ATTACHMENT A
GROUNDWATER: RESIDENTIAL AND INDUSTRIAL-COMMERCIAL
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS

Guidesheet Number →		#1	#2	#3	#4	#5	#6	#7	#8	#9
	Chemical Abstract Service Number	Residential & Commercial I Drinking Water Criteria	Industrial & Commercial II, III & IV Drinking Water Criteria	Groundwater Surface Water Interface Criteria	Residential & Commercial I Groundwater Volatilization to Indoor Air Inhalation Criteria	Industrial & Commercial II, III & IV Groundwater Volatilization to Indoor Air Inhalation Criteria	Groundwater Contact Criteria	Water Solubility	Flammability and Explosivity Screening Level	Acute Inhalation Screening Level
n-Butanol {I}	71363	950	2,700	NA	NLV	NLV	8.8E+6	7.40E+7	2.4E+7	7.4E+7 {S}
2-Butanone (MEK) {I}	78933	13,000	38,000	2,200	2.4E+8 {S}	2.4E+8 {S}	2.4E+8 {S}	2.40E+8	ID	2.4E+8 {S}
n-Butyl acetate	123864	550	1,600	NA	6.7E+6 {S}	6.7E+6 {S}	1.8E+6	6.70E+6	1.2E+6	6.7E+6 {S}
t-Butyl alcohol	75650	3,900	11,000	NA	1.0E+9 {D,S}	1.0E+9 {D,S}	7.9E+7	1.0E+9	3.0E+7	ID
Butyl benzyl phthalate	85687	1,200	2,700 {S}	14 {X}	NLV	NLV	2,700 {S}	2,690	ID	ID
n-Butylbenzene	104518	80	230	NA	ID	ID	5,900	NA	ID	ID
sec-Butylbenzene	135988	80	230	NA	ID	ID	4,400	NA	ID	ID
tert-Butylbenzene {I}	98066	80	230	NA	ID	ID	8,900	NA	ID	ID
Cadmium {B}	7440439	5.0 {A}	5.0 {A}	{G,X}	NLV	NLV	1.9E+5	NA	ID	ID
Camphene {I}	79925	ID	ID	NA	ID	ID	ID	33,400	ID	ID
Caprolactam	105602	5,800	17,000	NA	NLV	NLV	3.9E+8	5.25E+9	NA	1.0E+9 {D}
Carbaryl	63252	700	2,000	NA	ID	ID	1.3E+5 {S}	1.26E+5	ID	ID
Carbazole	86748	85	350	10 {M}	NLV	NLV	7,400	7,480	ID	ID
Carbofuran	1563662	40 {A}	40 {A}	NA	NLV	NLV	3.4E+5	7.00E+5	ID	ID
Carbon disulfide {I,R}	75150	800	2,300	ID	2.5E+5	5.5E+5	1.2E+6 {S}	1.19E+6	6,500	ID
Carbon tetrachloride	56235	5.0 {A}	5.0 {A}	45 {X}	370	2,400	4,600	7.93E+5	ID	96,000
Chlordane {J}	57749	2.0 {A}	2.0 {A}	IP	56 {S}	56 {S}	15 {AA}	56	ID	ID
Chloride	16887006	2.5E+5 {E}	2.5E+5 {E}	1.25E+5 {X}	NLV	NLV	ID	NA	ID	ID
Chlorobenzene {I}	108907	100 {A}	100 {A}	47	2.1E+5	4.7E+5 {S}	86,000	4.72E+5	79,000	ID
1-Chloro-1,1-difluoroethane	75683	15,000	44,000	NA	3.9E+6 {S}	3.9E+6 {S}	3.9E+6 {S}	3.9E+06	ID	ID
Chloroethane	75003	430	1,700	ID	5.7E+6 {S}	5.7E+6 {S}	4.4E+5	5.74E+6	56,000	ID
2-Chloroethyl vinyl ether	110758	ID	ID	NA	ID	ID	ID	1.50E+7	ID	ID
Chloroform	67663	100 {A,W}	100 {A,W}	170 {X}	28,000	1.8E+5	1.5E+5	7.92E+6	ID	ID
Chloromethane {I}	74873	260	1,100	ID	8,600	52,000	4.9E+5	6.34E+6	18,000	2.1E+5
4-Chloro-3-methylphenol	59507	150	420	NA	NLV	NLV	79,000	3.90E+6	ID	ID
beta-Chloronaphthalene	91587	1,800	5,200	NA	ID	ID	6,700 {S}	6,740	ID	ID
2-Chlorophenol	95578	45	130	22	ID	ID	94,000	2.20E+7	ID	ID
o-Chlorotoluene {I}	95498	150	420	NA	3.7E+5 {S}	3.7E+5 {S}	44,000	3.73E+5	ID	ID
Chlorpyrifos	2921882	22	63	NA	2.9	6.6	1,100 {S}	1,120	ID	ID

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Chromium (III) {B,H}	16065831	100 {A}	100 {A}	{G,X}	NLV	NLV	2.9E+8	NA	ID	ID
Chromium (VI)	18540299	100 {A}	100 {A}	11	NLV	NLV	4.6E+5	NA	ID	ID
Chrysene {Q}	218019	5.0 {M}	5.0 {M}	ID	ID	ID	5.0 {M,AA}	1.6	ID	ID
Cobalt	7440484	40	100	100	NLV	NLV	2.4E+6	NA	ID	ID
Copper	7440508	1,000 {E}	1,000 {E}	{G}	NLV	NLV	7.4E+6	NA	ID	ID
Cyanazine	21725462	10 {M}	10 {M}	56 {X}	NLV	NLV	2,800	1.70E+5	ID	ID
Cyanide {R}	57125	200 {A}	200 {A}	20 {M}	NLV	NLV	57,000	NA	ID	ID
Cyclohexanone	108941	33,000	94,000	NA	1,400	3,300	2.3E+7 {S}	2.30E+7	NA	ID
Dacthal	1861321	73	210	NA	NLV	NLV	500 {S}	500	ID	ID
Dalapon	75990	200 {A}	200 {A}	NA	NLV	NLV	1.2E+7	5.02E+8	ID	ID
4-4'-DDD	72548	9.1	37	NA	NLV	NLV	44 {AA}	90	ID	ID
4-4'-DDE	72559	4.3	15	NA	ID	ID	27 {AA}	120	ID	ID
4-4'-DDT	50293	3.6	10	0.02 {M}	NLV	NLV	13 {AA}	25	NA	ID
Decabromodiphenyl ether	1163195	30 {S}	30 {S}	NA	30 {S}	30 {S}	30 {S}	30	ID	ID
Di-n-butyl phthalate	84742	880	2,500	9.7	NLV	NLV	11,000 {S}	11,200	NA	ID
Di(2-ethylhexyl) adipate	103231	400 {A}	400 {A}	NA	NLV	NLV	470 {S}	471	ID	ID
Di-n-octyl phthalate	117840	130	380	ID	NLV	NLV	400	3,000	ID	ID
Diacetone alcohol {I}	123422	ID	ID	NA	NLV	NLV	ID	1.0E+9	1.0E+9 {D}	ID
Diazinon	333415	1.3	3.8	NA	NLV	NLV	1,300	68,800	NA	ID
Dibenzo(a,h)anthracene {Q}	53703	5.0 {M}	5.0 {M}	ID	NLV	NLV	5.0 {M,AA}	2.49	ID	ID
Dibenzofuran	132649	ID	ID	4.0	ID	ID	ID	10,000	ID	ID
Dibromochloromethane	124481	100 {A,W}	100 {A,W}	ID	15,000	1.1E+5	18,000	2.60E+6	ID	ID
Dibromochloropropane	96128	0.2 {A}	0.2 {A}	NA	1,200 {S}	1,200 {S}	390	1,230	ID	ID
Dibromomethane	74953	80	230	NA	ID	ID	5.3E+5	1.10E+7	ID	ID
1,2-Dichlorobenzene	95501	600 {A}	600 {A}	16	1.6E+5 {S}	1.6E+5 {S}	1.6E+5 {S}	1.56E+5	NA	1.6E+5 {S}
1,3-Dichlorobenzene	541731	6.6	19	38	ID	ID	2,000	1.11E+5	ID	ID
1,4-Dichlorobenzene	106467	75 {A}	75 {A}	13	16,000	74,000 {S}	6,400	73,800	NA	ID
3,3'-Dichlorobenzidine	91941	1.1	4.3	0.3 {M,X}	NLV	NLV	180	3,110	ID	ID
Dichlorodifluoromethane	75718	1,700	4,800	ID	2.2E+5	3.0E+5 {S}	3.0E+5 {S}	3.00E+5	ID	ID

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1,1-Dichloroethane	75343	880	2,500	ID	1.0E+6	2.3E+6	2.4E+6	5.06E+6	1.9E+5	ID
1,2-Dichloroethane (I)	107062	5.0 (A)	5.0 (A)	360 (X)	9,600	59,000	19,000	8.52E+6	1.3E+6	ID
1,1-Dichloroethylene (I)	75354	7.0 (A)	7.0 (A)	65 (X)	200	1,300	11,000	2.25E+6	48,000	1.4E+5
cis-1,2-Dichloroethylene	156592	70 (A)	70 (A)	ID	96,000	2.2E+5	2.0E+5	3.50E+6	2.7E+5	ID
trans-1,2-Dichloroethylene	156605	100 (A)	100 (A)	ID	85,000	2.0E+5	2.2E+5	6.30E+6	1.2E+5	ID
2,6-Dichloro-4-nitroaniline	99309	2,200	6,300	NA	NLV	NLV	7,000 (S)	7,000	ID	ID
2,4-Dichlorophenol	120832	73	210	19	NLV	NLV	48,000	4.50E+6	ID	ID
2,4-Dichlorophenoxyacetic acid	94757	70 (A)	70 (A)	220	NLV	NLV	1.2E+5	6.80E+5	ID	ID
1,2-Dichloropropane (I)	78875	5.0 (A)	5.0 (A)	290 (X)	16,000	36,000	16,000	2.80E+6	2.7E+5	2.8E+6 (S)
1,3-Dichloropropene	542756	21	63	NA	2.0	13	13,000	2.80E+6	66,000	ID
Dichlorovos	62737	1.6	6.7	NA	NLV	NLV	5,900	1.60E+7	NA	ID
Dicyclohexyl phthalate	84617	ID	ID	NA	ID	ID	ID	4,000	ID	ID
Dieldrin	60571	0.11	0.43	0.02 (M)	200 (S)	200 (S)	2.4 (AA)	195	ID	ID
Diethyl ether	60297	10 (E,M)	10 (E,M)	ID	6.1E+7 (S)	6.1E+7 (S)	3.5E+7	6.10E+7	3.2E+5	6.1E+7 (S)
Diethyl phthalate	84662	5,500	16,000	NA	NLV	NLV	1.1E+6 (S)	1.08E+6	NA	ID
Diethylene glycol monobutyl ether	112345	88	250	NA	NLV	NLV	4.0E+6	1.0E+9	ID	ID
Diisopropyl ether	108203	30	86	NA	ID	ID	8,000 (S)	8,041	ID	ID
Diisopropylamine (I)	108189	5.6	16	NA	ID	ID	21,000	3.69E+7	2.3E+6	ID
Dimethyl phthalate	131113	73,000	2.1E+5	NA	NLV	NLV	4.2E+6 (S)	4.19E+6	NA	ID
N,N-Dimethylacetamide	127195	180	520	4,100 (X)	NLV	NLV	2.3E+7	1.0E+9	NA	ID
N,N-Dimethylaniline	121697	16	46	NA	2.4E+5	1.3E+6 (S)	20,000	1.27E+6	NA	1.3E+6 (S)
Dimethylformamide (I)	68122	700	2,000	NA	NLV	NLV	1.1E+8	1.0E+9	ID	ID
2,4-Dimethylphenol	105679	370	1,000	380	NLV	NLV	5.2E+5	7.87E+6	ID	ID
2,6-Dimethylphenol	576261	4.4	13	NA	NLV	NLV	6,300	6.14E+6	ID	ID
3,4-Dimethylphenol	95658	10	29	NA	NLV	NLV	18,000	4.93E+6	ID	ID
Dimethylsulfoxide	67685	2.2E+5	6.3E+5	1.9E+5	NLV	NLV	1.7E+8 (S)	1.66E+8	ID	ID
2,4-Dinitrotoluene	121142	7.7	32	NA	NLV	NLV	8,600	2.70E+5	ID	ID
Dinoseb	88857	7.0 (A)	7.0 (A)	NA	ID	ID	7,000	52,000	ID	ID
1,4-Dioxane (I)	123911	85	350	2,800 (X)	NLV	NLV	1.7E+6	9.00E+8	7.2E+7	ID
Diquat	85007	20 (A)	20 (A)	NA	NLV	NLV	7.0E+5 (S)	7.00E+5	ID	ID
Diuron	330541	31	90	NA	NLV	NLV	37,000 (S)	37,300	ID	ID
Endosulfan (J)	115297	1.7	4.8	NA	ID	ID	510 (S)	510	ID	ID

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Endothall	145733	100 {A}	100 {A}	NA	NLV	NLV	2.5E+7 {AA}	1.00E+8	ID	ID
Endrin	72208	2.0 {A}	2.0 {A}	IP	NLV	NLV	160 {AA}	250	ID	ID
Epichlorohydrin {I}	106898	5.0 {M}	6.0	NA	3.2E+5	6.3E+5	11,000	6.60E+7	2.3E+7	ID
Ethanol {I}	64175	1.9E+6	3.8E+6	IP	NLV	NLV	1.0E+9 {D}	1.0E+9	4.8E+7	ID
Ethyl acetate {I}	141786	6,600	19,000	NA	6.4E+7 {S}	6.4E+7 {S}	6.4E+7 {S}	6.40E+7	2.1E+6	ID
Ethylbenzene {I}	100414	74 {E}	74 {E}	18	1.7E+5 {S}	1.7E+5 {S}	1.7E+5 {S}	1.69E+5	22,000	1.7E+5 {S}
Ethylene dibromide	106934	1.0 {A,M}	1.0 {A,M}	1.0 {M}	2,400	15,000	25	4.20E+6	ID	ID
Ethylene glycol	107211	15,000	42,000	1.9E+5 {X}	NLV	NLV	1.0E+9 {D,S}	1.0E+9	NA	1.0E+9 {D}
Ethylene glycol monobutyl ether	111762	3,700	10,000	NA	2.9E+6	6.5E+6	5.3E+7	2.24E+8	NA	ID
Fluoranthene	206440	210 {S}	210 {S}	1.6	210 {S}	210 {S}	210 {S}	206	ID	ID
Fluorene	86737	880	2,000 {S}	12	2,000 {S}	2,000 {S}	2,000 {S}	1,980	ID	ID
Fluorine (soluble fluoride) {B}	7782414	2,000 {E}	2,000 {E}	NA	NLV	NLV	1.2E+7	NA	ID	ID
Formaldehyde	50000	1,300	3,800	120	63,000	3.6E+5	3.0E+7	5.50E+8	ID	61,000
Formic acid {I,U}	64186	18,000 {M}	29,000	ID	7.7E+6	1.5E+7	6.0E+8	1.0E+9	6.6E+8	3.5E+8
1-Formylpiperidine	2591868	60	230	NA	ID	ID	ID	NA	ID	ID
Gentian violet	548629	15	63	NA	NLV	NLV	1.0E+6 {S}	1.00E+6	ID	ID
Glyphosate	1071836	700 {A}	700 {A}	NA	NLV	NLV	1.2E+7 {S,AA}	1.16E+7	ID	ID
Heptachlor	76448	0.4 {A}	0.4 {A}	NA	180 {S}	180 {S}	2.9 {AA}	180	ID	ID
Heptachlor epoxide	1024573	0.2 {A}	0.2 {A}	NA	NLV	NLV	9.0 {AA}	200	ID	ID
n-Heptane	142825	2,700 {S}	2,700 {S}	NA	2,700 {S}	2,700 {S}	2,700 {S}	2,690	100	2,700 {S}
Hexabromobenzene	87821	10 {M}	10 {M}	ID	ID	ID	10 {M}	0.17	ID	ID
Hexachlorobenzene (C-66)	118741	1.0 {A}	1.0 {A}	ID	440	3,000	4.6	6,200	ID	ID
Hexachlorobutadiene (C-46)	87683	15	42	0.053	1,600	3,200 {S}	400	3,230	ID	ID
alpha-Hexachlorocyclohexane	319846	0.43	1.7	NA	2,000 {S}	2,000 {S}	60	2,000	ID	ID
beta-Hexachlorocyclohexane	319857	0.88	3.6	NA	NLV	NLV	120	240	ID	ID
Hexachlorocyclopentadiene (C-56)	77474	50 {A}	50 {A}	ID	ID	ID	1,800 {S}	1,800	ID	ID
Hexachloroethane	67721	7.3	21	6.7 {X}	27,000	50,000 {S}	1,900	50,000	ID	ID
n-Hexane	110543	3,000	8,600	NA	12,000 {S}	12,000 {S}	12,000 {S}	12,000	12,000 {S}	ID
2-Hexanone	591786	1,000	2,900	NA	4.2E+6	8.8E+6	5.2E+6	1.60E+7	ID	ID
Indeno(1,2,3-cd)pyrene {Q}	193395	5.0 {M}	5.0 {M}	ID	NLV	NLV	5.0 {M,AA}	0.022	ID	ID
Iron {B}	7439896	300 {E}	300 {E}	NA	NLV	NLV	5.8E+7	NA	ID	ID
Isobutyl alcohol {I}	78831	2,300	6,700	NA	7.6E+7 {S}	7.6E+7 {S}	2.5E+7	7.60E+7	ID	ID

