturing plants were shown to have an increased incidence of lung cancer. Also, case reports of arsenical pesticide applicators have demonstrated an association between arsenic exposure and lung cancer (1).

Evidence for the carcinogenicity of arsenic via oral exposure comes from an epidemiological study where an arsenic-contaminated water supply was associated with a significant increase in cancer of the bladder, lung, liver, kidney, skin and colon (1).

Because of arsenic's carcinogenic potential in humans, the EPA has classified it as a Group A carcinogen-human carcinogen. The carcinogenic slope factor for arsenic by inhalation exposure is 15.1 $(mg/kg/day)^{-1}$. Also, a carcinogenic slope factor of 1.75 x 10 (mg/kg/day) has been derived for ingestion exposure to this element (1,4).

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

While various forms of inorganic arsenic seem to have roughly similar toxicities in aquatic organisms, they all seem to be much more toxic than the organic forms. Acute toxicity of adult freshwater animals has been shown to occur at arsenic trioxide levels as low as 812 µg/L and as low as 40 µg/L in early life stage organisms (8).

Ambient Water Quality Criteria for the protection of aquatic organisms are as follows: (1)

Freshwater:

Acute Toxicity:	3.6×10^2 µg/L (Arsenic III)
Chronic Toxicity:	1.9×10^2 µg/L (Arsenic III)

Marine:

Acute Toxicity:	6.9×10^1 µg/L (Arsenic III)
Chronic Toxicity:	3.6×10^1 µg/L (Arsenic III)

Terrestrial and Avian

Information on arsenic toxicity among terrestrial wildlife is very limited. However, arsenic poisoning has been known to occur on rare occasions in domestic animals. Arsenic poisoning in domestic animals leads to hyperemia and edema of the gastrointestinal tract, hemorrhage of the cardiac serosal surfaces and peritoneum, and pulmonary congestion and edema (8).

REGULATORY LEVELS AND CRITERIA

The following regulatory levels and criteria have been established for arsenic:

OSHA PEL-TWA (9):	10 $\mu g/m^3$ (inorganic)
ACGIH TLV-TWA (10):	0.01 mg/m^3
MCL(1):	0.05 mg/lL
EPA Ambient Water Quality Criteria (5):	
Ingestion of Water and Aquatic Organisms:	2.2×10^{-6} mg/L
Ingestion of Organisms Only:	1.75×10^{-5} mg/L

SUMMARY OF CRITERIA

EPA Carcinogenic Classification (1):	Group A-human carcinogen
Cancer Slope Factor (Inhalation) (1):	15.1 $(mg/kg/day)^{-1}$
Cancer Slope Factor (Oral) (4):	1.75×10^{0} $(mg/kg/day)^{-1}$
Oral RfD (1):	3×10^{-4} mg/kg/day
Inhalation RfD (4):	Not Determined
NOAEL (4):	0.009 mg/L

REFERENCES

1. IRIS. Integrated Risk Information System. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. 1994.

2. Klaassen, C.D., M.O. Amdur, and J. Doull, eds. Casarett and Doull's Toxicology - The Basic Science of Poisons. Third Edition. MacMillan Publishing Comany, New York, New York, 1987.

3. Hawley, G.G., The Condensed Chemical Dictionary-Eleventh Edition. Van Nostrand Reinhold Company, Inc., New York, New York. 1987.

4. HEAST. Health Effects Assessment Summary Tables. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. March 1994.

5. Toxicological Profile for Arsenic. U.S. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, and U.S. Environmental Protection Agency. Atlanta, Georgia. January 1988.

6. Sax, N.I. and R.J. Lewis. Hazardous Chemicals Desk Reference. Van Nostrand Reinhold Company, Inc. New York, New York. 1987.

7. Hazardous Waste Land Treatment. U.S. Environmental Protection Agency. April 1983.

8. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency. Washington, D.C. September 1985.

9. 29 Code of Federal Regulations Part 1910.1018. 1993.

10. American Conference of Governmental Industrial Hygienists (ACGIH). Threshold Limit Values and Biological Exposure Indices. 1993-1994.

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Revisor: Rich Hoff

BARIUM

INTRODUCTION

Chemical Name:	Barium
CAS Number:	7440-39-3
Molecular Formula:	Ba
Molecular Weight:	137.3 g/mole
Chemical Structure:	Ba

Barium is a silvery-white, slightly lustrous, somewhat malleable metal. It is used in various alloys, paints, soap, paper, and rubber, and in the manufacture of ceramics and glass. Barium compounds also are used in diagnostic radiology (3,4).

FATE AND TRANSPORT

BCF (1):	Not Significant
Solubility (1):	
In Water:	Decomposes; combines with sulfate present in natural waters to form $BaSO_4$, which has a solubility of 1.6 mg/L @ 20° C
In Organics:	Soluble in alcohol, insoluble in benzene
Vapor Pressure:	Not Reported
Specific Gravity (1):	3.5

Barium is extremely reactive, decomposes in water, and readily forms insoluble carbonate and sulfate salts. It is generally present in surface water and groundwater only in trace amounts. Barium is not soluble at more than a few parts per million in water that contains sulfate at more than a few parts per million. It is rare to find barium in drinking water at concentrations in excess of 1 mg/L (1). In terms of atmospheric transport, barium can adhere to particulates and be transported via the wind (1).

PHARMACOKINETICS

The absorption, metabolism and excretion of barium and its compounds depend upon the solubility of the specific barium compound. Insoluble forms, such as barium sulfate, are not toxic by either ingestion or inhalation. The soluble salts of barium are absorbed, and small amounts are accumulated in the skeleton (3). However, the biological half-life for barium is generally less than 24 hours (1).

The primary route of barium elimination is through the feces (3). Urinary excretion of barium occurs to a much lesser extent because it is reabsorbed by the renal tubules of the kidney.

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

Soluble salts of barium, such as barium chloride and barium carbonate, are highly toxic by exposure via ingestion or inhalation (1).

The most important effect of acute barium poisoning is a strong, prolonged stimulant action of muscle including smooth, cardiac, and skeletal muscles. This tends to lead to a transient increase in blood pressure due to vasoconstriction (1,3).

Effects on the hematopoietic system and cerebral cortex have also been reported in humans. Accidental ingestion of soluble barium salts has resulted in gastroenteritis, muscular paralysis and ventricular fibrillation (1).

Baritosis, a benign form of pneumoconiosis, is an occupational disease arising from the inhalation of barium sulfate, barium oxide, or barium carbonate dust (1,3).

The EPA has established an oral RfD for barium of 7×10^{-2} mg/kg/day, based on increased blood pressure. EPA has placed a confidence rating of "medium" on this RfD (2). This value is based on a study involving the administration of barium chloride in drinking water to 11 male volunteers. The volunteers were given 1.5 L/day of distilled and charcoal-filtered water containing 0 mg/L barium for the first two weeks, 5 mg/L for weeks 3 to 6, and 10 mg/L for weeks 7 to 10. There were no changes in systolic or diastolic blood pressures or serum chemistry. There was an increase in serum calcium levels that was attributed to a decrease in serum albumin levels. However, these increases were not clinically significant (2). The RFDi was based on a four month inhalation study in rats that demonstrated fetotoxicity. A NOEL of 0.8 mg/cu m was identified in this study (5).

Carcinogenic Effects

Currently, there are no reports of carcinogenicity associated with exposure to barium (1). The EPA has not evaluated barium with respect to carcinogenic potential.

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

Information regarding the aquatic impact potential of barium was not readily available (1).

Terrestrial and Avian

Adequate data for characterization of toxicity to wildlife and domestic animals are not available (1).

REGULATORY LEVELS AND CRITERIA

Maximum Contaminant Level (MCL) (2):	2.0 mg/L
MCLG (2)	2 mg/L

OSHA PEL-TWA (1):	0.5 mg/m^3 (soluble compounds)
ACGIH TLV-TWA (1):	0.5 mg/m^3 (soluble compounds)
EPA Carcinogenic Classification (2):	Group D-not classified as a carcinogen
Oral RfD (2):	7×10^{-2} mg/kg/day
Inhalation RfD(5):	1.43×10^{-4} mg/kg/day

REFERENCES

1. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergence Response, U.S. Environmental Protection Agency, Washington D.C. September, 1985.

2. IRIS. Integrated Risk Information System. Office of Research and Development, U.S Environmental Protection Agency, Washington, D.C. 1994.

3. Casarett L.J, and Doull, J., Toxicology-the Basic Science of Poisons-Third Edition. Macmillan Publishing Company, New York, New York. 1986.

4. Sax, N.I. and R. Lewis, Hazardous Chemicals Desk Reference. Van Nostrand Reinhold Company, Inc. New York, New York. 1987.

5. HEAST. Health Effects Assessment Summary Tables. Office of Emergency and Remedial Response, USEPA. March 1994.

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BERYLLIUM

INTRODUCTION

Chemical Name:	Beryllium
CAS Number:	7440-41-7
Molecular Formula:	Be
Molecular Weight:	9.01 g/mole

Beryllium is a dark gray metal from the alkaline earth family. Most of the beryllium ore that is mined is converted into metal alloys which are used in the fields of electronics and metal fabrication. Pure beryllium is used in nuclear weapons and reactors and x-ray transmission windows and mirrors (4).

FATE AND TRANSPORT

BCF:	100 for freshwater and marine plants, invertebrates, and fish (4)
Solubility:	
In Water:	Insoluble
In Organics (1):	Soluble in dilute acid and alkali; insoluble in alcohol, ether, and CCl_4
Specific Gravity (1):	1.85 @ 20° C

Beryllium can be present in the air, water, and soil although it can not be degraded by environmental fate processes. However, it may transform from one beryllium compound to another. The major source of its emissions to the environment is the release of particulates and fly ash into the atmosphere through the combustion of coal and fuel oil. Other sources of emission are associated with ore processing, metal fabrication, and beryllium oxide production and use. Beryllium is most likely found in the environment in the particulate form rather than the dissolved form (4).

There is no information regarding the aquatic or soil biotransformation of beryllium and its compounds (4).

The removal of beryllium from the atmosphere occurs through wet and dry deposition. Because beryllium displaces divalent cations which share common sorption sites, in most types of soil, it is expected to be tightly adsorbed. Since the BCF is reported at <1000, beryllium will not significantly bioaccumulate (4).

PHARMACOKINETICS

Beryllium enters the body through inhalation of air, consumption of food, and contact with water. The primary route of exposure is by inhalation. Based on animal studies, pulmonary absorption does not appear to be extensive, and absorption through the gastrointestinal tract and the skin appears to

be minimal. Dermal exposure to soluble beryllium compounds can cause contact dermatitis in humans (4).

Animal studies indicate that once beryllium enters the body via inhalation, it is circulated in the blood as an orthophosphate colloid and then distributed to the bone, liver, and kidneys in both humans and animals. Oral exposure of soluble beryllium in animal studies showed that distribution of the compound was mainly to the liver and intestine whereas insoluble beryllium was found mainly in the intestine.

Although beryllium is not biotransformed, soluble beryllium compounds are partially converted to more insoluble forms in the lungs (4).

Due to the poor absorption of beryllium compounds through the gastrointestinal tract, excretion of beryllium after oral administration of the compound is primarily in the feces, as demonstrated in animal studies. Following oral exposure to animals, only a very small amount appears in the urine; however, if beryllium is inhaled, a large portion of the absorbed beryllium is excreted in the urine (4).

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

The most profound effect from inhalation appears in the lungs. Exposure to beryllium oxide or to soluble beryllium compounds may lead to the development of acute chemical pneumonitis. Beryllium and chemical pneumonitis in humans may result from exposures ranging from < 2 to 1000 $\mu g/m^3$. Chronic exposure to insoluble forms may lead to berylliosis. The most common clinical symptom of berylliosis is a granulomatous lung inflammation. Additional respiratory effects are rhinitis, pharyngitis, and tracheobronchitis. Besides the lung, beryllium also accumulates in the bone, liver and kidneys (1,4). No studies were identified describing the toxicity of beryllium when administered to humans by the oral route (4).

Beryllium can be absorbed through the skin; however, this route is minor. Exposure levels producing skin lesions associated with acute dermal exposure were not available (4). Also, direct contact with the eyes may cause inflammation to the conjunctiva (1).

No human data were available concerning decreased longevity. One study involving mice reported acute oral LD_{50}s of 18 to 20 mg/kg. The EPA has verified an oral RfD of 0.005 mg/kg/day. This figure was based on a study where rats were exposed to beryllium sulfate in drinking water at a concentration of 5 mg/L. A NOAEL was calculated at 5 mg/L (3).

Carcinogenic Effects

This chemical is among the substances classifed as a probable human carcinogen. This classification is based on limited evidence of carcinogenicity in humans from epidemiologic studies (3). Studies indicating increased lung cancer in individuals who have been exposed to beryllium failed to account for confounding factors such as lung cancer associated with smoking, and did not include employees of the beryllium industry who were not exposed to the beryllium (control groups) (4).

There has been sufficient information to link beryllium to lung cancer via inhalation in animals; osteosarcomas have been observed in rabbits via intravenous or intramedullary injection (3). Also, there has been sufficient information to link beryllium to an induction of tumors via inhalation and intratracheal instillation in rats and monkeys, and the induction of osteosarcomas in rabbits by intravenous or intramedullary injection in multiple studies.

Slight increases in cancer incidence were reported in Long-Evans rats that were administered 5 ppm beryllium sulfate in drinking water for a lifetime. An increase in reticulum cell carcomas of the lungs was seen in male Wistar-derived rats administered beryllium sulfate in the diet at 5 and 50 ppm, but not at 500 ppm.

Osteogenic sarcomas were induced in rabbits by intravenous injection of beryllium compounds. Bone tumors were induced by beryllium oxide, zinc beryllium silicate, beryllium phosphate, beryllium silicate, and beryllium metal.

Lung tumors (adenomas and adenocarcinomas) have been induced via the inhalation route in both male and female Sprague-Dawley rats during exposure periods of up to 72 weeks by beryllium sulfate, in Sherman and Wistar rats by beryllium phosphate, beryllium fluoride, and zinc beryllium silicate, in male Charles River CR-CD rats by beryl ore, and in both male and female rhesus monkeys by beryllium sulfate. Positive results were seen in rats exposed to beryllium sulfate at concentrations as low as 2 $\mu g/m^3$ (3).

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

Available data are not adequate to develop ambient water quality criteria for aquatic life protection. However, the EPA has reported the lowest concentration of beryllium known to cause toxic effects. The criterion for acute beryllium exposure to freshwater organisms is 130 $\mu g/L$. The chronic exposure for freshwater organisms is 5.3 $\mu g/L$. No saltwater acute or chronic studies are available (4).

Terrestrial and Avian

No data are available for terrestrial and avian life forms (4).

REGULATORY LEVELS AND CRITERIA

OSHA Ceiling Limit (4):	5 $\mu g/m^3$
OSHA PEL-TWA (4):	2 $\mu g/m^3$
ACGIH TLV-TWA (4):	2 $\mu g/m^3$
Ingestion of water and fish (3):	6.8×10^{-3} $\mu g/L$
Ingestion of organisms only (3):	1.17×10^{-1} $\mu g/L$
Reportable quantity (3):	10 lbs
MCL (3):	0.004 mg/L
MCLG (3):	0.004 mg/L

SUMMARY OF CRITERIA

EPA Carcinogenic Classification (3):	Group B2-Probable human carcinogen
Cancer Slope Factor (Oral) (3):	4.3 $(mg/kg/day)^{-1}$
Cancer Slope Factory (Inhalation) (3):	8.4 $(mg/kg/day)^{-1}$
Oral RfD (3):	0.005 mg/kg/day
Inhalation RfD (3):	Not available
NOAEL (7):	50 mg/kg/day

REFERENCES

1. Chemical,Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. September 1985.

2. Hawley, G.G. The Condensed Chemical Dictionary - Eleventh Edition. Van Nostrand Reinhold Company, Inc., New York, New York. 1987.

3. IRIS. Integrated Risk Information System. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. 1994.

4. Toxicological Profile for Beryllium. (Draft). Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, and U. S. Environmental Protection Agency. Atlanta, Georgia. October 1987.

5. SPHEM. Superfund Public Health Evaluation Manual. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. October 1986.

6. U. S. Environmental Protection Agency, Federal Register, National Primary and Secondary Drinking Water Regulations, Proposed Rule, Vol. 55, No. 143, July 25, 1990.

7. HEAST. Health Effects Assessment Summary Tables. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. March 1994.

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CADMIUM

INTRODUCTION

Chemical Name:	Cadmium
CAS Number:	7440-43-9
Molecular Formula:	Cd
Molecular Weight:	112.4 g/mole

Cadmium is a soft, blue-white, malleable metal or grayish-white powder. It is obtained as a by-product from the treatment of copper, lead, and iron (1). Its primary uses are as a pigment, and in batteries, specialized metal alloys, and photography (2).

FATE AND TRANSPORT

BCF:	81 (4)
Solubility (4) :	Salts are water soluble; metal is insoluble
Specific Gravity (1):	8.642

Cadmium can be present in the air, water, and soil. Most often, cadmium exists in small particles which tend to be more persistent. Photochemical reactions are not involved in the atmospheric fate of cadmium. The largest source of atmospheric cadmium occurs as a result of fossil fuel combustion (4).

In water, cadmium is relatively mobile and may exist as a hydrated ion or as metal inorganic complexes. Many inorganic cadmium compounds are soluble in water; however, cadmium oxide and sulfide have very low solubilities (4).

Cadmium exists in soil as free cadmium compounds. It is strongly accumulated by organisms through food and water. The bioaccumulation capabilities of cadmium allow for elevated cadmium concentrations in mollusks, crustaceans, fish, and aquatic plants. Elevated cadmium levels in beef and poultry are often a result of cadmium-containing fertilizers (4).

PHARMACOKINETICS

Cadmium readily enters the body through ingestion of water or food and the inhalation of ambient air. Increased cadmium levels are largely attributed to plumbing, municipal incinerators, coal combustion, food grown in phosphate fertilizers, and smoking. Dermal exposure to cadmium is not considered a significant pathway (4).

Absorption of inhaled cadmium through the lung is dependent on particle size and whether or not the particles are respirable. It has been estimated that roughly 30 to 60 percent of inhaled cadmium is absorbed. Cadmium ingested in food or water is poorly absorbed (one to six percent) from the gastrointestinal tract of humans (4).

Cadmium is distributed to most organs in the body; however, the areas of greatest accumulation are the kidneys and liver. The primary route of excretion is through the urine. However, since only a small amount of cadmium is excreted per day, there is a strong tendency for cadmium to accumulate in the body over time. The half-life in humans ranges from 17 to 38 years (4).

Cadmium is not known to undergo any direct metabolic conversions in vivo such as oxidation, reduction, or alkylation. However, the cadmium ion does bind to protein and nonprotein sulfhydryl groups and to anionic groups in proteins and other molecules (4).

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

The primary adverse health effect in humans associated with long-term cadmium exposure is renal dysfunction. Manifestation, associated with abnormal renal function include the formation of renal stones, formation, disturbances in mineral metabolism, and renal functional lesions (4).

In the industrial environment, acute pulmonary exposure may lead to pneumonitis and severe pulmonary edema. Also, bone disorders, such as, osteomalacia, osteoporosis, and spontaneous bone fracture, have been observed in humans who are chronically exposed to cadmium (4). In recent studies, it has been found that relatively low doses of cadmium can alter the immune response in experimental animals; however, there is little evidence for suppression of the immune response in chronically exposed human populations (4). Other systemic effects include immunosuppression in animals, anemia, possible effects on the endocrine system, and defects in sensory function in humans. The LD_{50} in rats is 225 mg/kg (4). Cadmium is also an animal teratogen and reproductive toxin in laboratory animals.

The EPA has established an oral RfD values of 5.0×10^{-4} mg/kg/day (water) and 1.0×10^{0} mg/kg/day (food). A concentration of 200 μg cadmium/gm wet human renal cortex is the highest renal level not associated with significant proteinuria. The toxicokinetic model assumes that 0.01% day of the cadmium body burden is eliminated per day. Assuming 2.5% of absorption of cadmium from food or 5% from water, the toxicokinetic model predicts that the NOAEL for chronic cadmium exposure is 0.005 and 0.01 mg cadmium/kg/day from water and food, respectively.

Carcinogenic Effects

Cadmium is classified as an EPA Group B1 carcinogen, a probable human carcinogen by inhalation. An Inhalation Cancer Slope Factor of 6.3 has been established by EPA (3).

There is a significant association between cadmium and bronchogenic carcinomas and total malignant neoplasms in animals (4). Also, there is limited evidence which links cadmium inhalation exposure to an increased incidence of prostate cancer in exposed workers.

Studies with experimental animals have shown cadmium to produce significant increases in lung tumors. Also, administration of cadmium by injection has led to tumor formation at the injection site (4). Based on a large number of studies, it has been hypothesized that cadmium is not directly mutagenic, but impedes genetic repair (4).

It should be noted that carcinogenic effects have not been reported in either humans or laboratory animals exposed orally or dermally to cadmium (4).

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

Laboratory experiments suggest that cadmium may have adverse effects on reproduction in fish at levels present in lightly to moderately polluted water (1).

Freshwater fish and invertebrates exhibit an acute LC_{50} ranging from 100 to 1000 µg/L. Saltwater species were 10-fold more tolerant to cadmium. The bioconcentration factors are generally less than 1000, but as high as 10,000 for some freshwater fish (1).

Ambient Water Quality Criteria have been established for cadmium and are as follows (3):

Freshwater:	
Acute toxicity:	3.9 µg/L (1-hr)*
Chronic toxicity:	1.1 µg/L (4-day)*
Marine:	
Acute toxicity:	$4.3 \times 10^{+1}$ µg/L (1-hr)
Chronic toxicity:	9.3 µg/L (4-day)

*Hardness dependent criteria

Terrestrial and Avian

No data characterizing adverse effects on domestic or wild animals are available (1).

SUMMARY OF REGULATORY LEVELS AND CRITERIA

EPA Carcinogenic Classification (3):	B1-Probable human carcinogen via inhalation
Cancer Potency Factor (inhalation) (3):	6.3×10^{0} $(mg/kg/day)^{-1}$
Oral RfD (3):	5×10^{-4} mg/kg/day (water)
	1×10^{-3} mg/kg/day (food)
Ingestion of water and organisms (3):	1.0×10^{1} µg/L
Reportable quantity (3):	10 lbs
OSHA PEL-TWA (7):	5 µg/m^3
MCL:	5.0 µg/L
MCLG (6):	5 µg/L
WHO (drinking water) (4):	0.005 mg/L
ACGIH TLV-TWA (8):	0.01 mg/m^3 (total dust/particulate)
	0.002 mg/m^3 (respirable fraction)

REFERENCES

1. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. September 1985.

2. Hawley, G.G. The Condensed Chemical Dictionary - Eleventh Edition. Van Nostrand Reinhold Company, Inc., New York, New York. 1987.

3. IRIS. Integrated Risk Information System. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. 1994.

4. Toxicological Profile for Cadmium. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, and U.S. Environmental Protection Agency. Atlanta, Georgia. March 1989.

5. SPHEM. Superfund Public Health Evaluation Manual. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. October 1986.

6. U. S. Environmental Protection Agency, Federal Register, National Primary Drinking Water Regulations; Final Rule, Vol. 56, No. 20, January 30, 1991.

7. 29 Code of Federal Regulations Part 1910.1027. 1993.

8. American Conference of Governmental Industrial Hygienists (ACGIH). Threshold Limit Values and Biological Exposure Indices. 1993-1994.

Date of Last Revision: 3/10/95
Revisor: Rachel San Pedro

CARBAZOLE

INTRODUCTION

Chemical Name: Carbazole
Synonyms (1): 9H-carbazole; 9-azofluorene; dibenzopyrrole; dibenzo(b,d)pyrrole; diphenylenimine
CAS Number (1): 86-74-8
Molecular Formula (1): $C_{12}H_9N$
Molecular Weight (1): 167.2 g/mole
Chemical Structure (1):

Carbazole is a white crystalline solid with a characteristic odor. It is a PAH produced in the U.S. as a constituent of coal tar. Refined carbazole is used in the synthesis of dyes and other chemicals, as an odor inhibitor in detergents and to make photographic plates sensitive to UV light. Coal tar is used in creosote wood preservatives and anticorrosion coatings, as a feedstock for carbon-black manufacture, and as a binder for road surfacings and electrodes.

Carbazole is emitted to the aquatic and atmospheric environments primarily by emissions and releases from the coal tar and coal tar use industries. Carbazole also occurs as a product of incomplete combustion of nitrogen-containing organic matter and has been found in stack emissions from waste incineration.

FATE AND TRANSPORT

Log K_{oc}: NA
Log K_{ow} (1): 3.72
$t_{1/2}$ (1): ~3 hours near water's surface in winter
Henry's Law Constant (1): 2.07 x 10^{-03} atm-m^3/mole @24°
Solubility (1): 1.03 mg/L in water @20°C; 1.2 mg/L in water @20-25°C
It is soluble in most organic solvents, including quinoline, pyridine, acetone, ether, benzene and absolute alcohol. It is slightly soluble in petroleum ether, chlorinated hydrocarbons and acetic acid.
Vapor Pressure: 60mm Hg @25°C (1); 7 x 10^{-04} mm Hg @20°C (1)
Density (1): NA
Specific Gravity (2): 1.1 g/mL (18/4°C)
BCF (1): 44-125

Experimental studies have shown that photolysis and biodegradation are the dominant fate processes in the removal of carbazole from the aquatic environment. Aquatic hydrolysis, oxidation, volatilization, and bioaccumulation are not environmentally significant. Carbazole is expected to rapidly photolyze in sunlit atmospheres based on its strong UV light absorption. It has been shown to degrade by

biodegradation in soil. Studies have shown that carbazole has medium soil mobility. The presence of carbazole in groundwater suggests that leaching occurs.

PHARMACOKINETICS

Limited pharmacokinetic data from rats indicate that this PAH is incompletely absorbed by the gastrointestinal (GI) tract, distributed throughout the body, metabolized primarily to 3-hydroxycarbazole and conjugated with glucuronic acid, and almost completely excreted in the urine within one day. This process is considered to be rapid absorption and excretion in the rat.

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

Information regarding chronic toxic effects unrelated to carcinogenesis, subchronic toxicity, teratogenicity or other reproductive effects were not located.

Carcinogenic Effects

USEPA classifies carbazole as a B2 carcinogen. Administration of carbazole in the diet of mice at concentrations of 0.15, 0.3 and 0.6 percent for 96 weeks produced significantly increased incidences of hepatocellular carcinomas, squamous cells carcinomas of the forestomach and related proliferative lesions in the liver and stomach. Inadequately designed or reported subcutaneous injection and dermal application studies with mice did not show local tumorigenic effects of carbazole. Supporting carcinogenesis evidence of carbazole derivatives has been reported in the past.

ENVIRONMENTAL EFFECTS

Aquatic, Terrestrial and Avian

Concentrations of carbazole in water at greater than or equal to 1 mg/L were acutely lethal to the saltwater fish, *Mugil cephalus*. Concentrations less than or equal to 0.1 mg/L were tolerated for one week. A concentration of 5 mg/L was lethal to freshwater fish, *Salmo gairdneri* and *Lepomis macrochirus*.

REGULATORY LEVELS AND CRITERIA

No criteria were located from the reference report.

SUMMARY OF TOXICOLOGICAL INDICES

Inhalation Cancer Slope Factor (2): 2×10^{-02} $(mg/kg/day)^{-1}$

REFERENCES:

(1) Health and Environmental Effects Profile for Carbazole. Environmental Criteria and Assessment Office. Office of Health and Environmental Assessment. Office of Research and Development. U.S. Environmental Protection Agency. Cincinnati, OH. April, 1986. EPA/600/X-86/334.

(2) USEPA, 1994a. U.S. Environmental Protection Agency. Region III Risk-Based Concentration Table, Fourth Quarter 1994. Philadelphia, PA. November 8, 1994.

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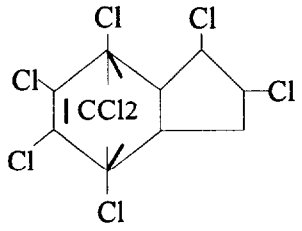
Revisor: Rich Hoff

CHLORDANE

INTRODUCTION

Chemical Name:	1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methamoindene	
Synonyms:	cis-Chlordane:	alpha-Chlordane
	trans-Chlordane:	gamma-Chlordane
CAS Number:	Chlordane (mixture):	57-74-9
	cis-Chlordane:	5103-74-2
	trans-Chlordane:	5103-71-9
Molecular Formula:	$C_{10}H_6Cl_8$	
Molecular Weight:	409.8	
Chemical Structure:		



Chlordane is an organochlorine pesticide that was formerly used on field crops and is presently used to control structural pests in homes. Technical chlordane is a complex mixture that includes two isomers of chlordane, heptachlor, and two isomers of nonachlor. It is very persistent in the environment and is strongly bioaccumulated in fish and other aquatic organisms. Chlordane causes liver tumors in mice, and the results of a mutagenicity assay were positive. It also has adverse reproductive effects in mice, and chronic exposure causes liver changes and adversely affects the central nervous system. Chlordane is very toxic to aquatic organisms (1).

Technical chlordane is a complex mixture, the major components of which are cis-Chlordane and trans-Chlordane. The technical product also contains a variety of other chlorinated hydrocarbons, including heptachlor. It is a viscous amber-colored liquid. Much of the available literature does not distinguish between the chlordane isomers and appears to discuss mixtures of these compounds (1).

FATE AND TRANSPORT

Boiling Point:	175°C at 2 mm Hg	
Melting Point:	cis-Chlordane	107-109°C
	trans-Chlordane	103-105°C
Specific Gravity:	1.59 - 1.635 at 16°C (technical chlordane)	
Solubility:		
In Water:	From 0.056 to 1.85 mg/liter at 25°C	
In Organics:	Miscible in aliphatic and aromatic solvents (technical chlordane)	
Log Octanol/Water Partition Coefficient:	2.78	

Vapor Pressure:	1×10^{-5} mm Hg at 20°C (refined product)
Flash Point:	Minimum 81°C (technical chlordane)

Chlordane is very persistent in the environment, resisting chemical and biological degradation into harmless substances. Chlordane in water is somewhat volatile, which is an important loss process. Loss of chlordane from aquatic systems occurs when organics are present, and when residue concentrations in sediment are higher than in water. Therefore, sorption to sediments is an in removing the chemical from the aquatic environment. Chlordane binds tightly to soil particles and persists for years in soil after surface application. However, chlordane applied as an emulsifiable concentrate is more readily volatilized than when it is applied as a granular formulation. Certain food and feed crops accumulate residues by absorption from the soil. Atmospheric transport of vapors and contaminated dust particles from soil application sites can occur (1).

HUMAN HEALTH EFFECTS

Mixtures of cis-Chlordane and trans-Chlordane produce liver cancer in mice. Chlordane also has mutagenic effects in at least one test system. Reproductive effects, including developmental defects and neonatal metabolic and biochemical disorders, are observed in the offspring of mice exposed to chlordane. Tests with laboratory animals, primarily rodents, demonstrate acute and chronic toxic effects. Either isomer alone, or a mixture of the two, appears to exhibit approximately equal toxicity. Acute effects include anorexia, weight loss, tremors, convulsions, and death. Chronic exposure to chlordane causes liver changes and induces or suppresses a variety of enzyme systems. In addition, chlordane may act as a cumulative neurotoxin. The oral LD_{50} in the rate is 283 mg/kg. Oxychlordane, an epoxide metabolite formed from either chlordane isomer, is significantly more acutely toxic than chlordane. The oral LD_{50} of oxychlordane administered to rats in corn oil is 19 mg/kg and 43 mg/kg when administered in an aqueous suspension (1).

Acute oral or skin exposure to chlordane can cause vomiting, seizures, electroencephalographic dysrhythmia, convulsions, and death in humans. However, most reports of human toxicity are inconclusive. Oxychlordane has been found in a high percentage of human adipose tissue samples and also in human milk samples (1).

ENVIRONMENTAL HEALTH EFFECTS

The toxic effects of chlordane are seen at relatively low concentrations in some fish and invertebrate species. Chlordane also shows strong tendencies for bioaccumulation in some aquatic and terrestrial organisms. It can concentrate at levels thousands of times greater than the surrounding water medium in a variety of aquatic organisms, including bacteria, algae, daphnids, and fish. The EPA criteria for acute exposure to freshwater species is 2.4 μg/L, and it is 4.3E-3 μg/L for chronic exposure. The corresponding acute and chronic values for saltwater species are 0.09 μg/L and 0.0040 μg/L. Very little information exists concerning the biotransformation of chlordane. Although biotransformations may be important for the ultimate degradation of chlordane, these processes are likely to be very slow (1).

Chlordane or oxychlordane residues have been found in a wide variety of wildlife and domestic animal species, but usually at relatively low levels. Chlordane does not appear to be extensively concentrated in the higher members of the terrestrial food chain. Studies indicate that chlordane may produce toxic effects in certain soil invertebrates after surface application. Although little

information concerning bioaccumulation in these organisms is available, the potential bioconcentration of chlordane or oxychlordane by terrestrial insectivores is of concern. Little information on the toxic effects of chlordane to mammalian wildlife and domestic animal species is available. Chlordane or oxychlordane residues have been found in crops, meat, fish, and poultry, dairy products, and eggs. Oral LD_{50} values for chlordane ranging from 331 to 858 ppm in the diet (approximately 25 to 50 mg/kg) are reported for a variety of wild bird species. Oral LD_{50} values ranging from 100 to 1,000 mg/kg are reported for a variety of animals, including rodents, goats, sheep, and chickens (1).

REGULATIONS AND STANDARDS

Ambient Water Quality Criteria (2):

- Aquatic Life
  - Freshwater
    - -- Acute Toxicity: 2.4 μg/L
    - -- Chronic Toxicity: 0.0043 μg/L
  - Saltwater
    - -- Acute Toxicity: 0.09 μg/L
    - -- Chronic Toxicity: 0.004 μg/L

- Human Health
  - Water and Organisms: 4.6E-4
  - Organisms only: 4.8E-4

Summary of Toxicological Indices (3):

- Weight of Evidence: B2 - probable human carcinogen
- Oral Cancer Slope Factor: 1.3 $(mg/kg/day)^{-1}$
- Inhalation Cancer Slope Factor: 1.29 $(mg/kg/day)^{-1}$
- Oral RfD: $6x10^{-5}$

Other Regulations

- OSHA PEL-TWA: 0.5 mg/m^3
- ACGIH TLV-TWA (skin): 0.5 mg/m^3
- Department of Transportation: Combustible Liquid
- SDWA MCL: 2 $\mu g/L$
  SDWA MCLG: 0 $\mu g/L$

REFERENCES

1. Clement Associates, Inc. Chemical, Physical, and Biological Properties of Compounds Present at Hazardous Waste Sites. Final Report. September 1985.

2. Ambient Water Quality Criteria. Office of Water, U.S. Environmental Protection Agency, Washington, D.C. May 1986.

3. IRIS. Integrated Risk Information System. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. 1994.

Date of Last Revision: 12/15/94
Revisor: Patrick B. Moroney

CHROMIUM

INTRODUCTION

Chemical Name:	Chromium
CAS Number:	Chromium (VI) 7440-47-3; Chromium (III) 16065-83-1
Molecular Formula:	Cr
Molecular Weight:	52 g/mole
Chemical Structure:	Cr

Chromium is a semi-gray heavy metal that generally exists in either a trivalent (III) or hexavalent (VI) state. Chromium occurs naturally in soil; however, it is no longer mined in the United States.

FATE AND TRANSPORT

BCF:	16 (2)
Degradation Products:	None
Solubility:	Metallic chromium is not soluble in water, but it is soluble in some acids and strong alkalies (4). Some chromium salts are water soluble (3).
Specific Gravity (3):	7.20 @ 28°C

Chromium and compounds can be present in air, water, and soil. In air, chromium is primarily associated with particulate matter which results from surface soil dispersion or particulate emission from industrial sources (3). Transport of chromium from water to air is not likely because chromium compounds do not volatilize from water. In the atmosphere, Cr(VI) can be reduced to Cr(III) at a significant rate by V^{+2}, V^{+3}, VO_2^+, Fe^{+2}, HSO_3, and As^{+3}. The residence time of atmospheric chromium is expected to be less than 10 days (1).

Cr(VI) as a component of a complex anion is quite soluble in water. Consequently, it is not adsorbed to any significant degree by clays or hydrous metal oxides. The anionic form of Cr(VI), therefore, is mobile in the aquatic environment (3). Cr(VI) is a moderately strong oxidizing agent. In water, it will react with a reducing agent to form Cr(III) which will subsequently hydrolyze to chromium hydroxide and precipitate out of solution. This Cr(III) precipitate tends to adsorb to sediment. Air deposition, runoff, and leaching from soil can introduce chromium into surface and groundwater. The residence time of Cr(III) in lake water is approximately 4.5 to 18 years (1).

Chromium probably occurs as insoluble $Cr_2O_3 \cdot nH_2O$ in soil, since the organic matter in soil is expected to convert soluble chromate into insoluble Cr_2O_3 (1). Cr(III), as an insoluble salt, tends to strongly adhere to clay particles and organic matter, whereas soluble Cr(VI) is not strongly adsorbed to soil (3).

PHARMACOKINETICS

The primary route of entry of chromium into the body is through the gastrointestinal tract. Inhalation and dermal absorption are the primary routes of entry into the body for occupational exposure (7).

Chromium is distributed in humans following inhalation to the lungs, lymph nodes, kidney, liver, bladder, and bone. Distribution of chromium after oral exposure resulted in accumulation in the lymph nodes and lungs followed by the spleen, liver, kidney, and heart. There was no information available among the reviewed literature concerning the distribution of chromium after dermal exposure (7).

In vitro studies indicate that chromium (VI) is reduced to chromium (III). During this process an intermediate, chromium V, appears to be formed which may represent the form of chromium that interacts with cellular macromolecules (7).

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

Human studies have identified chromium as a nephrotoxin that produces renal tubular necrosis. There is not sufficient evidence, however to quantitatively describe the effects. Limited data suggest that exposure by inhalation to chromium compounds can result in hepatic effects in humans and animals. Sufficient evidence is not available to relate chromium exposure to adverse reproductive or developmental effects. It should be noted that Cr(III) by the oral route is an essential trace element (1).

Chromium (III)

The verified chronic oral RfD for metallic Cr(III) (insoluble salts) is 1 mg/kg/day. The RfD is based on a no observed adverse effects level (NOAEL) derived from a study in which 60 male and female rats were fed chromic oxide baked in bread at a dietary level of 5 percent. They were fed bread 5 days/week for 600 feedings (840 total days). It was determined that the average amount of chromic oxide ingested was 1,800 g/kg body weight. An uncertainty factor of 100 and a modifying factor of 10 were applied to the NOAEL when calculating the RfD. The modifying factor was derived to address factors that if determined would lower the RfD (1,5). The confidence in the RfD is low; however, it is a conservative number. No effects due to chromic oxide were observed at any dose level (1). An Inhalation RfD for Chromium III is currently under review by the EPA (5).

Chromium (VI)

The EPA has established an oral RfD for Chromium VI of 5.0×10^{-3} mg/kg/day. No LOAEL was identified in the supporting study. However, a NOAEL of 2.4 mg/kg/day was reported. The supporting study involved the administration of drinking water containing 1 to 11 ppm chromium VI to Sprague-Dawley rats for one year. No significant adverse effects were seen on appearance, weight gain, or food consumption, and there were no pathologic changes in the blood or other tissues (5).

An inhalation RfD for Chromium VI is currently under review by the EPA (5).

Carcinogenic Effects

Chromium (III)

Cr(III) has been classified by the EPA as a Group D carcinogen (1). This means the chemical has not been classified because there is inadequate evidence of carcinogenicity in animals (5).

Chromium (VI)

The verified cancer unit risk for lifetime exposure by inhalation to Cr(VI) is 1.2×10^{-2} $(\mu g/m^3)^{-1}$. Inhaled Cr(VI) has been classified by EPA as a Group A-human carcinogen (1). There is sufficient evidence to support an association between exposure by inhalation and cancer (2). The potency factor is based on an epidemiology study in which chromate plant workers were studied and showed an increased incidence of lung cancer. The study documented total chromium exposure and did not differentiate between Cr(III) and Cr(VI) and consequently, the health risk may be underestimated (1,5). Although CR(VI) is carcinogenic by the inhalation route, there is no evidence that it is carcinogenic by the oral route (1).

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

Chromium is an essential nutrient. It is accumulated in a variety of aquatic and marine biota to levels quite higher than in ambient water. Therefore, it appears that the food chain is a more efficient pathway for chromium uptake than direct uptake from seawater (1).

Water and aquatic species characteristics modify the toxic effects of chromium on aquatic life. Cr(III) appears to be more acutely toxic to fish than Cr(VI); however, the reverse is true in chronic exposure studies (1).

The Ambient Water Quality Criteria for the level of chromium that will not affect aquatic organisms and their uses include the following:

- 4-day averages that should not be exceeded more than once every three years (5,6).

	Freshwater	Saltwater
Cr(VI)	11 µg/L	None
Cr(III)	$e^{(0.8190\,[\ln\,[\text{hardness}]+1.561])}$ or 210 µg/L (hardness dependent)	--

- 1-hour average that should not be exceeded more than once every 3 years (6).

	Freshwater	Saltwater
Cr(VI)	16 μg/L	1,100 μg/L
Cr(III)	$e^{(0.8190 [\ln [hardness]+3.688])}$ or 1,700 μg/L (hardness dependent)	10,300 μg/L (hardness dependent)

Terrestrial

No plants typically used as food or animal feed are chromium accumulators. Plants that absorb chromium do so through root uptake and do not efficiently transport it to the leaves. Also, there is little tendency for inorganic Cr(III) to accumulate along the food chain. No data are available for organochromium compounds (3).

REGULATORY LEVELS AND CRITERIA

OSHA PEL-TWA (10):	0.5 mg/m^3 (Chromium III)
	1.0 mg/m^3 (insoluble salts or chromium metal)
OSHA Ceiling Level (10):	1 mg/10 m^3 (chromic acid and chromates)
MCL (6):	0.1 mg/L
ACGIH TLV-TWA (9):	0.5 mg/m^3 (chromium metal)
	0.5 mg/m^3 (Chromium II and III compounds)
	0.05 mg/m^3 (water soluble Chromium VI)

Health Advisories (1):

One-day (Chromium VI):	Use 10-day valve
10-day (Child) (Chromium VI):	1.4 mg/L
Longer-Term (Child) (Chromium VI):	0.24 mg/L
Longer-Term (Adult) (Chromium VI):	0.84 mg/L
Lifetime (Adult) (Chromium VI):	0.120 mg/L

Ingestion of water and fish (Chromium III) (1):	170 mg/L
Ingestion of organisms only (Chromium III) (1):	3,433 mg/L

SUMMARY OF CRITERIA

Cr(III) -	EPA Carcinogenic Classification (1):	Group D-Not Classified
Cr(VI) -	EPA Carcinogenic Classification (1):	Group A-Human Carcinogen (Inhalation)

Cancer Slope Factor (1,5)

Cr(III):	Not Applicable
Cr(VI):	1.2×10^{-2} (μg/m^3)$^{-1}$ (Inhalation unit risk)
	42 (mg/kg/day)$^{-1}$ (Inhalation slope factor)

RfD (Oral) (1,5)

Cr(III):	1 mg/kg/day
Cr(VI):	5×10^{-3} mg/kg/day

Oral Drinking Water (7)

Cr (VI):	2×10^{-2} mg/kg/day

NOAEL (7)

Cr (III):	5%
Cr (VI):	2.4 mg/kg/day

REFERENCES

1. Toxicological Profile for Chromium. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, and U.S. Environmental Protection Agency. Atlanta, Georgia. July 1989.

2. SPHEM. Superfund Public Health Evaluation Manual. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. October 1986.

3. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. September 1985.

4. Hawley, G.G. The Condensed Chemical Dictionary - Tenth Edition. Van Nostrand Reinhold Company, Inc., New York, New York. 1981.

5. IRIS. Integrated Risk Information System. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. 1994.

6. Ambient Water Quality Criteria. Office of Water, U.S. Environmental Protection Agency, Washington, D.C. May 1986.

7. HEAST. Health Effects Assessment Summary Tables. Office of Emergency and Remedial Response. U. S. Environmental Protection Agency. March 1994.

8. U. S. Environmental Protection Agency, National Register, National Primary Drinking Water Regulations; Final Rule, Vol. 56, No. 20, January 30, 1991.

9. American Conference of Governmental Industrial Hygienist (ACGIH). Threshold Limit Values and Biological Exposure Indices. 1993-1994.

10. 29 Code of Federal Regulations Part 1910.1000, Table Z-1, 1993.

Date of Last Revision: 12/14/94
Revisor: Rich Hoff

COPPER

INTRODUCTION

Chemical Name:	Copper
Synonyms (1):	Bronze Powder, C.I. 77400
CAS Number (1):	7440-50-8
Molecular Formula:	Cu
Molecular Weight (1):	63.546 g/mole
Chemical Structure:	Cu

Copper is a reddish colored metal that occurs naturally in rock, soil, water, sediment, and air. Also, copper occurs naturally in plants and animals. A concentration of approximately 50 ppm can be found in the earth's crust. Copper is considered to be ductile and an excellent conductor. The primary uses of copper consist of use as the metal or alloy in the manufacture of wire, sheet metal, pipe, and other metal products. Copper compounds occur both naturally and are man-made and exhibit a characteristic blue-green color. Copper compounds are used in agriculture to treat plant diseases, for water treatment, and as preservatives for wood, leather, and fabrics (1,2,3).

FATE AND TRANSPORT

Fish BCF (4):	200 L/kg
Solubility(3):	In Water : Insoluble
Density (3):	8.92

The largest release of copper to the environment is to the land with an estimated 97% deposited to this media. Tailings and overburdens from copper mines and tailings from mills are the primary contributors. It is also released through mining operations, agriculture, solid waste, and sludge from publicly-owned treatment works. The majority of copper deposited in the soil is strongly adsorbed and remains in the upper few centimeters of soil. The copper adsorbs to organic matter, carbonate minerals, clay minerals, or hydrous iron and manganese oxides (3).

Copper is released to water bodies primarily through natural weathering of soil and discharges from industries and sewage treatment plants. The majority of copper in water is found in the form of particulates. Approximately 2.4% of total copper released to the environment is attributed to release into a waterway. An estimated 68% of release to water is associated with natural weathering or disturbed soil. Copper sulfate use represents 13% of releases to water. Only 2% is contributed by urban runoff. The copper discharged into waterways is in the form of particulate matter. The particulate matter either settles out, precipitates out, or adsorbs in organic matter, hydrous iron and manganese oxides, and clay in sediment. When copper is present as the Cu(I) ion, it tends to disproportionate to Cu(II) and copper metal. The concentration of dissolved copper depends on factors such as pH, the oxidation-reduction potential of the water, and the presence of competing cations, anions of insoluble cupric salts and organic and inorganic complexing agents (3).

Copper emitted to the air occurs from windblown dust, volcanos, and manufacturing processes such as primary copper smelters and ore processing facilities. An estimated 0.04% of all copper released to the environment is to the air. Copper is released to the atmosphere in the form of particulate matter or adsorbed to particulate matter. Gravitational settling accounts for the removal of particles that are >5 μm while smaller particles are removed by either dry deposition or washout by rain. Deposition rates in urban areas are 0.119 and 0.164 kg/ha/yr for dry and wet deposition, respectively. It is assumed that copper transformations in the atmosphere exist as oxides. As the oxides age, sulfatization may occur (3).

PHARMACOKINETICS

No data were located that studied absorption of copper through inhalation or dermal exposure. However, via oral exposure, copper is absorbed in the stomach and small intestine. In humans, approximately 60% of an oral dose of Cu^{64} as copper acetate was absorbed from the gastrointestinal tract. Once absorbed from the gastrointestinal tract, copper forms ionic copper or binds to amino acids. The factors which may affect copper absorption include: competition with other metals, the amount of copper in the stomach, certain dietary components, and forms of copper. High dietary ascorbic acid has been shown to impair copper absorption (3).

Studies regarding distribution of copper through inhalation and dermal exposure are not available. Through oral exposure, copper is distributed by loosely binding to plasma albumen and amino acids in the portal blood and transported to the liver. Studies have also shown that copper binds to transcuprein, a plasma protein. Once in the liver, copper is incorporated into ceruloplasmin and released into the plasma (3).

Copper is metabolized mainly by its transfer to and from various organic ligands. Several binding proteins for copper have been identified that are important in the uptake, storage, and release of copper from tissues (3).

Oral exposure is the only pathway which has been studied with regard to excretion. The major pathway for the excretion of copper is through bile following oral exposure. Studies have shown that 72% of ingested radioactive copper was excreted as copper acetate in the feces. Reabsorption of biliary copper is negligible; however, a fraction of fecal copper is of endogenous biliary origin (3).

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

Wilson's disease (hepatolenticular degeneration), is the only significant manifestation of copper toxicity in humans. Death has been reported upon ingestion of large amounts of copper and attributed to extensive hepatic centrilobular necrosis (3).

Systemic effects induced by copper ingestion include gastrointestinal irritation, manifested as vomiting, nausea, diarrhea, and anorexia. In individuals totally poisoned from copper, centrilobular necrosis of the liver and vecrosis and sloughing of tubular cells in the kidney have been observed (3).

Immunological effects in humans have been exhibited as allergic dermatitis upon contact with copper. Additionally, inhalation studies in mice have found that after exposure to copper, an impaired immune function is present (3).

Neurological effects are manifested as Wilson's disease. Wilson's disease affects the central nervous system and includes symptoms of poor coordination, psychological impairment, tremor, disturbed gait, and rigidity. Increased copper levels in the brain have been observed in humans with Wilson's disease and in animals exposed to high levels of copper (3).

Mice, mink, and hamsters injected with copper or fed a diet high in copper have shown developmental effects. These effects include fetal mortality and developmental abnormalities. No developmental effects have been reported in humans; however, there is a possibility that there may be an increased incidence of spontaneous abortion and miscarriage in women exposed to high levels of copper. Developmental effects have not been observed in healthy humans or in the offspring of mothers with Wilson's disease (3).

In humans, reproductive effects have not been reported when exposed to high levels of copper. Mink did not exhibit adverse effects when fed a diet high in copper. However, when a copper wire was inserted into the vas deferens or uterus of monkeys, rats, hamsters, and rabbits prior to conception or at gestational day 3, decreased fertility was observed (3).

The Drinking Water Criteria Document concluded toxicity data were inadequate for calculation of an RfD for copper.

Carcinogenic Effects

The EPA carcinogen classification for copper is Group D- inadequate evidence of carcinogenicity. An elevated incidence of cancer has not been observed in humans or animals exposed to copper via inhalation, oral, or dermal route of exposure (3).

Although there are no data on the mutagenicity of copper in humans, in vivo and in vitro studies of mammalian systems suggest that copper is a potential human mutagen (3).

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

Available data are not adequate for establishing water quality criteria. However, the bioconcentration factor of copper in fish has been developed. The results of these studies indicate a low potential for bioconcentration with a range of factors for fish of 10- 100. The bioconcentration factor for molluscs, such as oysters was considerably higher at a peak of 30,000. Evidence suggests that there is no biomagnification of copper in the food chain. The biomagnification ratio in fish studied from lakes that were known to have received elevated loadings of copper, revealed that the ratio was <1 (3).

Terrestrial and Avian

In bioaccumulation studies of pollutant concentrations in the muscle and livers of 10 mammal species in Donana National Park in Spain, no evidence of bioaccumulation was obtained. No evidence of copper biomagnification in the food chain was observed (3).

REGULATORY LEVELS AND CRITERIA

OSHA PEL-TWA	
Fumes (3):	0.1 mg/m^3
Dusts and Mists (3):	1.0 mg/m^3
EPA SMCL (3):	1.0 mg/L
MCL (3):	1.3 mg/L (Action Level)
MCLG (3):	1.3 mg/L
EPA Reportable Quantity (3):	5000 lbs
ACGIH TLV-TWA:	
Fumes (3):	0.2 mg/m^3
Dusts and Mists (3):	1.0 mg/m^3
Ambient Water Quality Criterion (3):	1.0 mg/L
1-Day Health Advisory (3):	1.3 mg/L

SUMMARY OF CRITERIA

EPA Classification (6):	Group D - Inadequate evidence of carcinogenicity
Noncarcinogenic Effects	
Oral RfD (5):	3.71×10^{-2} mg/kg/day
Inhalation RfC (6):	Not determined

REFERENCES

1. Sax, Irving N. and Richard J. Lewis, Sr. Hazardous Chemicals Desk Reference. Van Nostrand Reinhold Company, Inc., New York, New York. 1987.

2. Hawley, G.G., The Condensed Chemical Dictionary-Eleventh Edition. Van Nostrand Reinhold Company, Inc., New York, New York. 1987.

3. Toxicological Profile for Copper. (Draft) U.S. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, and U.S. Environmental Protection Agency. Atlanta, Georgia. October 1989.

4. SPHEM. Superfund Public Health Evaluation Manual. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. October 1986.

5. HEAST. Health Effects Assessment Summary Tables. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. March 1994.

6. Integrated Risk Information System (IRIS). U.S. Environmental Protection Agency. 1994.

Date of Last Revision: 11/10/94
Revisor: Rich Hoff

DDT SERIES PESTICIDES

INTRODUCTION

Technical DDT is a mixture containing 65-80% p,p'-DDT, 15-20% o,-p' DDT and up to 4% p,p'-DDD plus other trace materials. The metabolites of DDT include p,p'-DDE and o,p'-DDD. DDT isomers and their metabolites are usually found together and generally have the similar properties, therefore DDT has been referenced as the total combination of isomers and metabolites. However, specific differences between isomers are identified.

DDT, along with it's metabolites, are organochlorine pesticides which are very persistent in the environment. Historically, DDT was released to the environment during its formulation and extensive use as a pesticide in agricultural and vector control applications. It was banned from use in the United States in 1972, but is still used in other areas of the world. These compounds have been shown to be carcinogenic in mice and chronic exposure primarily cause liver and lung tumors and lymphomas. In addition, the nervous system appears to be one of the primary target organs for DDT toxicity in humans (6). In general, organochlorine pesticides are highly toxic to aquatic organisms, in addition to being responsible for a decreased population of many bird species (1).

Chemical Name:
p,p'-DDT: p,p'-1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane
p,p'-DDD: p,p'-1,1-Dichloro-2,2-bis(4-chlorophenyl)-ethane
p,p'-DDE: p,p'-1,1-Dichloro-2,2-bis(4-chlorophenyl)-ethene

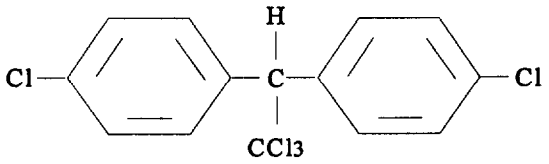
CAS Number (1):
p,p'-DDT: 50-29-3
p,p'-DDD: 72-54-8
p,p'-DDE: 72-55-9

Molecular Formula (1):
p,p'-DDT: $C_{14}H_9Cl_5$
p,p'-DDD: $C_{13}H_{10}Cl_4$
p,p'-DDE: $C_{14}H_8Cl_4$

Molecular Weight (1):
p,p'-DDT: 354.5 g/mole
p,p'-DDD: 320 g/mole
p,p'-DDE: 318 g/mole

Chemical Structure (6):

DDT:



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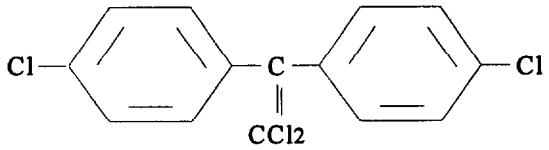

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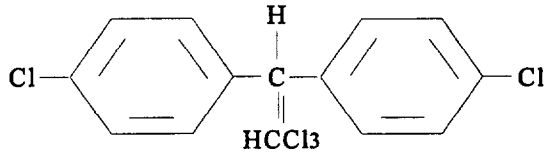


FATE AND TRANSPORT

Chemical and Physical Properties

Log K_{ow} (6):

p,p'-DDT:	6.19
p,p'-DDD:	6.20
p,p'-DDE:	7.00

Log K_{oc} (6):

p,p'-DDT:	5.4
p,p'-DDD:	5.9
p,p'-DDE:	6.6

Boiling Point (1):

p,p-DDT:	260°C

Melting Point:

DDT:	109°C
DDD:	112°C
DDE:	90°C

Solubility in Water @ 25°C (6):
p,p'-DDT: 3.4 μg/L
p,p'-DDD: 160 μg/L
p,p'-DDE: 120 μg/L

Solubility in Organics (1):
p,p'-DDT: Soluble in acetone, benzene, cyclohexane, morpholine, pyridine, and dioxane

Vapor Pressure (1):
p,p'-DDT: $1.9E^{-7}$ mm Hg at 25°C
p,p'-DDD: $1.0E^{-6}$ mm Hg at 30°C
p,p'-DDE: $6.5E^{-6}$ mm Hg at 20°C

TRANSPORT AND PARTITIONING

DDT and its metabolites may be transported from one medium to another by the processes of solubilization, adsorption, bioaccumulation, or volatilization. Each of these processes will be discussed in the following paragraphs. Studies of DDT transformations in soils predict prolonged persistence. During these extended periods of time, these compounds undergo extensive adsorption to soil particles, as predicted by their organic carbon partition coefficients (K_{oc}) of 2.4×10^5, 4.4×10^6, and 7.7×10^6, for DDT, DDE and DDD, respectively. DDT, DDE and DDD are only slightly soluble in water (solubilities of 0.0034, 0.12, and 0.160 mg/L at 25°C, respectively). Therefore, loss of these compounds in runoff is primarily due to transport of particulates to which these compounds are bound. Since they are bound strongly to soil, they are not easily displaced from their site of application, nor do they tend to leach to groundwater, and appreciable amounts may remain in the soil for extended periods of time. When DDT is released to water, it quickly adsorbs to particles and is subject to sedimentation, or may bioconcentrate in microorganisms and can become part of the food chain.(6)

Volatilization of DDT and DDE is known to account for considerable losses of these compounds from solids and water. Their tendency to volatilize can be predicted by their Henry's Law Constants, 5.13×10^{-4} and 6.8×10^{-5} atm-m^3/mol, respectively, and their vapor pressures, 5.5×10^{-6} and 6.5×10^{-6} Torr, respectively. The tendency of DDD to volatilize is approximately three-fold less than that of DDT or DDE. Estimates of the rate of evaporative losses of DDT from water range from several hours to 50 hours. Laboratory studies of the air/water partition coefficient of DDE indicate that it will volatilize from seawater 10 to 20 times faster than from freshwater. The authors suggest that this process may be related to interaction at the bubble-water surface (6).

Small particles which carry DDT or its degradation products may also be distributed through the atmosphere. Once volatilized or airborne, transport of these compounds into the ambient atmosphere of North America is facilitated by a circulation pattern which brings moisture from the Gulf of Mexico into the Midwest and airflow patterns across the eastern seaboard. Residues are removed from the atmosphere by precipitation, diffusion into large bodies of water, and chemical transformation. Precipitation is believed to account for the greatest rate of removal (6).

DDT, DDE, and DDD are highly lipid soluble, as reflected by their log octanol-water partition coefficients (log K_{ow}) of 6.19, 7.00, and 6.20, respectively. This lipophilic property, combined with

an extremely long half-life, has resulted in bioaccumulation (levels in organisms exceed those levels occurring in the surrounding environment). When they are present in ambient water, DDT and its metabolites are concentrated in freshwater and marine plankton, insects, mollusks, other invertebrates, and fish. As these organisms become part of the food chain, a progressive accumulation of residues may result in high levels of residues in organisms at the top of the food chain. In some cases, man may be the ultimate consumer of these contaminated organisms. The bioconcentration factor (BCF) is defined as the ratio at equilibrium between the concentration of the chemical in the organism or tissue of the organism, and the concentration of the chemical in the surrounding media. There are numerous measurements and estimates of BCFs in fish. Oliver and Niimi estimated the steady-state BCF in rainbow trout as 12000.

TRANSFORMATION AND DEGRADATION

The dominant mechanism for removal of DDT from the atmosphere is believed to be via precipitation and secondarily, particulate fallout. Under simulated atmospheric conditions, both DDT and DDE decompose to form carbon dioxide and hydrochloric acid (6).

AIR

In air and sunlight, DDT is subject to direct photooxidation and reaction with photochemically produced hydroxyl radicals. The latter process has an estimated half-life of two days. Since DDT residues are ubiquitous in the atmosphere, it seems likely that photodegradation must occur at a slow rate. DDT which reaches the photochemically active ionosphere may be rapidly destroyed by solar irradiation as indicated under laboratory conditions (6).

WATER

DDT present in water may be partitioned, transported, or converted in several ways: adsorption to sediments, bioconcentration in aquatic organisms, volatilization, photodegradation, and biodegradation. DDT in water is photodegradable by wavelengths of light which are present in the troposphere. DDT in excess of water solubility limits is adsorbed onto sediments which act as the primary reservoir for excess quantities of DDT. There it is available for ingestion by organisms. Biodegradation is reported to be a minor source of transformation (6).

SOIL

Four mechanisms have been suggested to account for most losses of DDT residues from soils: (1) volatilization, (2) removal by harvest of organic matter, (3) water runoff and (4) chemical transformation. DDT is subject to volatilization, with an estimated half-life of 100 days. Photoxidation of DDT is known to occur on soil surfaces; however, DDT is not known to hydrolyze. Biodegradation may occur under both aerobic and anaerobic conditions in the presence of certain microorganisms. Under aerobic conditions, slow conversion to DDE normally occurs, whereas, under anaerobic conditions, conversion to DDD results and is much more rapid than the aerobic conversion to DDE. Under aerobic conditions, dehydrochlorination is the dominant reaction, while under anaerobic conditions, reductive dechlorination occurs. Both metabolites are very resistant to further transformation. Due to the prolonged half-life of DDE, average levels of DDT are expected

to decline slowly while the ratio of DDE to DDT is expected to increase. Estimates of the half-life for DDT biodegraded in soil range from 2 to >15 years (6).

PHARMACOKINETICS

Absorption of DDT by the lung is considered to be a minor route of entry. Due to the large particle size, it does not enter into the smaller spaces of the lung, but is deposited in the upper respiratory tract, and due to the action of the mucociliary apparatus it is eventually swallowed. However, some particles may be small enough to enter the tracheal system. No studies have been located that quantify the rate or extent of absorption of DDT, DDD or DDE (6).

Absorption following ingestion of DDT, DDE and DDD is evident in humans from measurements of serum and adipose tissue concentrations of these chemicals after occupational exposure. Gastrointestinal absorption is evidenced by the presence of DDT and metabolites measured in bile and the induction of tumors in animals following oral administration of the compounds. Approximately 70-90% of the dose has been absorbed following oral exposure to DDT in vegetable oils (6).

Dermal absorption of DDT in humans is considered to be limited, but can be inferred by observation of toxicity following dermal application of DDT. Acute toxicity studies have shown that toxicity is less when DDT is applied dermally than when given by gavage or injection (6).

The distribution and storage of DDT in humans and animals has been extensively studied. DDT and its metabolites are lipid soluble compounds, and once absorbed readily distribute to all body tissues in proportion to respective tissue lipid content (6).

HUMAN HEALTH EFFECTS

Carcinogenic Effects

DDT has been classified as a B2 carcinogen, a probable human carcinogen, however, the existing epidemiological human health research data for carcinogenicity are inadequate . The basis for the B2 classification is the observation of tumors (generally liver tumors) in various mouse strains and in three studies of rats. In addition, DDT is structurally similar to other probable carcinogens such as DDD and DDE. Lung tumors have also been observed in chronic studies of mice, while increased tumor incidence in hamsters have also been observed (2).

DDT has produced both negative and positive responses in tests for genotoxicity (2).

An oral slope factor (CSF) for DDT has been set at 3.4×10^{-1} $(mg/kg/day)^{-1}$ by the United States Environmental Protection Agency (USEPA). An inhalation unit risk number has also been set at $9.7E^{-5}$ $\mu g/m^3$, or an inhalation slope factor of 3.4×10^{-1} $(mg/kg/day)^{-1}$ (2).

For DDD the USEPA has set an oral slope factor of 2.4×10^{-1} $(mg/kg/day)^{-1}$, and for DDE the USEPA has set an oral slope factor of 3.4×10^{-1} $(mg/kg/day)^{-1}$ (2).

Noncarcinogenic Effects

Increased hepatocellular hypertrophy, cytoplasmic oxyphilia and peripheral basophilic cytoplasmic granules were observed in chronic rat studies where rats were fed commercial DDT. Liver lesions were also seen in one 2 year rat study. In addition, DDT-induced liver effects were observed in mice, hamsters and dogs. One three generation rat reproduction study showed offspring mortality at all administered doses. Three other rat studies showed no reproductive effects at much higher dose levels (2).

An oral reference dose (RfD) of $5x10^{-4}$ mg/kg/day has been set by the USEPA. The Lowest Observed Adverse Effects Level for the study in which the RfD was derived was 0.25 mg/kg-d. The study from which the RfD was derived was chosen for the following reasons; male rats were used in the study (male rats are more sensitive than female rats to DDT), the study was of sufficient length to observe toxic effects and several doses were administered in the diet over the range of the dose-response curve (2).

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

DDT has been extensively studied in freshwater invertebrates and fish and is quite toxic to most species. Saltwater species are even more sensitive than freshwater species (1).

Ambient Water Quality Criteria (AWQC) have been set for DDT, however, criteria have not been set for DDD and DDE, the Lowest Observed Adverse Effects Level (LOAEL) have been reported as a guideline for aquatic adverse effects for these two compounds (3).

DDT: (AWQC)

Freshwater Acute:	1.1 μg/L
Freshwater Chronic:	0.001 μg/L
Marine Acute:	0.13 μg/L
Marine Chronic:	0.001 μg/L

DDD: (LOAEL)

Freshwater Acute:	0.6 μg/L
Marine Acute:	3.6 μg/L

DDE: (LOAEL)

Freshwater Acute:	1,050 μg/L
Marine Acute:	14 μg/L

Terrestrial and Avian

DDT, DDD and DDE and other persistent organochlorine pesticides are primarily responsible for the great decrease in the reproductive capabilities and consequently in the populations of fish-eating birds, such as the bald eagle, brown pelican, and osprey. DDT has also been shown to decrease the populations of numerous other species of waterbirds, raptors, and passerines significantly (1).

OCCUPATIONAL REGULATORY LEVELS AND CRITERIA

Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL), Time-weighted average for DDT: 1 mg/m^3, skin (5).

American Conference of Governmental Industrial Hygienist (ACGIH) Time-Weighted Average Threshold Limit Value (TLV) for DDT: 1 mg/m^3 (4).

REFERENCES

1. Clement Associates Inc.. Chemical, Physical, and Biological properties of Compounds Present At Hazardous Waste Sites, Final Report. September 27, 1985.

2. USEPA. Integrated Risk Information System (IRIS). 1994.

3. USEPA. Ambient Water Quality Criteria. Office of Water Regulations and Standards, Criteria and Standards Division. October 1980.

4. ACGIH. Documentation of the Threshold Limit Values. 1993-1994.

5. OSHA. Title 29 Code of Federal Regulations, Part 1910.1000, Table Z-1. 1993.

6. Agency for Toxic Substances and Disease Registry. Toxicological Profile for p,p'-DDT, p,p'-DDE and p,p'-DDD. April 1989.

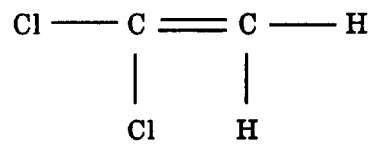
Date of Last Revision: 11/10/94

Revisor: Patrick B. Moroney

1,1-DICHLOROETHENE

INTRODUCTION

Chemical Name: 1,1-Dichloroethene
Synonyms (1): 1,1-DCE; VDC; Vinylidene chloride; Vinylidene dichloride
CAS Number (1): 75-35-4
Molecular Formula (1): $C_2H_2Cl_2$
Molecular Weight (2): 96.95 g/mole
Chemical Structure (1), (2):



1,1-Dichloroethene (1,1-DCE) is a clear, colorless liquid that has a mild, sweet smell. It is a man-made chemical that does not naturally occur in the environment. The most common use of 1,1-DCE is in the production of plastics such as packaging materials and flame-retardant fabrics. 1,1-DCE is also used for coating the interior of ship tanks and railroad tank cars, as well as steel piles and structures. Another use is as an intermediate in the production of 1,1,1-trichloroethane and in the manufacture of modacrylic fibers where it is combined with acrylonitrile (1),(2)

FATE AND TRANSPORT

Log K_{oc} (2): 1.81
Log K_{ow} (2): 2.13
(3): 1.84
$t_{1/2}$ (2): Air - 2.00 days
Surface Water - (1.00 - 6.00 days)
Henry's Law Constant (3): 3.40×10^{-2} atm-m^3/mol
Fish BCF (3): 5.6
Solubility:
In Water (3): $2.25 \times 10^{+3}$ mg/L
In Organics (2): Soluble
Vapor Pressure (2): 500 mm Hg @ 20°C
591 mm Hg @ 25°C
720 mm Hg @ 30°C
Density (1): 1.21 g/ml @ 20°C

The majority of 1,1-DCE released to the environment partitions to the atmosphere. 1,1-DCE is water soluble, and when released to the environment if will dissolve and remain in solution, resulting in surface water or groundwater contamination. 1,1-DCE has a low propensity for binding to organic or particulate matter, and therefore its movement within and between media is not inhibited by the adsorption processes (2).

In the atmosphere, 1,1-DCE reacts with OH and NO radicals to produce chloroacetyl chloride, phosgene, formaldehyde, carbon monoxide and nitric acid. Rapid photolysis occurs in the presence of nitrogen oxides. Also, rapid photodecomposition occurs in the presence of NOx and artificial lighting conditions. Because of a short atmospheric half-life, 1,1-DCE does not accumulate in the troposphere (2).

In waterways, biotransformation is the primary degradation pathway for 1,1-DCE. Biotransformation can occur either under aerobic or anaerobic conditions although results under aerobic conditions are conflicting. However, under anaerobic conditions, 1,1-DCE is nearly completely and quantitatively reduced to vinyl chloride after 108 days. Other degredation pathways, such as photolysis, hydrolysis, and oxidation are not significant transformation mechanisms for 1,1-DCE (2).

Information regarding soil degradation processes under aerobic conditions is lacking. Because of the tendency of 1,1-DCE to partition into the atmosphere, ambient concentrations in surface soil are expected to be low (2).

PHARMACOKINETICS

No human studies were available in the reviewed literature regarding absorption of 1,1-DCE by the inhalation, oral, or dermal exposure pathways. However, animal studies have revealed that 1,1-DCE rapidly absorbs following inhalation exposure. The 1,1-DCE absorption patterns suggest that the cumulative uptake was linear for levels up to 150 ppm. Steady-state was not achieved for higher levels. This indicates that 1,1-DCE uptake is saturable at higher levels. Animal studies involving absorption via oral exposure have indicated that 1,1-DCE ranging from 10 to 100 mg DCE/kg body weight is rapidly absorbed from the gastrointestinal tract of rats and mice. Because of the lack of human and animal studies involving dermal contact with 1,1-DCE, only assumptions on the absorption process can be made. Based on the physical and chemical properties of 1,1-DCE, it is thought that percutaneous absorption of the liquid form of 1,1-DCE is possible (2).

Human and animal studies regarding the distribution of 1,1-DCE through dermal exposure are not available. Studies have shown that 1,1-DCE is found in the liver and kidneys of rats following inhalation and oral exposure. Only small amounts were present in other tissues (2).

Studies denoting the human metabolism pattern of 1,1-DCE following exposure are not available. Animal studies indicate that the metabolic process is dependent upon the route of exposure and dose level. The initial step in the metabolism of 1,1-DCE is the formation of an epoxide intermediate. The main detoxification pathway for 1,1-DCE is purported to involve conjugation with hepatic glutathione. Conjugation with monochloroacetic acid followed by B-thionase activity appears to be the major metabolic route on a quantitative basis in rats. Thiodiglycollic acid is the predominant urinary metabolite (2).

No studies were available that addressed the excretion of 1,1-DCE in humans following inhalation, oral or dermal exposure. In rats, the majority of absorbed material is eliminated as metabolites in the urine. Approximately 1% of the parent compound is eliminated unchanged in expired air following inhalation. However, a greater portion may be eliminated unchanged through the lung once the metabolic processes become saturated. Excretion through the oral route of exposure is similar to the inhalation route. No studies were available concerning the excretion of 1,1-DCE following dermal contact (2).

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

Studies have shown that 1,1-DCE is toxic to both humans and animals. The source of human studies are primarily from accidental exposure to high concentrations for short periods of time. 1,1-DCE toxicity is mediated by metabolism to a reactive intermediate that ultimately compromises the viability of target organs. Animal studies have shown that the major target organs of 1,1-DCE toxicity are the liver, kidney, and lungs (2).

Respiratory effects in animals consist of irritation of the mucous membranes of the upper respiratory tract and pulmonary congestion, hyperemia, and morphological changes. These effects were induced by administration of high levels of 1,1-DCE via inhalation. It is believed in humans, that local, nonspecific irritation is exhibited upon inhalation of 1,1-DCE (2).

Hepatic effects in animals were exhibited following both inhalation and oral exposure to 1,1-DCE. Manifestations include biochemical changes and mild marked histological changes such as midzonal and/or centrilobular vacuolization, swelling, degeneration and necrosis. It is assumed that humans who have either been exposed to high levels of 1,1-DCE in an occupational setting, or those with compromised hepatic function, are at risk for 1,1-DCE induced liver toxicity (2).

Renal effects consisting of enzyme changes, hemoglobinuria, increases in organ weight, and tubular swelling, degeneration and necrosis are observed following both inhalation and oral exposure to 1,1-DCE in animals. Renal effects triggered by long-term exposure to 1,1-DCE in humans are not known (2).

Exposure to high concentrations of 1,1-DCE in humans affects the central nervous system. Complete recovery is possible if exposure is not prolonged. Also, central nervous system effects were observed in animals exposed via the inhalation route (2).

1,1-DCE has also exhibited teratogenic potential in animals. Developmental toxicity appears to be enhanced by inhalation exposure to 1,1-DCE as compared to oral exposure. Studies have shown that inhalation exposure at 80 to 160 ppm 1,1-DCE for 7 hours/day on gestation days 6 - 18 produced maternal toxicity, increased resorption, and skeletal alterations (2).

An oral RfD for 1,1-DCE has been derived by the EPA using the data from a drinking water study with Sprague-Dawley rate. Male and female rats were administered 50, 100 or 200 ppm 1,1-DCE in drinking water over a two year period and observed for treatment-related effects. From this study, a lowest observed adverse effect level (LOAEL) of 9 mg/kg/day was determined based on Sepotic lesions in the female rats. An uncertainty factory of 1000 was applied to this LOAEL to arrive at an oral RfD of 9×10^{-3} mg/kg/day.

Carcinogenic Effects

The EPA classified 1,1-DCE as a Group C carcinogen - possible human carcinogen. This classification is based on limited evidence of carcinogenicity in animals (4).

Studies involving the use of Swiss mice in the inhalation administration of 1,1-DCE have shown that at 25 ppm 1,1-DCE 4 hours daily, 5 days per week for 52 weeks, 1,1-DCE induces malignant tumors. Renal adenocarcinomas developed in 16% of male mice and 0.6% of the female mice (1). Mammary gland carcinomas and pulmonary adenomas were also observed in this study. The calculated inhalation and oral cancer slope factor for 1,1-DCE is 1.2 $(mg/kg/day)^{-1}$ (2). These cancer slope factors were derived using the data from the inhalation

study with Swiss mice described above. In another study, mice that had been topically administered 1,1-DCE showed an increased incidence of skin papillomas (1).

Supporting short-term assays are available for the carcinogen effects seen in animals. Genotoxicity studies suggest that 1,1-DCE exhibited mutagenic properties upon metabolic activation in bacteria and yeast. It is also capable of inducing gene conversion in yeast. In green plants, 1,1-DCE proved to be mutagenic without metabolic activation by mammalian systems. Chromosomal aberrations and sister chromatid exchanges in cultured mammalian cells in vitro and DNA damage in mice in vivo were exhibited in 1,1-DCE studies (2).

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

Ambient water quality lowest effect levels for the protection of aquatic organisms are as follows (4):

Freshwater:
- Acute Toxicity: $1.16 \times 10^{+4}$ µg/L
- Chronic Toxicity: None

Marine:
- Acute Toxicity: $2.24 \times 10^{+5}$ µg/L
- Chronic Toxicity: None

These quantifications occur at lower concentrations among species that are more sensitive than those tested (5).

Terrestrial and Avian

Information regarding the toxicity of 1,1-DCE to terrestrial and avian wildlife or domestic animals was not available (6).

REGULATORY LEVELS AND CRITERIA

OSHA TWA (8-hr) (1):	1 ppm
ACGIH TLV (8-hr TWA) (1):	5 ppm
ACGIH (15-min) (1):	20 ppm
EPA MCLG (1):	7 µg/L
EPA MCL (1):	7 µg/L
EPA Health Advisories (1):	
1-day (child):	2 mg/L
10-day (child):	1 mg/L
Longer-term (child):	1 mg/L
Longer-term (adult):	4 mg/L
Lifetime (adult):	7 µg/L
Reportable Quantity (1):	100 lbs
Ambient Water Quality Criteria (4):	
Water and Fish Consumption:	3.3×10^{-2} µg/L
Fish Consumption Only:	1.85 µg/L

SUMMARY OF CRITERIA

EPA Carcinogenic Classification (4):	Group C-Possible human carcinogen
Oral RfD (4):	9.00×10^{-3} mg/kg/day
Oral Cancer Slope Factor (4):	6.00×10^{-1} (mg/kg/day)$^{-1}$
Inhalation Cancer Slope Factor (4):	1.75×10^{-1} (mg/kg/day)$^{-1}$
LOAEL (4):	9 mg/kg/day

REFERENCES

1. The Installation Restoration Program Toxicology Guide. Biomedical and Environmental Information Analysis, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee. July 1989.

2. Toxicological Profile for 1,1-Dichloroethene. U.S. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, and U.S. Environmental Protection Agency. Atlanta, Georgia. December 1989.

3. SPHEM. Superfund Public Health Evaluation Manual. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. October 1986.

4. IRIS. Integrated Risk Information System. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. 1994.

5. Ambient Water Quality Criteria. Office of Water, U.S. Environmental Protection Agency, Washington, D.C. May 1986.

6. Chemical, Physical, and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergency Response, U.S, Environmental Protection Agency, Washington, D.C. September 1985.

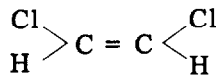
7. HEAST. Health Effects Assessment Summary Tables. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. March, 1994.

Date of Last Revision: 11/10/94
Revisor: Patrick B. Moroney

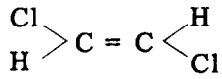
1,2-DICHLOROETHENE (CIS- AND TRANS-)

INTRODUCTION

Chemical Name:	1,2-Dichloroethene (cis- and trans-)
Synonyms (1):	1,2-Dichloro-(z)ethene; Cis-1,2-dichloroethene; Cis-1,2-dichloroethylene; Trans-1,2-dichloroethylene; 1,2-DCE
CAS Number (2):	Cis- 156-59-2 Trans- 156-60-5
Molecular Formula (2):	$C_2H_2Cl_2$
Molecular Weight (2):	96.94 g/mole
Chemical Structure (2):	



cis



trans

1,2-Dichloroethene (1,2-DCE) exists as the cis and trans isomers. It is a colorless, low-boiling liquid. The use of 1,2-DCE in the United States has not been widely developed due to its flammability characteristics. The trans isomer is used more frequently than the cis isomer or the 60:40 cis/trans mixture. The primary uses include a low-temperature extraction solvent or direct solvent in materials such as dyes, perfume oils, waxes, resins and thermoplastics (1).