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Isophorone	78591	770	3,100	570 {X}	NLV	NLV	9.9E+5	1.20E+7	NA	1.2E+7 {S}
Isopropyl alcohol {I}	67630	470	1,300	NA	NLV	NLV	1.3E+7	1.0E+9	3.0E+7	1.0E+9 {D}
Isopropyl benzene	98828	800	2,300	ID	56,000 {S}	56,000 {S}	56,000 {S}	56,000	15,000	ID
Lead	7439921	4.0 {L}	4.0 {L}	{G,X}	NLV	NLV	ID	NA	ID	ID
Lindane	58899	0.2 {A}	0.2 {A}	0.027	ID	ID	190	6,800	ID	ID
Lithium {B}	7439932	170	350	25	NLV	NLV	5.4E+6	NA	ID	ID
Magnesium {B}	7439954	4.0E+5	1.1E+6	NA	NLV	NLV	1.0E+9 {D}	NA	ID	ID
Manganese {B}	7439965	50 {E}	50 {E}	{G,X}	NLV	NLV	9.1E+6	NA	ID	ID
Mercury (inorganic)	7439976	2.0 {A}	2.0 {A}	1.3E-3 {Z}	NLV	NLV	56 {S}	56	ID	ID
Methane	74828	ID	ID	ID	{K}	{K}	ID	NA	{K}	ID
Methanol	67561	3,700	10,000	480	2.5E+6	6.0E+6	2.9E+7 {S}	2.90E+7	2.3E+6	2.9E+7 {S}
Methoxychlor	72435	40 {A}	40 {A}	NA	ID	ID	45 {S}	45	ID	ID
2-Methoxyethanol {I}	109864	7.3	21	NA	NLV	NLV	8.3E+5	1.0E+9	ID	ID
2-Methyl-4-chlorophenoxyacetic acid	94746	7.3	21	NA	NLV	NLV	9,200	9.24E+5	ID	ID
2-Methyl-4,6-dinitrophenol	534521	20 {M}	20 {M}	NA	NLV	NLV	9,500	2.00E+5	ID	ID
Methyl parathion	298000	1.8	5.2	NA	NLV	NLV	3,000	50,000	ID	ID
4-Methyl-2-pentanone (MIBK) {I}	108101	1,800	5,200	ID	2.0E+7 {S}	2.0E+7 {S}	1.3E+7	2.00E+7	ID	2.0E+7 {S}
Methyl-tert-butyl ether (MTBE)	1634044	40 {E}	40 {E}	730 {X}	4.7E+7 {S}	4.7E+7 {S}	6.9E+5	4.68E+7	ID	ID
N-Methyl-morpholine {I}	109024	20	56	NA	NLV	NLV	1.5E+6	1.0E+9	ID	ID
Methylcyclopentane {I}	96377	ID	ID	NA	ID	ID	ID	73,890	ID	ID
4,4'-Methylene-bis-2-chloroaniline (MBOCA)	101144	1.1	4.5	NA	NLV	NLV	110 {AA}	14,000	ID	ID
Methylene chloride	75092	5.0 {A}	5.0 {A}	940 {X}	2.2E+5	1.4E+6	2.2E+5	1.70E+7	ID	ID
2-Methylnaphthalene	91576	260	750	ID	ID	ID	25,000 {S}	24,600	ID	ID
Methylphenols {J}	1319773	370	1,000	71	NLV	NLV	8.1E+5	2.80E+7	NA	ID

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Guidesheet Number →		#1	#2	#3	#4	#5	#6	#7	#8	#9
	Chemical Abstract Service Number	Residential & Commercial I Drinking Water Criteria	Industrial & Commercial II, III & IV Drinking Water Criteria	Groundwater Surface Water Interface Criteria	Residential & Commercial I Groundwater Volatilization to Indoor Air Inhalation Criteria	Industrial & Commercial II, III & IV Groundwater Volatilization to Indoor Air Inhalation Criteria	Groundwater Contact Criteria	Water Solubility	Flammability and Explosivity Screening Level	Acute Inhalation Screening Level
Metolachlor	51218452	240	990	NA	NLV	NLV	91,000	5.30E+5	ID	ID
Mirex	2385855	0.02 {M}	0.02 {M}	NA	NA	NA	0.02 {M}	6.8E-6	NA	ID
Molybdenum {B}	7439987	37	100	800 {X}	NLV	NLV	9.7E+5	NA	ID	ID
Naphthalene	91203	520	1,500	13	31,000 {S}	31,000 {S}	31,000 {S}	31,000	31,000 {S}	31,000 {S}
Nickel {B}	7440020	100 {A}	100 {A}	{G}	NLV	NLV	7.4E+7	NA	ID	ID
Nitrate {B,N}	14797558	10,000 {A,N}	10,000 {A,N}	NA	NLV	NLV	3.1E+8	NA	ID	ID
Nitrite {B,N}	14797650	1,000 {A,N}	1,000 {A,N}	NA	NLV	NLV	1.9E+7	NA	ID	ID
Nitrobenzene {I}	98953	3.4	9.6	180 {X}	2.1E+6 {S}	2.1E+6 {S}	11,000	2.09E+6	NA	ID
2-Nitrophenol	88755	20	58	ID	NLV	NLV	79,000	2.50E+6	ID	ID
n-Nitroso-di-n-propylamine	621647	5.0 {M}	5.0 {M}	NA	NLV	NLV	360	9.89E+6	ID	ID
N-Nitrosodiphenylamine	86306	270	1,100	NA	NLV	NLV	35,000 {S}	35,100	ID	ID
Oxamyl	23135220	200 {A}	200 {A}	NA	NLV	NLV	6.2E+7	2.80E+8	ID	ID
Oxo-hexyl acetate	88230357	73	210	NA	ID	ID	ID	NA	ID	ID
Pendimethalin	40487421	280 {S}	280 {S}	NA	NLV	NLV	280 {S}	275	ID	ID
Pentachlorobenzene	608935	6.1	17	NA	ID	ID	240	650	ID	ID
Pentachloronitrobenzene	82688	32 {S}	32 {S}	NA	32 {S}	32 {S}	32 {S}	32	ID	ID
Pentachlorophenol	87865	1.0 {A}	1.0 {A}	{G,X}	NLV	NLV	200	1.85E+6	ID	ID
Pentane	109660	ID	ID	NA	38,000 {S}	38,000 {S}	ID	38,200	170	38,000 {S}
2-Pentene {I}	109682	ID	ID	NA	ID	ID	ID	2.03E+5	ID	ID
Phenanthrene	85018	52	150	5.0 {M}	1,000 {S}	1,000 {S}	1,000 {S}	1,000	ID	ID
Phenol	108952	4,400	13,000	210	NLV	NLV	2.9E+7	8.28E+7	NA	ID
Phosphorus (total)	7723140	63,000	2.4E+5	NA	NLV	NLV	ID	NA	ID	ID
Phthalic acid	88993	14,000	40,000	NA	NLV	NLV	1.4E+7 {S}	1.42E+7	ID	ID
Phthalic anhydride	85449	15,000	44,000	NA	NLV	NLV	6.2E+6 {S}	6.2E+6	NA	ID
Picloram	1918021	500 {A}	500 {A}	NA	NLV	NLV	4.3E+5 {S}	4.30E+5	ID	ID
Piperidine	110894	3.2	9.2	NA	NLV	NLV	34,000	1.0E+9	ID	ID
Polybrominated biphenyls {J}	67774327	0.032	0.09	IP	NLV	NLV	ID	1.66E+7	ID	ID
Polychlorinated biphenyls (PCBs) {J,T}	1336363	0.5 {A}	0.5 {A}	0.2 {M}	45 {S}	45 {S}	3.3 {AA}	44.7	ID	ID
Prometon	1610180	160	460	NA	NLV	NLV	1.8E+5	7.50E+5	ID	ID
Propachlor	1918167	95	270	NA	NLV	NLV	4.4E+5	6.55E+5	ID	ID
Propazine	139402	200	560	NA	NLV	NLV	8,600 {S}	8,600	ID	ID
Propionic acid	79094	12,000	35,000	ID	NLV	NLV	2.8E+8	1.0E+9	9.7E+8	ID

ATTACHMENT A
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Propyl alcohol {I}	71238	1,400	4,000	NA	NLV	NLV	2.8E+7	1.0E+9	3.6E+7	1.0E+9 {D}
n-Propylbenzene {I}	103651	80	230	ID	ID	ID	15,000	NA	ID	ID
Propylene glycol	57556	1.5E+5	4.2E+5	NA	NLV	NLV	1.0E+9 {D,S}	1.0E+9	ID	ID
Pyrene	129000	140 {S}	140 {S}	ID	140 {S}	140 {S}	140 {S}	135	ID	ID
Pyridine {I}	110861	7.3	21	NA	5,500	12,000	94,000	3.00E+5	41,000	ID
Selenium {B}	7782492	50 {A}	50 {A}	5.0	NLV	NLV	9.7E+5	NA	ID	ID
Silver {B}	7440224	34	98	0.2 {M}	NLV	NLV	1.5E+6	NA	ID	ID
Silvex (2,4,5-TP)	93721	50 {A}	50 {A}	NA	NLV	NLV	43,000	1.40E+5	ID	ID
Simazine	122349	4.0 {A}	4.0 {A}	NA	NLV	NLV	4,500 {S}	4,470	ID	ID
Sodium	7440235	1.2E+5	3.5E+5	NA	NLV	NLV	1.0E+9 {D}	NA	ID	ID
Strontium {B}	7440246	4,600	13,000	760	NLV	NLV	1.2E+8	NA	ID	ID
Styrene	100425	100 {A}	100 {A}	80	1.7E+5	3.1E+5 {S}	9,700	3.10E+5	68,000	3.1E+5 {S}
Sulfate	14808798	2.5E+5 {E}	2.5E+5 {E}	NA	NLV	NLV	ID	NA	ID	ID
Tebuthiuron	34014181	510	1,500	NA	NLV	NLV	2.5E+6 {S}	2.50E+6	ID	ID
2,3,7,8-Tetrabromodibenzo-p-dioxin {O}	50585416	{O}	{O}	{O}	NLV	NLV	{O}	0.00996	ID	ID
1,2,4,5-Tetrachlorobenzene	95943	1,300 {S}	1,300 {S}	2.9 {X}	ID	ID	1,300 {S}	1,300	ID	ID
2,3,7,8-Tetrachlorodibenzo-p-dioxin {O}	1746016	3.0E-5 {A}	3.0E-5 {A}	1.0E-5 {M}	NLV	NLV	1.0E-5 {M,O,AA}	0.019	ID	ID
1,1,1,2-Tetrachloroethane	630206	77	320	NA	15,000	96,000	30,000	1.10E+6	ID	ID
1,1,2,2-Tetrachloroethane	79345	8.5	35	78 {X}	12,000	77,000	4,700	2.97E+6	ID	ID
Tetrachloroethylene	127184	5.0 {A}	5.0 {A}	45 {X}	25,000	1.7E+5	12,000	2.0E+5	ID	2.0E+5 {S}
Tetrahydrofuran	109999	95	270	11,000 {X}	6.9E+6	1.6E+7	1.6E+6	1.0E+9	30,000	3.6E+6
Thallium {B}	7440280	2.0 {A}	2.0 {A}	3.7 {X}	NLV	NLV	13,000	NA	ID	ID
Toluene {I}	108883	790 {E}	790 {E}	140	5.3E+5 {S}	5.3E+5 {S}	5.3E+5 {S}	5.26E+5	31,000	ID
p-Toluidine	106490	15	62	NA	NLV	NLV	24,000	7.60E+6	NA	ID
Toxaphene	8001352	3.0 {A}	3.0 {A}	1.0 {M}	NLV	NLV	44	740	ID	740 {S}
Triallate	2303175	95	270	NA	ID	ID	4,000 {S}	4,000	ID	ID

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Tributylamine	102829	10	29	ID	14,000	75,000 {S}	2,300	75,400	ID	ID
1,2,4-Trichlorobenzene	120821	70 {A}	70 {A}	30	3.0E+5 {S}	3.0E+5 {S}	19,000	3.00E+5	NA	3.0E+5 {S}
1,1,1-Trichloroethane	71556	200 {A}	200 {A}	200	6.6E+5	1.3E+6 {S}	1.3E+6 {S}	1.33E+6	ID	1.3E+6 {S}
1,1,2-Trichloroethane	79005	5.0 {A}	5.0 {A}	330 {X}	17,000	1.1E+5	21,000	4.42E+6	1.8E+6	ID
Trichloroethylene	79016	5.0 {A}	5.0 {A}	200 {X}	15,000	97,000	37,000	1.10E+6	ID	1.1E+6 {S}
Trichlorofluoromethane	75694	2,600	7,300	NA	1.1E+6 {S}	1.1E+6 {S}	1.1E+6 {S}	1.10E+6	ID	1.1E+6 {S}
2,4,5-Trichlorophenol	95954	730	2,100	NA	NLV	NLV	1.7E+5	1.20E+6	ID	ID
2,4,6-Trichlorophenol	88062	120	470	4.4	NLV	NLV	10,000	8.00E+5	ID	ID
1,2,3-Trichloropropane	96184	42	120	NA	ID	ID	84,000	1.90E+6	NA	ID
1,1,2-Trichloro-1,2,2-trifluoroethane	76131	1.7E+5 {S}	1.7E+5 {S}	NA	1.7E+5 {S}	1.7E+5 {S}	1.7E+5 {S}	1.70E+5	ID	1.7E+5 {S}
Triethanolamine	102716	3,700	10,000	NA	NLV	NLV	1.0E+9 {D,S}	1.0E+9	ID	ID
Triethylene glycol	112276	10,000 {M}	12,000	NA	NLV	NLV	1.0E+6 {S}	1.00E+6	ID	ID
3-Trifluoromethyl-4-nitrophenol	88302	4,500	13,000	NA	NLV	NLV	5.0E+6 {S}	5.00E+6	ID	ID
Trifluralin	1582098	37	110	NA	ID	ID	2,400	8,100	ID	ID
2,2,4-Trimethyl pentane	540841	ID	ID	NA	ID	ID	ID	2,330	81	ID
2,4,4-Trimethyl-2-pentene {I}	107404	ID	ID	NA	ID	ID	ID	11,900	ID	ID
1,2,4-Trimethylbenzene {I}	95636	63 {E}	63 {E}	ID	56,000 {S}	56,000 {S}	56,000 {S}	55,890	37,000	ID
1,3,5-Trimethylbenzene {I}	108678	72 {E}	72 {E}	ID	61,000 {S}	61,000 {S}	61,000 {S}	61,150	ID	ID
Triphenyl phosphate	115866	1,200	1,400 {S}	NA	NLV	NLV	1,400 {S}	1,430	ID	ID
tris(2,3-Dibromopropyl)phosphate	126727	0.71	2.9	NA	4,700 {S}	4,700 {S}	2,100	4,700	ID	ID
Urea	57136	ID {N}	ID {N}	NA	NLV	NLV	ID	NA	ID	ID
Vanadium	7440622	4.5	62	12	NLV	NLV	9.7E+5	NA	ID	ID
Vinyl acetate {I}	108054	640	1,800	NA	4.1E+6	8.9E+6	8.0E+6	2.00E+7	8.8E+5	4.8E+6
Vinyl chloride	75014	2.0 {A}	2.0 {A}	15	110	690	570	2.76E+6	17,000	ID
White phosphorus {R}	12185103	0.11	0.31	NA	NLV	NLV	2,900	NA	ID	ID
Xylenes {I}	1330207	280 {E}	280 {E}	35	1.9E+5 {S}	1.9E+5 {S}	1.9E+5 {S}	1.86E+5	35,000	1.9E+5 {S}
Zinc {B}	7440666	2,400	5,000 {E}	{G}	NLV	NLV	1.1E+8	NA	ID	ID

ATTACHMENT A
SOIL: RESIDENTIAL AND COMMERCIAL I

PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS

Developed under the authority of the
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION ACT, 1994 PA 451, AS AMENDED

Soil criteria were calculated using currently available chemical-specific data and U.S. Environmental Protection Agency risk assessment guidance. Criteria may change for the next annual revision of the criteria tables. All criteria are expressed in units of parts per billion (ppb;ug/Kg). Scientific notation is represented by E+ or E- a value; for example, 2 x 10^6 is reported as 2.0E+6. Analytical results must be expressed as dry-weight concentrations for comparison to criteria. Please refer to Operational Memorandum #6 for recommended analytical methods and target detection limits.

			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number -->		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria	Groundwater Surface Water Interface Protection Criteria	Groundwater Contact Protection Criteria	Soil Volatilization to Indoor Air Inhalation Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria	Direct Contact Criteria	Soil Saturation Concentration Screening Levels
Acenaphthene	83329	NA	3.0E+5	4,400	9.7E+5	1.9E+8	8.1E+7	8.1E+7	8.1E+7	1.4E+10	4.1E+7	NA
Acenaphthylene	208968	NA	5,900	ID	4.4E+5	1.6E+6	2.2E+6	2.2E+6	2.2E+6	2.3E+9	1.6E+6	NA
Acetaldehyde (I)	75070	NA	19,000	NA	1.1E+8 (C)	2.2E+5	1.7E+5	1.7E+5	2.8E+5	6.0E+8	2.9E+7	1.1E+8
Acetic acid	64197	NA	9.0E+5 (M)	9.0E+5 (M)	6.5E+8 (C)	NLV	NLV	NLV	NLV	1.7E+10	1.3E+8	6.5E+8
Acetone (I)	67641	NA	15,000	34,000	1.1E+8 (C)	1.1E+8 (C)	1.3E+8	1.3E+8	1.9E+8	3.9E+11	2.3E+7	1.1E+8
Acetonitrile	75058	NA	2,800	NA	2.2E+7 (C)	4.8E+6	1.6E+6	1.6E+6	2.1E+6	4.0E+9	4.3E+6	2.2E+7
Acetophenone	98862	NA	30,000	NA	1.1E+6 (C)	1.1E+6 (C)	4.4E+7	ID	ID	3.3E+10	1.1E+6 (C)	1.1E+6
Acrolein (I)	107028	NA	2,400	NA	2.3E+7 (C)	410	310	310	610	1.3E+6	3.6E+6	2.3E+7
Acrylamide	79061	NA	6.0	NA	2.6E+5	NLV	NLV	NLV	NLV	2.4E+6	1,900	NA
Acrylic acid	79107	NA	78,000	NA	1.1E+8 (C)	2.4E+6	1.9E+5	2.3E+5	2.3E+5	6.7E+7	3.5E+7 (AD)	1.1E+8
Acrylonitrile (I)	107131	NA	52	98 (X)	2.8E+5	6,600	5,000	5,100	10,000	4.6E+7	16,000	8.3E+6
Alachlor	15972608	NA	52	290 (X)	44,000	NLV	NLV	NLV	NLV	ID	93,000	NA
Aldicarb	116063	NA	60	NA	2.4E+6	NLV	NLV	NLV	NLV	ID	2.3E+5	NA
Aldicarb sulfoxide	1646873	NA	80	NA	5.4E+7	NLV	NLV	NLV	NLV	ID	2.9E+5	NA
Aldicarb sulfone	1646884	NA	50 (M)	NA	4.2E+7	NLV	NLV	NLV	NLV	ID	2.5E+5	NA
Aldrin	309002	NA	NLL	NLL	NLL	1.3E+8	58,000	58,000	58,000	6.4E+5	1,000	NA
Aluminum (B)	7429905	6.9E+6	1,000	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	5.0E+7 (AD)	NA
Ammonia	7664417	NA	ID (N)	(AC)	ID	ID	ID	ID	ID	6.7E+9	ID	1.0E+7
Aniline	62533	NA	1,700 (M)	1,700 (M)	2.8E+6	NLV	NLV	NLV	NLV	6.7E+7	3.3E+5	4.5E+6
Anthracene	120127	NA	41,000	ID	41,000	1.0E+9 (D)	1.4E+9	1.4E+9	1.4E+9	6.7E+10	2.3E+8	NA
Antimony	7440360	NA	500 (M)	ID	4.9E+7	NLV	NLV	NLV	NLV	1.3E+7	1.8E+5	NA
Arsenic (B)	7440382	5,800	23,000	70,000 (X)	2.0E+6	NLV	NLV	NLV	NLV	7.2E+5	7,600	NA
Asbestos (AB)	1332214	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.0E+7 (M)	ID	NA
Atrazine	1912249	NA	60	150 (X)	1.1E+5	NLV	NLV	NLV	NLV	ID	71,000 (AD)	NA
Azobenzene	103333	NA	4,200	NA	3.0E+5	6.1E+6	6.3E+5	ID	ID	1.0E+8	1.4E+5	NA
Barium	7440393	75,000	1.3E+6	(G,X)	1.0E+9 (D)	NLV	NLV	NLV	NLV	3.3E+8	3.7E+7	NA

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Benzene (I)	71432	NA	100	4,000 (X)	2.2E+5	1,600	13,000	34,000	79,000	3.8E+8	1.8E+5	4.0E+5
Benzidine	92875	NA	1,000 (M)	ID	1,000 (M)	NLV	NLV	NLV	NLV	46,000	1,000 (M)	NA
Benzo(a)anthracene (Q)	56553	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	20,000	NA
Benzo(b)fluoranthene (Q)	205992	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	20,000	NA
Benzo(k)fluoranthene (Q)	207089	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	2.0E+5	NA
Benzo(g,h,i)perylene	191242	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	8.0E+8	2.5E+6	NA
Benzo(a)pyrene (Q)	50328	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.5E+6	2,000	NA
Benzoic acid	65850	NA	6.4E+5	NA	7.0E+7	NLV	NLV	NLV	NLV	ID	9.9E+8	NA
Benzyl alcohol	100516	NA	2.0E+5	NA	5.6E+6 (C)	NLV	NLV	NLV	NLV	3.3E+11	5.8E+6 (C)	5.8E+6
Benzyl chloride	100447	NA	200 (M)	NA	72,000	6,300	14,000	14,000	17,000	6.2E+7	48,000	2.3E+5
Beryllium	7440417	NA	51,000	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	1.3E+6	4.1E+5	NA
bis(2-Chloroethoxy)ethane	112265	NA	ID	NA	ID	NLV	NLV	NLV	NLV	ID	ID	2.7E+6
bis(2-Chloroethyl)ether (I)	111444	NA	330 (M)	NA	1.1E+5	8,300	3,800	3,800	3,800	9.4E+6	13,000	2.2E+6
bis(2-Ethylhexyl)phthalate	117817	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	7.0E+8	2.8E+6	1.0E+7
Boron (B)	7440428	NA	10,000	38,000	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	4.8E+7 (AD)	NA
Bromobenzene (I)	108861	NA	550	NA	3.6E+5	3.1E+5	4.5E+5	4.5E+5	4.5E+5	5.3E+8	5.4E+5	7.6E+5
Bromodichloromethane	75274	NA	2,000 (W)	ID	2.8E+5	1,200	9,100	9,700	19,000	8.4E+7	1.1E+5	1.5E+6
Bromoform	75252	NA	2,000 (W)	ID	8.7E+5 (C)	1.5E+5	9.0E+5	9.0E+5	9.0E+5	2.6E+9	8.2E+5	8.7E+5
Bromomethane	74839	NA	200	700	1.4E+6	860	11,000	57,000	1.4E+5	3.3E+8	3.2E+5	2.2E+6
n-Butanol (I)	71363	NA	19,000	NA	8.7E+6 (C)	NLV	NLV	NLV	NLV	2.3E+10	8.7E+6 (C)	8.7E+6
2-Butanone (MEK) (I)	78933	NA	2.6E+5	44,000	2.7E+7 (C)	2.7E+7 (C)	2.9E+7	2.9E+7	3.5E+7	6.7E+10	2.7E+7 (C,AD)	2.7E+7
n-Butyl acetate	123864	NA	11,000	NA	1.1E+6 (C)	1.1E+6 (C)	1.1E+8	2.6E+8	3.2E+8	4.7E+11	1.1E+6 (C)	1.1E+6
t-Butyl alcohol	75650	NA	78,000	NA	1.1E+8 (C)	1.1E+8 (C)	9.7E+7	2.0E+8	2.0E+8	1.3E+11	1.1E+8 (C)	1.1E+8
Butyl benzyl phthalate	85687	NA	3.1E+5 (C)	26,000 (X)	3.1E+5 (C)	NLV	NLV	NLV	NLV	4.7E+10	3.1E+5 (C)	3.1E+5
n-Butylbenzene	104518	NA	1,600	NA	1.2E+5	ID	ID	ID	ID	ID	2.5E+6	1.0E+7
sec-Butylbenzene	135988	NA	1,600	NA	88,000	ID	ID	ID	ID	ID	2.5E+6	1.0E+7
tert-Butylbenzene (I)	98066	NA	1,600	NA	1.8E+5	ID	ID	ID	ID	ID	2.5E+6	1.0E+7
Cadmium (B)	7440439	1,200	6,000	(G,X)	2.3E+8	NLV	NLV	NLV	NLV	1.7E+6	5.5E+5	NA
Camphene (I)	79925	NA	ID	NA	ID	ID	ID	ID	ID	ID	ID	NA
Caprolactam	105602	NA	1.2E+5	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	6.7E+8	5.3E+7 (AD)	NA
Carbaryl	63252	NA	14,000	NA	2.6E+6	ID	ID	ID	ID	ID	2.2E+7	NA
Carbazole	86748	NA	9,400	1,100	8.2E+5	NLV	NLV	NLV	NLV	ID	5.3E+5	NA

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			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number →		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria	Groundwater Surface Water Interface Protection Criteria	Groundwater Contact Protection Criteria	Soil Volatilization to Indoor Air Inhalation Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria	Direct Contact Criteria	Soil Saturation Concentration Screening Levels
Carbofuran	1563662	NA	800	NA	6.8E+6	NLV	NLV	NLV	NLV	ID	1.1E+6	NA
Carbon disulfide (I,R)	75150	NA	16,000	ID	2.8E+5 (C)	76,000	1.3E+6	7.9E+6	1.9E+7	4.7E+10	2.8E+5 (C,AD)	2.8E+5
Carbon tetrachloride	56235	NA	100	900 (X)	92,000	190	3,500	12,000	28,000	1.3E+8	96,000	3.9E+5
Chlordane (J)	57749	NA	NLL	NLL	NLL	1.1E+7	1.2E+6	1.2E+6	1.2E+6	3.1E+7	31,000	NA
Chloride	16887006	NA	5.0E+6	2.5E+6 (X)	ID	NLV	NLV	NLV	NLV	ID	5.0E+5 (F)	NA
Chlorobenzene (I)	108907	NA	2,000	940	2.6E+5 (C)	1.2E+5	7.7E+5	9.9E+5	2.1E+6	4.7E+9	2.6E+5 (C)	2.6E+5
1-Chloro-1,1-difluoroethane	75683	NA	3.0E+5	NA	9.6E+5 (C)	9.6E+5 (C)	7.9E+7	ID	ID	3.3E+12	9.6E+5 (C)	9.6E+5
Chloroethane	75003	NA	8,600	ID	9.5E+5 (C)	9.5E+5 (C)	3.0E+7	1.2E+8	2.8E+8	6.7E+11	9.5E+5 (C)	9.5E+5
2-Chloroethyl vinyl ether	110758	NA	ID	NA	ID	ID	ID	ID	ID	ID	ID	1.9E+6
Chloroform	67663	NA	2,000 (W)	3,400 (X)	1.5E+6 (C)	7,200	45,000	1.2E+5	2.7E+5	1.3E+9	1.2E+6	1.5E+6
Chloromethane (I)	74873	NA	5,200	ID	1.1E+6 (C)	2,300	40,000	4.1E+5	1.0E+6	4.9E+9	1.1E+6 (C)	1.1E+6
4-Chloro-3-methylphenol	59507	NA	5,800	NA	3.0E+6	NLV	NLV	NLV	NLV	ID	4.5E+6	NA
beta-Chloronaphthalene	91587	NA	6.2E+5	NA	2.3E+6	ID	ID	ID	ID	ID	5.6E+7	NA
2-Chlorophenol	95578	NA	900	440	1.9E+6	ID	ID	ID	ID	ID	1.4E+6	1.9E+7
o-Chlorotoluene (I)	95498	NA	3,300	NA	5.0E+5 (C)	5.0E+5 (C)	ID	ID	ID	1.7E+11	5.0E+5 (C)	5.0E+5
Chlorpyrifos	2921882	NA	17,000	NA	8.4E+5	130	4,600	ID	ID	1.3E+8	1.1E+7	NA
Chromium (III) (B,H)	16065831	18,000 (total)	1.0E+9 (D)	(G,X)	1.0E+9 (D)	NLV	NLV	NLV	NLV	3.3E+8	7.9E+8	NA
Chromium (VI)	18540299	18,000 (total)	30,000	3,300	1.4E+8	NLV	NLV	NLV	NLV	2.6E+5	2.5E+6	NA
Chrysene (Q)	218019	NA	NLL	NLL	NLL	ID	ID	ID	ID	ID	2.0E+6	NA
Cobalt	7440484	6,800	800	2,000	4.8E+7	NLV	NLV	NLV	NLV	1.3E+7	2.6E+6	NA
Copper	7440508	32,000	5.8E+6	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	1.3E+8	2.0E+7	NA
Cyanazine	21725462	NA	500 (M)	1,100 (X)	58,000	NLV	NLV	NLV	NLV	ID	14,000	NA
Cyanide (R)	57125	390 (Total)	4,000 (P)	400 (P)	2.5E+5 (P)	NLV	NLV	NLV	NLV	2.5E+5 (P)	12,000 (P)	NA
Cyclohexanone	108941	NA	5.2E+6	NA	2.2E+8 (C)	17,000	1.0E+6	ID	ID	6.7E+10	2.2E+8 (C)	2.2E+8
Dacthal	1861321	NA	50,000	NA	3.4E+5	NLV	NLV	NLV	NLV	ID	2.3E+6	NA