FATE AND TRANSPORT

	Cis-	Trans-
K_{oc} (3):	49	59
Log K_{ow} (2):	2.06	1.86
1/2t:		
Air (3):	2.10 days	130 days
Surface Water (3):	1.0 to 6.0 days	1.0 to 6.0 days
Henry's Law Constant (2): (atm-m3/mole)	3.37×10^{-3}	6.72×10^{-3}
Fish BCF (3):	1.6	1.6
Solubility (2):		
In Water:	6.3 g/L	3.5 g/L
In Organics:	Miscible with alcohol, ether, and acetone; very soluble in benzene and chloroform	
Vapor Pressure (2):	340 mm Hg @ 25°C	200 mm Hg @ 35°C

Cis- and trans-1,2 DCE are released into the environment primarily in air emissions and wastewater during its production and use in the manufacturing of perfumes, lacquers, and thermoplastics. Also,

1,2-DCE is formed from trichloroethylene, tetrachloroethylene, and 1,1,2,2-tetrachloroethane. It may exist in landfills, aquifers, and sediments. Cis-1,2-DCE is the most common isomer found; however, it is frequently misreported as trans-1,2-DCE, a priority pollutant. Most analytical procedures do not distinguish between the two isomers (2).

When released on to the soil, 1,2-DCE will either evaporate or leach into the ground water where very slow biodegradation occurs (2).

1,2-DCE will volatilize upon introduction into a water system with a half-life of 3 hours in a model river. Because of the relatively low K_{oc} value, it is suggested that biodegradation and adsorption to sediment will not be significant for either isomer (2).

In the atmosphere, 1,2-DCE will be reactive with photochemically produced hydroxyl radicals. The long half-life, 8 days, will allow for atmospheric dispersion prior to scavenging by rain (2).

1,2-DCE is not expected to bioconcentrate significantly in aquatic organisms. The bioconcentration factor, 1.6, was estimated from the log K_{ow} using a recommended regression equation (2).

PHARMACOKINETICS

Studies indicating the absorption, distribution, metabolism, and excretion of cis- and trans-1,2-DCE were not available. Because 1,2-DCE is not widely used, toxicologic data are limited.

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

The majority of 1,2-DCE studies are old an must be considered suspect. The purity of the samples and the ratio of the isomers were not always identified (1).

Oral LD_{50}s have been established for male and female mice exposed to trans-1,2-DCE. In male mice, an oral LD_{50} of 2122 mg/kg was reported while the LD_{50} for female mice was 2391 mg/kg.

Mice exposed to 1,2-DCE at concentrations of 0.1,1.0, or 2.0 mg/ml in drinking water for 90 days showed minimal toxic effects. At a concentration of 2.0 mg/ml, hepatic glutathione levels were significantly reduced in male mice and hepatic aniline hydroxylase activity was reduced in female mice at all three dose concentrations (1). In another study involving trans-1,2-DCE exposure at 402, 1311, or 3114 mg/kg/day in male rats and 353, 1257, or 2809 mg/kg/day in female rats for 90 days, no treatment related effects were observed which effected fluid consumption, body weight, hematology, serum chemistry, or urinalysis. A significant dose-dependent decrease in kidney weight was observed in female rats at the 1257 and 2809 mg/kg/day level (1). Lung effects were also reported in rats exposed to a single 8-hour exposure to 200 ppm of trans-1,2-DCE (1).

Other chronic toxicity studies have produced conflicting results. Some studies have demonstrated no adverse effects in rats, rabbits, guinea pigs and dogs exposed to either 500 or 1000 ppm of a 60% cis- / 40% trans- mixture of 1,2-DCE. The exposure lasted for 7 hours per day, 5 days per week for 6 months. However, other studies have reported that rats exposed to vapors of 200 ppm of

trans-1,2-DCE for 8 hours per day, 5 days per week for 16 weeks, produced adverse liver and lung effects, as well as decreased leukocyte counts (1).

Human studies are limited. It is known that 1,2-DCE was once used as a general anesthetic. In its limited industrial usage, no toxic effects due to occupational exposure have been noted. Symptoms associated with exposure to 2000 ppm of trans-1,2-DCE include burning of the eyes, vertigo and nausea. Because of its limited use, no long-term epidemiological studies have been conducted for 1,2-DCE exposure (1).

Data examining teratogencity, embryotoxicity and reproductive effects were not available (1).

HEAST has assigned an oral RfD value of 2.0×10^{-2} mg/kg/day to trans-1,2-DCE. From this study, a lowest observed adverse effect level (LOAEL) of 175 mg/kg/day and a no observed adverse effect level (NOAEL) of 17 mg/kg/day were determined. For cis-1,2-DCE, an oral RfD of 1.0×10^{-2} mg/kg/day has been established. This oral RfD value is based on a NOAEL of 32 mg/kg/day.

The oral trans-1,2-DCE RfD value was based on a study involving the administration of trans-1,2,DCE in drinking water to male and female CD-1 mice in concentrations ranging from 17 to 452 mg/kg/day for 90 days. In the male mice, there were significant increases in serum alkaline phosphatase levels at the highest concentrations of trans-1,2-DCE. In female mice, the thymus weight and lung weight were decreased at the higher concentrations of trans-1,2-DCE (7). The oral cis-1,2-DCE value was based on a study involving administration via gavage to rats over a 90-day time frame. Critical end points for this study were decreased hematocrit and hemoglobin in the exposed rats.

Carcinogenic Effects

The EPA classifies cis-1,2-Dichloroethene is a Group D carcinogen - not classifiable as to human carcinogenicity. This classification is based on the available human and animal studies (7). Information regarding the carcinogenicity of trans-1,2-dichloroethene has not been evaluated by the EPA for evidence of human carcinogenic potential (7).

The available supporting carcinogenicity data do not indicate a carcinogenic potential in animals. Genotoxic assays revealed negative results when 1,2-DCE was tested on four standard strains of Salmonella typhimurium. Negative results were also obtained in E. coli K12 reversion tests in the presence of mouse liver enzymes. In studies involving S. cerevisiae in suspension and in a host-mediated assay, both isomers were able to induce convertants in the suspension assay but only with metabolic activation. Only the cis isomer was capable of inducing revertants and convertants in the host-mediated assay. No increase in chromosomal aberrations or sister chromatid exchanges, with or without metabolic activation, was found in studies involving Chinese hamster lung cells treated with 1,2-DCE isomers (1).

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

Although data are not adequate for establishing criteria, the EPA has reported the lowest values of dichloroethylenes known to be toxic in aquatic organisms. These values are as follows (5):

Freshwater:

Acute Toxicity:	$11.6 \times 10^{+4}$ µg/L
Chronic Toxicity:	Not available

Marine:

Acute Toxicity:	$2.24 \times 10^{+5}$ µg/L
Chronic Toxicity:	Not available

Terrestrial and Avian

Information regarding the toxicity of 1,2-trans-DCE to wildlife and domestic animals is limited. For bluegill, the reported 96-hour LC_{50} value under static conditions is 1.35 x 10+5 µg/L (4).

No information addressing the toxicity of 1,2-cis-DCE to terrestrial and avian wildlife or domestic animals was available (4).

REGULATORY LEVELS AND CRITERIA

OSHA TWA (8-hr) (1):	200 ppm
ACGIH TLV (8-hr TWA) (1):	200 ppm
MCL (1):	Cis- 70 µg/L
	Trans- 100 µg/L

EPA Health Advisories and Cancer Risk Levels (1):

- 1 day (child):
  - Cis- 4 mg/L
  - Trans- 20 mg/L
- 10 day (child):
  - Cis- 1 mg/L
  - Trans- 2 mg/L
- Longer term (child):
  - Cis- 1 mg/L
  - Trans- 2 mg/L
- Longer term (adult):
  - Cis- 1 mg/L
  - Trans- 6 mg/L
- Lifetime (adult):
  - Cis- 0.07 mg/L
  - Trans- 0.1 mg/L

SUMMARY OF CRITERIA

EPA Carcinogenic Classification (7):	Group D–not classifiable as to human carcinogenicity
Oral RfD (trans–) (7):	2.0×10^{-2} mg/kg/day
Oral RfD (cis–) (6):	1.0×10^{-2} mg/kg/day
Oral RfD (mixture) (6):	9.0x10-3 mg/kg/day
NOAEL:	17 mg/kg/day
LOAEL:	175 mg/kg/day

REFERENCES

1. The Installation Restoration Program Toxicology Guide. Biomedical and Environmental Information Analysis, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee. July 1989.

2. Howard, Philip H. Handbook of Environmental Fate and Exposure Data, (Volume II). Lewis Publishers, Inc., Chelsea, Michigan, 1990.

3. SPHEM. Superfund Public Health Evaluation Manual. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. October 1986.

4. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. September 1985.

5. Ambient Water Quality Criteria. Office of Water, U.S. Environmental Protection Agency, Washington, D.C. May 1986.

6. HEAST. Health Effects Assessment Summary Tables. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. March 1994.

7. IRIS. Integrated Risk Information System. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. 1994.

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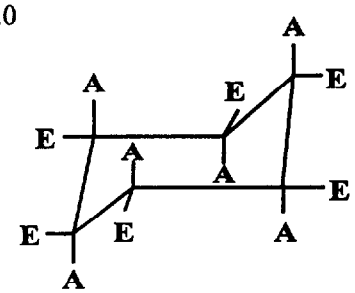
Revisor: Rich Hoff

alpha-, beta-, delta- and gamma-BHC (HEXACHLOROCYCLOHEXANE)

INTRODUCTION

Chemical Name: alpha, beta, delta, gamma-BHC (hexachlorocyclohexane)
CAS Numbers: 319-84-6, 319-85-7, 319-86-8, 58-89-9
Molecular Formula[1]: $C_6H_6Cl_6$
Molecular Weight[1]: 291.0
Chemical Structure[1]:



Orientation of Cl^- on ring	BHC Isomer
AAEEEE	α (alpha)
EEEEEE	β (beta)
AEEEEE	δ (delta)
AAAEEE	γ (gamma)

Alpha, beta, delta, and gamma-BHC are aliphatic chlorinated hydrocarbon pesticides representing the four major isomers of technical grade hexachlorocyclohexane (HCH). The gamma isomer (lindane) is generally the most toxicologically active[2]. The BHCs are fairly persistent in environmental media. The primary environmental fate of BHCs appears to be adsorption to soils and sediments and subsequent biodegradation.

FATE AND TRANSPORT

Log K_{oc}:	3.58, 3.58, 3.82, 3.58
Log K_{ow}:	3.89, 3.89, 4.15, 3.89
Henry's Law Constant (@ 20°C):	6×10^{-6}, 4.5×10^{-7}, 1.7×10^{-5}, 7.8×10^{-6} (@ 25°C)
Vapor Pressure (@ 20°C)[3]:	2.5×10^{-5}, 2.8×10^{-7}, 1.7×10^{-5}, 1.6×10^{-4} (@ 25°C)
Water Solubility (mg/L @ 25°C)[3]:	1.63, 0.24, 31.4, 7.8
BCF[4]:	100-500

BHCs, by virtue of their K_{ow} and K_{oc} values tend to adsorb to soils and sediments with subsequent biodegradation. Biodegradation of BHCs yields chemicals such as pentachlorocyclohexane, tetrachlorobenzene, trichlorophenol, and, therefore, may not result in substantial detoxification.

Gamma-BHC (lindane) has been shown to be rather persistent when applied to soil with as much as 10 percent remaining after 10 years[4].

PHARMACOKINETICS

Workers exposed to γ-HCH via inhalation of workplace air have exhibited adverse health effects such as hematological abnormalities and neurological effects. From this it can be inferred that humans absorb γ-HCH vapor or dusts via inhalation. The α-, β-, γ- and δ-isomers have been detected in the blood serum, adipose tissue and semen of individuals who have been occupationally and environmentally exposed to these chemicals via inhalation, demonstrating that absorption takes place. HCH is absorbed in humans upon oral exposure, as demonstrated by acute accidental poisoning cases wherein high blood levels have been detected. Gastrointestinal absorption has also been demonstrated in animals. Eight minutes after the administration of radiolabelled γ-HCH by stomach tube in fasting mice, a maximum of 17 percent of the administered dose was found in the gastrointestinal tract. In rats, absorption of technical-grade HCH has been quantified. Four days after the oral administration of a single dose, 95.8 percent of technical-grade HCH was absorbed in rats. Absorption of technical-grade HCH administered in the diet for 14 days was 94.9 percent in rats; the average absorption of these α-, β-, γ- and δ-isomers were 97.4 percent, 90.7 percent, 99.4 percent and 91.9 percent, respectively. Gamma-HCH is readily absorbed through the skin. Following whole body application of an anti-scabies lotion (γ-HCH is used to treat scabies) to scabies patients and volunteers, maximal blood levels in both scabies patients and volunteers were reported within 4-6 hours following application. When γ-HCH is applied topically to the forearm, 9 percent of the applied dose is absorbed rapidly, with maximum absorption occurring 2-3 days after application [5].

Alpha, β-, γ-HCH are distributed to the blood and adipose tissue upon inhalation exposure in humans. Gamma-HCH is distributed to the central nervous system (CNS) and the cerebral spinal fluid in humans orally exposed to γ-HCH. In laboratory rats exposed for 5, 10 or 15 days, γ-HCH and β-HCH are primarily stored in the fat. The overall distribution of γ-HCH was in the following order: fat>brain>kidney>muscle>lungs>heart>spleen>liver>blood. The overall distribution for the β-isomer was: fat>kidney>lungs>liver>muscle>heart>spleen>brain>blood. The distribution of α-HCH in rats dosed by gavage was fat>kidney>liver>brain>blood. Upon dermal exposure in humans γ-HCH is distributed to the brain as indicated in a case report of an autopsy of an infant treated with a whole body application of a 1 percent γ-HCH lotion.

Additionally, γ-HCH can be transferred to the fetus from pregnant woman through the placenta and to neonates through the milk. Males environmentally exposed to HCH accumulate γ-HCH and HCH isomers in adipose tissue and to a lesser extent in the testes or semen [5].

The metabolism of γ-HCH in humans is similar to that in mice and rats. Chlorophenols and chlorobenzenes are the primary metabolites of γ-HCH. The primary urinary metabolites of workers involved in γ-HCH production were chlorophenols. Almost 57.7 percent of the γ-HCH metabolites identified in the urine of workers during the last two hours of their shifts were 2, 3, 5-, 2, 4, 6- and 2, 4, 5 trichlorophenols. Other urinary metabolites detected were trichlorophenols, dichlorophenols, tetrachlorophenols and dihydroxychlorobenzenes. Following occupational exposure, pentachlorophenol has also been identified as a metabolite. Gamma-HCH is rapidly transformed by hepatic enzymes to form chlorophenols, chlorobenzene, chlorocyclohexanes,

chlorocyclohexanols and conjugates of mercapturic acid, glucuronide and sulfate in animals. In rats, the major urinary metabolites formed following intermediate oral exposure to α- or β-HCH, included tri- and tetrachlorophenols. In kidney tissue pentachlorocyclohexane was also identified. The P450 oxidative system appears to be responsible for the detoxification of γ-HCH [5].

Humans excrete γ-HCH and its metabolites in urine, milk and semen upon inhalation exposure. In the urine from humans occupationally exposed to HCH, chromatographic analyses revealed the presence of chlorinated phenols and all isomers of di-, tri- and tetrachlorophenol. In mice, the major route of elimination is via the urine following intermediate and chronic feeding of γ-HCH. Very little γ-HCH is eliminated in expired air and in the feces following oral administration in rodents. Very little HCH is excreted unaltered. In humans, nonmetabolized γ-HCH was excreted by healthy volunteers and scabies patients upon an acute, whole body application of a 0.3 percent γ-HCH emulsion [5].

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

BHCs can cause convulsions in humans exposed occupationally even by the topical (dermal) route. Nervousness, irritability, insomnia, vertigo, amblyopia, stupor and coma have been observed following excessive cutaneous application. BHCs can sensitize the heart to arrhythmias. Technical grade BHC is an irritant to the skin, eyes, and mucosa. Fatal cases of aplastic anemia have resulted from prolonged exposure to vaporized gamma-BHC[6].

The alpha and gamma isomers are CNS stimulants, but the beta and delta isomers are depressants.

Twenty male and female Wistar rats were administered 0, 0.2, 0.8, 4, 20, or 100 ppm gamma-BHC (lindane) (99.85 percent) in the diet. After 12 weeks, 15 animals were sacrificed. The remaining rats were fed the control diet for an additional 6 weeks before sacrifice. No treatment-related effects were noted on mortality, hematology, clinical chemistry, or urinalysis. Rats receiving 20 and 100 ppm lindane were observed to have greater-than-control incidence of the following: liver hypertrophy, kidney tubular degeneration, hyaline droplets, tubular distension, interstitial nephritis, and basophilic tubules. Since these effects were mild or rare in animals receiving 4 ppm, this represents a NOAEL. The reviewers of the study calculated the dose to be 0.29 mg/kg/day for males and 0.33 mg/kg/day for females, based on measured food intake[7].

In a 2-year feeding study, 10 Wistar rats/sex/group were exposed to 5, 10, 50, 100, 400, 800, or 1,600 ppm lindane. Slight liver and kidney damage and increased liver weights were noted at the 100 ppm level. If a food intake equal to 5 percent body weight is assumed, a NOAEL of 2.5 mg/kg bw/day (50 ppm) can be determined from this assay. In a two-year bioassay, four beagle dogs/sex/group were administered 0, 25, 50, or 100 ppm gamma-BHC in the diet. Treatment-related effects noted in the animals of the 100 ppm group were increased serum alkaline phosphatase and enlarged dark friable livers. A NOAEL was determined to be 50 ppm for gamma-BHC (1.6 mg/kg bw/day)[7].

Carcinogenic Effects

Dietary alpha-BHC has been shown to cause increased incidences of liver tumors in five mouse strains and in Wistar rats.

Groups of 20 to 40 male dd mice were treated with 100, 250, or 500 ppm alpha-HCH in the diet for 24 weeks. Liver nodules and hepatocelluar carcinomas were observed in the two upper dose groups. In a subsequent study, male DDY mice were maintained on a diet containing 500 ppm alpha-HCH for 16, 24, or 36 weeks, respectively. Incidence of liver tumors increased with continuous alpha-BHC administration. Incidence decreased, however, with recovery time. At 24 weeks most lesions observed were nodules, but by 60 or 72 weeks the tumors were primarily hepatocelluar carcinomas[7].

Schulte-Hermann and Parzefall noted an increased incidence of hepatic nodules and hepatocellular carcinomas in female Wistar rats treated with approximately 20 mg/kg/day alpha-BHC for their lifetime. Male Wistar rats were fed alpha-BHC in the diet at 500, 1000, or 1500 ppm for 24, 48, or 72 weeks. Liver nodules and carcinomas were observed in rats fed the two highest doses for 72 weeks. Both males and females of the dd strain responded in a dose-dependent fashion with liver nodules and hepatomas when fed 100, 300, or 600 ppm dietary alpha-BHC for 32 weeks, followed by 5 to 6 weeks basal diet. In a feeding study using male ICR-JCL mice, alpha-BHC produced hepatomas in 100 percent of the animals. Liver tumors have been observed as early as 24 to 26 weeks[7].

Dietary beta-BHC produced positive or marginally positive tumorigenic responses, characterized as benign hepatomas or hepatocellular carcinomas, have been observed in two strains of mice. The studies are limited in that small numbers of animals were used, no dose-response data are available, not all of the animals were examined histologically, or the duration of exposure was less than lifetime.

Thorpe and Walker fed 30 each male and female CF1 mice dietary beta-BHC at 200 ppm for 110 weeks. This resulted in 12 percent mortality of males and 25 percent of females during the first 3 months. A significantly increased incidence of liver tumors was observed in treated males and females.

No statistically significant evidence of increased tumor incidence as a consequence of beta-BHC feeding was seen in several small (5 to 20/group) studies with male and female dd mice fed 0 to 600 ppm for 24 to 32 weeks or in male Wistar rats fed 0 to 1000 ppm for >72 weeks.

Goto et al. maintained male ICR-JCL mice on a diet containing 600 ppm beta-BHC for 26 weeks. Relative liver weight was increased in the treated animals, and there was histologic evidence of benign neoplasms at an unspecified incidence.

USEPA has classified alpha-BHC as a B2; probable human carcinogen on the strength of laboratory dietary mouse studies. USEPA has also classified beta-BHC as a C; possible human carcinogen as a result of dietary mouse studies[7].

Ecological Effects

Gamma-BHC (lindane) is responsible for the effectiveness of technical hexachlorocyclohexane as an insecticide and is generally more toxic than the other isomers or technical BHC. In fact, the presence of the other BHC isomers decreases the toxicity of lindane to aquatic organisms, either by an antagonistic effect or by decreasing the chemical's solubility. Therefore, the toxicity of lindane and other BHCs are considered separately.

Lindane is acutely toxic to freshwater fish with LC_{50} values ranging from 2 μg/L to 141 μg/L; and to saltwater fish at levels of 7.3 to 104 μg/L. Lindane was acutely toxic to the pink shrimp at 0.17 μg/L. Acute-chronic ratios for lindane ranged from 7.5 to 63, and, therefore, the Final Chronic Value for the protection of freshwater species was determined to be 0.08 μg/L. Aquatic organisms appear to bioconcentrate between 100 and 500 times the steady-state concentration of lindane in the water.

Technical BHC was much less toxic than lindane, with acute toxicity ranging from 100 μg/L to 15,000 μg;/L for freshwater fish. Data on saltwater species also indicated that the technical compound was less acutely toxic. No information was available on the chronic toxicity of BHC. A bioconcentration factor was not reported but is probably similar to that for lindane[8].

No studies on the toxicity of the BHC isomers to terrestrial or domestic animals was found in the literature reviewed. However, voles at Love Canal that had decreased lifespans and reproductive ability had high levels of lindane in their livers[9].

REGULATORY LEVELS AND CRITERIA

ACGIH TLV-TWA:	0.5 mg/m^3 (lindane)
OSHA PEL-TWA[10]:	0.5 mg/m^3 (lindane)
Maximum Contaminant Level (MCL)[11]:	0.0002 mg/L (lindane)
MCLG[11]:	0.0002 mg/L (lindane)
Health Advisories[12,13]:	

Lindane	
10 day child	1.0 mg/L
1 day child	1.0 mg/L
Longer term child:	0.033 mg/L
Longer term adult:	0.12 mg/L
Lifetime:	0.0002 mg/L

Ambient Water Quality Criteria[13]

Water and Fish Consumption:	0.0092 μg/L (alpha), 0.0163 μg/L (beta), 0.0186 μg/L gamma
Fish Consumption Only:	0.031 μg/L (alpha), 0.0547 μg/L (beta), 0.0625 μg/L gamma
Acute Freshwater LEC:	100 μg/L (alpha), 100 μg/L (beta), 200 μg/L gamma
Acute Marine LEC:	0.031 μg/L (alpha), 0.0547 μg/L (beta),

	0.0625 μg/L gamma
Chronic Freshwater LEC:	0.08 μg/L (gamma)
Chronic Marine LEC:	None

SUMMARY OF TOXICOLOGICAL INDICES

USEPA Carcinogenic Classification:	B2 (alpha), C (beta), D (delta), C (gamma)
Oral RfD[7]:	$3x10^{-4}$ mg/kg/day (gamma)
Inhalation RfC[7]:	Pending
Oral Cancer Slope Factor[7,14]:	6.3 mg/kg/day^{-1} (alpha)
	1.8 mg/kg/day^{-1} (beta)
	1.3 mg/kg/day^{-1} (gamma)
Inhalation Cancer Slope Factor[7]:	1.79 mg/kg/day^{-1} (beta)
Inhalation Cancer Slope Factor[7]:	6.3 mg/kg/day^{-1} (alpha)
Drinking Water Unit Risk[7]:	1.8 x 10^{-4} per (μg/L)

REFERENCES

1. U. S. Environmental Protection Agency. 1982. Aquatic Fate Process Data for Organic Priority Pollutants. Final Report. 440/4-81-014.

2. International Agency for Research on Cancer (IARC). 1979. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. Vol. 30: Hexachlorohexane (Technical HCH and Lindane). World Health Organization, Lyon, France. pp. 195-329.

3. Verschueren, K. 1977. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Co., New York. p. 659.

4. Clement Associates. 1985. Chemical, Physical, and Biological Properties of Compounds Present at Hazardous Waste Sites. Final Report. Prepared for U. S. Environmental Protection Agency.

5. Toxicological Profile for Alpha-, Beta-, Gamma- and Delta- Hexachlorocyclohexane. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, and U.S. Environmental Protection Agency. Atlanta, Georgia, December 1988.

6. Goodman, L. S., A. G. Gilman, A. Gilman, A. 1980. Goodman and Gilman's The Pharmacological Basis of Therapeutics. Sixth Edition. Macmillan Publishing Co., Inc. New York.

7. U. S. Environmental Protection Agency. Integrated Risk Information System (IRIS). On-Line. 1994.

8. U. S. Environmental Protection Agency. 1979. Water-Related Environmental Fate of 129 Priority Pollutants. Washington, D. C. December 1979./ EPA 440/4-79-029.

9. Rowley, M. H., J. J. Christian, D. K. Basa, M. A. Pawlikowski, and B. Paigen. 1983. "Use of Small Mammals (Voles) to Assess a Hazardous Waste Site at Love Canal, Niagara Falls, New York." Arch. Environ. Contam. Toxicol. 12:383-397.

10. National Institute for Occupational Safety and Health (NIOSH). 1983. Registry of Toxic Effects of Chemical Substances. Data Base. Washington, D. C. October 1983.

11. U.S. Environmental Protection Agency. 1993. Drinking Water Regulations and Health Advisories. Office of Drinking Water. May 1993.

12. U.S. Environmental Protection Agency. 1984. Health Effects Assessment for Lindane. Environmental Criteria and Assessment Office, Cincinnati, Ohio. September 1984. ECAO-CIN-HO56. Final Draft.

13. U.S. Environmental Protection Agency. 1980. Ambient Water Quality Criteria for Hexachlorocyclohexane. Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D. C. October 1980. EPA 440/5-80-054.

14. HEAST. Health Effects Assessment Summary Tables. Office of Emergency and Remedial Response, USEPA. March 1994.

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Revisor: Rich Hoff

IRON

INTRODUCTION

Chemical Name: Iron
CAS Number (1): 7439-89-6
Molecular Formula (1): Fe
Molecular Weight (1): 55.847 g/mole

Iron is a silvery white, malleable metal. It is the fourth most abundant (by weight) of the elements that compose the earth's crust and is a major constituent of clay soils. Iron (III) hydroxide [Fe(OH)3] is formed in the environment through the corrosion of aluminum in the presence of moisture and oxygen. Iron in water may be present in varying quantities dependent upon the geology of the area and other chemical components of the waterway. (2,3).

HUMAN HEALTH EFFECTS

There is some evidence that high concentrations of certain soluble iron salts may be teratogenic in animals. The ingestion of excess amounts of iron can irritate the gastrointestinal tract. A dose of approximately 30 grams of a soluble ferric salt is likely to be fatal in humans. Long-term inhalation exposure in an occupational setting to iron-containing dusts and fumes, especially iron oxide, can cause siderosis, a type of benign pneumoconiosis. Exposure to aerosols and mists of soluble iron salts may produce respiratory and skin irritation (3).

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

The bivalent and trivalent irons are the primary forms of concern in the aquatic environment. The ferrous or bivalent form can persist in waters void of dissolved oxygen and typically originate from groundwater or mines where these are pumped or drained. The ferric or trivalent form is insoluble. Iron can exist in natural organometallic or humic compounds and colloidal forms. Black or brown swamp waters may contain iron concentrations of several milligrams per liter in the presence or absence of dissolved oxygen, but this iron form has little effect on aquatic life (2).

Much of the iron present in aquatic systems tends to partition into the bottom sediments. Iron has relative low mobility in soil. Atmospheric transport of iron is also possible (3).

The ambient water quality criteria for iron is 0.3 mg/L for domestic water supplies and 1.0 mg/L for freshwater aquatic life (2).

Terrestrial and Avian

Information regarding the toxicity of iron to terrestrial and avian wildlife and domestic animals was not located in the available literature (3).

REGULATORY LEVELS AND CRITERIA

OSHA Standard (3):	10 mg/m^3 TWA (iron oxide fume)
ACGIH TLV (3):	5 mg/m^3 TWA (iron dust and fume, as Fe)
	1 mg/m^3 TWA (soluble iron salts, as Fe)

REFERENCES

1. Hawley, G.G. The Condensed Chemical Dictionary-Eleventh Edition. Van Nostrand Reinhold Company, Inc., New York, New York. 1987.

2. Ambient Water Quality Criteria. Environmental Protection Agency. Office of Water Regulations and Standards. Washington, D.C. May. 1990.

3. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency. Washington, D.C. September, 1985.

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LEAD

INTRODUCTION

Chemical Name:	Lead
CAS Number:	7439-92-1
Molecular Formula:	Pb
Molecular Weight:	207 g/mole
Chemical Structure:	Pb

Elemental lead is a heavy, ductile, bluish-gray solid at ambient conditions. It is used widely in industry because of its softness, resistance to corrosion and radiation, and high density. Lead is also used as a paint pigment, in solder, and in storage batteries.

FATE AND TRANSPORT

BCF:	49 (1)
Degradation Products:	None
Solubility:	Lead is insoluble in water and organic solvents. It does dissolve in dilute nitric acid (2), and hot, concentrated sulfuric acid (3).
Specific Gravity (2):	11.35 @ 20°C

Lead and lead compounds can be present in air, water, and soil and are extremely persistent in water and soil (4). Metallic lead and common lead minerals are insoluble in water while manufactured alkyl lead compounds are water soluble. A major transport process for inorganic and organic lead compounds is atmospheric dispersion as particulate matter. Lead is removed from air by either wet or dry deposition. Photolysis of atmospheric organic lead compounds occurs rapidly (3). The average residence time of atmospheric lead is 7 to 30 days (4).

Natural lead compounds are not mobile in normal surface and groundwater because lead leached from ore is adsorbed by ferric hydroxide. It also readily combines with hydroxide, carbonate, and sulfate ions to form insoluble compounds. These compounds precipitate and settle in the bed sediment. Lead is not volatile, therefore, volatilization is not an important transport process from aquatic environments (3).

Sorption is a dominant effect on the distribution of lead in soil. Lead readily adsorbs to inorganic solids, organic material and hydrous iron and manganese oxides. Because of its affinity for other materials and its solubility characteristics, the mobility of lead in soil is low. (3). Most lead is retained in soil and not transported via leaching or runoff to surface water (4).

Lead is not readily taken up by plants. Consequently, its availability to terrestrial life forms is limited (3). Lead does not appear to significantly bioaccumulate in most fish (4). Microcosm studies indicate that lead is not biomagnified through the food chain (3).

PHARMACOKINETICS

Lead primarily enters the body by inhalation and ingestion. For all practical purposes, it will not enter the body by dermal contact. Approximately 30-50 percent of all inhaled lead particulate is deposited in the respiratory tract. Almost all of the lead present will be absorbed by the lungs. The primary site of absorption by ingestion in children is the gastrointestinal tract. Fifty percent of all dietary lead ingested by children is absorbed, whereas only 8-15 percent is absorbed by adults. Studies have also demonstrated that transplacental transfer of lead is possible.

Lead is not homogeneously distributed upon entering the body. It concentrates in the following three organs: bone, blood, and soft tissue. The lead in each of these compartments has a different rate of intercompartmental movement and residence time (4).

Inorganic lead is not metabolized in the body; rather it is absorbed, distributed and excreted. However, organic alkyl lead is metabolized in the liver via an oxidative dealkylation reaction which is catalyzed by cytochrome P-450 in animals (4).

Lead that is not absorbed by the respiratory or gastrointestinal tract is excreted in the feces. Blood lead not retained by the body is eliminated by the kidney or bile (4).

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

Numerous studies have been conducted on the toxic effects of lead. The data present dose-effect relationships and are expressed in terms of internal exposure measured in blood lead levels (4).

Lead affects various systems of the body. The endpoints elicited at low level exposure are neurobehavioral impairment, growth retardation in children, and hypertension in middle-aged men. High exposure levels produce encephalopathy, gastrointestinal effects, anemia, nephropathy, and electrocardiographic abnormalities (4).

Lead affects the hematopoietic system by interfering with heme biosynthesis and ferrochelatase. This interference results in a reduction of the hemoglobin concentration in blood and an increase in erythrocyte (red blood cell) destruction. The combination of these two effects produce hypochromic, normocytic anemia with associated reticulocytosis. The impairment of heme synthesis has a far ranging impact that is not limited to the hematopoietic system.

Lead exposure also affects the central nervous system. Overt neurological signs have been documented in adults with blood lead levels ranging as low as 40 to 60 μg/dl. Encephalopathy can occur at blood lead levels of 100 to 200 μg/dl and 80 to 100 μg/dl for adults and children, respectively. As indicated by these levels, children are much more sensitive to neurological effects of lead. Death or irreversible health effects may occur as a result of central nervous system impairment (4).

The cardiovascular system is also impacted by lead exposure. Common effects from high level exposure include cardiac lesions and electrocardiographic abnormalities. Hypertension has been

clearly related to lead exposure. Studies suggest that high blood pressure resulting from lead exposure may be mediated through effects on the kidney (4).

A direct relationship has been drawn between blood lead level and children's height, weight, and chest circumference. The strongest relationship was drawn with height. As the blood lead level increases the child's growth is retarded (4).

Exposure to lead has significantly effected the human reproductive system. Because lead accumulates in the bones and is sporadically released into the blood, exposure prior to pregnancy may affect the fetus. Blood lead reaches the fetus by crossing through the placental barrier. It was observed in animals that exposure to lead by non-natural routes (e.g., intravenous or intraperitoneal injection) resulted in malformations of the fetus (4).

In the body, lead can interact with other chemicals. Calcium and phosphorus reduce the amount of lead taken up by the body while zinc helps to reduce the toxic effects of lead. Cadmium increases the toxic effects of lead; and lead increases the toxic effects of mercury. Due to the effect of lead on the hemapoietic system, iron deficiency increases as blood lead increases (4).

Derivation of Oral Reference Dose for Lead

In a review of available toxicological data on the potentially adverse effects associated with various blood lead (PbB) levels in adults and children, Marcus (1986) has concluded that the effects on the enzymes of heme synthesis necessary for red blood cell formation occur at low PbB levels of about 10 micrograms per decaliter (μg/dL). Further, the author noted that neurotoxicity in children begins to appear at 15 to 20 μg/L and at 25 to 30 μg/dL in adults. According to the author, the data suggests, "that PbB values of 15 μg/dL should not be exceeded in children and values of 25 μg/dL should not be exceeded in adults".

In order to protect the fetus, it is necessary to set the PbB level in adults at 15 μg/dL since studies have indicated that the ratio of fetal/maternal PbB values can be approximated at a ratio of one to one (Marcus, 1986). It should be noted that this position is consistent with current EPA's conclusions that "PbB levels of 10 to 15 μg/dL constitute an appropriate range of concern for health effects that warrant avoidance" (Federal Register 50, No. 10, 26460-26550, June 7, 1991).

The acceptable daily intake (ADI) of lead via oral ingestion by adults has been determined to be 48 μg/day (Marcus, 1986). This value is equivalent to a PbB level (15 μg/dL) at which no adverse effects are observed to occur in humans.

Carcinogenic Effects

The EPA has stated that "little can be concluded from available epidemiological studies" concerning the carcinogenic potential of lead (4). However, the carcinogenicity of lead salts (primarily phosphates and acetates) administered via injection or the oral route has been demonstrated in rats and mice in several studies. In most of the investigations, the carcinogenic response has been demonstrated only at the highest dose. Although the EPA has stated that animal data are sufficient to conclude carcinogenicity in animals, the Agency has further stated that available toxicity data on metallic lead and lead compounds are inadequate for quantitative risk assessment (6).

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

Freshwater species are more sensitive to lead contamination in soft water than hard water for both acute and chronic exposure. The ambient water quality criteria for aquatic life are as follows (5):

Four-day average concentration that should not be exceeded more than one time per year.

Freshwater	Salt Water
$e^{(1.273 (\ln (\text{hardness}))-4.705)}$ µg/L or 3.2 µg/L	8.5 µg/L

One-hour average concentration that should not be exceeded more than one time per year.

Freshwater	Salt Water
$e^{(1.273 (\ln (\text{hardness}))-4.460)}$ µg/L or 82 µg/L	220 µg/L

The BCF for saltwater species ranges from 17.5 to 2570 µg/L (3).

Terrestrial

Lead occurs in the tissues of many wildlife species. Lead poisoning has also been reported for a variety of domestic animals including cattle, horses, dogs, and cats. Cattle appear to experience lead poisoning more often because of their indiscriminate eating habits (3).

REGULATORY LEVELS AND CRITERIA

Ambient Air Quality Standard (4):	1.5 µg/m^3
OSHA PEL-TWA (4):	50 µg/m^3
MCL (4):	0.015 mg/L (Action Level)
MCLG (4):	0 mg/L
Reportable Quantity (metallic) (4):	1 lb
ACGIH TLV-TWA (4):	0.15 mg/m^3 (inorganic lead, dust, and fumes)
	0.15 mg/m^3 (lead arsenate)
	0.05 mg/m^3 (lead chromate)
Ambient Water Quality Criterion:	50 µg/L

SUMMARY OF CRITERIA

EPA Carcinogenic Classification (4):	Group B2-probable human carcinogen
RfD (oral) (1)	Not Available
Cancer Slope Factor (oral, inhalation)	Not Available

REFERENCES

1. SPHEM. Superfund Public Health Evaluation Manual. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. October 1986.

2. Hawley, G.G. The Condensed Chemical Dictionary - Eleventh Edition. Van Nostrand Reinhold Company, Inc., New York, New York. 1981.

3. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. September 1985.

4. Toxicological Profile for Lead. U.S. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, and U.S. Environmental Protection Agency. Atlanta, Georgia. June 1990.

5. Ambient Water Quality Criteria. Office of Water, U.S. Environmental Protection Agency, Washington, D.C. May 1986.

6. IRIS. Integrated Risk Information System. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. 1994.

7. U. S. Environmental Protection Agency, Federal Register, Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, Vol. 56, No. 110, June 7, 1991.

8. Marcus, W.L., 1986. Lead Health Effects in Drinking Water, Toxicology and Industrial Health, Vol. 2, No. 4, pp. 363-407.

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MANGANESE

INTRODUCTION

Chemical Name:	Manganese
CAS Number:	7439-96-5
Molecular Formula:	Mn
Molecular Weight:	54.94 g/mole

Manganese is a brittle silvery metal which usually occurs as a complex with other metals such as iron. Manganese and its compounds are used in the making of steel alloys, dry-cell batteries, electrical coils, and other metallic fabrication applications. Other manganese uses include use as an oxidizing agent and as a food additive (3,4).

FATE AND TRANSPORT

Solubility:	
In Water:	Decomposes to ionic forms (1)
In Organics:	Readily dissolves in dilute mineral acids (4)
Specific Gravity:	7.20 (1)

Manganese can occur in soil, water, or air. Because it is an element, manganese cannot be degraded by environmental processes. However, it may transform from one manganese compound to another. While manganese can be transported in dusts or in water, the main source of routine manganese exposure is through ingestion of food. Vegetables, the germinal portions of grains, fruits, nuts, tea, and some spices are rich in manganese (3).

In the soil, the concentration and chemical form in which manganese can occur is affected by pH, cation exchange capacity, drainage, and other factors. Lowered pH and reducing conditions tend to favor solubility and hence, the mobility of manganese. Manganese often occurs at higher concentrations in the bottom of stratified lakes as a result of its release from bottom sediments as manganous ion under reducing conditions (1).

The presence of high concentrations of chlorides, nitrates, and sulfates may also increase manganese solubility. Under these conditions, manganese is more easily taken up by plants. Also, soils with limited cation exchange capacity have a poor ability to bind and retain manganese(1).

Atmospheric transport of manganese fumes or dusts is also possible. These materials can be returned to the earth by wet or dry deposition (1).

PHARMACOKINETICS

Manganese can enter the body through the ingestion of manganese-bearing food or through the inhalation of air containing manganese fumes or dusts. It is considered to be an essential element

and cofactor in a number of enzymatic reactions with daily intakes ranging from two to nine milligrams. Gastrointestinal absorption of the metal is less than five percent. Manganese is transported by a plasma-bound β1-globulin protein (probably transferrin). It is widely distributed throughout the body, concentrating in cells rich in mitochondria. Consequently, tissues such as the pancreas, liver, kidney, and intestines, which contain high numbers of these organelles, tend to be deposits for manganese (3).

The biological half-life for manganese in the body is 37 days. Manganese readily crosses the blood-brain barrier, with its half-life in the brain being somewhat longer than in the body as a whole (3).

Manganese is eliminated in the bile and is resorbed through an enterohepatic pathway through the intestine. The principal means of elimination is through the feces (3).

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

Noncarcinogenic effects in humans are most pronounced following inhalation exposure. The types of effects observed fall into two categories, depending upon the severity and duration of the exposure (3). The first type of effect observed, manganese pneunmonitis, is the result of acute exposure. Individuals acutely exposed exhibit a lung condition characterized by pathologic changes including epithelial necrosis, followed by mononuclear proliferation (3). The second, and more serious effect observed following chronic manganese exposure, is characterized by neurologic symptoms. Chronic manganese poisoning is characterized by psychiatric disorders manifested as irritability, difficulty walking, speech disturbances and compulsive behaviors. Long-term etiology includes development of a mask-like face and a Parkinsonian-like syndrome (3).

An inhalation reference concentration (RfC) of 5×10^{-5} mg/m^3 (1.43×10^{-5} mg/kg/day) for manganese has been developed (2). The basis for this value is increased prevalence of respiratory symptoms and psychomotor disturbances. Potential limitations to this RfC include the inability to calculate a true absorbed dose as a result of variable particle size and dosimetry effects.

Manganese is considered to be one of the least toxic of the trace elements via the ingestion exposure route. Certain sub-populations, such as the elderly, children, pregnant women, and iron-deficient individuals, may have in increased potential to accumulate excess manganese. However, toxicity from ingested manganese is rarely observed (2).

EPA has established an oral Reference Dose (RfD) for manganese of 5.0×10^{-3} mg/kg/day, based on central nervous system effects (2). This oral RfD is based on total dietary intake, and may not be valid if the intake is to occur from drinking water alone, as manganese in drinking water is more bioavailable than manganese from food.

Carcinogenic Effects

There are no epidemiological studies to suggest that manganese or its compounds are carcinogenic. Manganese is classified as a Group "D" carcinogen, indicating that it is not classifiable as a human carcinogen. The basis for this determination is the lack of existing studies to assess this material (2).

The evidence for rating manganese as a carcinogen in animals is considered to be inadequate. Most studies that have shown some evidence of carcinogenicity have failed to demonstrate a dose-response relationship (2).

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

Adequate data to develop ambient water quality criteria are not available at this time. A 48-hour LC_{50} value of 16 mg/L of manganese is reported for embryos of the oyster Crassostrea virginica. For the softshell clam, Mya arenaria, a 168-hour LC_{50} value of 300 mg/L is reported (1).

Terrestrial and Avian

Adequate data for characterization of the toxicity of manganese to wildlife or domestic animals are not available (1).

REGULATORY LEVELS AND CRITERIA

OSHA Ceiling Level (1):	5 mg/m^3
ACGIH TLV-TWA (1):	1 mg/m^3 (Fume)
STEL (1):	3 mg/m^3 (Fume)
TLV-TWA (1):	5 mg/m^3 (Dust and Compounds)

SUMMARY OF CRITERIA

EPA Carcinogenic Classification (2)	Group D-Not Classifiable
Oral RfD (water) (2)	5.00×10^{-3} mg/kg/day
Inhalation RfD (2)	1.43×10^{-5} mg/kg/day
Oral (food) RfD (2):	1.4×10^{-1} mg/kg/day
Secondary Maximum Containment Level (2)	0.05 mg/L
NOAEL (oral diet) (2):	0.14 mg/kg/day
NOAEL (oral drinking water) (2):	0.005 mg/kg/day
LOAEL (inhalation) (2):	0.05 mg/cu m
AWQC (5):	
Water and Organisms:	50 µg/L
Organisms Only:	100 µg/L

REFERENCES

1. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergence Response, U.S. Environmental Protection Agency, Washington D.C. September, 1985.

2. IRIS. Integrated Risk Information System. Office of Research and Development, U.S Environmental Protection Agency, Washington, D.C. 1994.

3. Klaassen, C.D., M.O. Amdur, and J. Doull, eds. Casarett and Doull's Toxicology - The Basic Science of Poisons, Third Edition. Macmillan Publishing Company, New York, New York. 1987.

4. Hawley, G.G., The Condensed Chemical Dictionary-Eleventh Edition. Van Nostrand Reinhold Company, Inc., New York, NY. 1987.

5. Ambient Water Quality Criteria. Office of Water, U.S. Environmental Protection Agency, Washington, D.C. 1993.

6. HEAST. Health Effects Assessment Summary Tables. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. January, 1992.

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MERCURY

INTRODUCTION

Chemical Name:	Mercury
CAS Number:	7439-97-6
Molecular Formula:	Hg
Molecular Weight:	200.59 g/mole
Chemical Structure:	Hg

Mercury is a silvery, heavy liquid with valences of +1, and +2. Mercury exists as insoluble elemental mercury, organic species, and inorganic species. Solubility depends upon the reduction-oxidation potential and the pH of the environment (2).

Common uses for mercury are amalgams, catalysts, electrical apparati, instruments such as thermometers and barometers, and neutron absorbers in nuclear power plants (2).

FATE AND TRANSPORT

Solubility (4):	81.3
In Water:	μg/L at 30° C; some salts and organic compounds are soluble (1).
Vapor Pressure(4):	0.0012mm Hg at 20° C (1)
Specific Gravity(4):	13.5939 at 20° C (1)

Mercury appears in ambient air, water, soil, and foodstuffs. Because mercury volatilizes from aquatic and terrestrial sources, the atmosphere becomes a reservoir for the element and its compounds. Wet and dry deposition processes return mercury to the land and surface, where it is absorbed in the soil and water surfaces. The sorption rate is related to the organic content of the soil. Since inorganic mercury is sorbed to particulate matter more readily than it is desorbed, sediments become repositories for inorganic forms of the compound. Although leaching is an insignificant transport process, mobilization from particulates can occur through biotic and abiotic oxidation and reduction to elemental mercury and bioconversion to volatile organic forms (1).

The transformation processes of mercury in the atmosphere, water, and soil are biotransformation and bioaccumulation. The primary transformation process is photolysis of organomercurials (1).

PHARMACOKINETICS

Inorganic mercury is absorbed rapidly by the lungs in humans. One study showed that 80 percent of inhaled elemental mercury vapor is retained in human tissues (4). Oral absorption of inorganic mercury is estimated to be about 10 percent while organic mercury is readily absorbed in humans (approximately 95 percent) (4). There are few dermal absorption studies with inorganic and organic mercury, but dermal absorption is known to occur with both types of mercury (4).

Inorganic mercury in body fluids is highly diffusible and lipophilic and, therefore, distributes to all tissues in the body. The highest levels of inorganic mercury occur in the kidney, while lower levels are found in the chest area and lung. Animal inhalation studies have shown mercury to concentrate in the kidney, intestinal mucosa, epithelial layers of the skin, salivary and sweat glands, pancreas, testes and prostate (4).

Organic mercury (i.e., methyl mercury) distributes readily to all tissues in the body following gastrointestinal tract absorption. It can cross diffusion barriers and penetrate membranes easily and, therefore, distributes uniformly in the body; the highest levels being found in the kidney. Organic mercury can easily cross over the placental barrier, and is secreted in breast milk in the inorganic form. Methyl mercury also tends to accumulate in the hair (4).

Inhaled inorganic mercury undergoes rapid oxidation to its divalent form primarily in the red blood cells, and in the lung. Rat studies indicate that inorganic mercury is oxidized in the liver, while other studies indicate that divalent mercury is reduced by mammalian tissue to elemental mercury after its oxidation (4).

Organic mercury (i.e., methyl mercury) is converted to an inorganic form before it enters the oxidation-reduction cycle. Phenyl mercury also metabolizes into inorganic mercury (4).

The urine and feces are the main excretory pathways of organic and inorganic mercury in humans. The fecal pathway is the primary excretory route for organic mercury. In humans, all mercury in the feces is in its inorganic form after organic mercury exposure. Minor amounts of mercury are excreted through saliva, bile and sweat (4).

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

Irreversible damage to the brain, kidneys, or developing fetus are effects of long-term exposure to mercury (1). In humans, inorganic mercury which is inhaled causes damage to the brain. If inorganic mercury is consumed through water or food, the effect will be focused in the kidneys. Adverse affects of inorganic mercury are characterized by tremors, memory loss, and kidney disease (1).

The EPA is currently reviewing the inhalation and oral RfDs for mercury.

Carcinogenic Effects

The EPA has classified mercury as a Group D carcinogen - not classifiable as to human carcinogenicity. No human data are available and animal studies are inadequate to determine carcinogenicity.

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

Freshwater plants exhibit a wide range of sensitivity to mercury, however, the most sensitive plant is less sensitive than the most sensitive freshwater animal.

Fish tend to be more resistant to mercury than mollusks and crustaceans. Aquatic organisms should not be adversely affected if the following average concentrations are not exceeded more than once every three years on the average.

Freshwater organisms:

4-day average: 0.012 µg/L (5)
1-hour average: 2.4 µg/L (5)

Marine organisms:

4-day average: 0.025 µg/L (5)
1-hour average: 2.1 µg/L (5)

Terrestrial and Avian

No data are available pertaining to the effects of mercury on terrestrial and avian life forms (4).

SUMMARY OF REGULATORY LEVELS AND CRITERIA

Oral RfD (6)	3.0×10^{-4} mg/kg/day (inorganic)
Inhalation RfD (6)	8.57×10^{-5} mg/kg/day (inorganic)
EPA Carcinogen Classification (3)	Group-D Not classified as a human carcinogen
AWQC (human)(4)	0.144 µg/L
MCL (4)	2 µg/L
OSHA Ceiling Level(7)	1 mg/10 m^3 (inorganic and vapor)

REFERENCES

1. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. September 1985.

2. Hawley, G.G. The Condensed Chemical Dictionary - Eleventh Edition. Van Nostrand Reinhold Company, Inc., New York, New York. 1987.

3. IRIS. Integrated Risk Information System. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. 1994.

4. Toxicological Profile for Mercury. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, and U.S. Environmental Protection Agency. Atlanta, Georgia. December 1989.

5. Ambient Water Quality Criteria. Office of Water, U.S. Environmental Protection Agency, Washington, D.C. May 1986.

6. HEAST. Health Effects Assessment Summary Tables. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. March 1994.

7. 29 Code of Federal Regulations, Parts 1910.1000, Table Z-2. 1993.

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NICKEL

INTRODUCTION

Chemical Name:	Nickel
CAS Number:	7440-02-0
Molecular Formula:	Ni
Molecular Weight:	58.7 g/mole
Chemical Structure:	Ni

Nickel is a malleable silver-white metal that occurs in valences 0,+1, +2, +3, and +4. It is almost always found in the divalent oxidation state in aquatic systems. Nickel is commonly used in alloys, electroplated protective coatings, and fuel cell electrodes. The main source of nickel in the atmosphere is due to the burning of fuel oil. Nickel-containing sewage sludge, the use of certain fertilizers and the deposition of aerosol particles are primarily responsible for nickel contaminated soil (1,2).

FATE AND TRANSPORT

Solubility (1):	Insoluble in water; some salts are soluble
Specific Gravity (1):	8.902 at 25°C

Nickel is found in the air, water, and soil. The average residence time for nickel in the atmosphere is seven days, the residence time in water is between 19 and 23,000 years, and the average time in soil is estimated to be 2400-3500 years (4).

The bioconcentration factors for most aquatic organisms suggests that bioaccumulation would not be significant. However, the BCFs for marine phytoplankton range from 20-8000. Nickel is reasonably mobile in soils with a low pH and cation exchange capacity. It is less mobile in soils with a high organic content. Uptake of nickel in plants from the soil is common (4).

There are no data referencing the significance of biodegradation, photolysis, or volatilization of nickel as environmental fate processes (1,4).

PHARMACOKINETICS

Quantitative data concerning the uptake of nickel by the respiratory tract are not available, however, studies have shown that nickel accumulates in the soft tissue of the lungs. Dietary nickel which has been ingested is absorbed at a level of 1-10%. Following ingestion of nickel, it was found in serum as ultrafilterable nickel, albumin-bound nickel, and in a metalloprotein. Oral doses of nickel chloride have been found to localize in the kidneys, lungs and central nervous system of animals (4).

Dermal penetration of nickel on human skin was found to occur at a level of 55 to 77% in one study. Studies concerning the distribution of nickel which is dermally absorbed are not available (4).

Once nickel is absorbed in the body it binds to a number of serum macromolecular components, (e.g. in humans, nickel binds to albumin, 1 - histidine and alpha-2-macroglobulin).

Most of the nickel that is introduced into the body by inhalation, oral, and dermal absorption is excreted in the urine. Unabsorbed nickel resulting from oral exposure is excreted in the feces (4).

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

In both humans and animals, the lung has been the organ targeted for nickel toxicity. Inhalation of nickel is associated with lung cancer, allergenic response, asthma, and pulmonary infections. No human or animal studies regarding dermal absorption are available. No studies concerning oral effects on humans have been identified. However, pulmonary effects on animals were observed when nickel was administered orally (4).

No immunological, renal, or hematological effects have been observed in humans. Injection studies have shown immunological effects in mice. These mice showed significant immunosuppression. Renal effects in mice consisted of aminoaciduria and proteinuria, which are indicative of renal dysfunction. Hematological effects in animals were exhibited by increased white blood cell counts, decreased hemoglobin concentration, decreased hematocrit, and histological lesions in the bone marrow (4).

Teratogenic and reproductive effects of nickel in humans and animals are inadequate. However, mammalian cell transformation data indicates that specific nickel compounds are mutagenic and cause chromosomal alterations (4).

The most common effect of nickel exposure is a sensitization reaction exhibited by dermatitis (4).

The oral RfD is 0.02 mg/kg/day (soluable salts) and is based on decreased organ and body weights in rats. A NOAEL of 5 mg/kg/day was identified. An uncertainty factor of 100 was applied based on a factor of 10 for interspecies extrapolation and a factor of 10 to protect sensitive populations; the modifying factor is 3 due to inadequacies in the reproductive studies (4). The oral RfD supporting study consisted of a 2-year feeding study using rats administered nickel sulfate hexahydrate in concentrations of 0, 100, 1000, or 2500 ppm in the diet. Body weight was significantly decreased at 1000 and 2500 ppm. No significant effects were reported at 100 ppm (3).

Carcinogenic Effects

Although the EPA has not assigned a carcinogen classification for soluble salts of nickel, it has assigned a Group A classification for nickel refinery dust, nickel carbonyl and nickel subsulfide. This classification indicates that there is sufficient evidence from epidemiologic studies to support a causal association between nickel exposure and cancer in humans (4). EPA has also established an inhalation slope factor of 8.4×10^{-1} $(mg/kg/day)^{-1}$ (3).

Epidemiological studies found that nickel-exposed workers developed three types of respiratory cancer: epidermoid, anaplastic, and pleomorphic carcinomas (4).

Experimental animal studies indicate that upon injection, tumors appear on animals at the injection site (4).

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

The Ambient Water Quality Criteria for the level of nickel that will not adversely affect aquatic organisms and their uses are as follows (5):

Freshwater:
- Acute toxicity: 1,400 µg/L*
- Chronic toxicity: 160 µg/L*

Saltwater:
- Acute toxicity: 140 µg/L
- Chronic toxicity: 7.1 µg/L

* Based on a hardness of 100 mg/L as $CaCO_3$ (calcium carbonate)

Terrestrial and Avian

No data are available for terrestrial and avian life forms (4).

REGULATORY LEVELS AND CRITERIA

OSHA PEL-TWA (8):	1.0 mg/m^3 (metal and insoluble compounds) 1.0 mg/m^3 (soluble compounds)
ACGIH TLV-TWA (9):	1.0 mg/m^3 (insoluble compounds, nickel sulfide roasting, fume and dust, and metal) 0.1 mg/m^3 (soluble compounds)
AWQC (4)	
Ingestion of Water and Organisms:	632 µg/L
Ingestion of Only Organisms:	4.77 µg/L (ingesting only organisms)
Reportable quantity (3)	1 lb
Maximum Contaminant Level (MCL) (6)	0.1 mg/L 0.1 mg/L

SUMMARY OF CRITERIA

EPA Carcinogenic Classification(3)	Group A-Sufficient evidence to support the causal association between nickel inhalation (nickel refinery dust, nickel carbonyl, and nickel subsulfide) and cancer
	Group C - Limited evidence of carcinogenicity to support the causal association between exposure (nickel soluble salts) and cancer.

Nickel Refinery Dust

Cancer Slope Factor (inhalation) (7)	8.4×10^{-1} $(mg/kg/day)^{-1}$

Nickel (Soluble Salts)

Oral RfD (3)	0.02 mg/kg/day
Inhalation RfD (3)	Pending

REFERENCES

1. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. September 1985.

2. Hawley, G.G. The Condensed Chemical Dictionary. Eleventh Edition. Van Nostrand Reinhold Company, Inc., New York, New York. 1987.

3. IRIS. Integrated Risk Information System. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. 1994.

4. Toxicological Profile for Nickel. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, and U.S. Environmental Protection Agency. Atlanta, Georgia. October 1988.

5. Ambient Water Quality Criteria. Office of Water, U.S. Environmental Protection Agency, Washington, D.C. May 1986.

6. U.S. EPA, Water Quality Criteria Summary. May 1, 1991.

7. U.S. EPA, Health Effects Assessment Summary Tables. FY-1992 Annual. Office of Research and Development, Office of Emergency and Remedial Response. March 1994.

8. OSHA. Title 29 Code of Federal Regulations, Part 1910.1000, Table Z-1. 1993.

9. ACGIH. Documentation of the Threshold Limit Values. 1993-1994.

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POLYCHLORINATED BIPHENYLS (PCBS)

INTRODUCTION

Chemical Name:	Polychlorinated Biphenyls (PCBs)
Synonyms and Trade Names:	Aroclor, Kanechlor, Clophen
CAS Numbers:	Aroclor 1242: 53469-21-9
	Aroclor 1248: 12672-29-6
	Aroclor 1254: 11097-69-1
	Aroclor 1260: 001336-36-3
Molecular Formula:	$C_6H_xCl_xC_6H_xClx$
Molecular Weights:	Aroclor 1242: 266.5 g/mole
	Aroclor 1248: 299.5 g/mole
	Aroclor 1254: 328.4 g/mole
	Aroclor 1260: 377.8 g/mole

The term polychlorinated biphenyls (PCBs) commonly refers to a variety of mixtures of individual biphenyl isomers, each consisting of two joined benzene rings and up to ten chlorine atoms. Mixtures of these isomers are known by their commercial designation of Aroclor. This trade name is followed by a four-digit number; the first two numbers indicate the type of isomer mixture and the last two numbers indicate the approximate weight percent of chlorine in the mixture (3).

PCBs are man-made chemicals that were used widely in transformers, electrical equipment and as lubricants (2). Because of their persistence and toxicity in the environment, their manufacture was discontinued in the United States in 1977 (1). However, PCB equipment manufactured before 1977 is currently still being used in the U.S. and this use is being regulated by the Environmental Protection Agency.

PCBs are very stable chemically and tend to be persistent in the environment. Persistence and bioaccumulation in living organisms also occur due to the high lipophilicity of these compounds (2).

CHEMICAL AND PHYSICAL PROPERTIES

Aroclor	**1242**	**1248**	**1254**	**1260**
Log K_{oc}	3.8	5.75	5.51	6.3
Log K_{ow} (2):	5.6	6.11	6.03	7.15
Henry's Law Constant(2): (atm-m^3/mol at 25° C)	$5.7x10^{-4}$	$3.5x10^{-3}$	$8.4x10^{-3}$	$7.1x10^{-3}$
Water Solubility (mg/L):	0.24	0.054	0.012	0.0027
Vapor Pressure(2): (mm Hg at 25° C)	$4.06x10^{-4}$	$4.94x10^{-4}$	$7.71x10^{-5}$	$4.0x10^{-5}$
Density (2):	1.35	1.41	1.50	1.57

FATE AND TRANSPORT

PCBs can be found in the atmosphere, water, and soil. Adsorption to sediments is the major fate process for PCBs in water. Because of lower water solubilities and higher octanol-water partition coefficients, higher chlorinated isomers will adsorb more strongly than the lower chlorinated isomers. This also indicates that significant leaching should not occur in soil under most conditions (2).

For PCBs that exist in the dissolved state in water, volatilization becomes the primary fate process. Therefore, the volatilization process is the major removal mechanism of PCBs from water sources. However, the rate of volatilization is dependent upon PCB adsorption to sediment (2).

In the atmosphere, PCBs exist in the vapor phase and can be removed by wet and dry deposition. A typical range of PCB concentrations in the atmosphere is between 1 and 250 μg/L (2).

Degradation of PCBs in the environment is dependent upon the degree of chlorination. Generally, the more chlorinated the PCB molecule, the more persistent it will be in the environment. Factors which determine biodegradability include the amount of chlorination, concentration, type of microbial population, available nutrients, and temperature (2). The dominant degradation process in the atmosphere is dependent upon the vapor phase reaction of PCBs with hydroxyl radicals (2).

Photolysis is thought to be the only transformation process in the aquatic environment. However, the process is extremely slow. It appears the hydrolysis and oxidation do not degrade PCBs (2).

In the atmosphere, typical airborne concentrations of PCBs are as follows (2):

Location	Concentration Range (mg/m^3)
Urban	0.5 to 30
Rural	0.1 to 2.0
Great Lakes	0.4 to 3.0
Marine	0.05 to 2.0
Remote	0.02 to 0.5

The concentrations of PCBs in the open waters of oceans and lakes are shown below (2):

Location	Concentration Range (μg/L)
North Pacific	0.04 to 0.59
Antarctic	0.035 to 0.069
North Atlantic	0.02 to 0.20
Lake Superior	0.63 to 3.30
Lake Michigan	3.0 to 9.0
Lake Huron	0.49 to 17.15

PCBs are found in the soils from different areas of the world in the following concentrations (2):

Location	Concentration Range (ppb)
Great Britain	2.3 to 444
South Wales/Scotland	4.5 to 47.7
Japan	<10 to 100
United States	
Everglades National Forest, Florida	<1 to 33
U.S. Urban areas	0.02 to 11.94
Rocky Mountain National Park	0.098 to 0.54
Great Lakes	2.5 to 251.7

PHARMACOKINETICS

PCBs are absorbed primarily through inhalation and dermal contact in occupational environments. However, the general public absorbs PCBs primarily through oral exposure, such as the ingestion of PCB contaminated fish (2).

Animal studies have shown that PCBs are readily absorbed, but studies to quantify the rate of absorption are needed. Studies indicate that PCBs are absorbed by the gastrointestinal tract, and have been found in the serum and breast milk of woman orally exposed to PCBs (2).

PCBs accumulate in human plasma and adipose tissue with the extent of accumulation dependent on the positions of chlorines on the PCB congeners. Congeners with chlorines in both 4 positions as opposed to the 3 ,4 positions were found in greater concentrations (2). Also, PCBs have been shown to accumulate in human breast milk. The extent of accumulation is approximately 4 to 10 times less than the concentration in maternal blood (2).

Animal studies have indicated maximum concentrations in the liver, brain, and adipose tissue. Studies show that distribution occurs in a biphasic manner. First, PCBs accumulate in the liver and muscle from the blood stream. Following this accumulation, PCBs are either stored in the adipose tissue or metabolized by the liver. It has been suggested that PCBs concentrate in the adipose tissue regardless of the route of exposure (2).

The metabolism of PCBs depends on chlorine content and on the site of chlorination. The major metabolic products are phenolic in nature. Other identified end products are sulfur-containing compounds, trans-dehydrodiols, polyhydroxylated PCBs and methyl ether derivatives (2).

Data regarding the excretion of PCBs following inhalation or dermal exposure are not available. When oral exposure occurs, excretion is dependent upon the metabolism of PCBs to more polar compounds (2).

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

The evaluation of the toxicity of PCBs is complicated by a number of factors including differences in isomer/congener/mixture composition, differences in species susceptibility, quantitatively inconsistent data, and varying degrees of contamination from other chemicals such as chlorinated dibenzofurans. Also, it should be noted that because of changes in congener and impurity composition resulting from environmental and/or biological transformations, PCBs currently in the environment may differ from the original PCB mixture (2).

Inhalation Exposure

There are no human data available regarding the lethality/decreased longevity of humans due to acute or chronic inhalation exposure. However, the primary target organs associated with PCB inhalation are the liver and cutaneous tissue. Occupational exposure has been associated with elevated serum levels in the liver and enzyme and dermatologic effects such as chloracne and skin rashes (2).

Human developmental studies have proved inconclusive and lack monitoring data. However, there were suggestions that mothers occupationally exposed to PCBs exhibited a slight decrease in birth weight and gestational age of offspring. No animal studies were available concerning developmental toxicity (2).

In animals, the liver and skin are unequivocal targets of PCB toxicity, especially in terms of chronic toxicity. The range of toxicity for dermal and hepatic effects is from 0.007 to 11.0 mg/m^3 (2).

Oral Exposure

There are no studies which address oral PCB exposure in humans. However, animal studies have established a single dose LD50s for rats and mice. The levels are 1,010 mg/kg for Aroclor 1254 and 750 mg/kg for Aroclor 1221, respectively (2).

Systemic effects in animals include perturbations of the liver and cutaneous tissues. Rats fed 0, 4, 8, and 16 ppm of Aroclor 1254 for 4 days resulted in an increase in liver weight at concentrations greater than 8 ppm and an increase of serum HDL cholesterol levels at 16 ppm. A lowest observed adverse effect level (LOAEL) of 5 ppm was identified in rats based on hepatic effects. At this level, hepatic microsomal enzyme activities increased, production of liver lipid content increased, and frank degenerative liver alterations were observed (2).

Developmental effects in humans from oral exposure to PCB contaminated fish include effects on birth weight, head circumference, gestational age and/or neonatal behavior. For animals, a LOAEL of 50 ppm in female rats has been identified based on fetotoxicity. At this level, effects such as reduced litter size, ultrastructural lesions in the thyroid follicular cells of neonates and weanlings and reduced serum levels of thyroid hormone were observed (2).

The only study relating PCBs to reproduction demonstrated that doses of >2 ppm Aroclor 1254 administered to mink for 4 months prior to mating and during gestation were lethal to fetuses and caused reproductive failure (2).

Dermal Exposure

Dermal exposure is a major route of PCB absorption. However, the current data does not allow for the quantification of dermal absorption to the total body burden of PCBs (2).

A study involving capacitor workers does not show clear evidence of liver disease. However, a correlation can be made between the PCB exposure and liver enzyme induction in the workers. It is not clear to what extent the dermal absorption affected the hepatic changes since inhalation exposure also occurred (2).

A study involving dermal exposure of Aroclor 1260 to female New Zealand rabbits for 5 days/week at a dose of 118 mg/day for 38 days produced degenerative lesions of the liver and kidneys, increased fetal porphyrin elimination and hyperplasia and hyperkeratosis of the follicular and epidermal epithelium (2). Other studies indicate that the median lethal dose for single dermal exposure for rabbits was >1269 mg/kg for Aroclor 1242 and 1248 to <3,169 for Aroclor 1221 (2).

No studies have been located which address immunological, neurological, developmental or reproductive effects of PCBs on humans or animals (2).

Carcinogenic Effects

The EPA has classified PCBs as a Group B2 carcinogen - a probable human carcinogen. This classification is based on the evidence of hepatocellular carcinomas in three strains of rats and two strains of mice. There is suggestive evidence that links PCBs to liver cancer in humans by the ingestion, inhalation, or dermal pathways. However, this evidence is inadequate due to confounding factors and lack of exposure quantification (4).

There have been several studies attempting to associate PCB exposure with carcinogenicity. In New Jersey, a petrochemical plant reported a statistically significant increase in malignant melanomas among 31 research and development employees and 41 refinery workers. Because the study failed to report quantified exposure levels and to identify the presence of other potential or known carcinogens, it was discredited (4).

Two outbreaks of poisoning following accidental consumption of PCB-contaminated rice oil (also containing polychlorinated dibenzofurans and polychlorinated quinones) occurred in Japan in 1968 (Yusho) and in Taiwan in 1979 (Yu-Cheng). A 16-year mortality study was completed which identified an increase in liver cancer in both males and females. There is strong evidence indicating the health effects were attributable to the polychlorinated dibenzofurans in the oil as opposed to the PCBs. Therefore, this study only suggests carcinogenicity of PCBs (4).

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

PCBs have the capability to bioaccumulate and biomagnify. For rainbow trout, bluegills and channel catfish, the 96-hour LC50 values were approximately 20 mg/liter. When the exposure was increased to 10 to 20 days, the average LC50 value was 0.1 mg/liter. Studies indicate that juvenile organisms appear to be more susceptible to PCBs than either eggs or adults (3).

A study which experimentally determined the bioconcentration factors of various Aroclors in aquatic species found bioconcentration factors ranging from 26,000 to 660,000 (2).

In a study conducted by the U.S. Fish and Wildlife Service, 315 fish from 107 stations nationwide were analyzed for PCBs. Results showed that 94% of all fish were found to contain PCB residues. The geometric mean concentration of all Aroclors was found to be 0.53 μg/g. It should be noted that this study included the analyses of whole fish samples which include both the edible and nonedible portions of the fish. Therefore, the concentration will not reflect the actual human exposure through oral consumption (2).

Subsequent studies have shown PCB levels in fish collected and analyzed from Lake Huron to contain 600 to 72,000 μg/g PCBs on a lipid basis. Analyses of 62 samples of commercial fish collected from Lake Ontario revealed PCB levels ranging from 0.11 to 4.90 ppm (2).

The Ambient Water Quality Criteria for the protection of aquatic organisms are as follows (3):

Freshwater:

Acute toxicity:	2.0 μg/L
Chronic toxicity:	0.014 μg/L

Marine:

Acute toxicity:	10.0 μg/L
Chronic toxicity:	0.030 μg/L

Terrestrial and Avian

PCBs can affect terrestrial wildlife in three primary ways: mortality, adversely affecting reproduction, and changing behavior. Behavioral effects include increased activity, decreased avoidance response, and decreased nesting (3).

In sensitive bird species, PCB levels of greater than 200 ppm in the diet or 10 mg/kg body weight caused some mortality. When the doses were increased to 1,500 ppm or 100 mg/kg body weight, extensive mortality was exhibited (3).

In studies in which chicken were fed levels of 20 ppm PCBs in the diet, lower egg production, deformities, decreased hatchability, lower growth, and survival were observed (3).

REGULATORY LEVELS AND CRITERIA

OSHA Advisory TWA (2):	Aroclor 1242 - 1.0 mg/m3
	Aroclor 1254 - 0.5 mg/m3
FDA Temporary Tolerances (2):	Foods - 0.2-3.0 ppm
	Packaging - 10.0 ppm
ACGIH (2):	
TLV-TWA for Aroclor 1242:	1.0 mg/m3
TLV-TWA for Aroclor 1254:	0.5 mg/m3
Ambient Water Quality Criteria (2):	0.79 to 0.0079 ng/L for carcinogenicity at 10^{-5} to 10^{-7} risk levels
Drinking Water Criteria (2):	MCLG: 0 μg/L
	MCL: 1 μg/L
Reportable Quantity (2):	10 lbs. (statutory)
	1 lb. (proposed)

SUMMARY OF TOXICOLOGICAL INDICES

EPA Carcinogenic Classification (4) Group: B2-Probable human carcinogen

Carcinogenic Effects:	
Oral CSF(4):	7.7 $(mg/kg/day)^{-1}$
Inhalation CSF (4):	Not Available.
Oral RfD (4) for Aroclor 1254:	2.0×10^{-5} mg/kg/day
NOAEL:	None
LOAEL:	0.005 mg/kg-day

REFERENCES

1. Hawley, G.G. The Condensed Chemical Dictionary-Eleventh Edition. Van Nostrand Reinhold Company, Inc., New York, New York. 1987.

2. Toxicological Profile for Selected PCBs (Aroclor-1260,-1254,-1248,-1242,-1232,-1221, and -1016). U.S. Agency for Toxic Substances and Disease Registry. U.S. Public Health Service, and U.S. Environmental Protection Agency, Atlanta, Georgia. June 1989.

3. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. September 1985.

4. IRIS. Integrated Risk Information System. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. 1994.

5. HEAST. Health Effects Assessment Summary Tables. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. March 1994.

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POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)

INTRODUCTION

The PAHs are a diverse class of compounds consisting of two or more substituted and unsubstituted polycyclic aromatic rings formed by the incomplete combustion of carbonaceous materials. PAHs are ubiquitous in the modern environment and commonly are constituents of coal tar, soot, vehicular exhausts, cigarette smoke, certain petroleum products, road tar, mineral oils, creosote and many cooked foods.

The physiochemical properties of the various PAHs are shown on Table 1.

FATE AND TRANSPORT

Other than naphthalene, the PAHs can be separated into two major groups based on chemical and physical properties relevant to their fate and transport. Table 2 lists the PAHs belonging to the anthracene group and benzo(a)pyrene group. The following paragraphs discuss the groups' fate and environmental pathways.

The Anthracene Group: (anthracene, acenaphthene, acenaphthalene, fluoranthene, fluorene, phenanthrene and pyrene): The majority of the information presented below is specific to anthracene. However, the properties and fate characteristics of anthracene are considered to be representative of the other PAHs in this group.

Under ambient conditions, atmospheric anthracene will exist predominantly (approximately 90%) in the vapor phase with very little adsorption to aerosols. Anthracene can be returned to aquatic and terrestrial systems by wet and dry deposition; however, the majority of the deposition will be dry. A significant amount of airborne anthracene may be removed and deposited near combustion sources. The anthracene remaining in the air will probably undergo photoxidation to quinones and other oxygenated compounds (8).

Dissolved anthracene can undergo some removal from surface waters via volatilization, but its low vapor pressure (2.4×10^{-4} torr at 25°C) prevents this from being a significant transport pathway. A half-life of 16 hours for anthracene was reported in the aquatic environment under maximum volatilization conditions (6). With a log octanol-water partition coefficient of 4.45, anthracene has a very strong tendency to partition from water to other environmental media. Adsorption and sedimentation are the primary environmental fates in aquatic systems with absorption both organic and non-organic particulate matter (6).

Anthracene in the aquatic system will tend to accumulate preferentially in the sediment and remain there unless considerable mixing at the sediment/water column interface occurs. In rivers, the major fate pathway is transport of sediment-adsorbed anthracene to the oceans, since neither photolysis

or anaerobic degradation are important fate pathways. Depending on the actual conditions in the environment, biotransformation could be an important fate process (6).

Biological processes such as uptake, depuration, and biodegradation are considered potential environmental fate mechanisms for anthracene. Bioaccumulation of anthracene is probably short-term, especially for vertebrates. Biodegradation by microorganisms may also be a significant fate process (6). Half-lives on the order of 1-2 weeks under laboratory conditions were reported for the anthracene group.

The Benzo[a]pyrene Group: (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[g,h,i]perylene, benzo[k]fluoranthene, chrysene, dibenzo[a,h]anthracene, indeno[1,2,3-c,d]pyrene): The majority of the information presented below is specific to benzo[a]pyrene; however, the properties and fate characteristics of benzo[a]pyrene are considered to be representative of the other PAHs in this group.

Under ambient conditions, atmospheric benzo[a]pyrene will exist predominantly (approximately 99%) adsorbed to aerosols. Benzo[a]pyrene can be returned to aquatic and terrestrial systems by wet and dry deposition; however, the majority of the deposition will be dry. A significant amount of airborne benzo[a]pyrene may be removed and deposited near combustion sources. The physical removal mechanisms are expected to be significant with an atmospheric residence time of approximately eight days (6).

Dissolved benzo[a]pyrene can undergo some removal from surface waters via volatilization, but its very low vapor pressure (5.6×10^{-9} torr at 25°C) prevents this from being significant. A half-life of 430 hours for benzo[a]pyrene was reported in aquatic environments under maximum volatilization conditions (6).

With a log octanol-water partition coefficient of 6.08, benzo[a]pyrene has a very strong tendency for water-lipid and water-sediment partitioning. Adsorption and sedimentation represent primary environmental pathways in aquatic systems through adsorption both organic and non-organic particulate matter (6).

Benzo[a]pyrene in aquatic systems will accumulate preferentially in sediments and tend to remain there unless considerable mixing occurs at the sediment/water column interface. In rivers, the major fate pathway is transport of adsorbed benzo[a]pyrene to oceans. Photolysis and biotransformation can also be important fate processes (6).

Biological processes such as uptake, depuration, and biodegradation are considered potential environmental fate mechanisms for benzo[a]pyrene. Bioaccumulation of benzo[a]pyrene is probably short-term, especially for vertebrates. Biodegradation by microorganisms is slower and not as extensive in the benzo[a]pyrene group as in the lower-molecular-weight PAHs (6). Half-lives on the order of months or longer under laboratory conditions were reported for the benzo[a]pyrene group.

PHARMACOKINETICS

No studies have been located concerning the absorption of PAHs via inhalation and oral ingestion. However, it can be inferred from the presence of urinary metabolites in workers exposed to PAHs that absorption occurs via inhalation. Rats orally administered PAHs showed elevated concentrations in the liver, lung and kidneys (11). In terms of dermal exposure, measurable quantities of PAHs were detected in blood after percutaneous exposure in humans (11).

PAHs were distributed to the lung, kidney, liver and gastrointestinal tract of rats following exposure via inhalation. Orally administered PAHs in the same species were detected in the liver, lung and kidney. Very little of the PAHs absorbed through the skin are distributed to tissues (11).

The lipophilicity of PAHs enables them to readily penetrate cellular membranes and circulate in the body indefinitely. However, metabolic processes alter PAHs both chemically and structurally producing more water-soluble and excretable compounds. These metabolic processes occur in all tissues. The following metabolic pathway is that of benzo[a]pyrene and is similar to that of the other PAHs. Benzol[a]pyrene is initially metabolized by the microsomal P-450 system to form an arene oxide. Once the arene oxide is formed, it undergoes hydration via epoxide hydrolase to form a dihydrodiol. Further metabolic activity can lead to the generation of diol epoxides which are believed responsible for BaPs toxic effects. Benzo[a]pyrene can also be oxidized spontaneously or metabolically to quinones (11).

In terms of elimination, animal studies suggest that PAHs are eliminated rapidly from the lung when the animals are exposed via inhalation (11). Rats orally exposed to PAHs excreted the compounds in the feces (11). PAHs applied to the skin of rats were determined to be excreted in the urine and feces equally (11).

HUMAN HEALTH EFFECTS

For practical purposes, PAHs are often separated into two categories, the carcinogenic and non-carcinogenic PAHs. This is a somewhat misleading categorization as some evidence exists that many of the non-carcinogenic PAHs have some, albeit weak, carcinogenic activity or act as promoters or co-carcinogens. Another factor complicating PAH categorization is that they do not occur alone in nature but as complex mixtures containing numerous PAHs of varying carcinogenic potencies. The potential interactions of the individual PAHs present as components of these mixtures must be addressed in attempting to quantify the carcinogenic and non-carcinogenic risks (7).

The USEPA, in reviewing the carcinogenicity of several PAHs, indicated those for which there was sufficient, limited, or inadequate, evidence of carcinogenicity. These classifications are presented in Table 3.

Benzo[a]anthracene, benzo[a]pyrene, benzo(b)fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, chrysene, indeno[1,2,3-c,d]pyrene, and dibenzo[a,h]anthracene are probable human carcinogens. Acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, phenanthrene and pyrene are either possible human carcinogens, the evidence is inadequate to assess carcinogenic potential, or there is no evidence for carcinogenicity (6).

Non-carcinogenic effects: Acute effects from direct contact with PAHs are generally limited to phototoxicity. Percutaneous exposure to PAHs, followed by exposure to sunlight, can result in dermatitis consisting of erythema, itching, and burning. Dermatitis can result from a single 90-minute exposure to a one-percent solution of coal tar. Chronic exposure to PAHs may result in chronic dermatitis, hyperkeratoses, and other skin disorders (1,2,3,4). PAHs have also been shown to cause cytotoxicity in rapidly proliferating cells throughout the body with the hematopoietic system, lymphoid system, and testes frequently noted as targets (10). This effect appears to result from PAH mediated inhibition of DNA replication (6).

The PAHs can also cause systemic toxicity at high doses. The liver and kidney of rats have exhibited slight morphological changes following oral administration of acenaphthene. The major effects linked to naphthalene exposure include cataracts with accompanying retinopathy and hemolytic anemia (6).