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			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number →		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria	Groundwater Surface Water Interface Protection Criteria	Groundwater Contact Protection Criteria	Soil Volatilization to Indoor Air Inhalation Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria	Direct Contact Criteria	Soil Saturation Concentration Screening Levels
Dalapon	75990	NA	4,000	NA	5.9E+7 (C)	NLV	NLV	NLV	NLV	ID	1.9E+7	5.9E+7
4-4 -DDD	72548	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	4.4E+7	95,000	NA
4-4 -DDE	72559	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	3.2E+7	45,000	NA
4-4 -DDT	50293	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	3.2E+7	57,000	NA
Decabromodiphenyl ether	1163195	NA	1.4E+5	NA	1.4E+5	1.0E+9 (D)	8.6E+7	ID	ID	2.3E+9	3.8E+6	NA
Di-n-butyl phthalate	84742	NA	7.6E+5 (C)	11,000	7.6E+5 (C)	NLV	NLV	NLV	NLV	3.3E+9	7.6E+5 (C)	7.6E+5
Di(2-ethylhexyl) adipate	103231	NA	9.6E+5 (C)	NA	9.6E+5 (C)	NLV	NLV	NLV	NLV	9.2E+9	9.6E+5 (C,AD)	9.6E+5
Di-n-octyl phthalate	117840	NA	1.0E+8	ID	1.4E+8 (C)	NLV	NLV	NLV	NLV	ID	8.9E+8	1.4E+8
Diacetone alcohol (I)	123422	NA	ID	NA	ID	NLV	NLV	NLV	NLV	1.6E+11	ID	1.1E+8
Diazinon	333415	NA	95	NA	95,000	NLV	NLV	NLV	NLV	ID	12,000 (AD)	3.1E+5
Dibenzo(a,h)anthracene (Q)	53703	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	2,000	NA
Dibenzofuran	132649	NA	ID	1,700	ID	ID	ID	ID	ID	ID	ID	NA
Dibromochloromethane	124481	NA	2,000 (W)	ID	3.6E+5	3,900	24,000	24,000	33,000	1.3E+8	1.1E+5	6.1E+5
Dibromochloropropane	96128	NA	4.0	NA	1,200 (C)	1,200 (C)	13,000	ID	ID	1.3E+7	1,200 (C)	1,200
Dibromomethane	74953	NA	1,600	NA	2.0E+6 (C)	ID	ID	ID	ID	ID	2.0E+6 (C)	2.0E+6
1,2-Dichlorobenzene	95501	NA	14,000	360	2.1E+5 (C)	2.1E+5 (C)	3.9E+7	3.9E+7	5.2E+7	1.0E+11	2.1E+5 (C)	2.1E+5
1,3-Dichlorobenzene	541731	NA	170	1,100	51,000	ID	ID	ID	ID	ID	1.7E+5 (C)	1.7E+5
1,4-Dichlorobenzene	106467	NA	1,700	290	1.4E+5	19,000	77,000	77,000	1.1E+5	4.5E+8	4.0E+5	NA
3,3 -Dichlorobenzidine	91941	NA	2,000 (M)	2,000 (M,X)	4,600	NLV	NLV	NLV	NLV	6.5E+6	6,600	NA
Dichlorodifluoromethane	75718	NA	95,000	ID	1.0E+6 (C)	9.0E+5	5.3E+7	5.5E+8	1.4E+9	3.3E+12	1.0E+6 (C)	1.0E+6
1,1-Dichloroethane	75343	NA	18,000	ID	8.9E+5 (C)	2.3E+5	2.1E+6	5.9E+6	1.4E+7	3.3E+10	8.9E+5 (C)	8.9E+5
1,2-Dichloroethane (I)	107062	NA	100	7,200 (X)	3.8E+5	2,100	6,200	11,000	26,000	1.2E+8	91,000	1.2E+6
1,1-Dichloroethylene (I)	75354	NA	140	1,300 (X)	2.2E+5	62	1,100	5,300	13,000	6.2E+7	2.0E+5	5.7E+5
cis-1,2-Dichloroethylene	156592	NA	1,400	ID	6.4E+5 (C)	23,000	1.8E+5	4.2E+5	9.9E+5	2.3E+9	6.4E+5 (C)	6.4E+5
trans-1,2-Dichloroethylene	156605	NA	2,000	ID	1.4E+6 (C)	23,000	2.8E+5	6.3E+5	2.0E+6	4.7E+9	1.4E+6 (C)	1.4E+6
2,6-Dichloro-4-nitroaniline	99309	NA	44,000	NA	1.4E+5	NLV	NLV	NLV	NLV	ID	6.8E+7	NA
2,4-Dichlorophenol	120832	NA	1,500	380	9.6E+5	NLV	NLV	NLV	NLV	5.1E+9	6.6E+5 (AD)	1.6E+6
2,4-Dichlorophenoxyacetic acid	94757	NA	1,400	4,400	2.4E+6	NLV	NLV	NLV	NLV	6.7E+9	2.5E+6	NA
1,2-Dichloropropane (I)	78875	NA	100	5,800 (X)	3.2E+5	4,000	25,000	50,000	1.1E+5	2.7E+8	1.4E+5	5.5E+5
1,3-Dichloropropene	542756	NA	420	NA	2.8E+5	10 (M)	10 (M)	35	83	4.0E+5	1.3E+5	6.2E+5
Dichlorovos	62737	NA	50 (M)	NA	1.2E+5	NLV	NLV	NLV	NLV	3.3E+7	10,000	2.2E+6
Dicyclohexyl phthalate	84617	NA	ID	NA	ID	ID	ID	ID	ID	ID	ID	NA

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			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number →		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria	Groundwater Surface Water Interface Protection Criteria	Groundwater Contact Protection Criteria	Soil Volatilization to Indoor Air Inhalation Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria	Direct Contact Criteria	Soil Saturation Concentration Screening Levels
Dieldrin	60571	NA	NLL	NLL	NLL	1.4E+5	19,000	19,000	19,000	6.8E+5	1,100	NA
Diethyl ether	60297	NA	200	ID	7.4E+6 (C)	7.4E+6 (C)	8.5E+7	1.5E+8	3.4E+8	8.0E+11	7.4E+6 (C)	7.4E+6
Diethyl phthalate	84662	NA	1.1E+5	NA	7.4E+5 (C)	NLV	NLV	NLV	NLV	3.3E+9	7.4E+5 (C)	7.4E+5
Diethylene glycol monobutyl ether	112345	NA	1,800	NA	8.0E+7	NLV	NLV	NLV	NLV	1.3E+9	2.7E+6	1.1E+8
Diisopropyl ether	108203	NA	600	NA	1,300 (C)	ID	ID	ID	ID	ID	1,300 (C)	1,300
Diisopropylamine (I)	108189	NA	110	NA	4.2E+5	ID	ID	ID	ID	ID	1.7E+5	6.7E+6
Dimethyl phthalate	131113	NA	7.9E+5 (C)	NA	7.9E+5 (C)	NLV	NLV	NLV	NLV	3.3E+9	7.9E+5 (C)	7.9E+5
N,N-Dimethylacetamide	127195	NA	3,600	82,000 (X)	1.1E+8 (C)	NLV	NLV	NLV	NLV	ID	5.6E+6	1.1E+8
N,N-Dimethylaniline	121697	NA	320	NA	4.0E+5	1.7E+5	1.5E+5	ID	ID	2.6E+8	5.0E+5	8.0E+5
Dimethylformamide (I)	68122	NA	14,000	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	2.0E+9	2.2E+7	1.1E+8
2,4-Dimethylphenol	105679	NA	7,400	7,600	1.0E+7	NLV	NLV	NLV	NLV	4.7E+9	1.1E+7	NA
2,6-Dimethylphenol	576261	NA	330 (M)	NA	1.3E+5	NLV	NLV	NLV	NLV	ID	1.4E+5	NA
3,4-Dimethylphenol	95658	NA	330 (M)	NA	3.6E+5	NLV	NLV	NLV	NLV	ID	3.2E+5	NA
Dimethylsulfoxide	67685	NA	4.4E+6	3.8E+6	1.8E+7 (C)	NLV	NLV	NLV	NLV	ID	1.8E+7 (C)	1.8E+7
2,4-Dinitrotoluene	121142	NA	430	NA	1.7E+5	NLV	NLV	NLV	NLV	1.6E+7	48,000	NA
Dinoseb	88857	NA	300	NA	1.4E+5 (C)	ID	ID	ID	ID	ID	66,000 (AD)	1.4E+5
1,4-Dioxane (I)	123911	NA	1,700	56,000	3.4E+7	NLV	NLV	NLV	NLV	5.7E+8	5.3E+5	9.7E+7
Diquat	85007	NA	400	NA	1.4E+7	NLV	NLV	NLV	NLV	ID	5.0E+5	NA
Diuron	330541	NA	620	NA	7.4E+5	NLV	NLV	NLV	NLV	4.7E+8	9.7E+5	NA
Endosulfan (J)	115297	NA	NLL	NLL	NLL	ID	ID	ID	ID	ID	1.4E+6	NA
Endothall	145733	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	2.3E+9	3.8E+6	NA
Endrin	72208	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	65,000	NA
Epichlorohydrin (I)	106898	NA	100	NA	2.2E+5	64,000	31,000	31,000	35,000	6.7E+7	8,900	7.3E+6
Ethanol (I)	64175	NA	3.8E+7	IP	1.1E+8 (C)	NLV	NLV	NLV	NLV	1.3E+12	1.1E+8 (C,AD)	1.1E+8
Ethyl acetate (I)	141786	NA	1.3E+5	NA	7.5E+6 (C)	7.5E+6 (C)	4.9E+7	4.9E+7	9.8E+7	2.1E+11	7.5E+6 (C)	7.5E+6
Ethylbenzene (I)	100414	NA	1,500	360	1.4E+5 (C)	1.4E+5 (C)	9.5E+6	1.4E+7	3.0E+7	6.7E+10	1.4E+5 (C)	1.4E+5
Ethylene dibromide	106934	NA	10 (M)	20	500	670	1,700	1,700	3,300	1.4E+7	92	8.9E+5
Ethylene glycol	107211	NA	3.0E+5	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	6.7E+10	1.1E+8 (C)	1.1E+8
Ethylene glycol monobutyl ether	111762	NA	74,000	NA	4.1E+7 (C)	7.4E+5	1.8E+7	1.5E+8	3.6E+8	8.7E+11	4.1E+7 (C)	4.1E+7
Fluoranthene	206440	NA	7.3E+5	5,500	7.3E+5	1.0E+9 (D)	7.4E+8	7.4E+8	7.4E+8	9.3E+9	4.6E+7	NA
Fluorene	86737	NA	3.9E+5	5,300	8.9E+5	5.8E+8	1.3E+8	1.3E+8	1.3E+8	9.3E+9	2.7E+7	NA
Fluorine (soluble fluoride) (B)	7782414	NA	40,000	NA	2.4E+8	NLV	NLV	NLV	NLV	ID	9.0E+6 (AD)	NA

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			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number →		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria	Groundwater Surface Water Interface Protection Criteria	Groundwater Contact Protection Criteria	Soil Volatilization to Indoor Air Inhalation Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria	Direct Contact Criteria	Soil Saturation Concentration Screening Levels
Formaldehyde	50000	NA	26,000	2,400	6.0E+7 (C)	12,000	13,000	23,000	52,000	2.4E+8	4.1E+7	6.0E+7
Formic acid (I,U)	64186	NA	9.0E+5 (M)	ID	1.1E+8 (C)	1.5E+6	9.0E+5 (M)	9.0E+5 (M)	9.0E+5 (M)	1.3E+8	1.1E+6 (C)	1.1E+8
1-Formylpiperidine	2591868	NA	1,600	NA	ID	ID	ID	ID	ID	ID	2.5E+6	1.0E+7
Gentian violet	548629	NA	300	NA	2.0E+7	NLV	NLV	NLV	NLV	ID	96,000	NA
Glyphosate	1071836	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	1.1E+7 (AD)	NA
Heptachlor	76448	NA	NLL	NLL	NLL	3.5E+5	62,000	62,000	62,000	2.4E+6	5,600	NA
Heptachlor epoxide	1024573	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.2E+6	3,100	NA
n-Heptane	142825	NA	2.4E+5 (C)	NA	2.4E+5 (C)	2.4E+5 (C)	2.1E+7	ID	ID	2.3E+11	2.4E+5 (C)	2.4E+5
Hexabromobenzene	87821	NA	3.2E+5	ID	3.2E+5	ID	ID	ID	ID	ID	1.1E+6	NA
Hexachlorobenzene (C-66)	118741	NA	1,800	ID	8,200	41,000	17,000	17,000	17,000	6.8E+6	8,900	NA
Hexachlorobutadiene (C-46)	87683	NA	26,000	330 (M)	3.5E+5 (C)	1.3E+5	1.3E+5	1.3E+5	1.3E+5	1.4E+8	1.0E+5	3.5E+5
alpha-Hexachlorocyclohexane	319846	NA	18	NA	2,500	30,000	12,000	22,000	25,000	1.7E+6	2,600	NA
beta-Hexachlorocyclohexane	319857	NA	37	NA	5,100	NLV	NLV	NLV	NLV	5.9E+6	5,400	NA
Hexachlorocyclopentadiene (C-56)	77474	NA	3.2E+5	ID	7.2E+5 (C)	ID	ID	ID	ID	ID	7.2E+5 (C)	7.2E+5
Hexachloroethane	67721	NA	430	1,800 (X)	1.1E+5	40,000	5.5E+5	9.3E+5	9.3E+5	2.3E+8	2.3E+5	NA
n-Hexane	110543	NA	44,000 (C)	NA	44,000 (C)	44,000 (C)	3.0E+6	ID	ID	1.3E+10	44,000 (C)	44,000
2-Hexanone	591786	NA	20,000	NA	2.5E+6 (C)	9.9E+5	1.1E+6	ID	ID	2.7E+9	2.5E+6 (C)	2.5E+6
Indeno(1,2,3-cd)pyrene (Q)	193395	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	20,000	NA
Iron (B)	7439896	1.2E+7	6,000	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	1.6E+8	NA
Isobutyl alcohol (I)	78831	NA	46,000	NA	8.9E+6 (C)	8.9E+6 (C)	7.9E+7	7.9E+7	7.9E+7	1.0E+11	8.9E+6 (C)	8.9E+6
Isophorone	78591	NA	15,000	11,000 (X)	2.4E+6 (C)	NLV	NLV	NLV	NLV	1.2E+10	2.4E+6 (C)	2.4E+6
Isopropyl alcohol (I)	67630	NA	9,400	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	1.5E+10	1.4E+7	1.1E+8
Isopropyl benzene	98828	NA	91,000	ID	3.9E+5 (C)	3.9E+5 (C)	1.7E+8	ID	ID	5.8E+9	3.9E+5 (C)	3.9E+5
Lead	7439921	21,000	7.0E+5	(G,M,X)	ID	NLV	NLV	NLV	NLV	1.0E+8	4.0E+5	NA
Lindane	58899	NA	20 (M)	20 (M)	7,100	ID	ID	ID	ID	ID	8,300	NA
Lithium (B)	7439932	9,800	3,400	500	1.1E+8	NLV	NLV	NLV	NLV	ID	4.2E+6 (AD)	NA
Magnesium (B)	7439954	NA	8.0E+6	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	6.7E+9	1.0E+9 (D)	NA
Manganese (B)	7439965	4.4E+5	1,000	(G,X)	1.8E+8	NLV	NLV	NLV	NLV	3.3E+6	2.5E+7	NA
Mercury (Inorganic)	7439976	130	1,700	100 (M)	47,000	NLV	NLV	NLV	NLV	ID	1.6E+5	NA
Methane	74828	NA	ID	ID	ID	(K)	ID	ID	ID	ID	ID	ID
Methanol	67561	NA	74,000	9,600	3.1E+6 (C)	5.0E+5	3.1E+7	4.4E+7	9.6E+7	2.2E+11	3.1E+6 (C)	3.1E+6
Methoxychlor	72435	NA	16,000	NA	18,000	ID	ID	ID	ID	ID	1.9E+6	NA