Carcinogenic effects: Most carcinogenic PAHs are not direct carcinogens but require metabolic activation before carcinogenesis is initiated (6). The metabolites of carcinogenic PAHs have been found to bind to DNA in every tissue examined regardless of species, dose, or route of administration (6).

In mice, carcinogenic PAHs can produce hepatomas and lung adenomas following repeated oral administration and bladder tumors following implantation. In addition, they can produce tumors in mice following subcutaneous injection (6). Lung tumors have developed in hamsters and mice following intratracheal and intravenous administration, respectively (8).

REGULATORY LEVELS AND CRITERIA

OSHA PEL (1):	0.2 mg/m^3 (coal tar pitch volatiles - benzene soluble fraction)
ACGIH TLV TWA (11):	0.2 mg/m^3 (coal tar pitch volatiles - benzene soluble fraction)
NIOSH REL TWA (11):	0.1 mg/m^3 (benzene soluble PAH)
IDLH (11):	400 mg/m^3 (coal tar pitch volatiles)
Reportable Quantity (11):	1 lb

REFERENCES

1. ATSDR 1987a. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Benzo[a]Pyrene (Draft). Atlanta, Georgia. October 1987.

2. ATSDR 1987b. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Benzo[b]Fluoranthene (Draft). Atlanta, Georgia. November 1987.

3. ATSDR 1987c. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Benzo[a]Anthracene (Draft). Atlanta, Georgia. October 1987.

4. ATSDR 1987d. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Chrysene (Draft). Atlanta, Georgia. October 1987.

5. U. S. Environmental Protection Agency, 1980. Ambient Water Quality Criteria for Polynuclear Aromatic Hydrocarbons. Office of Water Regulations and Standards, Washington, D.C. October 1980. EPA 440/5-80-069.

6. U. S. Environmental Protection Agency, 1982. An Exposure and Risk Assessment for Benzo[a]Pyrene and Other Polycyclic Aromatic Hydrocarbons. Vols. I-IV. Office of Water Regulations and Standards. Washington, D.C. 1982. EPA 440/4-85-020-VI.

7. U. S. Environmental Protection Agency, 1984. Health Effects Assessment for Polycyclic Aromatic Hydrocarbons (PAHs). Environmental Criteral and Assessment Office, Cincinnati, Ohio. September 1984. EPA 540/1-86-013.

8. U. S. Environmental Protection Agency, 1985. Chemical, Physical, and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Remedial Response. Washington, D.C. September 1985.

9. U. S. Environmental Protection Agency, 1986. Superfund Public Health Evaluation Manual. Office of Emergency and Remedial Response. Washington, D.C. October 1986. EPA 540/1-86-060.

10. Santodonato 1981. Santodonato, J., Howard, P., and Basu, D. 1981. Health and Ecological Assessment of Polynuclear Aromatic Hydrocarbons. Journal of Environmental Pathology and Toxicology. 5:1-364.

11. Toxicological Profile for Polycyclic Aromatic Hydro Carbons (Draft). Agency for Toxic Substances and Disease Registry, U.S. Public Health Service and the U.S. EPA Atlanta, GA. October 1989.

12. IRIS. Integrated Risk Information System. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. 1994.

TABLE 1

POLYNUCLEAR AROMATIC HYDROCARBON PHYSICAL AND CHEMICAL INFORMATION

	Formula	Water Solubility* (mg/L)	Vapor Pressure* (torr)	Henry's Law Constant (atm-m^3/mole)	Log K_{oc}	Log K_{ow}
Anthracene	$C_{14}H_{10}$	0.045	2.4×10^{-4}	1.25×10^{-3}	4.20	4.45
Acenaphthene	$C_{12}H_{10}$	3.47	1.5×10^{-3}	1.5×10^{-4}	1.25	3.97
Acenaphthylene	$C_{12}H_8$	3.42	1.6×10^{-3}	9.33×10^{-5}	3.72	4.33
Fluoranthene	$C_{16}H_{10}$	0.26	5×10^{-6}	5.12×10^{-6}	4.64	5.33
Fluorene	$C_{13}H_{10}$	1.69	1×10^{-2}	1.29×10^{-3}	3.65	4.18
Phenanthrene	$C_{14}H_{10}$	1.0	9.6×10^{-4}	2.25×10^{-4}	4.20	4.46
Pyrene	$C_{16}H_{10}$	0.14	2.5×10^{-6}	4.75×10^{-6}	4.64	5.32
Benzo[a]pyrene	$C_{20}H_{12}$	3.8×10^{-3}	5.6×10^{-9}	4.89×10^{-7}	--	6.08
Benzo[a]anthracene	$C_{18}H_{12}$	5.7×10^{-3}	2.2×10^{-8}	7.34×10^{-7}	5.34	5.61
Benzo[b)fluoranthene	$C_{20}H_{12}$	1.0×10^{-3}	5.0×10^{-7}	1.66×10^{-4}	--	6.08
Benzo[k]fluoranthene	$C_{20}H_{12}$	5.5×10^{-4}	5.0×10^{-7}	3.02×10^{-4}	--	6.08
Benzo[g,h,i]perylene	$C_{22}H_{12}$	3.0×10^{-4}	1.0×10^{-10}	1.21×10^{-7}	--	6.51
Chrysene	$C_{12}H_{12}$	1.8×10^{-3}	6.3×10^{-9}	1.05×10^{-6}	5.34	5.61
Indeno[1,2,3-c,d]pyrene	$C_{22}H_{12}$	5.0×10^{-4}	1.0×10^{-10}	6.0×10^{-10}	--	6.51

*Values expressed at 25°C.
Source: Ref. 8

TABLE 2

MAJOR GROUPINGS OF POLYNUCLEAR AROMATIC HYDROCARBONS*

THE ANTHRACENE GROUP

- Anthracene
- Acenaphthene
- Acenaphthylene
- Fluoranthene
- Fluorene
- Phenanthrene
- Pyrene

THE BENZO[a]PYRENE GROUP

- Benzo[a]anthracene
- Benzo[a]pyrene
- Benzo[b]fluoranthene
- Benzo[g,h,i]perylene
- Benzo[k]fluoranthene
- Chrysene
- Dibenzo[a,h]anthracene
- Indeno[1,2,3-c,d]pyrene

* Note: Naphthalene is addressed in a separate toxicity profile.

TABLE 3

CLASSIFICATION OF PAHS ACCORDING TO EVIDENCE FOR CARCINOGENICITY

Chemicals for which there is sufficient evidence that they are carcinogens:

Benzo(a)anthracene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Chrysene
Dibenz(a,h)anthracene
Indeno(1,2,3-c,d)pyrene

Chemicals for which the evidence is inadequate to assess their carcinogenicity:

Acenaphthylene
Anthracene
Benzo(g,h,i)perylene
Fluoranthene
Fluorene
Naphthalene
Phenanthrene
Pyrene

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THALLIUM

INTRODUCTION

Acute exposure to soluble thallium compounds has been associated in humans with gastrointestinal irritation; damage of the liver, kidneys, and central and peripheral nervous systems; pulmonary edema; degenerative changes in the adrenals; and ocular effects.

CAS Number:	7440-28-0
Chemical Formula:	Tl
IUPAC Name:	Thallium

CHEMICAL AND PHYSICAL PROPERTIES

Atomic Weight:	204.37
Boiling Point:	1,457°C
Melting Point:	303.5°C
Specific Gravity:	11.85
Solubility in Water:	Insoluble (many compounds are soluble)

FATE AND TRANSPORT

In reducing environments, thallium may be precipitated as the metal or as thallium sulfide. However, much of the thallium present in aquatic systems is likely to remain in solution and be transported to the oceans. Active removal of some dissolved thallium by sorption to clay minerals and hydrous metal oxides present in bed sediments is probably an important environmental fate process. Thallium is readily taken up by aquatic organisms, and bioaccumulation may also be an important fate process. Results of limited studies with algae suggest that thallium may also be available for food chain magnification. There is no evidence to suggest that photolysis or volatilization are important environmental processes. Although there is speculation that thallium can be methylated under aerobic conditions by electrophilic attack, biotransformation does not appear to be an important process in aquatic systems.

HUMAN HEALTH EFFECTS

There is no evidence that thallium is carcinogenic in humans or experimental animals, and it does not appear to have significant mutagenic activity. Exposure to thallium salts during critical developmental stages is reported to produce achondioplasia in chickens and rats. No other significant teratogenic effects are reported.

Thallium, in the form of soluble compounds, is readily absorbed through the skin and gastrointestinal tract. Symptoms associated with acute poisoning in humans include gastrointestinal irritation; liver and kidney damage; pulmonary edema; degenerative change in the adrenals, peripheral nervous system, and central nervous system; and ocular effects, including optic neuritis

and, rarely, cataracts. The estimated lethal dose for humans is 8 to 12 mg/kg. In experimental animals, thallium compounds produce effects similar to those seen in humans. Rats appear to be particularly sensitive to the cataractogenic activity of thallium. Regardless of the specific thallium compound tested, rate of intake, or route of administration, LD_{50} values for a variety of species range from about 3 to 92 mg/kg.

The oral RfD of 8×10^{-5} mg/kg/day applies to thallium carbonate, chloride or sulfate. It is based on a subchronic (90D), gavage study, using thallium sulfate in Sprague-Dawley rats. The NOAEL determined in the study was 0.25 mg/kg/day. Target organs included the liver, blood and hair. Critical effects were increased SGOT, increased serum LDH an alopecia (3).

Toxicity to Wildlife and Domestic Animals

Acute and chronic toxicity of thallium to freshwater aquatic life occurs at concentrations as low as 1,400 and 40 μg/liter, respectively. Acute toxicity to saltwater aquatic life occurs at concentrations as low as 2,130 μg/liter. Toxic effects would be expected to occur at lower concentrations among species more sensitive than those tested. Bioconcentration factors ranged from about 11 for the mussel Mytilus edulis to about 1.5×10^5 for other freshwater and marine invertebrates. Values of about 1×10^5 are reported for marine and freshwater fish.

REGULATORY LEVELS AND CRITERIA

Ambient Water Quality Criteria (USEPA):

Aquatic Life

The available data are not adequate for establishing criteria.

Human Health

EPA Carcinogenic Classification:	D--not classified as a carcinogen
Criterion:	13 μg/liter
OSHA PEL-TWA:	0.1 mg (soluable compounds as Tl)
ACGIH TLV:	0.1 mg/m^3 (elemental and soluble compounds, as Tl)
Oral Reference Dose (RfD):	8×10^{-5} mg/kg/day for thallium carbonate/ chloride/sulfate

REFERENCES

1. American Conference of Governmental Industrial Hygienists (ACGIH). 1980. Documentation of the Threshold Limit Values. 1993-1994.

2. Doull, J., Klaassen, C.D., and Amdur, M.O. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. 2nd ed. Macmillan Publishing Company, New York. 778 pages.

3. IRIS. Integrated Risk Information System. Office of Research and Development, USEPA, Washington, D.C. 1994.

4. National Institute for Occupational Safety and Health (NIOSH). 1984. Registry of Toxic Effects of Chemical Substances. Data Base. Washington, D.C. July 1984.

5. Shepard, T.H. 1980. Catalog of Teratogenic Agents. 3rd ed. Johns Hopkins University Press, Baltimore. 410 pages.

6. U.S. Environmental Protection Agency (USEPA). 1979. Water-Related Environmental Fate of 129 Priority Pollutants. Washington, D.C. December 1979. EPA 440/4-79-029.

7. U.S. Environmental Protection Agency (USEPA). 1980. Ambient Water Quality Criteria for Thallium. Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. October 1980. EPA 440/5-80.

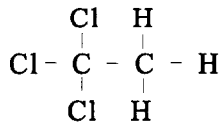
8. Weast, R.E., ed. 1981. Handbook of Chemistry and Physics. 62nd ed. CRC Press, Cleveland, Ohio. 2,332 pages.

Date of Last Revision: 2/23/95
Revisor: Rich Hoff

1,1,1-TRICHLOROETHANE

INTRODUCTION

Chemical Name:	1,1,1-Trichloroethane
Synonyms:	Methyl chloroform, chloroethene
CAS Number:	71-55-6
Molecular Formula:	$C_2H_3Cl_3$
Molecular Weight:	133.40 g/mole
Chemical Structure:	



1,1,1-Trichloroethane (1,1,1-TCA) exists as a colorless liquid and is a man-made chemical which does not occur naturally. It is insoluble in water but soluble in alcohol and ether. Common uses for 1,1,1-TCA are as a solvent for cleaning precision instruments, metal degreasing, pesticide, and textile processing (1). Approximately 700 million pounds of 1,1,1-TCA were produced in 1987 (2).

FATE AND TRANSPORT

Log K_{oc} (2):	2.03
Log K_{ow} (2):	2.49
$t_{1/2}$:	2-6 years in the atmosphere
Henry's Law Constant (2):	6.3×10^{-3} to 17.2×10^{-3} atm-m^3/mol at 25°C
BCF (2):	9 for bluegill and sunfish
Solubility (1):	
In Water:	Insoluble
In Organics:	alcohol and ether
Vapor Pressure (3):	123 mm Hg at 20°C
Vapor Density (3):	4.63
Specific Gravity (3):	1.34 at 20°C (liquid)

In the environment, 1,1,1-TCA can be found as a liquid, vapor, or dissolved in water and other chemicals (3).

Volatilization into the atmosphere is the dominant environmental fate of 1,1,1-TCA. Once in the air, it reacts slowly with photochemically produced hydroxyl radicals. Because of its long atmospheric half-life, a proportion of 1,1,1-TCA is capable of reaching the stratosphere where degradation can occur by reaction with ozone. The long atmospheric half-life also allows 1,1,1-TCA to be transported long distances from its original point of release. Because 1,1,1-TCA

is moderately soluble, precipitation may wash the compound out of the atmosphere. However, the 1,1,1-TCA would be expected to re-volatilize after reaching the land surface (2).

In soil, liquid 1,1,1-TCA has the capability to be highly mobile which results in a potential for groundwater contamination. An important primary fate process is exhibited as volatilization; however, information on biodegradation in the soil is lacking. 1,1,1-TCA does not undergo aerobic biodegradation (2).

Volatilization of 1,1,1-TCA occurs upon its release to surface water. Neither adsorption to sediment nor bioconcentration in aquatic organisms is recognized as an important environmental fate (2).

PHARMACOKINETICS

1,1,1-TCA can enter the body through inhalation of contaminated air, or by drinking water or ingestion of food containing 1,1,1-TCA (2).

If liquid 1,1,1-TCA contacts the skin, rapid evaporation into the atmosphere limits the amount capable of penetrating the skin. Upon inhalation, 60 to 80% 1,1,1-TCA will be eliminated from the body via exchange of air within 2 hours, and 90 to 99% will be eliminated within 50 hours (2).

Upon entering the systemic circulation, 1,1,1-TCA, is metabolized by the body and excreted within a few days either through the urine or exhalation. The major metabolites of 1,1,1-TCA are water soluble trichloroethanol, a trichloroethanol glucuronide conjugate, trichloroacetic acid, and carbon dioxide. If chronic exposure occurs, it is possible for the metabolites to accumulate in the body (2).

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

Acute exposure to high concentrations of 1,1,1-TCA via inhalation has been found to have lethal effects on humans and animals. Incidences of accidental exposure in humans have indicated that 6,000 to 20,000 ppm 1,1,1-TCA are lethal. Nausea, vomiting, and diarrhea are more common manifestations following acute exposure to 1,1,1-TCA. Mild eye irritation has also been reported from 1,1,1-TCA exposure (2).

The systemic effects on humans consist of central nervous system depression, respiratory arrest or severe cardiac arrhythmia. There is some indication of irreversible toxic effects on the heart following long-term exposure to 1,1,1-TCA. Inhalation may also produce mild hepatic effects (2).

Very high dermal dose levels have killed rabbits. Dermal effects on humans consist of mild irritation to chemical burns, mild erythema, and fine scaling (2).

There have been either no studies conducted or no effects exhibited regarding the effects of 1,1,1-TCA on the respiratory, cardiovascular, gastrointestinal, hematological, musculoskeletal, or renal systems via oral or dermal exposure. Also, studies involving immunological, neurological, developmental, reproductive, and genotoxic effects have not been conclusive or have produced insignificant results (2).

The cardiovascular, gastrointestinal, hepatic, renal, and ocular systems are affected when inhalation exposure occurs. In addition, neurological effects including mild motor impairments, euphoria, anesthesia, and death are exhibited upon varied levels of inhalation exposure (2).

The EPA has derived both an oral and inhalation RfD for exposure to 1,1,1-TCA. Both the oral and inhalation RfDs were calculated from an inhalation study with male and female guinea pigs at concentrations of 500, 1,000, 2,000, and 10,000 ppm for 7 hours per day, 5 days per week for 6 months. At the three highest concentrations, there was evidence of hepatotoxicity in the exposed animals. A no observed adverse affect level (NOAEL) of 90 and 304 mg/kg/day was identified for the oral and inhalation route, respectively. The oral NOAEL was determined based on a route to route extrapolation. An uncertainty factor of 1,000 was applied to both of the NOAEL values derive the oral RfD dose of 9×10^{-2} mg/kg/day.

USEPA Region III has established an inhalation RfD of 2.86×10^{-1} mg/kg/day for 1,1,1-TCA. As of February 1995, both the oral and inhalation RfDs had been withdrawn.

Carcinogenic Effects

The EPA has classified 1,1,1-TCA as a Group D carcinogen - not classifiable as to human carcinogenicity. The basis for this decision is lack of reported human data and in conclusive carcinogenicity data in animal studies (4).

Short-term bioassays have shown evidence of 1,1,1-TCA mutagenicity in Salmonella. A positive result in mammalian cell transformation tests and occasional positive results in other mammalian cell assays suggest that 1,1,1-TCA may be genotoxic in animals (2, 4).

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

Although data are not adequate for establishing criteria, the EPA has reported the lowest values of 1,1,1-TCA known to be toxic in aquatic organisms. These values are as follows (3):

Freshwater (4):
- Acute toxicity: 18 mg/liter
- Chronic toxicity: 8.4 mg/liter

Marine (4):
- Acute toxicity: 31.2 mg/liter
- Chronic toxicity: No available data

Terrestrial and Avian

Information regarding the toxicity of 1,1,1-TCA to terrestrial and avian wildlife or domestic animals was not available (3).

REGULATORY LEVELS AND CRITERIA

The following regulatory levels and criteria have been established for 1,1,1-TCA:

OSHA (7,8)	PEL-TWA	350 ppm
	TLV-TWA	350 ppm
	TLV-STEL	450 ppm

Ambient water quality criterion (2):	18 mg/liter
Maximum contaminant level (2):	200 µg/liter
Maximum contaminant level goal (2):	20 µg/liter
Reportable quantity (2):	1,000 pounds

SUMMARY OF TOXICOLOGICAL INDICES

EPA Carcinogenic Classification (5): D-Not classifiable as to human carcinogenicity

Noncarcinogenic Effects:

Oral RfD (9):	9.0×10^{-2} mg/kg/day
Inhalation RfD (9):	2.86×10^{-1} mg/kg/day

REFERENCES

1. Hawley, G.G., The Condensed Chemical Dictionary-Eleventh Edition. Van Nostrand Reinhold Company, Inc., New York, NY, 1987.

2. Toxicological Profile for 1,1,1-Trichloroethane. (Draft) U.S. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, and U.S. Environmental Protection Agency. Atlanta, Georgia. October 1989.

3. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. September 1985.

4. IRIS. Integrated Risk Information System. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. 1995.

5. HEAST. Health Effects Assessment Summary Tables. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. March 1994.

6. Ambient Water Quality Criteria. Office of Water, U.S. Environmental Protection Agency, Washington, D.C. May 1986.

7. 29 Code of Federal Regulations Part 1910.1000, Table Z-1. 1994.

8. 1994-1995 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. ACGIH.

9. Risk-Based Concentration Summary Table. Region III, United States Environmental Protection Agency, Philadelphia, PA. November, 1994.

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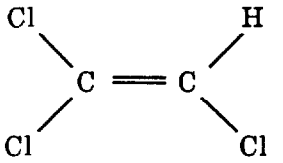
Revisor: Rich Hoff

TRICHLOROETHENE

INTRODUCTION

Chemical Name: Trichloroethene
CAS Number: 79-01-6
Common Names: Trichloroethene; 1,2,2-Trichloroethylene; TCE
Molecular Formula: C_2HCl_3
Molecular Weight: 131.40 g/mole
Chemical Structure:



Trichloroethene (TCE) is a colorless liquid at standard temperature and pressure. It is a man-made chemical primarily used as a solvent in degreasing operations (1).

FATE AND TRANSPORT

Log K_{oc} (9): 2.10
Log K_{ow}: 2.29 (3)
2.42(1)
$t_{1/2}$ (1): Surface Water: 1-28 days
Henry's Law Constant (1): 0.02 atm-m3/mole @ 20°C
0.01 atm-m3/mole @ 25°C
Fish Bioaccumulation Factor (BCF) (1): 17
Degradation Products:
In Water: Dichloroethylene and vinyl chloride
In Air: Phosgene, dichloroacetyl chloride, and formyl chloride (1); hydrochloric acid, carbon monoxide, carbon dioxide and carboxylic acid (3).
Solubility:
In Water (1): 1.07 g/kg @ 20°C
1,366 mg/L @ 25°C
In Organics (1): Miscible with many common organic solvents such as ether, alcohol and chloroform
Vapor Pressure (1): 59 mm Hg @ 20°C
74 mm Hg @ 25°C
Specific Gravity (1): 1.465 @ 20°C

TCE rapidly volatilizes into the atmosphere. Consequently, the atmosphere is the primary recipient of TCE releases. The average half-life of atmospheric TCE is approximately 3.7 days (1). In the atmosphere, the dominant transformation process is the reaction of TCE with hydroxyl radicals. Various degradation products result from this photooxidation process

including hydrochloric acid, carbon monoxide, carbon dioxide, carboxylic acid, phosgene, dichloroacetyl chloride and formyl chloride (3, 4).

TCE readily volatilizes from surface water into the atmosphere. This is the primary migration pathway of TCE from surface water. Once TCE enters the atmosphere, it degrades by the process described above (1).

Slow degradation of TCE in soil occurs under anaerobic conditions. The Koc value indicates that TCE is quite mobile in soil and will readily leach into groundwater (1).

Once TCE has entered the groundwater, it remains there for years since volatilization is not a viable migration pathway. TCE in groundwater degrades primarily into dichloroethylene. To a lesser degree, it will degrade to vinyl chloride (1). TCE may be present in groundwater as a degradation product of perchloroethylene (4).

TCE, unlike other chlorinated compounds, has a low potential for bioaccumulation in fish, animals, and the food chain (4).

PHARMACOKINETICS

TCE is primarily absorbed into the body via inhalation and ingestion. To a lesser degree, it can be absorbed into the body by direct dermal contact (1).

The primary target organs for inhaled TCE are the central nervous system (CNS), liver, kidney, and hematological system. Principal organs targeted by oral exposure include the liver, kidney, and immunological system (1).

TCE distributes throughout all tissues but tends to concentrate in the fat, kidney, adrenals, vas deferens, epididymis, brain, and liver (4). Once in the body, TCE undergoes extensive metabolism. Numerous metabolites such as trichloroethanol, Trichloroethene-glucuronide, trichloroacetic acid, chloral hydrate (hypnotic agent), Trichloroethene oxide, trichloroacetaldehyde, and chloroacetic acid are generated (1, 4).

There are two primary routes of excretion for TCE. Unmetabolized TCE is excreted by exhalation while TCE metabolites are excreted in the urine (1). Other routes of excretion include sweat, feces, and saliva, but occur to a much lesser extent (4).

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

Adverse effects to the CNS, kidney, liver, and immune system due to TCE exposure have been documented.

Animal studies show that inhalation of TCE impairs neurological functions such as limb movement control, perception and reaction time. It is expected that larger quantities of TCE by oral exposure are required to create similar effects on the CNS as those experienced by inhalation. This is hypothesized since ingested TCE is subject to first pass elimination by the liver and lungs. It has been demonstrated that the trichloroethanol metabolite is three times as effective as the parent compound in inducing adverse effects on CNS (1). A relationship between exposure and renal effects has also been established in chronic animal studies. Inhalation and/or ingestion of TCE produced histological alterations characterized by renal tubular alterations and/or toxic nephropathy (1). Other chronic studies have identified an association between TCE exposure and deficiencies of the immune system. The effects of TCE

on the immune system are similar to those generated by other chlorinated hydrocarbons (1). A provisional oral reference dose of $6x10^{-3}$ mg/kg/day has been provided by EPA's Environmental Criteria and Assessment Office (ECAO) (7).

It has been documented that acute inhalation exposure to high TCE concentrations have caused severe liver damage. However, it is unlikely that long-term exposure to ambient air concentrations will adversely effect the liver. The most common hepatic effect in TCE-exposed animals is liver enlargement. Histological alterations characterized by cellular hypertrophy were associated with the liver enlargement (1).

Developmental effects from exposure to TCE result from ingestion but not inhalation. Animal studies on the ingestion of TCE indicate that there are reproductive effects such as reduced testis and epididymis weight and sperm mortality (1).

The EPA has not derived an inhalation RfD for TCE.

Carcinogenic Effects

TCE is classified by the EPA as a B2 carcinogen - Probable Human Carcinogen. This means there is sufficient evidence of carcinogenicity in animals; however, evidence of carcinogenicity in humans is inadequate (5).

Animal studies indicate that TCE exposure produced liver and lung tumors in mice and kidney adenocarcinomas, testicular leydig cell tumors, and possibly leukemia in rats (1).

Studies are being conducted to determine if TCE metabolites are involved in cancer development. It is known that trichloroacetic acid and dichloroacetic acid (both metabolites of TCE) are complete carcinogens in the male mouse liver (1). Although the liver appears to be the main site of TCE, there is evidence for extrahepatic TCE metabolism which may be responsible for extrahepatic sites of toxicity.

A provisional inhalation cancer slope factor of 6.0×10^{-3} $(mg/kg/day)^{-1}$ has been provided by the EPA's ECAO (7).

Based on two gavage studies, an oral cancer slope factor of 1.1×10^{-2} $(mg/kg/day)^{-1}$ was derived for TCE (10). B6C3F1 male and female mice were exposed to 0, 1169, or 2339 mg/kg/day and 0, 869 or 1,739 mg/kg/day, respectively, 5 days per week for 8 weeks. The researchers noted a statistically significant increase in hepatocellular carcinomas in male mice at both dose levels and in female mice at the highest dose level. In another study, TCE administration to B6C3F1 male and female mice resulted in an increased incidence of hepatocellular carcinonomas. These results are consistent with those found in the previous B6C3F1 mice cancer bioassay (1).

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

Although ambient water quality criteria have not been established for TCE, the lowest values known to cause toxicity in aquatic organisms have been reported. These values are as follows (3, 6):

Freshwater:

Acute toxicity:	45,000 µg/L
Chronic toxicity:	Not available

Marine:

Acute toxicity:	2,000 µg/L
Chronic toxicity:	Not available

REGULATORY LEVELS AND CRITERIA

MCLG (1):	0 mg/L
MCL (1):	5 µg/L
OSHA PEL-TWA (8):	100 ppm
ACGIH TLV-TWA (2):	50 ppm
ACGIH TLV-STEL (2):	100 ppm
Reportable Quantity:	1,000 lbs
WQC (6)	
Ingestion of Water and Organisms:	2.7 µg/L
Ingestion of Organisms Only:	8.0 µg/L

SUMMARY OF TOXICOLOGICAL INDICES

EPA Carcinogenic Classification (1):	Group B2-probable human carcinogen
Noncarcinogenic Effects:	
Oral RfD (7):	6.0×10^{-3} mg/kg/day
Inhalation RfC (7):	Not Available
Carcinogenic Effects (7):	
Oral CSF (7):	1.1×10^{-2} (mg/kg/day)$^{-1}$
Inhalation CSF (7):	6.0×10^{-3} (mg/kg/day)$^{-1}$

REFERENCES

1. Toxicological Profile for Trichloroethene. U.S. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, and U.S. Environmental Protection Agency. Atlanta, Georgia. October 1989.

2. ACGIH. Documentation of the Threshold Limit Values. 1993-1994.

3. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. September 1985.

4. Health Advisory for Trichloroethene. Office of Drinking Water, U.S. Environmental Protection Agency, Washington, D.C. March 1987.

5. IRIS. Integrated Risk Information System. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. 1994.

6. Ambient Water Quality Criteria. Office of Drinking Water, U.S. Environmental Protection Agency, Washington, D.C. May 1986.

7. Risk-Based Concentration Table. Technical Support Section, U.S. Environmental Protection Agency, Region III, Philadelphia, Pennsylvania. July 1994.

8. OSHA. Title 29 Code of Federal Regulations, Part 1910.1000, Table Z-1. 1993.

9. USEPA, Aquatic Fate Process Data for Organic Priority Pollutants. Final Report. Office of Water Regulations and Standards (WH-553). December 1982.

10. HEAST. Health Effects Assessment Summary Tables. Office of Emergency and Remedial Response, USEPA. March 1994.

TOXICITY SUMMARY FOR 1,3,5-TRINITROBENZENE

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EXECUTIVE SUMMARY

1,3,5-Trinitrobenzene, a dimorphic crystalline solid, is a Class A explosive that is less sensitive to impact, but more powerful than 2,4,6-trinitrotoluene (Budavaro et al., 1989; Fedoroff et al., 1962). It has also had limited use in the vulcanization of rubber (Barnhart, 1981).

The information available on the toxicity of 1,3,5-trinitrobenzene was composed primarily of Russian abstracts. Therefore, most of the toxicity information derived for 1,3,5-trinitrobenzene is by analogy to the structurally similar compounds 1,3-dinitrobenzene and 2,4,6-trinitrotoluene. Little is known about the absorption, distribution, metabolism, and excretion of 1,3,5-trinitrobenzene; however, both 1,3-dinitrobenzene and 2,4,6-trinitrotoluene are extensively absorbed following oral exposure and are distributed to the liver, kidney, lung and spleen (Parke, 1961; El-hawari et al., 1981). The metabolism and excretion of 1,3,5-trinitrobenzene would likely be similar to that of 1,3-dinitrobenzene and 2,4,6-trinitrotoluene and consist of nitro-reduction, glucuronide conjugation, and excretion primarily in the urine (El-hawari et al., 1981; Parke, 1961).

Munition workers exposed to 1,3,5-trinitrobenzene have developed skin irritation, liver damage, and anemia (Hathaway, 1977; Morton et al., 1976; Stewart et al., 1945). Animal studies have shown that oral treatment with structurally similar 1,3 dinitrobenzene or 2,4,6-trinitrotoluene induces anemia and increases methemoglobin concentration. These compounds also induce liver and spleen hypertrophy, and induce degeneration of the germinal epithelial lining of the seminiferous tubules resulting in decreased spermatogenesis (Cody et al, 1981; Levine et al., 1983, 1984; Furedi et al., 1984a,b). Toxicity studies of 1,3,5-trinitrobenzene, 1,3-dinitrobenzene, or 2,4,6-trinitrotoluene following inhalation exposure were unavailable.

On the basis of increased spleen weights in rats following treatment with 1,3-dinitrobenzene in their drinking water (Cody et al., 1981), the U.S. EPA (199la,b) has assigned a subchronic and chronic reference dose (RfD) of 5E-4 mg/kg/day and 5E-5 mg/kg/day, respectively, for 1,3,5-trinitrobenzene. The RfD's were derived from a NOAEL of 3 ppm for 1,3-dinitrobenzene that was converted to 0.51 mg/kg/day 1,3,5-trinitrobenzene. This was done using the molecular weight ratio of 1,3,5-trinitro-benzene/ 1,3-dinitrobenzene (213.11/168.11 = 1.27). A reference concentration (RfC) following inhalation exposure to 1,3,5-trinitrobenzene has not been derived.

Information was not available concerning developmental or reproductive toxicity induced by 1,3,5-trinitrobenzene, 1,3-dinitrobenzene, or 2,4,6-trinitrotoluene. No cancer bioassays or epidemiological studies were available to assess the carcinogenicity of 1,3,5-trinitrobenzene. U.S. EPA (199Oa,b) has not assigned a weight-of-evidence classification for 1,3,5-trinitrobenzene.

1.0 INTRODUCTION

1,3,5-Trinitrobenzene (CAS Number 99-35-4) is known by the synonyms trinitrobenzene, 2,4,6-trinitrobenzene, symmetrical trinitrobenzene, and sym-trinitrobenzenc (Budavari et al., 1989; Sax and Lewis, 1989; Weast, 1989). A dimorphic solid with a molecular weight of 213.11, 1,3,5-trinitrobenzene forms yellow orthorhombic bipyramidal crystals that have melting points of 121-123 C for the more common form and 61 C for the rarer form. With a vapor pressure of 3.2×10^{-6} mm Hg, 1,3,5-trinitrobenzene slowly sublimes at 20 C. Prepared by the decarboxylation of trinitrobenzoic acid or by the oxidation of 2,4,6-trinitrotoluene (TNT), 1,3,5-trinitrobenzene is a Class A explosive that is less sensitive to impact, but more powerful and brisant than 2,4,6-trinitrotoluene (Budavari et al., 1989; Fedoroff et al., 1962). 1,3,5-Trinitrobenzene is slightly soluble in water (0.03 g) and ethanol (2.1 g), but is more soluble in chloroform (6.2 g), benzene (6.2 g), toluene (11.8 g), acetone (59.1 g) and pyridine (112.6 g) (units are expressed as g 1,3,5-trinitrobenzene/100 g solvent at 17 C, Fedoroff et al., 1962). Used primarily in explosive compositions and munitions, 1,3,5-trinitrobenzene has had limited use in the vulcanization of rubber (Barnhart, 1981) and as a pH indicator (Durst and Bates, 1981).

An anthropogenic environmental contaminant, exposure to 1,3,5 trinitrobenzene can occur through contact with wastewater effluents released from facilities that synthesize, produce or demilitarize munitions, or from the disposal of solid 2,4,6-trinitrotoluene wastes (Ryon et al., 1984; U.S. EPA, 1989). Limited information is available; however, on the quantity of 1,3,5-trinitrobenzene in the environment. Data on oral, dermal, or inhalation exposure of humans to 1,3,5-trinitrobenzene were not identified in the available literature.

2.0 METABOLISM AND DISPOSITION

Information on the absorption, distribution, metabolism, and excretion of 1,3,5-trinitrobenzene was unavailable. Therefore, these parameters will be discussed by analogy to two structurally similar compounds, 1,3-dinitrobenzene and 2,4,6-trinitrotoluene.

2.1 Absorption

1,3-Dinitrobenzene and 2,4,6-trinitrotoluene were extensively absorbed by rats following oral treatment (Parke, 1961; El-hawari et al., 1981). 2,4,6-Trinitrotoluene was not appreciably absorbed through the skin of rats, mice, and dogs; however, dermal absorption was equal to that of oral absorption in rabbits (El-hawari

et al., 1981). Data on the dermal absorption of 1,3-dinitrobenzene and inhalation absorption of 1,3-dinitrobenzene and 2,4,6-trinitrotoluene were unavailable.

2.2 Distribution

In rats, rabbits and dogs, the concentration of 2,4,6-trinitrotoluene 24 hours after oral or dermal treatment was highest in the liver followed by the kidney, lung, and spleen (El-hawari et al., 1981). Reports of seminiferous tubule degeneration in rats and dogs (Dilly et al., 1982; Levine et al., 1984) and necrotic areas within the bone marrow of rats (Martin, 1974) indicate 2,4,6-trinitrotoluene or a metabolite is distributed to these organs.

2.3 Metabolism

Parke (1961) reported that the primary metabolites present in the urine of rabbits treated with 1,3-dinitrobenzene were 1,3-phenylenediamine, 2-amino -4-nitrophenol, and 2,4-dinitrophenol. Approximately 30% of the dose detected in the urine had undergone glucuronide conjugation and an additional 6%, had undergone sulfate conjugation. El-hawari et al. (1981) reported that 2,4,6-trinitrotoluene was metabolized to 2- and 4-hydroxylaminedinitrotoluene, 2- and 4-monoamino-dinitrotoluene, and 2,6- and 4,6-diaminomononitrotoluene, and that the methyl group had undergone oxidation. Glucuronide conjugates of these metabolites were identified in the urine and bile. Therefore, 1,3,5-trinitrobenzene metabolism likely proceeds via nitro reduction as reported for 1,3-dinitrobenzene and 2,4,6-trinitrotoluene to yield mono- and dinitroamines. These metabolites would likely undergo conjugation with glucuronide prior to excretion.

2.4 Excretion

Parke (1961) reported that 65-93% of a 50 or 100 mg/kg oral dose of 1,3-dinitro[^{14}C]-benzene was excreted in the urine within 48 hours. Less than 5% of the dose was recovered in the feces. El-hawari et al. (1981) reported that although species differences in the excretion of 2,4,6-trinitrotoluene existed, 24 hours following oral or dermal treatment of rats, mice, rabbits, and dogs with 5, 50, or 100 mg/kg ^{14}C 2,4,6-trinitrotoluene, the majority of the radioactivity was found in the urine with only minor amounts found in the feces and <1% in the expired air. Based on these studies, the majority of 1,3,5-trinitrobenzene would likely be excreted in the urine with minor amounts excreted in the feces and little in the expired air.

3.0 NONCARCINOGENIC HEALTH EFFECTS

3.1 Oral Exposures

3.1.1 Acute Toxicity

3.1.1.1 Human

Information on the acute oral toxicity of 1,3,5-trinitrobenzene in humans was not available.

3.1.1.2 Animal

Korolev et al. (1977) reported 1,3,5-trinitrobenzene LD_{50}s of 600 mg/kg for white mice, 450 mg/kg for white rats, and 730 mg/kg for guinea pigs. Toxicity to the animals was characterized by central nervous system and respiratory disorders and cyanosis. Korolev et al. (1977) also reported that two of ten rats died following daily oral doses of 90 mg/kg 1,3,5-trinitrobenzene for 30 days. Timofievskaya and Rodionova (1973) reported an oral 1,3,5-trinitrobenzene LD_{50} of 572 mg/kg in mice. Senczuk et al. (1976) reported that a single oral dose of 0.4 μmol/kg (85 μg/kg) 1,3,5-trinitrobenzene induced methemoglobin formation in Wistar rats.

3.12 Subchronic Toxicity

3.12.1 Human

Information on the subchronic oral toxicity of 1,3,5-trinitrobenzene in humans was not available.

3.12.2 Animal

Information on the subchronic oral toxicity of 1,3,5-trinitrobenzene to animals was unavailable. Because the subchronic RfD is based on a study of 1,3-dinitrobenzene, it will be briefly reviewed. In addition, the results of subchronic studies of structurally 2,4,6-trinitrotoluene, which is structurally similar, will also be presented.

Cody et al. (1981) treated 20 male and 20 female Carworth Farm rats for 16 weeks with 3, 8, or 20 mg/L 1,3-dinitrobenzene in their drinking water. These doses were equivalent to 0.40, 1.13, or 2.64 mg/kg/day for

male rats and 0.48, 132, or 3.10 mg/kg/day for female rats in the 3, 8, and 20 mg/L treatment groups, respectively. Rats receiving 3 mg/L 1,3-dinitrobenzenc did not show signs of toxicity. Both sexes of rats treated with 8 mg/L 1,3-dinitrobenzene had statistically significant and dose-dependent increases in absolute and relative spleen weights. Upon microscopic examination, the spleens of rats in the 8 mg/L and 20 mg/L-treatment groups showed a dose-dependent increase of hemosiderin. Significant decreases in the absolute and relative testicular weight of male rats and the body weight of female rats were observed in the 20 mg/L treatment groups. Microscopically, the testicular tissue of rats treated with 20 mg/L 1,3-dinitrobenzene showed a slight to moderate decrease in spermatogenesis.

Levine et al. (1983) studied the effects of 2,4,6-trinitrotoluene on beagle dogs. Six male and six female dogs/treatment group received daily gelatin capsules containing doses equivalent to 0.0, 0.5, 2.0, 8.0, or 32.0 mg/kg for 26 weeks. At the end of the study, the body weight of male dogs treated with 8 mg/kg/day 2,4,6-trinitrotoluene was statistically decreased. Decreases of the hematocrit, hemoglobin and red blood cell counts and increases in methemoglobin were dose-dependent in both sexes of dogs and statistically significant at 2,4,6-trinitrotoluene doses 8 mg/kg/day. The absolute and relative liver weights of male dogs receiving 8 mg/kg/day and male and female dogs receiving 32 mg/kg/day 2,4,6-trinitrotoluene were statistically increased. Microscopically, the liver of male dogs treated with 32 mg/kg/day was cirrhotic Hepatic hemosiderosis was present in both sexes of dogs treated with 8 mg/kg/day 2,4,6-trinitrotoluene. Relative and absolute increases in spleen weight were reported for both sexes of dogs receiving 32 mg/kg/day 2,4,6-trinitrotoluene and in female dogs receiving 8 mg/kg//day. Microscopically, the spleens showed marked to severe congestion related to 2,4,6-trinitrotoluene treatment.

Levine et al. (1984) also studied the toxicity of 2,4,6-trinitrotoluene in rats. F344 rats (10/sex/group) were treated with doses equivalent to 1.0, 5.0, 25.0, 125.0, or 300 mg/kg/day 2,4,6-trinitrotoluene for 13 weeks. Male and female rats treated with 125 mg/kg/day 2,4,6-trinitrotoluene had body weights significantly decreased relative to untreated control rats. Dose-related decreases in the hematocrit, hemoglobin and red blood cell counts were seen in male rats treated with 25 mg/kg/day and female rats treated with 125 mg/kg/day. Methemoglobinemia was observed in both sexes of rats treated with 300 mg/kg/day 2,4,6-trinitrotoluene. The liver weight was increased in male and female rats receiving 25 mg/kg/day. Microscopically, dose-dependent congestive lesions of the spleen and hyperplasia of the liver were observed in all rats treated with 125 mg/kg/day. Microscopic examination of testicular tissue of male rats receiving 125 or 300 mg/kg/day 2,4,6-trinitrotoluene showed a dose-related degeneration of the germinal epithelial lining of the seminiferous tubules.

3.1.3 Chronic Toxicity

3.13.1 Human

Information on the chronic oral toxicity of 1,3,5-trinitrobenzene in humans was unavailable.

3.13 2 Animals

Information on the chronic oral toxicity of 1,3,5-trinitrobenzene to animals was unavailable. Because of the lack of information on 1,3,5-trinitrobenzene, chronic toxicity studies of 2,4,6-trinitrotoluene, which is structurally similar, are presented.

Furedi et al (1984a) studied the effects of chronic 2,4,6-trinitrotoluene treatment to male and female F344 rats. The rats were fed diets that contained doses of 2,4,6-trinitrotoluene equivalent to 0.4, 2.0, 10.0, or 50.0 mg/kg for 24 months. Although treatment did not affect survival in either sex, there was a dose related decrease in body weight and food consumption of male rats treated with 10 mg/kg/day 2,4,6-trinitrotoluene. Male and female rats treated with 10 mg/kg/day 2,4,6-trinitrotoluene had decreased hemoglobin, hematocrit and red blood cell counts, and increased methemoglobin concentrations. Although male rats treated with 50 mg/kg/day had increased ocular discharges, neither sex of rats developed ophthalmologic abnormalities. A dose-related increase in the absolute and relative liver and kidney weight of rats treated with 10 mg/kg/day and the absolute spleen weight of rats treated with 50 mg/kg/day was observed. Microscopically, the liver hyperplasia observed in male rats treated with 10 mg/kg/day was associated with peliosis and cystic degeneration. The spleen of rats treated with 2 mg/kg/day had increased pigmentation, sinusoidal congestion and areas of extramedullary hematopoiesis. An increase in sternal bone marrow fibrosis was observed in female rats treated with 2.0 mg/kg/day and in male rats treated with 50 mg/kg/day 2,4,6-trinitrotoluene.

Furedi et al., (1984b) also studied the effects of chronic 2,4,6-trinitrotoluene treatment to male and female B6C3F, mice. The mice were fed diets containing 2,4,6-trinitrotoluene equivalent to 1.5, 10.0, or 70 mg/kg/day for 24 months. Other than hepatomegaly and mild anemia in male and female mice receiving 70 mg/kg/day, no other apparent adverse effects were observed related to 2,4,6-trinitrotoluene treatment.

3.1.4 Developmental and Reproductive Toxically

Information on the developmental and reproductive toxicity of 1,3,5-trinitrobenzene in humans or animals was unavailable.

3.1.5 Reference Dose

3.15.1 Subchronic

ORAL RfD: 5E-4 mg/kg/day (U.S. EPA, 1991a)

UNCERTAINTY FACTOR: 1000

NOAEL: 3 mg/L 1,3-Dinitrobenzene in drinking water, converted to 0.51 mg/kg/day 1,3,5-trinitrobenzene

LOAEL: 8 mg/L 1,3-Dinitrobenzene in drinking water, converted to 1.43 mg/kg/day 1,3,5-trinitrobenzene

COMMENT: The same study (Section 3.1.2.2) applies to the subchronic and chronic RfD. The LOAEL was based on increased spleen weights in Carworth Farm male rats treated with 8 mg/L (1.13 mg/kg/day) 1,3-dinitrobenzene. The NOAEL and LOAEL were converted to mg/kg/day 1,3,5trinitrobenzene by multiplying the concentration of 1,3-dinitrobenzene by the molecular weight ratio of 1,3,5-trinitrobenzene/1,3-dinitrobenzene (213.11/168.11 = 1.2J7). The uncertainty factor of 1000 includes a- factor of 10 for interspecies extrapolation, 10 for sensitive members of the human population, and 10 for the derivation of an RfD by analogy to structurally similar 1,3-dinitrobenzene.

3.1.5.2 Chronic

ORAL RfD: 5E-5 mg/kg/day (U.S.EPA, 1991b)

UNCERTAINTY FACTOR: 10,000

MODIFYING FACTOR: 1

NOAEL: 3 mg/L 1,3-Dinitrobenzene in drinking water, converted to 0.51 mg/kg/day 1,3,5-trinitrobenzene

LOAEL: 8 mg/L 1,3-Dinitrobenzene in drinking water, converted to 1.43 mg/kg/day 1,3,5-trinitrobenzene

CONFIDENCE:

Study	Medium
Data Base	Low
RfD	Low

VERIFICATION DATE: 9/7/88

PRINCIPAL STUDY: Cody et al., 1981

COMMENTS: The LOAEL was based on increased spleen weights in Carworth Farm male rats treated with 8 mg/L (1.13 mg/kg/day) 1,3-dinitrobenzene. The NOAEL and LOAEL were converted to mg/kg/day 1,3,5-trinitrobenzene by multiplying the concentration of 1,3-dinitrobenzene by the molecular weight ratio of 1,3,5-trinitrobenzene/1,3-dinitrobenzene (213.11/168.11 = 1.27). The uncertainty factor of 10,000 includes a factor of 10 for subchronic to chronic exposure, 10 for interspecies extrapolation, 10 for sensitive members of the human population, and 10 for the derivation of an RfD by analogy to structurally similar 1,3-dinitrobenzene.

3.2 INHALATION EXPOSURES

3.2.1 Acute Toxicity

3.2.1.1 Human

Information on the acute toxicity of 1,3,5-trinitrobenzene in humans following inhalation exposure was unavailable. Information on structurally similar 1,3-dinitrobenzene or 2,4,6-trinitrotoluene was also unavailable.

3.1.1.2 Animals

Timofievskaya and Rodionova (1973) reported that mice exposed to air saturated with 1,3,5-trinitrobenzenc for 24 hours was not toxic; however experimental details were unavailable.

3.2.2 Subchronic Toxicity

Toxicity information was available for humans occupationally exposed to atmospheric concentrations of 2,4,6-trinitrotoluene. However, the route of exposure cannot be conclusively established as inhalation. Therefore, these studies are presented in Section 3.3.1- Other Routes of Exposure, Human. Information on the subchronic inhalation toxicity of 1,3,5-trinitrobenzene, 1,3-dinitrobenzene or 2,4,6-trinitrotoluene in animals was unavailable.

3.2.3 Chronic Toxicity

Toxicity information was available for humans occupationally exposed to atmospheric concentrations of 1,3,5-trinitrobenzene and 2,4,6-trinitrotoluene. However, the route of exposure cannot be conclusively established as inhalation. Therefore, these studies are presented in Section 3.3.1 - Other Routes of Exposure, Human. Information on the chronic inhalation toxicity of 1,3,5-trinitrobenzene, 1,3-dinitrobenzene or 2,4,6-trinitrotoluene in animals was unavailable.

3.2.4 Developmental and Reproductive Toxicity

Information on the developmental or reproductive inhalation toxicity of 1,3,5-trinitrobenzene in humans or animals was unavailable. In addition, information was not available for structurally similar 1,3dinitrobenzene or 2,4,6-trinitrotoluene.

3.2.5 Reference Concentration

A reference concentration (RfC) for 1,3,5-trinitrobenzene has not been derived.

3.3 Other Routes of Exposure

3.3.1 Human

Stewart et al. (1945) reported that of 62 munition plant workers, 85% developed skin rashes and had decreased hemoglobin concentrations when occupationally exposed to 0.3-1.3 mg/m^3 1,3,5-trinitrobenzene

for 4-11 weeks. In a follow-up study, differences could not be detected between control workers and exposed workers after the atmospheric concentration of 2,4,6-trinitrotoluene was reduced to 0.08459 mg/m^3.

Hathaway (1977) reported that workers exposed to concentrations of 2,4,6-trinitrotoluene between 0.01 and 4.0 mg/m^3 developed skin irritation, liver damage and anemia. Morton et al. (1976) reported that the serum activities of lactic acid dehydrogenase (LDH) and serum glutamic oxaloacetic transaminase (SGOT, AST) in munition workers increased significantly ($p < 0.005$) when the atmospheric concentration of 2,4,6-trinitrotoluene increased from 0.3 to 0.8 mg/m^3. The hemoglobin concentration of the workers was unaffected. Harkonen et al. (1983) reported that 6/12 workers occupationally exposed to atmospheric concentrations of 0.14-0.58 mg/m^3 2,4,6-trinitrotoluene for 6.8 years developed equatorial lens opacities, although visual acuity and visual fields were unaffected.

3.3.2 Animal

Timofievskaya and Rodinova (1973) reported that 1,3,5-trinitrobenzene applied to the shaved skin of mice produced hyperemia, edema and hemorrhages. They also reported that 50 mg 1,3,5-trinitrobenzene instilled into the eye of rabbits produced irritation. Further details of these studies were unavailable.

Watanabe et al. (1976) compared single 100 Fmol/kg (213 mg/kg) intraperitoneal injections of 1,3-dinitrobenzene, 1,4-dinitrobenzene, and 1,3,5-trinitrobenzene for the induction of methemoglobinemia in male Wistar rats. Five hours after treatment, 1,3-dinitrobenzene and 1,4-dinitrobenzene induced greater methemoglobin production than 1,3,5-trinitrobenzenc. Concurrent control data were not reported. In in vitro studies, 1,3,5-trinitrobenzene, 1,2-, 1,3, and 1,4-dinitrobenzene induced statistically significant increases in methemoglobin concentration compared to control red blood cells (Watanabe et al7 1976). Further details of these studies were not available.

3.4 Target Organs/Critical Effects

3.4.1 Oral Exposures

3.4.1.1 Primary Target Organs

1) Red Blood Cell: 1,3,5-Trinitrobenzene induced methemoglobinemia in rats following a single oral dose. The structurally similar compound 2,4,6-trinitrotoluene induced methemoglobinemia in rats, dogs, and mice following subchronic and chronic exposure. In association with the induced methemoglobinemia were decreases in the hemoglobin, hematocrit and red blood cell counts and increased central nervous system disorders and cyanosis.

2) Liver: Following subchronic exposure to dogs and subchronic and chronic exposure to rats, 2,4,6-trinitrotoluene induced hyperplasia, cystic degeneration, hemosiderosis, and peliosis.

3) Testes: Rats treated for 16, or 13 weeks with 1,3-dinitrobenzene and 2,4,6-trinitrotoluene, respectively, had decreased absolute and relative testicular weights. Microscopically, the testicular tissue showed a dose-related degeneration of the germinal epithelial lining of the seminiferous tubules leading to a decrease in spermatogenesis.

3.4.1.2 Other Target Organs

Spleen: Rats and dogs treated with 1,3-dinitrobenzene and 2,4,6-trinitrotoluene had increased absolute and relative spleen weights. Microscopically, the spleen had increased pigmentation, sinusoidal congestion and areas of extramedullary hematopoiesis. These conditions likely arose secondarily to methemoglobinemia.

3.4.2 Inhalation Exposures

Because data describing toxicity induced by 1,3,5-trinitrobenzene or by structurally similar 1,3-dinitrobenzene or 2,4,6-trinitrotoluene were not available, target organs can not be identified.

4.0 CARCINOGENICITY

4.1 Oral Exposures

Information on the carcinogenicity of 1,3,5-trinitrobenzene following oral exposure in humans or animals was unavailable. Information on the carcinogenicity of structurally similar 1,3-dinitro-benzene was unavailable. A brief description of oral carcinogenicity studies of 2,4,6-trinitrotoluene, which is structurally similar, are presented.

Furedi et al. (1984a) studied the carcinogenicity of 2,4,6-trinitrotoluene using male and female F344 rats fed diets containing doses equivalent to 0.0, 0.4, 2.0, 10.0, or 50 mg/kg/day for two years. 2,4,6-Trinitrotoluene treatment induced a significant increase in the incidence of urinary bladder papillomas and carcinomas in female rats (0/54, control; 0/54, 0.4 mg/kg/day; 0/55, 2.0 mg/kg/day, 1/55, 10 mg/kg/day, 17/55, 50 mg/kg/day). Although hyperplasia of the liver (males) and kidney (females) was observed in rats treated with 50 mg/kg/day 2,4,6-trinitrotoluene, other sites of tumor formation were not identified.

Furedi et al (1984b) also studied the carcinogeniuty of 2,4,6-trinutrotoluene using B6C3FI mice. Male and female mice were treated with doses equivalent to 0.0, 1.5, 10.0, or 70.0 mg/kg/day trinitro-toluene for two years. The authors reported a statistically significant increase in the incidence of all types of malignant lymphoma combined with lymphocytic and granulocytic leukemia in the spleen of female mice treated with 70 mg/kg/day 2,4,6-trinitrotoluene. However, when all types of malignant lymphomas and lymphocytic leukemia were counted in all animal tissues combined rather than for a single organ, the incidence of tumors was not statistically significant (U.S. EPA, 1990b). Therefore, U.S. EPA (1990b) considers the neoplasms observed in the mouse study to be unrelated to 2,4,6-trinitrotoluene treatment.

4.2 Inhalation Exposures

Information on the carcinogenicity of 1,3,5-trinitrobenzene following inhalation exposure in humans or animals was unavailable. Information on the carcinogenicity of structurally similar 2,4,6-trinitrotoluene or 1,3-dinitrobenzene was unavailable.

4.3 Other Routes of Exposure

Information on the carcinogenicity of 1,3,5-trinitrobenzene following other routes of exposure in humans or animals was unavailable. Information on the carcinogenicity of structurally similar 2,4,6-trinitrotolucnc or 1,3-dinitrobenzenc was unavailable.

4.4 EPA Weight-of-Evidence

Oral and inhalation weight-of-evidence classifications for 1,3,5-trinitrobenzene have not been assigned.

4.5 Slope Factors

A slope factor for 1,3,5-trinitrobenzene following oral or inhalation exposure has not been derived.

5.0 REFERENCES

Barnhart, R.R. 1981. Rubber Compounding. In: Kirk-Othmer Encyclopedia of Chemical Technology, 3rd ed., Volume 20, A. Stannden, Ed., John Wiley and Sons, New York, NY, pp. 393, 468.

Budavari S., M.J. O'Neil and A. Smith (Eds). 1989. In: The Merck Index. Merck & Co., Inc., Rahway, NJ, p. 1530.

Cody, T.E., S. Witherup, L. Hastings, K. Stemmer, and R.T. Christian. 1981. 1,3-Dinitrobenzene: Toxic effect in vivo and in vitro. J. Toxicol. Environ. Health. 7(5): 829-847. (Cited in U.S. EPA, 1989, 1991)

Dilly, J.V., C.A. Tyson, R.J. Spanggord, D.P. Sasmore, G.W. Newell, and J.C. Dacre. 1982. Short-term oral toxicity of 2,4,6-trinitrotoluene in mice, rats and dogs. J. Toxicol. Environ. Health 9(4): 565-585.

Durst, RA. and R.G. Bates. 1981. Hydrogen-ion Activity. In: Kirk-Othmer Encyclopedia of Chemical Technology, 3rd ed7 Volume 13, A. Stannden, Ed., John Wiley and Sons, New York, NY, pp. 10-11.

El-hawari, A.M., J.R. Hodgson, J.M. Winston, M.D. Sawyer, M. Hainje and C.C. Lee. 1981. Species differences in the disposition and metabolism of 2,4,6-trinitrotoluene as a function of route of administration.

Final Report. Midwest Research Institute, Project No. 4274-B, Kansas City, MO, DAMD17-76-C 6066. ADA114-025. (Cited in U.S. EPA, 1990a)

Fedoroff, B.T., O.E. Sheffield, E.F. Reese, and G.D. Clift (Eds). 1962. In: Encyclopedia of Explosives and Related Items, PATR 2700, Volume 2, Picatinny Arsenal, Dover, NJ, pp. B48-B49.

Furedi, E.M., B.S. Levine, D.E. Gordon, V.S. Rac, and P M. Lish. 1984a. Determination of the chronic mammaLian toxicological effects of TNT (Twenty-four month chronic toxicity/carcinogenicity study of trinitrotoluene (WI) in the Flscher 344 rat). Fmal Report - Phase III, Volume 1. IIT Research Institute, Project No. L6116 Study No. 9, Chicago, IL. DAMD1779-C-9120. AD-A168 637. (Cited in U.S. EPA, 1990a)

Furedi E M., B.S. Levine, J.W. Sagartz, V.S. Rac, and P.M. Lish. 1984b. Determination of the chronic mammalian toxicological effects of TNT (Twenty-four month chronic toxicity/carcinogenicity study of trinitrotoluene (TN"I) in the B6C3F, hybrid mouse). Final Report - Phase IV, Volume 1. IIT Research Institute, Project No. L6116 Study No. 11, Chicago, IL. DAMD17-79-C-9120. AD-A168 754. (Cited in U.S. EPA, 1990a)

Harkonen, H7 M. Karki A. Lahti, and H. Savolainen. 1983. Early equatorial cataracts in workers exposed to trinitrotoluene. Am. J. Ophthalmol. 95(6): 807-810. (Cited in U.S. EPA, 1990a)

Hathaway, JA. 1977. Trinitrotoluene: A review of reported dose-related effects providing documentation for a workplace standard. J. Occup. Med. 19(5): 341-345. (Cited in U.S. EPA, 1990a)

Korolev, AA., T. Vo'itesekhovskaia, M.V. Bogdanov, M.V. Arsenteva, and TA. Azkharova. 1977. Experimental data on the hygienic standardization of dinitrotoluene and trinitrobenzol in the water reservoirs. Gig. Sanit. 10: 17-20 (Russian - cited in U.S. EPA, 1989).

Levine, B.S., J.H. Rust, J.M. Burns and P.M. Lish. 1983. Determination of the chronic mammalian toxicological effects of TNT. Twenty-six week subchronic oral toxicity study of trinitrotoluene (TNT in the beagle dog. Phase II, Final Report, IIT Research Institute, Report No. Loll6, Study No. 5, Chicago, IL. DAMD 17-79-C-9120, AD-A157 082. (Cited in U.S.EPA, 1990a)

Levine, B.S., E.M. Furedi, D.E. Gordon, P.M. Lish, and JJ. Barkely. 1984. Subchronic toxicity of trinitrotoluene in Fischer 344 rats. Toxicology 32: 253-265.

Martin, D.P. 1974. Subacule toxicity of RDX and TNT in monkeys. Final Report. Litton Bionetics, Inc. Project No. 1366, Kensington, MD. N0001s73-COlG2. NR 108-985. AD-A044 650/0. (Cited in U.S. EPA, 1990a)

Morton, A.R., M.V. Ranadive, and JA. Hathaway. 1976. Biological effects of trinitrotoluene from exposure below the threshold limit value. Am. Ind. Hyg. Assoc. J. 37(1: 0. (Cited in U S. EPA, 1990a)

Parke, D. 19ol. Studies in detoxification. V. The metabolism of m-dinitro[benzene in the rabbit. Biochem. J. 78: 262-271.

Ryon, M.G., B.C. Pal, S.S. Talmage and R.H. Ross. 1984. Database assessment of the health and environmental effects of munition production waste products. Final Report. ORNL-6018. (NTIS DE&S 016512). Oak Ridge National Laboratory, Oak Ridge, TN.

Sax, N.I. and RJ. Lewis, (Eds). 1989. In: Dangerous. Properties of Industrial Materials, Seventh Ed., Volume III, Van Nostrand Reinhold, New York, NY, p. 3403.

Senczuk, W., J. Jodynis, and H. Rogal. 1976. Effect of the chemical structure of some aromatic compounds on their methemoglobin-inducing properties " Aromatic nitro compounds. Bromat. Chem. Toksykol. 9(3): 289-294 (Russian - cited in U.S. EPA, 1989).

Stewart, A., L.T. Witts, G. Higgins, et al. 1945. Some early effects of exposure to trinitrotoluene. Br. J. Ind. Med. 2 74-82. (Cited in Hathaway, 1977)

Timofievskaya, LA. and R.P. Rodionova. 1973. Comparative evaluation of the toxicity of some aromatic polynitro compounds. ToksikoL Novykh Promysh. Khim. 13: 138-144 (R——an - cited in U.S. EPA, 1989).

U.S. EPA. 1989. Health and Environmental Effects Profile for 1,3,5-Trinitrobenzene. Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Cincinnati OH, ECAO-CIN-G071

U.S. EPA. 1990a. Health and Environmental Effects Document for 2,4,STrinitrotoluene. Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Cincinnati, OH, ECAO CINB089.

U.S. EPA. 1990b. 2,4,6-Trinitrotoluene. Integrated Risk Information System (IRIS). Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Cincinnati OH.

U.S. EPA. 1991a. Health Effects Assessment Summary Tables. Annual FY@}. Prepared by the Office of 0 Health and Environmental Assessment, Environmental Criteria and Assessment Office, cincinnati, OH, for the Office of Emergency and Remedial Response, Washington, DC. NTIS PS91-921199.

U.S. EPA. 1991b. 1,3,5-Trinitrobenzene. Integrated Risk Information Syste ll (IRIS). Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Cncinnati OH.

Watanabe, T., N. Ishihara, and M. Ikeda. 1976. Toxicity of and biological! monitoring for 1,3-diamino-2,4,~ trinitrobenzene and other nitro-amino derivatives of benzene and chlorotoczne. Intl. Arch. Occup. Environ. Health 37: 157-168.

Weast, R.C. (Ed.). 1989. In: CRC (Chemical Rubber Company) Handbook for Chemistry and Physics, 69th ed., MJ. Astle and W.H. Beyer, Assoc. Ed., CRC Press, Inc., Boca Raton, FL., p C-119.

TOXICITY SUMMARY
for
2,4,6-TRINITROTOLUENE

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EXECUTIVE SUMMARY

2,4,6-Trinitrotoluene (TNT) is used as a high explosive in military armaments and as a chemical intermediate in the manufacture of dyestuffs and photographic chemicals (Sax and Lewis, 1987). TNT is likely to enter the environment in wastewater effluents from production facilities and from leachates at waste disposal sites. Mobility in soil may be limited by strong adsorption to soil particles (USEPA, 1990).

TNT is absorbed through the gastrointestinal tract, skin and lungs; is distributed primarily to the liver, kidneys, lungs and fat; and is excreted mainly in the urine and bile (El-hawari et al., 1981). Metabolism occurs by nitroreduction to amino and hydroxylamino derivatives and by oxidation to benzyl alcohol and benzoic acid derivatives (El-hawari et al., 1981).

In animals, signs of acute toxicity to TNT include ataxia, tremors, and mild convulsions. Splenic hemosiderosis, leukopenia, thrombocytosis, slight hepatomegaly, and increase in kidney weight occurred in mice fed a dietary level equivalent to 700 mg TNT/kg/day for 28 days (Levine et al, 1984b). Oral LD50 values of 660-1320 mg/kg have been reported for rats (Dilley et al., 1982).

The primary target organs for TNT toxicity in experimental animals following subchronic and chronic oral exposures are: (1) liver (hepatocytomegaly and cirrhosis); (2) blood (hemolytic anemia with secondary alterations in the spleen); and (3) testes (degeneration of the germinal epithelium lining the seminiferous tubules). The LOAEL for hepatotoxicity in dogs was 0.5 mg/kg/day (Levine et al., 1990a).

Chronic oral toxicity studies on rats have also demonstrated TNT-induced anemia and hepatotoxicity, as well as adverse effects on the kidney (hypertrophy and nephropathy) and sternal bone marrow fibrosis (Furedi et al., 1984a).

The Reference Dose for chronic oral exposures, 0.0005 mg/kg/day, is based on a LOAEL of 0.5 mg/kg/day for liver effects in dogs (USEPA, 1991b). The subchronic oral RfD is the same as the chronic RfD and is based on the same study (USEPA, 1991a).

Information on the inhalation toxicity of TNT is derived mainly from occupational exposure studies, which indicate that the major effects of chronic exposure to TNT are anemia (decreases in Hgb, Hct, and RBC count), liver dysfunction (increases in serum lactic dehydrogenase, glutamic oxaloacetic transaminase, and bilirubin), and cataracts (equatorial lens opacities) (USEPA, 1989, 1990). Other reported effects of TNT exposure include dermatitis, leukocytosis, neurological disorders, and nephrotoxicity (Cone, 1944, Zakhari and Villaume, 1978).

An inhalation Reference Concentration (RfC) for TNT has not been derived.

Limited information is available on the reproductive or developmental toxicity of TNT to animals or humans following inhalation exposures. Information from occupational exposure studies suggests that TNT may cause menstrual disorders and male impotency (Zakhari and Villaume, 1978; Jiang et al., 1991).

No epidemiological evidence is available showing an association between chronic TNT exposure and tumorigenicity in humans. In animal carcinogenicity studies, a significant increase in urinary bladder papillomas and carcinomas was seen in female F344 rats dosed with 50 mg TNT/kg/day for 24 mo (Furedi et al., 1984a). This study was used by USEPA to calculate a slope factor of 0.03 $(mg/kg/day)^{-1}$ (USEPA, 1991). TNT is classified in weight-of-evidence Group C, "possible human carcinogen" (USEPA, 1991a, b).

1.0 INTRODUCTION

2,4,6-Trinitrotoluene (TNT) is a yellow crystalline solid used as a high explosive in military armaments and as a chemical intermediate in the manufacture of dyestuffs and photographic chemicals (Sax and Lewis, 1987). It is slightly soluble in water (104-113 mg/L) and soluble in alcohol, ether, acetone, benzene and carbon disulfide (USEPA, 1990). It has a density of 1.654 g/mL, a vapor pressure of 8.02 x 104 mm Hg at 25°C, and a log K_{ow} of 1.60 (USEPA, 1990).

TNT is likely to enter the environment in wastewater effluents from production facilities and from leachates at waste disposal sites. Direct photolysis (half-life 14 hr.) and microbial degradation are expected to be the major loss pathways. Mobility in soil may be limited by strong adsorption to soil particles. Volatilization to the atmosphere from water or soil is not expected to be significant (USEPA, 1990).

2.0 Metabolism and Disposition

2.1 Adsorption

TNT is absorbed through the gastrointestinal tract, the skin and the lungs. Studies on laboratory animals dosed with radiolabelled TNT have shown that rates of absorption, as indicated by the 24-hr recovery of radioactivity in the urine, can be as high as 74.3% following oral dosing and 52.8% after dermal exposures. Following intratracheal dosing to rats, urinary recovery was 12.7-19.3% after 4 hr (El-hawari et al., 1981).

2.2 Distribution

In laboratory animals dosed orally, dermally or intratracheally with radiolabelled TNT, recovery of radioactivity was highest in blood, liver, kidneys, lungs, and fat (El-hawari et al., 1981).

2.3 . Metabolism

TNT is extensively metabolized by nitroreduction to various derivatives, including hydroxylaminodinitrotoluenes, amino-dinitrotoluenes, and diamino-nitrotoluenes (El-hawari et al.,

1981). The methyl group can also be oxidized to form benzyl alcohol and benzoic acid derivatives. Some metabolites may undergo conjugation reactions with glucuronic acid.

2.4 Excretion

TNT and its metabolites are excreted primarily in the urine and bile (El-hawari et al., 1981). Only a small fraction (~0.1%) is eliminated through the lungs.

3.0 NONCARCINOGENIC HEALTH EFFECTS

3.1 Oral Exposures

3.1.1 Acute Toxicity

3.1.1.1 Human

Information on the acute oral toxicity of TNT to humans was not available.

3.1.1.2 Animal

Oral LD_{50}s of 660 mg/kg in male and female mice and 1320 and 795 mg/kg in male and female rats, respectively, have been reported (Dilley et al., 1982). Signs of acute toxicity may include: ataxia, tremors, cyanosis, respiratory paralysis, and mild convulsions (USEPA, 1989).

Twenty-eight day treatment of B6C3FI mice with dietary TNT equivalent to 700 mg/kg resulted in splenic hemosiderosis, leukopenia, thrombocytosis, slight hepatomegaly, and increase in kidney weight (Levine et al, 1984b).

3.1.2 Subchronic Toxicity

3.1.2.1 Human

Information on the subchronic oral toxicity of TNT to humans was not available.

3.1.2.2 Animal

The subchronic oral toxicity of TNT has been evaluated in several animal species, including dogs, rats, mice, and monkeys. In a 90-day study on beagles, the test animals (3/sex/group) were fed TNT (purity not reported) in a commercial feed at concentrations equivalent to dose levels of 0 (control), 0.02, 0.1 or 1.0 mg/kg/day (Hart, 1974). Hematological parameters, serum chemistry tests, and urinalysis, as well as gross and microscopic appearance of organs and tissues, were not affected by the treatment. Temporary episodes of emesis occurred but tolerance appeared to develop.

In a study conducted by Dilley et al. (1982), beagles (5/sex/group) received TNT (>99% pure) in gelatin capsules, daily for one or 13 weeks, in doses equivalent to 0 (control), 0.2, 2.0 or 20 mg/kg/day. Changes in hematological parameters and in the gross and microscopical appearance of the spleen were suggestive of hemolytic anemia at the highest dose.

In a third study on beagles, Levine et al. (1983; see also Levine et al., 1990a), administered TNT (99.1%) in gelatin capsules at dose levels equivalent to 0 (controls), 0.5, 2.0, 8.0, or 32 mg/kg/day (6 animals/sex/dose) for 26 weeks. Clinical signs of toxicity attributed to TNT treatment included transient ataxia, darkening of the tongue and gums, evidence of jaundice, orange-brown urine, and orange-red feces. Reductions in body weight and food consumption occurred primarily in the high-dose animals. Dose-related anemia (decreased hematocrit, hemoglobin and erythrocyte counts); methemoglobinemia; reticulocytosis, microcytosis, and increased numbers of nucleated RBCs were seen in animals receiving 8 and 32 mg/kg/day. Serum chemistry effects, also seen primarily at the highest doses, included a decrease in SGPT (serum glutamic pyruvic transaminase) and increases in globulin, LDH (lactic dehydrogenase), and total and direct bilirubin. Urinary bilirubin was also elevated. Significant ($p<0.05$) increases in relative and absolute liver weights occurred in males receiving 8 and 32 mg/kg/day and in females receiving 32 mg/kg/day. There was also a dose-related increase in hepatocytomegaly and in the incidence and severity of cloudy swelling of the

hepatocytes. Microscopic evidence of cirrhosis, observed only in the treated animals, was reported in one male in the 8 mg/kg/day dose group and in six males and one female in the 32 mg/kg/day group. One female receiving 2 mg/kg/day and all animals receiving 8 and 32 mg/kg/day exhibited hemosiderosis in the histocytes of the liver. A dose level of 0.5 mg/kg/day was identified as a LOAEL for effects on the liver. Relative and absolute spleen weights increased significantly ($p<0.05$) in females receiving 8 and 32 mg/kg/day and in males receiving 32 mg/kg/day. Enlargement of the spleen with marked to severe congestion was attributed to TNT treatment. A slight but statistically nonsignificant increase in relative kidney weight was seen in high-dose females but not in males.

The subchronic toxicity of TNT has also been evaluated in several studies on rats. In a 13-week study, Levine et al. (1984a) fed F344 rats (10/sex/dose group) a commercial diet containing TNT (99.1% pure) at dose levels equivalent to 1, 5, 25, 125 or 300 mg/kg/day. Lethargy, ataxia, and reductions in food intake and body weight gain were observed in animals receiving doses $\geq$125 mg/kg/day. Two deaths, in rats receiving 300 mg/kg/day, were attributed to severe anemia. Dose-related anemia (decreased hematocrit, hemoglobin and erythrocyte counts) was observed in treated rats. These changes were statistically significant ($p\leq0.05$) for males receiving $\geq$25 mg/kg/day, and for females receiving $\geq$125 mg/kg/day. Methemoglobinemia occurred in both males and females administered doses of 300 mg/kg/day. Serum cholesterol levels and relative spleen weights increased significantly in both males and females receiving $\geq$125 mg/kg/day. Dose-dependent congestive lesions were observed in the spleen. Hyperplasia was found in the liver of animals receiving doses of $\geq$125 mg/kg/day. Histological examination of the testes revealed dose-related degeneration of the germinal epithelium lining the seminiferous tubules in rats in the 125 and 300 mg/kg/day dose groups. The investigators concluded that the liver, testes and blood were the main targets of TNT toxicity and that the splenic lesions were secondary to the hemolytic effect. In addition, in rats dosed with 300 mg/kg/day degenerative lesions were seen in tracts of cerebellar folia. In a more recent study, Levine et al. (199Ob) administered TNT to F344 rats for 13 weeks at dietary levels equivalent to 5 and 125 mg/kg/day. Adverse toxic effects, occurring in the high-dose groups, were similar to those reported in the earlier study (i.e., anemia, hypercholesterolemia, hepatomegaly, splenomegaly and testicular atrophy, with accompanying histological lesions).

In another study, Dilley et al. (1982) fed Sprague-Dawley rats (20/sex/group) a commercial diet containing TNT at concentrations of 0.002, 0.01, 0.05, or 0.25%. Dose levels were equivalent to 1.40, 6.97, 34.7 and 160 mg/kg/day for males and 1.45, 7.41, 36.4 and 164 mg/kg/day for females.

Treatment lasted for 4 or 13 weeks. Red-colored urine, observed in animals on the 0.05 and 0.25% TNT diets, was the only clinical sign observed during treatment. Hematologic changes included decreased hemoglobin and hematocrit concentrations and RBC count, and increased mean corpuscular volume and leukocyte count, particularly at the highest dose level. Other effects were confined to those rats on the 0.25% TNT diet. Body weight gain was significantly ($p < 0.01$) reduced; spleen weight and the spleen/brain weight ratios (both sexes) were significantly increased, and absolute and relative testes weight were significantly decreased. At weeks 4 and 13, the treated rats showed a significant ($p<0.01$) increase in serum cholesterol. Also at week 13, SGPT and serum iron levels were markedly ($p<.01$) reduced in males but not in females. Hemosiderosis of the spleen (both sexes) and testicular atrophy accompanied by hyperplasia were found in animals sacrificed immediately after treatment. Males allowed to recover for 4 weeks showed atrophy of the epididymis.

Swiss-Webster mice were fed a commercial diet containing TNT at concentrations of 0.001, 0.005, 0.025, 0.125% for 4 or 13 weeks (Dilley et al., 1982). Dose levels were equivalent to 1.56, 7.46, 35.7, or 193 mg/kg/day for males and 1.57, 8.06, 37.8, or 188 mg/kg/day for females. Mild hematological changes, indicative of hemolytic anemia, occurred in animals in the high-dose groups. Histological examination revealed hemosiderosis of the spleen in animals on the 0.025% and 0.125% TNT diets and hepatic necrosis in some males in the high-dose group.

Martin (1974) conducted a study using cynomolgus monkeys (3/sex/group) in which TNT (purity not reported) was suspended in methylcellulose and administered by gavage at dose levels of 0 (solvent alone), 0.02, 0.1 or 1.0 mg/kg/day for 90 days. Hematology, serum chemistry, urinalysis, and liver function tests revealed no alterations attributable to TNT treatment. Gross lesions, observed only with the two higher doses, included two cases of subcapsular renal hemorrhage and one case of mucosal reddening and focal thickening of the large intestine. Histological examination revealed increases in the numbers of necrotic megakaryocytes in bone marrow and increased amounts of iron-positive material in the liver.

3.1.3 Chronic Toxicity

3.13.1 Human

Information on the chronic oral toxicity of TNT to humans was not available.

3.13.2 Animal

Furedi et al. (1984a) evaluated the chronic toxicity of TNT in rats. In this study, 6- to 7-week-old F344 rats (75/sex/group) were fed TNT (>99% pure) mixed in a commercial diet. Equivalent dose levels were 0 (control), 0.4, 2, 10 or 50 mg/kg/day for $\leq$ 24 months. Survival rates were not affected by the TNT. There was an apparent increase in ocular discharge in high-dose males during the second year of the study. Dose-related reductions in body weight gain and in food consumption occurred in animals receiving $\geq$10 mg/kg/day. Effects of TNT treatment were seen mainly at the highest doses and included: decreases in hematocrit and hemoglobin concentrations and RBC count; methemoglobinemia; thrombocytosis; increases in serum cholesterol, total protein, albumin, globulin, and BUN (blood urea nitrogen); hypotriglyceridemia in females; and hypertriglyceridemia in males. Kidney weight was increased in the two highest dose groups, and histological examination revealed hypertrophy of the proximal convoluted tubules, increased pigmentation and chronic nephropathy. Dose-related hepatomegaly and increased incidence of hepatocellular hyperplasia associated with peliosis and cystic degeneration were also seen in the two highest dose groups. In addition, high-dose females exhibited a significant increase in urinary bladder lesions (including hyperplasia of the mucosal epithelium) and females receiving $\geq$2 mg/kg/day exhibited a significant increase in the incidence of sternal bone marrow fibrosis. The latter effect was also seen in high-dose males. Absolute spleen weight was increased at the highest dose and was accompanied by increased pigmentation, sinusoidal congestion and extramedullary hematopoiesis.

Furedi et al. (1984b) also investigated the chronic toxicity of TNT in mice. In this study B6C3F$_1$ hybrid mice (75/sex/dose) were fed TNT (>99.8%) in a commercial diet for $\leq$24 months. Equivalent dose levels were 0 (control), 1.5, 10, and 70 mg/kg/day. Treatment did not reduce survival rates of the test animals; however, body weight gain was significantly reduced in both high-dose males and females. Anemia (reduced hematocrit, hemoglobin and RBC counts) and hepatomegaly (without evidence of histological changes) occurred in some animals in the high-dose group.

3.1.4 Developmental and Reproductive Toxicity

No data were available in the literature on the effects of TNT on the reproductive viability of animals or humans. However, laboratory studies have demonstrated that TNT causes adverse effects on the male reproductive system of rodents. In F344 rats, a dose-related degeneration of the germinal epithelium lining the seminiferous tubules was seen in males receiving a dietary equivalent of 125 and 300 mg/kg/day for 13 weeks (Levine et al., 1984a). In Sprague-Dawley rats, testicular atrophy, accompanied by hyperplasia occurred in animals receiving a dietary equivalent of 160 mg/kg/day for 13 weeks (Dilley et al., 1982). Males allowed to recover for 4 weeks showed atrophy of the epididymis. In tests on Wistar rats, Jiang et al. (1991) found that treatment with TNT (200 mg/kg/day, by gavage, 6 days/wk for up to 6 weeks) resulted in significant decreases in absolute testicular weight, in testicular zinc concentration (after 2 weeks), and in testicular copper concentration (after 6 weeks).

No information is available on the developmental toxicity of TNT.

3.15 Reference Dose

3.15.1 Subchronic

ORAL RfD: 0.0005 mg/kg/day (USEPA, 1991a)
UNCERTAINTY FACTOR: 1000
MODIFYING FACTOR: 1
LOAEL: 0.5 mg/kg/day, 26-wk feeding study, dogs

COMMENT: The same study applies to the subchronic and chronic RfD (see Section 3.1.5.1).