ATTACHMENT A
SOIL: RESIDENTIAL AND COMMERCIAL I
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS

			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number →		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria	Groundwater Surface Water Interface Protection Criteria	Groundwater Contact Protection Criteria	Soil Volatilization to Indoor Air Inhalation Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria	Direct Contact Criteria	Soil Saturation Concentration Screening Levels
2-Methoxyethanol (I)	109864	NA	150	NA	1.7E+7	NLV	NLV	NLV	NLV	1.3E+9	2.3E+5	1.1E+8
2-Methyl-4-chlorophenoxyacetic acid	94746	NA	390	NA	4.9E+5	NLV	NLV	NLV	NLV	ID	2.3E+5	NA
2-Methyl-4,6-dinitrophenol	534521	NA	1,700 (M)	NA	1.9E+5	NLV	NLV	NLV	NLV	ID	79,000	NA
Methyl parathion	298000	NA	46	NA	76,000	NLV	NLV	NLV	NLV	ID	56,000	NA
4-Methyl-2-pentanone (MIBK) (I)	108101	NA	36,000	ID	2.7E+6 (C)	2.7E+6 (C)	4.5E+7	4.5E+7	6.7E+7	1.4E+11	2.7E+6 (C)	2.7E+6
Methyl-tert-butyl ether (MTBE)	1634044	NA	800	15,000 (X)	5.9E+6 (C)	5.9E+6 (C)	2.5E+7	3.9E+7	6.7E+7	2.0E+11	1.8E+6	5.9E+6
N-Methyl-morpholine (I)	109024	NA	400	NA	3.0E+7	NLV	NLV	NLV	NLV	ID	6.1E+5	1.1E+8
Methylcyclopentane (I)	96377	NA	ID	NA	ID	ID	ID	ID	ID	ID	ID	3.5E+5
4,4-Methylene-bis-2-chloroaniline (MBOCA)	101144	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	8.4E+7	6,800	NA
Methylene chloride	75092	NA	100	19,000 (X)	2.3E+6 (C)	45,000	2.1E+5	5.9E+5	1.4E+6	6.6E+9	1.3E+6	2.3E+6
2-Methylnaphthalene	91576	NA	57,000	ID	5.5E+6	ID	ID	ID	ID	ID	8.1E+6	NA
Methylphenols (J)	1319773	NA	7,400	1,400	1.6E+7	NLV	NLV	NLV	NLV	6.7E+9	1.1E+7	NA
Metolachlor	51218452	NA	4,800	NA	4.4E+5 (C)	NLV	NLV	NLV	NLV	ID	4.4E+5 (C,AD)	4.4E+5
Mirex	2385855	NA	NLL	NLL	NLL	ID	ID	ID	ID	ID	9,600	NA
Molybdenum (B)	7439987	NA	740	16,000 (X)	1.9E+7	NLV	NLV	NLV	NLV	ID	2.6E+6	NA
Naphthalene	91203	NA	35,000	870	2.1E+6	2.5E+5	3.0E+5	3.0E+5	3.0E+5	2.0E+8	1.6E+7	NA
Nickel (B)	7440020	20,000	1.0E+5	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	1.3E+7	4.0E+7	NA
Nitrate (B,N)	14797558	NA	2.0E+5 (N)	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	ID	NA
Nitrite (B,N)	14797650	NA	20,000 (N)	NA	3.8E+8	NLV	NLV	NLV	NLV	ID	ID	NA
Nitrobenzene (I)	98953	NA	330 (M)	3,600 (X)	2.2E+5	4.9E+5 (C)	3.9E+6	3.9E+6	3.9E+6	3.3E+9	1.0E+5	4.9E+5
2-Nitrophenol	88755	NA	400	ID	1.6E+6	NLV	NLV	NLV	NLV	ID	6.3E+5	NA
n-Nitroso-di-n-propylamine	621647	NA	330 (M)	NA	7,200	NLV	NLV	NLV	NLV	1.6E+6	1,200	1.5E+6
N-Nitrosodiphenylamine	86306	NA	5,400	NA	7.0E+5	NLV	NLV	NLV	NLV	ID	1.7E+6	NA
Oxamyl	23135220	NA	4,000	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	8.6E+6	NA
Oxo-hexyl acetate	88230357	NA	1,500	NA	ID	ID	ID	ID	ID	5.4E+9	2.3E+6	1.0E+7
Pendimethalin	40487421	NA	1.1E+6	NA	1.1E+6	NLV	NLV	NLV	NLV	ID	4.6E+7	NA
Pentachlorobenzene	608935	NA	29,000	NA	1.9E+5 (C)	ID	ID	ID	ID	ID	1.9E+5 (C)	1.9E+5
Pentachloronitrobenzene	82688	NA	37,000	NA	37,000	1.2E+5	2.3E+5	2.3E+5	2.3E+5	3.3E+8	1.7E+6	NA
Pentachlorophenol	87865	NA	22	(G,X)	4,300	NLV	NLV	NLV	NLV	1.0E+8	90,000	NA
Pentane	109660	NA	ID	NA	ID	2.4E+5 (C)	3.7E+7	ID	ID	1.2E+12	ID	2.4E+5
2-Pentene (I)	109682	NA	ID	NA	ID	ID	ID	ID	ID	ID	ID	2.2E+5
Phenanthrene	85018	NA	56,000	2,300	1.1E+6	1.8E+6	9,300	31,000	31,000	6.7E+6	1.6E+6	NA

ATTACHMENT A
SOIL: RESIDENTIAL AND COMMERCIAL I
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS

			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number →		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria	Groundwater Surface Water Interface Protection Criteria	Groundwater Contact Protection Criteria	Soil Volatilization to Indoor Air Inhalation Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria	Direct Contact Criteria	Soil Saturation Concentration Screening Levels
Phenol	108952	NA	88,000	4,200	1.2E+7 (C)	NLV	NLV	NLV	NLV	4.0E+10	1.2E+7 (C,AD)	1.2E+7
Phosphorus (total)	7723140	NA	1.3E+6	NA	ID	NLV	NLV	NLV	NLV	ID	1.0E+9 (D)	NA
Phthalic acid	88993	NA	2.8E+5	NA	1.7E+6 (C)	NLV	NLV	NLV	NLV	ID	1.7E+6 (C)	1.7E+6
Phthalic anhydride	85449	NA	3.0E+5	NA	1.1E+6 (C)	NLV	NLV	NLV	NLV	ID	1.1E+6 (C)	1.1E+6
Picloram	1918021	NA	10,000	NA	8.6E+6	NLV	NLV	NLV	NLV	ID	1.6E+7	NA
Pipendine	110894	NA	64	NA	6.8E+5	NLV	NLV	NLV	NLV	9.3E+9	99,000	1.2E+8
Polybrominated biphenyls (J)	67774327	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	1,200	NA
Polychlorinated biphenyls (PCBs) (J,T)	1336363	NA	NLL	NLL	NLL	3.0E+6	2.4E+5	7.9E+6	7.9E+6	5.2E+6	(T)	NA
Prometon	1610180	NA	4,900	NA	5.5E+6	NLV	NLV	NLV	NLV	ID	5.0E+6	NA
Propachlor	1918167	NA	1,900	NA	8.8E+6	NLV	NLV	NLV	NLV	ID	2.9E+6	NA
Propazine	139402	NA	4,000	NA	1.7E+5	NLV	NLV	NLV	NLV	ID	6.1E+6	NA
Propionic acid	79094	NA	2.4E+5	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	2.0E+10	1.1E+8 (C)	1.1E+8
Propyl alcohol (I)	71238	NA	28,000	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	4.9E+10	1.3E+7 (AD)	1.1E+8
n-Propylbenzene (I)	103651	NA	1,600	NA	3.0E+5	ID	ID	ID	ID	1.3E+9	2.5E+6	1.0E+7
Propylene glycol	57556	NA	3.0E+6	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	4.0E+11	1.1E+8 (C)	1.1E+8
Pyrene	129000	NA	4.8E+5	ID	4.8E+5	1.0E+9 (D)	6.5E+8	6.5E+8	6.5E+8	8.7E+9	2.9E+7	NA
Pyridine (I)	110861	NA	330 (M)	NA	37,000 (C)	1,100	8,200	40,000	97,000	2.3E+8	37,000 (C)	37,000
Selenium (B)	7782492	410	4,000	400	7.8E+7	NLV	NLV	NLV	NLV	1.3E+8	2.6E+6	NA
Silver (B)	7440224	1,000	4,500	500 (M)	2.0E+6	NLV	NLV	NLV	NLV	6.7E+6	2.5E+6	NA
Silvex (2,4,5-TP)	93721	NA	3,600	NA	3.1E+6	NLV	NLV	NLV	NLV	ID	1.7E+6	NA
Simazine	122349	NA	80	NA	90,000	NLV	NLV	NLV	NLV	ID	1.2E+6	NA

ATTACHMENT A
SOIL: RESIDENTIAL AND COMMERCIAL I
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS

			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number →		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria	Groundwater Surface Water Interface Protection Criteria	Groundwater Contact Protection Criteria	Soil Volatilization to Indoor Air Inhalation Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria	Direct Contact Criteria	Soil Saturation Concentration Screening Levels
Sodium	7440235	NA	2.5E+6	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	1.0E+9 (D)	NA
Strontium (B)	7440246	NA	92,000	15,000	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	3.3E+8	NA
Styrene	100425	NA	2,700	2,200	2.7E+5	2.5E+5	9.7E+5	9.7E+5	1.4E+6	5.5E+9	4.0E+5	5.2E+5
Sulfate	14808798	NA	5.0E+6	NA	ID	NLV	NLV	NLV	NLV	ID	ID	NA
Tebuthiuron	34014181	NA	10,000	NA	5.0E+7	NLV	NLV	NLV	NLV	ID	4.6E+6 (AD)	NA
2,3,7,8-Tetrabromodibenzo-p-dioxin (O)	50585416	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	(O)	(O)	NA
1,2,4,5-Tetrachlorobenzene	95943	NA	1.5E+6	3,400 (X)	1.5E+6	ID	ID	ID	ID	ID	7.7E+7	NA
2,3,7,8-Tetrachlorodibenzo-p-dioxin (O)	1746016	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	71 (O)	0.09 (O)	NA
1,1,1,2-Tetrachloroethane	630206	NA	1,500	NA	4.4E+5 (C)	6,200	36,000	54,000	1.0E+5	4.2E+8	4.4E+5 (C)	4.4E+5
1,1,2,2-Tetrachloroethane	79345	NA	170	1,600 (X)	94,000	4,300	10,000	10,000	14,000	5.4E+7	53,000	8.7E+5
Tetrachloroethylene	127184	NA	100	900 (X)	88,000 (C)	11,000	1.8E+5	4.8E+5	1.1E+6	5.4E+9	88,000 (C)	88,000
Tetrahydrofuran	109999	NA	1,900	2.2E+5 (X)	3.2E+7	1.3E+6	1.3E+7	ID	ID	3.9E+11	2.9E+8	1.2E+8
Thallium (B)	7440280	NA	2,300	4,200 (X)	1.5E+7	NLV	NLV	NLV	NLV	ID	35,000	NA
Toluene (I)	108883	NA	16,000	2,800	2.5E+5 (C)	2.5E+5 (C)	2.8E+6	5.1E+6	1.2E+7	2.7E+10	2.5E+5 (C)	2.5E+5
p-Toluidine	106490	NA	660 (M)	NA	4.8E+5	NLV	NLV	NLV	NLV	1.0E+8	94,000	1.2E+6
Toxaphene	8001352	NA	24,000	860	3.6E+5	NLV	NLV	NLV	NLV	9.7E+6	20,000	NA
Thallate	2303175	NA	95,000	NA	2.5E+5 (C)	ID	ID	ID	ID	ID	2.5E+5 (C)	2.5E+5
Tributylamine	102829	NA	7,800	ID	1.8E+6	5.8E+5	6.0E+5	ID	ID	4.7E+8	7.9E+5	3.7E+6
1,2,4-Trichlorobenzene	120821	NA	4,200	1,800	1.1E+6	1.1E+6 (C)	2.8E+7	2.8E+7	2.8E+7	2.5E+10	9.9E+5 (AD)	1.1E+6
1,1,1-Trichloroethane	71556	NA	4,000	4,000	4.6E+5 (C)	2.5E+5	3.8E+6	1.2E+7	2.8E+7	6.7E+10	4.6E+5 (C)	4.6E+5
1,1,2-Trichloroethane	79005	NA	100	6,600 (X)	4.2E+5	4,600	17,000	21,000	44,000	1.9E+8	1.8E+5	9.2E+5
Trichloroethylene	79016	NA	100	4,000 (X)	5.0E+5 (C)	7,100	78,000	1.7E+5	3.9E+5	1.8E+9	5.0E+5 (C)	5.0E+5
Trichlorofluoromethane	75694	NA	52,000	NA	5.6E+5 (C)	5.6E+5 (C)	9.2E+7	6.3E+8	1.5E+9	3.8E+12	5.6E+5 (C)	5.6E+5
2,4,5-Trichlorophenol	95954	NA	39,000	NA	9.1E+6	NLV	NLV	NLV	NLV	2.3E+10	2.3E+7	NA
2,4,6-Trichlorophenol	88062	NA	2,400	330 (M)	2.0E+5	NLV	NLV	NLV	NLV	1.0E+9	7.1E+5	NA
1,2,3-Trichloropropane	96184	NA	840	NA	8.3E+5 (C)	ID	ID	ID	ID	ID	8.3E+5 (C)	8.3E+5
1,1,2-Trichloro-1,2,2-trifluoroethane	76131	NA	5.5E+5 (C)	NA	5.5E+5 (C)	5.5E+5 (C)	1.8E+8	8.8E+8	2.1E+9	5.1E+12	5.5E+5 (C)	5.5E+5
Triethanolamine	102716	NA	74,000	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	3.3E+9	1.1E+8	1.1E+8
Triethylene glycol	112276	NA	2.0E+5	NA	1.1E+5 (C)	NLV	NLV	NLV	NLV	ID	1.1E+5 (C,AD)	1.1E+5
3-Trifluoromethyl-4-nitrophenol	88302	NA	1.1E+5	NA	1.2E+8	NLV	NLV	NLV	NLV	ID	4.1E+7 (AD)	NA
Trifluralin	1582098	NA	1.9E+5	NA	1.2E+7	ID	ID	ID	ID	ID	2.0E+6	NA
2,2,4-Trimethyl pentane	540841	NA	ID	NA	ID	ID	ID	ID	ID	ID	ID	19,000

ATTACHMENT A
SOIL: RESIDENTIAL AND COMMERCIAL I
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS

			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number →		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria	Groundwater Surface Water Interface Protection Criteria	Groundwater Contact Protection Criteria	Soil Volatilization to Indoor Air Inhalation Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria	Direct Contact Criteria	Soil Saturation Concentration Screening Levels
2,4,4-Trimethyl-2-pentene (I)	107404	NA	ID	NA	ID	ID	ID	ID	ID	ID	ID	56,000
1,2,4-Trimethylbenzene (I)	95636	NA	2,100	ID	1.1E+5 (C)	1.1E+5 (C)	2.1E+7	5.0E+8	5.0E+8	8.2E+10	1.1E+5 (C)	1.1E+5
1,3,5-Trimethylbenzene (I)	108678	NA	1,800	ID	94,000 (C)	94,000 (C)	1.6E+7	3.6E+8	3.8E+8	8.2E+10	94,000 (C)	94,000
Triphenyl phosphate	115866	NA	1.1E+5 (C)	NA	1.1E+5 (C)	ID	ID	ID	ID	ID	1.1E+5 (C)	1.1E+5
tris(2,3-Dibromopropyl)phosphate	126727	NA	66	NA	27,000 (C)	27,000 (C)	18,000	18,000	18,000	5.9E+6	4,400	27,000
Urea	57136	NA	ID (N)	NA	ID	NLV	NLV	NLV	NLV	ID	ID	NA
Vanadium	7440622	NA	72,000	1.9E+5	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	7.5E+5	NA
Vinyl acetate (I)	108054	NA	13,000	NA	2.4E+6 (C)	7.9E+5	1.7E+6	2.6E+8	5.8E+6	1.3E+10	2.4E+6 (C,AD)	2.4E+6
Vinyl chloride	75014	NA	40	300	11,000	28	440	3,100	7,600	3.7E+7	4,000	4.9E+5
White phosphorus (R)	12185103	NA	2.2	NA	58,000	NLV	NLV	NLV	NLV	ID	2,300 (AD)	NA
Xylenes (I)	1330207	NA	5,600	700	1.5E+5 (C)	1.5E+5 (C)	4.6E+7	6.1E+7	1.3E+8	2.9E+11	1.5E+5 (C)	1.5E+5
Zinc (B)	7440666	47,000	2.4E+6	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	1.7E+8	NA

ATTACHMENT A
SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS

Developed under the authority of the
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION ACT, 1994 PA 451, AS AMENDED

Soil criteria were calculated using currently available chemical-specific data and U.S. Environmental Protection Agency risk assessment guidance. Criteria may change for the next annual revision of the criteria tables. All criteria are expressed in units of parts per billion (ppb;ug/Kg). Scientific notation is represented by E+ or E- a value; for example, 2 x 10^6 is reported as 2.0E+6. Analytical results must be expressed as dry-weight concentrations for comparison to criteria. Please refer to Operational Memorandum #6 for recommended analytical methods and target detection limits.

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number ➤		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria	Industrial and Commercial Drinking Water Protection Criteria	Groundwater Surface Water Interface Protection Criteria	Groundwater Contact Protection Criteria	Soil Volatilization to Indoor Air Inhalation Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
Acenaphthene	83329	NA	3.0E+5	8.8E+5	4,400	9.7E+5	3.5E+8	9.7E+7	9.7E+7	9.7E+7	6.2E+9	2.0E+8	3.6E+8	2.6E+8	NA
Acenaphthylene	208968	NA	5,900	17,000	ID	4.4E+5	3.0E+6	2.7E+6	2.7E+6	2.7E+6	1.0E+9	8.0E+6	1.4E+7	1.0E+7	NA
Acetaldehyde (I)	75070	NA	19,000	54,000	NA	1.1E+8 (C)	4.0E+5	2.1E+5	2.1E+5	2.9E+5	2.6E+8	1.1E+8 (C)	1.1E+8 (C)	1.1E+8 (C)	1.1E+8
Acetic acid	64197	NA	9.0E+5 (M)	9.0E+5 (M)	9.0E+5 (M)	6.5E+8 (C)	NLV	NLV	NLV	NLV	7.4E+9	6.4E+8	6.5E+8 (C)	6.5E+8 (C)	6.5E+8
Acetone (I)	67641	NA	15,000	42,000	34,000	1.1E+8 (C)	1.1E+8 (C)	1.6E+8	1.6E+8	2.0E+8	1.7E+11	1.1E+8	1.1E+8 (C)	1.1E+8 (C)	1.1E+8
Acetonitrile	75058	NA	2,800	8,000	NA	2.2E+7 (C)	8.8E+6	1.9E+6	1.9E+6	2.2E+6	1.8E+9	2.1E+7	2.2E+7 (C)	2.2E+7 (C)	2.2E+7
Acetophenone	98862	NA	30,000	88,000	NA	1.1E+6 (C)	1.1E+6 (C)	5.2E+7	ID	ID	1.4E+10	1.1E+6 (C)	1.1E+6 (C)	1.1E+6 (C)	1.1E+6
Acrolein (I)	107028	NA	2,400	6,600	NA	2.3E+7 (C)	760	370	370	630	5.9E+5	1.8E+7	2.3E+7 (C)	2.3E+7	2.3E+7
Acrylamide	79061	NA	6.0	24	NA	2.6E+5	NLV	NLV	NLV	NLV	3.0E+6	13,000	24,000	17,000	NA
Acrylic acid	79107	NA	78,000	2.2E+5	NA	1.1E+8 (C)	5.5E+6	2.2E+5	2.7E+5	2.7E+5	2.9E+7	1.1E+8 (C,AD)	1.1E+8 (C,AD)	1.1E+8 (C,AD)	1.1E+8
Acrylonitrile (I)	107131	NA	52	220	98 (X)	2.8E+5	35,000	17,000	17,000	31,000	5.8E+7	1.1E+5	2.0E+5	1.5E+5	8.3E+6
Alachlor	15972608	NA	52	52	290 (X)	44,000	NLV	NLV	NLV	NLV	ID	5.3E+5	1.3E+6	7.8E+5	NA
Aldicarb	116063	NA	60	60	NA	2.4E+6	NLV	NLV	NLV	NLV	ID	1.1E+6	2.0E+6	1.5E+6	NA
Aldicarb sulfoxide	1646873	NA	80	80	NA	5.4E+7	NLV	NLV	NLV	NLV	ID	1.5E+6	2.8E+6	1.9E+6	NA
Aldicarb sulfone	1646884	NA	50 (M)	50 (M)	NA	4.2E+7	NLV	NLV	NLV	NLV	ID	1.2E+6	2.2E+6	1.6E+6	NA
Aldrin	309002	NA	NLL	NLL	NLL	NLL	7.1E+6	2.0E+5	2.0E+5	2.0E+5	8.0E+5	5,900	15,000	8,600	NA
Aluminum (B)	7429905	6.9E+6	1,000	1,000	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	6.6E+8 (AD)	8.1E+8 (AD)	7.3E+8 (AD)	NA
Ammonia	7664417	NA	ID (N)	ID (N)	(AC)	ID	ID	ID	ID	ID	2.9E+9	ID	ID	ID	1.0E+7
Aniline	62533	NA	1,700 (M)	4,400	1,700 (M)	2.8E+6	NLV	NLV	NLV	NLV	2.9E+7	2.3E+6	4.2E+6	3.0E+6	4.5E+6
Anthracene	120127	NA	41,000	41,000	ID	41,000	1.0E+9 (D)	1.6E+9	1.6E+9	1.6E+9	2.9E+10	1.0E+9 (D)	1.0E+9 (D)	1.0E+9 (D)	NA
Antimony	7440360	NA	500 (M)	4,300	ID	4.9E+7	NLV	NLV	NLV	NLV	5.9E+6	1.2E+6	1.4E+6	1.3E+6	NA
Arsenic (B)	7440382	5,800	23,000	23,000	70,000 (X)	2.0E+6	NLV	NLV	NLV	NLV	9.1E+5	61,000	90,000	74,000	NA
Asbestos (AB)	1332214	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.0E+7 (M)	ID	ID	ID	NA
Atrazine	1912249	NA	60	60	150 (X)	1.1E+5	NLV	NLV	NLV	NLV	ID	5.0E+5 (AD)	9.0E+5 (AD)	6.6E+5 (AD)	NA
Azobenzene	103333	NA	4,200	17,000	NA	3.0E+5	3.2E+7	2.1E+6	ID	ID	1.3E+8	1.0E+6	1.8E+6	1.3E+6	NA

ATTACHMENT A
SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number →		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria	Industrial and Commercial Drinking Water Protection Criteria	Groundwater Surface Water Interface Protection Criteria	Groundwater Contact Protection Criteria	Soil Volatilization to Indoor Air Inhalation Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
Barium	7440393	75,000	1.3E+6	1.3E+6	(G,X)	1.0E+9 (D)	NLV	NLV	NLV	NLV	1.5E+8	2.5E+8	2.9E+8	2.7E+6	NA
Benzene (I)	71432	NA	100	100	4,000 (X)	2.2E+5	8,400	45,000	99,000	2.3E+5	4.7E+8	4.0E+5 (C)	4.0E+5 (C)	4.0E+5 (C)	4.0E+5
Benzidine	92875	NA	1,000 (M)	1,000 (M)	ID	1,000 (M)	NLV	NLV	NLV	NLV	59,000	1,000 (M)	1,000 (M)	1,000 (M)	NA
Benzo(a)anthracene (Q)	56553	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	1.0E+5	3.0E+5	1.6E+5	NA
Benzo(b)fluoranthene (Q)	205992	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	1.0E+5	3.0E+5	1.6E+5	NA
Benzo(k)fluoranthene (Q)	207089	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	1.0E+8	3.0E+6	1.6E+6	NA
Benzo(g,h,i)perylene	191242	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	3.5E+8	9.1E+6	2.7E+7	1.4E+7	NA
Benzo(a)pyrene (Q)	50328	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.9E+8	10,000	30,000	16,000	NA
Benzoic acid	65850	NA	6.4E+5	1.8E+6	NA	7.0E+7	NLV	NLV	NLV	NLV	ID	1.0E+9 (D)	1.0E+9 (D)	1.0E+9 (D)	NA
Benzyl alcohol	100516	NA	2.0E+5	5.8E+5	NA	5.8E+6 (C)	NLV	NLV	NLV	NLV	1.5E+11	5.8E+6 (C)	5.8E+6 (C)	5.8E+6 (C)	5.8E+6
Benzyl chloride	100447	NA	200 (M)	640	NA	72,000	33,000	48,000	48,000	52,000	7.8E+7	2.3E+5 (C)	2.3E+5 (C)	2.3E+5 (C)	2.3E+5
Beryllium	7440417	NA	51,000	51,000	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	5.9E+5	3.1E+6	3.1E+8	3.1E+6	NA
bis(2-Chloroethoxy)ethane	112265	NA	ID	ID	NA	ID	NLV	NLV	NLV	NLV	ID	ID	ID	ID	2.7E+6
bis(2-Chloroethyl)ether (I)	111444	NA	330 (M)	330 (M)	NA	1.1E+5	44,000	13,000	13,000	13,000	1.2E+7	89,000	1.6E+5	1.2E+5	2.2E+6
bis(2-Ethylhexyl)phthalate	117817	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	8.9E+8	1.0E+7 (C)	1.0E+7 (C)	1.0E+7 (C)	1.0E+7
Boron (B)	7440428	NA	10,000	10,000	38,000	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	6.4E+8 (AD)	7.8E+8 (AD)	7.1E+8 (AD)	NA
Bromobenzene (I)	108861	NA	550	1,500	NA	3.6E+5	5.8E+5	5.4E+5	5.4E+5	5.4E+5	2.4E+8	7.6E+5 (C)	7.6E+5 (C)	7.6E+5 (C)	7.6E+5
Bromodichloromethane	75274	NA	2,000 (W)	2,000 (W)	ID	2.8E+5	6,400	31,000	31,000	57,000	1.1E+8	7.5E+5	1.3E+6	9.7E+5	1.5E+6
Bromoform	75252	NA	2,000 (W)	2,000 (W)	ID	8.7E+5 (C)	7.7E+5	3.1E+6	3.1E+8	3.1E+6	3.6E+9	8.7E+5 (C)	8.7E+5 (C)	8.7E+5 (C)	8.7E+5
Bromomethane	74839	NA	200	580	700	1.4E+8	1,600	13,000	57,000	1.4E+5	1.5E+8	1.6E+6	2.2E+6 (C)	2.0E+6	2.2E+6
n-Butanol (I)	71363	NA	19,000	54,000	NA	8.7E+6 (C)	NLV	NLV	NLV	NLV	1.0E+10	8.7E+6 (C)	8.7E+6 (C)	8.7E+6 (C)	8.7E+6
2-Butanone (MEK) (I)	78933	NA	2.6E+5	7.6E+5	44,000	2.7E+7 (C)	2.7E+7 (C)	3.5E+7	3.5E+7	3.6E+7	2.9E+10	2.7E+7 (C,AD)	2.7E+7 (C,AD)	2.7E+7 (C,AD)	2.7E+7
n-Butyl acetate	123864	NA	11,000	32,000	NA	1.1E+6 (C)	1.1E+6 (C)	1.4E+8	3.1E+8	3.5E+8	2.1E+11	1.1E+6 (C)	1.1E+6 (C)	1.1E+6 (C)	1.1E+6
t-Butyl alcohol	75650	NA	78,000	2.2E+5	NA	1.1E+8 (C)	1.1E+8 (C)	1.2E+8	ID	ID	5.6E+10	1.1E+8 (C)	1.1E+8 (C)	1.1E+8 (C)	1.1E+8
Butyl benzyl phthalate	85687	NA	3.1E+5 (C)	3.1E+5 (C)	26,000 (X)	3.1E+5 (C)	NLV	NLV	NLV	NLV	2.1E+10	3.1E+5 (C)	3.1E+5 (C)	3.1E+5 (C)	3.1E+5
n-Butylbenzene	104518	NA	1,600	4,600	NA	1.2E+5	ID	ID	ID	ID	ID	1.0E+7 (C)	1.0E+7 (C)	1.0E+7 (C)	1.0E+7
sec-Butylbenzene	135988	NA	1,600	4,600	NA	88,000	ID	ID	ID	ID	ID	1.0E+7 (C)	1.0E+7 (C)	1.0E+7 (C)	1.0E+7
tert-Butylbenzene (I)	98066	NA	1,600	4,600	NA	1.8E+5	ID	ID	ID	ID	ID	1.0E+7 (C)	1.0E+7 (C)	1.0E+7 (C)	1.0E+7
Cadmium (B)	7440439	1,200	6,000	6,000	(G,X)	2.3E+8	NLV	NLV	NLV	NLV	2.2E+8	4.1E+8	4.2E+8	4.1E+8	NA
Camphene (I)	79925	NA	ID	ID	NA	ID	ID	ID	ID	ID	ID	ID	ID	ID	NA
Caprolactam	105602	NA	1.2E+5	3.4E+5	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	2.9E+8	4.5E+8 (AD)	9.4E+8 (AD)	6.2E+8 (AD)	NA