3.1.5.2 Chronic

ORAL RfD: 0.0005 mg/kg /day (USEPA, 1991a,b)
UNCERTAINTY FACTOR: 1000
MODIFYING FACTOR: 1
LOAEL: 0.5 mg/kg/day, 26-wk feeding study, dogs

CONFIDENCE:

Study :	Medium
Data Base:	Medium
RfD	Medium

VERIFICATION DATE: 04/20/88

PRINCIPAL STUDY: U.S. DOD, 1983 (Levine et al., 1990a)

COMMENT: The LOAEL was based on trace to mild evidence of hepatocellular swelling and hepatocytomegaly at 0.5 mg/kg/day; more severe effects were seen at higher doses. The Uncertainty Factor of 1000 allows for uncertainties in laboratory animal-to-human dose extrapolation, interindividual sensitivity, subchronic to chronic extrapolation, and LOAEL-to-NOAEL extrapolation.

3.2 INHALATION EXPOSURES

3.2.1 Acute Toxicity

3.2.1.1 Human

General information derived from occupational exposure studies, as summarized by Zakhari and Villaume (1978), indicate that initial exposure to TNT may result in mild irritation to the respiratory passages (nasal discomfort, sneezing, epistaxis and rhinitis), skin (erythema and papulae eruptions, progressing to desquamation and exfoliation) and gastrointestinal system (nausea, anorexia, and constipation). It has also been reported that some individuals deficient in glucose4-phosphate dehydrogenase may show signs of hemolytic anemic within 2-3 days of exposure to TNT (Djerassi and Vitany, 1972). In cases of severe TNT poisoning, signs of cyanosis may occur as a result of methemoglobin formation (Zakhari and Villaume, 1978).

3.3.2.3 Animal

Information on the acute inhalation toxicity of TNT to animals is not available.

3.2.2 Subchronic Toxicity

3.2.2.1 Human

Information on the subchronic inhalation toxicity of TNT to humans is derived mainly from occupational exposure studies. These studies demonstrate that the blood is especially susceptible to toxic effects of TNT. Friedlander et al. (1974) reported that anemic conditions occurred in workers exposed for 6 months to TNT concentrations ranging from <0.02 to >3 mg/m^3. Reductions in hemoglobin and hematocrit were seen when the values were compared with preexposure concentrations and also with concentrations in groups of nonexposed controls (USEPA, 1989). Significant differences were also found in RBC counts, BUN, reticulocytes, eosinophils and blood glucose. The signs of anemia disappeared when the 8-hr/(day exposures were reduced to 0.08-0.59 mg/m_3 (USEPA, 1990).

Stewart et al. (1945) reported decreases in hemoglobin and hematocrit concentrations and RBC counts, and increases in reticulocytes and serum bilirubin, in individuals exposed to TNT concentrations of 0.3-1.3 mg/m^3 for 611 weeks (Stewart et al., 1945). Skin rashes were also present in some of the exposed workers.

3.2.2.2 Animal

Information on the subchronic inhalation toxicity of TNT to animals was not available.

3.2.3 Chronic Toxicity

3.2.3.1 Human

Exposure to TNT in munition plants in the early part of the 20th century resulted in numerous and occasionally fatal cases of aplastic anemia and toxic hepatitis (Zakhari and Villaume, 1978). The

exposure levels and durations causing such severe effects were not clearly documented; however, more recent occupational exposure studies have demonstrated that effects on the blood and liver can occur at relatively low TNT concentrations. In a study of 533 workers exposed to TNT concentrations of 0.01-1.84 mg/m^3, Buck and Wilson (1975) found dose-response relationships in hemoglobin and hematocrit levels and in reticulocyte counts. These changes were suggestive of low grade hemolysis with a compensatory mild reticulocytosis (USEPA, 1989). Liver function tests did not reveal any evidence of hepatotoxicity, but it was noted that only 12.2% of the workers were exposed to TNT levels above 0.5 mg/m^3. Other studies have shown that liver functions may be altered by TNT exposures greater than 0.5 mg/m^3. In munition plant workers, significant increases in serum LDH (lactic dehydrogenase) ($p<0.005$) and SGOT (serum glutamic oxaloacetic transaminase) ($p<0.01$) occurred when the concentration of TNT in the air increased from 0.3 to 0.8 mg/m^3 over a 30-day period due to an increase in production (Morton et al., 1976). In a study conducted by Goodwin (1972), the thymol turbidity test was used to measure the irritant effect of TNT on the liver of munition plant workers. The average value of 1.80 McLagen units in the TNT workers was almost twice as high as the average preemployment level of 0.93 McLagen units Two percent of the 1537 workers were reported to have "classical symptoms of liver damage". Air concentrations of TNT ranged from 0.2-4.7 mg/m^3, with a mean value of 2.38 mg/m^3.

It has been reported that chronic exposure to TNT may result in the formation of cataracts (Zakhari and Villaume, 1978; Hassman and Juran, 1968; Harkonen et al., 1983; Makitie, et al., 1984). Harkonen et al. (1983) found that 6 of 12 workers exposed to 0.14-0.58 mg TNT/m^3 for an average duration of 6.8 years had developed equatorial lens opacities, but without adverse effects on visual acuity or visual fields. Makitie et al. (1984) reported cataracts in 18 of 21 TNT workers exposed for an average of 12.3 years to concentrations of 0.10.4 mg/m^3. Cataracts, which may form in the absence of systemic effects, may be due to the direct contact and absorption of TNT into the eye (USEPA, 1989).

Other reported effects of TNT exposure include: dermatitis; leukocytosis, neurological disorders (neurasthenia, nystagmus, irregularities in muscle reflexes and adiadochokinesia); and zephrotoxicity (Cone, 1944, Hamilton 1946; Zakhari and Villaume, 1978). In most cases, exposure-response data for these effects are not available, and some effects may have been due to acute exposures to high TNT concentrations, possibly superimposed on lower chronic levels.

3.2.3.2 Animal

Information on the chronic inhalation toxicity of TNT to animals was not available.

3.2.4 Developmental and Reproductive Toxicity

Little information was found in the available literature on the effects of TNT on the reproductive viability of animals following inhalation exposures. Data obtained from occupational exposure studies have identified female menstrual disorders (hypo- or hypermenorrhea) and male impotency as possible effects of prolonged exposure to TNT (Zakhari and Villaume, 1978; Jiang et al., 1991).

Information on the developmental toxicity of TNT following inhalation exposures was not available.

3.2.5 Reference Dose/Concentration

Subchronic and chronic RfCs for TNT have not been derived.

3.3 Other Routes of Exposure

3.3.1 Acute Toxicity

3.3.1.1 Human

Information on the acute toxicity of TNT to humans by other exposure routes was not available.

3.3.1.2 Animal

Single intraperitoneal injections of 100 mg/kg of TNT to adult male Wistar rats resulted in membrane damage in the brain, kidneys, and liver (Zitting et al., 1982). TST is considered to be a mild irritant to the skin but not to the eye and it is also a moderate skin sensitizing agent (USEPA, 1989).

3.3 2 Subchronic Toxicity

Information on the subchronic toxicity of TNT to humans or animals by other exposure routes was not available.

3.3.3 Chronic Toxicity

Information on the chronic toxicity of TNT to humans or animals by other exposure routes was not available.

3.3.4 Developmental and Reproductive Toxicib

Information on the developmental and reproductive toxicity of TNT to humans or animals by other exposure routes was not available.

3.4 Target Organ/Critical Effects

3.4.1 Oral Exposures

Information on target organs following oral exposures is based primarily on animal studies.

3.4.1.1 Primary Target Organs

1) Liver: Hepatocytic cloudy swelling and hepatocytomegaly; cirrhosis.

2) Blood: Anemia, decreased hematocrit, hemoglobin, and RBC count.

3) Testes: Degeneration of the germinal epithelium of the seminiferous tubules; decrease in zinc and copper content.

3.4.12 Other Target Organs

1) Kidney: Hypertrophy of the proximal convoluted tubules, increased pigmentation, and chronic nephropathy.

2) Spleen: Increased pigmentation, sinusoidal congestion, and extramedullar hematopesis; probably secondary to anemia.

3) Bone: Fibrosis.

3.4.2 Inhalation Exposures

Information on target organs following inhalation exposures is based primarily on occupational exposure studies.

3.4 2.1 Primary Target Organs

1) Liver: Increases in serum LDH and SGOT; hepatitis.

2) Blood: Anemia; reduced hemoglobin, hematocrit, RBC count.

3) Eye: Cataracts.

3.4.2.2 Other Target Organs

1) Skin: Irritation, rashes.

2) Nervous system: Neurasthenia, nystagmus, abnormal muscle reflexes.

3) Reproductive system: Menstrual disorders; male impotency.

4) Kidney: Nephrotoxicity.

4.0 CARCINOGENICITY

4.1 Oral Exposures

4.1.1 Human

Information on the carcinogenicity of TNT to humans following oral exposure was not available.

4.1 2 Animal

The carcinogenic effects of dietary TNT-were studied in male and female F344 rats by Furedi et al. (1984a). Dose levels were 0, 0.4, 2, 10, or 50 mg/kg/day for ≤24 mos. A significant increase in the combined incidence of urinary bladder papillomas and carcinomas was seen in the high-dose females (I7/55). There were also increased incidences of hepatocellular hyperplasia in high-dose males and renal and urinary bladder hyperplasia in high-dose females.

The carcinogenic effects of dietary TNT were also studied in male and female $B6C3F_1$ mice by Furedi et al. (1984b). Dose levels were 0, 1.5, 10, or 70 mg/kg/day for ≤24 mos. A significant ($p \leq 0.05$) increase in the combined incidence of leukemia and malignant lymphomas in the spleen was seen in the high-dose females. However, according to STP guidelines, it is inappropriate to combine the incidence of leukemia and malignant lymphomas for only a single organ because these tumors can occur throughout the entire hematopoietic system (USEPA 1989). When the incidence of these tumors in all organs was combined, by sex or for both sexes together, it was not statistically significant (USEPA, 1989).

4.2 Inhalation Exposures

Information on the carcinogenicity of TNT after inhalation exposures was not available.

4.3 Other Routes of Exposure

Information on the carcinogenicity of TNT by other routes of exposure was not available.

4.4 EPA Weight-of-evidence

4.4.1 Oral

Classification-C: possible human carcinogen

Basis: Evidence of human carcinogenicity is inadequate. Urinary bladder papillomas and carcinomas were observed in female F344 rats (Furedi et al., 1984a). The compound was found to be mutagenic in Salmollella with and without metabolic activation.

Other Data: The related compounds, 2,4- and 2,6-dinitrotoluene have been shown to be carcinogenic in two species of animals and are classified as B2 carcinogens (USEPA, 1990). According to EPA, several of the metabolic byproducts of TNT, including N-hydroxylated compounds and aminobenzene derivatives are likely to form DNA adducts and, therefore, be potentially mutagenic and carcinogenic.

4.4.2 Inhalation

Not assigned.

4.5 Carcinogenicity Slope Factors

4.5.1 Oral

SLOPE FACTOR: 3.0E-2 $(mg/kg/day)^{-1}$
DRINKING WATER UNIT RISK: 9.0E-7$(\mu g/L)^{-1}$
VERIFICATION DATE: 09/22/88 (USEPA, 1991b)

4.5 2 Inhalation

Not calculated.

5.0 REFERENCES

Buck, C.R. and S.E. Wilson. 1975. Adverse Health Effects of Selected Explosives. Occupational Health Special Study No. 32-049-75/76, U.S. EHA. (Cited in USEPA, 1990).

Cone, T.E. 1944. A review of the effects of trinitrotoluene (TNT) on the formal elements of blood. J. Ind. Hyg. Toxicol. 26:260-263. (Cited in USEPA, 1990).

Dilley, J.V., CA. Tyson, RJ. Spanggord, D.P. Sasmore, G. W. Newell and J.C. Dacre. 1982. Short-term oral toxicity of 2,4,6-trinitrotoluene in mice, rats and dogs. J. Toxicol. Environ. Health 9(4):56S-585. (Cited in USEPA, 1990)

Djerassi L.S. and L. Vitany. 1975. Hemolytic episode in G6PD deficient workers exposed to TNT. Br. J. Ind. Med. 32:54-58. (Cited in Zakhari and Villaume 1978).

El-hawari, A.M., J.R. Hodgson, J.M. Winston, M.D. Sawyer, M. Hainje and C.C. Lee. 1981. species differences in the disposition and metabolism of 2,4,6-trinitrotoluene as a function of route of administration. Final Report. Midwest Research Institute, Project No. 4274-B, Kansas City, MO. DAMD17-76-C-6066. AD-A114-025. (Cited in USEPA, 1989, 1990).

Friedlander, B.R., K.W. Vorphal, R.E. Glenn and P.T. Jordan. 1974. Occupational Health Special Study No. 99-020-74, APE1300 Wash-out Plant, U.S.A. E.HA. (Cited in USEPA, 1990)

Furedi, E.M., B.S. Levine, D.E. Gordon, V.S. Rac and P.M. Lish. 1984a. Determination of the chronic mammalian toxicological effects of TNT (Twenty-four month chronic toxicity/carcinogenicity study of trinitrotoluene (TNT) in Fischer 344 rats). Final Report - Phase III. Volume 1. ITT Research Institute, Project No. L6116, Study No. 9, Chicago, IL. DAMD17-79-C-9120. AD-A168 637.

Furedi, E.M., B.S. Levine, J.W. Sagartz, V.S. Rac and P.M. Lish. 1984b. Determination of the chronic mammalian toxicological effects of TNT (Twenty-four month chronic toxicity/carcinogenicity study of trinitrotoluene (TNT) in B6C3F1 hybrid mice). Final Report - Phase

IV. Volume 1. ITT Research Institute, Project No. L6116, Study No. 11, Chicago, IL. DAMD17-79-C-9120. AD-1168 754.

Goodwin, J.W. 1972. Twenty years handling TNT in a shell loading plant. Amer. Ind. Hyg. Assoc. J. 33(1):4144. (Cited in USEPA, 1990)

Hamilton, A.M. 1946. Monocytes as an index of TNT absorption. Br. J. Ind. Med. 3:24-26. (Cited in USEPA, 1989).

Harkonen, H., M. Karki, A. Lahti and H. Savolainen. 1983. Early equatorial cataracts in workers exposed to trinitrotoluene. Am. J. Ophthalmol. 95(6):807-810. (Cited in USEPA, 1989, 1990).

Hart, E.R. 1974. Subacute toxicity of RDX and TNT in dogs. Final Report. Litton Bionetics, Inc., Project No. 1399, Kensington, MD. N00014-73-C-0162. AD-A03S 717. (Cited in USEPA, 1990).

Hassman, P. and J. Juran. 1968. Cataracts in persons working with trinitrotoluene (TNT). Int. Arch. Gewerbepath. Gewerbehyg. 24:310-318. In German. (Cited in USEPA, 1989).

Jiang, Q.-G., J.-G. Sun and X.-F. Qin 1991. The effects of trinitrotoluene toxicity on zinc and copper metabolism. Toxicol. Letters 55:343-349.

Levine B.S., J.H. Rust, J.M. Burns and P.M. Lish. 1983. Determination of the chronic mammalian toxicological effects of TNT. Twenty-six week subchronic oral toxicity study of trinitrotoluene (TNT) in the beagle dog.

Phase II, Final Report, IIT, Research Institute, Report No. L6116, Study No 5, Chicago, IL. DAMD 17-79-C9120, AD-A157 082. (Cited in USEPA, 1990).

Levine, B.S., E.M. Furedi, D.E. Gordon, P.M. Lish and JJ. Barkely. 1984a. Subchronic toxicity of trinitrotoluene in Fischer 344 rats. Toxicology 32: 253-265. (Cited in USEPA, 1990).

Levine, B.S., E.M. Furedi, J.M. Burns and P.M. Lish. 1984b. Four week subchronic (exploratory/range finding) oral toxicity study of trinitrotoluene (TNT) in the B6C3F1 hybrid mouse. Final Report. IIT Research Institute. Project No. L6116, Study No. 8, Chicago, IL. As Appendix IV in Furedi et al., 1984b. (Cited in USEPA, 1990).

Levine, B.S., J.H. Rust, JJ. Barkely, E.M. Furedi and P.M. Lish. 1990a. Six-month oral toxicity study of trinitrotoluene in beagle dogs. Toxicology 63:233-244.

Levine, B.S., E.M. Furedi, D.E. Gordon, JJ. Sarkely and P.M. Lish. 1990b. Toxic interactions of the munitions compounds TNT and RDX in F344 rats. Fund. Appl. Toxicol. 15:373-380.

Makitie, J, H. Harkonen, S. Someroja and R. Ahonen. 1984. Trinitrotoluene induced lens opacities and the use of retroillumination photography. ACTA Ophthalmol. (Suppl.) 164:40. (Cited in USEPA, 1989).

Martin, D.P. 1974. Subacute toxicity of RDX and TNT in monkeys. Final Report. Litton Bioetics, Inc. Project No. 1366. Kensington, MD. N000014-73-C0162. NR 108-985. AD-A044 650/0. (Cited in USEPA, 1990).

Morton, A.R., M.V. Ranadive and J A. Hathaway. 1976. Biological effects of trinitrotolucte from exposure below the threshold limit value. Am. Ind. Hyg. Assoc. J. 37(1):55-60. (Cited in USEPA, 1990).

Sax, N.I. and RJ. Lewis. 1987. Hawley's Condensed Chemical Dictionary. 11th ed. Van Nostrand Co., New York, NY. p 1191.

Stewart, A., L.T. Witts, G. Higgins, et al. 1945. Some early effects of exposure to trinitrotoluene. Br. J. Ind. Med. 2.:74-82.

USEPA. 1989. Trinitrotoluene - Health Advisory. Office of Drinking Water, U.S. Environmental Protection Agency, Washington, DC.

USEPA. 1990. Health and Environmental Effects Document for 2,4,6-Trinitrotoluene. Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Cincinnati, OH. ECAO-CIN-G089.

USEPA. 1991a. Health Effects Summary Tables. Annual FY-91. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH, for the Office of Emergency and Remedial Response. Washington, DC. OERR 9200.6-303(91-1). NTIS PB91-921199.

US EPA. 1991b. Integrated Risk Information System (IRIS). Risk Estimate for Carcinogenicity and Reference Dose for Oral Exposure for 2,4,6-Trinitrotoluene. Online file. Office of Health and Environmental Assessment, Cincinnati, OH.

U.S. DOD. 1983. AD-A157 002 Available from Defense Technical Center, Cameron Station, Alexandria, VA 22314. (Cited in USEPA, 1991b).

Zakhari, A and J.E. Villaume. 1978. A Literature Review - Problem definition studies on selected toxic chemicals. Occupational health and safety aspects of 2,4,6-trinitrotoluene (TNT). Final report. Science Information Services Organization, Philadelphia, PA. DAMD 17-77-C-7020, AD7055 683. (Cited in USEPA, 1989).

Zitting, A, G. Szumanska, J. Nickels and H. Savolainen. 1982. Acute toxic effects of trinitrotoluene in rat brain, liver and kidney; Role of radical production. Arch. Toxicol. 51(1):53-64. (Cited in USEPA, 1990).

Date of Last Revision: 12/15/94
Revisor: Rich Hoff

VANADIUM

INTRODUCTION

Chemical Name: Vanadium
CAS Number (1): 7440-62-2
Molecular Formula (1): V
Molecular Weight (1): 50.94 g/mole

Vanadium is a bright, white, soft ductile metal. It is not found native, but is found in the following ores: patronite, roscoelite, carnotite and vanadinite (1). It can also be found in foods, such as milk, seafoods, cereals, and vegetables (2). Vanadium is used as the target material for x-rays, in the manufacture of alloy steels, and as a catalyst for sulfuric acid and synthetic rubber (1).

FATE AND TRANSPORT

Vanadium is capable of being transported in water systems. The extent of transport is dependant upon the chemical species present and by environmental factors determining its solubility and binding to organic materials. In the atmosphere, vanadium is transported as fumes and particulates. Vanadium does bioaccumulate in humans and animals (3).

PHARMACOKINETICS

Vanadium is moderately absorbed human adipose tissue. Parenteral administration increases levels in the liver and kidney in animals, but these amounts may only be transient. Vanadium can also be found in lung tissue if it is inhaled, but other organs contain negligible amounts. Since vanadium is moderately absorbed, it has been suggested that a homeostatic mechanism maintains the normal levels of vanadium upon excessive exposure. The primary route of excretion is through urine (2).

HUMAN HEALTH EFFECTS

Vanadium has not produced carcinogenic, mutagenic, teratogenic, or reproductive effects in humans or animals. However, industrial exposure to airborne vanadium compounds can cause eye and skin irritation. Also, gastrointestinal distress, nausea, vomiting, abdominal pain, cardiac palpitation, tremor, nervous depression, and kidney damage have been linked with industrial exposure. Oral exposure may produce gastrointestinal disturbances, slight abnormalities of clinical chemistry related to renal function and nervous system effects. Symptoms associated with inhalation exposure to vanadium include acute upper and lower respiratory irritation with mucous discharge and bronchitic, cough, bronchospasm, and chest pain. These effects can occur at concentrations as low as 0.1 mg/m^3 (2). Additionally, studies suggest that the liver, adrenals, and bone marrow may be adversely affected by subacute exposure at high concentrations (2).

The toxicity of vanadium increases as the valence number increases. (Vanadium can be found in the 0, +2, +3, +4, and +5 oxidation states.) A study reported an oral LD_{50} of 130 mg/kg vanadium trioxide (3).

HEAST (4) reports on oral RfD of 7.0×10^{-3} mg/kg/day based on a NOAEL of 5 ppm in drinking water administered to rats over a lifetime.

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

Ambient water quality criteria have not been established for vanadium. Limited information on the toxicity of vanadium to aquatic organisms has revealed that freshwater fish had 96-hour LC_{50} value ranging from 5,000 to 100,000 µg/L. The majority of the values were approximately 10,000 µg/L. A 96- hour LC_{50} value of less than 0.16 µg/L was reported for daphnids. Chronic toxicity was reported to be around 2,000 µg/L. The lowest value causing an adverse toxic effect was 500 µg/L for a 6-day LC_{50} in a guppy (3).

Terrestrial and Avian

Information regarding the toxicity of vanadium to terrestrial and avian life is very limited. It was reported that calcium vanadate was fatal to chicks fed 200 to 600 ppm for 11 to 32 days (3).

REGULATORY LEVELS AND CRITERIA

OSHA Ceiling Level (5):	0.5 mg/m^3 (respirable dust) 0.1 mg/m^3 (fume)
ACGIH TLV-TWA (6):	0.05 mg/m^3 (vanadium pentoxide, respirable dust or fumes)
Oral RfD (4):	7×10^{-3} mg/kg/day

REFERENCES

1. Hawley, G.G. The Condensed Chemical Dictionary-Eleventh Edition. Van Nostrand Reinhold Company, Inc., New York, New York. 1987.

2. Klaasen, C.D., Andur, M.O., and Doull, J., Eds. Casarett and Doull's Toxicology, The Basic Science of Poisons, Third Edition. Macmillian Publishing Company. New York, New York. 1987.

3. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. September 1985.

4. HEAST. Health Effects Assessment Summary Tables. Office of Emergency and Remedial Response. U.S. Environmental Protection Agency. March 1994.

5. 29 Code of Federal Regulations Part 1910.1000, Table Z-1. 1993.

6. American Conference of Governmental Industrial Hygienists (ACGIH). Threshold Limit Values and Biological Exposure Indices. 1993-1994.

Date of Last Revision: 12/15/94
Revisor: Patrick B. Moroney

ZINC

INTRODUCTION

Chemical Name: Zinc
Synonyms (1): Zinc dust; Zinc powder
Trade Names (1,2): Asarco; Blue powder; CI 77945; JASAD; PASCO
CAS Number (1): 7440-66-6
Molecular Formula (1): Zn
Molecular Weight (1): 65.38 g/mole
Chemical Structure (1): Zn

Zinc is a shiny white metal with a bluish-gray luster that exhibits a valence of +2 and has five stable isotopes. It is derived from the pyrometallurgical or distillation process, or the hydrometallurgical or electrolytic process. Among zincs uses are as an alloy in brass, bronze, and die-casting alloys; galvanizing iron; as a fungicide; and as a protective coating for other metals (3).

FATE AND TRANSPORT

Density (1): 7.14
Solubility (1):
In Water: Insoluble
In Organics: Soluble in acetic acid and alkali

Zinc occurs in the environment in the +2 oxidation state in both the suspended and dissolved forms. Sorption to other materials is the dominant environmental fate of zinc. The predominant fate of zinc in an aerobic aquatic system is the sorption of the divalent cation by hydrous iron and manganese oxide, clay minerals, and organic material. The efficiency of these materials in removing zinc from solution varies according to their compositions and concentrations, the pH and salinity of the water (1).

Zinc concentrations in air are relatively low and fairly constant except near industrial sources such as smelters (1).

Zinc is strongly bioaccumulated even in the absence of abnormally high ambient concentrations although it does not appear to biomagnify. Although zinc is actively bioaccumulated in aquatic systems, the biota appear to represent a relatively minor sink compared to the sediments (8).

PHARMACOKINETICS

The efficiency with which zinc is absorbed following ingestion has been reported to be approximately 80 percent (4). Information was not available on zinc absorption via other routes of exposure. Zinc is primarily distributed to the prostate gland, liver, bone, muscle, kidney, and pancreas following absorption.

During initial absorption, zinc binds to carrier macromolecules by a process influenced by prostaglandins E2 and F2 and chelated by the tryptophan derivative picolinic acid. Zinc induces metallothionein synthesis in mucosal cells. Zinc also binds to metallothionein in

other tissues including liver, salivary glands, intestinal mucosa, and pancreas. In blood, zinc binds principally to albumin and beta-2-macroglobulin proteins. It also binds to the enzyme acid phosphatase which is most abundant in the prostate gland. Binding with metallothionein may be followed by release into the gastrointestinal tract via the salivary glands, intestinal mucosa, pancreas, and liver (5). Urinary excretion constitutes an important route and is correlated quantitatively with dietary zinc intake (5). However, the major route of elimination is in feces. (6).

HUMAN HEALTH EFFECTS

Noncarcinogenic Effects

In humans, death has been exhibited following acute inhalation of zinc chloride. The concentration of zinc chloride was unknown and other chemicals were detected. Therefore, death can not be exclusively attributed to zinc exposure. Death was reported in ferrets and mice following acute and intermediate oral exposure. However, no animal studies addressing the effects of zinc following inhalation exposure were located (1).

The adverse effects of zinc following acute inhalation exposure were limited to the respiratory tract of both humans and animals. Following oral exposure, zinc has been shown to cause adverse effects on the gastrointestinal system. The hematological and renal systems are also affected following acute, intermediate, and chronic exposures in humans and animals (1).

Zinc has been found to reduce the serum HDL-cholesterol levels in humans following intermediate oral exposure. The decrease in HDL levels may increase risk of coronary artery disease (1).

Zinc is essential to maintain one's health. However, ingestion of high levels of zinc present a potential for gastrointestinal disorders in humans and animals such as pancreatic abnormalities and gastrointestinal irritation. Biochemical changes (increased serum amylase levels and hypocalcemia) were evident in humans following ingestion of a zinc chloride solution. Animal studies have shown adverse effects including pancreatic fibrosis and degeneration and necrosis of acinar cells of the pancreas. Zinc has also caused internal bleeding in humans and animals following ingestion of high levels (1).

Respiratory disorders have been observed in humans and animals following acute inhalation exposure to zinc compounds. Acute exposure to high concentrations of zinc oxide in humans cause metal fume fever, and penetrates the alveoli, damages lung tissue and transiently impairs pulmonary function. The same effects have been exhibited in animals. Zinc compounds such as zinc chloride cause more damage to respiratory tissue following inhalation exposure than other compounds (1).

Hematological effects in humans and animals following high level acute, intermediate or chronic oral exposure to zinc and zinc compounds consist of anemia which can be exacerbated by gastrointestinal bleeding. These effects occur over a wide range of concentrations depending upon the species (1).

No adverse hepatic effects were reported following intermediate oral exposure to zinc in humans. This indicates that the liver is not a primary target organ for zinc toxicity. Hepatic necrosis was reported in sheep following acute and intermediate exposure, and enzymatic changes where exhibited in rats exposed following intermediate exposure to zinc (1).

The only renal effects observed were in laboratory animals following intermediate oral exposure to zinc compounds. No adverse renal effects have occurred in humans (1).

In vitro studies suggest that neurological symptoms and lethargy can occur in humans following oral administration of zinc. These studies indicate that zinc inhibits the entry of calcium ions into the nerve terminals, which influences the release of neurotransmitters. Additionally, zinc has been known to be toxic to neurons and glia cells of the central nervous system (1).

Zinc has retarded fetal growth and altered fetal and maternal concentrations of zinc and copper in rats. Congenital malformations such as exencephaly and rib fusions have been exhibited in offspring of pregnant hamsters injected intravenously with zinc sulfate. There is no evidence of these effects occurring in humans (1).

The EPA has established an oral RfD value of 3.0×10^{-1} mg/kg/day for zinc. This value is based on a LOAEL of 1 mg/kg/day in human females. Zinc exposure affected the blood as manifested by decreased concentration of the blood enzyme erythrocyte superoxide dismutase (ESOD) (9).

Carcinogenic Effects

Zinc has not been shown to be carcinogenic. Therefore, the EPA has not assigned a carcinogenicity classification of D for zinc (1).

Although studies have failed to provide evidence for mutagenicity of zinc, there are indications that zinc is a weak clastogen. Human studies involving the treatment of human lymphocytes in cultures with zinc have shown a slight increase in chromosomal aberrations (1).

ENVIRONMENTAL HEALTH EFFECTS

Aquatic

The EPA has established Ambient Water Quality Criteria for zinc in order to protect freshwater and marine aquatic life. The criteria are as follows (7):

Freshwater:
- Acute toxicity: 120* µg/L
- Chronic toxicity: 110 µg/L*

Saltwater:
- Acute toxicity: 95 µg/L
- Chronic toxicity: 86 µg/L

*Hardness dependent criteria.

Terrestrial and Avian

Information regarding the toxicity of zinc to terrestrial and avian wildlife or domestic animals was not available.

REGULATORY LEVELS AND CRITERIA

SMCL (8):	5 mg/L
Reportable Quantity (1):	1,000 lbs
Permissible Level in bottled water (1):	5.0 mg/L
OSHA Standard PEL TWA (10):	5 mg/m^3 (zinc oxide fume/zinc oxide dust, respirable fraction) 15 mg/m^3 (zinc oxide, total dust)

ACGIH TLV (11):

Compound	TWA	STEL
Zinc chloride fume:	1 mg/m^3	2 mg/m^3
Zinc oxide fume:	5 mg/m^3	10 mg/m^3
Zinc oxide dust:	10 mg/m^3	--
Zinc chromates:	0.01 mg/m^3	--

SUMMARY OF CRITERIA

Oral RfD (9):	3.0×10^{-1} mg/kg/day
NOAEL (9):	2.14 mg/kg/day
Uncertainty Factor (9):	10

REFERENCES

1. Toxicological Profile for Zinc. U.S. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, and U.S. Environmental Protection Agency. Atlanta, Georgia. December 1989.

2. Sax, Irving N. and Richard J. Lewis, Sr. Hazardous Chemicals Desk Reference. Van Nostrand Reinhold Company, Inc., New York, New York. 1987.

3. Hawley, G.G. The Condensed Chemical Dictionary-Eleventh Edition. Van Nostrand Reinhold Company, Inc., New York, New York. 1987.

4. U.S. Environmental Protection Agency (1984). Health Effects Assessment for Zinc (and Compounds). Environmental Criteria and Assessment Office, Cincinnati; and Office of Solid Waste and Emergency Response, Washington, D.C. EPA/540/1-86/048. 47 pp.

5. Klaassen, C.D., M.O. Amdur, and J. Doull, eds. (1986). Casarett and Doull's Toxicology--The Basic Science of Poisons, Third edition. Macmillan, New York. 974 pp.

6. Leonard, A., G.B. Gerber, and F. Leonard (1986). Mutagenicity, carcinogenicity, and teratogenicity of zinc. Mut. Res. 168:343-353.

7. Ambient Water Quality Criteria. Office of Water, U.S. Environmental Protection Agency, Washington D.C. May 1986.

8. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. September 1985.

9. IRIS. Integrated Risk Information System. Office of Research and Development, USEPA, Washington, D.C. 1994.

10. 29 Code of Federal Regularions Part 1910.1000. Table Z-1. 1993.

11. American Conference of Governmental Industrial Hygienists (ACGIH). Threshold Limit Values and Biological Exposure Indices. 1993-1994.

APPENDIX L
ECOLOGICAL TOXICOLOGICAL PROFILES

AS.TOX
4/4/95
M.Suminski

ARSENIC

Ecological Toxicological Profile

INTRODUCTION

Chemical Name: Arsenic
CAS Number: 7440-38-2
Synonyms: Arsenic inorganic, gray-arsenic

Arsenic is a naturally occurring element in the earth's crust. Pure arsenic is a gray-colored metal, but this form is not common in the environment. Arsenic is usually found combined with one or more other elements such as oxygen, chlorine, and sulfur. Arsenic combined with these elements is referred to as inorganic arsenic. Arsenic combined with carbon and hydrogen is referred to as organic arsenic[11].

Arsenic enters the environment both as the result of natural forces (volcanos and weathering of arsenic-containing rocks) and human activity (metal smelting, glass manufacturing, pesticide production and application, and fossil-fuel burning)[11].

Arsenic in the environment may undergo a complex cycle of chemical interconversions and transfers between media. Atmospheric emission, which are usually adsorbed to particulate matter, may undergo oxidation before being returned to the surface by wet or dry deposition. Arsenic in water may undergo either reduction or oxidation, depending on pH, the electrochemical oxidation-reduction potential (Eh), and other ions present. Soluble forms of arsenic tend to be quite mobile in water, while less soluble species adsorb to clay or soil particles[11].

AS.TOX
4/4/95
M.Suminski

FATE IN THE ENVIRONMENT

Parameter	Value	Reference
Log K_{ow}	NA	NA
Solubility	1.000 E-06 mg/L @25 C	1
Log K_{oc}	4.97	1
Vapor Pressure	NA	NA
Bioconcentration Factor	3 (invertebrates) 4 (fish)	2

NA - Not Available

TERRESTRIAL FATE

Soil Flora and Fauna

Species	Concentration (mg/kg)	Endpoint	Reference
Plant	10	Benchmark	3
Flora	5	Screening Level	2
Earthworm	60	Benchmark	4
Microorganisms	100	Benchmark	4

AS.TOX
4/4/95
M.Suminski

Vertebrates

Test Species	Effect Dose (mg/kg/day)	Endpoint	Effect	Reference
Poultry (Mallard Duck)	5.1	chronic NOAEL	mortality	5
Mouse	0.13	chronic LOAEL	reproductive	6
Cattle	0.25	MTL	NA	7
Rabbit	2.9	MTL	NA	7

NA - Not Applicable
MTL - Mineral Tolerance Level
NOAEL - No Observed Adverse Effect Level
LOAEL - Lowest Observed Adverse Effect Level

AS.TOX
4/4/95
M.Suminski

REGULATORY LEVELS AND CRITERIA

Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS (As III)[8]		
Marine	690	36
Freshwater	360	190
USEPA Region III [2]		
Marine Flora (As III)	NE	19
Marine Flora (As IV)	NE	13
Marine Fauna (As III)	NE	36
Freshwater Fauna (As)	NE	874
Freshwater Flora (As IV)	48	NE
Freshwater Fauna (As III)	NE	190
USEPA AWQC[9]		
Marine	69	190
Freshwater	360	36

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established

AS.TOX
4/4/95
M.Suminski

Aquatic Life - Sediment

Sediment Screening Values	ER-L (mg/kg)	ER-M (mg/kg)
USEPA Region III[2] total As As III	8,200 (fauna)* 57 (AET)	NE NE
Long et al.[10]	8.2	70

NE - Not Established
AET - Apparent Effects Threshold
* Screening Level

REFERENCES

(1) Reed, M., D. French, W. Knauss, S. Feng, F. French III, S. Pavignano, (Applied Science Associates), R. Bishop, M. Welsh, and J. Press (HBRS, Inc.). 1994. The CERCLA Type A Natural Resource Damage Assessment Model for the Great Lakes Environments (NRDAM/GLE), Volume III - Databases. U.S. Department of Interior, Office of Environmental Policy and Compliance. Washington, D.C. August 1994.

(2) United States Environmental Protection Agency. 1995. Region III BTAG Screening Levels. Office of Superfund. Philadelphia, Pennsylvania. January 1995.

(3) Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants. Environmental Sciences Division, Oak Ridge National Laboratory. ES/ER/TM-85/RI. September 1994.

(4) Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process. Environmental Sciences Division, Oak Ridge National Laboratory. September 1994.

(5) United States. Fish and Wildlife Service, 1964. Pesticide-Wildlife Studies, 1963: A Review of Fish and Wildlife Service Investigations During the Calendar Year. FWS Circular 199.

(6) Schroeder H.A. and M. Mitchener, 1971. "Toxic Effects of Trace Elements on the Reproduction of Mice and Rats." Arch. Environ. Health 23:102-106. Cited in ASTDR, 1989 (Arsenic).

(8) National Academy of Sciences. 1980. Mineral Tolerance of Domestic Animals. National Research Council, Commission on Natural Resources, Committee on Animal Nutrition.

(7) Commonwealth of Virginia. 1992. Water Quality Standards. State Water Control Board. May 1992.

(8) United States Environmental Protection Agency. 1992. Surface Water Quality Criteria. Federal Register. Volume 57, No. 246. December 1992.

(10) Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. "Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments." Environmental Management, 19:81-97.

(11) Agency for Toxic Substances and Disease Registry. 1989. Toxicological Profile for Arsenic. U.S. Public Health Service ASTDR/TP-88/02. March 1989.

Cd.tox
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j.golden

CADMIUM

Ecological Toxicological Profile

INTRODUCTION

Chemical Name: Cadmium
CAS Number: 7440-43-9
Synonyms: C.I. 77180; Colloidal Cadmium

Cadmium is a soft, blue-white, malleable metal or gray-blue powder. Cadmium is used for electroplating, in pigment production, and in the manufacturing of plastic stabilizers and batteries. Sources of cadmium include smelter fumes and dusts, incineration products from cadmium-containing materials, fertilizer, and municipal wastewater and sludge discharges. It also is an industrial byproduct of the manufacturing of zinc, copper, and lead[1].

Cadmium compounds have varying degrees of solubility ranging from very soluble (cadmium salts) to nearly insoluble (cadmium metal). The solubility affects cadmium adsorption and toxicity[1]. Cadmium may exist in water as a hydrated ion or as metal inorganic complexes. Adsorption and desorption processes are the most likely processes controlling the concentrations of cadmium released into natural waters. Cadmium is more mobile in aquatic environments than most heavy metals[2].

Adsorption and desorption rates of cadmium are rapid on mud solids and particles of clay, silica, humic material, and other naturally occurring solids. Changes in the physical chemistry of a waterbody (especially pH and redox potential) influence the suspension of cadmium from the sediments into the water column. During anaerobic conditions, cadmium is more likely to release from the sediments into the water column. Cadmium is not likely to partition from the water into the atmosphere because cadmium does not form volatile compounds[1].

Aquatic and terrestrial organisms bioaccumulate cadmium up the food chain. Bioconcentration in fish is dependent upon the pH and the organic content of the water[1]. Cadmium may adversely impact the reproduction success of fish[3].

Cadmium exists in soil as free cadmium compounds. Cadmium released to soils may leach into water, especially under acidic conditions. The transformation of cadmium in soil is dependent on sorption and desorption from water, and includes precipitation, dissolution, complexation, and ion exchange. Factors affecting transformation in soil include cation exchange capacity; pH; and the content of clay minerals, carbonate minerals, oxides, organic matter, and oxygen[1].

Cadmium is readily taken up by plant roots and tranlocates through the plant and accumulated. Cadmium depresses the uptake of iron, manganese, and probably calcium, magnesium, and nitrogen.

Symptoms of plant toxicity include necrosis, wilting, reduced zinc levels, and reduction in growth. Agronomic crops are more sensitive to cadmium toxicity than trees[4].

Cadmium can exist in the atmosphere as suspended particulate matter derived from sea spray, industrial emissions, combustion of fossil fuels, or the erosion of soils. Cadmium in the atmosphere will remain for approximately one to ten days before deposition occurs. Cadmium in the atmosphere usually takes the form of oxides, sulfates, sulfides, and chlorides. These complexes are stable and do not readily undergo photochemical reactions. Transformation of cadmium compounds in the air is mainly through dissolution in water or dilute acids[1].

FATE IN THE ENVIRONMENT

Parameter	Value	Reference
Log K_{ow}	NA	
Solubility	Insoluble	1
Log K_{oc}	4.97	5
Vapor Pressure	0	5
Bioconcentration Factor	64 (fish) 10,000 (invertebrates) 4,900 (fish)	6 7 7

NA - Not Available

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TERRESTRIAL EFFECTS

Soil Flora and Fauna

Species	Concentration (mg/kg)	Endpoint	Reference
earthworm	20	Benchmark	8
microorganisms	20	Benchmark	8
plants	3	Benchmark	4
flora	0.0025	Screening Level	7

Vertebrates

Test Species	Effect Dose (mg/kg/day)	Endpoint	Effect	Reference
Cattle	0.5	MTL	NA	9
Mallard Duck	1.45	chronic NOAEL	reproductive	14
Rabbit	0.03	MTL	NA	9
Dog	0.75	subchronic NOAEL	reproductive	10
Rat	0.004	chronic NOAEL	systemic	15

NA - Not Applicable
MTL - Mineral Tolerance Level
NOAEL - No Observed Adverse Effects Level

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REGULATORY LEVELS AND CRITERIA

Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[11]		
freshwater	$e^{(1.128[\ln(hardness^*)]-3.828)}$	$e^{(0.7852[\ln(hardness^*)]-3.490)}$
marine	43	9.3
USEPA Region III[7]		
Freshwater Fauna	NE	0.15**
Freshwater Flora	NE	1.1**
Marine Fauna	NE	9.3
Marine Fauna	NE	NE
USEPA AWQC[12]		
freshwater	$e^{(1.128[\ln(hardness^*)]-3.828)}$	$e^{(0.7852[\ln(hardness^*)]-3.490)}$
marine	43	9.3

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established
* Hardness based on calcium carbonate (mg/L)
** Value based on hardness and/or pH

Aquatic Life - Sediment

Sediment Screening Values	ER-L (mg/kg)	ER-M (mg/kg)
USEPA Region III[7]	0.676*(flora)	NE
Long et al. [13]	1.2	9.6

NE - Not Established
* Threshold Effects Level

REFERENCES

1. United States Agency for Toxic Substances and Disease Registry. 1991. Toxicological Profile for Cadmium - Draft. Atlanta, Georgia. 1991.

2. Eisler, Ronald. 1985. Cadmium Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. US Department of Interior - Fish and Wildlife Service. July 1985 Biological Report 85 (1.2).

3. Davis, Robert. 1994. Berkley Products Company Dump Ecological Risk Assessment. USEPA Region III. December 1994.

4. Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants. Environmental Sciences Division, Oak Ridge National Laboratory. ES/ER/TM-85/RI. September

5. Reed, M., D. French, W. Knauss, S. Feng, F. French III, S. Pavignano, (Applied Science Associates), R. Bishop, M. Welsh, and J. Press (HBRS, Inc.). 1994. The CERCLA Type A Natural Resource Damage Assessment Model for the Great Lakes Environments (NRDAM/GLE), Volume III - Databases. U.S. Department of Interior, Office of Environmental Policy and Compliance. Washington, D.C. August 1994.

6. United States Environmental Protection Agency. 1995. "Toxic Substance Spreadsheet." Region IV, Water Quality Standards Section, Water Management Division. January 1995.

7. United States Environmental Protection Agency. 1995. Region III BTAG Screening Levels. Office of Superfund. Philadelphia, Pennsylvania. January 1995.

8. Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process. Environmental Sciences Division, Oak Ridge National Laboratory. September 1994.

9. National Academy of Sciences (NAS). 1980. Mineral Tolerance of Domestic Animals. National Research Council, Commission on Natural Resources, Committee on Animal Nutrition.

10. Loser E and D. Lorke. 1977. "Semichronic Oral Toxicity of Cadmium. II. Studies on Dogs." Toxicology 7:225-232. Cited in ASTDR, 1991 (Cadmium).

11.. Commonwealth of Virginia. 1992. Water Quality Standards. State Water Control Board. May 1992.

12. United States Environmental Protection Agency. 1992. Surface Water Quality Criteria. Federal Register. Volume 57, No. 246. December 1992.

13. Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. "Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine

Sediments." Environmental Management, 19:81-97

14. White, D.H., and M.T. Finley. 1978. "Uptake and Retention of Dietary Cadmium in Mallard Ducks." Environ. Res. 17:53-59

15. Kopp S.J., T. Glonek, H.M. Perry Jr. et.al., 1982. "Cardiovascular Actions of Cadmium at Environmental Exposure Levels." Science 217:837-839. Cited in ASTDR, 1991 (Cadmium).

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Chlordane

Ecological Toxicological Profile

INTRODUCTION

Chemical Name: 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methano-1H-indene
CAS Number: 12789-03-6 (technical)
57-74-9 (nonstereospecific)
5103-71-9 (cis or alpha- isomer)
5103-74-2 (trans or beta- isomer)
5564-34-7 (gamma- isomer)
Synonyms: 1,2,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanoindan
Trade Names: Chlordan; Velsicol 1068; octachlor; termicide; C-100

Pure chlordane is a mixture composed of primarily cis-chlordane and trans-chlordane. It is a white crystalline solid with a mild, pungent odor. Chlordane is a man-made insecticide, which was used from 1948 to 1988 on food crops (specifically corn) and to control household termites. Consequently, it was intentionally applied to soils both in agricultural and urban settings. Due to its persistence indoors, its use as a termicide was stopped[1].

Chlordane is expected to persist for more than 20 years in some soils. Volatilization appears to be the only major removal mechanism from soil. Leaching to groundwater from soil is not a likely removal mechanism. Adsorption to sediments and volatilization are significant removal mechanisms in water. In air, chlordane will degrade by photolysis and hydroxyl radical reaction. Rainout and dry deposition are not expected to be significant removal mechanisms[1].

Chlordane will bioconcentrate in both marine and freshwater species, as well as bacteria[1].

FATE IN THE ENVIRONMENT

Parameter	Values	Reference
Log K_{ow}	5.5	2
Solubility	0.56 mg/L in water	3
Log K_{oc}	5.15	3
Vapor Pressure	$1x10^{-5}$ mm Hg	3
Bioconcentration Factor	14,100 (fish)	11

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TERRESTRIAL EFFECTS

Soil Flora and Fauna

Species	Effect Concentration (mg/kg)	Endpoint	Reference
Earthworm	<100	Screening Level	4
Invertebrates	<100	Screening Level	4
Plants	NA	NA	

NA - Not Available

Chlordane, total - Vertebrates

Test Species	Effect Dose (mg/kg/day)	Endpoint	Effect	Reference.
Rat	0.055	chronic NOAEL	systemic	6
Poultry (blackbird)	2.14	chronic NOAEL	mortality	7
Cattle	10	subchronic NOEL	not reported	5

LOAEL - Lowest Observed Adverse Effects Level
NOAEL - No Observed Adverse Effects Level
NOEL - No Observed Effects Level

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REGULATORY LEVELS AND CRITERIA

Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[8]		
Freshwater	2.4	0.0043
Marine	0.09	0.0040
USEPA Region III[4]		
Freshwater Fauna	0.0043	NE
Marine Fauna	NE	0.004
USEPA AWQC[9]		
Freshwater	2.4	0.0043
Marine	0.09	0.0040

WQS - Water Quality Standards
AWQC - Ambient Water Quality Standards
NE - Not Established

Aquatic Life - Sediment

Sediment Screening Values	ER-L (ug/kg)	ER-M (ug/kg)
USEPA Region III[4]	NE	NE
Long and Morgan[10]	0.5	6.0

NE - Not Established

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REFERENCES

1 Agency for Toxic Substances and Disease Registry. 1990. Toxicological Profile for Chlordane. U. S. Public Health Service. April 14, 1989.

2. United States Environmental Protection Agency. 1991. Superfund Chemical Data Matrix. Hazardous Site Evaluation Division. Washington, DC. January, 1991.

3 United States Environmental Protection Agency. 1986. Superfund Public Health Evaluation Manual. EPA/540/1-86/060. Office of Emergency and Remedial Response. Washington, DC. October, 1986.

4 United States Environmental Protection Agency. 1995. Region III BTAG Screening Levels. Office of Superfund. Philadelphia, Pennsylvania. January 1995.

5 Ford, K.L., F.M. Applehans, and R. Ober. 1991. Development of Toxicity Reference Values for Terrestrial Wildlife. In HMC-Northeast 1991 Conference Proceedings Sponsored by the Hazardous Materials Control Research Institute. July 10-12, 1991.

6 Velsicol Chemical Company. 1983. MRID No. 00138591, 00144313. Available from USEPA. Write to FOI, USEPA, Washington D.C., 20460. Cited in IRIS. October, 1994 (Chlordane).

7 Stickel, L.F., W.H. Stickel, R.A. Dryland, and D.L. Hughes. 1983. "Oxychlordane, HCS-3260, and Nonachlor in Birds: Lethal Residues and Loss Rates." J. Toxicol. Environ. Health. 12:611-622.

8 Commonwealth of Virginia. 1992. Water Quality Standards. State Water Control Board. May 1992.

9 United States Environmental Protection Agency. 1992. Surface Water Quality Criteria. Federal Register. Volume 57, No. 246. December 1992.

10 Long E.R. and L.G. Morgan. 1990 "The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program." NOAA Technical Memorandum. NOS OMSA 62. National Oceanic and Atmospheric Administration, Seattle, WA. Cited in: Sediment Classification Methods Compendium. USEPA - Office of Water. September 1992.

11 United States Environmental Protection Agency. 1995. "Toxic Substance Spreadsheet." Region IV, Water Quality Standards Section, Water Management Division. January 1995.

Cr.tox
2/16/95
j.golden

CHROMIUM

Ecological Toxicological Profile

INTRODUCTION

Chemical Name: Chromium
CAS Number: Chromium (III) 16065-83-1; Chromium (VI) 18540-29-9
Synonyms: Chromic Ion; Chromium Hexavalent Ion

Chromium is a semi-gray, heavy metal that exists in either a trivalent (III) or hexavalent (VI) state. Chromium (III) occurs naturally in the environment; whereas, chromium (VI) is produced by industrial processes. The metal chromium, is used for making steel and other alloys. Chromium (III) is used as brick lining for high-temperature, industrial furnaces. Chromium compounds (III and VI) are used for chrome plating, manufacture of dyes pigments, leather, wood preserves, and cooling tower water treatment[1].

The majority of chromium released into water will settle into the sediment; however, a small portion of chromium may dissolve into the water column. Soluble chromium compounds dissolved in the water column can remain in the water for years before settling into the bottom sediments. Chromium does not volatilize from the water surface. Chromium (VI) in the water column will eventually be reduced to Chromium (III) by organic matter in the water column[1].

Fish do not readily accumulated chromium from the water column. Chromium is not expected to biomagnify in the aquatic food chain. The bioavailability of chromium (III) to freshwater invertebrates decreases with the addition of humic acid. The decrease in bioavailability of the free form of chromium is due to its complexation with humic acid[1].

Chromium released into soil is mainly water-insoluble or is bound to the soil. However, a small fraction of chromium in soil will dissolve and may be transported deeper in the soil to groundwater. The transport of chromium in soil is dependent on the type and condition of the soil. Chromium is present in most soils in the form of chromium (III)[1]. Chromium (III), as an insoluble salt, tends to strongly adhere to clay particles and organic matter; whereas, soluble chromium (VI) is not strongly adsorbed to soil[2]. The fate of chromium in soil is dependent on the redox potential and the pH of the soil[1].

Plants growing in chromium-containing soil will uptake the chromium into its roots, but only a small fraction of the chromium will translocate in the above-ground, edible portions of the

plants. There is no evidence that chromium will bioaccumulate in plants. In addition, there is no evidence that chromium will biomagnify along the terrestrial food chain[1].

The toxicity of chromium (III) to mammals is low because of its membrane permeability is poor and it is noncorrosive. In addition, there is an unlikelihood that chromium (III) will biomagnify in food chains. Chromium (VI) is considered more toxic to wildlife because of its high oxidizing potential and it easily penetrates biological membranes[1].

Chromium is present in the air primarily in particulate form which results from surface soil dispersion or particulate emission from industrial sources[2]. Naturally occurring gaseous forms of chromium are rare. Chromium compounds released into the air will remain in the air for less than ten days. The transport and partitioning of particulate matter in the atmosphere is dependent of the particle size and density. Chromium (VI) can be rapidly reduced in the atmosphere to chromium (III)[1].

FATE IN THE ENVIRONMENT

Parameter	Value		Reference
	Chromium (III)	Chromium (VI)	
Log K_{ow}	No Data	No Data	1
Water Solubility	Insoluble	Insoluble	1
Log K_{oc}	No Data	No Data	1
Vapor Pressure	No Data	No Data	1
Bioconcentration Factor	16 (fish) 192 (invertebrates) 1,000,000 (invertebrates) (Cr total)	16 (fish) 192 (invertebrates) 3.4 (fish) 1,000 (plants) (Cr total)	3 4 4 4

TERRESTRIAL EFFECTS

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Soil Flora and Fauna

Species	Effect Concentration (mg/kg)	Endpoint	Reference
Earthworm	0.4	Benchmark	5
Fauna	0.0075	Screening Level	4
Microorganisms	10	Benchmark	5
Plants	1	Benchmark	6
Flora	0.02	Screening Level	4

Vertebrates

Test Species	Effect Dose (mg/kg/day)	Endpoint	Effect	Reference
Cattle	5	MTL	NA	7
Poultry	50	MTL	NA	7
Rabbit	58	MTL	NA	7
Rat	2.41	chronic NOAEL	growth/food consumption	8

MTL - Mineral Tolerance Level
NOAEL - No Observed Adverse Effects Level
NA - Not Applicable

REGULATORY LEVELS AND CRITERIA

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Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[9]		
Chromium III		
freshwater	$e^{(0.8190[\ln(hardness^*)]+3.688)}$	$e^{(0.8190[\ln(hardness^*)]+1.561)}$
marine	NE	NE
Chromium VI		
freshwater	16	11
marine	1100	50
USEPA Region III[4]		
Chromium III		
freshwater fauna	NE	NE
marine fauna	10,300	210**
Chromium VI		
freshwater fauna	NE	1
freshwater flora	NE	2
marine fauna	NE	50
USEPA AWQC[10]		
Chromium III		
freshwater	$e^{(0.8190[\ln(hardness^*)]+3.688)}$	$e^{(0.8190[\ln(hardness^*)]+1.561)}$
marine	NE	NE
Chromium VI		
freshwater	16	11
marine	1100	50

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established
* Hardness based on calcium carbonate concentration (mg/L)
** Value based on hardness and/or pH

Aquatic Life - Sediment

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Sediment Screening Values	ER-L (mg/kg)	ER-M (mg/kg)
USEPA Region III[4]		
Total Chromium	260 (fauna)*; 5 (flora)	NE
Chromium III	81 (fauna)	NE
Chromium VI	<81 (fauna)	NE
Long et al.[11]	81	370

* Apparent Effect Threshold
NE - Not Established

REFERENCES

1. United States Agency for Toxic Substances and Disease Registry. 1991 . Toxicological Profile for Chromium - Draft. Atlanta, Georgia. October 1991.

2. Chemical, Physical and Biological Properties of Compounds Present in Hazardous Waste Sites. 1985. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. September 1985.

3. United States Environmental Protection Agency. 1995. "Toxic Substance Spreadsheet." Region IV, Water Quality Standards Section, Water Management Division. January 1995.

4. United States Environmental Protection Agency. 1995. Region III BTAG Screening Levels. Office of Superfund. Philadelphia, Pennsylvania. February 1995.

5. Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process. Environmental Sciences Division, Oak Ridge National Laboratory. September 1994.

6. Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants. Environmental Sciences Division, Oak Ridge National Laboratory. ES/ER/TM-85/RI. September 1994.

7. National Academy of Sciences (NAS). 1980. Mineral Tolerance of Domestic Animals. National Research Council, Commission on Natural Resources, Committee on Animal Nutrition.

8. MacKenzie, R.D., R.U. Byerrum, C.F. Decker, C.A. Hoppert and R.F. Langham. 1958. "Chronic Toxicity Studies. II. Hexavalent and Trivalent Chromium Administered in Drinking Water to Rats." Am. Med. Assoc. Arch. Ind. Health. 18:232-234. Cited in Chromium IRIS, Accessed January 1995..

9. Commonwealth of Virginia. 1992. Water Quality Standards. State Water Control Board. May 1992.

10. United States Environmental Protection Agency. 1992. Surface Water Quality Criteria. Federal Register. Volume 57, No. 246. December 1992.

11. Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. "Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments." Environmental Management, 19:81-97

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3/15/95
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COPPER

Ecological Toxicological Profile

INTRODUCTION

Chemical Name: Copper
CAS Number: 7440-50-8
Synonyms: 1721 gold; ANAC 110

Copper is a reddish colored metal that occurs naturally in rock, soil, water, sediment and air. Copper also occurs naturally in plants and animals. Copper is used primarily as a metal or alloy in the manufacture of wire, sheet metals, pipe, and other metal products. Copper compounds are used in agriculture to treat plant diseases, for water treatment, and as preservatives for wood, leather, and fabrics[1].

The physicochemical form of copper released to the environment determines the impact of the element to the environment. Copper is released to water through natural weathering of soil and discharges from industries and sewage treatment plants. Copper released into water will most likely take the form of copper (II). Most copper in water is bound to organic matter; little is present in the free or readily exchangeable form. The concentration of dissolved copper in water is dependent on such factors as pH, the oxidation-reduction potential of the water, the presence of competing cations and anions of soluble cupric salts. and the presence of organic/inorganic complexing agents[1].

The process of complexation, adsorption, and precipitation control the amount of copper (II) released into water. Copper released into water tends to bind to the bottom sediments. Organics and iron oxides are the most important contributor to binding of copper by aerobic sediments. However, copper is typically associated with carbonates. In anaerobic sediment, copper (II) will be reduced to copper (I) and insoluble cuprous salts will form[1].

Copper released to soil will be strongly adsorbed and remain in the upper few centimeters of soil. In most soils, the pH, organic matter, and ionic strength of the soil solutions are the key factors affected adsorption. Copper will adsorb to organic matter, carbonate minerals, clay minerals, or hydrous iron and manganese oxides. Sandy soils with low pH have the greatest potential for leaching[1].

Copper released into the air will most likely take the form of particulate matter as an oxide, sulfate, or carbonate. Copper is removed from the atmosphere by gravitational settling, dry deposition, and washout by rain and clouds[1].

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FATE IN THE ENVIRONMENT

Parameter	Value	Reference
Log K_{ow}	NE	
Solubility	0.2	1
Log K_{oc}	4.26	1
Vapor Pressure	0	1
Bioconcentration Factor	36 (fish) 51.2 (fish) 23.53 (plant)	2 3 3

TERRESTRIAL EFFECTS

Soil Flora and Fauna

Species	Effect Concentration (mg/kg)	Endpoint	Reference
Earthworm	50	Benchmark	4
Microorganisms	100	Benchmark	4
Fauna	0.04	Screening Level	3
Plants	100	Benchmark	5

Vertebrates

Test Species	Effect Dose (mg/kg/day)	Endpoint	Effect	Reference
Cattle	0.5	MTL	NA	6
Poultry	15	MTL	NA	6
Rabbit	11.61	MTL	NA	6
Mink	12.9	chronic NOAEL	reproductive	7

NA - Not Applicable
MTL - Mineral Tolerance Level
NOAEL - No Observed Adverse Effect Level

REGULATORY LEVELS AND CRITERIA

Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[8]		
freshwater	$e^{(0.9422[\ln(hardness^*)] -1.464)}$	$e^{(0.8545[\ln(hardness^*)] -1.465)}$
marine	2.9	2.9
Region III BTAG-Fauna[3]		
freshwater	6.5*	NE
marine	2.9	NE
USEPA AWQC[9]		
freshwater	$e^{(0.9422[\ln(hardness^*)] -1.464)}$	$e^{(0.8545[\ln(hardness^*)] -1.465)}$
marine	2.9	2.9

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established
* Hardness based on calcium carbonate concentration (mg/L)
** Value based on hardness and/or pH

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Aquatic Life - Sediment

Sediment Screening Values	ER-L (mg/kg)	ER-M (mg/kg)
USEPA Region III[3]	34*	NE
Long et al.[10]	34	270

* Screening Level
NE - Not Evaluated

REFERENCES

1. Agency for Toxic Substances and Disease Registry. 1989. Toxicological Profile for Copper - Draft. Atlanta, Georgia. October 1989.

2. United States Environmental Protection Agency. 1995. "Toxic Substance Spreadsheet." Region IV, Water Quality Standards Section, Water Management Division. January 1995.

3. United States Environmental Protection Agency. 1995. Region III BTAG Screening Levels. Office of Superfund. Philadelphia, Pennsylvania. January 1995.

4. Will, M.E. and G.W. Suter II. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process. Environmental Sciences Division - Oak Ridge National Laboratory. September 1994.

5. Will, M.E. and G.W. Suter II. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1994 Revision. Environmental Sciences Division - Oak Ridge National Laboratory. September 1994.

6. National Academy of Sciences (NAS). 1980. Mineral Tolerance of Domestic Animals. National Research Council, Commission on Natural Resources, Committee on Animal Nutrition.

7. Aulerich, R.J., R.K., Ringer, M.R., Bleavins, et. al. 1982. "Effects of Supplemental Dietary Copper on Growth, Reproductive Performance and Kit Survival of Standard Dark Mink and the Acute Toxicity of Copper to Mink." J. Animal Sci. 55:337-343. Cited in ASDTR, 1989 (Copper).

8. Commonwealth of Virginia. 1992. Water Quality Standards. State Water Control Board.

May 1992.

9. United States Environmental Protection Agency. 1992. Surface Water Quality Criteria. Federal Register. Volume 57, No. 246. December 1992.

10. Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. "Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments." Environmental Management, 19:81-97

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DDT, DDE and DDD

Ecological Toxicological Profile

INTRODUCTION

Chemical Name: DDT, DDE and DDD
CAS Number: 50-29-5 DDT
72-55-9 DDE
72-54-8 DDD
Synonyms: DDT 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane; p,p'-DDT; dichlorodiphenyl trichloroethane; 4,4'-DDT; (trade names) Genitox; Anofex; Detoxan; Pentachlorin; Dicophane
DDE 1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene; DDT dihydrochloride; p,p'-DDE; dichlorodiphenyldichloroethylene
DDD 1,1-dichloro-2,2-bis(p-chlorophenyl)ethane; 4,4'-DDD; 1,1-bis(4-chlorophenyl)-2,2-dichloroethane; TDE

Historically, DDT was released to the environment during its formulation and extensive use as a pesticide in agricultural and vector control applications. Its primary metabolites are DDE and DDD. Although DDT was banned for use in this country in 1972, it is still being used in several areas in the world, particularly tropical countries. DDT and its primary metabolites are not known to occur naturally in the environment. However, due to its extensive past use of DDT worldwide and the persistence of DDT and is metabolites, these compounds are virtually ubiquitous and are continually being transformed and redistributed in the environment. DDT and its metabolites have been detected in virtually all media[1].

DDT and its metabolites may be transported among media by the processes of solubilization, adsorption, bioaccumulation or volatilization. DDT, DDE and DDD in the atmosphere are subject to photodegradation or redeposition by rain or dry deposition[1].

DDT and its environmental degradation products preferentially bind to soil and sediment , where they may be subject to photodegradation on the surface and biodegradation in the subsurface. Under certain conditions, DDT may persist for long periods of time or may be converted to DDE, which persists for an even longer duration. Consequently, these compounds are not easily displaced from their site of application, whether by runoff or leaching to groundwater. However, volatilization of DDT and DDE from soil accounts for considerable losses of these compounds. The tendency of DDD to volatilize is approximately three-fold less than that of DDT or DDE[1].

When DDT is released to water, it quickly absorbs to particles and is subject to sedimentation,

volatilization, photodegradation and uptake into the food chain. Similar to soil, volatilization accounts for loss of these compounds from water. One study found that DDE volatilizes from seawater 10 to 20 times faster than from freshwater[1].

DDT, DDE and DDD are highly lipid soluble. This lipophilic property, combined with an extremely long half-life, results in bioaccumulation. When present in ambient water, DDT and its metabolites are concentrated in freshwater and marine plankton, insects, mollusks, and other invertebrates and fish. As these organisms become part of the food chain, a progressive accumulation of residues may result in high levels of residues in organisms at the top of the food chain[1].

FATE IN THE ENVIRONMENT

Parameter	DDT	DDE	DDD	Reference
Log K_{ow}	6.4	5.7	6	2
Solubility	$5x10^{-3}$ mg/L in water	4x10-2 mg/L in water	$1x10^{-1}$ mg/L in water	3
Log K_{oc}	5.39	6.64	5.89	3
Vapor Pressure	$55.x10^{-6}$ mm Hg	$6.5x10^{-6}$ mm Hg	$1.89x10^{-6}$ mm Hg	3
Bioconcentration Factor	53,600 (fish) 100,000 (fish) 690,000 (invertebrate) 21,580 (plant)	53,600 (fish) 81,000 (fish) 59,000 (invertebrate 10,000 (plant)	53,600 (fish) 52,500 (fish) 47,900 (invertebrate) 6,210 (plant)	11 4 4 4

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TERRESTRIAL EFFECTS

Soil Flora and Fauna

Species	Effect Concentration (ug/kg)	Endpoint	Reference
DDT			
Earthworm	4	Screening Level	4
Invertebrates	4	Screening Level	4
Plants	NA	NA	
DDE			
Earthworm	100	Screening Level	4
Invertebrates	100	Screening Level	4
Plants	NA	NA	
DDD			
Earthworm	100	Screening Level	4
Invertebrates	100	Screening Level	4
Plants	NA	NA	

NA - Not Available

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Vertebrates

Test Species	Effect Dose (mg/kg/day)	Endpoint	Effect	Reference
DDT Poultry (quail)	0.088	subchronic NOEL	not reported	5
Rat	0.8	chronic NOAEL	reproductive	6
DDE Poultry (quail)	0.088	subchronic NOEL	not reported	5
Rat	0.8	chronic NOAEL	reproductive	6
DDD NA	NA	NA	NA	

NA - Not Available
NOEL - No Observed Effects Level
NOAEL - No Observed Adverse Effects Level

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REGULATORY LEVELS AND CRITERIA

Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[7]		
DDT		
Freshwater	1.1	0.0010
Marine	0.13	0.0010
DDE, DDD	NE	NE
USEPA Region III[4]		
DDT		
Freshwater Flora	5,000	NE
Freshwater Fauna	NE	0.001
Marine Flora	5,000	NE
Marine Fauna	NE	0.001
DDD		
Freshwater Fauna	0.6	NE
Marine Fauna	0.68	NE
DDE		
Freshwater Fauna	1,050	NE
Marine Fauna	14	NE
USEPA AWQC[8]		
DDT		
Freshwater	1.1	0.001
Marine	0.13	0.001
DDE, DDD	NE	NE

WQS - Water Quality Standards
AWQC - Ambient Water Quality Standards
NE - Not Established

Aquatic Life - Sediment

Sediment Screening Values	ER-L (ug/kg)	ER-M (ug/kg)
USEPA Region III[4]		
DDT	8*	NE
DDE	2.2*	NE
DDD	NE	NE
Long et al.[9]		
DDT	1.58	46.1
DDE	2.2	27
Long and Morgan[10]		
DDD	2	20

NE - Not Established

REFERENCES

1 Agency for Toxic Substances and Disease Registry. 1990. Toxicological Profile for p,p'-DDT, p,p'-DDE and p,p'-DDD. U. S. Public Health Service. April 14, 1989.

2 United States Environmental Protection Agency. 1991. Superfund Chemical Data Matrix. Hazardous Site Evaluation Division. Washington, DC. January 1991.

3 United States Environmental Protection Agency. 1986. Superfund Public Health Evaluation Manual. EPA/540/1-86/060. Office of Emergency and Remedial Response. Washington, DC. October, 1986.

4 United States Environmental Protection Agency. 1995. Region III BTAG Screening Levels. Office of Superfund. Philadelphia, Pennsylvania. January 1995.

5 Ford, K.L., F.M. Applehans, and R. Ober. 1991. Development of Toxicity References Values for Terrestrial Wildlife. In HMC-Northeast. '91 Conference Proceedings. Sponsored by the Hazardous Materials Control Research Institute. July 10-12, 1991.

6 Fitzhugh, O.G. 1948. Use of DDT Insecticides on Food Products. Ind. Eng. Chem. 40:704-705.

7 Commonwealth of Virginia. 1992. Water Quality Standards. State Water Control Board. May 1992.

8 United States Environmental Protection Agency. 1992. Surface Water Quality Criteria. Federal Register. Volume 57, No. 246. December 1992.

9 Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. "Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments." Environmental Management, 19:81-97.7

10 Long E.R. and L.G. Morgan. 1990. "The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program." NOAA Technical Memorandum. NOS OMSA 62. National Oceanic and Atmospheric Administration, Seattle, WA. Cited in: Sediment Classification Methods Compendium. USEPA - Office of Water. September 1992.

11 United States Environmental Protection Agency. 1995. "Toxic Substance Spreadsheet." Region IV, Water Quality Standards Section, Water Management Division. January 1995.

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IRON

Ecological Toxicological Profile

INTRODUCTION

Chemical Name: Iron
CAS Number: 7439-89-6

Iron is a silvery white, malleable metal. It is the fourth most abundant (by weight) of the elements that compose the earth's crust and is a major constituent of clay soils[1]

Iron in water may be present in varying quantities dependent upon the geology of the area and other chemical components of the water body[1,2]. The bivalent and trivalent irons are the primary forms of concern in the aquatic environment. The ferrous or bivalent form can persist in waters void of dissolved oxygen and typically originate from groundwater of mines where these are pumped or drained. The ferric or trivalent form is insoluble. Iron can exist in natural organometallic or humic compounds and colloidal forms. Black or brown swamp waters may contain iron concentrations of several milligrams per liter in the presence or absence of dissolved oxygen, but this iron form has little effect on aquatic life[1]. The majority of iron entering water bodies is likely to partition into the bottom sediments[2].

Iron released into soil has relatively low mobility potential. However, iron can be transported through the atmosphere[2].

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FATE IN THE ENVIRONMENT

Parameter	Value	Reference
Log K_{ow}	NA	
Solubility	0.000001	3
Log K_{oc}	4.97	3
Vapor Pressure	0	3
Bioconcentration Factor		
Freshwater	NA	
Marine	NA	
LC_{50}		
fish (hours)	1,486	3
EC_{50}		
benthos (growth)	3,616	3
zooplankton (growth)	341	3
plants (growth)	2,371	3

NA - Not Available

TERRESTRIAL EFFECTS

Soil Flora and Fauna

Species	Effect Concentration (mg/kg)	Endpoint	Reference
Invertebrates	3,515	NOEC	4
Microorganisms	200	Benchmark	4
Flora	100	Screening Value	5

NE - Not Established
NOEC - No Observed Effects Concentration

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Vertebrates

Test Species	Effect Dose (mg/kg/day)	Endpoint	Effect	Reference
Cattle	5	MTL	NA	6
Poultry	50	MTL	NA	6
Rabbit	29	MTL	NA	6

MTL - Mineral Tolerance Level
NA - Not Applicable

REGULATORY LEVELS AND CRITERIA

Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[7]		
freshwater	NE	NE
marine	NE	NE
USEPA Region III - Fauna[5]		
freshwater	NE	320
marine	NE	NE
USEPA AWQC[8]		
freshwater	1,000	NE
marine	NE	NE

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established

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Aquatic Life - Sediment

Sediment Screening Values	ER-L (mg/kg)	ER-M (mg/kg)
Tetra Tech AET[9]	27,000 (amphipod)	NE

AET - Apparent Effects Threshold

REFERENCES

1. United States Environmental Protection Agency. 1990. Ambient Water Quality Criteria. Office of Water Regulations and Standards. Washington, D.C. May 1990.

2. United States Environmental Protection Agency. 1985. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergency Response. Washington, D.C. September 1985.

3. Reed, M., D. French, W. Knauss, S. Feng, F. French III, S. Pavignano, (Applied Science Associates), R. Bishop, M. Welsh, and J. Press (HBRS, Inc.). 1994. The CERCLA Type A Natural Resource Damage Assessment Model for the Great Lakes Environments (NRDAM/GLE), Volume III - Databases. U.S. Department of Interior, Office of Environmental Policy and Compliance. Washington, D.C. August 1994.

4. Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process. Environmental Sciences Division, Oak Ridge National Laboratory. September 1994.

5. United States Environmental Protection Agency. 1995. Region III BTAG Screening Levels. Office of Superfund. Philadelphia, Pennsylvania. January 1995.

6. National Academy of Sciences (NAS). 1980. Mineral Tolerance of Domestic Animals. National Research Council, Commission on Natural Resources, Committee on Animal Nutrition.

7. Commonwealth of Virginia. 1992. Water Quality Standards. State Water Control Board. May 1992.

8. United States Environmental Protection Agency. 1992. Surface Water Quality Criteria. Federal Register. Volume 57, No. 246. December 1992.

9. Tetra Tech, Inc. 1986. Development of Sediment Quality Values for Puget Sound, Volume I. Puget Sound Dredged Disposal Analysis Report. Cited in J. Fitchko, 1989.

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Fitchko, J. 1989. Criteria for Contaminated Soil/Sediment Cleanup. Pudvan Publishing Co., Inc. Northbrood IL.

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MERCURY

Ecological Toxicological Profile

INTRODUCTION

Chemical Name: Mercury
CAS Number: 7439-97-6
Synonyms: hydragyrum; quicksilver; liquid silver; colloidal mercury

Mercury is a silvery, heavy liquid with valences of +1 and +2. Mercury exists as insoluble elemental mercury, organic species, and inorganic species. Solubility depends upon the reduction-oxidation potential, and the pH of the environment[1]. Mercury is commonly used for amalgams, catalysts, electrical apparatuses, instruments such as thermometers and barometers, and neutron absorbers in nuclear power plants[2].

Mercury released to the environment will remain there indefinitely. The form that mercury exists in (organic or inorganic) may change with time. Chemical speciation is probably the most important variable influencing the ecotoxicology of mercury[3]. Inorganic mercury can be methylated by microorganisms indigenous to soils, freshwater, and salt water. This process is mediated by various microbial populations under both aerobic and anaerobic conditions. Methyl mercury is the most hazardous mercury species due to its high stability, its lipid solubility, and its possession of ionic properties that create a high ability to penetrate membranes in living organisms. Methylmercury in surface waters is rapidly accumulated by aquatic organisms. The top-level predator species usually contain the highest concentrations of methyl mercury[3].

Freshwater plants exhibit a wide range of sensitivity to mercury; however, the most sensitive aquatic plant is less sensitive than the most sensitive freshwater animal. Fish tend to be more resistant to mercury than mollusks and crustaceans.

Mercury released into soils or surface water will exist in the mercuric state (Hg^{++}) and mercurous (H^{+}) states as a number of complex ions with varying water solubilities. Mercuric mercury, present as complexes and chelates with ligands, is probably the most predominant form of mercury present in surface waters[4].

Volatile forms of mercury present in surface water is expected to evaporate into the air; whereas, solid forms of mercury partition to particulates or are transported in the water column, depending on their solubility. The two most important transformation processes in the fate of mercury in surface waters are biotransformation and bioaccumulation. Photolysis of organomercurials also may occur in surface waters[4].

Mercury released into soils may undergo the same chemical and biological transformations as mercury released into surface waters. Mercuric mercury usually forms complexes with chloride and hydroxide ions in soils, the specific compounds form are dependent on pH, salt content, and composition of the soil solution[4].

Mercury released into the atmosphere will most likely undergo photolysis or organomercurials. Metallic mercury vapor may also be oxidized to other forms in the removal of the compound from the atmosphere by precipitation. Mercury vapor can be transported long distances before wet and dry deposition process return the element to the earth. The atmosphere is the smallest environmental reservoir of mercury[4].

FATE IN THE ENVIRONMENT

Parameter	Value	Reference
Log K_{ow}	NA	
Solubility	5.6E-03	4
Log K_{oc}	2.43	5
Vapor Pressure	0.002	4
Bioconcentration Factor	23,661 (invertebrates) 7,000 (fish) 5,500 (fish) 3,760 (estuarine organisms) 9,000 (open ocean organisms)	6 6 7 7 7

NA - Not Applicable

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TERRESTRIAL EFFECTS

Soil Flora and Fauna

Species	Effect Concentration (mg/kg)	Endpoint	Reference
Earthworm	0.1	Benchmark	8
Invertebrates	300	NOEC	8
Microorganisms	30	Benchmark	8
Fauna	0.058	Screening Level	6
Plants	0.3	Benchmark	9

NOEC - No Observed Effects Concentration

Vertebrates

Test Species	Effect Dose (mg/kg/day)	Endpoint	Effect	Reference
Cattle	0.01	MTL	NA	10
Poultry	0.1	MTL	NA	10
Rabbit	0.12	MTL	NA	10
Rat	0.32	chronic NOAEL	systemic	11

MTL - Mineral Tolerance Level
NOAEL - No Observed Adverse Effects Level
NA - Not Applicable

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REGULATORY LEVELS AND CRITERIA

Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[12]		
freshwater	2.4	0.012
marine	2.1	0.025
USEPA Region III[6]		
freshwater flora	NE	NE
freshwater fauna	NE	0.012
marine flora	NE	NE
marine fauna	NE	0.025
USEPA AWQC[13]		
freshwater	2.4	0.012
marine	2.1	0.025

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established

Aquatic Life - Sediment

Sediment Screening Values	ER-L (mg/kg)	ER-M (mg/kg)
USEPA Region III[6]	0.15 (fauna)*	NE
Long et al.[14]	0.15	0.71

NE - Not Established
* Screening Level

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REFERENCES

1 Chemical, Physical and Biological Properties of Compounds Present in Hazardous Waste Sites. 1985. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. September 1985.

2. Hawley, G.G. 1987. The Condensed Chemical Dictionary - Eleventh Edition. Van Nostrand Reinhold Company, Inc., New York, New York. 1987.

3. Eisler, Ronald. 1987. Mercury Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S Department of the Interior. Fish and Wildlife Service. Biological Report 85(1.10). April 1987.

4. Agency for Toxic Substances and Disease Registry. 1989. Toxicological Profile for Mercury-Draft. U.S. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, and U.S. Environmental Protection Agency. Atlanta, Georgia. December 1988.

5. Reed, M., D. French, W. Knauss, S. Feng, F. French III, S. Pavignano, (Applied Science Associates), R. Bishop, M. Welsh, and J. Press (HBRS, Inc.). 1994. The CERCLA Type A Natural Resource Damage Assessment Model for the Great Lakes Environments (NRDAM/GLE), Volume III - Databases. U.S. Department of Interior, Office of Environmental Policy and Compliance. Washington, D.C. August 1994.

6. United States Environmental Protection Agency. 1995. Region III BTAG Screening Levels. Office of Superfund. Philadelphia, Pennsylvania. January 1995.

7. United States Environmental Protection Agency. 1995. "Toxic Substance Spreadsheet." Region IV, Water Quality Standards Section, Water Management Division. January 1995.

8. Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process. Environmental Sciences Division, Oak Ridge National Laboratory. September 1994.

9. Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants. Environmental Sciences Division, Oak Ridge National Laboratory. ES/ER/TM-85/RI. September 1994.

10. National Academy of Sciences (NAS). 1980. Mineral Tolerance of Domestic Animals. National Research Council, Commission on Natural Resources, Committee on Animal Nutrition.

11. Fitzhugh, O.G., A.A. Nelson, and E.P. Laug et .al. 1950. "Chronic Oral Toxicities of Mercuric-Phenyl and Mercuric Salts." Arch. Ind. Hyg. Med. 2:433-442. Cited in ASTDR,

1989 (Mercury).

12. Commonwealth of Virginia. 1992. Water Quality Standards. State Water Control Board. May 1992.

13. United States Environmental Protection Agency. 1992. Surface Water Quality Criteria. Federal Register. Volume 57, No. 246. December 1992.

14. Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. "Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments." Environmental Management, 19:81-97

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NICKEL

Ecological Toxicological Profile

INTRODUCTION

Chemical Name: Nickel
CAS Number: 7440-02-0
Synonyms: NP 2; HCA 1; Raney alloy; Raney Nickel

Nickel is a naturally occurring silvery metal that is found in the earth's crust. Nickel and its compounds are found in all parts of the environment, including plants and animals. Primary nickel is recovered from mined ore and nickel matte, and secondary nickel is recovered from scrap metal[1].

Nickel released into water will exist in both soluble and insoluble forms depending on the chemical and physical properties of the water. Nickel has not been shown to volatize from the water surface. Nickel is significantly bioaccumulated in some, but not all aquatic species[1]. Nickel adversely influences cell membranes with increasing water hardness[2].

Nickel is extremely persistent in soil; however, it still has the potential to leach through soil into groundwater. The average residence time of nickel in soil is estimated to be 2,400 to 3,500 years. The sorption of nickel into soils has found to correlate with suspension pH, total iron, and surface area. Organic complexing agents in soil tend to restrict the movement and availability of nickel in soil by forming organo-nickel complexes. Nickel is not expected to volatize from soils[1]. Nickel is not essential to plants in some instances it produces toxic effects[2].

Nickel released into the atmosphere will exist primarily in aerosol form. Airborne nickel will remain in the atmosphere for varying periods of time depending upon factors such as concentration, density and particle size, and precipitation. The average residence time of nickel in the atmosphere is seven days, with typical residence time ranging from one to twenty-one days. The predominant nickel species in air tend to be nickel oxide, nickel sulfate, complex oxides of nickel and other metals, and to a lesser extent, metallic nickel, and nickel subsulfide[1].

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FATE IN THE ENVIRONMENT

Parameter	Value	Reference
Log K_{ow}	NA	
Solubility	Insoluble	1
Log K_{oc}	4.97	3
Vapor Pressure	0.0	3
Bioconcentration Factor	40,000 (plant) 100 (fish) 47 (fish)	4 4 5

NA - Not Available

TERRESTRIAL EFFECTS

Soil Flora and Fauna

Species	Effect Concentration (mg/kg)	Endpoint	Reference
Earthworm	200	Benchmark	6
Microorganisms	90	Benchmark	6
Plants	30	Benchmark	7
Flora	2.5	Screening Level	4

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Vertebrates

Test Species	Effect Dose (mg/kg/day)	Endpoint	Effect	Reference
Cattle	0.25	MTL	NA	8
Poultry	15	MTL	NA	8
Rabbit	2.9	MTL	NA	8
Dog	25	chronic NOAEL	growth	9
Rat	5	chronic NOAEL	growth	9

MTL - Mineral Tolerance Level
NOAEL - No Observed Adverse Effects Level
NA - Not Applicable

REGULATORY LEVELS AND CRITERIA

Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[10]		
freshwater	$e^{(0.8460[\ln(hardness^*)]+3.3612)}$	$e^{(0.8460[\ln(hardness^*)]+1.1645)}$
marine	75	8.3
USEPA Region III[4]		
freshwater flora	NE	NE
freshwater fauna	NE	14.77**
marine flora	NE	NE
marine fauna	NE	8.3**
USEPA AWQC[11]		
freshwater	$e^{(0.8460[\ln(hardness^*)]+3.3612)}$	$e^{(0.8460[\ln(hardness^*)]+1.1645)}$
marine	75	8.3

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established
* Hardness based on calcium carbonate (mg/L)
** Value based on hardness and/or pH

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Aquatic Life - Sediment

Sediment Screening Values	ER-L (mg/kg)	ER-M (mg/kg)
USEPA Region III[4]	20.9 (fauna)*	NE
Long et al.[12]	20.9	51.6

NE - Not Established
* Screening Level

REFERENCES

1. United States Agency for Toxic Substances and Disease Registry. 1988. Toxicological Profile for Nickel. U.S. Environmental Protection Agency and U.S. Public Health Service. Atlanta, Georgia. December 1988.

2. Davis, Robert. 1994. Berkley Products Company Dump Ecological Risk Assessment. USEPA Region III. December 1994.

3. Reed, M., D. French, W. Knauss, S. Feng, F. French III, S. Pavignano, (Applied Science Associates), R. Bishop, M. Welsh, and J. Press (HBRS, Inc.). 1994. The CERCLA Type A Natural Resource Damage Assessment Model for the Great Lakes Environments (NRDAM/GLE), Volume III - Databases. U.S. Department of Interior, Office of Environmental Policy and Compliance. Washington, D.C. August 1994.

4. United States Environmental Protection Agency. 1995. Region III BTAG Screening Levels. Office of Superfund. Philadelphia, Pennsylvania. January 1995.

5. United States Environmental Protection Agency. 1995. "Toxic Substance Spreadsheet." Region IV, Water Quality Standards Section, Water Management Division. January 1995.

6. Will, M.E. and G.W. Suter II. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process. Environmental Sciences Division - Oak Ridge National Laboratory. September 1994.

7. Will, M.E. and G.W. Suter II. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1994 Revision. Environmental Sciences Division - Oak Ridge National Laboratory. September 1994.

8. National Academy of Sciences (NAS). 1980. Mineral Tolerance of Domestic Animals. National

Research Council, Commission on Natural Resources, Committee on Animal Nutrition.

9. Ambrose, A.M., D.S. Larson, J.R. Borzelleca and G.R. Hennigar, Jr. 1976. "Long-Term Toxologic Assessment of Nickel in Rats and Dogs." J. Food Science Technology. 13:181-187. Cited in IRIS, Accessed January 1995 (Nickel).

10. Commonwealth of Virginia. 1992. Water Quality Standards. State Water Control Board. May 1992.

11. United States Environmental Protection Agency. 1992. Surface Water Quality Criteria. Federal Register. Volume 57, No. 246. December 1992.

12. Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. "Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments." Environmental Management, 19:81-97

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POLYCYCLIC AROMATIC HYDROCARBONS

Ecological Toxicological Profile

INTRODUCTION

Chemical Name: Polycyclic aromatic hydrocarbons
CAS Number:

208-96-8	acenaphthylene
83-32-9	acenaphthene
120-12-7	anthracene
56-55-3	benzo(a)anthracene
205-99-2	benzo(b)fluoranthene
207-08-9	benzo(k)fluoranthene
191-24-2	benzo(g,h,i)perylene
50-32-8	benzo(a)pyrene
218-01-9	chrysene
53-70-3	dibenz(a,h)anthracene
206-44-0	fluoranthene
86-73-7	fluorene
193-39-5	indeno(1,2,3-cd)pyrene
85-01-8	phenanthrene
129-00-00	pyrene

Synonyms:

acenaphthylene	cyclopenta[de]naphthalene
acenaphthene	1,2-dihydroacenaphthylene; 1,8-dihydroacenapthaline; 1,8-ethylenenapthalene;1,2-dihydroacenaphthylene
anthracene	anthracin; green oil; paranaphthalene; tetra olive; NZG; anthracene oil
benzo(a)anthracene	benz(a)anthracene; 1,2-benzanthracene; benzo(b)phenanthrene; 2,3-benzophenanthrene; tetraphene
benzo(b)fluoranthene	3 ,4-benz(e)acephenanthrylene; 2,3-benzfluoranthene; 3,4-benzfluoranthene; 2,3-benzofluoranthene; 3,4-benzofluoranthene; benzo(e)fluoranthene; B(b)f
benzo(k)fluoranthene	8,9-benzfluoranthene; 8,9-benzofluoranthene; 11,12-benzofluoranthene; 2,3,1,8-binaphthylene; dibenzo(bjk)fluorene
benzo(g,h,i)perylene	1,12-benzoperylene
benzo(a)pyrene	benzo[def]chrysene; 3,4-benzopyrene; 3,4-benzpyrene; benz[a]pyrene; BP; B(a)P
chrysene	1,2-benzophenanthrene; benzo(a)phenanthrene; 1,2-benzphenanthrene; benz(a)phenanthrene; 1,2,5,6-dibenzonaphthalene
dibenz(a,h)anthracene	1,2,5,6-dibenz(a,h)anthracene (d); dibenzo(a,h)anthracene; DB(a,h)

	A; DBA; 1,2:4,6-dibenz(a,h)anthracene; 1,2:5,6-dibenz(a)anthracene (b)
fluoranthene	1,2-(1,8-naphthylene)benzene; 1,2-benzacenaphthene; 1,2-(1,8-naphthalenediyl)benzene; benzo(jk)fluorene
fluorene	ortho-biphenylene methane; diphenylenemethane; 2,2-methylene biphenyl; 2,3-benzidene
indeno(1,2,3-cd)-pyrene	1P; ortho-phenylenepyrene; 1,10-(ortho-phenylene)pyrene; pyrene1,10-(1,2-phenylene)pyrene; 2,3-ortho-phenylene pyrene (b) indenopyrene
phenanthrene	phenantrin (b)
pyrene	benzo(def)phenanthrene; beta-pyrene (b)

The PAHs are a diverse group of compounds consisting of two or more substituted and unsubstituted polycyclic aromatic rings formed by the incomplete combustion of carbonaceous materials[1].

PAHs are ubiquitous in the modern environment and commonly are constituents of coal tar, soot, vehicular exhausts, cigarette smoke, certain petroleum products, road tar, mineral oils, creosote and many cooked foods. PAHs also are released to the environment through natural sources such as volcano and forest fire emissions. However, most of the emissions result from anthropogenic sources, largely wood burning for homes. Vehicular emissions are another primary source of PAHs. Hazardous waste sites can be a concentrated source on a local scale. Examples of such sites include former manufactured gas sites (i.e., sources of coal tar) and abandoned wood treatment plants (i.e., sources of creosote)[1].

In the air, PAHs are found sorbed to particulates and as gases. Particle-bound PAHs can be transported long distances and are removed from the atmosphere by precipitation and dry deposition[1].

PAHs are transferred from surface water by volatilization and sorption to settling particles. The compounds are transformed in surface water by photooxidation, chemical oxidation and microbial metabolism[1].

In soil and sediments, microbial metabolism is the major process for degradation of PAHs[1]. Although PAHs accumulate in terrestrial and aquatic plants, many organisms are able to metabolize and eliminate these compounds. Vertebrates can readily metabolize PAHs; whereas, lower forms (insects and worms) cannot metabolize PAHs as quickly. Food chain uptake does not appear to be a major exposure source to PAHs for aquatic animals[1].

FATE IN THE ENVIRONMENT

Acenaphthylene

Parameter	Value	Reference
Log K_{ow}	4.1	2
Solubility	3.93 mg/L in water	1
Log K_{oc}	3.4	3
Vapor Pressure	0.029 torr @20°C	1
Bioconcentration Factor	30 (fish)	4

Acenaphthene

Parameter	Value	Reference
Log K_{ow}	3.9	2
Solubility	3.42 mg/L in water	3
Log K_{oc}	3.76	5
Vapor Pressure	4.47×10^{-3} mm Hg	1
Bioconcentration Factor	242 (fish)	4

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Anthracene

Parameter	Value	Reference
Log K_{ow}	4.5	2
Solubility	4.5×10^{-2} mg/L in water	3
Log K_{oc}	4.15	3
Vapor Pressure	1 mm @145°C	1
Bioconcentration Factor	16, 800 (fish) 30 (fish) 912 (invertebrates)	6 4 4

Benzo(a)anthracene

Parameter	Value	Reference
Log K_{ow}	5.6 5.7	3 2
Solubility	5.7×10^{-3} mg/L in water	3
Log K_{oc}	6.14	3
Vapor Pressure	2.2×10^{-8} mm Hg	3
Bioconcentration Factor	9200 (fish) 30 fish) 134,248 (invertebrates)	6 4 4

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Benzo(b)fluoranthene

Parameter	Value	Reference
Log K_{ow}	6.6	2
Solubility	1.4×10^{-2} mg/L in water	3
Log K_{oc}	5.74	3
Vapor Pressure	10^{-11} to 10^{-6} torr @ 20°C	1
Bioconcentration Factor	30 (fish)	4

Benzo(k)fluoranthene

Parameter	Value	Reference
Log K_{ow}	6.1	3
Solubility	4.3×10^{-3} mg/L in water	3
Log K_{oc}	5.74	3
Vapor Pressure	5×10^{-7} torr @20°C	1
Bioconcentration Factor	30 (fish)	4

Benzo(g,h,i)perylene

Parameter	Value	Reference
Log K_{ow}	6.5	3
Solubility	7×10^{-4} mg/L in water 2.6x10-4 mg/L @25°C	3 1
Log K_{oc}	6.2	3
Vapor Pressure	1.03×10^{-10} mm Hg @25°C	1, 3
Bioconcentration Factor	30 (fish)	4

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Benzo(a)pryene

Parameter	Value	Reference
Log K_{ow}	6.06 6.0	3 2
Solubility	1.2×10^{-3} mg/L in water	3
Log K_{oc}	6.74	3
Vapor Pressure	5.6×10^{-9} mm Hg	13
Bioconcentration Factor	930 (fish) 30 (fish) 132,248 (invertebrates) 5,258 (plants)	6 4 6 6

Chrysene

Parameter	Value	Reference
Log K_{ow}	5.7 5.61	2 3
Solubility	1.8×10^{-3} mg/L	3
Log K_{oc}	5.3	3
Vapor Pressure	6.3×10^{-9} mm Hg	1, 3
Bioconcentration Factor	30 (fish)	4

Dibenz(a,h)anthracene

Parameter	Value	Reference
Log K_{ow}	6.5	2
Solubility	$5x10^{-4}$ mg/L in water	1, 3
Log K_{oc}	6.8	3
Vapor Pressure	$1x10^{-10}$ mm Hg	1, 3
Bioconcentration Factor	30 (fish)	4

Fluoranthene

Parameter	Value	Reference
Log K_{ow}	4.9	3
Solubility	$2.06x10^{-1}$ mg/L in water	3
Log K_{oc}	4.9	3
Vapor Pressure	$5x10^{-6}$ mm Hg 0.01 mm Hg @20°C	3 1
Bioconcentration Factor	1,150 (fish)	4

Fluorene

Parameter	Value	Reference
Log K_{ow}	4.2	2
Solubility	1.69 mg/L in water	3
Log K_{oc}	3.86	1
Vapor Pressure	$7.1x10^{-4}$ mm Hg 10 mm Hg @146°C	3 1
Bioconcentration Factor	30	4

Indeno(1,2,3-cd)pyrene

Parameter	Value	Reference
Log K_{ow}	6.5	3
Solubility	5.3×10^{-4} mg/L in water	3
Log K_{oc}	6.5	3
Vapor Pressure	1×10^{-10} mm Hg	3
Bioconcentration Factor	30 (fish)	4

Phenanthrene

Parameter	Value	Reference
Log K_{ow}	4.5	1
Solubility	1.0 - 1.6 mg/L in water	1
Log K_{oc}	4.5	1
Vapor Pressure	9.6×10^{-4}	1
Bioconcentration Factor	30 (fish)	4

Pyrene

Parameter	Value	Reference
Log K_{ow}	5.3	2
Solubility	0.132	3
Log K_{oc}	0.66	3
Vapor Pressure	2.5×10^{-6}	3

Bioconcentration Factor	970 (fish) 30 (fish)	6 4

TERRESTRIAL EFFECTS

Soil Flora and Fauna[7]

Species	Effect Concentration (ug/kg)	Endpoint	Reference
Acenaphthene Plant	NA	NA	NA
Earthworm	100	Screening Level	6
Invertebrate	100	Screening Level	6
Microorganisms and Microbial Processes	NA	NA	NA
Acenaphthylene Plant	NA	NA	NA
Earthworm	100	Screening Level	6
Invertebrate	100	Screening Level	6
Microorganisms and Microbial Processes	NA	NA	NA
Anthracene Plant	NA	NA	NA
Earthworm	100	Screening Level	6
Invertebrates	100	Screening Level	6
Microorganisms and Microbial Processes	NA	NA	NA
Benzo(a)anthracene Plant	NA	NA	NA
Earthworm	100	Screening Level	6
Invertebrates	100	Screening Level	6

Species	Effect Concentration (ug/kg)	Endpoint	Reference
Microorganisms and Microbial Processes	NA	NA	NA
Benzo(b)fluoranthene Plant	NA	NA	NA
Earthworm	100	Screening Level	6
Invertebrates	100	Screening Level	6
Microorganisms and Microbial Processes	NA	NA	NA
Benzo(k)fluoranthene Plant	NA	NA	NA
Earthworm	100	Screening Level	6
Invertebrates	100	Screening Level	6
Microorganism and Microbial Processes	NA	NA	NA
Benzo(g,h,i)perylene Plant	NA	NA	NA
Earthworm	100	Screening Level	6
Invertebrates	100	Screening Level	6
Microorganisms and Microbial Processes	NA	NA	NA
Benzo(a)pyrene Plant	NA	NA	NA
Earthworm	20,000	Screening Level	6
Invertebrates	25,000	Benchmark	7
Microorganisms and Microbial Processes	NA	NA	NA

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Species	Effect Concentration (ug/kg)	Endpoint	Reference
Chrysene			
Plant	NA	NA	NA
Earthworm	100	Screening Level	6
Invertebrates	100	Screening Level	6
Microorganisms and Microbial Processes	NA	NA	NA
Dibenz(a,h)anthracene			
Plant	NA	NA	NA
Earthworm	100	Screening Level	6
Invertebrates	100	Screening Level	6
Microorganisms and Microbial Processes	NA	NA	NA
Fluoranthene			
Plant	NA	NA	NA
Earthworm	100	Screening Level	6
Invertebrates	100	Screening Level	6
Microorganisms and Microbial Processes	NA	NA	NA
Fluorene			
Plant	NA	NA	NA
Earthworm	30,000	Screening Level	6
Invertebrates	100	Screening Level	6
Microorganisms and Microbial Processes	NA	NA	NA

Species	Effect Concentration (ug/kg)	Endpoint	Reference
Indeno(1,2,3-cd)pyrene Plant	NA	NA	NA
Earthworm	100	Screening Level	6
Invertebrates	100	Screening Level	6
Microorganisms and Microbial Processes	NA	NA	NA
Phenanthrene Plant	NA	NA	NA
Earthworm	100	Screening Level	6
Invertebrates	100	Screening Level	6
Microorganisms and Microbial Processes	100	Screening Level	6
Pyrene Plant	NA	NA	NA
Earthworm	100	Screening Level	6
Invertebrates	100	Screening Level	6
Microorganisms and Microbial Processes	NA	NA	NA

Acenaphthene - Vertebrates

Test Species	Effect Dose (mg/kg/day)	Endpoint	Effect	Reference
Rat	175	chronic NOAEL	Systemic	8

NOAEL - No Observed Adverse Effect Level

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Anthracene - Vertebrates

Test Species	Effect Dose (mg/kg/day)	Endpoint	Effect	Reference
Mouse	1,000	subchronic NOAEL	none	8

NOAEL - No Observed Adverse Effect Level

Benzo(a)anthracene - Vertebrates

Test Species	Effect Dose (mg/kg/day)	Endpoint	Effect	Reference
Mouse	1	NOAEL		8

NOAEL - No Observed Adverse Effect Level

Benzo(a)pyrene - Vertebrates *

Test Species	Effect Dose (mg/kg/day)	Endpoint	Effect	Reference
Mouse	10.00	chronic LOAEL	reproductive	9

* Value also used for the following PAHs:: benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

LOAEL - Lowest Observed Adverse Effect Level

Fluoranthene - Vertebrates

Test Species	Effect Dose (mg/kg/day)	Endpoint	Effect	Reference
Mouse	125	subchronic NOAEL	Systemic	10

NOAEL - No Observed Adverse Effect Level

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Fluorene - Vertebrates

Test Species	Effect Dose (mg/kg/day)	Endpoint	Effect	Reference
Mouse	125	subchronic NOAEL	Systemic	10

NOAEL - No Observed Adverse Effect Level

Phenanthrene - Vertebrates

Test Species	Effect Dose (mg/kg/day)	Endpoint	Effect	Reference
Rat	41	chronic NOAEL	reproduction	14

NOAEL - No Observed Adverse Effect Level

Pyrene - Vertebrates

Test Species	Effect Dose (mg/kg/day)	Endpoint	Effect	Reference
Mouse	75	subchronic NOAEL	Systemic	8

NOAEL - No Observed Adverse Effect Level

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REGULATORY LEVELS AND CRITERIA

Acenaphthylene - Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[11]	NE	NE
USEPA Region III[6] Marine Fauna	300	NE
USEPA AWQC[12]	NE	NE

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established

Acenaphthylene - Aquatic Life - Sediment

Sediment Screening Values	ER-L (ug/kg)	ER-M (ug/kg)
USEPA Region III[6]	44*	NE
Long et al.[13]	44	640

NE - Not Established
* Screening Level

Acenaphthene - Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[11]	NE	NE
USEPA Region III[6]		
Marine Fauna	NE	710
Freshwater Fauna	NE	520
USEPA AWQC[12]		
Marine	970	710
Freshwater	1,700	520

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established

Acenaphthene - Aquatic Life - Sediment

Sediment Screening Values	ER-L (ug/kg)	ER-M (ug/kg)
USEPA Region III[6]	16*	NE
Long et al.[13]	16	500

NE - Not Established
* Screening Level

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Anthracene - Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[11]	NE	NE
USEPA Region III[6]		
Marine Fauna	NE	NE
Freshwater Fauna	NE	0.1
USEPA AWQC[12]	NE	NE

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria, 1992 and 1991
NE - Not Established

Anthracene - Aquatic Life - Sediment

Sediment Screening Values	ER-L (ug/kg)	ER-M (ug/kg)
USEPA Region III[6]	85.3*	NE
Long et al.[13]	85.3	1,100

NE - Not Established
* Screening Level

Benzo(a)anthracene - Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[11]	NE	NE
USEPA Region III[6] Marine Fauna Freshwater Fauna	 NE NE	 81.3 6.3
USEPA AWQC[12]	NE	NE

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established

Benzo(a)anthracene - Aquatic Life - Sediment

Sediment Screening Values	ER-L (ug/kg)	ER-M (ug/kg)
USEPA Region III[6]	261*	NE
Long et al.[13]	261	1,600

NE - Not Established
* Screening Level

Benzo(b)fluoranthene - Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[11]	NE	NE
USEPA Region III[6] Marine Fauna Freshwater Fauna	 300 NE	 NE NE
USEPA AWQC[12]	NE	NE

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established

Benzo(b)fluoranthene - Aquatic Life - Sediment

Sediment Screening Values	ER-L (ug/kg)	ER-M (ug/kg)
USEPA Region III[6]	3,200*	NE
Long et al.[13]	NE	NE

NE - Not Established
* Screening Level

Benzo(k)fluoranthene - Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[11]	NE	NE
USEPA Region III[6]		
Marine Fauna	300	NE
Freshwater Fauna	NE	NE
USEPA AWQC[12]	NE	NE

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established

Benzo(k)fluoranthene - Aquatic Life - Sediment

Sediment Screening Values	ER-L (ug/kg)	ER-M (ug/kg)
USEPA Region III[6]	NE	NE
Long et al.[13]	NE	NE

NE - Not Established

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Benzo(g,h,i)perylene - Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[11]	NE	NE
USEPA Region III[6] Marine Fauna Freshwater Fauna	 300 NE	 NE NE
USEPA AWQC[12]	NE	NE

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established

Benzo(g,h,i)perylene - Aquatic Life - Sediment

Sediment Screening Values	ER-L (ug/kg)	ER-M (ug/kg)
USEPA Region III[6]	670 (AET)	NE
Long et al.[13]	NE	NE

NE - Not Established
AET - Apparent Effects Threshold

Benzo(a)pyrene - Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[11]	NE	NE
USEPA Region III[6]		
Marine Fauna	210	NE
Freshwater Fauna	NE	NE
USEPA AWQC[12]	NE	NE

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established

Benzo(a)pyrene - Aquatic Life - Sediment

Sediment Screening Values	ER-L (ug/kg)	ER-M (ug/kg)
USEPA Region III[6]	430*	NE
Long et al.[13]	430	1,600

NE - Not Established
* Screening Level

Chrysene - Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[11]	NE	NE
USEPA Region III[6] Marine Fauna Freshwater Fauna	 300 NE	 NE NE
USEPA AWQC[12]	NE	NE

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established

Chrysene - Aquatic Life - Sediment

Sediment Screening Values	ER-L (ug/kg)	ER-M (ug/kg)
USEPA Region III[6]	384*	NE
Long et al.[13]	384	2,800

NE - Not Established
* Screening Level

Dibenz(a,h)anthracene - Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[11]	NE	NE
USEPA Region III[6]		
Marine Fauna	300	NE
Freshwater Fauna	NE	NE
USEPA AWQC[12]	NE	NE

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established

Dibenz(a,h)anthracene - Aquatic Life - Sediment

Sediment Screening Values	ER-L (ug/kg)	ER-M (ug/kg)
USEPA Region III[6]	63.4*	NE
Long et al.[13]	63.4	260

NE - Not Established
* Screening Level

Fluoranthene - Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[11]	NE	NE
USEPA Region III[6]		
Marine Fauna	NE	16
Freshwater Fauna	3,980	NE
USEPA AWQC[12]		
Marine	40	16
Freshwater	3,980	NE

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established

Fluoranthene - Aquatic Life - Sediment

Sediment Screening Values	ER-L (ug/kg)	ER-M (ug/kg)
USEPA Region III[6]	600*	NE
Long et al.[13]	600	5,100

NE - Not Established
* Screening Level

Fluorene - Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[11]	NE	NE
USEPA Region III[6] Marine Fauna Freshwater Fauna	 300 NE	 NE 430
USEPA AWQC[12]	NE	NE

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established

Fluorene - Aquatic Life - Sediment

Sediment Screening Values	ER-L (ug/kg)	ER-M (ug/kg)
USEPA Region III[6]	19*	NE
Long et al.[13]	19	540

NE - Not Established
* Screening Level

Indeno(1,2,3-cd)pyrene - Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[11]	NE	NE
USEPA Region III[6] Marine Fauna Freshwater Fauna	 NE NE	 300 NE
USEPA AWQC[12]	NE	NE

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established

Indeno(1,2,3-cd)pyrene - Aquatic Life - Sediment

Sediment Screening Values	ER-L (ug/kg)	ER-M (ug/kg)
USEPA Region III[6]	600 (AET)	NE
Long et al.[13]	NE	NE

NE - Not Established
AET - Apparent Effects Threshold

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Phenanthrene - Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[11]	NE	NE
USEPA Region III[6]		
Marine Fauna	NE	4.6*
Freshwater Fauna	NE	6.3*
USEPA AWQC[12]		
Marine	7.7	4.6
Freshwater	30	6.3

* Proposed Criteria
WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established

Phenanthrene - Aquatic Life - Sediment

Sediment Screening Values	ER-L (ug/kg)	ER-M (ug/kg)
USEPA Region III[6]	240*	NE
Long et al.[13]	240	1,500

NE - Not Established
* Screening Level

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Pyrene - Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[11]	NE	NE
USEPA Region III[6] Marine Fauna Freshwater Fauna	 300 NE	 NE NE
USEPA AWQC[12]	NE	NE

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established

Pyrene - Aquatic Life - Sediment

Sediment Screening Values	ER-L (ug/kg)	ER-M (ug/kg)
USEPA Region III[6]	665*	NE
Long et al.[13]	665	2,600

NE - Not Established
* Screening Level

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REFERENCES

1 Agency for Toxic Substances and Disease Registry. 1990. Toxicological Profile for Polycyclic Aromatic Hydrocarbons. U.S. Public Health Service. Atlanta, Georgia. February 16, 1990.

2 United States Environmental Protection Agency. 1991. Superfund Chemical Data Matrix. Hazardous Site Evaluation Division. Washington, DC. January, 1991.

3 United States Environmental Protection Agency. 1986. Superfund Public Health Evaluation Manual. EPA/540/1-86/060. Office of Emergency and Remedial Response. Washington, DC. October, 1986.

4 United States Environmental Protection Agency. 1995. Toxic Substance Spreadsheet. Region IV. Atlanta, Georgia. January 1995.

5 United States Environmental Protection Agency. 1993. Sediment Quality Criteria.

6 United States Environmental Protection Agency. 1995. Region III BTAG Screening Levels. Region III. Philadelphia, PA. January 1995.

7 Will, M.E. and G.W. Suter II. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process. Environmental Sciences Division - Oak Ridge National Laboratory. September 1994.

8 United States Environmental Protection Agency. 1989. Mouse Oral Subchronic Study. Conducted by Toxicity Research Labs, LTD. Muskegon, MI for the Office of Solid Waste. Cited in IRIS. After Jan. 1992.

9 MacKenzie, K.M. and D.M. Angevine, 1981. "Infertility in Mice Exposed in Utero to Benzo(a)pyrene." Biol. Reprod. 24: 183-191. Cited in ATSDR, 1989 (PAHs).

10 United States Environmental Protection Agency. 1988. 13-Week Mouse Oral Subchronic Study. Prepared by Toxicity Research Labs, LTD. Muskegan, MI for the Office of Solid Waste. Cited in IRIS. Jan. 1995

11 Commonwealth of Virginia. 1992. Water Quality Standards. State Water Control Board. May 1992.

12 United States Environmental Protection Agency. 1991 and 1992. Federal Ambient Water Quality Criteria. Federal Register. Volume 57 No. 246. December 1992 and May 1991.

13 Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. "Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments." Environmental

Management, 19:81-97

14 Schmal, D. 1955. The Testing of Napthalene ande Anthracene for Carcinogenic Effects on Rats. Z Krebsforsch 60:697-710. Cited In: ASTDR, 1990 Napthalene.

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LEAD

Ecological Toxicological Profile

INTRODUCTION

Chemical Name: Lead
CAS Number: 7439-92-1
Synonyms: Lead flake; Lead S 2; PB-S 100

Lead is ubiquitous and is a characteristic trace constituent in rocks, soils, water, plants, animals, and air. Lead is used in the manufacture of storage batteries, gasoline additives, pigments, alloys, and ammunition[1].

Lead compounds are extremely persistent in water and soil. Natural lead compounds are not mobile in surface and groundwater because lead leached from ore is adsorbed by ferric hydroxide. Lead also readily combines with hydroxide, carbonate, and sulfate ions to form insoluble compounds. These compounds precipitate and settle in the bottom sediment. Lead is not volatile, therefore, volatilization is not an important transport process from the aquatic environment[2].

In water, lead is most soluble and bioavailable under conditions of low pH, low organic content; low concentrations of suspended sediments; and low concentrations of the salts of calcium, cadmium, iron, manganese, and zinc. Lead tends to concentrate in the water surface microlayer (the upper 0.3 mm of water), especially when surface organic matter is present in thin films. However, most lead entering natural waters will precipitate to the sediment bottom as carbonates or hydroxides. Migration and speciation of lead in water is influenced by the water flow rate, increased flow rate results in increased concentrations of particulate and labile lead and a decrease in bound forms. At low stream flow, lead is rapidly removed from the water column by sedimentation[1].

Lead in sediment is mobilized and released when the pH decreases suddenly or ionic composition changes. Methylation of lead occurs in the sediments and is positively correlated to increasing temperature, reduced pH, and high microbial activities[3].

Sorption is a dominant effect on the distribution of lead in soil. Lead readily adsorbs to inorganic solids, organic material and hydrous iron and manganese oxides. Because of its affinity for other materials, and its solubility characteristics, the mobility of lead in soil is low[2]. Most lead is retained in soil and not transported via leaching or runoff to surface water[4].
Lead is not readily taken up by plants. Therefore, its availability to terrestrial life forms also is limited[2]. However, excessive amounts of lead can cause growth inhabitation, as well as reduced photosynthesis, mitosis, and water absorption[1]. Inorganic and organic lead compound disperse in the atmosphere as particulate matter. Lead is removed from the atmosphere by wet or dry deposition. Photolysis of atmospheric organic lead compounds occurs rapidly[2]. The average residence time of atmospheric lead is seven to thirty days[4].

Lead does not appear to significantly bioaccumulated in most fish[4]. Microcosm studies indicate that lead is not biomagnified through the food chain[2]. Lead concentrations tended to decrease markedly with increasing trophic level in both detritus-based and grazing aquatic food chains. However, lead is toxic to all phyla of aquatic biota, though effects are modified significantly by various biological and abiotic conditions[1].

Lead adversely impacts survival, growth, development, and metabolism of most terrestrial species. The organic forms of lead tend to be more toxic to wildlife than the inorganic lead compounds, but the inorganic forms are easily converted into organic lead forms by microorganisms[3].

FATE IN THE ENVIRONMENT

Parameter	Value	Reference
Log K_{ow}	NA	
Solubility	NA	
Log K_{oc}	4.97	5
Vapor Pressure	0	5
Bioconcentration Factor	17.5 (invertebrates) 726 (fish) 49 (fish)	6 6 7

NA - Not Available

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TERRESTRIAL EFFECTS

Soil Flora and Fauna

Species	Effect Concentration (mg/kg)	Endpoint	Reference
Earthworm	500	Benchmark	8
Invertebrates	300	NOEC	8
Microorganisms	900	Benchmark	8
Fauna	0.01	Screening Level	6
Plants	50	Benchmark	9
Flora	0.0125	Screening Level	6

NOEC - No Observed Effects Concentration

Vertebrates

Test Species	Effect Dose (mg/kg/day)	Endpoint	Effect	Reference
Cattle	0.15	MTL	NA	10
American Kestrel	3.85	chronic NOAEL	reproductive	11
Rabbit	1.74	MTL	NA	10
Rat	8	chronic NOAEL	reproductive	12

MTL - Mineral Tolerance Level
NOAEL - No Observed Adverse Effects Level
NA - Not Applicable

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REGULATORY LEVELS AND CRITERIA

Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[13]		
freshwater	$e^{(1.273[\ln(hardness^*)]-1.460)}$	$e^{(1.273[\ln(hardness^*)]-4.705)}$
marine	220	8.5
USEPA Region III[6]		
freshwater flora	NE	NE
freshwater fauna	NE	1**
marine flora	NE	5.1**
marine fauna	NE	NE
USEPA AWQC[14]		
freshwater	$e^{(1.273[\ln(hardness^*)]-1.460)}$	$e^{(1.273[\ln(hardness^*)]-4.705)}$
marine	220	8.5

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established
* Hardness based on calcium carbonate (mg/L)
** Value based on hardness and/or pH

Aquatic Life - Sediment

Sediment Screening Values	ER-L (mg/kg)	ER-M (mg/kg)
USEPA Region III[6]	46.7 (fauna)*	NE
Long et al.[15]	46.7	218

* Screening Level
NE - Not Established

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REFERENCES

1. Eisler, Ronald. 1988. Lead Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S Department of the Interior. Fish and Wildlife Service. Biological Report 85(1.4).

2. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Site. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. September 1985.

3. Davis, Robert. 1994. Berkley Products Company Dump Ecological Risk Assessment. USEPA Region III. December 1994.

4. United States Agency for Toxic Substances and Disease Registry. 1990. Toxicological Profile for Lead. U.S. Environmental Protection Agency and U.S. Public Health Service. Atlanta, Georgia. June 1990.

5. Reed, M., D. French, W. Knauss, S. Feng, F. French III, S. Pavignano, (Applied Science Associates), R. Bishop, M. Welsh, and J. Press (HBRS, Inc.). 1994. The CERCLA Type A Natural Resource Damage Assessment Model for the Great Lakes Environments (NRDAM/GLE), Volume III - Databases. U.S. Department of Interior, Office of Environmental Policy and Compliance. Washington, D.C. August 1994.

6. United States Environmental Protection Agency. 1995. Region III BTAG Screening Levels. Office of Superfund. Philadelphia, Pennsylvania. January 1995.

7. United States Environmental Protection Agency. 1995. "Toxic Substance Spreadsheet." Region IV, Water Quality Standards Section, Water Management Division. January 1995.

8. Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process. Environmental Sciences Division, Oak Ridge National Laboratory. September 1994.

9. Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants. Environmental Sciences Division, Oak Ridge National Laboratory. ES/ER/TM- 85/RI. September 1994.

10. National Academy of Sciences (NAS). 1980. Mineral Tolerance of Domestic Animals. National Research Council, Commission on Natural Resources, Committee on Animal Nutrition.

11. Pattee, O.H. 1984. "Eggshell Thickness and Reproduction in American Kestrels Exposed to Chronic Dietary Lead." Arch. Environ. Contam. Toxicol. 13:29-34.

12. Azar, A., H.J. Trochimowicz and M.E. Maxfield. 1973. "Review of Lead Studies in Animals

Carried out at Haskell Laboratory - Two Year Feeding Study and Response to Hemorrhage Study." In Barth D., A. Berlin, R. Engel, P. Recht and J. Smeets, Ed. Environmental Health Aspects of Lead: Proceedings International Symposium; October 1972; Amsterdam, The Netherlands. Commission of the European Communities, Luxemberg. p. 199-208. Cited in IRIS, Accessed January 1995 (Lead).

13. Commonwealth of Virginia. 1992. Water Quality Standards. State Water Control Board. May 1992.

14. United States Environmental Protection Agency. 1992. Surface Water Quality Criteria. Federal Register. Volume 57, No. 246. December 1992.

15. Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. "Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments." Environmental Management, 19:81-97

16. Long, E. R., and L.G. Morgan. 1990. "The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program." NOAA Technical Memorandum. NOS OMA 62. National Oceanic and Atmospheric Administration, Seattle, WA. Cited in: Sediment Classification Methods Compendium. USEPA - Office of Water. September 1992.

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ZINC

Ecological Toxicological Profile

INTRODUCTION

Chemical Name: Zinc
CAS Number: 7440-66-6
Synonyms: Blue Powder; JASAD; PASCO; LS 2

Zinc is bluish-white metal that dissolves readily in strong acids. Zinc compounds are found naturally in air, soil, and water, and are present in all foods. However, zinc is not found in nature in the free state. Zinc is commonly mined by underground and open pit mining. Zinc is commonly used as a protective coating for other metals. Zinc also is used in alloys such as bronze and brass, for electrical apparatus in many common goods, and in organic chemical extractions and reductions. Zinc chloride is used by the military to create smoke bombs. In pharmaceuticals, salts of zinc are used as solubilizing agents in many drugs. In addition, zinc is used with copper to make U.S. pennies[1].

Zinc released into surface water does not volatize, but primarily settles into the bottom sediments. Zinc can be present in water as either suspended or dissolved compounds. Dissolved zinc may occur as the free (hydrated) zinc ion or as dissolved complexes and compounds with varying degrees of stability. Suspended (undissolved) zinc may be dissolved following minor changes in the water chemistry or may be sorbed to suspended matter. The sorption of zinc is affected by the nature of the zinc, the concentrations of the zinc, the pH, and the salinity of the water. Zinc tends to be more absorbed at higher pH concentration (>7). Desorption of zinc from sediments occurs as salinity increases[1].

Sorption of zinc is the dominant fate of zinc in the aquatic environment. Zinc partitions to sediments or suspended solids in surface water via sorption onto hydrous iron and manganese oxides, clay minerals, and organic matter. Transport of zinc in the aquatic environment is dependent upon the composition of suspended and bed sediments, dissolved and particulate iron and manganese concentrations, pH, salinity, concentrations of complexing ligands, and the concentration of zinc[2]. In freshwater, zinc is the most soluble at low pH and low alkalinity concentrations. In natural waters, two reactions can occur: the competition for complexation sites between metal ions, and the competition between different ligands for the same metal ion[1].

Zinc is actively accumulated in aquatic systems. However, biota appear to represent a minor sink for zinc compared to the sediments[1]. Zinc bioavailability and toxicity to aquatic organisms are highest under conditions of low pH, low alkalinity, low dissolved oxygen, and elevated temperatures. Soluble species of zinc are the most bioavailable and most toxic[2].

Zinc released onto soil is likely to be strongly absorbed. The mobility of zinc in soil is dependent upon the solubility of the speciated forms of the compound and on the soil properties (sorption potential, pH, salinity;

anaerobic). Little land-disposed zinc is in a soluble form; therefore, mobility is limited by a slow dissolution. Consequently, zinc is not likely to migrate into groundwater[1].

Zinc released to the air is commonly found as a stable species such as zinc oxide. Chemical interaction of zinc compounds in the atmosphere may result in a change in the speciation of the compound. Atmospheric interactions are greatest for particles with smaller diameters. Zinc concentrations in the environment are relatively low. Volatilization does not appear to be an important process for zinc[1].

FATE IN THE ENVIRONMENT

Parameter	Value	Reference
Log K_{ow}	NA	
Solubility	Insoluble	1
Log K_{oc}	4.97	3
Vapor Pressure	0.0	3
Bioconcentration Factor	50,000 (plants) 100,000 (invertebrates) 2,000 (fish) 47 (fish)	4 4 4 5

NA - Not Available

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TERRESTRIAL EFFECTS

Soil Flora and Fauna

Species	Effect Concentration (mg/kg)	Endpoint	Reference
Earthworm	200	Benchmark	6
Invertebrates	800	NOEC	6
Microorganisms	100	Benchmark	6
Plants	50	Benchmark	7
Flora	4.8	Screening Level	4

NOEC - No Observed Effects Level

Vertebrates

Test Species	Effect Dose (mg/kg/day)	Endpoint	Reference
Cattle	2.5	MTL	8
Poultry	50	MTL	8
Rabbit	29	MTL	8
Dog	1	subchronic (safe diet)	9

MTL - Mineral Tolerance Level

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REGULATORY LEVELS AND CRITERIA

Aquatic Life - Surface Water

State or Federal Standard/Criteria	Acute (ug/L)	Chronic (ug/L)
Virginia WQS[10]		
freshwater	$e^{(0.8473[\ln(hardness^*)]+0.8604)}$	$e^{(0.8473[\ln(hardness^*)]+0.7614)}$
marine	95	86
USEPA Region III[4]		
freshwater flora	NE	110**
freshwater fauna	NE	110**
marine flora	NE	86
marine fauna	NE	86
USEPA AWQC[11]		
freshwater	$e^{(0.8473[\ln(hardness^*)]+0.8604)}$	$e^{(0.8473[\ln(hardness^*)]+0.7614)}$
marine	95	86

WQS - Water Quality Standards
AWQC - Ambient Water Quality Criteria
NE - Not Established
* Hardness is based on calcium carbonate (mg/L)
** Value is based on hardness and/or pH

Aquatic Life - Sediment

Sediment Screening Values	ER-L (mg/kg)	ER-M (mg/kg)
USEPA Region III[4]	150 (fauna)*	NE
Long et al.[12]	150	410

NE - Not Established
* Screening Value

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REFERENCES

1. United States Agency for Toxic Substances and Disease Registry. 1989. Toxicological Profile for Zinc. U.S. Environmental Protection Agency and U.S. Public Health Service, Atlanta, Georgia. December 1989.

2. Eisler, Ronald. 1993. Zinc Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S Department of the Interior. Fish and Wildlife Service. Biological Report 26. April 1993.

3. Reed, M., D. French, W. Knauss, S. Feng, F. French III, S. Pavignano, (Applied Science Associates), R. Bishop, M. Welsh, and J. Press (HBRS, Inc.). 1994. The CERCLA Type A Natural Resource Damage Assessment Model for the Great Lakes Environments (NRDAM/GLE), Volume III - Databases. U.S. Department of Interior, Office of Environmental Policy and Compliance. Washington, D.C. August 1994.

4. United States Environmental Protection Agency. 1995. Region III BTAG Screening Levels. Office of Superfund. Philadelphia, Pennsylvania. January 1995.

5. United States Environmental Protection Agency. 1995. "Toxic Substance Spreadsheet." Region IV, Water Quality Standards Section, Water Management Division. January 1995.

6. Will, M.E. and G.W. Suter II. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process. Environmental Sciences Division - Oak Ridge National Laboratory. September 1994.

7. Will, M.E. and G.W. Suter II. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1994 Revision. Environmental Sciences Division - Oak Ridge National Laboratory. September 1994.

8. National Academy of Sciences (NAS). 1980. Mineral Tolerance of Domestic Animals. National Research Council, Commission on Natural Resources, Committee on Animal Nutrition.

9. Drinker, K.P., P.K. Thompson, and M. Marsh. 1927. " An Investigation of the Effects of the Long-Continued Ingestion of Zinc, in the Form of Zinc Oxide, by Cats and Dogs, Together with Observations Upon the Excretion and the Storage of Zinc." Am. J. Physiol. 80:31. Cited in NAS, 1980.

10. Commonwealth of Virginia. 1992. Water Quality Standards. State Water Control Board. May 1992.

11. United States Environmental Protection Agency. 1992. Surface Water Quality Criteria. Federal Register. Volume 57, No. 246. December 1992.

12. Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. "Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments." Environmental Management, 19:81-97

APPENDIX M
RISK ASSESSMENT CALCULATIONS

TABLE - 1
SSA 1 - ACCIDENTAL INGESTION OF SURFACE SOILS - (1)
SUMMARY OF RISK SCREENING
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
FUTURE RESIDENTS
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Carcinogens
ILCRi = (Ci/RBCi) x 1E-06
TOTAL ILCR = ILCR1 + ILCR2 ... ILCRn

ILCR = Incremental Lifetime Cancer Risk
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/l)
1E-06 = Risk assessment point of departure

Noncarcinogens
HQ1 = Ci/RBCi
HI = HQ1 + HQ2 ... HQn

HQ = Hazard Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/kg)
HI = Hazard Index

COPC	Ci (mg/kg)	Residential Soil RBC (mg/kg)	(n,c)	ILCR	ILCR Percent Contrib.		HQ	HI Percent Contrib.
Benzo(a)anthracene	2.674	0.88	c	3.0E-06	2.9%		NA	0.0%
Benzo(b)fluoranthene	5.722	0.88	c	6.5E-06	6.1%		NA	0.0%
Benzo(k)fluoranthene	4.001	8.8	c	4.5E-07	0.4%		NA	0.0%
Benzo(a)pyrene	3.114	0.088	c	3.5E-05	33.2%		NA	0.0%
Dibenzo(a,h)anthracene	2.631	0.088	c	3.0E-05	28.1%		NA	0.0%
Ideno(1,2,3-cd)pyrene	5.174	0.88	c	5.9E-06	5.5%		NA	0.0%
Dieldrin	0.017	0.04	c	4.3E-07	0.4%		NA	0.0%
1,3,5-Trinitrobenzene	0.171	3.9	n	NA	0.0%		4.4E-02	5.7%
Aluminum	2898.1	78000	n	NA	0.0%		3.7E-02	4.8%
Arsenic	8.51	0.37	c	2.3E-05	21.6%		NA	0.0%
Arsenic	8.51	23	n	NA	0.0%		3.7E-01	48.1%
Beryllium	0.28	0.15	c	1.9E-06	1.8%		NA	0.0%
Cadmium	0.52	39	n	NA	0.0%		1.3E-02	1.73%
Manganese	119.11	390	n	NA	0.0%		3.1E-01	39.7%
		Total ILCR:		1.1E-04	100.0%	HI:	7.7E-01	100.0%

n = noncarcinogen
c = carcinogenic
NA = Not applicable
(1) Concentrations are normal 95% UCL values, or maximum values if the UCL was exceeded.

TABLE - 2
SSA 1 - ACCIDENTAL INGESTION OF SUBSURFACE SOILS - (1)
SUMMARY OF RISK SCREENING
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
FUTURE RESIDENTS
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Carcinogens
ILCRi = (Ci/RBCi) x 1E-06
TOTAL ILCR = ILCR1 + ILCR2 ... ILCRn

ILCR = Incremental Lifetime Cancer Risk
Ci = Detected concentration in a medium (mg/kg, ug/
RBC = Risk-Based Concentration (mg/kg, ug/l)
1E-06 = Risk assessment point of departure

Noncarcinogens
HQ1 = Ci/RBCi
HI = HQ1 + HQ2 ... HQn

HQ = Hazard Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC= Risk-Based Concentration (mg/kg, ug/kg)
HI = Hazard Index

COPC	Ci (mg/kg)	Residential Soil RBC (mg/kg)	(n,c)	ILCR	ILCR Percent Contrib.	HQ	HI Percent Contrib.
Benzo(a)anthracene	0.518	0.88	c	5.9E-07	1.7%	NA	0.0%
Benzo(a)pyrene	0.651	0.088	c	7.4E-06	21.1%	NA	0.0%
Benzo(b)fluoranthene	0.812	0.88	c	9.2E-07	2.6%	NA	0.0%
Benzo(k)fluoranthene	1.165	8.8	c	1.3E-07	0.4%	NA	0.0%
Dibenzo(a,h)anthracene	0.21	0.088	c	2.4E-06	6.8%	NA	0.0%
Ideno(1,2,3-cd)pyrene	0.281	0.88	c	3.2E-07	0.9%	NA	0.0%
Aluminum	5236.84	78000	n	NA	0.0%	6.7E-02	9.3%
Arsenic	6.98	0.37	c	1.9E-05	53.8%	NA	0.0%
Arsenic	6.98	23	n	NA	0.0%	3.0E-01	42.0%
Beryllium	0.67	0.15	c	4.5E-06	12.7%	NA	0.0%
Manganese	100.85	390	n	NA	0.0%	2.6E-01	35.8%
Thallium	0.59	6.3	n	NA	0.0%	9.4E-02	13.0%
		Total ILCR:		3.5E-05	100.0%	HI: 7.2E-01	100.0%

n = noncarcinogen
c = carcinogenic
NA = Not applicable
(1) Concentrations are normal 95% UCL values, or maximum values if the UCL was exceeded.

TABLE - 3
SSA 1 - INGESTION OF GROUNDWATER USED AS DRINKING WATER
ORGANICS AND UNFILTERED INORGANIC COPCs
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
FUTURE RESIDENTS
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Carcinogens	Noncarcinogens
ILCRi = (Ci/RBCi) x 1E-06	HQ1 = Ci/RBCi
TOTAL ILCR = ILCR1 + ILCR2 ... ILCRn	HI = HQ1 + HQ2 ... HQn
ILCR = Incremental Lifetime Cancer Risk	HQ = Hazard Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)	Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/l)	RBC = Risk-Based Concentration (mg/kg, ug/kg)
1E-06 = Risk assessment point of departure	HI = Hazard Index

COPC	Ci (ug/L)	Tapwater RBC (ug/L)	(n,c)	ILCR	ILCR Percent Contrib.		HQ	HQ Percent Contrib.
2,4,6-Trinitrotoluene	1.53	2.2	c	7.0E-07	6.2%		NA	0.0%
RDX	6.47	0.61	c	1.1E-05	93.8%		NA	0.0%
Aluminum	47750.14	37000	n	NA	0.0%		1.3E+00	12.2%
Barium	338.79	2600	n	NA	0.0%		1.3E-01	1.2%
Cadmium	1.3	18	n	NA	0.0%		7.2E-02	0.7%
Manganese	1556.45	180	n	NA	0.0%		8.6E+00	81.6%
Vanadium	117.21	260	n	NA	0.0%		4.5E-01	4.3%
		Total ILCR:		1.1E-05	100.0%	HI:	1.1E+01	100.0%

n = noncarcinogen
c = carcinogenic
NA = not applicable
(1) Concentrations are normal 95% UCL values, or maximum values if the UCL was exceeded.

TABLE - 4
SSA 1 - INGESTION OF GROUNDWATER USED AS DRINKING WATER
ORGANICS AND FILTERED INORGANIC COPCs
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
FUTURE RESIDENTS
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Carcinogens

ILCRi = (Ci/RBCi) x 1E-06
TOTAL ILCR = ILCR1 + ILCR2 ... ILCRn

ILCR = Incremental Lifetime Cancer Risk
Ci = Detected concentration in a medium (mg/kg, ug/L
RBC = Risk-Based Concentration (mg/kg, ug/l)
1E-06 = Risk assessment point of departure

Noncarcinogens

HQ1 = Ci/RBCi
HI = HQ1 + HQ2 ... HQn

HQ = Hazard Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/kg)
HI = Hazard Index

COPC	Ci (ug/L)	Tapwater RBC (ug/L)	(n,c)	ILCR	ILCR Percent Contrib.		HQ	HQ Percent Contrib.
2,4,6-Trinitrotoluene	1.53	2.2	c	7.0E-07	6.2%		NA	0.0%
RDX	6.47	0.61	c	1.1E-05	93.8%		NA	0.0%
Dissolved Manganese	53.86	180	n	NA	0.0%		3.0E-01	18.5%
Dissolved Thallium	3.83	2.9	n	NA	0.0%		1.3E+00	81.5%
			Total ILCR:	1.1E-05	100.0%	HI:	1.6E+00	100.0%

n = noncarcinogen
c = carcinogenic
NA = not applicable
(1) Concentrations are normal 95% UCL values, or maximum values if the UCL was exceeded.

TABLE - 5
SSA 1 - SURFACE WATER
SUMMARY OF ECOLOGICAL RISK SCREENING - LOCATION AO1SW04-01
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

EQ = Ci/(AWQC or ER-L)
EI = EQ1 + EQ2...EQn

EQ = Ecological Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
AWQC = Ambient Water Quality Criteria
ER-L = Sediment screening value, Effects Range-Low value (mg/kg)
EI = Ecological Index

COPC	Ci (ug/L)	AWQC (ug/L)	Ecological Quotient	EQ Percent Contrib.
Cadmium	2.4	1.1	2.2E+00	1.9%
Chromium	19	11	1.7E+00	1.5%
Copper	57.5	12	4.8E+00	4.2%
Iron	39000	1000	3.9E+01	34.3%
Lead	112	3.2	3.5E+01	30.8%
Mercury	0.31	0.012	2.6E+01	22.8%
Zinc	551	110	5.0E+00	4.4%
		EI:	1.1E+02	100.0%

(1) The exposure concentrations values are the maximum detected values.

TABLE - 6
SSA 1 - SEDIMENTS
SUMMARY OF ECOLOGICAL RISK SCREENING (1)
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

EQ = Ci/(AWQC or ER-L)
EI = EQ1 + EQ2...EQn

EQ = Ecological Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
AWQC = Ambient Water Quality Criteria
ER-L = Sediment screening value, Effects Range-Low value (mg/kg)
EI = Ecological Index

COPC	Ci (mg/kg)	ER-L (mg/kg)	Ecological Quotient	EQ Percent Contrib.
Benzo(b)fluoranthene	0.27	0.261	1.0E+00	34.0%
4,4'-DDT	0.0017	0.00158	1.1E+00	35.3%
Mercury	0.14	0.15	9.3E-01	30.7%
		EI:	3.0E+00	100.0%

(1) Concentrations are normal 95% UCL values, or maximum values if the UCL was exceeded.

TABLE - 7
SSA 6 - ACCIDENTAL INGESTION OF SURFACE SOILS - (1)
SUMMARY OF RISK SCREENING
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
FUTURE RESIDENTS
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Carcinogens

ILCRi = (Ci/RBCi) x 1E-06
TOTAL ILCR = ILCR1 + ILCR2 ... ILCRn

ILCR = Incremental Lifetime Cancer Risk
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/l)
1E-06 = Risk assessment point of departure

Noncarcinogens

HQ1 = Ci/RBCi
HI = HQ1 + HQ2 ... HQn

HQ = Hazard Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/kg)
HI = Hazard Index

COPC	Ci (mg/kg)	Residential Soil RBC (mg/kg)	(n,c)	ILCR	ILCR Percent Contrib.		HQ	HQ Percent Contrib.
Benzo(a)pyrene	0.181	0.088	c	2.1E-06	14.4%		NA	0.0%
Alpha-chlordane	0.152	0.49	c	3.1E-07	2.2%		NA	0.0%
Dieldrin	0.009	0.04	c	2.25E-07	1.6%		NA	0.0%
Gamma-chlordane	0.152	0.49	c	3.1E-07	2.2%		NA	0.0%
Aroclor-1254	0.389	1.6	n	NA	0.0%		2.4E-01	30.9%
Aroclor-1254	0.389	0.083	c	4.7E-06	32.7%		NA	0.0%
Aluminum	5624.95	78000	n	NA	0.0%		7.2E-02	9.2%
Antimony	2.36	31	n	NA	0.0%		7.6E-02	9.7%
Arsenic	1.85	0.37	c	5.0E-06	34.9%		NA	0.0%
Arsenic	1.85	23	n	NA	0.0%		8.0E-02	10.2%
Beryllium	0.26	0.15	c	1.7E-06	12.1%		NA	0.0%
Cadmium	0.96	39	n	NA	0.0%		2.5E-02	3.1%
Manganese	103.5	390	n	NA	0.0%		2.7E-01	33.8%
Mercury	0.55	23	n	NA	0.0%		2.4E-02	3.0%
			Total ILCR:	1.4E-05	100.0%	HI:	7.9E-01	100.0%

n = noncarcinogen
c = carcinogenic
NA = not applicable
(1) Concentrations are normal 95% UCL values, or maximum values if the UCL was exceeded.

TABLE - 8
SSA 6 - ACCIDENTAL INGESTION OF SUBSURFACE SOILS - (1)
SUMMARY OF RISK SCREENING
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
FUTURE RESIDENTS
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Carcinogens

ILCRi = (Ci/RBCi) x 1E-06
TOTAL ILCR = ILCR1 + ILCR2 ... ILCRn

ILCR = Incremental Lifetime Cancer Risk
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/l)
1E-06 = Risk assessment point of departure

Noncarcinogens

HQ1 = Ci/RBCi
HI = HQ1 + HQ2 ... HQn

HQ = Hazard Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/kg)
HI = Hazard Index

COPC	Ci (mg/kg)	Residential Soil RBC (mg/kg)	(n,c)	ILCR	ILCR Percent Contrib.	HQ	HQ Percent Contrib.
1,3,5-Trinitrobenzene	0.21	3.9	n	NA	0.0%	5.4E-02	6.0%
Aluminum	6018.37	78000	n	NA	0.0%	7.7E-02	8.7%
Antimony	1.83	31	n	NA	0.0%	5.9E-02	6.6%
Arsenic	8.3	0.37	c	2.2E-05	89.1%	NA	0.0%
Arsenic	8.3	23	n	NA	0.0%	3.6E-01	40.5%
Beryllium	0.41	0.15	c	2.7E-06	10.9%	NA	0.0%
Manganese	79.55	390	n	NA	0.0%	2.0E-01	22.9%
Mercury	0.32	23	n	NA	0.0%	1.4E-02	1.6%
Thallium	0.54	6.3	n	NA	0.0%	8.6E-02	9.6%
Vanadium	19.84	550	n	NA	0.0%	3.6E-02	4.1%
			Total ILCR:	2.5E-05	100.0%	HI: 8.9E-01	100.0%

n = noncarcinogen
c = carcinogenic
NA = Not applicable
(1) Concentrations are normal 95% UCL values, or maximum values if the UCL was exceeded.

TABLE - 9
SSA 6 - ACCIDENTAL INGESTION OF SUBSURFACE SOILS - TEST PITS
SUMMARY OF RISK SCREENING
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
FUTURE RESIDENTS
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Carcinogens	Noncarcinogens
ILCRi = (Ci/RBCi) x 1E-06	HQ1 = Ci/RBCi
TOTAL ILCR = ILCR1 + ILCR2 ... ILCRn	HI = HQ1 + HQ2 ... HQn

ILCR = Incremental Lifetime Cancer Risk
Ci = Detected concentration in a medium (mg/kg, u
RBC = Risk-Based Concentration (mg/kg, ug/l)
1E-06 = Risk assessment point of departure

HQ = Hazard Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/kg)
HI = Hazard Index

COPC	Ci (mg/kg)	Residential Soil RBC (mg/kg)	(n,c)	ILCR	ILCR Percent Contrib.		HQ	HI Percent Contrib.
Dieldrin	0.02	0.04	c	6.1E-07	0.3%		NA	0.0%
alpha-Chlordane	0.20	0.49	c	4.0E-07	0.2%		NA	0.0%
Aroclor-1254	13.57	1.6	n	NA	0.0%		8.5E+00	67.6%
Aroclor-1254	13.57	0.083	c	1.6E-04	84.4%		NA	0.0%
Aroclor-1260	0.89	0.083	c	1.1E-05	5.5%		NA	0.0%
1,3,5-Trinitrobenzene	0.18	3.9	n	NA	0.0%		4.6E-02	0.4%
Aluminum	7603.34	78000	n	NA	0.0%		9.7E-02	0.8%
Arsenic	6.06	0.37	c	1.6E-05	8.5%		NA	0.0%
Arsenic	6.06	23	n	NA	0.0%		2.6E-01	2.1%
Beryllium	0.32	0.15	c	2.1E-06	1.1%		NA	0.0%
Cadmium	136.58	39	n	NA	0.0%		3.5E+00	27.9%
Manganese	60.14	390	n	NA	0.0%		1.5E-01	1.2%
		Total ILCR:		1.9E-04	100.0%	HI:	1.3E+01	100.0%

n = noncarcinogen
c = carcinogenic
NA = Not applicable
(1) Concentrations are normal 95% UCL values, or maximum values if the UCL was exceeded.

TABLE - 10
SSA 6 - INGESTION OF GROUNDWATER USED AS DRINKING WATER
ORGANICS AND UNFILTERED INORGANIC COPCs
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
FUTURE RESIDENTS
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Carcinogens

ILCRi = (Ci/RBCi) x 1E-06
TOTAL ILCR = ILCR1 + ILCR2 ... ILCRn

ILCR = Incremental Lifetime Cancer Risk
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/l)
1E-06 = Risk assessment point of departure

Noncarcinogens

HQ1 = Ci/RBCi
HI = HQ1 + HQ2 ... HQn

HQ = Hazard Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/kg)
HI = Hazard Index

COPC	Ci (ug/L)	Tapwater RBC (ug/L)	(n,c)	ILCR	ILCR Percent Contrib.	HQ	HQ Percent Contrib.
cis-1,2-Dichloroethene	3.52	61	n	NA	0.0%	5.8E-02	0.3%
Nitrobenzene	1.38	3.4	n	NA	0.0%	4.1E-01	1.9%
Aluminum	51391.72	37000	n	NA	0.0%	1.4E+00	6.7%
Arsenic	135.51	0.038	c	3.6E-03	93.9%	NA	0.0%
Arsenic	135.51	11	n	NA	0.0%	1.2E+01	59.0%
Barium	222.83	2600	n	NA	0.0%	8.6E-02	0.4%
Beryllium	3.71	0.016	c	2.3E-04	6.1%	NA	0.0%
Cadmium	7.89	18	n	NA	0.0%	4.4E-01	2.1%
Chromium	203.92	180	n	NA	0.0%	1.1E+00	5.4%
Manganese	814.66	180	n	NA	0.0%	4.5E+00	21.7%
Nickel	94.26	730	n	NA	0.0%	1.3E-01	0.6%
Vanadium	221.37	260	n	NA	0.0%	8.5E-01	4.1%
			Total ILCR:	3.8E-03	100.0%	HI: 2.1E+01	100.0%

n = noncarcinogen
c = carcinogenic
NA = not applicable
(1) Concentrations are normal 95% UCL values, or maximum values if the UCL was exceeded.

TABLE - 11
SSA 6 - INGESTION OF GROUNDWATER USED AS DRINKING WATER
ORGANICS AND FILTERED INORGANIC COPCs
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
FUTURE RESIDENTS
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Carcinogens

ILCRi = (Ci/RBCi) x 1E-06
TOTAL ILCR = ILCR1 + ILCR2 ... ILCRn

ILCR = Incremental Lifetime Cancer Risk
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/l)
1E-06 = Risk assessment point of departure

Noncarcinogens

HQ1 = Ci/RBCi
HI = HQ1 + HQ2 ... HQn

HQ = Hazard Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/kg)
HI = Hazard Index

COPC	Ci (ug/L)	Tapwater RBC (ug/L)	(n,c)	ILCR	ILCR Percent Contrib.		HQ	HQ Percent Contrib.
cis 1,2-Dichloroethene	3.52	61	n	NA	NA		5.8E-02	3.2%
Nitrobenzene	1.38	3.4	n	NA	NA		4.1E-01	22.6%
Dissolved Beryllium	0.22	0.016	c	1.4E-05	100.0%		NA	0.0%
Dissolved Manganese	43.01	180	n	NA	NA		2.4E-01	13.3%
Dissolved Thallium	3.16	2.9	n	NA	NA		1.1E+00	60.8%
		Total ILCR:		1.4E-05	100.0%	HI:	1.8E+00	13.3%

n = noncarcinogen
c = carcinogenic
NA = not applicable
(1) Concentrations are normal 95% UCL values, or maximum values if the UCL was exceeded.

TABLE - 12
SSA 7 - ACCIDENTAL INGESTION OF SURFACE SOILS - (1)
SUMMARY OF RISK SCREENING
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
FUTURE RESIDENTS
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Carcinogens

ILCRi = (Ci/RBCi) x 1E-06
TOTAL ILCR = ILCR1 + ILCR2 ... ILCRn

ILCR = Incremental Lifetime Cancer Risk
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/l)
1E-06 = Risk assessment point of departure

Noncarcinogens

HQ1 = Ci/RBCi
HI = HQ1 + HQ2 ... HQn

HQ = Hazard Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/kg)
HI = Hazard Index

COPC	Ci (mg/kg)	Residential Soil RBC (mg/kg)	(n,c)	ILCR	ILCR Percent Contrib.		HQ	HQ Percent Contrib.
Benzo(a)pyrene	0.17	0.088	c	1.9E-06	16.9%		NA	0.0%
Aluminum	8270	78000	n	NA	0.0%		1.1E-01	10.0%
Arsenic	2.7	0.37	c	7.3E-06	63.8%		NA	0.0%
Arsenic	2.7	23	n	NA	0.0%		1.2E-01	11.0%
Beryllium	0.33	0.15	c	2.2E-06	19.2%		NA	0.0%
Manganese	328	390	n	NA	0.0%		8.4E-01	79.0%
		Total	ILCR:	1.1E-05	100.0%	HI:	1.1E+00	100.0%

n = noncarcinogen
c = carcinogenic
NA = not applicable
(1) Exposure point concentration values are the maximum detected concentrations.

TABLE - 13
SSA 7 - ACCIDENTAL INGESTION OF SUBSURFACE SOILS - (1)
SUMMARY OF RISK SCREENING
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
FUTURE RESIDENTS
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Carcinogens

ILCRi = (Ci/RBCi) x 1E-06
TOTAL ILCR = ILCR1 + ILCR2 ... ILCRn

ILCR = Incremental Lifetime Cancer Risk
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/l)
1E-06 = Risk assessment point of departure

Noncarcinogens

HQ1 = Ci/RBCi
HI = HQ1 + HQ2 ... HQn

HQ = Hazard Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/kg)
HI = Hazard Index

COPC	Ci (mg/kg)	Residential Soil RBC (mg/kg)	(n,c)	ILCR	ILCR Percent Contrib.	HQ	HQ Percent Contrib.
Aroclor 1260	0.597	0.083	c	7.2E-06	19.7%	NA	0.0%
Aluminum	8031.81	78000	n	NA	0.0%	1.0E-01	8.7%
Antimony	1.63	31	n	NA	0.0%	5.3E-02	4.5%
Arsenic	9.08	0.37	c	2.5E-05	67.2%	NA	0.0%
Arsenic	9.08	23	n	NA	0.0%	3.9E-01	33.5%
Beryllium	0.72	0.15	c	4.8E-06	13.1%	NA	0.0%
Manganese	194.7	390	n	NA	0.0%	5.0E-01	42.4%
Thallium	0.81	6.3	n	NA	0.0%	1.3E-01	10.9%
			Total ILCR:	3.7E-05	100.0%	HI: 1.2E+00	100.0%

n = noncarcinogen
c = carcinogenic
NA = Not applicable
(1) Concentrations are normal 95% UCL values, or maximum values if the UCL was exceeded.

TABLE - 14
SSA 7 - ACCIDENTAL INGESTION OF SUBSURFACE SOILS - TEST PITS
SUMMARY OF RISK SCREENING
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
FUTURE RESIDENTS
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Carcinogens	Noncarcinogens
ILCRi = (Ci/RBCi) x 1E-06	HQ1 = Ci/RBCi
TOTAL ILCR = ILCR1 + ILCR2 ... ILCRn	HI = HQ1 + HQ2 ... HQn
ILCR = Incremental Lifetime Cancer Risk	HQ = Hazard Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)	Ci = Detected concentration in a medium (mg/kg, u
RBC = Risk-Based Concentration (mg/kg, ug/l)	RBC = Risk-Based Concentration (mg/kg, ug/kg)
1E-06 = Risk assessment point of departure	HI = Hazard Index

COPC	Ci (mg/kg)	Residential Soil RBC (mg/kg)	(n,c)	ILCR	ILCR Percent Contrib.		HQ	HI Percent Contrib.
Aroclor-1260	0.98	0.083	c	1.2E-05	36.7%		NA	0.0%
Aluminum	13600	78000	n	NA	0.0%		1.7E-01	11.2%
Arsenic	5.6	0.37	c	1.5E-05	47.1%		NA	0.0%
Arsenic	5.6	23	n	NA	0.0%		2.4E-01	15.7%
Beryllium	0.78	0.15	c	5.2E-06	16.2%		NA	0.0%
Manganese	443	390	n	NA	0.0%		1.1E+00	73.1%
		Total	ILCR:	3.2E-05	100.0%	HI:	1.6E+00	100.0%

n = noncarcinogen
c = carcinogenic
NA = Not applicable
(1) Exposure point concentration values are the maximum detected concentrations.

TABLE - 15
SSA 7 - INGESTION OF GROUNDWATER USED AS DRINKING WATER
ORGANICS AND UNFILTERED INORGANIC COPCs
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
FUTURE RESIDENTS
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Carcinogens

ILCRi = (Ci/RBCi) x 1E-06
TOTAL ILCR = ILCR1 + ILCR2 ... ILCRn

ILCR = Incremental Lifetime Cancer Risk
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/l)
1E-06 = Risk assessment point of departure

Noncarcinogens

HQ1 = Ci/RBCi
HI = HQ1 + HQ2 ... HQn

HQ = Hazard Quotient
Ci = Detected concentration in a medium (mg/kg, u
RBC = Risk-Based Concentration (mg/kg, ug/kg)
HI = Hazard Index

COPC	Ci (ug/L)	Tapwater RBC (ug/L)	(n,c)	ILCR	ILCR Percent Contrib.	HQ	HQ Percent Contrib.
1,1-Dichloroethene	110	0.044	c	2.5E-03	10.3%	NA	0.0%
1,1,1-Trichloroethane	700	1300	n	NA	0.0%	5.4E-01	0.5%
Carbazole	4	3.4	c	1.2E-06	0.0%	NA	0.0%
Aldrin	0.026	0.004	c	6.5E-06	0.0%	NA	0.0%
alpha-BHC	0.042	0.011	c	3.8E-06	0.0%	NA	0.0%
Dieldrin	0.033	0.0042	c	7.9E-06	0.0%	NA	0.0%
RDX	48	0.61	c	7.9E-05	0.3%	NA	0.0%
Aluminum	206000	37000	n	NA	0.0%	5.6E+00	4.7%
Antimony	53.4	15	n	NA	0.0%	3.6E+00	3.0%
Arsenic	825	0.038	c	2.2E-02	89.3%	NA	0.0%
Arsenic	825	11	n	NA	0.0%	7.5E+01	63.7%
Barium	972	2600	n	NA	0.0%	3.7E-01	0.3%
Copper	782	1400	n	NA	0.0%	5.6E-01	0.5%
Manganese	3950	180	n	NA	0.0%	2.2E+01	18.6%
Nickel	391	730	n	NA	0.0%	5.4E-01	0.5%
Thallium	15.5	2.9	n	NA	0.0%	5.3E+00	4.5%
Vanadium	1100	260	n	NA	0.0%	4.2E+00	3.6%
Zinc	1130	11000	n	NA	0.0%	1.0E-01	0.1%
		Total	ILCR:	2.4E-02	100.0%	HI: 1.2E+02	100.0%

n = noncarcinogen
c = carcinogenic
NA = not applicable
(1) Exposure point concentration values are the maximum detected concentrations.

TABLE - 16
SSA 7 - INGESTION OF GROUNDWATER USED AS DRINKING WATER
ORGANICS AND FILTERED INORGANIC COPCs
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
FUTURE RESIDENTS
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Carcinogens
ILCRi = (Ci/RBCi) x 1E-06
TOTAL ILCR = ILCR1 + ILCR2 ... ILCRn

ILCR = Incremental Lifetime Cancer Risk
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/l)
1E-06 = Risk assessment point of departure

Noncarcinogens
HQ1 = Ci/RBCi
HI = HQ1 + HQ2 ... HQn

HQ = Hazard Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/kg)
HI = Hazard Index

COPC	Ci (ug/L)	Tapwater RBC (ug/L)	(n,c)	ILCR	ILCR Percent Contrib.		HQ	HQ Percent Contrib.
1,1-Dichloroethene	110	0.044	c	2.5E-03	83.8%		NA	0.0%
1,1,1-Trichloroethane	700	1300	n	NA	0.0%		5.4E-01	4.9%
Carbazole	4	3.4	c	1.2E-06	0.0%		NA	0.0%
Aldrin	0.026	0.004	c	6.5E-06	0.2%		NA	0.0%
alpha-BHC	0.042	0.011	c	3.8E-06	0.1%		NA	0.0%
Dieldrin	0.033	0.0042	c	7.9E-06	0.3%		NA	0.0%
RDX	48	0.61	c	7.9E-05	2.6%		NA	0.0%
Dissolved Antimony	13.7	15	n	NA	0.0%		9.1E-01	8.3%
Dissolved Arsenic	14.6	0.038	c	3.8E-04	12.9%		NA	0.0%
Dissolved Arsenic	14.6	11	n	NA	0.0%		1.3E+00	12.1%
Dissolved Manganese	1020	180	n	NA	0.0%		5.7E+00	51.7%
Dissolved Thallium	7.3	2.9	n	NA	0.0%		2.5E+00	23.0%
		Total	ILCR:	3.0E-03	100.0%	HI:	1.1E+01	100.0%

n = noncarcinogen
c = carcinogenic
NA = not applicable
(1) Exposure point concentration values are the maximum detected concentrations.

TABLE - 17
SSA 7 - SURFACE WATER
SUMMARY OF ECOLOGICAL RISK SCREENING
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

EQ = Ci/(AWQC or ER-L)
EI = EQ1 + EQ2...EQn

EQ = Ecological Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
AWQC = Ambient Water Quality Criteria
ER-L = Sediment screening value, Effects Range-Low value (mg/kg)
EI = Ecological Index

COPC	Ci (ug/L)	AWQC (ug/L)	Ecological Quotient	EQ Percent Contrib.
No COPCs	--	--	--	--
		EI:		

TABLE - 18
SSA 7 - SEDIMENTS
SUMMARY OF ECOLOGICAL RISK SCREENING (1)
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

EQ = Ci/(AWQC or ER-L)
EI = EQ1 + EQ2...EQn

EQ = Ecological Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
AWQC = Ambient Water Quality Criteria
ER-L = Sediment screening value, Effects Range-Low value (mg/kg)
EI = Ecological Index

COPC	Ci (mg/kg)	ER-L (mg/kg)	Ecological Quotient	EQ Percent Contrib.
Benzo(k)fluoranthene	0.34	0.261	1.3E+00	37.9%
Arsenic	11.32	8.2	1.4E+00	40.2%
Nickel	15.85	21	7.5E-01	22.0%
		EI:	3.4E+00	100.0%

(1) Concentrations are normal 95% UCL values, or maximum values if the UCL was exceeded.

TABLE - 19
SSA 15 - ACCIDENTAL INGESTION OF SURFACE SOILS - (1)
SUMMARY OF RISK SCREENING
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
FUTURE RESIDENTS
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Carcinogens

ILCRi = (Ci/RBCi) x 1E-06
TOTAL ILCR = ILCR1 + ILCR2 ... ILCRn

ILCR = Incremental Lifetime Cancer Risk
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/l)
1E-06 = Risk assessment point of departure

Noncarcinogens

HQ1 = Ci/RBCi
HI = HQ1 + HQ2 ... HQn

HQ = Hazard Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/kg)
HI = Hazard Index

COPC	Ci (mg/kg)	Residential Soil RBC (mg/kg)	(n,c)	ILCR	ILCR Percent Contrib.		HQ	HQ Percent Contrib.
Antimony	2.69	31	n	NA	0.0%		8.7E-02	9.1%
Arsenic	13.64	0.37	c	3.7E-05	93.1%		NA	0.0%
Arsenic	13.64	23	n	NA	0.0%		5.9E-01	62.2%
Beryllium	0.41	0.15	c	2.7E-06	6.9%		NA	0.0%
Manganese	106.55	390	n	NA	0.0%		2.7E-01	28.7%
		Total	ILCR:	4.0E-05	100.0%	HI:	9.5E-01	100.0%

n = noncarcinogen
c = carcinogenic
NA = not applicable
(1) Concentrations are normal 95% UCL values, or maximum values if the UCL was exceeded.

TABLE - 20
SSA 15 - ACCIDENTAL INGESTION OF SUBSURFACE SOILS - (1)
SUMMARY OF RISK SCREENING
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
FUTURE RESIDENTS
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Carcinogens

ILCRi = (Ci/RBCi) x 1E-06
TOTAL ILCR = ILCR1 + ILCR2 ... ILCRn

ILCR = Incremental Lifetime Cancer Risk
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/l)
1E-06 = Risk assessment point of departure

Noncarcinogens

HQ1 = Ci/RBCi
HI = HQ1 + HQ2 ... HQn

HQ = Hazard Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/kg)
HI = Hazard Index

COPC	Ci (mg/kg)	Residential Soil RBC (mg/kg)	(n,c)	ILCR	ILCR Percent Contrib.		HQ	HQ Percent Contrib.
Aluminum	5962.2	78000	n	NA	0.0%		7.6E-02	3.7%
Antimony	2.76	31	n	NA	0.0%		8.9E-02	4.4%
Arsenic	14.96	0.37	c	4.0E-05	88.2%		NA	0.0%
Arsenic	14.96	23	n	NA	0.0%		6.5E-01	31.8%
Beryllium	0.81	0.15	c	5.4E-06	11.8%		NA	0.0%
Manganese	439.81	390	n	NA	0.0%		1.1E+00	55.2%
Thallium	0.63	6.3	n	NA	0.0%		1.0E-01	4.9%
			Total ILCR:	4.6E-05	100.0%	HI:	2.0E+00	100.0%

n = noncarcinogen
c = carcinogenic
NA = Not applicable
(1) Concentrations are normal 95% UCL values, or maximum values if the UCL was exceeded.

TABLE - 21
SSA 15 - INGESTION OF GROUNDWATER USED AS DRINKING WATER
ORGANICS AND UNFILTERED INORGANIC COPCs
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
FUTURE RESIDENTS
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Carcinogens

ILCRi = (Ci/RBCi) x 1E-06
TOTAL ILCR = ILCR1 + ILCR2 ... ILCRn

ILCR = Incremental Lifetime Cancer Risk
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/l)
1E-06 = Risk assessment point of departure

Noncarcinogens

HQ1 = Ci/RBCi
HI = HQ1 + HQ2 ... HQn

HQ = Hazard Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/kg)
HI = Hazard Index

COPC	Ci (ug/L)	Tapwater RBC (ug/L)	(n,c)	ILCR	ILCR Percent Contrib.		HQ	HQ Percent Contrib.
1,1-Dichloroethene	0.6	0.044	c	1.4E-05	67.6%		NA	0.0%
Trichloroethene	7	1.6	c	4.4E-06	21.7%		NA	0.0%
beta-BHC	0.05	0.037	c	1.4E-06	6.7%		NA	0.0%
4,4'-DDT	0.16	0.2	c	8.0E-07	4.0%		NA	0.0%
Barium	849	2600	n	NA	0.0%		3.3E-01	16.7%
Nickel	263	730	n	NA	0.0%		3.6E-01	18.5%
Vanadium	329	260	n	NA	0.0%		1.3E+00	64.8%
		Total	ILCR:	2.0E-05	100.0%	HI:	2.0E+00	100.0%

n = noncarcinogen
c = carcinogenic
NA = not applicable
(1) Concentrations are normal 95% UCL values, or maximum values if the UCL was exceeded.