ATTACHMENT A
SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number →		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria	Industrial and Commercial Drinking Water Protection Criteria	Groundwater Surface Water Interface Protection Criteria	Groundwater Contact Protection Criteria	Soil Volatilization to Indoor Air Inhalation Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
Carbaryl	63252	NA	14,000	40,000	NA	2.6E+6	ID	ID	ID	ID	ID	1.1E+8	1.9E+8	1.4E+8	NA
Carbazole	86748	NA	9,400	39,000	1,100	8.2E+5	NLV	NLV	NLV	NLV	ID	3.7E+6	8.7E+6	4.9E+6	NA
Carbofuran	1563662	NA	800	800	NA	6.8E+6	NLV	NLV	NLV	NLV	ID	5.6E+8	1.0E+7	7.3E+6	NA
Carbon disulfide {I,R}	75150	NA	16,000	46,000	ID	2.8E+5 {C}	1.4E+5	1.6E+6	8.0E+6	1.9E+7	2.1E+10	2.8E+5 {C,AD}	2.8E+5 {C,AD}	2.8E+5 {C,AD}	2.8E+5
Carbon tetrachloride	56235	NA	100	100	900 {X}	92,000	990	12,000	34,000	79,000	1.7E+8	3.9E+5 {C}	3.9E+5 {C}	3.9E+5 {C}	3.9E+5
Chlordane {J}	57749	NA	NLL	NLL	NLL	NLL	5.9E+7	4.2E+6	4.2E+6	4.2E+6	2.1E+7	2.4E+5	3.8E+5	3.0E+5	NA
Chloride	16887006	NA	5.0E+6	5.0E+6	2.5E+6 {X}	ID	NLV	NLV	NLV	NLV	ID	5.0E+5 {F}	5.0E+5 {F}	5.0E+5 {F}	NA
Chlorobenzene {I}	108907	NA	2,000	2,000	940	2.6E+5 {C}	2.2E+5	9.2E+5	1.1E+6	2.1E+6	2.1E+9	2.6E+5 {C}	2.6E+5 {C}	2.6E+5 {C}	2.6E+5
1-Chloro-1,1-difluoroethane	75683	NA	3.0E+5	8.8E+5	NA	9.6E+5 {C}	9.6E+5 {C}	9.4E+7	ID	ID	1.5E+12	9.6E+5 {C}	9.6E+5 {C}	9.6E+5 {C}	9.6E+5
Chloroethane	75003	NA	8,600	34,000	ID	9.5E+5 {C}	9.5E+5 {C}	3.6E+7	1.2E+8	2.8E+8	2.9E+11	9.5E+5 {C}	9.5E+5 {C}	9.5E+5 {C}	9.5E+5
2-Chloroethyl vinyl ether	110758	NA	ID	ID	NA	ID	ID	ID	ID	ID	ID	ID	ID	ID	1.9E+6
Chloroform	67663	NA	2,000 {W}	2,000 {W}	3,400 {X}	1.5E+8 {C}	38,000	1.5E+5	3.4E+5	7.9E+5	1.6E+9	1.5E+6 {C}	1.5E+6 {C}	1.5E+6 {C}	1.5E+6
Chloromethane {I}	74873	NA	5,200	22,000	ID	1.1E+6 {C}	12,000	1.4E+5	1.2E+6	2.9E+6	6.1E+9	1.1E+6 {C}	1.1E+6 {C}	1.1E+6 {C}	1.1E+6
4-Chloro-3-methylphenol	59507	NA	5,800	16,000	NA	3.0E+6	NLV	NLV	NLV	NLV	ID	2.2E+7	4.0E+7	2.9E+7	NA
beta-Chloronaphthalene	91587	NA	8.2E+5	1.8E+6	NA	2.3E+6	ID	ID	ID	ID	ID	2.8E+8	5.0E+8	3.6E+8	NA
2-Chlorophenol	95578	NA	900	2,600	440	1.9E+6	ID	ID	ID	ID	ID	6.9E+6	1.2E+7	9.0E+6	1.9E+7
o-Chlorotoluene {I}	95498	NA	3,300	9,300	NA	5.0E+5 {C}	5.0E+5 {C}	ID	ID	ID	7.6E+10	5.0E+5 {C}	5.0E+5 {C}	5.0E+5 {C}	5.0E+5
Chlorpyrifos	2921882	NA	17,000	48,000	NA	8.4E+5	240	5,500	ID	ID	5.9E+7	4.6E+7	1.2E+8	6.7E+7	NA
Chromium (III) {B,H}	16065831	18,000 (total)	1.0E+9 {D}	1.0E+9 {D}	{G,X}	1.0E+9 {D}	NLV	NLV	NLV	NLV	1.5E+8	1.0E+9 {D}	1.0E+9 {D}	1.0E+9 {D}	NA
Chromium (VI)	18540299	18,000 (total)	30,000	30,000	3,300	1.4E+8	NLV	NLV	NLV	NLV	2.4E+5	1.7E+7	2.0E+7	1.8E+7	NA
Chrysene {Q}	218019	NA	NLL	NLL	NLL	NLL	ID	ID	ID	ID	ID	1.0E+7	3.0E+7	1.6E+7	NA
Cobalt	7440484	6,800	800	2,000	2,000	4.8E+7	NLV	NLV	NLV	NLV	5.9E+6	1.8E+7	2.1E+7	1.9E+7	NA
Copper	7440508	32,000	5.8E+6	5.8E+6	{G}	1.0E+9 {D}	NLV	NLV	NLV	NLV	5.9E+7	1.4E+8	1.6E+8	1.5E+8	NA
Cyanazine	21725462	NA	500 {M}	500 {M}	1,100 {X}	56,000	NLV	NLV	NLV	NLV	ID	1.0E+5	1.8E+5	1.3E+5	NA
Cyanide {R}	57125	390 (Total)	4,000 {P}	4,000 {P}	400 {P}	2.5E+5 {P}	NLV	NLV	NLV	NLV	2.5E+5 {P}	2.5E+5 {P}	2.5E+5 {P}	2.5E+5 {P}	NA
Cyclohexanone	108941	NA	5.2E+6	1.5E+7	NA	2.2E+8 {C}	32,000	1.3E+6	ID	ID	2.9E+10	2.2E+8 {C}	2.2E+8 {C}	2.2E+8 {C}	2.2E+8
Dacthal	1861321	NA	50,000	1.4E+5	NA	3.4E+5	NLV	NLV	NLV	NLV	ID	1.1E+7	2.0E+7	1.5E+7	NA
Dalapon	75990	NA	4,000	4,000	NA	5.9E+7 {C}	NLV	NLV	NLV	NLV	ID	5.9E+7 {C}	5.9E+7 {C}	5.9E+7 {C}	5.9E+7
4-4'-DDD	72548	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	5.6E+7	5.4E+5	1.4E+6	7.9E+5	NA
4-4'-DDE	72559	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	4.0E+7	2.6E+5	6.4E+5	3.7E+5	NA
4-4'-DDT	50293	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	4.0E+7	4.6E+5	6.8E+5	5.5E+5	NA

ATTACHMENT A
SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guideshee Number ➤		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria	Industrial and Commercial Drinking Water Protection Criteria	Groundwater Surface Water Interface Protection Criteria	Groundwater Contact Protection Criteria	Soil Volatilization to Indoor Air Inhalation Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
Decabromodiphenyl ether	1163195	NA	1.4E+5	1.4E+5	NA	1.4E+5	1.0E+9 (D)	1.0E+8	ID	ID	1.0E+9	1.5E+7	3.8E+7	2.2E+7	NA
Di-n-butyl phthalate	84742	NA	7.6E+5 (C)	7.6E+5 (C)	11,000	7.6E+5 (C)	NLV	NLV	NLV	NLV	1.5E+9	7.6E+5 (C)	7.6E+5 (C)	7.6E+5 (C)	7.6E+5
Di(2-ethylhexyl) adipate	103231	NA	9.6E+5 (C)	9.6E+5 (C)	NA	9.6E+5 (C)	NLV	NLV	NLV	NLV	1.2E+10	9.6E+5 (C,AD)	9.6E+5 (C,AD)	9.6E+5 (C,AD)	9.6E+5
Di-n-octyl phthalate	117840	NA	1.0E+8	1.4E+8 (C)	ID	1.4E+8 (C)	NLV	NLV	NLV	NLV	ID	2.8E+7	6.9E+7	4.0E+7	1.4E+8
Diacetone alcohol (I)	123422	NA	ID	ID	NA	ID	NLV	NLV	NLV	NLV	7.1E+10	ID	ID	ID	1.1E+8
Diazinon	333415	NA	95	280	NA	95,000	NLV	NLV	NLV	NLV	ID	1.0E+5 (AD)	2.1E+5 (AD)	1.4E+5 (AD)	3.1E+5
Dibenzo(a,h)anthracene (Q)	53703	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	10,000	30,000	16,000	NA
Dibenzofuran	132649	NA	ID	ID	1,700	ID	ID	ID	ID	ID	ID	ID	ID	ID	NA
Dibromochloromethane	124481	NA	2,000 (W)	2,000 (W)	ID	3.6E+5	21,000	80,000	80,000	98,000	1.6E+8	6.1E+5 (C)	6.1E+5 (C)	6.1E+5 (C)	6.1E+5
Dibromochloropropane	96128	NA	4.0	4.0 (M)	NA	1,200 (C)	1,200 (C)	1.5E+4	ID	ID	5.9E+6	1,200 (C)	1,200 (C)	1,200 (C)	1,200
Dibromomethane	74953	NA	1,600	4,600	NA	2.0E+6 (C)	ID	ID	ID	ID	ID	2.0E+6 (C)	2.0E+6 (C)	2.0E+6 (C)	2.0E+6
1,2-Dichlorobenzene	95501	NA	14,000	14,000	360	2.1E+5 (C)	2.1E+5 (C)	4.6E+7	4.6E+7	5.5E+7	4.4E+10	2.1E+5 (C)	2.1E+5 (C)	2.1E+5 (C)	2.1E+5
1,3-Dichlorobenzene	541731	NA	170	480	1,100	51,000	ID	ID	ID	ID	ID	1.7E+5 (C)	1.7E+5 (C)	1.7E+5 (C)	1.7E+5
1,4-Dichlorobenzene	106467	NA	1,700	1,700	290	1.4E+5	1.0E+5	2.6E+5	2.6E+5	3.4E+5	5.7E+8	2.9E+6	5.1E+6	3.7E+6	NA
3,3'-Dichlorobenzidine	91941	NA	2,000 (M)	2,000 (M)	2,000 (M,X)	4,600	NLV	NLV	NLV	NLV	8.2E+6	47,000	83,000	61,000	NA
Dichlorodifluoromethane	75718	NA	95,000	2.7E+5	ID	1.0E+8 (C)	1.0E+6 (C)	6.3E+7	5.5E+8	1.4E+9	1.5E+12	1.0E+6 (C)	1.0E+6 (C)	1.0E+6 (C)	1.0E+6
1,1-Dichloroethane	75343	NA	18,000	50,000	ID	8.9E+5 (C)	4.3E+5	2.5E+6	6.0E+6	1.4E+7	1.5E+10	8.9E+5 (C)	8.9E+5 (C)	8.9E+5 (C)	8.9E+5
1,2-Dichloroethane (I)	107062	NA	100	100	7,200 (X)	3.8E+5	11,000	21,000	33,000	74,000	1.5E+8	6.4E+5	1.1E+6	8.4E+5	1.2E+6
1,1-Dichloroethylene (I)	75354	NA	140	140	1,300 (X)	2.2E+5	330	3,700	15,000	37,000	7.8E+7	5.7E+5 (C)	5.7E+5 (C)	5.7E+5 (C)	5.7E+5
cis-1,2-Dichloroethylene	156592	NA	1,400	1,400	ID	6.4E+5 (C)	42,000	2.1E+5	4.3E+5	1.0E+6	1.0E+9	6.4E+5 (C)	6.4E+5 (C)	6.4E+5 (C)	6.4E+5
trans-1,2-Dichloroethylene	156605	NA	2,000	2,000	ID	1.4E+6 (C)	43,000	3.3E+5	8.4E+5	2.0E+6	2.1E+9	1.4E+6 (C)	1.4E+6 (C)	1.4E+6 (C)	1.4E+6
2,6-Dichloro-4-nitroaniline	99309	NA	44,000	1.3E+5	NA	1.4E+5	NLV	NLV	NLV	NLV	ID	3.4E+8	6.0E+8	4.4E+8	NA
2,4-Dichlorophenol	120832	NA	1,500	4,200	380	9.6E+5	NLV	NLV	NLV	NLV	2.3E+9	1.8E+6 (C,AD)	1.8E+6 (C,AD)	1.8E+6 (C,AD)	1.8E+6
2,4-Dichlorophenoxyacetic acid	94757	NA	1,400	1,400	4,400	2.4E+6	NLV	NLV	NLV	NLV	2.9E+9	1.5E+7	2.0E+7	1.7E+7	NA
1,2-Dichloropropane (I)	78875	NA	100	100	5,800 (X)	3.2E+5	7,400	30,000	51,000	1.2E+5	1.2E+8	5.5E+5 (C)	5.5E+5 (C)	5.5E+5 (C)	5.5E+5
1,3-Dichloropropene	542756	NA	420	1,300	NA	2.6E+5	10 (M)	31	100	240	5.0E+5	6.2E+5 (C)	6.2E+5 (C)	6.2E+5 (C)	6.2E+5
Dichlorovos	62737	NA	50 (M)	130	NA	1.2E+5	NLV	NLV	NLV	NLV	1.5E+7	72,000	1.3E+5	93,000	2.2E+6
Dicyclohexyl phthalate	84617	NA	ID	ID	NA	ID	ID	ID	ID	ID	ID	ID	ID	ID	NA
Dieldrin	60571	NA	NLL	NLL	NLL	NLL	7.2E+5	64,000	64,000	64,000	8.5E+5	6,400	16,000	9,300	NA
Diethyl ether	60297	NA	200	200	ID	7.4E+6 (C)	7.4E+6 (C)	1.0E+8	1.6E+8	3.5E+8	3.5E+11	7.4E+6 (C)	7.4E+6 (C)	7.4E+6 (C)	7.4E+6
Diethyl phthalate	84662	NA	1.1E+5	3.2E+5	NA	7.4E+5 (C)	NLV	NLV	NLV	NLV	1.5E+9	7.4E+5 (C)	7.4E+5 (C)	7.4E+5 (C)	7.4E+5