TABLE - 22
SSA 15 - INGESTION OF GROUNDWATER USED AS DRINKING WATER
ORGANICS AND FILTERED INORGANIC COPCs
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
FUTURE RESIDENTS
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Carcinogens

ILCRi = (Ci/RBCi) x 1E-06
TOTAL ILCR = ILCR1 + ILCR2 ... ILCRn

ILCR = Incremental Lifetime Cancer Risk
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/l)
1E-06 = Risk assessment point of departure

Noncarcinogens

HQ1 = Ci/RBCi
HI = HQ1 + HQ2 ... HQn

HQ = Hazard Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/kg)
HI = Hazard Index

COPC	Ci (ug/L)	Tapwater RBC (ug/L)	(n,c)	ILCR	ILCR Percent Contrib.		HQ	HQ Percent Contrib.
1,1-Dichloroethene	0.6	0.044	c	1.4E-05	67.6%		NA	0.0%
Trichloroethene	7	1.6	c	4.4E-06	21.7%		NA	0.0%
beta-BHC	0.05	0.037	c	1.4E-06	6.7%		NA	0.0%
4,4'-DDT	0.16	0.2	c	8.0E-07	4.0%		NA	0.0%
Dissolved Manganese	155	180	n	NA	0.0%		8.6E-01	100.0%
		Total	ILCR:	2.0E-05	100.0%	HI:	8.6E-01	100.0%

n = noncarcinogen
c = carcinogenic
NA = not applicable
(1) Concentrations are normal 95% UCL values, or maximum values if the UCL was exceeded.

TABLE - 23
SSA 15 - SURFACE WATER
SUMMARY OF ECOLOGICAL RISK SCREENING
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

EQ = Ci/(AWQC or ER-L)
EI = EQ1 + EQ2...EQn

EQ = Ecological Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
AWQC = Ambient Water Quality Criteria
ER-L = Sediment screening value, Effects Range-Low value (mg/kg)
EI = Ecological Index

COPC	Ci (ug/L)	AWQC (ug/L)	Ecological Quotient	EQ Percent Contrib.
1,1-Dichloroethene (1)	1	11600	8.6E-05	0.3%
1,1-Dichloroethane	0.5	NA	--	0.0%
Trichloroethene	500	21900	2.3E-02	77.2%
Vinyl Chloride	2	NA	--	0.0%
cis-1,2-Dichloroethene	77	11600	6.6E-03	22.5%
		EI:	3.0E-02	100.0%

(1) AWQC for dichloroethylenes used as a surrogate.
(2) Exposure point concentration values are the maximum detected concentrations.

TABLE - 24
SSA 15 - SEDIMENTS
SUMMARY OF ECOLOGICAL RISK SCREENING - (1)
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

EQ = Ci/(AWQC or ER-L)
EI = EQ1 + EQ2...EQn

EQ = Ecological Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
AWQC = Ambient Water Quality Criteria
ER-L = Sediment screening value, Effects Range-Low value (mg/kg)
EI = Ecological Index

COPC	Ci (mg/kg)	ER-L (mg/kg)	Ecological Quotient	EQ Percent Contrib.
Trichloroethene	0.007	NA	0.0E+00	0.0%
4,4'-DDD	0.04232	0.00158	2.7E+01	27.2%
4,4'-DDE	0.02614	0.0022	1.2E+01	12.0%
4,4'-DDT	0.06398	0.00158	4.0E+01	41.1%
alpha-Chlordane	0.00408	0.0005	8.2E+00	8.3%
gamma-Chlordane	0.00439	0.0005	8.8E+00	8.9%
Mercury	0.38	0.15	2.5E+00	2.6%
		EI:	9.9E+01	100.0%

(1) Concentrations are normal 95% UCL values, or maximum values if the UCL was exceeded.
NA - No established criteria.

APPENDIX N
OHM ANALYTICAL AND VALIDATION SUMMARIES

OHM Remediation Services Corp.
A Subsidiary of OHM Corporation

ANALYTICAL DIVISION

Laboratory Analysis Report

Client: OHM Remediation Services Corp.
Eastern Region (Trenton, NJ)

Attn: Ken Kukkonen
Ron Kenyon

Project: 15629N - NEESA; Yorktown Naval Weapons Station, Yorktown, VA

Sample(s): 0001/0003, 0005, 0008A/B, 0009A/B, 0010A/B, 0011A/B, 0012A/B and 0013

Sample Type(s): Liquid and Solid

Analysis Performed: Conventional, Metals and Organics

Date Sample Received: October 21, 1994

Date Order Received: October 21, 1994

Joblink(s): 616891

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Reviewed and Approved by: *Thomas E. Gran, Ph.D., Vice President* *Date:* *January 23, 1995*

16406 U.S. Route 224 East ■ P.O. Box 551 ■ Findlay, OH 45839-0551 ■ 419-423-3526

Narrative for SDG # 08A/B

Laboratory: Analytical Services Corp.

Project #: OHM # 15629

Project Location: Naval Weapons Station
Yorktown, Virginia

Samples in this Sample Delivery Group (SDG):

0008A/B	0011A/B	0005
0009A/B	0012A/B	0013
0010A/B	0001/0003	

Volatile Organics by GC/MS

Zero of 42 surrogate recoveries were outside QC limits.

Two of 20 matrix spike recoveries and zero of 10 matrix RPD's were outside QC limits. Compounds were outside QC limits due to the high levels present in the unspiked sample.

All target compounds were inadvertently spiked for this analytical batch. Only the required CLP spiking compounds were reported on Form III.

There were low levels of target compounds detected in the method blank and associated samples at levels below the CRQL. All results affected have been flagged with the appropriate qualifier.

There were target compounds detected in the Field/Rinsate blank.

Initial calibration criteria were met.

Acetone and Methyl Ethyl Ketone were outside calibration Check criteria on 10/28/94, ID #c9760.d and c9766.d, and on 10/29/94, ID #c9779d. Methyl Ethyl Ketone was not detected in any samples analyzed against this standard but would have been detected if present in any of the samples. All other compounds were within calibration check criteria, therefore, the calibration standard was accepted. All other calibration check standards were within acceptance criteria.

All internal standard criteria were met for this SDG.

All holding times were met for this SDG.

Semivolatile Organics by GC/MS

Zero of 54 surrogates were outside QC limits.

Zero of 18 matrix spike recoveries and one of 9 matrix RPD's were outside QC limits.

All method blank criteria were met for this SDG.

All compounds met initial and continuing calibration criteria.

All internal standard area counts and retention times were within QC limits.

No GPC cleanup was performed on the solid samples submitted in this SDG.

All holding times were met for this SDG.

Pesticides/PCB's by GC

Zero of 48 surrogates were outside QC limits.

Zero of 12 solid matrix spike recoveries and zero of 6 solid matrix RPD's were outside QC limits.

Matrix spike data is not available for water samples # 0005 (field blank) due to the insufficient sample volume supplied. QA/QC acceptance was based on blank (method) spike recoveries which were within QC limits.

All method blank criteria were met for this SDG.

Five compounds were outside initial calibration criteria on 10/25/94 for the primary and confirmation analysis, one of which was DCB and the other compounds were not detected in any of the samples in this SDG. Due to this fact, the initial calibration curves were accepted.

Two compounds were outside continuing calibration criteria on 10/26/94 for the primary and confirmation analysis. One compound was outside continuing calibration criteria on 10/26/94 for the primary analysis.

No GPC cleanup was performed on solid samples submitted in this SDG.

All holding times were met for this SDG.

Explosives by HPLC

CLP Forms and/or analytical requirements do not apply to all Explosives Level C type deliverable requirements. Every effort was made to conform to the CLP format and all applicable CLP/Level C forms have been included.

Zero of 24 matrix spike recoveries and zero of 12 matrix RPD's were outside QC limits.

All method blank criteria were met for this SDG.

All initial calibration criteria were met for this SDG.

One compound was outside continuing calibration criteria on 11/1/94.

All sample holding times were met for this SDG.

Signature: _____ Name: William A. Fithian
Date: 1/19/95 Title: Technical Project Manager

SUMMARY OF ANALYTICAL METHODOLOGY

Parameter	Reference	Method
Conventionals		
Solids, Total (solid)	CAWW	160.3
Metals		
Total Metals	SW-846	6010
Mercury by Cold Vapor	SW-846	7471
Mercury by Cold Vapor (liquid)	SW-846	7470
Organics		
Pesticides and PCBs by GC	SW-846	8080
Volatile Compounds by GC/MS	CLP	SOW
Semi-volatile Compounds by GC/MS	CLP	SOW
Explosives Analysis, LC	SW-846	8330A

Narrative for SDG # 08A/B

Metals

Initial calibration criteria were not within QC limits for Potassium and Sodium. Arsenic, Potassium, Sodium and Selenium did not pass all continuing calibration criteria but should not negatively impact the data validity.

The CRDL standard met all QC criteria.

All solid method blank criteria were within QC limits.

Low levels of Barium, Cadmium, Iron, Sodium and Zinc were detected in the aqueous method blank. All associated samples have been flagged with the appropriate qualifier. This anomaly should not impact the validity of the data generated.

Low soil spike recoveries were noted for Antimony, Cobalt, Selenium and Silver. All Post Spike recoveries were within acceptable QC limits.

Aluminum, Arsenic, Calcium, Chromium, Iron, Lead, Mercury and Zinc were outside QC limits due to the high levels of these elements present in the unspiked sample.

Post spike recoveries were outside QC limits for Selenium in sample 0008A/B and 0009A/B and have been flagged with the appropriate qualifier. Post spike recoveries were outside QC limits for Arsenic in sample 0011A/B and 0012A/B and have been flagged with the appropriate qualifier.

Duplicate results were >10% for Copper and Iron. This will have minimal impact on the validity of the data submitted.

All Laboratory Control Samples (LCS) were within acceptable QC limits.

All holding times were met for this SDG.

No Quarterly Linearity Checks are available for this SDG.

OHM Remediation Services Corp.
A Subsidiary of OHM Corporation

ANALYTICAL DIVISION

Laboratory Analysis Report

Client: OHM Remediation Services Corp.
Eastern Region (Trenton, NJ)

Attn: Ken Kukkonen
Ron Kenyon

Project: 15629N - NEESA; Yorktown Naval Weapons Station, Yorktown, VA

Sample Type(s): Liquid and Solid

Analysis Performed: Organics, Metals and Conventionals

Date Sample Received: November 4, 1994

Date Order Received: November 4, 1994

Joblink(s): 617009

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Reviewed and Approved by: J. Knatow for
Thomas E. Gran, Ph.D., Vice President

Date: *February 27, 1995*

16406 U.S. Route 224 East ■ P.O. Box 551 ■ Findlay, OH 45839-0551 ■ 419-423-3526

Narrative for SDG # A01SS-06, Report # 1

Laboratory: Analytical Services Corp.

Project #: OHM # 15629

Project Location: Naval Weapons Station, Yorktown, Virginia

Samples in this Sample Delivery Group (SDG):

A01SS-06	A01SS-12	A01SS-23	A01SS-29
A01SS-07	A01SS-13	A01SS-24	A01SS-30
A01SS-08	A01SS-14	A01SS-25	A01SS-31
A01SS-09	A01SS-20	A01SS-26	A01SS-32
A01SS-10	A01SS-21	A01SS-27	FRINSATE
A01SS-11	A01SS-22	A01SS-28	

Volatile Organics by GC/MS

Zero of 90 surrogate recoveries were outside QC limits.

Two of 20 matrix spike recoveries and one of ten matrix RPD's were outside QC limits.

One of ten blank spike (method spike) recoveries were outside QC limits.

Hexane and 1,1,2-Trichloro-1,2,2-trifuoroethane are used in the laboratory and should be viewed with caution.

In the Initial calibration analyzed on November 8, 1994 two responses for Toluene were removed by the analyst and not caught during subsequent reviews. This is not a normal practice for ASC. The analysts have been advised as to the procedure for sample reanalysis for difficulties encountered during the initial calibration procedure. Toluene was the only compound with difficulties during the Initial and Continuing calibration.

Most target compounds were spiked for this analytical batch. Only the required CLP spiking compounds are reported on Form III.

There were low levels of target compounds detected in the method blank and associated samples at levels below the CRQL. All results affected have been flagged with the appropriate qualifier.

All holding times were met for this SDG.

The library search results for A01SS-14 were mixed during the report format stage and will be found as pages 000094 through 000103.

Semivolatile Organics by GC/MS

Eleven of 210 surrogates were outside QC limits.

Sixteen of 44 soil matrix spike recoveries and one of 22 soil matrix RPD's were outside QC limits.

Matrix spike data is not available for the water sample #A01SS-2A/B (Field Blank) due to the insufficient sample volume supplied. QA/QC acceptance was based on blank (method) spike recoveries which were within QC limits.

There were low levels of target compounds detected in the method blank and associated samples at levels below the CRQL. All results affected have been flagged with the appropriate qualifier.

No GPC cleanup was performed on the solid samples submitted in this SDG.

Pesticides/PCB's by GC

7 of 58 surrogates were outside Advisory QC limits.

All matrix spike recoveries were in control and 3 duplicate RPD's were outside of QC limits.

All blank spike recoveries were in control.

All method blank criteria were met for this SDG.

No GPC cleanup was performed on solid samples submitted in this SDG.

All holding times were met for this SDG.

Explosives by HPLC

CLP Forms and/or analytical requirements do not apply to all Explosives Level C type deliverable requirements. Every effort was made to conform to the CLP format and all applicable CLP/Level C forms have been included.

All matrix spike recoveries and matrix spike duplicate RPD's were within control limits.

A sample from another SDG# was utilized for the matrix spike/matrix spike duplicate for this SDG.

All method blank criteria were met for this SDG.

All initial calibration criteria were met for this SDG.

All sample holding times were met for this SDG.

Metals

CLP Forms and/or analytical requirements do not apply to all Level C type deliverable requirements. Every effort was made to conform to the CLP format and all applicable CLP/Level C forms have been included.

All of the initial calibration criteria were within QC limits.

All Method Blank criteria were within QC limits.

Low spike recoveries were noted for 2 of 23 analytes for the first prep batch, 6 of 23 analytes for the second prep batch and 4 of 23 analytes for the third prep batch. All data associated with these out of control matrix spike recoveries have been flagged appropriately with the "N" qualifier.

Aluminum, calcium, iron and manganese were outside QC limits due to the high levels of these elements present in the unspiked sample. Post spikes were not required.

Post spike recoveries were outside QC limits for thallium in sample numbers: A01SS-16, A01SS-17, A01ss-18, A01ss-19, A01SS-33, A01SS-34, A01SS-37, A01SS-38, A01SS-39, A01SS-40, A01SS-41, A01SS-42, and A01SS-79. These samples have been flagged with the appropriate "W" qualifier.

Post spike recoveries were outside QC limits for selenium in sample numbers: A01SS-35, A01SS-36, A01SS-37, A01SS-40, A01SS-44, and A01SS-46. These samples have been flagged with the appropriate "W" qualifier.

Duplicate RPD results were >20% for 12 of the analytes within the three prep batches. All data associated with these out of control RPD's, have been appropriately flagged with the "*" qualifier.

All Laboratory Control Samples (LCS) were within acceptable QC limits.

All holding times were met for this SDG.

Conventionals

CLP Forms and/or analytical requirements do not apply to all Conventional Level C deliverable requirements. Every effort was made to conform to the CLP format and all applicable CLP/Level C forms have been included.

The method blank contained cyanide at a level which was below the CRDL but above the IDL. This result was flagged with the "B" qualifier.

The matrix spike and sample duplicate were within QC limits for this SDG.

All initial and continuing calibration criteria were met for this SDG.

The LCS was within acceptable QC limits.

All sample holding times were met for this SDG.

Signature: J. Hnatow Name: Joseph A. Hnatow
Date: 2/27/95 Title: Laboratory Manager

SUMMARY OF ANALYTICAL METHODOLOGY

Parameter	Reference	Method
Organics		
Pesticides and PCBs by GC	SW-846	8080
Volatile Compounds by GC/MS	CLP	SOW
Semi-volatile Compounds by GC/MS	CLP	SOW
Explosives Analysis, LC	SW-846	8330A
Metals		
Total Metals	SW-846	6010
Mercury by Cold Vapor	SW-846	7471
Conventionals		
Solids, Total (solid)	CAWW	160.3

OHM Remediation Services Corp.
A Subsidiary of OHM Corporation

ANALYTICAL DIVISION

Laboratory Analysis Report

Client: OHM Remediation Services Corp.
Eastern Region (Trenton, NJ)

Attn: Ken Kukkonen
Ron Kenyon

Project: 15629N - NEESA; Yorktown Naval Weapons Station, Yorktown, VA

Sample Type(s): Liquid and Solid

Analysis Performed: Organics, Metals, RCRA TCLP Leachate Parameters and Conventionals

Date Sample Received: December 3, 1994

Date Order Received: December 3, 1994

Joblink(s): 617195

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Reviewed and Approved by: J. Hnatow for
Thomas E. Gran, Ph.D., Vice President

Date: *February 27, 1995*

16406 U.S. Route 224 East ■ P.O. Box 551 ■ Findlay, OH 45839-0551 ■ 419-423-3526

Narrative for SDG # A01SS-06, Report # 1

Laboratory: Analytical Services Corp.

Project #: OHM # 15629

Project Location: Naval Weapons Station, Yorktown, Virginia

Samples in this Sample Delivery Group (SDG):

A01SS-06	A01SS-12	A01SS-23	A01SS-29
A01SS-07	A01SS-13	A01SS-24	A01SS-30
A01SS-08	A01SS-14	A01SS-25	A01SS-31
A01SS-09	A01SS-20	A01SS-26	A01SS-32
A01SS-10	A01SS-21	A01SS-27	FRINSATE
A01SS-11	A01SS-22	A01SS-28	

Overall Report Comments

In performing the analyses for this project, the laboratory did not use the SDG Numbers as specified by the EPA Statement of Work (Inorganic or Organic). While this may causes some difficulty in reviewing and validating this data, please be aware that the laboratory has a strictly defined sample batching system in use. Understanding how the laboratory batches samples will help the data reviewer greatly.

When samples are batched for quality control purposes the batch is named by the following system. The first letter of the QA batch determines what regulation or system the work is being performed under. For this data all batches are started with an "N" for NFESC. The second character is the matrix of the samples (1 for aqueous, 2 for solids, and 7 for TCLP leachates). The third character designates what laboratory group will do the work (M for ICP metals, R for furnace metals, G for mercury, I for inorganics or conventional tests, C for GC/MS SVA, V for GC/MS VOA, P for GC pesticides/PCBs, H for herbicides and Q for explosives by HPLC). The four or five numbers which then appear are sequential batch numbers. The batch N7M2378 would represent the batch 2378 with TCLP leachate samples analyzed for ICP metals under the NFESC program. The batch N2C2378 would represent the batch 2378 containing solid samples analyzed for GC/MS SVA's under the NFESC program. In reviewing the samples it will become apparent that the laboratory did analyze the samples correctly, but used the SDG numbers incorrectly.

In the five reports for this project the data reviewer will need to watch the ASC batch numbers to make sense of the reported data. In some of the latter reports the batch number is used as the SDG number and hopefully this will make it easier to determine how the samples were grouped for analysis.

Please be aware that the laboratory shortens Analytical Services Corp. to ASC and both designations will be found in the report.

A number of samples in this project exhibited internal standard interferences for both VOA and SVA by GC/MS analyses. These samples were reinjected to verify and in some cases diluted to provide appropriate data. Only the results from the reported data are presented within this report.

The information presented on Form IV references the blank ASC considers to be the QA batch method blank. This blank was not analyzed on all SVA instruments utilized for the various tests and Form IV can not be considered as completely accurate.

Volatile Organics by GC/MS

Zero of 90 surrogate recoveries were outside QC limits.

Two of 20 matrix spike recoveries and one of ten matrix RPD's were outside QC limits.

One of ten blank spike (method spike) recoveries were outside QC limits.

Hexane and 1,1,2-Trichloro-1,2,2-trifuoroethane are used in the laboratory and should be viewed with caution.

In the Initial calibration analyzed on November 8, 1994 two responses for Toluene were removed by the analyst and not caught during subsequent reviews. This is not a normal practice for ASC. The analysts have been advised as to the procedure for sample reanalysis for difficulties encountered during the initial calibration procedure. Toluene was the only compound with difficulties during the Initial and Continuing calibration.

Most target compounds were spiked for this analytical batch. Only the required CLP spiking compounds are reported on Form III.

There were low levels of target compounds detected in the method blank and associated samples at levels below the CRQL. All results affected have been flagged with the appropriate qualifier.

All holding times were met for this SDG.

The library search results for A01SS-14 were mixed during the report format stage and will be found as pages 000094 through 000103.

Semivolatile Organics by GC/MS

Eleven of 210 surrogates were outside QC limits.

Sixteen of 44 soil matrix spike recoveries and one of 22 soil matrix RPD's were outside QC limits.

Matrix spike data is not available for the water sample #A01SS-2A/B (Field Blank) due to the insufficient sample volume supplied. QA/QC acceptance was based on blank (method) spike recoveries which were within QC limits.

There were low levels of target compounds detected in the method blank and associated samples at levels below the CRQL. All results affected have been flagged with the appropriate qualifier.

No GPC cleanup was performed on the solid samples submitted in this SDG.

Pesticides/PCB's by GC

7 of 58 surrogates were outside Advisory QC limits.

All matrix spike recoveries were in control and 3 duplicate RPD's were outside of QC limits.

All blank spike recoveries were in control.

All method blank criteria were met for this SDG.

No GPC cleanup was performed on solid samples submitted in this SDG.

All holding times were met for this SDG.

Explosives by HPLC

CLP Forms and/or analytical requirements do not apply to all Explosives Level C type deliverable requirements. Every effort was made to conform to the CLP format and all applicable CLP/Level C forms have been included.

All matrix spike recoveries and matrix spike duplicate RPD's were within control limits.

A sample from another SDG# was utilized for the matrix spike/matrix spike duplicate for this SDG.

All method blank criteria were met for this SDG.

All initial calibration criteria were met for this SDG.

All sample holding times were met for this SDG.

Metals

CLP Forms and/or analytical requirements do not apply to all Level C type deliverable requirements. Every effort was made to conform to the CLP format and all applicable CLP/Level C forms have been included.

All of the initial calibration criteria were within QC limits.

All Method Blank criteria were within QC limits.

Low spike recoveries were noted for 2 of 23 analytes for the first prep batch, 6 of 23 analytes for the second prep batch and 4 of 23 analytes for the third prep batch. All data associated with these out of control matrix spike recoveries have been flagged appropriately with the "N" qualifier.

Aluminum, calcium, iron and manganese were outside QC limits due to the high levels of these elements present in the unspiked sample. Post spikes were not required.

All Laboratory Control Samples (LCS) were within acceptable QC limits.

All holding times were met for this SDG.

Conventionals

CLP Forms and/or analytical requirements do not apply to all Conventional Level C deliverable requirements. Every effort was made to conform to the CLP format and all applicable CLP/Level C forms have been included.

The method blank contained cyanide at a level which was below the CRDL but above the IDL. This result was flagged with the "B" qualifier.

The matrix spike and sample duplicate were within QC limits for this SDG.

All initial and continuing calibration criteria were met for this SDG.

The LCS was within acceptable QC limits.

All sample holding times were met for this SDG.

Signature: J. Hnatow Name: Joseph A. Hnatow
Date: 2/27/95 Title: Laboratory Manager

SUMMARY OF ANALYTICAL METHODOLOGY

Parameter	Reference	Method
Organics		
Pesticides and PCBs by GC	SW-846	8080
Volatile Compounds by GC/MS	CLP	SOW
Semi-volatile Compounds by GC/MS	CLP	SOW
Explosives Analysis, LC	SW-846	8330A
Metals		
Total Metals	SW-846	6010
Mercury by Cold Vapor	SW-846	7471
RCRA TCLP		
Leachate Preparation	SW-846	1311
Herbicides by GC	SW-846	8150 (1)
Pesticides by GC	SW-846	8080
Metals	SW-846	6010
Mercury by Cold Vapor	SW-846	7470
Semi-volatile Compounds by GC/MS	SW-846	8270
Volatile Compounds by GC/MS	SW-846	8240
Conventionals		
Solids, Total (solid)	CAWW	160.3
RCRA Characteristics		
pH, Electrode (solid)	SW-846	9045
Reactive Sulfide	SW-846	7.3.4.2
Flash Point, Seta Flash	SW-846	1020
Reactive Cyanide	SW-846	7.3.3.2

OHM Remediation Services Corp.
A Subsidiary of OHM Corporation

ANALYTICAL DIVISION

Laboratory Analysis Report

Client: OHM Remediation Services Corp.
Eastern Region (Trenton, NJ)

Attn: Ken Kukkonen
Ron Kenyon

Project: 15629N - NEESA; Yorktown Naval Weapons Station, Yorktown, VA

Sample Type(s): Liquid and Solid

Analysis Performed: Organics, Metals and Conventionals

Date Sample Received: November 5, 1994

Date Order Received: November 5, 1994

Joblink(s): 617018

This report is "PROPRIETARY AND CONFIDENTIAL" and delivered to, and intended for the exclusive use of the above named client only. OHM Remediation Services Corp., Analytical Division, assumes no responsibility or liability for the reliance hereon or use hereof by anyone other than the above named client.

Reviewed and Approved by: *Thomas E. Gran, Ph.D., Vice President* *Date:* *February 27, 1995*

16406 U.S. Route 224 East ■ P.O. Box 551 ■ Findlay, OH 45839-0551 ■ 419-423-3526

Narrative for SDG # A01SS-1, Report # 3

Laboratory: Analytical Services Corp.

Project #: OHM # 15629

Project Location: Naval Weapons Station, Yorktown, Virginia

Samples in this Sample Delivery Group (SDG):

A01SS-2A/D	A01SS-33	A01SS-40	A01SS-46
A01SS-3A/D	A01SS-34	A01SS-41	A01SS-47
A01SS-15	A01SS-35	A01SS-42	A01SS-77
A01SS-16	A01SS-36	A01SS-43	A01SS-78
A01SS-17	A01SS-37	A01SS-44	A01SS-79
A01SS-18	A01SS-38	A01SS-45	A01SS-80
A01SS-19	A01SS-39		

Overall Report Comments

In performing the analyses for this project, the laboratory did not use the SDG Numbers as specified by the EPA Statement of Work (Inorganic or Organic). While this may causes some difficulty in reviewing and validating this data, please be aware that the laboratory has a strictly defined sample batching system in use. Understanding how the laboratory batches samples will help the data reviewer greatly.

When samples are batched for quality control purposes the batch is named by the following system. The first letter of the QA batch determines what regulation or system the work is being performed under. For this data all batches are started with an "N" for NFESC. The second character is the matrix of the samples (1 for aqueous, 2 for solids, and 7 for TCLP leachates). The third character designates what laboratory group will do the work (M for ICP metals, R for furnace metals, G for mercury, I for inorganics or conventional tests, C for GC/MS SVA, V for GC/MS VOA, P for GC pesticides/PCBs, H for herbicides and Q for explosives by HPLC). The four or five numbers which then appear are sequential batch numbers. The batch N7M2378 would represent the batch 2378 with TCLP leachate samples analyzed for ICP metals under the NFESC program. The batch N2C2378 would represent the batch 2378 containing solid samples analyzed for GC/MS SVA's under the NFESC program. In reviewing the samples it will become apparent that the laboratory did analyze the samples correctly, but used the SDG numbers incorrectly.

In the five reports for this project the data reviewer will need to watch the ASC batch numbers to make sense of the reported data. In some of the latter reports the batch number is used as

the SDG number and hopefully this will make it easier to determine how the samples were grouped for analysis.

Please be aware that the laboratory shortens Analytical Services Corp. to ASC and both designations will be found in the report.

A number of samples in this project exhibited internal standard interferences for both VOA and SVA by GC/MS analyses. These samples were reinjected to verify and in some cases diluted to provide appropriate data. Only the results from the reported data are presented within this report. The other data files are available for your review if you deem them necessary.

The information presented on Form IV references the blank ASC considers to be the QA batch method blank. This blank was not analyzed on all SVA instruments utilized for the various tests and Form IV can not be considered as completely accurate.

Volatile Organics by GC/MS

Two of 111 surrogate recoveries were outside QC limits.

Zero of 30 matrix spike recoveries and zero of 22 matrix RPD's were outside QC limits.

Hexane and 1,1,2-Trichloro-1,2,2-trifuoroethane are used in the laboratory and should be viewed with caution.

In the Initial Calibration only four points were used instead of the complete five points. The fifth standard (200 ppb, VSTD200) was analyzed followed by samples on a sixteen place autosampler. Due to holdtime considerations the next set of samples was loaded and the 5-point initial calibration was not reviewed completely before the samples were analyzed. As soon as the mistake was discovered a new calibration was completed, however, some of the samples were reported against the 4-point calibration.

Most target compounds were spiked for this analytical batch. Only the required CLP spiking compounds are reported on Form III.

There were low levels of target compounds detected in the method blank and associated samples at levels below the CRQL. All results affected have been flagged with the appropriate qualifier.

Some of the samples which had internal standard problems were not rerun due to holdtime considerations.

Semivolatile Organics by GC/MS

Eight of 210 surrogates were outside QC limits.

Seven of 44 soil matrix spike recoveries and zero of 22 soil matrix RPD's were outside QC limits.

Matrix spike data is not available for the water sample #A01SS-2A/B (Field Blank) due to the insufficient sample volume supplied. QA/QC acceptance was based on blank (method) spike recoveries which were within QC limits.

There were low levels of target compounds detected in the method blank and associated samples at levels below the CRQL. All results affected have been flagged with the appropriate qualifier.

No GPC cleanup was performed on the solid samples submitted in this SDG.

Pesticides/PCB's by GC

One of 70 surrogates were outside QC limits.

One of 24 soil matrix spike recoveries and two of 12 soil matrix RPD's were outside QC limits.

Matrix spike data is not available for water samples # A01SS-3A/D (field blank) due to the insufficient sample volume supplied. QA/QC acceptance was based on blank (method) spike recoveries which were within QC limits.

A sample from another SDG# was utilized for the one of the soil matrix spike/matrix spike duplicates for this SDG.

All method blank criteria were met for this SDG.

No GPC cleanup was performed on solid samples submitted in this SDG.

All holding times were met for this SDG.

Explosives by HPLC

CLP Forms and/or analytical requirements do not apply to all Explosives Level C type deliverable requirements. Every effort was made to conform to the CLP format and all applicable CLP/Level C forms have been included.

All matrix spike recoveries and matrix spike duplicate RPD's were in control.

All method blank criteria were met for this SDG.

All sample holding times were met for this SDG.

Metals

CLP Forms and/or analytical requirements do not apply to all TCLP Level C type deliverable requirements. Every effort was made to conform to the CLP format and all applicable CLP/Level C forms have been included.

All of the initial calibration criteria were within QC limits.

All continuing calibration criteria were within QC limits, with the exception of two arsenic, one selenium and one thallium.

All Method Blank criteria were within QC limits.

All data associated with analyte matrix spike recoveries outside the 75% - 125% control limits, have been flagged with an "N" qualifier.

All data associated with duplicate RPD's which were >20%, have been flagged with a "*" qualifier.

Post digestion spikes for graphite furnace AA which were outside the 85%-115% control limits but had a sample absorbance <50% of the spike absorbance, were flagged with a "W" qualifier.

All Laboratory Control Samples (LCS) were within acceptable QC limits.

All holding times were met for this SDG.

Conventionals

All method blanks were in control.

The matrix spikes and sample duplicates were within QC limits for this SDG.

All initial calibration criteria were met for this SDG.

All LCS's were within acceptable QC limits.

All sample holding times were met for this SDG.

Signature: J. Hnatow Name: Joseph A. Hnatow
Date: 2/27/95 Title: Laboratory Manager

SUMMARY OF ANALYTICAL METHODOLOGY

Parameter	Reference	Method
Organics		
Pesticides and PCBs by GC	SW-846	8080
Volatile Compounds by GC/MS	CLP	SOW
Semi-volatile Compounds by GC/MS	CLP	SOW
Explosives Analysis, LC	SW-846	8330A
Metals		
Total Metals	SW-846	6010
Mercury by Cold Vapor	SW-846	7471
Mercury by Cold Vapor (liquid)	SW-846	7470
Conventionals		
Solids, Total (solid)	CAWW	160.3

#4

OHM Remediation Services Corp.
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ANALYTICAL DIVISION

Laboratory Analysis Report

Client: OHM Remediation Services Corp.
Eastern Region (Trenton, NJ)

Attn: Ken Kukkonen
Ron Kenyon

Project: 15629N - NEESA; Yorktown Naval Weapons Station, Yorktown, VA

Sample Type(s): Liquid and Solid

Analysis Performed: Organics, Metals and Conventionals

Date Sample Received: November 9 and 11, 1994

Date Order Received: November 9 and 11, 1994

Joblink(s): 617048 and 617067

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Reviewed and Approved by: J. Hnatow for
Thomas E. Gran, Ph.D., Vice President

Date: *February 27, 1995*

16406 U.S. Route 224 East ■ P.O. Box 551 ■ Findlay, OH 45839-0551 ■ 419-423-3526

Narrative for Report # 4

Laboratory: Analytical Services Corp.

Project #: OHM # 15629

Project Location: Naval Weapons Station, Yorktown, Virginia

Samples in this Sample Delivery Group (SDG):

A01SS-49	A02SS-67	A02SS-74	A02SS-87
A01SS-50	A02SS-68	A02SS-75	A02SS-88
A01SS-51	A02SS-69	A02SS-76	A02S2-89
A01SS-52	A02SS-70	A02SS-81	A02S2-91
A01SS-53	A02SS-71	A02SS-82	A01SS-92
A01SS-54	A02SS- 72	A02SS-83	A01SS-93
A01SS-86	A02SS-73	A02SS-84	A02SS-94
RB-06B2/C/D	RB-06A/B1		

Overall Report Comments

In performing the analyses for this project, the laboratory did not use the SDG Numbers as specified by the EPA Statement of Work (Inorganic or Organic). While this may causes some difficulty in reviewing and validating this data, please be aware that the laboratory has a strictly defined sample batching system in use. Understanding how the laboratory batches samples will help the data reviewer greatly.

When samples are batched for quality control purposes the batch is named by the following system. The first letter of the QA batch determines what regulation or system the work is being performed under. For this data all batches are started with an "N" for NFESC. The second character is the matrix of the samples (1 for aqueous, 2 for solids, and 7 for TCLP leachates). The third character designates what laboratory group will do the work (M for ICP metals, R for furnace metals, G for mercury, I for inorganics or conventional tests, C for GC/MS SVA, V for GC/MS VOA, P for GC pesticides/PCBs, H for herbicides and Q for explosives by HPLC). The four or five numbers which then appear are sequential batch numbers. The batch N7M2378 would represent the batch 2378 with TCLP leachate samples analyzed for ICP metals under the NFESC program. The batch N2C2378 would represent the batch 2378 containing solid samples analyzed for GC/MS SVA's under the NFESC program. In reviewing the samples it will become apparent that the laboratory did analyze the samples correctly, but used the SDG numbers incorrectly.

In the five reports for this project the data reviewer will need to watch the ASC batch numbers to make sense of the reported data. In this report the GC/MS data is referenced by the laboratory

batch number as the SDG number.

Please be aware that the laboratory shortens Analytical Services Corp. to ASC and both designations will be found in the report.

A number of samples in this project exhibited internal standard interferences for both VOA and SVA by GC/MS analyses. These samples were reinjected to verify and in some cases diluted to provide appropriate data. Only the results from the reported data are presented within this report. The other data files are available for your review if you deem them necessary.

The information presented on Form IV references the blank ASC considers to be the QA batch method blank. This blank was not analyzed on all SVA instruments utilized for the various tests and Form IV can not be considered as completely accurate.

Volatile Organics by GC/MS

Four of 150 surrogate recoveries were outside QC limits.

Zero of 30 matrix spike recoveries and one of 15 matrix RPD's were outside QC limits.

Hexane appeared as an artifact that was known to be a laboratory contaminant. This compound elutes at approximately 8.8 minutes and was not included as part of the TIC screen data reported on Form I-VOA TIC.

All target compounds were inadvertently spiked for this analytical batch. Only the required CLP spiking compounds were reported on Form III.

Semivolatile Organics by GC/MS

Twenty-eight of 318 surrogates were outside QC limits.

Twelve of 66 matrix spike recoveries and one of 33 soil matrix RPD's were outside QC limits.

No GPC cleanup was performed on the solid samples submitted in this SDG.

Pesticides/PCB's by GC

Pesticides within this data package appear under four SDG numbers: N1P41683, N2P41674, N2P41675 and N2P41690.

4 of 108 surrogates were outside Advisory QC limits.

All matrix spike recoveries were in control with the exception of heptachlor in the spike on sample #A02SS-89, SDG# N2P41690.

All duplicate RPD's were in control, with the exception of heptachlor in the MS/MSD in sample #A05SS-62, SDG# N2P41675.

All blank spike recoveries were in control.

All method blank criteria were met for this SDG.

No GPC cleanup was performed on solid samples submitted in this SDG.

Explosives by HPLC

All explosives data within this report are reported under SDG# A01SS-19.

CLP Forms and/or analytical requirements do not apply to all Explosives Level C type deliverable requirements. Every effort was made to conform to the CLP format and all applicable CLP/Level C forms have been included.

All matrix spike recoveries and matrix spike duplicate RPD's were within control limits with the exception of the RPD for 1,3-Dinitrobenzene for sample #A02SS-89.

Blank spike ID N2Q41676QS was out of control for HMX and blank spike ID N1Q41671 was out of control for 2,6-DNT and Tetryl.

The blank spike N1Q41671 was spiked at a level 2x higher than normal. This sample was therfore analyzed both straight and at a dilution.

A sample from another SDG# was utilized for the matrix spike/matrix spike duplicate in this SDG.

All method blank criteria were met for this SDG.

Second column confirmation analyses were performed on samples in this SDG. A copy of the standard cromatogram has been included in this data package. It has been placed in the data package immediately following the copies of the initial calibration standards chromatograms.

All sample holding times were met for this SDG.

Metals

All metals data within this report are reported under SDG #'s A01SS-19 and A01SS-58.

CLP Forms and/or analytical requirements do not apply to all Level C type deliverable requirements. Every effort was made to conform to the CLP format and all applicable CLP/Level C forms have been included.

All of the initial calibration criteria were within QC limits.

All furnace continuing calibrations for SDG #A01SS-19 were in control with the exception of one arsenic CCV which had a %recovery of 89.6%. All furnace continuing calibrations for SDG #A01SS-58 were in control with the exception of one arsenic, %recovery = 86.7% and one selenium, %recovery = 87.6%.

All Method Blank criteria were within QC limits.

All data associated with analyte matrix spike recoveries outside the 75% - 125% control limits, have been flagged with an "N" qualifier.

All data associated with duplicate RPD's which were >20%, have been flagged with a "*" qualifier.

Post digestion spikes for graphite furnace AA which were outside the 85%-115% control limits but had a sample absorbance <50% of the spike absorbance, were flagged with a "W" qualifier.

All Laboratory Control Samples (LCS) were within acceptable QC limits.

All holding times were met for this SDG.

Mercury analysis was not performed on sample #A02SS-94. This sample was inadvertantly missed and the problem was not detected until after the holding time had expired.

Conventionals

CLP Forms and/or analytical requirements do not apply to all Conventional Level C deliverable requirements. Every effort was made to conform to the CLP format and all applicable CLP/Level C forms have been included.

The matrix spike and sample duplicate were within QC limits for this SDG.

All initial and continuing calibration criteria were met for this SDG.

The LCS was within acceptable QC limits.

All sample holding times were met for this SDG.

Signature: J. Hnatow Name: Joseph A. Hnatow
Date: 2-27-95 Title: Laboratory Manager

SUMMARY OF ANALYTICAL METHODOLOGY

Parameter	Reference	Method
Organics		
Pesticides and PCBs by GC	SW-846	8080
Volatile Compounds by GC/MS	CLP	SOW
Semi-volatile Compounds by GC/MS	CLP	SOW
Explosives Analysis, LC	SW-846	8330A
Metals		
Total Metals	SW-846	6010
Mercury by Cold Vapor	SW-846	7471
Mercury by Cold Vapor (liquid)	SW-846	7470
Conventionals		
Solids, Total (solid)	CAWW	160.3
Cyanide, Total	SW-846	9010
Cyanide, Total	CLP	335.2

OHM Remediation Services Corp.
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ANALYTICAL DIVISION

Laboratory Analysis Report

Client: OHM Remediation Services Corp.
Eastern Region (Trenton, NJ)

Attn: Ken Kukkonen
Ron Kenyon

Project: 15629N - NEESA; Yorktown Naval Weapons Station, Yorktown, VA

Sample Type(s): Liquid and Solid

Analysis Performed: Organics, Metals, RCRA TCLP Leachate Parameters and Conventionals

Date Sample Received: November 14, 1994 and
December 7, 9, 10 and 13 through 15, 1994

Date Order Received: November 14, 1994 and
December 7, 9, 10 and 13 through 15, 1994

Joblink(s): 617092, 617208, 617251, 617257, 617263, 617266 and 617273

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Reviewed and Approved by: _____ *Date:* *February 27, 1995*
Thomas E. Gran, Ph.D., Vice President

16406 U.S. Route 224 East ■ P.O. Box 551 ■ Findlay, OH 45839-0551 ■ 419-423-3526

Narrative for SDG # A01SS-1, Report # 5

Laboratory: Analytical Services Corp.

Project #: OHM # 15629

Project Location: Naval Weapons Station, Yorktown, Virginia

Samples in this Sample Delivery Group (SDG):

A01SS-06B	A01SS-53B	A01SS-106	A02SS-83B
A01SS-16B	A01SS-54B	A01SS-109	A02SS-92B
A01SS-17B	A01SS-95	A01SS-110	A02S2-107C
A01SS-18B	A01SS96B	A01SS-111	A02S2-108A
A01SS-26B	A01SS-103B	A01SS-112	A02SS-RIN9
A01SS-33B	A01SS-104	A01SS-113	RB-01A/D
A01SS-42B	A01SS-105	A02SS-74D	FB-01A/B
A02SS-93C	A02SS-93D	R-8	TB-2
TB-3(12/9)	TB-3(12/10)	TB-4	TB-5

Overall Report Comments

In performing the analyses for this project, the laboratory did not use the SDG Numbers as specified by the EPA Statement of Work (Inorganic or Organic). While this may causes some difficulty in reviewing and validating this data, please be aware that the laboratory has a strictly defined sample batching system in use. Understanding how the laboratory batches samples will help the data reviewer greatly.

When samples are batched for quality control purposes the batch is named by the following system. The first letter of the QA batch determines what regulation or system the work is being performed under. For this data all batches are started with an "N" for NFESC. The second character is the matrix of the samples (1 for aqueous, 2 for solids, and 7 for TCLP leachates). The third character designates what laboratory group will do the work (M for ICP metals, R for furnace metals, G for mercury, I for inorganics or conventional tests, C for GC/MS SVA, V for GC/MS VOA, P for GC pesticides/PCBs, H for herbicides and Q for explosives by HPLC). The four or five numbers which then appear are sequential batch numbers. The batch N7M2378 would represent the batch 2378 with TCLP leachate samples analyzed for ICP metals under the NFESC program. The batch N2C2378 would represent the batch 2378 containing solid samples analyzed for GC/MS SVA's under the NFESC program. In reviewing the samples it will become apparent that the laboratory did analyze the samples correctly, but used the SDG numbers incorrectly.

In the five reports for this project the data reviewer will need to watch the ASC batch numbers

to make sense of the reported data. In this report the GC/MS data is referenced by the laboratory batch number as the SDG number.

Please be aware that the laboratory shortens Analytical Services Corp. to ASC and both designations will be found in the report.

A number of samples in this project exhibited internal standard interferences for both VOA and SVA by GC/MS analyses. These samples were reinjected to verify and in some cases diluted to provide appropriate data. Only the results from the reported data are presented within this report. The other data files are available for your review if you deem them necessary.

The information presented on Form IV references the blank ASC considers to be the QA batch method blank. This blank was not analyzed on all SVA instruments utilized for the various tests and Form IV can not be considered as completely accurate.

Volatile Organics by GC/MS

Four of 225 surrogate recoveries were outside QC limits.

Zero of 104 matrix spike recoveries and zero of 52 matrix RPD's were outside QC limits.

Hexane and 1,1,2-Trichloro-1,2,2-trifuoroethane are used in the laboratory and should be viewed with caution.

Most target compounds were spiked for this analytical batch. Only the required CLP spiking compounds are reported on Form III.

There were low levels of target compounds detected in the method blank and associated samples at levels below the CRQL. All results affected have been flagged with the appropriate qualifier.

Some of the samples which had internal standard problems were not rerun due to holdtime considerations.

One sample (RB-01A/D) should have been diluted for acetone. This was inadvertently missed by the analyst.

Semivolatile Organics by GC/MS

Eight of 210 surrogates were outside QC limits.

Seven of 44 soil matrix spike recoveries and zero of 22 soil matrix RPD's were outside QC limits.

Matrix spike data is not available for the water sample #A01SS-2A/B (Field Blank) due to the insufficient sample volume supplied. QA/QC acceptance was based on blank (method) spike recoveries which were within QC limits.

There were low levels of target compounds detected in the method blank and associated samples at levels below the CRQL. All results affected have been flagged with the appropriate qualifier.

No GPC cleanup was performed on the solid samples submitted in this SDG.

TCLP Herbicides

Herbicides within this report are under SDG# A01SS-104.

CLP Forms and/or analytical requirements do not apply to all TCLP Herbicide Level C type deliverable requirements. Every effort was made to conform to the CLP format and all applicable CLP/Level C forms have been included.

All matrix spike recoveries were in control and all MS/MSD RPD's were in control.

All method blank criteria were met for this SDG.

All initial and continuing calibration criteria were met for this SDG.

A sample from another SDG was used for the MS/MSD.

All sample holding times were met for this SDG.

Explosives by HPLC

The explosives within this report are reported under SDG #'s N2Q41691, N2Q41865, N2Q41818 and N1Q41815.

CLP Forms and/or analytical requirements do not apply to all Explosives Level C type deliverable requirements. Every effort was made to conform to the CLP format and all applicable CLP/Level C forms have been included.

All matrix spike recoveries were in control with the exception of Tetryl in sample A02SS-RIN9 in SDG #N1Q41815.

All MS/MSD RPD's were in control with the exception of 1,3-Dinitrobenzene in SDG #N2Q41691.

All method blank criteria were met for this SDG.

All blank spike recoveries were in control with the exception of Tetryl for SDG #N1Q41815.

Due to insufficient sample volume, only a matrix spike could be performed on sample A02SS-RIN9 in SDG #N1Q41815.

Second column confirmation analyses were performed on samples in this SDG. A copy of the standard cromatogram has been included in this data package. It has been placed in the data package immediately following the copies of the initial calibration standards chromatograms.

All sample holding times were met for this SDG.

Total And TCLP Metals

Metals data within this data package are reported under the following SDG #'s: A01SS-104, A01SS-3, A01SS-18, A01SS-74, A01SS-93 and A01SS-111.

All Method Blank criteria were within QC limits.

All data associated with analyte matrix spike recoveries outside the 75% - 125% control limits, have been flagged with an "N" qualifier.

All data associated with duplicate RPD's which were >20%, have been flagged with a "*" qualifier.

Post digestion spikes for graphite furnace AA which were outside the 85%-115% control limits but had a sample absorbance <50% of the spike absorbance, were flagged with a "W" qualifier.

All Laboratory Control Samples (LCS) were within acceptable QC limits.

All holding times were met for this SDG.

Conventionals

CLP Forms and/or analytical requirements do not apply to all Conventional Level C deliverable requirements. Every effort was made to conform to the CLP format and all applicable CLP/Level C forms have been included.

The pH results are reported in standard units and not mg/kg.

The Flashpoint results are reported in °C not mg/kg.

The method qualifier for pH (Electrode) is "PH", for Reactive Cyanide it is "RC", for Reactive

Sulfide it is "RS". The CLP manual does not address these results or this method for reporting.

The method blank was within QC limits for this SDG.

The matrix spike and sample duplicate were within QC limits for this SDG.

All initial and continuing calibration criteria were met for this SDG.

The LCS was within acceptable QC limits.

All sample holding times were met for this SDG.

Signature: J. Hnatow Name: Joseph A. Hnatow
Date: 2/27/95 Title: Laboratory Manager

SUMMARY OF ANALYTICAL METHODOLOGY

Parameter	Reference	Method
Organics		
Pesticides and PCBs by GC	SW-846	8080
Volatile Compounds by GC/MS	CLP	SOW
Semi-volatile Compounds by GC/MS	CLP	SOW
Explosives Analysis, LC	SW-846	8330A
Metals		
Total Metals	SW-846	6010
Mercury by Cold Vapor	SW-846	7471
Mercury by Cold Vapor (liquid)	SW-846	7470
RCRA TCLP		
Leachate Preparation	SW-846	1311
Herbicides by GC	SW-846	8150 (1)
Pesticides by GC	SW-846	8080
Metals	SW-846	6010
Mercury by Cold Vapor	SW-846	7470
Semi-volatile Compounds by GC/MS	SW-846	8270
Volatile Compounds by GC/MS	SW-846	8240
Conventionals		
Solids, Total (solid)	CAWW	160.3
Cyanide, Total	SW-846	9010
Cyanide, Total	CLP	335.2
RCRA Characteristics		
pH, Electrode (solid)	SW-846	9045
Reactive Sulfide	SW-846	7.3.4.2
Flash Point, Seta Flash	SW-846	1020
Reactive Cyanide	SW-846	7.3.3.2

Lidya Gulizia
1927 East Lester Avenue
Fresno, California 93720

June 2, 1995

Mr. Ken Kukkonen
Project Manager
OHM Remediation Services Corp.
200 Horizon Center Blvd.
Trenton, New Jersey 08691-1904

Dear Mr. Kukkonen:

Enclosed is the data validation report for organic and inorganic samples collected in support of the post-construction soil program at the Naval Weapons Station at Yorktown, Virginia.

Overall, the data are acceptable as provided by Analytical Services Corporation (ASC). There are some contractual non-compliances and deviations that were performed by the laboratory which could potentially affect portions of the sample results. While some of these are minor, others may be considered to be more significant by the oversight reviewer.

Please feel free to call me with any questions at (209)297-5315. I will available to respond to any quality assurance or data review issues that may arise as a result of this report.

Thank you for the opportunity to work with you and your staff. I look forward to working with OHM on future projects which may require data review and validation.

Sincerely,

Lidya Gulizia

Lidya Gulizia

LG

enclosure: Data Validation Report

Lidya Gulizia
1927 East Lester Avenue
Fresno, California 93720

June 3, 1995

Bob Lynch
OHM Remediation Services Corp.
200 Horizon Center Boulevard
Trenton, New Jersey 08691-1904

Dear Bob:

Enclosed is the remaining addition to Appendix E Supporting Documentation of the Yorktown Weapons Station validation report. Place it directly behind the portion previously provided to you on Friday. This completes the report in full.

There are some additional changes to the data that were noticed by me as I was preparing the Data Summary Forms for Appendix B. You'll need to change your data tables accordingly. They are as follows:

(1) Change 2-butanone to rejected (qualifier "R") in samples A01SS-54 and rinsate blank data for #2, #3, and #4. You may or may not have had that qualified on the draft copies sent (VOC fraction).

(2) Change hexachlorocyclopentadiene to rejected (qualifier "R") in sample A01SS-06B. Remove "R" qualifier from hexachlorobutadiene to prior result from lab (SVOC fraction).

(3) Check your inorganic tables against the data I prepared in Appendix B Data Summary Forms. Place brackets around data points everywhere where I've indicated on the tables. As I prepared this appendix, I realized the lab had not applied the "B" qualifier for sample values between the instrument detection limit (IDL) and contract required detection limit (CRDL) for all analytes as required in the USEPA protocol. They missed a significant portion (reason unknown) that I picked up in preparing this final deliverable.

If you have any questions regarding these changes, please call me at (209)297-5315. I've also provided you with the Region III instructions for the preparation of the cover memo. Let me know if you need additional guidance with it.

Thanks for all your help. Once again, I'll be available to respond to any data issues and/or comments.

Sincerely,

Lidya Gulizia

Lidya Gulizia

LG

Enclosure: Appendix E - added pages
USEPA Region III Reporting Instructions

ORGANIC DATA VALIDATION REPORT PREPARATION

1.0 Purpose

The purpose of this procedure is to establish a report format for organic data review report writing according to EPA Region III protocol and is based on and applies to organic data review level M3 only.

2.0 Discussion

After completion of data review, the data reviewer will be responsible for compiling review notes and writing a report. The outline below describes the steps to follow in preparing the organic data review report.

3.0 Procedure

3.1 Organic Data Validation Narrative

The validation narrative is for the data user. Because the data user may not be familiar with EPA abbreviations, it is necessary to write out commonly used acronyms such as RAS, DAS, etc..

3.1.1 The first page of the report should be printed on letterhead. The address of the report should include the following information and be in the established format for Region III, as:

Date:	Month DD, YEAR (Date report is sent to EPA)	
Subject:	Organic Data Validation for Case (case #) Site (write site name)	
From:	Reviewer Name Reviewer Title	Oversight Reviewer Name Reviewer Title
To:	Remedial Project Manager EPA Region III	

3.1.2 Overview

The first section of the report is the overview, and is presented in paragraph form after the title "OVERVIEW". Information in this paragraph should include:

- Case or DAS (Delivered Analytical Services) Number
- Analytes
- Number of samples
- Matrix (or matrices and number of samples of each matrix)
- Number of QC samples (field and/or equipment blanks, trip blanks, field duplicates, etc.)
- The SOW under which the laboratory performed the analyses
- Laboratory name and its CLP Code

A statement should also be made that the samples were analyzed through the Contract Laboratory Program (CLP),

and whether they were performed as a Routine Analytical Services (RAS) or Delivered Analytical Services (DAS). If results exceeded the levels identified in the EPA 10-day Chemical Health Advisory Levels (Attachment A), such exceedances are mentioned in the overview paragraph(s).

3.1.3 **Summary**

The summary section, written below the title "**SUMMARY**", is a general statement noting whether the samples were successfully analyzed or if there were any analyses determined unsuccessful (e.g., data were qualified unusable).

3.1.4 **Major Problems**

After the section title, "**MAJOR PROBLEMS**", any problems identified during the validation that seriously affect data usability and any data that are qualified unusable, "R", is noted in this portion of the narrative. Identification of the support documentation included in the appendices of the report (see Section 3.1.8) which identifies each problem is referenced. Each identified problem is reported in a separate paragraph.

NOTE: Paragraphs in the major and minor problems sections and the "Notes" section are presented in "bulleted" format.

3.1.5 **Minor Problems**

The section title, "**MINOR PROBLEMS**" is followed by a series of bulleted paragraphs describing biases identified during the data review which may qualify data as "J", "UJ", "K", "L", or "UL". Examples of these problems are discussed thoroughly in the Functional Guidelines for Organic Data Validation as Modified by Region III. As in the reporting of major problems, support documentation is referenced for each problem described.

Problems listed in this section of the narrative are listed according to the hierarchy of qualifiers, beginning with the most serious ("J", "UJ") first. If problems are identified in more than one organic fraction, each fraction is identified.

3.1.6 **Notes**

This section follows the minor problems section and is used to identify issues and information which may be beneficial to the data user, and includes a paragraph describing any blank contamination found and its possible effects on sample results. Maximum levels of the blank contaminants are listed in tabular form. Common lab contaminants are identified with an asterisk (*). Other information which shall be included in the "Notes" section includes, but is not limited to: variances in methodology which did not affect samples, dilutions used, non-spiked MS/MSD comparisons, a field duplicate

comparison summary (in tabular form with relative percent differences [RPDs]), and a general statement regarding actions taken during the review of tentatively identified compounds (TICs). As in the problems descriptions, reference is made to support documentation included in the appendices of the report.

3.1.7 Report Content Statement

A short paragraph, not bulleted, follows the notes section stating that the data were reviewed in accordance with the Functional Guidelines for Evaluating Organic Analyses, as modified for use in Region III, and that the text of the report only addresses those problems which affect data usability.

3.1.8 Attachments

Under the section title "ATTACHMENTS", a list of appendices and their contents is included. The appendices normally listed and their order are:

Appendix A - Glossary of Data Qualifiers
Appendix B - Data Summary Forms
Appendix C - Laboratory Reported Results
Appendix D - Laboratory Reported TICs
Appendix E - Support Documentation

see next page for attachment

3.2 Appendices

Appendices are separated from the main body of the report by title pages containing, centered on the page, the appendix name and title.

3.2.1 Appendix A - Glossary of Data Qualifier Codes

A listing of all organic data qualifiers used in Region III and their definitions is included in Attachment D.

3.2.2 Appendix B - Data Summary Forms

3.2.2.1 The full title of this appendix is "Data Summary. These include:
(a) All positive results for target compounds with qualifier codes where applicable.
(b) All unusable detection limits (qualified "R")."

3.2.2.2 Included are Data Summary Forms for all fractions analyzed, sequentially numbered beginning with the volatile organic fraction, for all samples analyzed. Information on the Data Summary Forms includes: organic fraction identified, sample matrix, concentration units, site, case number, SDG number if multiple SDGs are reported, sampling date(s), sample numbers, dilution factors used (if none, identified as 1.0), sample locations, sample identifications (e.g., trip blank, field duplicate), contract required quantitation limit for each analyte, all target analytes, all positive results and

quantitation limits with qualifier codes where applicable, and all unusable detection limits qualified "R".

NOTE: Standard generation of the Data Summary Forms can be done on a spreadsheet program. Blank Data Summary Forms for both aqueous and solid samples are included in Attachment E.

3.2.3 Appendix C - Results as Reported by the Laboratory for all Target Compounds

After the title page, Appendix C contains photocopies of all of the Form Is. The Form Is for all samples for the volatile organics fraction are included first, followed by Form Is for all samples for semivolatile organic compounds and pesticides/PCBs. The sample order of the Form Is should match the sample order as listed on the Data Summary Forms.

3.2.4 Appendix D - Reviewed and Accepted (Corrected) Tentatively Identified Compounds

Appendix D contains photocopies of the Tentatively Identified Compounds forms (Form I VOA - TIC and Form I SV - TIC) for each sample, with all volatile organics forms preceding all semivolatile organics forms. If corrections to the TIC forms are made during validation, use the word "corrected" in the appendix title. All TIC forms are included even if no TICs were identified by the laboratory.

3.2.5 Appendix F - Support Documentation

Appendix F for the organic data review report includes all support documentation needed to substantiate the findings described in the narrative. In addition to copies of specific supporting forms from the data package, the appendix will include:

3.2.5.1 Table I, "Calibration Outliers", is a compilation of all Response Factors (RFs), percent Relative Standard Deviations (%RSDs), and percent Differences (%Ds) which were outside of the control limits for both volatile and semivolatile organic compounds. Examples of Table I are included in Attachment F. Table I also includes the qualifiers applied during validation to compound results because of these outliers, and the definitions of the qualifier codes used.

3.2.5.2 Initial and continuing calibration data are included for all volatile and semivolatile compounds (Forms VI VOA, VII VOA, VI SV-1 and -2, and VII SV-1 and -2), with a reviewer-written list of samples affected by each calibration.

3.2.5.3 Copies of the laboratory case narrative, sample traffic report/chain of custody (TR/COC), and EPA Shipping Log.

4.0 Assembling the Report

The organic report shall be assembled in the order presented in Sections 3.1 and 3.2 of this document. The narrative is followed by the Appendices as described.

5.0 Review and Distribution

After the report is completed and assembled, it should be reviewed internally by optional peer review(s), oversight chemist review(s), and team manager review.

5.1 The report should be submitted to a senior oversight chemist for its first internal review. The internal review may be assigned to another validator or be performed by the oversight chemist.

5.1.1 The reviewer will review the document. Any deficiencies, inconsistencies, or other comments should be returned to the validator.

5.1.2 The reviewer will return the review to the validator, who will make the required corrections.

5.1.3 The process will continue (Steps 5.1 - 5.1.2) until the document requires no further revision.

5.1.4 The validator will initial the first page of the narrative next to his/her name.

5.1.5 The final review is performed by the team manager, who will read and review the document. If the report is acceptable to the team manager, he will initial the narrative next to his name.

5.2 The completed report is submitted to the EPA oversight chemist for review.

5.2.1 All internal review checklists are removed, and the rest of the document is copied for the validator files. The internal review checklists and document copy are then placed in a filing area.

5.2.2 The original document is placed in an inter-office envelope addressed to the EPA RPM.

5.3 Upon completion of review by the EPA oversight chemist, the document will either be approved as submitted or revisions will be required.

5.3.1 If revisions are required by the EPA oversight chemist, the validator must complete those revisions and submit the document for internal review as outlined above beginning in section 5.1.

5.3.1.1 All resubmissions are labelled as revision 1 (or subsequent).

OVERVIEW

The case consisted of field and quality control (QC) samples collected in support of the post-construction soil program at the Naval Weapons Station in Yorktown, Virginia. The case number was not provided. The analytical program provided analyses for the 1990 U.S. Environmental Protection Agency (USEPA) Target Compound List (TCL) for volatile organics, semivolatile organics, pesticides and polychlorinated biphenyls (PCBs); for the 1990 USEPA Target Analyte List (TAL) of inorganics (metals and cyanide); and trace analyses for nitroaromatic and nitroamine residues, i.e. explosives. Additionally, a small group of soil samples were analyzed for Toxicity Characteristic Leachate Procedure (TCLP) organic and inorganic parameters in accordance with the TCLP Final Rule. All volatile and semivolatile sample spectra were supplementally searched for non-TCL compounds in accordance with the analytical protocols.

Altogether, the sampling program consisted of 112 surface and subsurface soil samples. Nine soil field-duplicate pairs were sampled to verify sampling and laboratory precision. Aqueous QC samples were incorporated into the sampling program and consisted of the following samples: nine rinsate blanks, one field blank and six trip blanks. The rinsate blanks and field blank were analyzed for the full set of organic and inorganic parameters (excluding TCLP analyses) whenever possible and when sufficient sample volumes were provided. Trip blank samples were analyzed for TCL volatile organic compounds plus library search only. In accordance with the analytical protocols, the laboratory provided matrix spike, spike duplicate, and laboratory duplicate analyses to verify precision and accuracy in the sample matrix. Additionally, blank spikes were analyzed for all parameters in accordance with the Naval Energy and Environmental Support Activity (NEESA) Level C chemical analysis quality assurance requirements.

All TCL volatile organic, semivolatile organic compound, and pesticide/PCB analyses were performed in accordance with the 1990 USEPA Contract Laboratory Program (CLP) Organic Statement of Work (SOW) OLM03.1. TAL inorganic analyses were performed in accordance with the 1990 USEPA CLP Inorganics SOW ILM04.0. Analyses for explosive residues were performed in accordance with the laboratory standard operating procedure (SOP) based on the requirements of USEPA SW-846 Method 8330A, Third Edition, Second Update. Similarly, TCLP analyses were performed in accordance with USEPA SW-846 Method 1311 and other SW-846 methods specific to the compounds of interest.

Laboratory analyses were performed by Analytical Services Corporation (ASC), an analytical division of OHM Remediation Services Corporation, located in Findlay, Ohio. The samples were not analyzed through the CLP, but volatile, semivolatile, pesticides/PCBs, and inorganics analyses were conducted in accordance with its protocols as a Routine Analytical Services (RAS).

SUMMARY

Other than the exceptions noted below, most samples collected in support of the Yorktown post-construction soil program were analyzed successfully. In some cases, one to two analytes in both the organic and inorganic fractions were rejected due to calibration deficiencies or matrix bias. Results for 2-butanone, hexachlorocyclopentadiene and pentachlorophenol (PCP) reported as non-detected were rejected in many samples due to poor calibration responses. In the inorganic fraction, antimony and selenium were rejected for low bias in the matrix spike analyses. These sample qualifications are fully detailed in the discussion of major problems.

The TCL volatiles analysis of A01SS-16 was determined unusable due to poor instrument sensitivity and response during analysis.

The results for the semivolatile acid fraction for the field blank sample FB01A/B were determined unusable since the associated laboratory QC samples exceeded the method QC limits.

Similarly, Tetryl results in two rinsate blanks were determined unusable since the associated laboratory QC samples exceeded the method QC limits.

MAJOR PROBLEMS

This section of the narrative identifies any problems identified during the validation that seriously affect data usability and any data that are qualified unusable "R".

Volatile Organic Compounds

- Due to poor instrument responses in two initial calibration sequences and their associated continuing calibrations, 2-butanone data were rejected in 46 TCL soil samples and 6 TCLP analyses. The samples counts noted above include all dilution and QC samples, such as blanks, spikes, etc.. Refer to Table 1 in Appendix E and the calibration summaries in the supporting documentation for the calibration outliers and associated responses. The list of samples in which 2-butanone results were rejected is as follows: soil samples A01SS-49, A01SS-50, A01SS-54, A02SS-67, A02SS-68, A05SS-56, A05SS-58, A05SS-59, A05SS-60, A05SS-62, A05SS-63, and A05SS-65; TCLP samples A01SS-101, A01SS-104, A01SS-105, AND A01SS-106; rinsate blanks 0001/0003, A01SS-2A/B, A01SS-3A/D, RB-04A/C/D, RB-06, RB-01A/D, R-8, and A02SS-RIN9; field blank FB01A/B; trip blanks TB-3 (samples December 8, 1994), TB-3 (sampled December 9, 1994), TB-4, and TB-5.

- The volatile analysis of sample A01SS-16B was rejected (qualified R) as unusable since all three VOC internal standards (IS) were reported with extremely low area

counts. Refer to the Form VIII in the supporting documentation in Appendix E for a summary of the reported area counts for this sample.

Semivolatile Organic Compounds

- The semivolatile acid fraction of the field blank sample FB01A/B was rejected (qualified R) as unusable due to zero recoveries of the acid surrogate compounds in the field blank, method blank and blank spike samples.

- Due to poor instrument responses in nine continuing calibration sequences, hexachlorocyclopentadiene data were rejected in 58 TCL soil samples and two rinsate blanks. Refer to Table 1 in Appendix E and the calibration summaries in the supporting documentation for the calibration outliers and associated responses. The list of samples in which hexachlorocyclopentadiene results were rejected is as follows: soil samples A01SS-06, A01SS-06B, A01SS-08, A01SS-09, A01SS-10, A01SS-12, A01SS-14, A01SS-16B, A01SS-17B, A01SS-19, A01SS-20, A01SS-21, A01SS-22, A01SS-23, A01SS-24, A01SS-25, A01SS-26, A01SS-27, A01SS-28, A01SS-29, A01SS-30, A01SS-33B, A01SS-38, A01SS-39, A01SS-40, A01SS-41, A01SS-42, A01SS-43, A01SS-45, A01SS-46, A01SS-47, A01SS-49, A01SS-50, A01SS-77, A01SS-78, A01SS-79, A01SS-80, A01SS-86, A02SS-75, A02SS-81, A02SS-82, A02SS-83, A02SS-84, A02SS-87, A02SS-88, A02SS-89, A02SS-91, A02SS-92, A02SS-93, A02SS-94, A05SS-58, A05SS-59, A05SS-60, A05SS-62, A05SS-63, A05SS-64, and A05SS-65; and rinsate blanks RB-05B and RB-06A/B1.

- Due to poor instrument responses in three continuing calibration sequences, PCP data were rejected in 27 TCL soil samples. Refer to Table 1 in Appendix E and the calibration summaries in the supporting documentation for the calibration outliers and associated responses. The list of samples in which PCP results were rejected is as follows: soil samples A01SS-06B, A01SS-16B, A01SS-17B, A01SS-33B, A01SS-86, A02SS-67, A02SS-68, A02SS-69, A02SS-70, A02SS-71, A02SS-72, A02SS-73, A02SS-74, A02SS-76, A02SS-81, A02SS-84, A02SS-89, A02SS-91, A02SS-92, A02SS-93, A02SS-94, A05SS-58, A05SS-59, A05SS-60, A05SS-63, A05SS-64, A05SS-65, A05SS-66, and A05SS-85.

Explosives

- The results for Tetryl in the analysis for explosives were rejected in rinsate blanks A01SS-RIN9 and R-8 due to poor Tetryl recoveries in the blank and matrix spikes.

Metals

- Antimony results were rejected in the following samples due to matrix spike recoveries less than 30 percent and sample values less than the instrument detection limit (IDL): A01SS-21; A01SS-22; A01SS-23; A01SS-24; A01SS-25; A01SS-26; A01SS-27;

A01SS-28; A01SS-29; A01SS-30; A05SS-63; A05SS-64; A05SS-65; A05SS-62; A05SS-66; A05SS-60; A01SS-49; A01SS-50; A01SS-51; A01SS-52; A01SS-53; A01SS-54; A05SS-56; A05SS-58; A05SS-59; A02SS-67; A02SS-68; A02SS-69; A02SS-70; A02SS-71; A02SS-72; A02SS-74; A02SS-75; A02SS-76; A02SS-81; A02SS-82; A02SS-83; A02SS-84; A02SS-87; A02SS-88; A02SS-89; A02SS-91; A02SS-92; A02SS-93; A02SS-94; A01SS-105; A01SS-106; A01SS-18B; A01SS-26B; A01SS-103A; A05SS-102; A01SS-96B; A01SS-06B; A01SS-16B; A01SS-17B; A01SS-33B; A01SS-95; A01SS-42B; A01SS-53B; A01SS-54B; A01SS-96B; A02SS-93; A01SS-109; A01SS-110; and A01SS-113.

- Selenium results were rejected in the following samples due to matrix spike recoveries less than 30 percent and sample values less than the IDL: A05SS-63; A05SS-64; A05SS-65; A01SS-86; A05SS-62; A05SS-66; A05SS-85; A01SS-49; A01SS-50; A01SS-51; A01SS-52; A01SS-53; A01SS-54; A05SS-56; A05SS-58; A05SS-59; A05SS-60; A02SS-108A; A02SS-74D; A02SS-83B; A02SS-92B; A02SS-107C; and A02SS-108A.

MINOR PROBLEMS

This section of the narrative identifies any biases identified during the data which may qualify the data as biased high, biased low, or bias undetermined.

Volatile Organic Compounds

- Technical holding times exceeded 14 days for volatile organic compound (VOC) analyses of soil samples A01SS-37, A01SS-38, A01SS-39 and A01SS-112; trip blank sample TB-01; and the dilution analyses for rinsate R-8 (R-8DL) and trip blank TB-2 (TB-2DL). All positive results were qualified "L" for low bias and the sample quantitation limits were qualified "UL" to indicate that the quantitation limits are probably higher. Refer to the Form Is in Appendix C for each sample noted above and the chain-of-custody (COC) records in Appendix E to verify the technical holding times. A holding time of 14 days was used for the review of non-aqueous samples. Since the holding times were not grossly exceeded, it is believed that the VOC data for these samples obtained from analyses beyond the holding time were not adversely affected.

- The VOC IS area counts were less than a factor of two (-50%) from the area counts of the associated calibration standard for several samples. The laboratory certified in the narratives and in discussions with the data reviewer that most, if not all samples, were reinjected to verify the low IS area counts found in the original analyses. The verification analyses were not provided in the reports, however, the laboratory restated that matrix interferences affected the recoveries of the IS compounds. Based on the assumption that the laboratory verified the bulk of the sample analyses with outlier IS compounds, the data review and validation continued using the available data. For

fourteen samples, the area counts for chlorobenzene-d5 (CBZ-d5) were lower, and for five samples, both the 1,4-difluorobenzene (1,4-DFB) and the CBZ-d5 areas were below the lower limit established by the associated standard. In three samples, one in which there was an extreme loss of sensitivity, all three IS compounds (CBZ-d5, 1,4-DFB and bromochloromethane [BCM]) were below the lower area count limits. Corresponding target compounds for each outlier IS were qualified as estimated (J), estimated at the quantitation limit (UJ), or rejected (R) depending on the calculated area counts. The affected samples, IS outlier(s), and qualification action(s) are summarized below.

Sample ID	IS Outlier(s)	Qualification Actions
A01SS-08	CBZ-d5	Positive-J; Non-detected-UJ
A01SS-16B	BCM; 1,4-DFB; CBZ-d5	All Rejected (R)
A01SS-36	CBZ-d5	Positive-J; Non-detected-UJ
A01SS-38	CBZ-d5	Positive-J; Non-detected-UJ
A01SS-42	CBZ-d5	Positive-J; Non-detected-UJ
A01SS-53	1,4-DFB; CBZ-d5	Positive-J; Non-detected-UJ
A01SS-54	CBZ-d5	Positive-J; Non-detected-UJ
A05SS-58	CBZ-d5	Positive-J; Non-detected-UJ
A02SS-67	CBZ-d5	Positive-J; Non-detected-UJ
A02SS-68	CBZ-d5	Positive-J; Non-detected-UJ
A02SS-69	CBZ-d5	Positive-J; Non-detected-UJ
A02SS-72	CBZ-d5	Positive-J; Non-detected-UJ
A02SS-73	CBZ-d5	Positive-J; Non-detected-UJ
A02SS-74	CBZ-d5	Positive-J; Non-detected-UJ
A02SS-75	CBZ-d5	Positive-J; Non-detected-UJ
A02SS-76	CBZ-d5	Positive-J; Non-detected-UJ
A01SS-78	CBZ-d5	Positive-J; Non-detected-UJ
A02SS-83	CBZ-d5	Positive-J; Non-detected-UJ
A02SS-88	1,4-DFB; CBZ-d5	Positive-J; Non-detected-UJ
A01SS-104(soil)	1,4-DFB; CBZ-d5	Positive-J; Non-detected-UJ
A01SS-105(soil)	BCM; 1,4-DFB; CBZ-d5	Positive-J; Non-detected-UJ
A01SS-106(soil)	BCM; 1,4-DFB; CBZ-d5	Positive-J; Non-detected-UJ

- Due to an instrumentation error, the 20 part per billion (ppb) volatile calibration standard was omitted in the initial calibration sequence performed on September 24, 1994 for instrument MSC.i (Lab Files C9206 and C9208 through C9210). Since the instrument response factors and linearity were verified over the working range of the method using the 4-point curve, the laboratory accepted the calibration curve and used it as the basis for the verification of subsequent continuing calibrations. In the opinion of the data reviewer, sample data were not affected adversely by this contractual non-compliance and no sample qualifications were assessed due to it.

- In the VOC initial calibration sequence analyzed on November 15, 1994 on instrument MSA.i, the 200 ppb volatile calibration standard was run out of sequence due to laboratory error. Consequently, the laboratory used a 4-point curve to verify linearity and instrument response for all continuing calibrations associated with this initial calibration. With the exception of acetone, all other volatile compounds met the required criteria for instrument response and percent relative standard deviation (%RSD). All associated volatile sample data were reviewed to determine if any data were reported above the level of the highest standard used in constructing the calibration curve, i.e. 100 ppb level. Acetone in sample A01SS-41 was reported above 100 ppb. This result was qualified as estimated "J" since it was above the level of the highest standard and the sample was not reinjected to bring it within the range of the calibration curve. No other sample data were qualified due to this deficiency.

- In total, eight VOC initial calibrations and 31 continuing calibrations were analyzed in support of the samples in this case. In many of these, the calibration outliers consisted of poor responses for the ketones, such as acetone; 2-butanone (reported as methyl ethyl ketone in the raw data); 2-hexanone; and 4-methyl-2-pentanone. All of the volatile calibration outliers are summarized in Table 1 of Appendix E and are discussed below. Refer to these tables in Appendix E to determine which samples are associated with the calibration deficiencies.

- In the VOC initial calibration sequence analyzed on September 22, 1994 on instrument MSC.i (Lab Files C9158-C9162), the average relative response factor (RRF) for 2-butanone was less than (<) 0.05. All associated positive sample data for 2-butanone were qualified "L" for low bias. All associated samples in which 2-butanone was not detected were qualified "R" and rejected as unusable.

- The average RRF for 2-butanone was similarly below 0.05 in the VOC initial calibration analyzed on November 23, 1994 on instrument MSC.i (Lab Files C0220-C0224). All associated positive sample data and non-detected 2-butanone results were qualified as described above. The RRF for 2-butanone was <0.05 in all of the continuing calibrations associated with this initial calibration sequence. They were as follows:

Calibration Date	Lab File
December 15, 1994	C0563
December 17, 1994	C0608
December 22, 1994	C0725
December 23, 1994	C0750
December 26, 1994	C0773

All associated positive 2-butanone data were qualified "L" for low bias and non-detected results were qualified "R" and rejected as unusable.

- The %RSD criterion for acetone exceeded the 30 percent limit in the volatile initial calibrations analyzed on November 15, 1994 on instrument MSA.i (Lab Files A4677-A4680) and on November 23, 1994 on instrument MSC.i (Lab Files C0226-C0230). Positive acetone data for all samples associated with these two initial calibrations were qualified estimated "J".

- In the VOC initial calibration analyzed on November 8, 1994 on instrument MSC.i (Lab Files C9964-C9970), the laboratory omitted two standard levels (20 ppb and 100 ppb) in the calibration curve of toluene due to contamination. All toluene sample data associated with this initial calibration were calculated based on an average RRF generated from a 3-point curve. In all subsequent continuing calibrations associated with this initial calibration, the percent difference (%D) criterion exceeded the upper limit of 25 percent. All positive toluene sample data were qualified estimated "J" in all associated samples in accordance with the validation guidelines. Toluene non-detects were qualified estimated at the sample quantitation limits "UJ" based on the professional judgment of the reviewer, due to the use of a 3-point calibration curve and contractual non-compliance. The following VOC continuing calibrations on instrument MSC.i were associated with the toluene deficiency in the initial calibration:

Calibration Date	Lab File
November 10, 1994	C0018
November 11, 1994	C0035
November 13, 1994	C0064
November 14, 1994	C0088
November 15, 1994	C0117
November 15, 1994	C0113
November 17, 1994	C0150
November 18, 1994	C0173

- The %D for acetone was outside the ± 25.0% limit and was grossly exceeded (greater than [>] 50%) in the VOC continuing calibration analyzed on October 28, 1994 on instrument MSC.i (Lab File C9760). Positive acetone results were qualified "J" and non-detects were qualified "UJ" since the %D was grossly exceeded. In the same continuing calibration, the RRF for 2-butanone is <0.05 and the %D is outside the ± 25% criterion (30.1%). Positive results for 2-butanone in all associated samples were qualified "L" for low bias and non-detected 2-butanone results were qualified "R" as unusable.

- The %D criterion was exceeded for the following VOC target analytes in the continuing calibration analyzed on November 14, 1994 on instrument MSC.i (Lab File C0093): chloromethane; acetone; 1,2-dichloroethane (1,2-DCA); 1,1,1-trichloroethane (1,1,1-TCA); carbon tetrachloride; bromodichloromethane; and bromoform. Positive results for these analytes in all associated samples were qualified estimated "J". No

qualifications to non-detected VOCs that were noted above were necessary. Additionally, the 2-butanone RRF was <0.05 in this VOC continuing calibration. All 2-butanone data were previously qualified based on the initial calibration average RRF for 2-butanone.

- The %D for bromoform was >25% in the VOC continuing calibration analyzed on November 15, 1994 on instrument MSC.i (Lab File C0110). Positive results for bromoform in all associated samples were qualified estimated "J". Additionally, the RRF for 2-butanone was <0.05 in this VOC continuing calibration. All 2-butanone data were previously qualified based on the average RRF in the initial calibration.

- The RRF for 2-butanone was <0.05 in the VOC continuing calibration analyzed on November 19, 1994 on instrument MSC.i (Lab File C0195). All associated 2-butanone data were previously qualified based on the average RRF in the initial calibration.

- The %D criteria were exceeded for 2-butanone and grossly exceeded (>50%) for acetone in the VOC continuing calibrations analyzed on October 28, 1994 (Lab File C9766) and on October 30, 1994 (Lab File C9779) on instrument MSC.i. Positive acetone results were qualified "J" and non-detects were qualified "UJ" since the %D was grossly exceeded. Positive results for 2-butanone in all associated samples were qualified estimated "J".

- The %D for chloromethane was >25% in the VOC continuing calibration analyzed on November 13, 1994 on instrument MSC.i (Lab File C0064). Positive results for chloromethane in all associated samples were qualified estimated "J".

- In the VOC continuing calibration analyzed on November 17, 1994 on instrument MSC.i (Lab File C0150), the RRF was <0.05 for 2-butanone and the %D was greater than 25% for the following compounds: acetone; 4-methyl-2-pentanone; and toluene (previously discussed). Positive 2-butanone data were qualified "L" for low bias and non-detected 2-butanone data were qualified "R" and rejected as unusable. Positive sample results for those analytes with exceeded %D criteria were qualified "J" in all associated samples.

- The %D for acetone was >25% in the VOC continuing calibration analyzed on November 15, 1994 on instrument MSA.i (Lab File A4693). Positive acetone results were qualified "J" in all associated samples.

- The %D for chloromethane was >25% in the VOC continuing calibration analyzed on December 2, 1994 on instrument MSA.i (Lab File A4823). Positive chloromethane results were qualified "J" in all associated samples.

- The %D for acetone was >25% in the VOC continuing calibration analyzed on December 17, 1994 on instrument MSC.i (Lab File C0608). Positive acetone results were qualified "J" in all associated samples.

- The %D for bromoform was >25% in the VOC continuing calibration analyzed on December 13, 1994 on instrument MSC.i (Lab File C0522). Positive bromoform results were qualified "J" in all associated samples.

- The %Ds for vinyl chloride were >25% in the VOC continuing calibrations analyzed on December 17, 1994 (Lab File C0609) and on December 18, 1994 (Lab File C0632) on instrument MSC.i. Positive vinyl chloride results were qualified "J" in all associated samples.

- The %D was >25% in the VOC continuing calibration analyzed on December 20, 1994 (Lab File C0686) on instrument MSC.i for the following analytes: chloromethane; acetone; 4-methyl-2-pentanone; and 2-hexanone. Positive results for these analytes were qualified "J" in all associated samples.

- The %D was >25% in the VOC continuing calibration analyzed on December 21, 1994 (Lab File C0704) on instrument MSC.i for the following analytes: acetone; 4-methyl-2-pentanone; and 2-hexanone. Positive results for these analytes were qualified "J" in all associated samples.

Semivolatile Organic Compounds

- In total, six semivolatile organic compound (SVOC) initial calibrations and 21 continuing calibrations were analyzed in support of the samples in this case. In many of these, the calibration outliers consisted of compounds which historically perform poorly and exhibit erratic behavior. All of the SVOC calibration outliers are summarized in Table 1 of Appendix E. Refer to Table 1 in Appendix E to determine which samples are associated with the calibration deficiencies.

- In the SVOC initial calibration sequences for instrument MSE.i analyzed on November 3, 1994 (Lab Files E2600-E2604) and on November 28, 1994 (Lab Files E2994-E2998), the %RSDs for hexachlorocyclopentadiene were >30%. Positive results for hexachlorocyclopentadiene were qualified estimated "J".

- In the SVOC initial calibration sequence analyzed on December 21, 1994 on instrument MSB.1 (Lab Files B5274-B5278), the %RSD was exceeded for the following compounds: PCP; di-n-butylphthalate; and di-n-octylphthalate. Positive results for these analytes in the associated samples were qualified estimated "J".

- The %D criteria were exceeded in the SVOC continuing calibration analyzed on November 9, 1994 on instrument MSA.i (Lab File A4632) for the following

compounds: 2,4-dinitrophenol; PCP; and 3,3'-dichlorobenzidine. Positive results were qualified estimated "J".

- The %D criteria were exceeded in the SVOC continuing calibration analyzed on November 16, 1994 on instrument MSE.i (Lab File E2826) for the following compounds: n-nitroso-di-n-propylamine; hexachlorocyclopentadiene; and 2,4-dinitrophenol. Additionally, the RRF for hexachlorocyclopentadiene was <0.05 in this SVOC continuing calibration. Positive results for n-nitroso-di-n-propylamine and 2,4-dinitrophenol were qualified estimated "J". Positive results for hexachlorocyclopentadiene were qualified "L" for low bias and non-detected results were qualified "R" and rejected as unusable.

- The %D criteria and RRF were outside of the prescribed limits for hexachlorocyclopentadiene in the SVOC continuing calibration analyzed on November 17, 1994 on instrument MSE.i (Lab File E2847). Positive results were qualified "L" for low bias and non-detected results were qualified "R" and rejected as unusable.

- The %D criteria were exceeded in the SVOC continuing calibration analyzed on November 17, 1994 on instrument MSE.i (Lab File E2861) for the following compounds: n-nitroso-di-n-propylamine; hexachlorocyclopentadiene; and 2,4-dinitrophenol. Additionally, the RRF for hexachlorocyclopentadiene was <0.05 in the SVOC continuing calibration standard. Positive results for n-nitroso-di-n-propylamine and 2,4-dinitrophenol were qualified estimated "J". Positive results for hexachlorocyclopentadiene were qualified "L" for low bias and non-detected results were qualified "R" and rejected as unusable.

- The %D and RRF were outside of the prescribed limits for hexachlorocyclopentadiene in the SVOC continuing calibration analyzed on November 18, 1994 on instrument MSE.i (Lab File E2872). Positive results for hexachlorocyclopentadiene were qualified "L" for low bias and non-detected results were qualified "R" and rejected as unusable.

- The %D criteria were exceeded in the SVOC continuing calibration analyzed on November 20, 1994 on instrument MSE.i (Lab File E2893) for the following compounds: n-nitroso-di-n-propylamine; hexachlorocyclopentadiene; and 2,4-dinitrophenol. Positive results for n-nitroso-di-n-propylamine and 2,4-dinitrophenol were qualified estimated "J". Positive results for hexachlorocyclopentadiene were qualified "L" for low bias and non-detected results were qualified "R" and rejected as unusable.

- The %D and RRF were outside of the prescribed limits for hexachlorocyclopentadiene in the SVOC continuing calibration analyzed on November 21, 1994 on instrument MSE.i (Lab File E2921). Positive results for hexachlorocyclopentadiene were qualified "L" for low bias and non-detected results were qualified "R" and rejected as unusable.

- The %D and RRF were outside of the prescribed limits for hexachlorocyclopentadiene and PCP in the SVOC continuing calibration analyzed on November 22, 1994 on instrument MSE.i (Lab File E2943). Positive results for both compounds were qualified "L" for low bias and non-detected results were qualified "R" and rejected as unusable.

- The %D criteria were exceeded in the SVOC continuing calibration analyzed on November 17, 1994 on instrument MSB.i (Lab File B4972) for the following compounds: 4-nitrophenol; PCP; and benzo(k)fluoranthene. Positive results for these analytes were qualified estimated "J".

- The %D criteria were exceeded in the SVOC continuing calibration analyzed on November 18, 1994 on instrument MSB.i (Lab File B4987) for the following compounds: bis(2-chloroethyl)ether; 2-methylphenol; bis(2-chloroisopropyl)ether; 4-methylphenol; 4-nitrophenol; and bis(2-ethylhexyl)phthalate. Positive results for these analytes were qualified estimated "J".

- The %D criteria were exceeded in the SVOC continuing calibration analyzed on November 29, 1994 on instrument MSE.i (Lab File E3002) for the following compounds: hexachlorocyclopentadiene; PCP; and di-n-butylphthalate. Additionally, the RRF was <0.05 for PCP in this continuing calibration. Positive results for hexachlorocyclopentadiene and di-n-butylphthalate were qualified estimated "J". Positive results for PCP were qualified "L" for low bias and non-detected results were qualified "R" and rejected as unusable.

- The %D criteria were exceeded in the SVOC continuing calibration analyzed on November 30, 1994 on instrument MSE.i (Lab File E3023) for hexachlorocylopentadiene and 2-4-dinitrophenol. Additionally, the RRF was <0.05 for hexachlorocylopentadiene in this continuing calibration. Positive results for 2,4-dinitrophenol were qualified estimated "J". Positive results for hexachlorocyclopentadiene were qualified "L" for low bias and non-detected results were qualified "R" and rejected as unusable.

- The %D criteria were exceeded in the SVOC continuing calibration analyzed on December 1, 1994 on instrument MSE.i (Lab File E3067) for hexachlorocyclopentadiene and benzo(g,h,i)perylene. Additionally, the RRFs were <0.05 for hexachlorocyclopentadiene and PCP. Positive results for benzo(g,h,i)perylene were qualified estimated "J". Positive results for hexachlorocyclopentadiene and PCP were qualified "L" for low bias and non-detected results were qualified "R" and rejected as unusable.

- The %D criterion for hexachlorocyclopentadiene was exceeded in the SVOC continuing calibration analyzed on December 2, 1994 on instrument MSE.i (Lab File E3087). Positive results were qualified estimated "J".

- The %D criteria were exceeded in the SVOC continuing calibration analyzed on December 16, 1994 on instrument MSB.i (Lab File B5208) for 2,4-dinitrophenol and PCP. Positive results for these compounds were qualified estimated "J".

- The %D criterion was exceeded for 2,4-dinitrophenol in the SVOC continuing calibration analyzed on December 20, 1994 on instrument MSB.i (Lab File B5256). Positive results for 2,4-dinitrophenol were qualified estimated "J".

- The %D criteria were exceeded for 2,4-dinitrophenol and PCP in the SVOC continuing calibration analyzed on December 21, 1994 on instrument MSB.i (Lab File B5289). Positive results for these compounds were qualified estimated "J".

- The %D criteria were exceeded in the SVOC continuing calibration analyzed on December 22, 1994 on instrument MSB.i (Lab File B5308) for the following compounds: 2,4-dinitrophenol; di-n-octylphthalate; and benzo (g,h,i)perylene. Positive results for these compounds were qualified estimated "J".

- The SVOC IS area counts were less than a factor of two (-50%) from the area counts of the associated calibration standard for several samples. The laboratory certified in the narratives and in discussions with the data reviewer that most, if not all samples, were reinjected to verify the low IS counts found in the original analyses. The laboratory provided confirmation data for 12 of the samples. All of the low IS area counts were for the perylene-d12 standard in the samples. For samples A01SS-42 and A01SS-25DL, the chrysene-d12 standard recoveries, in addition to perylene-d12, were low. For these samples in which the IS area counts were outside the prescribed limits of the associated standard, positive results for compounds quantitated using those standards were qualified estimated "J". Non-detected compounds using an outlier IS area count were qualified "UJ" at the sample quantitation limits. The affected samples, IS outlier(s), and qualification actions are summarized below. Samples for which reanalysis data were provided are noted with an asterisk (*).

Sample ID	IS Outlier(s)	Qualification Action
A01SS-10	Perylene-d12	Positive-J; Non-detected-UJ
A01SS-11	Perylene-d12	Positive-J; Non-detected-UJ
A01SS-12	Perylene-d12	Positive-J; Non-detected-UJ
A01SS-13	Perylene-d12	Positive-J; Non-detected-UJ
A01SS-14	Perylene-d12	Positive-J; Non-detected-UJ
A01SS-18*	Perylene-d12	Positive-J; Non-detected-UJ
A01SS-20	Perylene-d12	Positive-J; Non-detected-UJ
A01SS-21	Perylene-d12	Positive-J; Non-detected-UJ
A01SS-22	Perylene-d12	Positive-J; Non-detected-UJ
A01SS-23	Perylene-d12	Positive-J; Non-detected-UJ
A01SS-24	Perylene-d12	Positive-J; Non-detected-UJ

A01SS-25	Perylene-d12	Positive-J; Non-detected-UJ
A01SS-25DL	Chrysene-d12; Perylene-d12	Positive-J; Non-detected-UJ
A01SS-30	Perylene-d12	Positive-J; Non-detected-UJ
A01SS-32	Perylene-d12	Positive-J; Non-detected-UJ
A01SS-36*	Perylene-d12	Positive-J; Non-detected-UJ
A01SS-37*	Perylene-d12	Positive-J; Non-detected-UJ
A01SS-38*	Perylene-d12	Positive-J; Non-detected-UJ
A01SS-39*	Perylene-d12	Positive-J; Non-detected-UJ
A01SS-40*	Perylene-d12	Positive-J; Non-detected-UJ
A01SS-42*	Chrysene-d12; Perylene-d12	Positive-J; Non-detected-UJ
A01SS-47*	Perylene-d12	Positive-J; Non-detected-UJ
A05SS-64*	Perylene-d12	Positive-J; Non-detected-UJ
A05SS-65*	Perylene-d12	Positive-J; Non-detected-UJ
A02SS-76*	Perylene-d12	Positive-J; Non-detected-UJ
A05SS-86*	Perylene-d12	Positive-J; Non-detected-UJ
A02SS-89	Perylene-d12	Positive-J; Non-detected-UJ
A01SS-104	Perylene-d12	Positive-J; Non-detected-UJ
FB01A/B	Perylene-d12	Positive-J; Non-detected-UJ

- In the SVOC MS/MSD analyses of A01SS-14, a high bias for semivolatile acid compounds was evident from the recovery (%R) summary data. No positive results for any phenolic compounds were reported in this sample. Sample quantitation limits for phenols were qualified "UJ" to indicated that the acid compounds were not detected and that the quantitation limits may be inaccurate or imprecise. The pyrene %Rs were reported at 0% for the MS and 76% for the MSD samples. Zero %R was reported for the MS sample since the MS concentration was less than the unspiked sample concentration. The pyrene positive result was qualified estimated "J" due to the spike sample variation.

- The PCP recoveries for A01SS-16 MS/MSD were 193 %R and 178 %R, respectively. PCP was not detected in the unspiked sample analysis. No sample qualification was assessed for the high PCP recoveries in A01SS-16. The %Rs for pyrene were 233 %R and 189 %R, respectively, for the MS/MSD analyses of A01SS-16. The positive pyrene result was qualified "K" for high bias in A01SS-16.

- The PCP recoveries in the MS/MSD analyses of A01SS-97 were 231 %R and 229 %R percent, respectively. No qualifications for high bias were assessed due to these outliers since PCP was not detected in the original sample analysis.

- In the MS/MSD analyses of A05SS-58, the %R for both PCP and pyrene were above 150%. The PCP in the unspiked analysis of A05SS-58 was previously rejected

(qualified R) due to calibration outliers and supersedes MS/MSD qualification. The positive pyrene result was estimated "K" for high bias in this sample.

- The PCP recoveries for the MS/MSD analyses of A02SS-81, A01SS-06B, and A01SS-18B were all above the upper advisory limit. The PCP result in A02SS-81 was qualified "K" for high bias in the MS/MSD analyses. No other qualifications for MS/MSD high bias were required since the PCP result in A01SS-06b was previously rejected for calibration and PCP was not detected in sample A01SS-18B.

- Zero percent recoveries were reported for 2,4-dinitrotoluene in A01SS-104 since the concentrations detected in the MS/MSD samples for this compound were less than that reported for the unspiked sample. The 2,4-dinitrotoluene result in A01SS-104 was qualified estimated "J" due to the inaccuracy of results found in the unspiked and spiked sample analyses.

Pesticides/PCBs

- Pesticide/PCB technical holding times were exceeded by one day for the analyses of soil samples A01SS-31 and A01SS-32. Quantitation limits were estimated "UJ" for all pesticide compounds in these sample analyses. Since PCBs are extremely persistent in the environment in non-aqueous matrices and would not degrade significantly during sample storage, PCB compounds were not qualified in these samples due to the holding time exceedances. Refer to the Form Is in Appendix C for each sample noted above and the COC records in the supporting documentation contained in Appendix E to verify the technical holding times.

- Instrument calibration was reviewed to determine if the laboratory instrumentation was capable of producing acceptable qualitative and quantitative data for Pesticide and PCB, i.e. Aroclor target compounds. Several initial calibration sequences were non-compliant with the requirements of the SOW (<20%RSD) since more than two single component target pesticides per column exceeded the %RSD criteria and were greater than 30 percent RSD. Continuing calibration check standards verify instrument performance over intervals of time during sample analysis. Several continuing calibration checks were non-compliant with the SOW requirements (<25%D) since more than two target compounds exceeded the %D limits. In all, eight initial and over 50 continuing calibration sequences were established for three analytical columns to provide the primary and confirmation sample analyses. Calibration sequences with %RSD or %D outliers are summarized in the following sections and include a special notation if non-compliant with the SOW requirements.

- The %RSD for the following single-component analytes exceeded 20 percent for the DB-608 column initial calibration sequence analyzed on October 25, 1994: alpha-BHC; delta-BHC; gamma-BHC (Lindane); 4,4'-DDD; and 4,4"-DDT. This initial calibration sequence is non-compliant with the requirements of the SOW.

- The %RSD was exceeded in the initial calibration sequence for the DB-5 column analyses performed on October 25, 1994 for the following analytes: alpha-BHC; delta-BHC; gamma-BHC (Lindane); Aldrin; and 4,4'-DDD. The % RSD was grossly exceeded (>50%) for alpha-BHC and delta-BHC. This initial calibration sequence is non-compliant with the requirements of the SOW.

- The %RSD was exceeded in the initial calibration sequence (Lab Files Y7138-Y7142) for the DB-5 column analyses performed on November 4, 1994 (15:02) for alpha-BHC and delta-BHC.

- The %RSD was exceeded in the initial calibration sequence (Lab Files V0003-V0007) for the DB-5 column analyses performed on November 12, 1994 (17:02) for the following analytes: alpha-BHC; gamma-BHC (Lindane); delta-BHC; 4,4-DDE; and Endrin. This initial calibration sequence is non-compliant with the requirements of the SOW.

- The %RSD was exceeded in the initial calibration sequence (Lab Files Z7564-Z7569) for the DB-608 column analyses performed on November 28, 1994 (15:41) for the following analytes: alpha-BHC; gamma-BHC; 4,4'-DDD; 4,4"-DDT; and delta-BHC. The positive results for gamma-BHC (Lindane) and 4,4'-DDT were qualified estimated "J" in sample A01SS-104. In samples A01SS-105 and A01SS-106, positive results for gamma-BHC were qualified estimated "J" due to the initial calibration outlier. This initial calibration sequence is non-compliant with the requirements of the SOW.

- The %RSD was exceeded in the initial calibration sequence (Lab Files Y7502-Y7507) for the DB-5 column analyses performed on November 28, 1994 (15:37) for the following analytes: alpha-BHC; gamma-BHC; 4,4'-DDD; 4,4'-DDT; and delta-BHC. This initial calibration sequence is non-compliant with the requirements of the SOW.

- The %RSD was exceeded in the initial calibration sequence (Lab Files E0003-E0007) for the DB-17 column analyses performed on November 13, 1994 (13:21) for the following analytes: alpha-BHC; gamma-BHC (Lindane); delta-BHC; Aldrin; 4,4'-DDE; Dieldrin; Endrin: 4,4'-DDD; and 4,4'-DDT. This initial calibration sequence is non-compliant with the requirements of the SOW.

- The %D was exceeded for Heptachlor in the continuing calibration verification (Lab File E0087) analyzed on November 18, 1994 (07:11) for the DB-17 column.

- The %D was exceeded for Heptachlor in the continuing calibration verification (Lab File E0094) analyzed on November 18, 1994 (12:25) for the DB-17 column.

- The %D criteria were exceeded in the continuing calibration verification (Lab File V0127) analyzed on November 19, 1994 (00:53) on the DB-5 column for the following

analytes: alpha-BHC; gamma-BHC (Lindane); delta-BHC; 4,4'-DDE; and Methoxychlor. This continuing calibration standard is non-compliant with the requirements of the SOW.

- The %D criteria were exceeded in the continuing calibration verification (Lab File Z7463) analyzed on November 18, 1994 (17:22) on the DB-608 column for the following analytes: Heptachlor; Endrin; 4,4'-DDT; and Methoxychlor. The %D for Endrin and Methoxychlor were grossly exceeded (>50%). This continuing calibration standard is non-compliant with the requirements of the SOW.

- The %D criteria were exceeded for 4,4'-DDT and Methoxychlor in the continuing calibration verification (Lab File Z7833) for the DB-608 column analyses performed on December 14, 1994 (21:40).

- The %D criteria were exceeded in the continuing calibration verification (Lab File Y7393) analyzed on November 18, 1994 (17:22) on the DB-5 column for the following analytes: Heptachlor; Dieldrin; Endrin; 4,4'-DDT; Endosulfan Sulfate; and Methoxychlor. The %D was grossly exceeded (>50%) for Methoxychlor. This standard is non-compliant with the requirements of the SOW.

- The %D criterion was exceeded for Methoxychlor on the DB-5 column in the continuing calibration verification (Lab File Y7405) analyzed on November 19, 1994 (02:17).

- The %D criterion was exceeded for Methoxychlor on the DB-5 column in the continuing calibration verification (Lab File Y7412) analyzed on November 19, 1994 (07:29).

- The %D criterion was exceed for delta-BHC on the DB-5 column in the continuing calibration verification (Lab File Y7781) analyzed on December 14, 1994 (22:26).

- The %D criterion was exceeded for delta-BHC on the DB-5 column in the continuing calibration verification (Lab File Y7877) analyzed on December 20, 1994 (14:13).

- The %D criterion was exceeded for delta-BHC on the DB-5 column in the continuing calibration verification (Lab File Y7889) analyzed on December 20, 1994 (23:11).

Explosives

- In the analysis of explosive compounds, initial and continuing calibrations of the instrument were evaluated using the guidelines specified in USEPA SW-846 Methods 8330A and 8000. Five-point initial calibrations were established based on the response factors of the peak areas for each analyte. A 20 percent limit for %RSD was used to verify linearity. Continuing calibrations with a mid-point standard were performed

from which the response factors for each analyte were compared with the response factor obtained during the initial calibration. The Method 8330A-specified limit of 15% D was used to verify continuing calibration by the data reviewer although the laboratory used a limit of 20%D as specified in their SOP. Additionally, the laboratory SOP specified duplicate injections of the standards during initial calibration (only) as opposed to Method 8330A requirements which specified triplicate injections for initial and continuing calibration standards. No action was taken by the data reviewer for these method modifications other than those stated below.

- The %D for m-Nitrotoluene and p-Nitrotoluene were exceed in the continuing calibration standard (Lab File EN01C16A) analyzed on November 1, 1994.

- The %D for Tetryl was exceeded in the continuing calibration standard (Lab File EN16A01A) analyzed on November 15, 1994 (20:35).

- The %D for 2,6-Dinitrotoluene (2,6-DNT) was exceeded in the continuing calibration standard (Lab File EN16B00A) analyzed on November 16, 1994 (03:54).

- The %D for Tetryl was exceeded in the continuing calibration standard (Lab File EN16B00A) analyzed on November 16, 1994 (10:47).

- The %D for 2,6-DNT was exceeded in the continuing calibration standard (Lab File EN16D00A) analyzed on November 16, 1994 (13:37).

- The %D for 1,3,5-Trinitrobenzene (1,3,5-TNB) was exceeded in the continuing calibration standard (Lab File ED13A01A) analyzed December 13, 1994 (13:33) on the C-18 column.

- The %D for Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) was exceeded in the continuing calibration standard (Lab File EN17B02A) analyzed on November 17, 1994 (12:05).

- The %Ds were exceeded for 1,3,5-TNB and p-Nitrotoluene in the continuing calibration standard (Lab File EN17D02A) analyzed on November 17, 1994 (18:23).

- The %D for 1,3,5-TNB was exceeded in the continuing calibration standard (Lab File EN17F02A) analyzed November 17, 1994 (20:39) on the C-18 column.

- The %D for Tetryl was exceeded in the continuing calibration standard (Lab File EN19A00A) analyzed November 19, 1994 (15:09) on the C-18 column.

- The %Ds were exceeded for several analytes in the continuing calibration standard (Lab File EN01B05B.D) analyzed November 18, 1994 (16:23) on the C-18 column. The following analytes were reported with %D outliers: Octahydro-1,3,5,7-tetranitro-

1,3,5,7-tetrazocine (HMX); 1,3,5-TNB; 1,3-Dinitrobenzene (1,3-DNB); Tetryl; Nitrobenzene; 2,4,6-TNT; 2,4-Dinitrotoluene (2,4-DNT); and m-Nitrotoluene. The positive results for 1,3,5-TNB in A02SS-70, A02SS-71 and A02SS-72, and the positive results for 2,4,6-TNT in A02SS-73, were qualified estimated "J" due to the calibration outliers.

- The %Ds were exceeded for the following analytes in the continuing calibration standard (Lab File EN18B00A) analyzed November 18, 1994 (22:47) on the CC-18 column: HMX; 1,3,5-TNB; 1,3-DNB; Tetryl; Nitrobenzene; 2,4,6-TNT; and 2,4-DNT. The positive results for Tetryl in A02SS-83, A02SS-88 and A05SS-85, and the 2,4,6-TNT positive in A02SS-84, were qualified estimated "J" due to the calibration outliers.

- The %Ds were exceeded for the following analytes in the continuing calibration standard (Lab File EN18D00A) analyzed November 19, 1994 (01:39) on the C-18 column: 1,3,5-TNB; Tetryl; Nitrobenzene; 2,4,6-TNT; and 2,4-DNT.

- The %D was exceeded for 1,3,5-TNB and grossly exceeded for Tetryl (>50%) in the continuing calibration standard (Lab File EJ04A01A) analyzed January 4, 1995 (19:04) on the C-18 column.

- The %D was exceeded for 1,3,5-TNB and grossly exceeded for Tetryl (>50%) in the continuing calibration standard (Lab File EJ04B01A) analyzed January 4, 1995 (22:30) on the C-18 column.

Metals

- In sample delivery group (SDG) No. 0008A/B, the initial calibration criteria were not met for potassium and sodium. Sample results for all samples within this SDG were qualified "L" for low bias if greater than the instrument detection limit (>IDL) and "UL" if less than the IDL (<IDL). The soil samples in this SDG were: 0008A/B; 0009A/B; 0010A/B; 0011A/B; and 0012A/B. Rinsate blank 0013 was similarly qualified for low bias for potassium and sodium.

- The thallium recovery in the initial calibration for SDG No. A01SS-18 was greater than the 110 percent upper limit criterion. No sample qualifications were assessed since all samples possibly associated with the outlier thallium were reported <IDL.

- With the exception of the sample qualifications discussed below, no other qualifications to any sample in the case were assessed for inorganic continuing calibration outliers. The data reviewer was unable to correlate sample association to deficient continuing calibration verifications (CCV) from the provided laboratory deliverables.

- The following table summarizes the CCV outliers found for each SDG. Where possible, the data reviewer attempted to assign the sequential position number to the

CCV although the dates of analysis were not provided and the CCV sequence number may not refer to standards in the same calibration sequence.

SDG No.	Analyte	CCV Outliers (%R)
A01SS-06	Potassium	CCV2 (114.7)
	Arsenic	CCV2 (114.2); CCV5 (86.5)
A01SS-97	Thallium	CCV3 (87.0)
	Selenium	CCV2 (88.7)
008A/B	Arsenic	CCV2 (81.8)
	Potassium	CCV1 (88.7)
	Sodium	CCV1 (87.9)
	Thallium	CCV4 (112.1)
	Selenium	CCV2 (86.7)
A01SS-1	Potassium	CCV2 (114.5)
	Arsenic	CCV3 (112.6)
	Selenium	CCV4 (87.3)
	Thallium	CCV5 (114.0)
A01SS-19	Sodium	CCV1 (111.5)
A01SS-58	Arsenic	CCV4 (86.7)
	Iron	CCV2 (113.2)
	Selenium	CCV7 (87.9); CCV8 (87.6)
	Thallium	CCV3 (112.3)
A01SS-104	Arsenic	CCV4 (87.3)
	Potassium	CCV3 (112.3)
	Thallium	CCV1 (113.0); CCV2 (111.5)
A01SS-3	Barium	CCV2 (36.8)
	Silver	CCV1 (115.1); CCV2 (115.2); CCV3 (112.9)
	Selenium	CCV2 (85.1)
A01SS-18	Arsenic	CCV4 (87.3)
	Potassium	CCV3 (112.3)
	Thallium	CCV1 (113.0); CCV2 (111.5)
	Thallium	CCV1 (112.5)
A02SS-74	Silver	CCV1 (80.1); CCV2 (81.7)
A02SS-93	Thallium	CCV1 (115.5); CCV2 (112.0)

A01SS-111	Arsenic	CCV1 (114.4); CCV2 (114.2); CCV3 (119.8)
	Thallium	CCV1 (111.5)
	Silver	CCV1 (80.1); CCV2 (81.7)

- With the exception of three CCVs, all other CCV recoveries were within 85 to 115 percent of the true values. In some cases, sample results may be biased slightly high or low. Of the three CCVs outside of the 85 to 115 percent expanded acceptance window, barium was grossly exceeded in one with a recovery of 36.8 percent. In this instance, associated positive sample results would be qualified "L" for low bias and results <IDL would be rejected. All barium sample results in SDG No. A01SS-3 were >IDL. Since the CCV recovery was significantly lower than the acceptance window, the reviewer elected to qualify all samples in the SDG since the run logs to determine analysis sequence and sample association to the CCV were not provided in the reporting deliverable. The following samples were qualified "L" for barium in SDG No. A01SS-3: A01SS-06B; A01SS-16B; A01SS-17B; A01SS-33B; A01SS-95; A01SS-42B; A01SS-53B; A01SS-54B; and A01SS-96B.

- Some analytes were outside of the ±20% control limits of the true values for the inductively coupled plasma (ICP) analyses of the interference check samples (ICS). They are summarized by inorganic SDG No. below.

SDG No.	Analyte	%R (Initial/Final)
008A/B	Barium	77.5 (final)
	Lead	68.1 (initial)
A01SS-06	Antimony	63.4 (final)

- Barium results in SDG No. 008A/B were qualified biased low "L" for soil samples 0008A/B; 0009A/B; 0010A/B; 0011A/B; 0012A/B; and rinsate blank 0013. Additionally, lead results in all the samples noted above, with the exception of rinsate blank 0013, were qualified "L" for low bias due to the ICS recovery.

- No sample qualifications were assessed for the antimony ICS outlier in SDG A01SS-06 since more than one ICS sequences were analyzed and sample association could not be determined from the available data.

- Aqueous laboratory control samples (LCS) for metals were analyzed to monitor overall performance as required in the NEESA Level C QA requirements. The inorganic SOW specifies that LCS must be prepared for each matrix analyzed. LCS results for metals were provided in the laboratory reports for aqueous LCS only. In several SDGs, more than one LCS were prepared, but sample association could not be determined from the

available data provided for the NEESA Level C deliverables. Of the LCS outliers, with the exception of one nickel LCS recovery, all other outliers fell between 73 and 79 percent. Qualifications were assessed where the data reviewer could definitively ascertain association or where there was sufficient cause in the reviewer's judgment to qualify all samples in the SDG. In all cases, greater consideration was given to the matrix spike sample results discussed later which superseded the LCS results in some instances.

- The following table summarizes the LCS outliers reported in the case.

SDG No.	Analyte	LCS %R
A01SS-19	Arsenic	78.5
	Arsenic	75.0
	Selenium	78.0
A01SS-58	Arsenic	75.0
	Manganese	79.1
	Selenium	78.0
	Thallium	75.5
A01SS-104	Arsenic	78.4
A01SS-18	Arsenic	78.4
A01SS-74	Nickel	41.0
A01SS-111	Mercury	73.2

- In SDG No. A01SS-19, two of three LCS recoveries for arsenic were below the lower control limit (80%R). Arsenic results for all samples of the SDG were qualified for low bias "L" if >IDL and "UL" if < IDL. Low bias "L" qualifications were assessed to the following samples >IDL: A01SS-52; A01SS-53; A01SS-54; A05SS-56; A05SS-58; A05SS-59; A05SS-60; A05SS-63; A05SS-62; A05SS-66; and A05SS-85. Low bias "UL" qualifications were assessed to the following samples <IDL: A01SS-49; A01SS-50; A01SS-51; A05SS-64; A05SS-65; A01SS-86; and rinsate blank RB-04 A/C/D. Sample qualifications for the selenium outlier were not assessed in this SDG.

- In SDG No. A01SS-104, the LCS recovery for arsenic associated with the soil analyses of samples A01SS-104; A01SS-105; and A01SS-106 was <80%. The arsenic results for these samples were reported as >IDL and were qualified "L" for low bias due to the LCS recovery.

- The LCS recovery for nickel in SDG No. A02SS-74 was <50%. This LCS was associated with samples A02SS-74D; A02SS-83B; A02SS-92B; A02SS-107C; and A02SS-108A. The nickel results for these samples were >IDL and were qualified "L" for low bias due to the LCS outlier.

- Laboratory-duplicate sample analyses were performed on the following samples: 0012A/B; A01SS-20; A01SS-30; A01SS-36; A01SS-97 A01SS-101 (TCLP leachate); A01SS-101 (soil); A01SS-100; A01SS-44; A01SS-80; A05SS-85; A05SS-60; A01SS-106; A01SS-110; A01SS-96B; A01SS-109; A01SS-111; A01SS-112; and A01SS-113. Duplicate-sample analyses were also performed on rinsate blanks, however, the following discussion focuses on the soil and leachate matrices only.

- In accordance with the inorganic validation guidelines, the following limits were used in the data review of laboratory duplicates. An RPD control limit of 35 percent for soils was used for all soil analyses when sample values for both duplicates were greater than five times (5X) the contract required detection limits (CRDL). For duplicate samples values less than (<) the CRDL, a control limit of plus or minus two times the CRDL (±2X CRDL) was used to evaluate samples. The laboratory used a limit of 20 percent, as specified in the inorganic SOW, to determine RPD outliers and sample flags even though a limit of ± CRDL is specified for sample values <5X CRDL.

- In laboratory-duplicate samples A01SS-20, the RPD between the duplicates exceeded the control limits for cadmium (Cd), lead (Pb [by ICP]), and zinc (Zn). The following samples associated with A01SS-20 were qualified by the laboratory for the RPD outliers: A01SS-06; A01SS-07; A01SS-08; A01SS-09; A01SS-10; A01SS-11; A01SS-12; A01SS-13; A01SS-14; and A01SS-20. In all associated samples, analytes with exceeded RPD were flagged as estimated "J" unless previously qualified "B" for blank contamination which superseded the "J" quantitation qualifier. The following table summarizes qualification actions for the samples noted above.

Sample ID	Analytes Flagged "J"	Analytes where "B" superseded "J"
A01SS-06	Pb	Cd, Zn
A01SS-07	Pb	Cd, Zn
A01SS-08	Pb, Zn	Cd
A01SS-09	Pb, Zn	Cd
A01SS-10	Pb	Cd, Zn
A01SS-11	Pb	Cd, Zn
A01SS-12	Pb	Cd, Zn
A01SS-13	Pb	Cd, Zn
A01SS-14	Pb, Zn	Cd
A01SS-20	Pb, Zn	Cd

- In laboratory-duplicate samples A01SS-44, the RPD was exceeded for iron (Fe). The following samples associated with A01SS-44 were qualified by the laboratory for the RPD outlier: A01SS-19; A01SS-37; A01SS-38; A01SS-39; A01SS-40; A01SS-41; A01SS-42; A01SS-43; A01SS-44; and A01SS-79. All of the above sample results for Fe were qualified estimated "J" due to the RPD outlier.

- In laboratory-duplicate samples A05SS-60, the RPDs were exceeded for Pb and manganese (Mn). The following samples associated with A05SS-60 were qualified by the laboratory for the RPD outlier: A01SS-49; A01SS-50; A01SS-51; A01SS-52; A01SS-53; A01SS-54; A05SS-56; A05SS-58; A05SS-59; and A05SS-60. All of the above samples results for Pb and Mn were qualified estimated "J" due to the RPD outliers.

- In laboratory-duplicate samples A01SS-106, the RPD for copper (Cu) was exceeded. Samples A01SS-104; A01SS-105; A01SS-106; A01SS-18B; A01SS-26B; A01SS-103A; and A05SS-102 were associated with A01SS-106. The results for Cu in A01SS-104; A01SS-105; and A01SS-106 were qualified estimated "J" due to the RPD outlier. In all other samples noted above, Cu results were previously flagged "B" which superseded the "J" qualifier for quantitation.

- In laboratory-duplicate samples A01SS-109, the RPDs for aluminum (Al), Cu and Zn were exceeded. Samples A02SS-93B; A01SS-109; and A01SS-110 were associated with A01SS-109. The following table summarizes qualification actions for the samples noted above.

Sample ID	Analytes Flagged "J"	Analytes where "B" superseded "J"
A02SS-93B	Al	Cu, Zn
A01SS-109	Al, Cu, Zn	-
A01SS-110	Al, Zn	Cu

- Matrix spike analyses were performed on the following samples: 0008A/B; A01SS-20; A01SS-30; A01SS-36; A01SS-97; A01SS-101 (TCLP leachate); A01SS-100; A01SS-44; A01SS-80; A02SS-74; A02SS-94; A02SS-88; A05SS-85; A05SS-60; A01SS-106; A01SS-110; A01SS-96B; A02SS-108A; A01SS-109l A01SS-111; A01SS-112; and A01SS-113. Several samples were spiked for mercury and/or graphite furnace analytes and not for ICP analytes. Lead and arsenic spikes were prepared for both graphite furnace and ICP analyses, when appropriate.

- In the matrix spike analysis of 0008A/B, the following analytes were outside of the required criteria: antimony (Sb), As, Cd, chromium (Cr), cobalt (Co), mercury (Hg), nickel (Ni), selenium (Se), and silver (Ag). Samples 0008A/B; 0009A/B; 0010A/B; 0011A/B; and 0012A/B were associated with the MS analysis of 0008A/B.

- Sb, Se, and Ag were qualified biased low "UL" in all of the samples noted above since the samples results were <IDL and the recovery was between 30 and 74%.

- As results were qualified biased low "L" in samples 0008A/B; 0009A/B; and 0012A/B and "UL" in samples 0010A/B and 0011A/B based on an MS recovery between 30 and 74%.

- Cd, Co, and Ni results were qualified biased low "L" in all samples noted above based on an MS recovery between 30 and 74%.

- Cr results were qualified biased extremely low "L" in all samples noted above based on an MS recovery <30%.

- Hg results in samples 0008A/B; 0009A/B; 0010A/B; and 0011A/B were qualified "UL" and sample 0012 A/B was qualified "L" for low bias based on an MS recovery between 30 and 74%.

- In the matrix spike analysis of A01SS-20, the following analytes were outside of the required criteria: Sb, As, Cr, Co, Ni, potassium (K), Se, Ag, and vanadium (V). Samples A01SS-06; A01SS-07; A01SS-08; A01SS-09; A01SS-10; A01SS-11; A01SS-12; A01SS-13; A01SS-14; and A01SS-20 were associated with the MS analysis of A01SS-20.

- With the exception of A01SS-06, Sb results were qualified biased low "UL" in all of the above samples since sample results were <IDL and the recovery was between 30 and 74%. In sample A01SS-06, the Sb result was previously qualified "B" which superseded the "J" qualifier for quantitation.

- The As result in A01SS-06 was qualified biased low "L" since the sample results was >IDL and the MS recovery (on the ICP) was between 30 and 74%. Arsenic results were previously flagged "B" which superseded the "L" qualifier for low bias in the following samples: A01SS-07; A01SS-08; A01SS-09; A01SS-10; A01SS-14; and A01SS-20.

- The MS recoveries of Cr, Co, and V were between 30 and 75%. Cr, Co, and V results in all samples associated with the MS analysis of A01SS-20 were >IDL and previously flagged "B" which superseded the "L" qualifier for low bias in the MS analysis.

- The sample results for Ni and K in all samples associated with the MS analysis of A01SS-20 were >IDL for both analytes. The MS recoveries for these analytes were between 30 and 75% in A01SS-20. Sample results for both analytes were qualified "L" for low bias in all samples noted above associated with the MS analysis of A01SS-20.

- The sample results for Se and Ag in all samples associated with the MS analysis of A01SS-20 were <IDL. The MS recoveries for these analytes were between 30 and 75% in A01SS-20. Sample results for both analytes were qualified "UL" for low bias in all samples noted above associated with the MS analysis of A01SS-20.

- In the MS analysis of A01SS-30, the following analytes were outside of the required criteria: Sb, As, Cr, Hg, K, and Ag. Samples A01SS-21; A01SS-22; A01SS-23; A01SS-24; A01SS-25; A01SS-26; A01SS-27; A01SS-28; A01SS-29; and A01SS-30 were associated with the MS analysis of A01SS-30.

- The MS recovery for Sb in A01SS-30 was <30% and all of the associated Sb sample results were <IDL. All the Sb data for samples associated with the MS analysis of A01SS-30 were qualified unusable "R".

- The MS recovery for As analyzed by ICP in A01SS-30 was between 30 and 75%. Samples A01SS-22; A01SS-24; A01SS-28; and A01SS-30 were associated with and were previously qualified "B" which superseded the "L" qualifier for low bias in the MS analysis.

- The MS recovery for As analyzed by graphite furnace atomic absorption (GFAA) was <30%. Samples A01SS-21; A01SS-23; A01SS-25; A01SS-26; A01SS-27; and A01SS-29 were associated with the MS analysis of A01SS-30 for As by GFAA. With the exception of A01SS-27, all of the samples noted above were previously flagged "B" which superseded the "L" qualifier for low bias in the MS analysis. The As result in A01SS-27 was qualified "UL" for low bias since the result was <IDL.

- The MS recovery for Cr in A01SS-30 was between 30 and 75%. With the exception of A01SS-22 and A01SS-30, all of the samples associated with this MS were previously qualified "B" which superseded the "L" qualifier for low bias in the MS analysis. The Cr results in A01SS-22 and A01SS-30 were qualified "L" for low bias since the results were >IDL.

- The MS recovery for Hg in A01SS-30 was between 30 and 75%. With the exception of samples A01SS-22; A01SS-24; and A01SS-28, all other sample results for Hg were >IDL and were qualified "L" for low bias in the MS analysis of A01SS-30. The samples results in A01SS-22; A01SS-24; and A01SS-28 were qualified "UL" since the results were <IDL.

- The MS recovery for K in A01SS-30 was between 30 and 75%. With the exception of samples A01SS-27 and A01SS-28, all other sample results for K were >IDL and were qualified "L" for low bias in the MS analysis of A01SS-30. The sample results for A01SS-27 and A01SS-28 were qualified "UL" since the results were <IDL.

- The MS recovery for Ag in A01SS-30 was between 30 and 75%. All of the sample results for Ag associated with the MS analysis of A01SS-30 were <IDL and were qualified "UL" for low bias in the MS analysis.

- In the matrix spike analysis of A01SS-36, Se and Ag recoveries were between 30 and 75%. Samples A01SS-31; A01SS-32; A01SS-15; A01SS-16; A01SS-17; A01SS-18; A01SS-33; A01SS-34; A01SS-35; A01SS-36; A01SS-46; A01SS-47; A01SS-77; A01SS-78; and A01SS-80 were associated with this MS analysis.

- All samples associated with the MS analysis of A01SS-36 were reported <IDL for both analytes in each sample with the exception of A01SS-33; A01SS-34 and A01SS-36. Se and Ag results in all samples <IDL were qualified "UL" for low bias in the MS analysis. In sample A01SS-33, Se was reported >IDL and Ag was reported <IDL. Se was qualified "L" and Ag was qualified "UL" for low bias in A01SS-33. In samples A01SS-34, and A01SS-36, Se was reported <IDL and Ag was reported >IDL in both samples. Se results were qualified "UL" and Ag results were qualified "L" for low bias in both A01SS-34 and A01SS-36.

- In the MS analysis of A01SS-101, the Se recovery was between 30 and 75%. In the MS analysis of A01SS-97, Sb and Ni recoveries were between 30 and 75%. All of these soil samples: A01SS-97; A01SS-98; A01SS-99; A01SS-100; and A01SS-101 were associated with both of these MS analyses.

- All of the samples associated with A01SS-97 and A01SS-101 noted above were <IDL for Sb and Se. All were qualified "UL" for low bias in the MS analyses for both Sb and Se.

- All of the samples associated with A01SS-97 noted above were >IDL for Ni and were qualified "L" for low bias in the MS analysis.

- In the MS analysis of A01SS-44, the following analytes were outside of the required criteria: As (by ICP), As (by GFAA), Cr, K, Se, and Ag. Samples A01SS-19; A01SS-37; A01SS-38; A01SS-39; A01SS-40; A01SS-41; A01SS-42; A01SS-43; A01SS-44; and A01SS-79 were associated with the MS analysis of A01SS-44.

- The MS recoveries for As by ICP and by GFAA were between 30 and 75%. All of the samples noted above and associated with these MS analyses were reported as >IDL. All of the associated samples were qualified "L" for low bias in the MS analyses.

- The MS recovery for Cr in A01SS-44 was between 30 and 75%. All of the sample results for Cr associated with the MS analysis of A01SS-44 were >IDL. All of the sample results noted above were qualified "L" for low bias in the MS analysis.

- The MS recovery for K in A01SS-44 was between 30 and 75%. All of the sample results for K with the exception of A01SS-43 were reported >IDL. These results were qualified "L" for low bias in the MS analysis of A01SS-44. The sample result for A01SS-43 was <IDL and qualified "UL" for low bias in the MS analysis.

- The MS recoveries for Se and Ag in A01SS-44 were between 30 and 75%. All of the sample results associated with the MS analysis of A01SS-44 were <IDL. All results were qualified "UL" for low bias in the MS analysis.

- In the MS analysis of A01SS-80, the following analytes were outside of the required criteria: Sb, As (by GFAA), Se, and Ag. Sample A01SS-45 was associated with this MS analysis. The MS recovery for Sb was <30%. The Sb result in A01SS-45 was

>IDL and was qualified "L" for extremely low bias, which was superseded by a "B" qualifier previously assessed. The As result in A01SS-45 was >IDL and was qualified "L" based on an MS recovery between 30 and 75%. For both Se and Ag, the results were <IDL and the MS recoveries were between 30 and 75%. Both results in A01SS-45 were qualified "UL" for low bias in the MS analysis.

- In the MS analysis of A05SS-85, the following analytes were outside of the required criteria: Sb, Ca, Se, Ag, and thallium (Tl). Samples A05SS-63; A05SS-64; A05SS-65; A01SS-86; A05SS-62; A05SS-66: and A05SS-85 were associated with the MS analysis of A05SS-85.

- The MS recovery for Sb in A05SS-85 was <30%. All samples, with the exception of A01SS-86 and A05SS-85 were <IDL and were qualified as unusable "R". The Sb results in A05SS-85 and A01SS-86 were >IDL. The results were qualified "L" for low bias in the MS analysis which was superseded by the "B" qualifier previously assessed.

- The MS recovery for Ca was >125% in the MS analysis of A05SS-85. the following samples were >IDL and were qualified "K" biased high: A05SS-63; A01SS-86; A05SS-62; A05SS-66; and A05SS-85. In samples A05SS-64 and A05SS-65, the results for Ca were previously qualified "B" which superseded the "K" qualifier for high bias in the MS analysis.

- The MS recovery for Se in A05SS-85 was <30%. All samples associated with A05SS-85 were reported as <IDL and were qualified as unusable "R".

- The MS recoveries for Ag and Tl in A05SS-85 were between 30 and 75%. The results for both of these analytes in all samples were qualified "UL" for low bias in the MS analyses, since the results were <IDL.

- In the MS analysis of A05SS-60, the following analytes were outside of the required criteria: Sb, As, Pb, Se, Ag, and Zn. The following samples were associated with the MS analysis of A05SS-60: A01SS-49; A01SS-50; A01SS-51; A01SS-52; A01SS-53; A01SS-54; A05SS-56; A05SS-58; A05SS-59; and A05SS-60.

- The MS recovery for Sb in A05SS-60 was <30%. All samples associated with A05SS-60 were reported as <IDL and were qualified as unusable "R".

- The MS recovery for As in A05SS-60 was between 30 and 75%. All As sample results associated with the MS analysis of A05SS-60 in SDG No. A01SS-19 were previously qualified "L" and "UL" for low bias due to an LCS outlier.

- The MS recovery for Pb in A05SS-60 was >125%. All Pb sample results associated with this MS analysis were previously qualified estimated "J" for laboratory-duplicate precision which superseded the "K" qualifier for high bias in the MS analysis.

- The MS recovery for Se in A05SS-60 was <30%. All samples associated with A05SS-60 were reported as <IDL for Se and were qualified as unusable "R".

- The MS recovery for Ag in A05SS-60 was between 30 and 75%. All of the samples results for Ag associated with the MS analysis of A05SS-60 were <IDL and were qualified "UL" for low bias in the MS analysis.

- The MS recovery for Zn in A05SS-60 was >125%. All of the sample results for Zn associated with the MS analysis of A05SS-60 were >IDL and were qualified "K" for high bias in the MS analysis.

- In the MS analysis of A02SS-74, the Sb recovery was <30%. The following samples were associated with this MS analysis: A02SS-67; A02SS-68; A02SS-69; A02SS-70; A02SS-71; A02SS-72; A02SS-73; and A02SS-74. With the exception of A02SS-73, all other Sb sample results for the associated samples were <IDL and were qualified as unusable "R" due to extremely low recovery in the MS sample. In sample A02SS-73, the sample results was previously flagged with "B" which superseded the "L" qualifier for biased extremely low.

- In the MS analysis of A02SS-94, the following analytes were outside of the required criteria: Sb, As, Ca, Cu, K, Ag, and Tl. The following samples were associated with the MS analysis of A02SS-94: A02SS-75; A02SS-76; A02SS-81; A02SS-82; A02SS-83; A02SS-84; A02SS-87; A02SS-88; A02SS-89; A02SS-91; A02SS-92; A02SS-93; and A02SS-94.

- The MS recovery for Sb in A02SS-94 was <30%. All samples associated with A02SS-94 were reported as <IDL and were qualified as unusable "R".

- The MS recovery for As in A02SS-94 was between 30 and 75%. The following samples were reported as <IDL and were qualified "UL" for low bias: A02SS-75; A02SS-82; A02SS-83; A02SS-84; A02SS-89; and A02SS-93. The following samples were reported as >IDL and were qualified "L" for low bias: A02SS-75; A02SS-81; A02SS-87; A02SS-88; A02SS-91; A02SS-92; and A02SS-94.

- The MS recoveries for Ca, Cu, and K in A02SS-94 were between 30 and 75%. All of the sample results for Ca associated with the MS analysis of A02SS-94 were >IDL and were qualified "L" for low bias in the MS analysis.

- The MS recovery for Ag in A02SS-94 was between 30 and 75%. The following samples were reported as <IDL and were qualified "UL" for low bias: A02SS-75; A02SS-81; A02SS-82; A02SS-83; A02SS-84; A02SS-87; A02SS-88; A02SS-89; and A02SS-93. The following samples were reported as >IDL and were qualified "L" for low bias: A02SS-91; A02SS-92; and A02SS-94.

- The MS recovery for Tl in A02SS-94 was between 30 and 75%. All of the sample results for Tl associated with the MS analysis of A02SS-94 were <IDL and were qualified "UL" for low bias in the MS analysis.

- In the MS analysis of A01SS-106, the following analytes were outside of the required criteria: Sb, beryllium (Be), Ni, V, and Hg. Samples A01SS-104; A01SS-105; A01SS-106; A01SS-18B; A01SS-26B; A01SS-103A; and A05SS-102 were associated with the MS analysis of A01SS-106.

- The MS recovery for Sb in A01SS-106 was <30%. The Sb result in A01SS-104 was >IDL and was qualified "L" for biased extremely low. The Sb results in samples A01SS-105; A01SS-106; A01SS-18B; A01SS-26B; A01SS-103A; and A05SS-102 were <IDL and qualified "R" as unusable.

- The MS recoveries for Be, Ni, and V in A01SS-106 were between 30 and 75%. All of the Be and V results associated with the MS analysis of A01SS-106 were >IDL and were qualified "L" for low bias in the MS analysis. The results for A01SS-104; A01SS-105; and A01SS-106 were qualified "L" for low bias due to the MS recovery. Samples A01SS-18B; A01SS-26B; A01SS-103A; and A05SS-102 were previously qualified "B" which superseded the "L" qualifier for low bias.

- The MS recovery for Hg in A01SS-106 was between 30 and 75%. All of the results associated with the MS analysis of A01SS-106 were >IDL and were qualified "L" for low bias in the MS analysis.

- In the MS analysis of A01SS-96B, the recoveries for Sb, Se and Ag were outside of the required criteria. The following samples were associated with the MS analysis of A01SS-96B: A01SS-06B; A01SS-16B; A01SS-17B; A01SS-33B; A01SS-95; A01SS-42B; A01SS-53B; A01SS-54B; and A01SS-96B.

- The MS recovery for Sb in A01SS-96B was <30%. The Sb results in all samples associated with A01SS-96B were reported as <IDL and were qualified unusable "R".

- The MS recoveries for Se and Ag in A01SS-96B were between 30 and 75%. All of the sample results for Se and Ag were <IDL and were qualified "UL" for low bias in the MS analysis.

- In the MS analysis of A02SS-108A, the following analytes were outside of the required criteria: Sb, As, barium (Ba), Cd, Ca, Cr, Co, Cu, Pb, Mg, Mn, Ni, K, Se, Ag, V, and Zn. The following samples were associated with A02SS-108A: A02SS-74D; A02SS-83B; A02SS-92B; A02SS-107C; and A02SS-108A.

- The MS recovery for Sb in A02SS-108A was <30%. The Sb results in all samples associated with A02SS-108A were reported as <IDL and were qualified unusable "R".

- The MS recovery for As in A02SS-108A was between 30 and 75%. The As results in samples A02SS-74D; A02SS-92B; and A02SS-108A were >IDL and were qualified "L" for low bias. In samples A02SS-83B and A02SS-107C, The As results were <IDL and were qualified "UL" for low bias in the MS analysis.

- The MS recoveries for Ba, Cd, Co, Cu, and Pb in sample A02SS-108A were between 30 and 75%. All samples results for these analytes were >IDL and were qualified "L" for low bias in the MS analysis. The Cr results were >IDL and were qualified "L" for biased extremely low since the MS recovery was <30%.

- The MS recovery for Mg in A02SS-108A was <30%. The Mg results in samples A02SS-74D and A02SS-108A were qualified "L" for biased extremely low in the MS analysis. Samples A02SS-83B; A02SS-92B; and A02SS-107C were previously flagged "B" which superseded the "L" qualifier for low bias.

- The MS recovery for Mn in A02SS-108A was between 30 and 75%. All sample results associated with A02SS-108A were >IDL and were qualified "L" for low bias in the MS analysis.

- The MS recovery for Ni in A02SS-108A was between 30 and 75%. All Ni results in SDG No. A02SS-74 were previously qualified "L" for low bias in the LCS analysis.

- The MS recovery for K in A02SS-108A was <30%. All K results associated with A02SS-108A were >IDL and were qualified "L" for low bias in the MS analysis.

- The MS recovery for Se in A02SS-108A was <30%. The Se results in all samples associated with A02SS-108A were reported as <IDL and were qualified unusable "R".

- The MS recovery for Ag in A02SS-108A was between 30 and 75%. All sample results associated with A02SS-108A were <IDL and were qualified "L" for low bias in the MS analysis.

- The MS recoveries for V and Zn in A02SS-108A were between 30 and 75%. With the exception of the Zn result in sample A02SS-83B, all results for V and Zn were >IDL and were qualified "L" for low bias in the MS analysis. In sample A02SS-83B, the Zn results was previously qualified "B" which superseded the "L" qualifier for low bias.

- In the MS analysis of A01SS-109, the following analytes were outside of the required criteria: Sb, Ba, Cr, Cu, Pb, Mg, K, and Se. Samples A02SS-93; A01SS-109; and A01SS-110 were associated with the MS analysis of A01SS-109.

- The MS recovery for Sb in A01SS-109 was <30%. The Sb results in all samples associated with A01SS-109 were <IDL and were qualified unusable "R".

- The MS recoveries for Ba and K in A01SS-109 were <30%. The Ba and K results in all samples associated with A01SS-109 were >IDL and were qualified "L" for extremely low bias in the MS analyses.

- The MS recoveries for Cr and Mg in A01SS-109 were between 30 and 75%. The Cr and Mg results in all samples associated with A01SS-109 were >IDL and were qualified "L" for low bias in the MS analyses.

- The MS recovery for Cu in A01SS-109 was between 30 and 75%. All sample results were previously qualified "B" which superseded the "L" qualifier for low bias in the MS analysis.

- The MS recovery for Pb in A01SS-109 was >125%. The Pb results in all samples associated with A01SS-109 were >IDL and were qualified "K" for high bias in the MS analysis.

- The MS recovery for Se in A01SS-109 was between 30 and 75%. All sample results for Se in samples associated with A01SS-109 were <IDL and qualified "UL" for low bias in the MS analysis.

- In the MS analysis of A01SS-111, the Sb recovery was between 30 and 75%. The Sb results in associated samples A01SS-111 and A01SS-112 were <IDL and were qualified "UL" for low bias in the MS analysis.

- In the MS analysis of A01SS-112, the following analytes were outside the required criteria: As, Pb, Hg, and Se. Samples A01SS-111 and A01SS-112 were associated with these MS analyses.

- The MS recoveries for As and Pb in A01SS-112 were >125%. The As and Pb sample results for A01SS-111 and A01SS-112 were >IDL and were qualified "K" for high bias in the MS analysis.

- The MS recovery for Hg in A01SS-112 was between 30 and 75%. The Hg results in A01SS-111 was >IDL and was qualified "L" for low bias in the MS analysis. The Hg result in A01SS-112 was <IDL and was qualified "UL" for low bias.

- The MS recovery for Se in A01SS-112 was between 30 and 75%. The Se results in both A01SS-111 and A01SS-112 were <IDL and were qualified "UL" for low bias in the MS analysis.

- In the MS analysis of A01SS-113, the following analytes were outside the required criteria: Sb, As, Cd, Cr, Cu, Se, Ag, and V.

- The MS recovery for Sb in A01SS-113 was <30%. The result in A01SS-113 was <IDL and was qualified as unusable "R".

- The MS recoveries for As, Cr, and V for A01SS-113 were between 30 and 75%. The results for these analytes in A01SS-113 were >IDL and were qualified "L" for low bias in the MS analysis.

- The MS recoveries for Cd and Cu in A01SS-113 were between 30 and 75%. The results for Cd and Cu were previously flagged "B" which superseded the "L" qualifier for low bias in sample A01SS-113.

- The MS recoveries for Se and Ag in A01SS-113 were between 30 and 75%. The sample results for these analytes in A01SS-113 were <IDL and were qualified "UL" for low bias in the MS analysis.

- A limited review of GFAA quality control was performed using the available data provided in the NEESA Level C report deliverable. The Form I summary data were reviewed for flags pertaining to outlier analytical spike recoveries and samples requiring method of standard addition (MSA) analyses for quantitation of GFAA analytes. No raw data were provided to verify the accuracy of the flags, the GFAA analysis scheme, precision of duplicate injections, and bias of analytical and post-digestion spikes.

- The following table summarizes quantitation qualifiers assessed for analytical spike recoveries flagged by the laboratory. Although the laboratory indicated in the case narratives that analytical spike recoveries were exceeded, no indication of bias or magnitude of the spike recovery was provided. Based on this information, analytes flagged with "W" for outlier analytical spikes were qualified estimated "J" and "UJ" since no direction of bias could be determined.

SDG No.	Sample ID	Analyte	Qualifier Code
0008/A	0008A/B	Se	UJ
	0009A/B	As	Superseded
	0009A/B	Se	UJ
	0011A/B	As	Superseded
	0012A/B	As	Superseded
	0012A/B	Se	UJ
A01SS-1	A01SS-15	Se	Superseded
	A01SS-16	Tl	UJ
	A01SS-17	Tl	UJ
	A01SS-18	Tl	UJ
	A01SS-19	Tl	UJ
	A01SS-33	Tl	UJ
	A01SS-34	Tl	UJ
	A01SS-35	Se	Superseded
	A01SS-36	Se	Superseded
	A01SS-37	Se	Superseded
	A01SS-37	Tl	UJ
	A01SS-38	Tl	UJ

	A01SS-39	Tl	UJ
	A01SS-40	Se	Superseded
	A01SS-40	Tl	UJ
	A01SS-41	Tl	UJ
	A01SS-42	Tl	UJ
	A01SS-44	Se	Superseded
	A01SS-46	Se	Superseded
	A01SS-79	Tl	UJ
A01SS-19	A01SS-51	As	Superseded
	A01SS-52	Se	(Rejected)
	A05SS-56	Se	(Rejected)
	A05SS-59	Se	(Rejected)
	A05SS-66	As	Superseded
	A05SS-66	Tl	UJ
	A05SS-85	As	Superseded
A01SS-58	A02SS-69	Se	UJ
	A02SS-70	Se	UJ
	A02SS-71	Se	UJ
	A02SS-73	As	J
	A02SS-75	Tl	UJ
	A02SS-76	Tl	UJ
	A02SS-81	Se	UJ
	A02SS-82	Se	UJ
	A02SS-83	Se	UJ
	A02SS-83	Tl	UJ
	A02SS-84	Se	UJ
	A02SS-84	Tl	UJ
	A02SS-87	Se	UJ
	A02SS-88	Tl	UJ
	A02SS-89	Tl	UJ
	A02SS-91	Se	UJ
	A02SS-91	Tl	UJ
	A02SS-92	Tl	UJ
	A02SS-93	Tl	UJ
A01SS-104	A01SS-104	As	J
	A01SS-104	Tl	UJ
	A01SS-105	Tl	UJ
	A01SS-106	As	J
A01SS-18	A01SS-18B	As	J
	A01SS-26B	Tl	UJ
	A01SS-103A	As	J
	A01SS-103A	Tl	UJ
	A05SS-102	As	J
A01SS-3	A01SS-06B	Se	Superseded
	A01SS-16B	Se	Superseded

	A01SS-17B	Se	Superseded
	A01SS-33B	Se	Superseded
	A01SS-95	Se	Superseded
	A01SS-42B	Se	Superseded
	A01SS-53B	Se	Superseded
	A01SS-54B	Se	Superseded
	A01SS-96B	Se	Superseded
A02SS-74	A02SS-74D	As	Superseded
	A02SS-74D	Se	(Rejected)
	A02SS-83B	As	Superseded
	A02SS-83B	Se	(Rejected)
	A02SS-92B	As	Superseded
	A02SS-92B	Se	(Rejected)
	A02SS-107C	As	Superseded
	A02SS-107C	Se	(Rejected)
	A02SS-108A	As	Superseded
	A02SS-108A	Se	(Rejected)
A01SS-111	A01SS-111	Se	UJ
	A01SS-112	Se	UJ
	A01SS-113	Tl	UJ

- The calcium results in samples A01SS-14 and A01SS-22 were qualified estimated "J" since the concentrations were above the linear range of the ICP instrument and not subsequently reanalyzed by dilution due to laboratory error.

NOTES

This section identifies issues and information that may be beneficial to the data user.

- As stated in the laboratory narratives, ASC did not use the USEPA conventions for defining SDGs and batching samples. This deviation from the SOW impeded the data review of some QC criteria for organic parameters, while not affecting others.

- Due to a log-in error, the rinse blank identified on the COC record as RB07A through D was identified as sample RB01A/B/C/D in the analytical data. The data reviewer confirmed the log-in discrepancy with the laboratory, but otherwise, took no further action.

Volatile Organic Compounds

- Blank contamination was found in almost all laboratory method blanks, trip blanks, the field blank and rinsate blanks. The contaminants consisted primarily of the common laboratory contaminants (methylene chloride, acetone and 2-butanone); various solvents used in the lab and/or the field (hexane and Freon-113); and other low-level

contaminants often attributed to specific and routine laboratory processes (trap and column bleed). For qualification purposes with the exception of acetone, all blanks, regardless of origin, were used in the identification of sample contamination.

- In the case of acetone, the reviewer believed that there was convincing evidence that the acetone contamination should be reviewed using differing maximum contaminant levels based on specific sampling periods and laboratory delivery dates. On this basis, the acetone comparisons of contaminated blanks were applied to certain associated samples. The maximum contaminant table presented below includes three acetone entries presented in increasing concentration, and the lists of associated SDGs and/or ASC laboratory "joblink" identifications.

- The following maximum contaminant levels for the noted analytes were identified in blanks associated with this case:

Analyte/TIC (RT)	Concentration (ppb)	Blank Type/LAB ID	Associated Samples
Methylene Chloride*	10	Soil Method Blank/N2V4008V	All
Acetone*	11	Method Blank/N1V3978V	SDG 008A/B (ASC Joblink#616891); SDG A01SS-06 (ASC Joblink#617009); SDG A01SS-97 (ASC Joblink#617195);
Acetone*	270D	Rinsate Blank/A01SS-3A/D	SDG A01SS-1 (ASC Joblink#617018); SDG N2V3030; SDG N2V4038 (ASC Joblink #617048 and 617067)
Acetone*	27000D	Rinsate Blank/R-8	SDG N1V4036; SDG N2V4040; SDG N7V4092; SDG N1V4098; SDG N2V4099; SDG N1V4108; SDG N2V4104; SDG N7V4112; (ASC Joblink#617092, 617208, 617251, 617257, 617263, 617266 & 617273)
1,2-Dichloroethane	1J	Field Blank/FB01	All
2-Butanone*	10J	Soil Method Blank/N2V3979V	All
2-Hexanone	2J	Soil Method Blank/N2V4008V	All
Tetrachloroethene	1J	Soil Method Blank/N2V4008V	All
1,1,2,2-Tetrachloroethane	1J	Aqueous Method Blank/N1V3978V	All
Toluene	1J	Soil Method Blank/N2V3979V	All
Chlorobenzene	1J	Soil Method Blank/N2V3979V	All
Ethylbenzene	1J	Aqueous Method Blank/N1V4108V	All
Styrene	1J	Trip Blank/TB-3	All
Xylene (Total)	3J	Aqueous Method Blank/N1V4017V	All
1,1,2-Trichloro-1,2,2-trifluoroethane (5.67)	16JN	Soil Method Blank/N2V4013V	All
Hexane (7.49)	6JN	Rinsate Blank/A01SS-2A/B	All

* Common laboratory contaminants.

- Several blanks related to field activities and/or sample shipment were reported with substantial acetone levels. It is the recommendation of the data reviewer that sample decontamination procedures and other handling procedures be thoroughly reviewed and investigated prior to further sampling events.

- On the first day of sampling, an aqueous sample was collected at Area 5 as a rinsate blank, but not identified as such except for under the sample description. This sample was designated sample "0001 through 0003" on the COC and "0001/0003" in the laboratory data. The following VOC analytes and concentrations were reported in sample 0001/0003:

Compound/TIC (RT)	Concentration (ppb)
Methylene Chloride	2BJ
Acetone	19B
Benzene	66
Toluene	190
Ethylbenzene	16
Xylene (total)	73B

  Several analytes were identified as method blank contaminants (B qualifier) as they were found at low levels (1 to 2ppb) in the associated method blank. The aromatic VOCs (benzene, toluene, ethylbenzene, xylenes [BTEX]), however, appear to be field introduced and at significant concentration levels. The instrument runs were reviewed to determine if sample carryover existed and none was found as both the method blank and blank spike directly preceded the sample injection and did not contain the BTEX compounds above 1 to 2 ppb. The laboratory additionally analyzed this sample as matrix spike/matrix spike duplicate (MS/MSD) samples. Both of the spike samples exhibited similar BTEX levels as the unspiked sample. Since the BTEX detected in this rinsate blank sample appears to be restricted to the rinsate only, no action in other samples was taken based on the BTEX levels detected in it. The BTEX compounds in rinsate blank 0001/0003 will be flagged as tentatively-identified "N" since the levels were clearly greater and qualitatively different than the consistent level of contamination detected in the other blanks and samples of the case.

- Volatile system monitoring compound (SMC) recoveries were reviewed to verify that no SMC recovery was out of specification and that the samples were reanalyzed if the recoveries were outside the criteria. With the exception of one sample of a field duplicate pair and some blank spike and matrix spike samples, all other SMC recoveries were within the specified limits. None of the matrix spike samples were reanalyzed since the SMC compounds were typically out in both samples of the matrix spike duplicate pair and the results of the duplicates confirmed each other. No sample qualifications were made to any sample due to SMC outliers.

- Data for MS/MSD samples were generated to determine precision and accuracy of the methods in various matrices. Although MS/MSD analyses were performed on both the soil and aqueous sample matrices, the following discussion will focus on the results of the soil MS/MSD analyses only. All aqueous MS/MSD analyses, with the exception of the TCLP analyses, were performed on either rinsate blanks or on a trip blank sample and, therefore, do not provide precision and accuracy data attributable to a field sample matrix. Since the sampling program consisted of primarily soil samples and a small number of TCLP analyses, the MS/MSD discussion focuses on these matrices only. Volatile organic MS/MSD analyses in the soil matrix were performed on the following samples: 0008A/B; A01SS-32; A01SS-06; A01SS-97; A01SS-40; A01SS-49; A02SS-82; A01SS-06B; and A01SS-18B. Of these, only the spike recoveries for toluene in soil sample A01SS-06 were outside the recovery limits. The laboratory reported zero recoveries for both MS/MSD in sample A01SS-06 for toluene since the concentration found in the unspiked sample exceeded the toluene concentration reported in the MS/MSD analyses. These samples were analyzed and quantitated using the initial calibration sequence in which the toluene response and linearity were determined based on a 3-point curve. As discussed previously, all continuing calibrations associated with this initial calibration were reported with %D outliers for toluene. Based on this information and since all associated samples were previously qualified based on the calibration deficiency, no additional action was taken due to the toluene MS/MSD outliers in sample A01SS-06. All other VOC recoveries for soil and leachate MS/MSD analyses were within the prescribed limits for recovery and precision. No comparisons of non-spiked compounds present in the MS/MSD samples versus the original (unspiked) sample results were made since the laboratory inadvertently spiked all volatiles in the spike samples. Only the TCL compounds were summarized on the Form III MS/MSD summaries.

- Several volatile aqueous QC samples were diluted for high acetone levels in order to bring the sample concentrations within the linear range of the instrument for quantitation. Most likely, all of the dilutions were required due to blank contamination that resulted from field or laboratory contamination/sample carryover, or a combination of both. In several blank samples, the original acetone results were confirmed by the dilution analyses. However, in trip blank samples TB-2 and TB-3, although the lab confirmed the qualitative presence of acetone, the quantitative results of the dilutions were less than those found in the original analyses. These discrepancies may have resulted from random lab contamination and/or from carryover from rinsate blank R-8.

- The following samples were collected in duplicate in the field:

Sample ID	Replicate Sample ID
A01SS-18	A01SS-78
A01SS-19	A01SS-77

A01SS-35	A01SS-79
A01SS-46*	A01SS-80*
A01SS-50*	A01SS-86*
A05SS-62	A05SS-85
A02SS-82*	A02SS-89*
A02SS-93*	A02SS-94*
A01SS-16B*	A01SS-96B*

For the field samples noted above with an asterisk, no TCL compounds were detected in either sample of the field-duplicate pair.

- Most of the analytes originally reported were qualified for blank contamination and are not included in the field-duplicate comparisons. For those considered "real" after blank review, the relative percent difference (RPD) between the original and duplicate results for each analyte (in ug/Kg) are presented below. No calculation (NC) of RPD was made when an analyte in one sample of the field-duplicate pair was reported as a blank contaminant, or not detected in one of the sample pair.

Analyte	Sample ID	Field Duplicate ID	RPD
	A01SS-18	A01SS-78	
Trichloroethene	3J	3J	0
	A01SS-19	A01SS-77	
Trichloroethene	2J	2J	0
	A01SS-35	A01SS-79	
Trichloroethene	2J	1J	67
Toluene	20J	5U	NC
	A05SS-62	A05SS-85	
1,1,2-TCA	2J	6U	NC

J Estimated concentration.
NC Not calculated.
U Not detected.

- A duplicate comparison for sample A01SS-16B and duplicate A01SS-96B was not possible since the VOC results for A01SS-16B were rejected due to poor internal standard recoveries. All other RPD results for the sample-duplicate pairs were acceptable.

- Discrepancies were found between the Form I VOC results and the quantitation reports for several samples. Typically compounds were negated on the quantitation report, but showed a positive, low-level hit on the Form I summary. The laboratory was asked to verify the data and provide corrected Form I results as necessary. Corrected data were provided for the following samples in the VOC fraction: A01SS-36; A02SS-83; A02SS-87; A02SS-88; A02SS-93; A01SS-42B; A01SS-54B; A01SS-95; A01SS-106 (soil); A02SS-81; and A02SS-92B. All corrected data were inserted into the report by the data reviewer and may be found in Appendix C.

- Two trip blank samples identified as TB-3 were collected and analyzed by the laboratory. The trip blanks may be differentiated by the sampling and receipt dates which are summarized below.

Sample ID	Sampling Date	Receipt Date
TB-3	December 8, 1994	December 9, 1994
TB-3	December 9, 1994	December 10, 1994

- VOC data were reported for a sample identified as 120894TB by the laboratory which did not appear in the COC records. This sample was created by the laboratory to provide MS/MSD data for aqueous samples and consisted of laboratory water.

- A "D" qualifier was used by the data reviewer to indicate a result which was derived from a dilution analysis and incorporated in sample data of a lesser dilution or original analysis. When required, the "D" qualifier was superseded by the "J" qualifier to indicate that the data was estimated.

Semivolatile Organic Compounds

- Blank contamination was found in several method blanks and rinse blanks. The following SVOC maximum contaminant levels (in ug/Kg or ug/L) for the noted analytes were identified in the blanks associated with this case:

Analyte/TIC (RT)	Concentration	Blank Type/Lab ID
2,6-Dinitrotoluene	280J ug/Kg	Soil Method Blank/ N2C41631C
Bis(2-ethylhexyl)phthalate	9J ug/L	Rinsate Blank/R-8
Di-n-butylphthalate	1J ug/L	Water Method Blank/N1C41843C
Di-n-octylphthalate	44 ug/Kg	Soil Method Blank/N2C41631C
4-Methyl-2-heptanone	240JN ug/Kg	Soil Method Blank/N2C41689C
1,1,2-Trichloro-1-propene	82JN ug/Kg	Soil Method Blank/N2C41816C
m-Nitrophenyl butyric acid	120JN ug/Kg	Soil Method Blank/N2C41798C
1,2,3-Trichloro-1-propene	97JN ug/Kg	Soil Method Blank/N2C41672C
2-Methyl-1,5-hexadiene-3-ol	180JN ug/KG	Soil Method Blank/N2C41798C

2-Methyl-propanoic acid	8JN ug/L	Rinse Blank/A01SS-2A/B
Eicosane	74JN ug/Kg	Soil Method blank/N2C41879C
Butylated Hydroxytoluene	7JN ug/L	Rinsate Blank/Frinsate
Benzophenone	32JN ug/L	Rinsate Blank/A01SS-2A/B
Bis(2-ethyl)hexanedioic acid	2JN ug/L	Rinsate Blank/R-8
Didecyl phthalate	3JN ug/L	Rinsate Blank/R-8
(Z)-9-Octadecenamide	4JN ug/L	Rinsate Blank/A02SS-RIN9
Pentatriacontane	7JN ug/L	Rinsate Blank/A02SS-RIN9
Hexatriacontane	8JN ug/L	Rinsate Blank/A02SS-RIN9
Unknown (6.16)	84J ug/Kg	Soil Method Blank/N2C41816C
Unknown (6.26)	120J ug/Kg	Soil Method Blank/N2C41816C
Unknown Hydrocarbon (6.42)	100J ug/Kg	Soil Method Blank/N241672C
Unknown Hydrocarbon (6.47)	170J ug/Kg	Soil Method Blank/N2C41689C
Unknown Hydrocarbon (6.57)	480J ug/Kg	Soil Method Blank/N2C41689C
Unknown Hydrocarbon (6.59)	310J ug/Kg	Soil Method Blank/N2C41672C
Unknown Hydrocarbon (6.64)	130J ug/Kg	Soil Method Blank/N2C41673C
Unknown Hydrocarbon (6.66)	500J ug/Kg	Soil Method Blank/N2C41689C
Unknown Hydrocarbon (6.68)	430J ug/Kg	Soil Method Blank/N2C41672C
Unknown Hydrocarbon (16.29)	91J ug/Kg	Soil Method Blank/N2C41689C
Unknown Hydrocarbon (16.46)	190J ug/Kg	Soil Method Blank/N2C41689C
Unknown Hydrocarbon (17.22)	130J ug/Kg	Soil Method Blank/N2C41689C
Unknown Hydrocarbon (19.61)	180J ug/Kg	Soil Method Blank/N2C41673C
Unknown Phthalate (22.95)	4J ug/L	Rinsate Blank/R-8
Unknown Phthalate (23.13)	3J ug/L	Rinsate Blank/R-8
Unknown Phthalate (23.22)	3J ug/L	Rinsate Blank/R-8
Unknown Phthalate (23.29)	3J ug/L	Rinsate Blank/R-8

- With the exception of the field blank FB01A/B sample analysis and the associated method and blank spike analyses, all other SVOC analyses produced acceptable surrogate recoveries. Although a number of samples did have one base/neutral (BN) or acid surrogate out of specification, no other samples except for those noted above had two or more surrogates within the same semivolatile fraction (BN or acid) out of criteria or had surrogate recoveries less than 10 percent. Zero recoveries for all three acid fraction surrogates were reported for FB01A/B and the batch method blank and blank spike. This sample was not reextracted and reanalyzed since limited sample volume was received at the laboratory. All acid fraction SVOCs were qualified as unusable "R" in field sample FB01A/B. Refer to the Form II SV-1 Water Semivolatile Surrogate Recovery summary in Appendix E for FB01A/B surrogate recovery data.

- Analyses of MS/MSD samples were performed to determine precision and accuracy of the methods in the soil and leachate matrices. SVOC MS/MSD analyses in the soil matrix were performed on the following samples: 0011A/B; A01SS-14; A01SS-16; A01SS-97; A01SS-79; A05SS-58; A02SS-81; A01SS-06B; A01SS-18B; A01SS-104; and A02SS-93B. In the TCLP leachate matrix, the MS/MSD analyses were performed

on A01SS-101. Generally, most spiked analyses exhibited acceptable precision and accuracy in the sample matrix. High bias was noted in the PCP spiked analyses for several samples even when PCP was not detected in the original unspiked analysis. High bias was also noted for pyrene in several MS/MSD samples, however, pyrene was found at notably high concentrations in a number of site samples. Sample qualifications were applied to some of the unspiked samples analyses of the MS/MSD samples depending on the bias found and the magnitude of the outlier. The following samples were qualified for PCP and/or pyrene: A01SS-16 (pyrene only); A05SS-58 (pyrene only); and A02SS-81 (PCP only). No comparisons of non-spiked sample results were made since the lab spiked all compounds in the MS/MSD samples. Only the TCL compounds were summarized on the Form III MS/MSD summaries.

- The following samples were collected in duplicate in the field:

Sample ID	Replicate Sample ID
A01SS-18	A01SS-78
A01SS-19	A01SS-77
A01SS-35*	A01SS-79*
A01SS-46*	A01SS-80*
A01SS-50*	A01SS-86*
A05SS-62	A05SS-85
A02SS-82*	A02SS-89*
A02SS-93*	A02SS-94*
A01SS-16B	A01SS-96B

For the field samples noted above with an asterisk, no TCL semivolatile compounds were detected in either sample of the field-duplicate pair. The RPD for TCL detected in the remainder of the field duplicate samples were calculated and are presented below for each sample pair. TCL analytes flagged as blank contaminants were not included in the field-duplicate sample summary. For those field samples in which an analyte was detected in only on sample of the field-duplicate sample pair, the RPD was not calculated (NC) and was noted as such in the summary table.

Analyte	Sample ID	Field Duplicate ID	RPD
	A01SS-18	A01SS-78	
Phenol	79J	500U	NC
4-Methylphenol	700	180J	370
Acenaphthylene	92J	240J	89
Phenanthrene	380J	370J	2.7
Anthracene	110J	220J	67
Carbazole	480U	78J	NC
Fluoranthene	960	2000	70

Pyrene	1200	3700	102
Benzo(a)anthracene	450J	1100	84
Chrysene	1000	2600	89
Benzo(b)fluoranthene	1400	4900	111
Benzo(k)fluoranthene	820J	2800	109
Benzo(a)pyrene	550	1900	110
Indeno(1,2,3-cd)pyrene	170J	410J	83
Dibenz(a,h)anthracene	480U	180J	NC
Benzo(g,h,i)perylene	170J	460J	92

	A01SS-19	A01SS-77	
Acenaphthylene	100J	98J	2
Acenaphthene	80J	380U	NC
Fluorene	61J	380U	NC
Phenanthrene	680	260J	89
Anthracene	150J	100J	40
Carbazole	100J	50J	67
Fluoranthene	2800	970	97
Pyrene	2700	1200	77
Benzo(a)anthracene	620	460	30
Chrysene	1700	1300	27
Benzo(b)fluoranthene	360U	2300	NC
Benzo(k)fluoranthene	1400	1400	0
Benzo(a)pyrene	1000	900	11
Indeno(1,2,3-cd)pyrene	330J	270J	20
Dibenz(a,h)anthracene	140J	110J	24
Benzo(g,h,i)perylene	360	300J	18

	A05SS-62	A05SS-85	
Acenaphthylene	400U	44J	NC
Phenanthrene	69J	58J	17
Anthracene	17J	19J	11
Fluoranthene	140J	120J	15
Pyrene	260J	110J	27
Benzo(a)anthracene	60J	56J	7
Chrysene	80J	76J	5
Benzo(b)fluoranthene	150J	57J	89
Benzo(k)fluoranthene	400U	54J	NC
Benzo(a)pyrene	71J	55J	25
Benzo(g,h,i)perylene	400U	41J	NC

	A01SS-16B	A01SS-96B	
Acenaphthylene	110J	73J	40
Phenanthrene	62J	49J	23
Anthracene	95J	55J	53

Fluoranthene	700	440	46
Pyrene	960	480	67
Benzo(a)anthracene	480	230J	70
Chrysene	830	380J	74
Benzo(b)fluoranthene	1400	450	103
Benzo(k)fluoranthene	1100	300J	114
Benzo(a)pyrene	520	200J	89
Indeno(1,2,3-cd)pyrene	190J	110J	53
Benzo(g,h,i)perylene	220J	110J	67

Although the RPD results show some variation, most of the variability was with sample concentrations at the level of or estimated below the quantitation limits. The results of the field-duplicate sample pairs are acceptable and no qualifications were assessed based on RPD results.

- TIC results were examined and qualified for blank contamination (flagged "B") where appropriate. Additionally, TIC results were reviewed for the presence of aldol-condensation products and TCL compounds from both the VOC and SVOC analytical fractions. Aldol-condensation products were negated from the TIC summary by means of a drawn line and noted as "aldol". TCL compounds were similarly negated from the summary and noted either as "TCL for a SVOC target compound or "VOC" if from the TCL volatiles fraction. All blank TIC results (with positive detects) are attached in the support documentation section (Appendix E) of the data review report.

- Discrepancies were found between the Form I SVOC results and quantitation reports for several samples. Typically, compounds were negated on the quantitation report, but showed a positive, low-level hit on the Form I summary. The laboratory was asked to verify the data and provide corrected Form I results as necessary. Corrected data were provided for the following samples in the SVOC fraction: A01SS-06B; A07SS-33B; and A01SS-111. All corrected data were inserted into the report by the data reviewer and may be found in Appendix C.

- Gel permeation chromatography (GPC) clean-ups were not performed on any soil samples submitted for SVOC analysis in this case. GPC clean-ups are required for all soil/sediment extracts. The failure to employ this clean-up procedure represents a technical non-compliance with the organic SOW.

- Two sets of SVOC sample results with the same File IDs were submitted for both A01SS-16 and A01SS-79. The sample results in each set differed slightly due to varying starting sample weights. The laboratory was notified of the error and informed the data reviewer of the correct data to be used for each sample. The correct SVOC data is provided in Appendix C and the eliminated data appears in the supporting documentation section in Appendix E with a notation made by the data reviewer.

- SVOC results were received in the laboratory reports for a sample identified as "076". The sample does not belong to the Yorktown case and was included erroneously by the laboratory. A copy of the SVOC data for sample 076 is included in the supporting documentation of Appendix E.

Pesticides/PCBs

- Due to the nature of the deliverables provided for NEESA Level C, the data reviewer was unable to verify that the samples were analyzed as part of a valid analysis sequence. The reviewer was unable to evaluate that (1) the target analyte resolution criteria were met for each column; (2) that the samples were bracketed by acceptable instrument blanks and Performance Evaluation Mixtures; and (3) that the retention times for both of the surrogates and the analytes were within the calculated retention time windows established by the initial calibration sequences for both columns.

- GPC clean-ups were not performed on any soil samples submitted for Pesticide/PCB analysis in this case. GPC clean-ups are required for all soil/sediment extracts. The failure to employ this clean-up procedure represents a technical non-compliance with the organic SOW.

- The laboratory reported results for technical Chlordane in most samples of the case. The organic SOW requires Chlordane to be reported as alpha- and gamma-Chlordane which the laboratory reported in a limited number of samples. No action was taken by the data reviewer for this non-compliance. The data summary forms in Appendix B were modified to reflect the compound(s) reported in each sample.

- With the exception of approximately 10 samples, the sample quantitation limits reported for the pesticide/PCB analyses were not adjusted based on the contract required quantitation limits (CRQLs).

- Surrogate spike recoveries of tetrachloro-m-xylene (TCX) and decachlorobiphenyl (DCB) were reviewed to determine laboratory performance and extraction efficiency in the sample matrix. Although some outliers were noted, only one sample in the case was qualified due to surrogate recovery. A complete assessment of surrogate recoveries was not possible since the laboratory typically reported TCX and DCB recoveries from the primary column analysis only.

- Sample 0009A/B was qualified "UJ" at the sample quantitation limits since two surrogate recoveries (both TCX) exceeded the recovery criteria and were biased low in both analytical columns.

- Analyses of MS/MSD samples were performed to determine precision and accuracy in the soil matrix. MS/MSD analyses for pesticides/PCBs were performed on the following samples: 0008A/B; A01SS-14; A01SS-31; A01SS-97; A01SS-45; A05SS-

62; A02SS-89; A01SS-16B; A01SS-18B; AND A02SS-93B. Most spiked analyses exhibited acceptable recoveries (%R) and duplicate spike precision. In the MS/MSD analyses of samples A01SS-97 and A02SS-93B, both sets of matrix spikes were reported with several analyte recoveries above the upper acceptance limit. No qualifications were assessed, however, since both samples were reported with non-detects for all analytes.

- The following samples were collected in duplicate in the field:

Sample ID	Replicate Sample ID
A01SS-18	A01SS-78
A01SS-19	A01SS-77
A01SS-35	A01SS-79
A01SS-46	A01SS-80
A01SS-50	A01SS-86
A05SS-62	A05SS-85
A02SS-82	A02SS-89
A02SS-93	A02SS-94
A01SS-16B	A01SS-96B

No positive target compounds were present in any of the field duplicate samples.

- The pesticide/PCB raw data for samples A01SS-86; A05SS-66; and A05SS-59 were not properly filed in the sample report and appeared following the wrong Form I results summary forms. The laboratory was advised of the error and corrected the ordering and pagination of the raw data to reflect the appropriate sample.

Explosives

- 2,4,6-TNT was detected as a blank contaminant in rinsate blanks R-8 and A02SS-RIN9. All sample results were reviewed and it was determined that all 2,4,6-TNT results found in the field samples were valid and substantially above the level that could be attributed to blank contamination. No other blank contamination was found in any other rinsate blank or method blank.

- Analyses of MS/MSD samples were performed in the following samples to determine precision and accuracy in a soil matrix: 0008A/B; A01SS-14; A01SS-18; A01SS-18B; A01SS-31; A01SS-86; A02SS-89; A01SS-97; and A02SS-93B. All recoveries and precision of spike results were within the laboratory designated acceptance limits for %R and RPD.

- An MS analysis was performed on the rinsate blank A01SS-RIN9 which resulted in a 13% recovery for Tetryl. A similarly low recovery (15%R) for Tetryl was calculated

for the blank spike (Lab ID N1Q41815) associated with the batch. Rinsate blanks R-8 and A01SS-RIN9 were associated with the MS and blank spike with the Tetryl spike outliers. Tetryl was not detected in either of the samples and was rejected in both of the rinsate blanks due to the spike deficiencies.

- The following samples were collected in duplicate in the field and analyzed for explosive residues:

Sample ID	Replicate Sample ID
A01SS-18	A01SS-78
A01SS-19*	A01SS-77*
A01SS-35*	A01SS-79*
A01SS-46*	A01SS-80*
A01SS-50*	A01SS-86*
A05SS-62	A05SS-85
A02SS-82*	A02SS-89*
A02SS-93*	A02SS-94*
A01SS-16B*	A01SS-96B*

For the field samples noted above with an asterisk, no positive results were detected in either sample of the field-duplicate pair. The RPD for explosive residues detected in the two remaining field duplicate sample pairs were calculated and are summarized below.

Analyte	Sample ID	Field Duplicate ID	RPD
	A01SS-18	A01SS-78	
1,3,5-TNB	280J	100J	95
	A05SS-62	A05SS-85	
Tetryl	240J	280J	15

- The raw data for samples A01SS-96; A01SS-42B; A01SS-53B; A01SS-54B; A01SS-96B; and rinsate blanks A02SS-RIN9 and R-8 were not properly filed in the sample report and appeared following the wrong Form I result summary forms. The laboratory was advised of the errors and corrected the ordering and pagination of the raw data to reflect the appropriate samples.

Metals

- In SDG No. 0008A/B, the following table summarizes the highest levels of blank contaminants detected in the initial calibration blanks (ICB); continuing calibration blanks (CCB); preparation blanks (PBLK); or field-generated blanks (field, rinsate, etc.).

Blank Contaminant/Blank Type	Blank Concentration	
	ug/L	mg/Kg
Barium/PBLK	3.440	0.69
Calcium/Rinsate Blank 0013	101	20.2
Copper/PBLK	5.48	1.10
Iron/Rinsate Blank 0013	14.7	2.94
Manganese/ICB	3.3	0.66
Sodium/Rinsate Blank 0013	262	524
Zinc/Rinsate Blank 0013	12.1	

- Copper results in 008A/B; 009A/B; 0010A/B; and 0011A/B were qualified "B" for prep blank contamination based on the validation guidelines. Sodium results were qualified "B" in 008A/B; 009A/B; 0010A/B; 0011A/B; and 0012 A/B based on the associated rinsate blank result.

- The following contaminants were detected in blank samples associated with samples in SDG No. A01SS-06.

Blank Contaminant/Blank Type	Blank Concentration	
	ug/L	mg/Kg
Aluminum/CCB	286.4	57.28
Antimony/CCB	111.0	22.2
Arsenic/ICB	45.3	9.06
Barium/CCB	4.0	0.8
Beryllium/CCB	1.8	0.36
Cadmium/CCB	2.1	0.42
Calcium/CCB	585	117
Chromium/CCB	9.0	1.8
Cobalt/ICB	23.7	4.74
Copper/CCB	18.4	3.68
Iron/CCB	56.0	11.2
Magnesium/CCB	157.1	31.42
Manganese/ICB	3.3	0.66
Silver/ICB	6.0	1.2
Sodium/CCB	237.9	47.6
Vanadium/CCB	26.4	5.28
Zinc/CCB	19.6	3.92

- Sample results for A01SS-06 and A01SS-32 were qualified "B" for antimony.

- The following samples in SDG No. A01SS-06 were qualified "B" for arsenic blank contamination: A01SS-07; A01SS-08; A01SS-09; A01SS-10; A01SS-14; A01SS-20; A01SS-21; A01SS-22; A01SS-23; A01SS-24; A01SS-25; A01SS-26; A01SS-28; A01SS-29; A01SS-30; A01SS-31; and A01SS-32.

- The barium result in A01SS-27 was qualified "B" for CCB contamination.

- All beryllium, cadmium, cobalt, sodium, and vanadium results for samples in SDG A01SS-06 were qualified "B" for ICB or CCB contamination.

- Calcium results in A01SS-07; A01SS-11; A01SS-24; A01SS-27; and A01SS-32 were qualified "B" for CCB contamination.

- All samples in SDG No. A01SS-06 with the exception of A01SS-22 and A01SS-30 were qualified "B" for chromium due to CCB contamination.

- All samples in SDG No. A01SS-06 with the exception of A01SS-20 were qualified "B" for copper due to CCB contamination.

- Magnesium results in A01SS-06; A01SS-07; A01SS-11; A01SS-23; A01SS-24; A01SS-27; and A01SS-32 were qualified "B" for CCB contamination.

- Zinc results in the following samples were qualified "B" due to CCB contamination: A01SS-06; A01SS-07; A01SS-10; A01SS-11; A01SS-12; A01SS-13; A01SS-21; A01SS-22; A01SS-23; and A01SS-29.

- The following contaminants were detected in blank samples associated with samples in SDG No. A01SS-97.

Blank Contaminant/Blank Type	Blank Concentration	
	ug/L	mg/Kg
Arsenic/CCB	37.8	7.56
Barium/ICB	5.0	1.0
Calcium/PBLK	57.4	11.5
Copper/CCB	6.2	1.24
Iron/PBLK	30.7	6.14
Lead/ICB	24.1	4.82
Silver/PBLK	8.3	1.66
Sodium/CCB	116.6	23.3
Vanadium/ICB	4.3	0.86
Zinc/CCB	5.4	1.08

- Arsenic results in A01SS-100 and A01SS-101 (both soil and leachate) were qualified "B" due to CCB contamination.

- Copper, lead results in A01SS-97; A01SS-98; A01SS-99; and A01SS-100 were qualified "B" due to CCB contamination.

- All sodium samples in SDG No. A01SS-97 were qualified "B" due to CCB contamination.

- Vanadium results in A01SS-97; A01SS-98; and A01SS-99 were qualified "B" due to ICB contamination.

- The following contaminants were detected in blank samples associated with samples in SDG No. A01SS-1.

Blank Contaminant/Blank Type	Blank Concentration	
	ug/L	mg/Kg
Aluminum/CCB	286	57.2
Antimony/CCB	41.3	8.26
Barium/CCB	6.6	1.32
Cadmium/PBLK	1.8	0.36
Calcium/CCB	142	28.4
Cobalt/CCB	6.9	1.38
Copper/CCB	25.5	5.1
Iron/CCB	31.9	6.38
Magnesium/CCB	157.0	31.4
Manganese/CCB	3.1	0.62
Sodium/CCB	294	58.8

- Antimony results in the following samples were qualified "B" due to CCB contamination: A01SS-18; A01SS-35; A01SS-43; A01SS-45; A01SS-46; and A01SS-47.

- Barium Results in samples A01SS-15 and A01SS-43 were qualified "B" due to CCB contamination.

- Cadmium results in the following samples were qualified "B" due to prep blank contamination: A01SS-16; A01SS-17; A01SS-18; A01SS-19; A01SS-34; A01SS-35; A01SS-36; A01SS-37; A01SS-39; A01SS-40; A01SS-41; A01SS-42; A01SS-43; A01SS-44; A01SS-45; A01SS-46; A01SS-47; A01SS-77; A01SS-78; A01SS-79; and A01SS-80.

- All cobalt results for samples in SDG No. A01SS-1 were qualified "B" due to CCB contamination.

- All copper results for samples in SDG No. A01SS-1 with the exception of A01SS-38 were qualified "B" due to CCB contamination.

- Magnesium results in the following samples were qualified "B" due to CCB contamination: A01SS-15; A01SS-16; A01SS-19; A01SS-34; A01SS-35; A01SS-41; A01SS-43; and A01SS-79.

- The following contaminants were detected in blank samples associated with samples in SDG No. A01SS-19.

Blank Contaminant/Blank Type	Blank Concentration	
	ug/L	mg/Kg
Antimony/PBLK	33.9	6.78
Barium/CCB	13.0	2.6
Cadmium/CCB	2.5	0.5
Calcium/PBLK	292.8	58.7
Cobalt/CCB	3.9	0.78
Iron/CCB	32.5	6.5
Magnesium/CCB	40.5	8.1
Manganese/Rinsate Blank #4	12	2.4
Nickel/Rinsate Blank #4	13	2.6
Sodium/CCB	293.1	58.6
Vanadium/CCB	6.8	1.36
Zinc/CCB	5.3	1.06

- Antimony results in samples A01SS-86 and A05SS-86 were qualified "B" due to prep blank contamination.

- Barium results in the following samples were qualified "B" due to CCB contamination: A05SS-50; A05SS-58; A05SS-64; A05SS-65; A01SS-86; A05SS-62; and A05SS-85.

- All cadmium results in SDG No. A01SS-19 with the exception of A05SS-65 were qualified "B" due to CCB contamination.

- Calcium results in samples A05SS-64 and A05SS-65 were qualified "B" due to prep blank contamination.

- Cobalt results in the following samples were qualified "B" due to CCB contamination: A01SS-49; A01SS-50; A01SS-51; A01SS-52; A01SS-53; A01SS-54; A05SS-58; A05SS-64; A01SS-86; A05SS-62; and A05SS-85.

- Manganese results in samples A05SS-64 and A05SS-65 were qualified "B" due to rinsate blank contamination.

- Nickel, and sodium results in all samples of SDG No. A01SS-19 were qualified "B" due to rinsate blank contamination.

- With the exception of the following samples, vanadium results in all other samples in SDG No. A01SS-19 were qualified "B" due to CCB contamination: A01SS-52; A05SS-56; A05SS-58; A05SS-59; A05SS-60; A05SS-63; A05SS-62; A05SS-66; and A05SS-85.

- Zinc results in samples A05SS-64 and A05SS-65 were qualified "B" due to CCB contamination.

- The following contaminants were detected in blank samples associated with samples in SDG No. A01SS-58.

Blank Contaminant/Blank Type	Blank Concentration	
	ug/L	mg/Kg
Aluminum/CCB	64.7	12.94
Antimony/CCB	40.7	8.14
Barium/CCB	9.8	1.96
Cadmium/CCB	2.2	0.44
Calcium/PBLK	61.5	12.3
Iron/Rinsate Blank #06	20	4.0
Manganese/CCB	3.3	0.66
Sodium/Rinsate Blank #06	126	25.2
Vanadium/CCB	6.5	1.3
Zinc/CCB	6.6	1.32

- The antimony result in A02SS-73 was qualified "B" due to CB contamination.

- The barium result in A02SS-92 was qualified "B" due to CCB contamination.

- All cadmium results in SDG A01SS-58, with the exception of A02SS-91, were qualified "B" for CCB contamination.

- All sodium results for samples in SDG No. A01SS-58 were qualified "B" for rinsate blank contamination.

- Vanadium results in samples A02SS-69; A02SS-71; and A02SS-75 were qualified "B" due to CCB contamination.

- Zinc results in samples A02SS-71; A02SS-75; and A02SS-87 were qualified "B" due to CCB contamination.

- The following contaminants were detected in blank samples associated with samples in SDG No. A01SS-104.

Blank Contaminant/Blank Type	Blank Concentration	
	ug/L	mg/Kg
Aluminum/PBLK	144	28.8
Barium/ICB	5.0	1.0
Cadmium/CCB	2.1	0.42
Calcium/PBLK	118.7	23.74
Cobalt/CCB	6.9	1.38
Copper/PBLK	9.6	1.92
Iron/PBLK	149.3	29.86
Magnesium/CCB	157	31.4
Manganese/CCB	3.1	0.62
Sodium/CCB	128	25.6
Vanadium/ICB	4.3	0.86
Zinc/PBLK	10.4	2.08

- Cobalt results in A01SS-104; A01SS-105; and A01SS-06 were qualified "B" due to CCB contamination.

- The sodium result in A01SS-05 was qualified "B" due to CCB contamination.

- The following contaminants were detected in blank samples associated with samples in SDG No. A01SS-3.

Blank Contaminant/Blank Type	Blank Concentration	
	ug/L	mg/Kg
Aluminum/PBLK	69.4	13.88
Barium/ICB	6.7	1.34
Cadmium/ICB	1.2	0.24
Calcium/PBLK	125	25
Chromium/PBLK	12.9	2.58
Copper/CCB	6.9	1.38
Iron/PBLK	112.5	22.5
Magnesium/CCB	41.4	8.28
Manganese/PBLK	3.2	0.64
Sodium/CCB	109.1	21.82

Vanadium/ICB	6.5	1.3
Zinc/PBLK	6.9	1.38

- All cadmium results in SDG No. A01SS-3 were qualified "B" due to ICB contamination.

- Chromium sample results for A01SS-06B; A01SS-17B; A01SS-33B; A01SS-95; A01SS-42B; and A01SS-53B were qualified "B" for prep blank contamination.

- All copper sample results in SDG No. A01SS-3, with the exception of A01SS-53B, were qualified "B" due to CCB contamination.

- All sodium results in SDG No. A01SS-3, with the exception of A01SS-17B, were qualified "B" due to CCB contamination.

- The following contaminants were detected in blank samples associated with samples in SDG No. A01SS-18.

Blank Contaminant/Blank Type	Blank Concentration	
	ug/L	mg/Kg
Aluminum/Rinsate Blank R-8	1350	270
Barium/Rinsate Blank R-8	11.5	2.3
Cadmium/CCB	2.1	0.42
Calcium/Rinsate Blank R-8	509	102
Chromium/Rinsate Blank R-8	8.46	1.69
Cobalt/CCB	6.9	1.38
Copper/Rinsate Blank R-8	12.1	2.42
Iron/Rinsate Blank R-8	2450	490
Magnesium/Rinsate Blank R-8	235	47
Manganese/Rinsate Blank R-8	35.7	7.14
Nickel/Rinsate Blank R-8	39.6	7.92
Selenium/Rinsate Blank R-8	9.75	1.95
Silver/PBLK	8.6	1.72
Sodium/CCB	128.0	25.6
Vanadium/ICB	4.3	0.86
Zinc/Rinsate Blank R-8	33	6.6

- Cadmium results in A01SS-18B; A01SS-26B; A01SS-103A; and A05SS-102 were qualified "B" due to CCB contamination.

- Calcium results in A01SS-26B were qualified "B" due to rinsate blank contamination.

- Chromium results in A01SS-26B and A01SS-103A were qualified "B" due to rinsate blank contamination.

- Cobalt results in A01SS-18B; A01SS-26B; and A01SS-103A were qualified "B" due to CCB contamination.

- Copper results in all soil samples of SDG No. A01SS-18 were qualified "B" due to rinsate blank contamination.

- The magnesium result in sample A01SS-103A was qualified "B" due to rinsate blank contamination.

- The manganese result in sample A01SS-18B was qualified "B" due to rinsate blank contamination.

- All nickel and sodium results in SDG No. A01SS-18 were qualified "B" due to rinsate blank and CCB contamination.

- Zinc results in samples A01SS-18B and A01SS-26B were qualified "B" due to rinsate blank contamination.

- The following contaminants were detected in blank samples associated with samples in SDG No. A02SS-74.

Blank Contaminant/Blank Type	Blank Concentration	
	ug/L	mg/Kg
Aluminum/Rinsate Blank (RIN-9)	131	26.2
Barium/Rinsate Blank (RIN-9)	4	0.8
Calcium/PBLK	79.6	15.9
Copper/PBLK	9.1	1.82
Iron/Rinsate blank (RIN-9)	145	29
Lead/Rinsate Blank (RIN-9)	4	0.8
Magnesium/Rinsate Blank (RIN-9)	267	53.4
Manganese/Rinsate Blank (RIN-9)	8	1.6
Selenium/ICB	1.3	0.26
Silver/CCB	8.1	1.62
Sodium/Rinsate Blank (RIN-9)	496	99.2
Zinc/PBLK	10.2	2.04

- Magnesium results in A02SS-83B; A02SS-92B; and A02SS-107C were qualified "B" due to rinsate blank contamination.

- All sodium results in SDG No. A02SS-74 were qualified "B" due to rinsate blank contamination.

- The zinc result in A02SS-83B was qualified "B" due to prep blank contamination.

- Calcium was detected in the rinsate blank A02SS-RIN9 at a concentration of 18300 micrograms per liter (ug/L). No other samples in SDG No. A02SS-74 were reported at the level reported in the rinsate blank. Since the concentration found in the rinsate blank was considerably greater than that reported for any sample, the rinsate blank was not used in the evaluation of calcium contamination.

- The following contaminants were detected in blank samples associated with SDG No. A02SS-93.

Blank Contaminant/Blank Type	Blank Concentration	
	ug/L	mg/Kg
Antimony/CCB	34.1	6.82
Barium/PBLK	1.5	0.3
Cadmium/CCB	3.4	0.68
Calcium/PBLK	76.8	15.36
Cobalt/CCB	6.9	1.38
Copper/PBLK	7.8	1.56
Iron/PBLK	24.4	4.88
Magnesium/PBLK	52.6	10.52
Manganese/PBLK	4.6	0.92
Mercury/CCB	0.2	0.1
Silver/CCB	9.1	1.82
Sodium/CCB	88.0	17.6
Vanadium/ICB	4.3	0.86
Zinc/CCB	11.1	2.22

- Cadmium, cobalt and sodium results in A02SS-93B; A01SS-109; and A01SS-110 were qualified "B" due to CCB contamination.

- Copper results in A02SS-93B and A01SS-110 were qualified "B" due to prep blank contamination.

- The Zinc result in sample A02SS-93B was qualified "B" due to CCB contamination.

- The following contaminants were detected in blank samples associated with SDG No. A01SS-111.

Blank Contaminant/Blank Type	Blank Concentration	
	ug/L	mg/Kg
Aluminum/PBLK	68.5	13.7
Barium/CCB	3.9	0.78
Cadmium/CCB	1.8	0.36
Calcium/PBLK	85.4	17.1
Copper/PBLK	9.3	1.86
Iron/CCB	38.5	7.7
Manganese/CCB	1.4	0.28
Selenium/ICB	1.7	0.34
Silver/PBLK	6.6	1.32
Zinc/PBLK	13.8	2.76

- All cadmium and copper results for samples A01SS-111; A01SS-112; and A01SS-113 were qualified "B" due to CCB and prep blank contamination, respectively.

- The silver result in A01SS-112 was qualified "B" due to prep blank contamination.

- Field-duplicate samples were collected and analyzed by the laboratory. The RPDs between the original and duplicate analyses were calculated and are summarized below for each field-duplicate sample pair. For field-duplicate pairs in which results are <IDL or suspected to be the result of blank contamination, the RPD was not provided. All concentrations are presented in mg/Kg on a dry-weight basis.

- Field-duplicate sample results were reviewed using the guidelines prescribed for the review of laboratory duplicates. A control limit of 35% was used for sample concentrations >5X CRDL and ±2X CRDL for concentrations <5X CRDL. Sample qualifications for estimation "J" were assessed (if required) only to the samples of the field-duplicate sample pair.

Analyte	Sample ID	Field Duplicate ID	RPD
	A01SS-18	A01SS-78	
Aluminum	2970	2740	8.1
Antimony	5.86B	1.04U	NC
Arsenic	38.6	44.1	13
Barium	20.2	19.3	4.6
Beryllium	0.355	0.287	21
Cadmium	0.383B	0.42B	NC
Calcium	6970	2990	80
Chromium	7.59	7.13	6.3
Cobalt	2.34B	1.73B	NC

Copper	10B	5.28B	NC
Iron	7450	7410	0.5
Lead	14.3	14	2.1
Magnesium	507	448	12
Manganese	74.5	83.9	12
Mercury	0.065	[0.063]	3.1
Nickel	3.37	2.56	27
Potassium	576	524	9.5
Selenium	0.203UL	0.159UL	NC
Silver	0.2UL	0.203UL	NC
Sodium	54.8B	21.8B	NC
Thallium	0.328U	0.257U	NC
Vanadium	14.3	14	2.1
Zinc	46.6	45.1	3.3

- In field-duplicate sample pair A01SS-18 and A01SS-78, the RPD for Ca was outside the required criteria. The sample results for Ca were estimated "J" in each of these samples.

Analyte	Sample ID	Field Duplicate ID	RPD
	A01SS-19	A01SS-77	
Aluminum	855	1350	45
Antimony	0.801U	0.898U	NC
Arsenic	12.6L	15.5	21
Barium	7.37	8.77	17
Beryllium	0.122	0.143	16
Cadmium	0.26B	0.271B	NC
Calcium	505	690	31
Chromium	1.76L	2.94	50
Cobalt	1.1B	1.14B	NC
Copper	5.35B	5.45B	NC
Iron	2420J	4220	54
Lead	8.09	8.13	0.5
Magnesium	84.4B	193	78
Manganese	80.1	84	4.8
Mercury	0.193	0.047U	NC
Nickel	[0.704]	1.47	70
Potassium	86B	152	55
Selenium	0.131UL	0.142UL	NC
Silver	0.156UL	0.175UL	NC
Sodium	[13.6B]	[17.3B]	NC
Thallium	0.211U	0.23U	NC
Vanadium	2.85	4.67	48

Zinc	31.2	32.5	4.1

- In field-duplicate sample pair A01SS-19 and A01SS-77, the RPD for Al and Fe were outside the required criteria. The sample results for Al and Fe were estimated "J" in each of these samples. The Fe result in A01SS-19 was previously qualified "J" and remains an estimated value.

Analyte	Sample ID	Field Duplicate ID	RPD
	A01SS-46	A01SS-80	
Aluminum	4890	4830	1.2
Antimony	[0.822B]	1.17U	NC
Arsenic	2.67	6.69	86
Barium	12.1	15.4	24
Beryllium	0.755	0.726	3.9
Cadmium	0.785B	0.767B	NC
Calcium	3400	12100	112
Chromium	16.3	15.4	5.7
Cobalt	5.8B	4.26B	NC
Copper	4.76B	5.03B	NC
Iron	24200	23200	4.2
Lead	4.55	6.79	40
Magnesium	957	976	2.0
Manganese	85.6	86.1	0.6
Mercury	0.051U	0.049U	NC
Nickel	5.37	5.47	1.8
Potassium	1040	983	5.6
Selenium	0.155UL	0.158UL	NC
Silver	0.154UL	0.196UL	NC
Sodium	[27.1B]	[110B]	NC
Thallium	0.25U	0.255U	NC
Vanadium	12.7	12.8	0.8
Zinc	31.1	31.2	0.3

- In field-duplicate sample pair A01SS-46 and A01SS-80, the RPD for Ca was outside the required criteria. the sample results for Ca were estimated "J" in each of these samples.

Analyte	Sample ID	Field Duplicate ID	RPD
	A02SS-82	A02SS-89	
Aluminum	2330	2390	2.5
Antimony	R	R	NC

Arsenic	0.226UL	0.23UL	NC
Barium	22.5	22.2	1.3
Beryllium	0.121	0.128	5.6
Cadmium	0.778B	0.549B	NC
Calcium	693L	532L	26
Chromium	3.78	3.84	1.6
Cobalt	[1.11]	[1.02]	8.4
Copper	34.9L	19.7L	56
Iron	2090	1750	18
Lead	8.3	5.61	39
Magnesium	136	125	8.4
Manganese	116	76.6	41
Mercury	0.029	0.029	0
Nickel	1.25	1.01	21
Potassium	186L	1766L	5.5
Selenium	0.125U	0.127U	NC
Silver	0.165UL	0.168UL	NC
Sodium	[12.1B]	[13B]	NC
Thallium	0.226UL	0.23UL	NC
Vanadium	10.2	11.8	15
Zinc	26.5	19.7	29

- In field-duplicate sample pair A02SS-82 and A02SS-89, the RPDs for Cu and Mn were outside the required criteria. The sample results for Cu in both samples were previously qualified "L" for low bias in the MS analysis. The data reviewer determined that the "L" qualifier for bias should be superseded by the "J" qualifier for imprecision since the measured imprecision (56% RPD) was greater than the magnitude of the low bias (72.9 %R) for accuracy. Mn results in both samples were estimated "J" for the RPD outlier.

Analyte	Sample ID	Field Duplicate ID	RPD
	A01SS-16B	A01SS-96B	
Aluminum	8140	7630	6.5
Antimony	R	R	NC
Arsenic	2.89	1.63	56
Barium	25.3L	26.2L	3.5
Beryllium	1.23	3.8	102
Cadmium	0.62B	1.43B	NC
Calcium	1280	2430	62
Chromium	19.9	29.7	40
Cobalt	3.01	10.7	112
Copper	2.88B	3.74B	NC
Iron	13000	25700	66
Lead	6.61	7.86	17

Magnesium	814	1550	62
Manganese	21.9	161	152
Mercury	0.016	0.014	6.7
Nickel	11.1	13.5	19.5
Potassium	890	1810	68
Selenium	0.73UL	0.163UL	NC
Silver	0.148UL	0.166UL	NC
Sodium	[18B]	[24.2B]	NC
Thallium	0.225U	0.251U	NC
Vanadium	13.3	17.1	25
Zinc	42.6	71.1	50

- In field-duplicate sample pair A01SS-16B and A01SS-96B, the RPDs were exceeded for the following analytes: Be, Cr, Fe, Mn, and Zn. Sample results for all the analytes noted above for both samples were estimated "J" due to the RPD outliers.

Analyte	Sample ID	Field Duplicate ID	RPD
	A01SS-35	A01SS-79	
Aluminum	1270	1200	5.7
Antimony	4.08B	0.832U	NC
Arsenic	[1.25]	1.1L	13
Barium	25.9	27	4.2
Beryllium	0.25	0.254	1.6
Cadmium	0.086B	0.081B	NC
Calcium	870	1280	38
Chromium	1.13	1.21	6.8
Cobalt	1.52B	1.38B	NC
Copper	2.96B	2.36B	NC
Iron	1270	1160J	9.1
Lead	29.9	36.6	20.1
Magnesium	103	130	23
Manganese	161	179	11
Mercury	0.13	0.142	8.8
Nickel	1.32	1.18	11
Potassium	[76.9]	[107L]	33
Selenium	0.144UL	0.132UL	NC
Silver	0.158UL	0.162UL	NC
Sodium	16.2B	12.7B	NC
Thallium	0.202U	0.214U	NC
Vanadium	4.4	4.97	12
Zinc	7.69	8.69	12

Analyte	Sample ID	Field Duplicate ID	RPD
	A01SS-50	A01SS-86	
Aluminum	945	934	1.2
Antimony	R	1.02B	NC
Arsenic	0.22UL	0.24UL	NC
Barium	14.4B	13.5B	NC
Beryllium	[0.111]	[0.104]	6.5
Cadmium	[0.087B]	[0.089B]	2.3
Calcium	1700	1470K	15
Chromium	1.53	1.58	3.2
Cobalt	0.791B	0.749B	5.5
Copper	2	1.8	11
Iron	1430	1400	2.1
Lead	7.5J	7.2	4.1
Magnesium	[124]	130	4.7
Manganese	107J	99.4	7.4
Mercury	0.046	0.054	16
Nickel	1.08B	[0.96B]	NC
Potassium	[121]	260	73
Selenium	R	R	NC
Silver	0.159UL	0.166UL	NC
Sodium	[4.18B]	[11.8B]	NC
Thallium	0.22U	0.24U	NC
Vanadium	3.93B	3.6B	NC
Zinc	8.1K	7.11	13

Analyte	Sample ID	Field Duplicate ID	RPD
	A05SS-62	A05SS-85	
Aluminum	2730	2930	7.1
Antimony	R	1.24B	NC
Arsenic	3.36L	3.71L	9.9
Barium	13.7B	12.2B	NC
Beryllium	0.198	0.168	16.4
Cadmium	0.229B	0.199B	NC
Calcium	1040K	881K	17
Chromium	5.3	5.57	5.0
Cobalt	2B	1.8B	NC
Copper	1.56	1.78	13
Iron	6040	250	3.4
Lead	9.7	8.58	12
Magnesium	179	163	9.4
Manganese	89.6	64.8	32

Mercury	0.009U	0.009U	NC
Nickel	2.55B	2.05B	NC
Potassium	193	180	3.8
Selenium	R	R	NC
Silver	0.177UL	0.165UL	NC
Sodium	[18.8B]	[20.7B]	NC
Thallium	0.22UL	0.24UL	NC
Vanadium	9.63	10.5	8.6
Zinc	12.6	10.7	16

Analyte	Sample ID	Field Duplicate ID	RPD
	A02SS-93	A02SS-94	
Aluminum	4000	3990	0.3
Antimony	R	R	NC
Arsenic	0.228UL	1.6L	NC
Barium	23	25.6	11
Beryllium	0.161	0.178	1.8
Cadmium	0.877B	0.919B	NC
Calcium	454L	522L	14
Chromium	7.11	7.25	1.9
Cobalt	1.51	1.66	9.4
Copper	6.83L	5.84L	16
Iron	5800	6710	15
Lead	6.63	8.34	23
Magnesium	151	154	2.0
Manganese	117	124	5.8
Mercury	0.014	-	NC
Nickel	2.66	2.72	2.2
Potassium	213L	231L	8.1
Selenium	0.126U	0.132U	NC
Silver	0.166UL	[0.172L]	NC
Sodium	[12.5B]	[11.2B]	NC
Thallium	0.228UL	0.24UL	NC
Vanadium	14	12.9	8.2
Zinc	17.3	17.7	2.3

- The laboratory did not apply the inorganic "B" flag to all sample results between the IDL and CRDL. The data reviewer added and replaced all "B" qualifiers on the data summary forms with brackets [ ] to indicate values between the IDL and CRDL in accordance with USEPA Region III guidelines. The "B" qualifier was applied to sample results to indicate suspected blank contamination.

- Two Form I inorganic summary forms were submitted for A02SS-75 and none were received for sample A02SS-76. The laboratory was advised of the error and corrected the sample identification on one of the Form I summaries to A02SS-76 after verifying the sample results to the laboratory raw data.

- Mercury data was not provided for sample A02SS-94 due to laboratory error.

Where applicable, data were reviewed in accordance with the USEPA Functional Guidelines for Evaluating Organic and Inorganic Analyses, as modified for use in the USEPA Region III. The text of the report only addresses those problems which affect data usability and which could be determined from the NEESA Level C reporting deliverables.

ATTACHMENTS

Appendix A - Glossary of Data Qualifiers
Appendix B - Data Summary Forms
Appendix C - Laboratory Reported Results
Appendix D - Reviewed and Corrected Tentatively Identified Compounds
Appendix E - Support Documentation

APPENDIX N.1
BLACK & VEATCH DATA

TABLE 1: VOLATILE and SEMIVOLATILE Organics

Detected Analytes	Region III RBC Table, 7/95-12/95 Residential Soil org. ug/kg inorg. mg/kg	Site Screening Area 19						Site 12					
		Case No. 24027, Sampling Dates: 9/19/95 through 9/21/95						Case No. 24027, 9/19/95 through 9/21/95 and Case No. 24070, 10/2/95 through 10/3/95					
		Surface Water Samples (SSA19)						Soil and Sediment Samples (Site 12)					
		EPA-SSA19-SW01 MCFT94 CFP67	Qualifier	EPA-SSA19-SW02 MCFT95 CFP68	Qualifier	EPA-SSA19-SW03 MCFT97 CFP71	Qualifier	EPA-S12-S01 MCFT98 CFP74	Qualifier	EPA-S12-SED01 MCFY69 CFP80	Qualifier	CFP89	Qualifie
Volatile Organics		(ug/l)		(ug/l)		(ug/l)		(ug/kg)		(ug/kg)		(ug/kg)	
Chloromethane	49,000	--		--		--		--		NA		--	
Bromomethane	110,000	--		--		--		--		NA		--	
Methylene Chloride	85,000	--		--		--		2	B	NA		--	
Acetone	7,800,000	10	B	18	B	--		17	B	NA		26	B
Carbon Disulfide	7,800,000	--		--		--		--		NA		--	
Chloroform	100,000	--		--		--		--		NA		--	
2-Butanone	6,300	--		--		--		--		NA		--	
Trichloroethene	58,000	--		--		--		--		NA		--	
Toluene	16,000,000	--		--		--		--		NA		--	
Ethylbenzene	7,800,000	--		--		--		--		NA		--	
Xylene	160,000,000	--		--		--		--		NA		--	
Semivolatile Organics		(ug/l)		(ug/l)		(ug/l)		(ug/kg)		(ug/kg)		(ug/kg)	
4-Methylphenol	390,000	--		--		--		--		--		NA	
Naphthalene	3,100,000	--		--		--		660	J	--		NA	
4-Chloroaniline	310,000	--		--		--		--		--		NA	
2-Methylnaphthalene	--	--		--		--		190	J	--		NA	
Acenaphthylene	--	--		--		--		--		69	J	NA	
2,6-Dinitrotoluene	78,000	--		--		--		--		--		NA	
Acenaphthene	4,700,000	--		--		--		1000	J	--		NA	
Dibenzofuran	310,000	--		--		--		630	J	--		NA	
2,4-Dinitrotoluene	160,000	--		--		--		--		--		NA	
Diethylphthalate	63,000,000	--		--		--		--		--		NA	
Fluorene	3,100,000	--		--		--		810	J	--		NA	
Phenanthrene	--	--		--		--		8800		520	J	NA	
Anthracene	23,000,000	--		--		--		2000		160	J	NA	
Carbazole	--	--		--		--		1200	J	79	J	NA	
Di-n-Butylphthalate	--	--		--		1	B	870	B	240	B	NA	
Fluoranthene	3,100,000	--		--		--		11000		1300		NA	
Pyrene	2,300,000	--		--		--		7500		1000		NA	
Butylbenzylphthalate	16,000,000	--		--		--		--		--		NA	
Benzo(a)Anthracene	880	--		--		--		4900		740		NA	
Chrysene	88,000	--		--		--		5200		990		NA	
bis (2-Ethylhexyl) phthalate	46,000	3	B	--		3	B	170	B	170	B	NA	
Di-n-octylphthalate	1,600,000	--		--		--		--		--		NA	
Benzo(b)fluoranthene	880	--		--		--		4300		960		NA	
Benzo(k)fluoranthene	8,800	--		--		--		3900		560		NA	
Benzo(a)pyrene	88	--		--		--		4500		740		NA	
Indeno(1,2,3-cd)pyrene	880	--		--		--		2000		370	J	NA	
Dibenz(a,h)anthracene	88	--		--		--		1000	J	190	J	NA	
Benzo(g,h,i)perylene	--	--		--		--		1500		300	J	NA	

TABLE 1: VOLATILE and SEMIVOLATILE Organics

Detected Analytes	Region III RBC Table, 7/95-12/95 Residential Soil org. ug/kg inorg. mg/kg	Site 12													
		Case No. 24027, Sampling Date: 9/19/95 through 9/21/95 and Case No. 24070, Sampling Dates: 10/2/95 through 10/3/95.													
		Soil and Sediment Samples (Site 12)													
		-S12-SED02 CFY70				EPA-S12-SED03 MCFY71				EPA-S12-SED04 MCFY72				EPA-S12-S02 MCFY73	Qualifier
		CFP81	Qualifie	CFP90	Qualifier	CFP82	Qualifier	CFP91	Qualifier	CFP83	Qualifier	CFP93	Qualifier	CFP84	
Volatile Organics		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)	
Chloromethane	49,000	--		--		--		--		--		--		--	
Bromomethane	110,000	--		--		--		--		--		--		--	
Methylene Chloride	85,000	--		3	J	--		230	B	--		--		2	B
Acetone	7,800,000	--		130	B	--		--		--		380	B	110	B
Carbon Disulfide	7,800,000	--		--		--		--		--		--		--	
Chloroform	100,000	--		--		--		--		--		--		--	
2-Butanone	6,300	--		6	J	--		11	J	--		10	J	12	J
Trichloroethene	58,000	--		--		--		--		--		--		--	
Toluene	16,000,000	--		--		--		--		--		--		--	
Ethylbenzene	7,800,000	--		--		--		--		--		--		--	
Xylene	160,000,000	--		--		--		--		--		--		--	
Semivolatile Organics		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)	
4-Methylphenol	390,000	--		NA		--		NA		--		NA		--	
Naphthalene	3,100,000	--		NA		--		NA		--		NA		--	
4-Chloroaniline	310,000	--		NA		--		NA		--		NA		3000	J
2-Methylnaphthalene	--	--		NA		--		NA		--		NA		--	
Acenaphthylene	--	--		NA		--		NA		--		NA		--	
2,6-Dinitrotoluene	78,000	--		NA		--		NA		--		NA		--	
Acenaphthene	4,700,000	--		NA		--		NA		--		NA		--	
Dibenzofuran	310,000	--		NA		--		NA		--		NA		--	
2,4-Dinitrotoluene	160,000	--		NA		--		NA		--		NA		--	
Diethylphthalate	63,000,000	69	B	NA		--		NA		--		NA		--	
Fluorene	3,100,000	--		NA		--		NA		--		NA		--	
Phenanthrene	--	--		NA		--		NA		--		NA		--	
Anthracene	23,000,000	--		NA		--		NA		--		NA		--	
Carbazole	--	--		NA		--		NA		--		NA		--	
Di-n-Butylphthalate	--	3000		NA		4900		NA		1400	B	NA		1200	B
Fluoranthene	3,100,000	89	J	NA		--		NA		--		NA		--	
Pyrene	2,300,000	75	J	NA		--		NA		--		NA		--	
Butylbenzylphthalate	16,000,000	630		NA		460	J	NA		--		NA		1600	J
Benzo(a)Anthracene	880	--		NA		--		NA		--		NA		--	
Chrysene	88,000	54	J	NA		--		NA		--		NA		--	
bis (2-Ethylhexyl) phthalate	46,000	76	B	NA		120	B	NA		--		NA		22000	
Di-n-octylphthalate	1,600,000	--		NA		--		NA		--		NA		--	
Benzo(b)fluoranthene	880	--		NA		--		NA		--		NA		--	
Benzo(k)fluoranthene	8,800	--		NA		--		NA		--		NA		--	
Benzo(a)pyrene	88	--		NA		--		NA		--		NA		--	
Indeno(1,2,3-cd)pyrene	880	--		NA		--		NA		--		NA		--	
Dibenz(a,h)anthracene	88	--		NA		--		NA		--		NA		--	
Benzo(g,h,i)perylene	--	--		NA		--		NA		--		NA		--	

TABLE 3: Nitroaromatics

Detected Analytes	Region III RBC Table, 7/95-12/95 Residential Soil		Site 12											
			Case No. 24027, Sample Dates: 9/19/95 through 9/21/95 and Case No. 24007, Sample Dates: 10/2/95 through 10/3/95.											
			Surface Water Samples (Site 12)											
			-S12-SW01 CFT99				EPA-S12-SW02 MCFY67				EPA-S12-SW03 MCFY68			
	org. ug/kg	inorg. mg/kg	CFP75	Qualifier	CFP88	Qualifier	CFP78	Qualifier	CFP92	Qualifier	CFP79	Qualifier	CFP94	Qualifier
Nitroaromatic and Nitramine Analysis			(ug/l)				(ug/l)				(ug/l)			
2-Amino-4,6-dinitrotoluene			--		NA		--		NA		--		NA	
1,3-Dinitrobenzene	7,800		--		NA		--		NA		--		NA	
2,4-Dinitrotoluene	160,000		--		NA		--		NA		--		NA	
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetro	3,900,000		--		NA		--		NA		--		NA	
Nitrobenzene	39,000		--		NA		--		NA		--		NA	
Hexahydro-1,3,5-trinitro-1,3,5-triazine	5,800		--		NA		--		NA		--		NA	
1,3,5-Trinitrobenzene	3,900		--		NA		--		NA		--		NA	
2,4,6-Trinitrotoluene	21,000		--		NA		--		NA		--		NA	
4-Amino-2,6-Dinitrotoluene			--		NA		--		NA		--		NA	
2-Nitrotoluene	780,000		--		NA		--		NA		--		NA	
3-Nitrotoluene	780,000		--		NA		--		NA		--		NA	
4-Nitrotoluene	780,000		--		NA		0.87	C	NA		--		NA	
Methyl-2,4,6-trinitrophenylnitramine			--		NA		--		NA		--		NA	
2,6-Dinitrotoluene	78,000		--		NA		--		NA		--		NA	

TABLE 3: Nitroaromatics

Detected Analytes	Region III RBC Table, 7/95-12/95 Residential Soil org. ug/kg inorg. mg/kg	Site 12													
		Case No. 24027, Sampling Date: 9/19/95 through 9/21/95 and Case No. 24070, Sampling Dates: 10/2/95 through 10/3/95													
		Soil and Sediment Samples (Site 12)													
		-S12-SED02 CFY70				EPA-S12-SED03 MCFY71				EPA-S12-SED04 MCFY72				EPA-S12-S02 MCFY73	Qualifier
		CFP81	Qualifie	CFP90	Qualifier	CFP82	Qualifier	CFP91	Qualifier	CFP83	Qualifier	CFP93	Qualifier	CFP84	
Nitroaromatic and Nitramine Analysis		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)	
2-Amino-4,6-dinitrotoluene		--		NA		--		NA		--		NA		--	
1,3-Dinitrobenzene	7,800	--		NA		--		NA		--		NA		--	
2,4-Dinitrotoluene	160,000	--		NA		--		NA		--		NA		--	
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetro	3,900,000	--		NA		--		NA		--		NA		--	
Nitrobenzene	39,000	--		NA		--		NA		--		NA		--	
Hexahydro-1,3,5-trinitro-1,3,5-triazine	5,800	--		NA		--		NA		--		NA		--	
1,3,5-Trinitrobenzene	3,900	--		NA		--		NA		--		NA		--	
2,4,6-Trinitrotoluene	21,000	--		NA		--		NA		--		NA		--	
4-Amino-2,6-Dinitrotoluene		--		NA		--		NA		--		NA		--	
2-Nitrotoluene	780,000	--		NA		--		NA		--		NA		--	
3-Nitrotoluene	780,000	--		NA		--		NA		--		NA		--	
4-Nitrotoluene	780,000	--		NA		--		NA		--		NA		--	
Methyl-2,4,6-trinitrophenylnitramine		--		NA		--		NA		--		NA		95	C,B
2,6-Dinitrotoluene	78,000	--		NA		--		NA		--		NA		--	

Inside "greenhouse"

TABLE 2: Pesticides/PCBs and Metals

Detected Analytes	Region III RBC Table, 7/95-12/95 Residential Soil org. ug/kg inorg. mg/kg	Site 12														
		Case No. 24027, Sampling Date: 9/19/95 through 9/21/95 and Case No. 24070, Sampling Dates: 10/2/95 through 10/3/95.														
		Soil and Sediment Samples (Site 12)														
		-S12-SED02 CFY70				EPA-S12-SED03 MCFY71				EPA-S12-SED04 MCFY72				EPA-S12-S02 MCFY73		
		CFP81	Qualifie	CFP90	Qualifier	CFP82	Qualifier	CFP91	Qualifier	CFP83	Qualifier	CFP93	Qualifier	CFP84	Qualifier	
Pesticides/PCBs		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)		
beta-BHC	350	--		NA		--		NA		--		NA		1.8		NJ
delta-BHC	550 (for beta-BHC)	--		NA		--		NA		--		NA		0.95		NJ
gamma-BHC (Lindane)	490	--		NA		--		NA		--		NA		2.4		
Aldrin	38	--		NA		--		NA		--		NA		--		
Heptachlor epoxide	70	--		NA		--		NA		--		NA		--		
Endosulfan I	470,000 (for Endosulfan)	--		NA		--		NA		--		NA		--		
Dieldrin	40	--		NA		0.6	NJ	NA		--		NA		6.6		NJ
4,4'-DDE	1,900	27	NJ	NA		4.5	J	NA		5.2		NA		31		J
Endrin	23,000	1.3	NJ	NA		--		NA		1.2	NJ	NA		--		
Endosulfan II	470,000 (for Endosulfan)	1.2	NJ	NA		--		NA		--		NA		--		
4,4'-DDD	2,700	--		NA		5.1	J	NA		7.4	NJ	NA		72		NJ
Endosulfan Sulfate	470,000	0.67	NJ	NA		--		NA		--		NA		--		
4,4'-DDT	1,900	17	NJ	NA		4.2	J	NA		2.9	J	NA		82		J
alpha-Chlordane	490 (for Chlordane)	15		NA		3.3		NA		3.1		NA		100		J
gamma-Chlordane	490 (for Chlordane)	10		NA		2.5		NA		2.2	J	NA		120		J
Toxaphene	380	--		NA		--		NA		--		NA		--		
Aroclor-1242	83 (for PCBs)	--		NA		--		NA		--		NA		--		
Aroclor-1254	1,600	55	J	NA		14	J	NA		23	J	NA		62		J
Metals		(mg/kg)		(mg/kg)		(mg/kg)		(mg/kg)		(mg/kg)		(mg/kg)		(mg/kg)		
Aluminum	78,000	NA		3500		NA		769		NA		889		4830		
Antimony	31	NA		--	UL	NA		--	UL	NA		--	UL	--		UL
Arsenic	23	NA		5.2		NA		1.3		NA		1.5		9.3		
Barium	5,500	NA		31.7		NA		6		NA		8.6		280		
Beryllium	16	NA		0.2		NA		0.05		NA		0.09		0.37		
Cadmium	39	NA		0.79		NA		--		NA		--		10.4		
Calcium	--	NA		61.00		NA		2670		NA		2610		1280		
Chromium	390	NA		9.6		NA		4		NA		4.3		42.9		
Cobalt	4,700	NA		2.8		NA		0.65		NA		--		2.3		
Copper	3,100	NA		11.5		NA		1.7		NA		2.4		143		
Iron	23,000	NA		13000		NA		2790		NA		3380		11400		
Lead	--	NA		19.1		NA		5.4		NA		6.2		• 394		
Magnesium	--	NA		386		NA		96.2		NA		123		426		
Manganese	390	NA		96.8		NA		30.7		NA		33.9		36.4		
Mercury	23	NA		--		NA		--		NA		--		• 4.7		
Nickel	1,600	NA		5.5		NA		--		NA		--		7.7		
Potassium	--	NA		280		NA		164		NA		154		295		
Selenium	390	NA		0.76		NA		--		NA		--		0.83		
Silver	390	NA		0.63	K	NA		0.51	K	NA		--		• 53.4	K	
Sodium	--	NA		77.1		NA		63.6		NA		53.5		73.7		
Thallium	5.6	NA		--		NA		--		NA		--		1.3	B	
Vanadium	550	NA		19.7		NA		4		NA		4.5		65.8		
Zinc	23,000	NA		131		NA		17.2		NA		222		258		

SSA 15
SURFACE SOIL DATA AND COPC SELECTION SUMMARY
COMBINING BAKER AND BLACK & VEATCH DATA
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Contaminant[1]	Region III Criteria[2]	Contaminant Frequency/Range[3]		Comparison to Criteria	COPC Selection
	Residential COC Value (mg/kg)	No. of Positive Detects/ No. of Samples	Range of Positive Detection (mg/kg)	No. of Positive Detects Above Residential COC Value	Selected as a COPC?
Volatiles:					
2-Butanone	4,700	1/7	0.012J	0	No
Semivolatiles:					
4-Chloroaniline	31	2/7	0.110J-3.0J	0	No
4-Chloro-3-methylphenol	--	1/7	0.350J	0	No
Benzo(g,h,i)perylene	310[5]	1/7	0.100J	0	No
bis(2-ethylhexyl)phthalate	46	4/7	0.067J - 22J	0	No
Butylbenzylphthalate	1,600	2/7	0.120J-1.6J	0	No
Di-n-Butylphthalate	780	2/7	0.130J - 0.470	0	No
Pesticides/PCBs:					
alpha-Chlordane	0.49[6]	4/7	0.0021J - 0.280	0	No
gamma-Chlordane	0.49[6]	2/7	0.12J-0.26	0	No
4,4 - DDD	2.7	4/7	0.0019J - 0.110	0	No
4,4'-DDE	1.9	7/7	0.0082J - 0.031J	0	No
4,4'-DDT	1.9	7/7	0.0024J - 0.082	0	No
Dieldrin	0.04	2/7	0.0066NJ-0.0092	0	No
Endosulfan Sulfate	47[7]	1/7	0.0085J	0	No
beta-BHC	0.35	1/7	0.0018NJ	0	No

SSA 15 (Continued)
SURFACE SOIL DATA AND COPC SELECTION SUMMARY
COMBINING BAKER AND BLACK AND VEATCH DATA
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Contaminant[1]	Region III Criteria[2]	Contaminant Frequency/Range[3]		Comparison to Criteria	COPC Selection
	Residential COC Value (mg/kg)	No. of Positive Detects/ No. of Samples	Range of Positive Detection (mg/kg)	No. of Positive Detects Above Residential COC Value	Selected as a COPC?
delta-BHC	0.35	1/7	0.00095NJ	0	No
gamma-BHC	0.49	1/7	0.0024	0	No
Aroclor-1254	0.16	1/7	0.062J	0	No
Inorganics:					
Aluminum	7,800	7/7	1290 - 6330	0	No
Antimony	3.1	1/7	4L	1	Yes
Arsenic (carc./noncarc.)	0.37/2.3	7/7	2.4 - 19.2	6/6	Yes
Barium	550	7/7	10.8 - 280	0	No
Beryllium	0.15	7/7	0.06 - 0.61	4	Yes
Cadmium	3.9	3/7	0.38 - 10.4	1	Yes
Calcium+	--	7/7	154 - 6490	--	No
Chromium	39[8]	7/7	3.3 - 42.9	1	Yes
Cobalt	470	7/7	0.53 - 6	0	No
Copper	290	7/7	3.2 - 14.3	0	No
Cyanide (total)	160	2/4	2.9K - 4.6L	0	No
Iron+	--	7/7	3,770 - 23,900	--	No
Lead	400[4]	7/7	9.1 - 394	0	No
Magnesium+	--	7/7	83.3 - 446	--	No

SSA 15 (Continued)
SURFACE SOIL DATA AND COPC SELECTION SUMMARY
COMBINING BAKER AND BLACK AND VEATCH DATA
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Contaminant[1]	Region III Criteria[2]	Contaminant Frequency/Range[3]		Comparison to Criteria	COPC Selection
	Residential COC Valuc (mg/kg)	No. of Positive Detects/ No. of Samples	Range of Positive Detection (mg/kg)	No. of Positive Detects Above Residential COC Value	Selected as a COPC?
Manganese	39	7/7	8.4J - 175J	3	Yes
Mercury	2.3	2/7	0.59K-4.7	1	Yes
Nickel	160	6/7	1 - 7.7	0	No
Potassium+	--	7/7	94.1J - 692	--	No
Selenium	39	4/7	0.67K - 1.1K	0	No
Silver	39	2/7	5.3-53.4K	1	Yes
Sodium+	--	7/7	15.8 - 121	--	No
Vanadium	55	7/7	7.4 - 65.8	1	Yes
Zinc	2,300	7/7	13.1J - 258	0	No

(1) Organic concentrations reported in μg/kg, Inorganic concentrations reported in mg/kg.
(2) COC = USEPA Region III COC screening value (USEPA, 1993a)
(3) J = Analyte was positively identified, value is estimated.
K = Estimated value, biased high
L = Estimated value, biased low
(4) Action level for residential soils (USEPA, 1994c)
(5) Naphthalene was used as a surrogate for the COC value.
(6) Chlordane was used as a surrogate for the COC value.
(7) Endosulfan was used as a surrogate for the COC value.
(8) Chromium (VI) COC value was used for chromium.
-- = No criteria published
+ = Essential Nutrients

SSA 15
SURFACE WATER DATA AND COPC SELECTION SUMMARY
COMBINING BAKER AND BLACK & VEATCH DATA
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Contaminant[1]	Federal/State Criteria[2]				Frequency/Range[3]		COPC Selection
	AWQC Freshwater Acute (μg/L)	AWQC Freshwater Chronic (μg/L)	Virginia Freshwater Acute (μg/L)	Virginia Freshwater Chronic (μg/L)	No. of Positive Detects/No. of Samples	Concentration Range (μg/L)	Retained as a COPC?
Volatiles:							
1,1-Dichloroethene	--	11,600	--	--	1/3	1	Yes
1,1-Dichloroethane	--	--	--	--	1/3	0.5J	Yes
Trichloroethene	45,000**	21,900**	--	--	2/4	420 - 500	Yes
Vinyl chloride	--	--	--	--	1/3	2	Yes
cis 1,2-Dichloroethene	--	--	--	--	2/3	49 - 77	Yes
Nitramines:							
4-Nitrotoluene	--	--	--	--	1/1	0.087	Yes
Inorganics (Total):							
Aluminum	750	87	--	--	4/4	50.5 - 81.6	No
Barium	--	--	--	--	4/4	32 - 43.2L	No
Cadmium	3.9*	1.1*	13.4	2.67	1/4	2.1K	Yes
Calcium+	--	--	--	--	4/4	91,900 - 114,000	No
Copper	18*	12*	49.6	30.05	1/4	4.1	No
Iron+	--	1000	--	--	3/4	331L - 889L	No
Lead	83*	3.2*	327.69	12.77	2/4	1.4 - 1.6	No
Magnesium+	--	--	--	--	4/4	2,620 - 3,220	No

SSA 15 (Continued)
SURFACE WATER DATA AND COPC SELECTION SUMMARY
COMBINING BAKER AND BLACK AND VEATCH DATA
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Contaminant[1]	Federal/State Criteria[2]				Frequency/Range[3]		COPC Selection
	AWQC Freshwater Acute (μg/L)	AWQC Freshwater Chronic (μg/L)	Virginia Freshwater Acute (μg/L)	Virginia Freshwater Chronic (μg/L)	No. of Positive Detects/No. of Samples	Concentration Range (μg/L)	Retained as a COPC?
Manganese	--	--	--	--	4/4	8.2L- 70.1	No
Potassium+	--	--	--	--	4/4	1,030 - 1,560	No
Silver	4.1	0.12	117	--	1/4	1	Yes
Sodium+	--	--	--	--	4/4	7,020 - 9,290	No
Thallium	1,400**	40**	--	--	2/4	7K - 7.6K	No
Vanadium	--	--	--	--	2/4	1.3-1.8L	No
Zinc	120*	110*	295.1	267.29	3/4	2.5J - 7.6J	No

Notes:

(1) All concentrations reported in μg/L
(2) Water Quality Criteria (WQC) human health values (recalculated) using IRIS as of 1990 and the Virginia Water Standards (Bureau of National Affairs - December 1994)
(3) B = Detected in associated blank(s)
J = Analyte was positively identified, value is estimated
K = Value is estimated; biased high
L = Value is estimated; biased low

-- = No criteria published
+ = Essential Nutrient
* = Hardness dependent criteria (100 mg/L $CaCO_3$ used)
** = Insufficient data to develop criteria. Value presented is the lowest observed effect level (LOEL).

SSA 15
SEDIMENT DATA AND COPC SELECTION SUMMARY
COMBINING BAKER AND BLACK & VEATCH DATA
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Contaminant[1]	Sediment Criteria[2]		Contaminant Frequency/Range[3]		Comparison to Criteria		COPC Selection
	SSV ER-M (mg/kg)	SSV ER-L (mg/kg)	No. of Positive Detects/ No. of Samples	Range of Positive Detections (mg/kg)	Positive Detects Above ER-M	Positive Detects Above ER-L	Retained as a COPC?
Volatiles:							
1,2-Dichloroethene (total)	--	--	1/5	0.002J	--	--	No
2-Butanone	--	--	1/6	0.011J	--	--	No
Benzene	--	--	1/5	0.002J	--	--	No
Toluene	--	--	1/6	0.005J	--	--	No
Trichloroethene	--	--	2/6	0.002J - 0.007J	--	--	Yes[6]
Xylene (total)	--	--	1/6	0.002J	--	--	No
Semivolatiles:							
bis(2-Ethylhexyl)Phthalate	--	5.3[5]	4/6	0.11J - 0.57	--	0	No
Fluoranthene	5.1	0.6	1/6	0.099J	0	0	No
Phenanthrene	1.5	0.24	2/6	0.047J - 0.062J	0	0	No
Di-n-butylphthalate	--	260[5]	1/6	4.9	--	0	No
Butyl Benzyl Phthalate	--	5.3[5]	1/6	0.46J	--	0	No
Pyrene	2.6	0.665	1/6	0.07J	0	0	No
Pesticides/PCBs:							
4,4'-DDD	0.0461	0.00158	5/5	0.0082 - 0.049J	1	5	Yes
4,4'-DDE	0.027	0.0022	5/5	0.0041J - 0.031	1	5	Yes

SSA 15 (Continued)
SEDIMENT DATA AND COPC SELECTION SUMMARY
COMBINING BAKER AND BLACK & VEATCH DATA
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Contaminant[1]	Sediment Criteria[2]		Contaminant Frequency/Range[3]		Comparison to Criteria		COPC Selection
	SSV ER-M (mg/kg)	SSV ER-L (mg/kg)	No. of Positive Detects/ No. of Samples	Range of Positive Detections (mg/kg)	Positive Detects Above ER-M	Positive Detects Above ER-L	Retained as a COPC?
4,4'-DDT	0.0461	0.00158	5/5	0.02 - 0.086	1	5	Yes
delta-BHC	--	--	4/5	0.00062J - 0.0015J	--	--	No
Dieldrin	--	--	1/6	0.0006NJ	--	--	No
alpha-Chlordane	0.006[4]	0.0005[4]	4/5	0.0022J - 0.0045	0	4	Yes
gamma-Chlordane	0.006[4]	0.0005[4]	4/5	0.0022 - 0.0054	0	4	Yes
Aroclor-1254	0.0227	0.18	1/6	0.014J	0	0	No
Inorganics:							
Aluminum	--	--	6/6	497 - 959	--	--	No
Arsenic	70	8.2	4/6	0.72 - 1.3	0	0	No
Barium	--	--	6/6	3 - 10.4	--	--	No
Beryllium	--	--	6/6	0.02 - 0.05	--	--	No
Cadmium+	9.6	1.2	3/6	0.38 - 0.43	0	0	No
Calcium+	--	--	6/6	682J - 4350J	--	--	No
Chromium	370	81	6/6	1.6L - 4	0	0	No
Cobalt	--	--	2/6	0.65-0.82	--	--	No
Copper	270	34	6/6	1.3 - 3.5	0	0	No
Iron+	--	--	6/6	1,050 - 2,790	--	--	No

SSA 15 (Continued)
SEDIMENT DATA AND COPC SELECTION SUMMARY
COMBINING BAKER AND BLACK & VEATCH DATA
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Contaminant[1]	Sediment Criteria[2]		Contaminant Frequency/Range[3]		Comparison to Criteria		COPC Selection
	SSV ER-M (mg/kg)	SSV ER-L (mg/kg)	No. of Positive Detects/ No. of Samples	Range of Positive Detections (mg/kg)	Positive Detects Above ER-M	Positive Detects Above ER-L	Retained as a COPC?
Lead	218	46.7	6/6	4.5J - 11.5J	0	0	No
Magnesium+	--	--	6/6	44.7 - 343	--	--	No
Manganese	--	--	6/6	5.20 - 37.4	--	--	No
Mercury	0.71	0.15	3/6	0.23 - 0.44	0	3	Yes
Potassium	--	--	1/6	0.164	--	--	No
Silver	3.7	1	2/6	0.51K-0.87L	0	0	No
Sodium+	--	--	6/6	30 - 63.6	--	--	No
Vanadium	--	--	6/6	2.3 - 4.3	--	--	No
Zinc	410	150	6/6	9.5J - 19.1J	0	0	No

(1) Organic concentrations converted to mg/kg, Inorganic concentrations reported in mg/kg.
(2) SSV = Sediment Screening Value (Long, et al, 1995)
(3) J = Analyte was positively identified. Reported value may not be accurate or precise.
L = Estimated value, biased low
(4) National Oceanic and Atmospheric Administration
(5) Region III BTAG Screening Levels range from 5.3 mg/kg (diethylphthalate) to 260 mg/kg (n-butylphthalate). The more conservative value for diethylphthalate was used.

-- = No criteria published
+ = Essential Nutrients

SSA 15 - ACCIDENTAL INGESTION OF SURFACE SOILS - (1)
SUMMARY OF RISK SCREENING
COMBINING BAKER AND BLACK AND VEATCH DATA
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
FUTURE RESIDENTS
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Carcinogens

ILCRi = (Ci/RBCi) x 1E-06
TOTAL ILCR = ILCR1 + ILCR2 ... ILCRn

ILCR = Incremental Lifetime Cancer Risk
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/l)
1E-06 = Risk assessment point of departure

Noncarcinogens

HQ1 = Ci/RBCi
HI = HQ1 + HQ2 ... HQn

HQ = Hazard Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
RBC = Risk-Based Concentration (mg/kg, ug/kg)
HI = Hazard Index

COPC	Ci (mg/kg)	Residential Soil RBC (mg/kg)	(n,c)	ILCR	ILCR Percent Contrib.		HQ	HQ Percent Contrib.
Antimony	2.69	31	n	NA	0.0%		8.7E-02	1.7%
Arsenic	13.64	0.37	c	3.7E-05	93.1%		NA	0.0%
Arsenic	13.64	23	n	NA	0.0%		5.9E-01	11.9%
Beryllium	0.41	0.15	c	2.7E-06	6.9%		NA	0.0%
Cadmium	4.52	3.9	n	NA	0.0%		1.2E+00	23.3%
Chromium	24.8	39	n	NA	0.0%		6.4E-01	12.8%
Mercury	2.07	2.3	n	NA	0.0%		9.0E-01	18.1%
Silver	23.14	39	n	NA	0.0%		5.9E-01	11.9%
Vanadium	40.64	55	n	NA	0.0%		7.4E-01	14.8%
Manganese	106.55	390	n	NA	0.0%		2.7E-01	5.5%
		Total	ILCR:	4.0E-05	100.0%	HI	5.0E+00	100.0%

n = noncarcinogen
c = carcinogenic
NA = not applicable
(1) Concentrations are normal 95% UCL values, or maximum values if the UCL was exceeded.

SSA 15 - SURFACE WATER
SUMMARY OF ECOLOGICAL RISK SCREENING
COMBINING BAKER AND BLACK AND VEATCH DATA
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

EQ = Ci/(AWQC or ER-L)
EI = EQ1 + EQ2...EQn

EQ = Ecological Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
AWQC = Ambient Water Quality Criteria
ER-L = Sediment screening value, Effects Range-Low value (mg/kg)
EI = Ecological Index

COPC	Ci (ug/L)	AWQC (ug/L)	Ecological Quotient	EQ Percent Contrib.
1,1-Dichloroethene (1)	1	11600	8.6E-05	0.0%
1,1-Dichloroethane	0.5	NA	--	0.0%
Trichloroethene	500	21900	2.3E-02	0.2%
Vinyl Chloride	2	NA	--	0.0%
4-Nitrotoluene	0.087	NA	--	0.0%
Cadmium	2.1	1.1	1.9E+00	18.6%
Silver	1	0.12	8.3E+00	81.1%
cis-1,2-Dichloroethene(1)	77	11600	6.6E-03	0.1%
		EI:	1.0E+01	100.0%

(1) Acute AWQC for dichloroethylenes used as a surrogate.
(2) Exposure point concentration values are the maximum detected concentrations.

SSA 19 - SEDIMENT
SUMMARY OF ECOLOGICAL RISK SCREENING (1)
COMBINING BAKER AND BLACK AND VEATCH DATA
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

EQ = Ci/(AWQC or ER-L)
EI = EQ1 + EQ2...EQn

EQ = Ecological Quotient
Ci = Detected concentration in a medium (mg/kg, ug/L)
AWQC = Ambient Water Quality Criteria
ER-L = Sediment screening value, Effects Range-Low value (mg/kg)
EI = Ecological Index

COPC	Ci (mg/kg)	ER-L (mg/kg)	Ecological Quotient	EQ Percent Contrib.
Tetrachloroethene	0.01	--	NA	0.0%
Trichloroethene	0.008	--	NA	0.0%
gamma-Chlordane	0.002	0.0005	4.0E+00	60.6%
Antimony	2.55	2	1.3E+00	19.3%
Arsenic	3.89	8.2	4.7E-01	7.2%
Copper	10.89	34	3.2E-01	4.9%
Mercury	0.08	0.15	5.3E-01	8.1%
		EI:	6.6E+00	100.0%

(1) Exposure concentrations are Normal 95% UCL concentrations.
-- = No published criteria.

APPENDIX O
TRANSMITTAL LETTER, FINAL RAC DESIGN PACKAGE FOR REMOVAL ACTIONS AT SSAs 2 AND 7

Baker

Baker Environmental, Inc.
Airport Office Park, Building 3
420 Rouser Road
Coraopolis, Pennsylvania 15108

(412) 269-6000
FAX (412) 269-2002

June 1, 1995

Commander
Atlantic Division
Naval Facilities Engineering Command
1510 Gilbert Street (Building N-26)
Norfolk, Virginia 23511-2699

Attn: Mr. Gregory P. Hatchett
Code 18226

Re: Contract N62470-89-D-4814
Navy CLEAN, District III
Contract Task Order (CTO) 0294
RAC Design Package for Removal Action
Site Screening Areas 3 and 7
Naval Weapons Station, Yorktown, Virginia

Dear Mr. Hatchett:

Baker Environmental, Inc. (Baker) is pleased to submit six (6) copies of the Final Design Package for the Removal Action at the referenced Site Screening Areas. This package includes the Design Drawings, Specifications, and the Construction Cost Estimate (including one copy each of the Drawings and Cost Estimate on computer disk), as well as one set of reproducible mylars of the Drawings and one set of original, unbound Specifications. The package also includes the comments (with Baker's responses) received on the 100% Submittal.

Two copies each of this submittal package have been sent to the ROICC office and the Commanding Officer, Naval Weapons Station, Yorktown (Activity). Five copies have been sent to Mr. Robert Thomson (USEPA Region III) as per his request, and two copies to Mr. Steve Mihalko (Virginia DEQ). Copies of this letter have been forwarded to Ms. Ollie Glodis (LANTDIV Code 02116) and Ms. Susan Gale (LANTDIV Code 1831).

bcc: APPajak/CF; JWMentz/RPWattras/PRGM F; JJKlacik/PJT F;
RFHoff; SJKretschman; Daily File
S.O.# 62470-294-SRN
Subfile # 5
Initials RFH

If you have any questions regarding this submittal, please contact me at (412) 269-6135 or Mr. Richard Hoff (Activity Coordinator) at (412) 269-2099.

Sincerely,

BAKER ENVIRONMENTAL, INC.

James J. Klacik

James J. Klacik, P.E.
Project Manager

JJK/lq

cc: Ms. Ollie Glodis, Code 02116 (letter only)
Ms. Susan Gale, Code 1831 (letter only)
ROICC Office, WPNSTA, Yorktown (2 sets)
Commanding Officer, WPNSTA, Yorktown (2 sets)

Baker
Baker Environmental, Inc.
420 Rouser Road
Airport Office Park Bldg. 3
Coraopolis, PA 15108
Telephone: (412) 269-6000
Fax: (412) 269-2002

Letter of Transmittal

To: U.S. EPA Region III
Office of Superfund VA/WVA Fed. Facilities
841 Chestnut Building
Philadelphia, PA 19107

Attn: Mr. Robert Thomson, P.E. (3HW71)

S.O. No. 62470-294-SRN
Project: CTO-0294,Weapons Station, Yorktown, VA
Date: June 1, 1995

We are forwarding the following: ■ Attached ❑ Under Separate Cover

DWG. NO.	NO. COPIES	TITLE OR DESCRIPTION	COMMENTS
	2	Final Design Submittal Removal Action at Site Screening Areas 3 & 7 Naval Weapons Station Yorktown, Virginia	

THESE ARE TRANSMITTED as checked below:

❑	As requested	❑	No exceptions taken	❑	Revise and resubmit
❑	For review and comment	❑	Rejected - See remarks	❑	Submit specified items
■	For your information	❑	Proceed subject to corrections noted	❑	_____

GENERAL COMMENTS:

cc: Mr. Gregory P. Hatchett, Code 18226

BAKER ENVIRONMENTAL, INC.

By: James J. Klacik, P.E.

Title: Project Manager

Baker

Baker Environmental, Inc.
420 Rouser Road
Airport Office Park Bldg. 3
Coraopolis, PA 15108
Telephone: (412) 269-6000
Fax: (412) 269-2002

Letter of Transmittal

To: Commonwealth of Virginia
Department of Environmental Quality
629 East Main Street
Richmond, Virginia 23219

Attn: Mr. Steve Mihalko

S.O. No. 62470-294-SRN
Project: CTO-0294,Weapons Station, Yorktown, VA
Date: June 1, 1995

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■	For your information	❑	Proceed subject to corrections noted	❑	_____

GENERAL COMMENTS:

cc: Mr. Gregory P. Hatchett, Code 18226

BAKER ENVIRONMENTAL, INC.

By: James J. Klacik, P.E.

Title: Project Manager

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
841 Chestnut Building
Philadelphia, Pennsylvania 19107

Office of Superfund
Robert Thomson, P.E.
Mail Code 3HW71

Direct Dial (215) 597-1110
FAX (215) 597-9890

Date: May 3, 1995

Ms. Brenda Norton, PE
Atlantic Division, Naval Facilities Engineering Command
Environmental Quality Division
Code: 1822
Building N 26, Room 54
1510 Gilbert Street
Norfolk, Va 23511-2699

Re: Naval Weapons Station, Yorktown, Va.
Non-time critical Removal Action(s)
SSAs 3 and 7
Review of draft *Engineering Evaluation/Cost Analysis, 100% Design Plans, Specifications and Construction Drawings*

Dear Ms. Norton:

The U.S. Environmental Protection Agency (EPA) has reviewed the Navy's draft *Engineering Evaluation/Cost Analysis, 100% Design Plans, Specifications and Construction Drawings* for the non-time critical removal actions planned for Site-Screening Areas (SSAs) 3 and 7 located at the Naval Weapons Station-Yorktown (WPNSTA) NPL facility, and we have the following comments to offer based upon our review:

General Comments

1) The major draw back with the basis of design document, specifications and plans is that the sampling and analysis plan for excavation sampling and other sampling is not provided. The Sampling and Analysis Plan defining the site specific sampling and analytical procedures are to be submitted by the contractor (spec 01010, Paragraph 1.3.1.1) at a later date. WHY?? There should be a provision in the specifications to allow the EPA to review the contractor's Sampling and Analysis Plan. In accordance with the National Contingency Plan 40 C.F.R. § 300.415(b)(4)(ii), the non-time critical Sampling and Analysis Plan should be submitted to EPA for review and approval before the non-time critical removal action begins.

2) The Basis of Design document indicates (page 6) that one of the removal action goals is to determine if further investigation efforts and remedial actions are warranted by sampling and analyzing the remaining soils from the open excavations prior to backfilling and site restoration activities. For this goal, the specification calls for one confirmation sample per 1000 square feet. This is not sufficient. Given the small size of these sites (220 gallon UST, small fire training pits), the frequency of confirmation sampling should be representative of the likelihood that contamination is still present. For example, for determining whether or not a release has occurred at an UST excavation site, a minimum of five confirmation sample locations is recommended underneath the excavated UST to determine whether or not a release has occurred.

3) What is the past and current function of the existing Water Bypass Vault in the median strip of Main Road adjacent to SSA 7. There may be a need to investigate this area, depending

on what the Vault was used for.

4) It is known from previous investigation work that the Main Road Disposal Area contains ordnance debris, however the documents do not discuss the use of an unexploded ordnance specialist during investigation. Is one needed?

Specific Comments to Specifications

1) Section 01010, Part 1.3.1.1, e, pg. 3.

The suggested air monitoring and sampling provisions identified in the Basis of Design document should be specified under this section. The Basis of Design document indicates, "The contractor shall perform real-time monitoring for organic vapors with a PID- or FID-type volatile organic detector and for explosive atmospheres with an explosimeter. High-volume air sampling shall be used to qualify any release of toxic particulates associated with remedial work at the project site in accordance with OSHA requirements for worker health and safety."

2) Section 01430, Part 3.1.1.1,

One sample every 1000 square feet is insufficient. The sampling design should be based upon the likelihood that contamination is still present, and not simply on volume.

3) Section 01430, Part 3.1.1.2,

The second paragraph should also include sampling of the sediment contained in the Fire Training Pits.

In Paragraph 3, a minimum frequency of grab and composite sampling is not specified..

There is also no provision in this section for the following requirement called for in the Basis of Design document: "In addition, the potentially contaminated soil shall contain no free liquid as demonstrated by EPA SW 846 Method 9095, Paint Filter Liquid Test".

4) Section 01430, Part 3.1.1.3,

This section does not provide for the concrete that has been excavated from the fire training pits at SSA 3, the concrete and associated debris from the removal of the UST at SSA 7, and from the metal debris removed at the Main Road Disposal Area at SSA 7.

5) Section 0220, Part 2.1.1

The base borrow pit is not indicated on the drawings. Moreover, soil obtained from WPNSTA property should be certified clean before using as fill.

6) Section 02220, Part 3.1.1.1, pg. 3,

What provisions are specified to: prevent surface water runoff from contacting contaminated material during construction activities and flowing off-site; dewater all excavated areas during construction; and collect, sample, analyze, and dispose any water accumulated in the excavation and staging areas.

7) Section 02220, Part 3.1.4, pg. 3,

Are provisions for a decontamination pad for vehicles, personnel, etc., during the removal

; at each site appropriate in this section?

oncludes EPA's comments concerning the review of the draft *Engineering Evaluation/Cost Design Plans, Specifications and Construction Drawings* for the non-time critical removal actions As 3 and 7 located at the WPNSTA. If you have any questions concerning the above, please l me at (215) 597-1110,

Sincerely,

Robert Thomson

Robert Thomson, PE
VA/WV Superfund Federal Facilities (3HW71)

Mihalko (VDEQ, Richmond)
arlow (WPNSTA, Code 09E)
Rola (BVWST, Phila.)