ATTACHMENT A
SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number ➤		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria	Industrial and Commercial Drinking Water Protection Criteria	Groundwater Surface Water Interface Protection Criteria	Groundwater Contact Protection Criteria	Soil Volatilization to Indoor Air Inhalation Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
Diethylene glycol monobutyl ether	112345	NA	1,800	5,000	NA	8.0E+7	NLV	NLV	NLV	NLV	5.9E+8	1.3E+7	2.4E+7	1.7E+7	1.1E+8
Diisopropyl ether	108203	NA	600	1,300 (C)	NA	1,300 (C)	ID	ID	ID	ID	ID	1,300 (C)	1,300 (C)	1,300 (C)	1,300
Diisopropylamine (I)	108189	NA	110	320	NA	4.2E+5	ID	ID	ID	ID	ID	8.6E+5	1.5E+6	1.1E+6	6.7E+6
Dimethyl phthalate	131113	NA	7.9E+5 (C)	7.9E+5 (C)	NA	7.9E+5 (C)	NLV	NLV	NLV	NLV	1.5E+9	7.9E+5 (C)	7.9E+5 (C)	7.9E+5 (C)	7.9E+5
N,N-Dimethylacetamide	127195	NA	3,600	10,000	82,000 (X)	1.1E+8 (C)	NLV	NLV	NLV	NLV	ID	2.8E+7	5.0E+7	3.6E+7	1.1E+8
N,N-Dimethylaniline	121697	NA	320	920	NA	4.0E+5	8.0E+5 (C)	5.2E+5	ID	ID	3.3E+8	8.0E+5 (C)	8.0E+5 (C)	8.0E+5 (C)	8.0E+5
Dimethylformamide (I)	68122	NA	14,000	40,000	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	8.8E+8	1.1E+8	1.1E+8 (C)	1.1E+8 (C)	1.1E+8
2,4-Dimethylphenol	105679	NA	7,400	20,000	7,600	1.0E+7	NLV	NLV	NLV	NLV	2.1E+9	5.6E+7	1.0E+8	7.3E+7	NA
2,6-Dimethylphenol	576261	NA	330 (M)	330 (M)	NA	1.3E+5	NLV	NLV	NLV	NLV	ID	6.7E+5	1.2E+6	8.7E+5	NA
3,4-Dimethylphenol	95658	NA	330 (M)	580	NA	3.6E+5	NLV	NLV	NLV	NLV	ID	1.6E+6	2.8E+6	2.0E+6	NA
Dimethylsulfoxide	67685	NA	4.4E+6	1.3E+7	3.8E+6	1.8E+7 (C)	NLV	NLV	NLV	NLV	ID	1.8E+7 (C)	1.8E+7 (C)	1.8E+7 (C)	1.8E+7
2,4-Dinitrotoluene	121142	NA	430	640	NA	1.7E+5	NLV	NLV	NLV	NLV	2.0E+7	3.4E+5	8.1E+5	4.4E+5	NA
Dinoseb	88857	NA	300	300	NA	1.4E+5 (C)	ID	ID	ID	ID	ID	1.4E+5 (C,AD)	1.4E+5 (C,AD)	1.4E+5 (C,AD)	1.4E+5
1,4-Dioxane (I)	123911	NA	1,700	7,000	56,000	3.4E+7	NLV	NLV	NLV	NLV	7.1E+8	3.7E+6	6.7E+6	4.9E+6	9.7E+7
Diquat	85007	NA	400	400	NA	1.4E+7	NLV	NLV	NLV	NLV	ID	2.5E+6	4.4E+6	3.2E+6	NA
Diuron	330541	NA	620	1,800	NA	7.4E+5	NLV	NLV	NLV	NLV	2.1E+8	4.8E+6	8.6E+6	6.3E+6	NA
Endosulfan (J)	115297	NA	NLL	NLL	NLL	NLL	ID	ID	ID	ID	ID	6.7E+6	1.2E+7	8.7E+6	NA
Endothall	145733	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.0E+9	1.9E+7	3.4E+7	2.5E+7	NA
Endrin	72208	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	2.6E+5	6.5E+5	3.8E+5	NA
Epichlorohydrin (I)	106898	NA	100	120	NA	2.2E+5	1.2E+5	37,000	37,000	37,000	2.9E+7	63,000	1.1E+5	82,000	7.3E+6
Ethanol (I)	64175	NA	3.8E+7	7.6E+7	IP	1.1E+8 (C)	NLV	NLV	NLV	NLV	5.6E+11	1.1E+8 (C,AD)	1.1E+8 (C,AD)	1.1E+8 (C,AD)	1.1E+8
Ethyl acetate (I)	141786	NA	1.3E+5	3.8E+5	NA	7.5E+6 (C)	7.5E+6 (C)	5.9E+7	5.9E+7	1.0E+8	9.4E+10	7.5E+6 (C)	7.5E+6 (C)	7.5E+6 (C)	7.5E+6
Ethylbenzene (I)	100414	NA	1,500	1,500	360	1.4E+5 (C)	1.4E+5 (C)	1.1E+7	1.4E+7	3.0E+7	2.9E+10	1.4E+5 (C)	1.4E+5 (C)	1.4E+5 (C)	1.4E+5
Ethylene dibromide	106934	NA	10 (M)	10 (M)	20	500	3,600	5,800	5,800	9,800	1.8E+7	660	1,200	850	8.9E+5
Ethylene glycol	107211	NA	3.0E+5	8.4E+5	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	2.9E+10	1.1E+8 (C)	1.1E+8 (C)	1.1E+8 (C)	1.1E+8
Ethylene glycol monobutyl ether	111762	NA	74,000	2.0E+5	NA	4.1E+7 (C)	1.4E+6	2.1E+7	1.5E+8	3.6E+8	3.8E+11	4.1E+7 (C)	4.1E+7 (C)	4.1E+7 (C)	4.1E+7
Fluoranthene	206440	NA	7.3E+5	7.3E+5	5,500	7.3E+5	1.0E+9 (D)	8.9E+8	8.8E+8	8.8E+8	4.1E+9	1.8E+8	4.6E+8	2.7E+8	NA
Fluorene	86737	NA	3.9E+5	8.9E+5	5,300	8.9E+5	1.0E+9 (D)	1.5E+8	1.5E+8	1.5E+8	4.1E+9	1.3E+8	2.4E+8	1.7E+8	NA
Fluorine (soluble fluoride) (B)	7782414	NA	40,000	40,000	NA	2.4E+8	NLV	NLV	NLV	NLV	ID	1.2E+8 (AD)	1.5E+8 (AD)	1.3E+8 (AD)	NA
Formaldehyde	50000	NA	26,000	76,000	2,400	6.0E+7 (C)	65,000	43,000	69,000	1.5E+5	3.0E+8	6.0E+7 (C)	6.0E+7 (C)	6.0E+7 (C)	6.0E+7
Formic acid (I,U)	64186	NA	9.0E+5 (M)	9.0E+5 (M)	ID	1.1E+8 (C)	2.8E+6	9.0E+5 (M)	9.0E+5 (M)	9.0E+5 (M)	5.9E+7	1.1E+8 (C)	1.1E+8 (C)	1.1E+8 (C)	1.1E+8

ATTACHMENT A
SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number →		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria	Industrial and Commercial Drinking Water Protection Criteria	Groundwater Surface Water Interface Protection Criteria	Groundwater Contact Protection Criteria	Soil Volatilization to Indoor Air Inhalation Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
1-Formylpiperidine	2591868	NA	1,600	4,600	NA	ID	ID	ID	ID	ID	ID	1.0E+7 (C)	1.0E+7 (C)	1.0E+7 (C)	1.0E+7
Gentian violet	548629	NA	300	1,300	NA	2.0E+7	NLV	NLV	NLV	NLV	ID	6.8E+5	1.2E+6	8.8E+5	NA
Glyphosate	1071836	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	7.4E+7 (AD)	2.2E+8 (AD)	1.1E+8 (AD)	NA
Heptachlor	76448	NA	NLL	NLL	NLL	NLL	1.9E+6	2.1E+5	2.1E+5	2.1E+5	3.0E+6	32,000	80,000	47,000	NA
Heptachlor epoxide	1024573	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.5E+6	13,000	33,000	19,000	NA
n-Heptane	142825	NA	2.4E+5 (C)	2.4E+5 (C)	NA	2.4E+5 (C)	2.4E+5 (C)	2.5E+7	ID	ID	1.0E+11	2.4E+5 (C)	2.4E+5 (C)	2.4E+5 (C)	2.4E+5
Hexabromobenzene	87821	NA	3.2E+5	3.2E+5	ID	3.2E+5	ID	ID	ID	ID	ID	4.3E+6	1.1E+7	6.3E+6	NA
Hexachlorobenzene (C-66)	118741	NA	1,800	1,800	ID	8,200	2.2E+5	56,000	56,000	56,000	8.5E+6	51,000	1.3E+5	75,000	NA
Hexachlorobutadiene (C-46)	87683	NA	26,000	72,000	330 (M)	3.5E+5 (C)	3.5E+5 (C)	4.6E+5	4.6E+5	4.6E+5	1.8E+8	3.5E+5 (C)	3.5E+5 (C)	3.5E+5 (C)	3.5E+5
alpha-Hexachlorocyclohexane	319846	NA	18	71	NA	2,500	1.6E+5	41,000	86,000	86,000	2.1E+6	19,000	33,000	24,000	NA
beta-Hexachlorocyclohexane	319857	NA	37	150	NA	5,100	NLV	NLV	NLV	NLV	7.4E+6	38,000	69,000	50,000	NA
Hexachlorocyclopentadiene (C-56)	77474	NA	3.2E+5	3.2E+5	ID	7.2E+5 (C)	ID	ID	ID	ID	ID	7.2E+5 (C)	7.2E+5 (C)	7.2E+5 (C)	7.2E+5
Hexachloroethane	67721	NA	430	1,200	1,800 (X)	1.1E+5	79,000	6.6E+5	1.4E+6	1.4E+6	1.0E+8	1.1E+6	2.0E+6	1.5E+6	NA
n-Hexane	110543	NA	44,000 (C)	44,000 (C)	NA	44,000 (C)	44,000 (C)	3.5E+6	ID	ID	5.9E+9	44,000 (C)	44,000 (C)	44,000 (C)	44,000
2-Hexanone	591786	NA	20,000	58,000	NA	2.5E+6 (C)	1.8E+6	1.3E+8	ID	ID	1.2E+9	2.5E+6 (C)	2.5E+6 (C)	2.5E+6 (C)	2.5E+6
Indeno(1,2,3-cd)pyrene (Q)	193395	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	1.0E+5	3.0E+5	1.6E+5	NA
Iron (B)	7439896	1.2E+7	6,000	6,000	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	1.0E+9 (D)	1.0E+9 (D)	1.0E+9 (D)	NA
Isobutyl alcohol (I)	78831	NA	46,000	1.3E+5	NA	8.9E+6 (C)	8.9E+6 (C)	9.5E+7	9.5E+7	9.5E+7	4.4E+10	8.9E+6 (C)	8.9E+6 (C)	8.9E+6 (C)	8.9E+6
Isophorone	78591	NA	15,000	62,000	11,000 (X)	2.4E+6 (C)	NLV	NLV	NLV	NLV	8.2E+9	2.4E+6 (C)	2.4E+6 (C)	2.4E+6 (C)	2.4E+6
Isopropyl alcohol (I)	67630	NA	9,400	26,000	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	6.5E+9	7.2E+7	1.1E+8 (C)	9.3E+7	1.1E+8
Isopropyl benzene	98828	NA	91,000	2.6E+5	ID	3.9E+5 (C)	3.9E+5 (C)	2.0E+6	ID	ID	2.6E+9	3.9E+5 (C)	3.9E+5 (C)	3.9E+5 (C)	3.9E+5
Lead	7439921	21,000	7.0E+5	7.0E+5	(G,M,X)	ID	NLV	NLV	NLV	NLV	4.4E+7	9.0E+5 (draft)	4.0E+5	4.0E+5	NA
Lindane	58899	NA	20 (M)	20 (M)	20 (M)	7,100	ID	ID	ID	ID	ID	73,000	96,000	84,000	NA
Lithium (B)	7439932	9,800	3,400	7,000	500	1.1E+8	NLV	NLV	NLV	NLV	ID	5.6E+7 (AD)	6.9E+7 (AD)	6.2E+7 (AD)	NA
Magnesium (B)	7439954	NA	8.0E+6	2.2E+7	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	2.9E+9	1.0E+9 (D)	1.0E+9 (D)	1.0E+9 (D)	NA
Manganese (B)	7439965	4.4E+5	1,000	1,000	(G,X)	1.8E+8	NLV	NLV	NLV	NLV	1.5E+6	1.7E+8	1.9E+8	1.8E+8	NA
Mercury (inorganic)	7439976	130	1,700	1,700	100 (M)	47,000	NLV	NLV	NLV	NLV	ID	1.1E+6	1.2E+6	1.2E+6	NA
Methane	74828	NA	ID	ID	ID	ID	(K)	ID	ID	ID	ID	ID	ID	ID	ID
Methanol	67561	NA	74,000	2.0E+5	9,600	3.1E+6 (C)	1.2E+6	3.7E+7	4.6E+7	9.7E+7	9.6E+10	3.1E+6 (C)	3.1E+6 (C)	3.1E+6 (C)	3.1E+6
Methoxychlor	72435	NA	16,000	16,000	NA	18,000	ID	ID	ID	ID	ID	7.7E+6	1.9E+7	1.1E+7	NA
2-Methoxyethanol (I)	109864	NA	150	420	NA	1.7E+7	NLV	NLV	NLV	NLV	5.9E+8	1.1E+6	2.0E+6	1.5E+6	1.1E+8

ATTACHMENT A
SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria	Industrial and Commercial Drinking Water Protection Criteria	Groundwater Surface Water Interface Protection Criteria	Groundwater Contact Protection Criteria	Soil Volatilization to Indoor Air Inhalation Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
2-Methyl-4-chlorophenoxyacetic acid	94746	NA	390	1,100	NA	4.9E+5	NLV	NLV	NLV	NLV	ID	1.1E+6	2.0E+6	1.5E+6	NA
2-Methyl-4,6-dinitrophenol	534521	NA	1,700 (M)	1,700 (M)	NA	1.9E+5	NLV	NLV	NLV	NLV	ID	3.9E+5	7.0E+5	5.1E+5	NA
Methyl parathion	298000	NA	46	130	NA	76,000	NLV	NLV	NLV	NLV	ID	2.8E+5	5.0E+5	3.6E+5	NA
4-Methyl-2-pentanone (MIBK) (I)	108101	NA	36,000	1.0E+5	ID	2.7E+6 (C)	2.7E+6 (C)	5.3E+7	5.3E+7	7.0E+7	6.0E+10	2.7E+6 (C)	2.7E+6 (C)	2.7E+6 (C)	2.7E+6
Methyl-tert-butyl ether (MTBE)	1634044	NA	800	800	15,000 (X)	5.9E+6 (C)	5.9E+6 (C)	3.0E+7	4.1E+7	8.9E+7	8.8E+10	5.9E+6 (C)	5.9E+6 (C)	5.9E+6 (C)	5.9E+6
N-Methyl-morpholine (I)	109024	NA	400	1,100	NA	3.0E+7	NLV	NLV	NLV	NLV	ID	3.0E+6	5.4E+6	3.9E+6	1.1E+8
Methylcyclopentane (I)	96377	NA	ID	ID	NA	ID	ID	ID	ID	ID	ID	ID	ID	ID	3.5E+5
4,4'-Methylene-bis-2-chloroaniline (MBOCA)	101144	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.1E+8	48,000	87,000	63,000	NA
Methylene chloride	75092	NA	100	100	19,000 (X)	2.3E+6 (C)	2.4E+5	7.0E+5	1.7E+6	4.0E+6	8.3E+9	2.3E+6 (C)	2.3E+6 (C)	2.3E+6 (C)	2.3E+6
2-Methylnaphthalene	91576	NA	57,000	1.7E+5	ID	5.5E+6	ID	ID	ID	ID	ID	4.0E+7	7.2E+7	5.2E+7	NA
Methylphenols (J)	1319773	NA	7,400	20,000	1,400	1.6E+7	NLV	NLV	NLV	NLV	2.9E+9	5.6E+7	1.0E+8	7.3E+7	NA
Metolachlor	51218452	NA	4,800	20,000	NA	4.4E+5 (C)	NLV	NLV	NLV	NLV	ID	4.4E+5 (C,AD)	4.4E+5 (C,AD)	4.4E+5 (C,AD)	4.4E+5
Mirex	2385855	NA	NLL	NLL	NLL	NLL	ID	ID	ID	ID	ID	5.5E+4	1.4E+5	80,000	NA
Molybdenum (B)	7439987	NA	740	2,000	16,000 (X)	1.9E+7	NLV	NLV	NLV	NLV	ID	1.8E+7	2.1E+7	1.9E+7	NA
Naphthalene	91203	NA	35,000	1.0E+5	870	2.1E+6	4.7E+5	3.5E+5	3.5E+5	3.5E+5	8.8E+7	8.0E+7	1.4E+8	1.0E+8	NA
Nickel (B)	7440020	20,000	1.0E+5	1.0E+5	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	1.6E+7	2.7E+8	3.1E+8	2.9E+8	NA
Nitrate (B,N)	14797558	NA	2.0E+5 (N)	2.0E+5 (N)	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	ID	ID	ID	NA
Nitrite (B,N)	14797650	NA	20,000 (N)	20,000 (N)	NA	3.8E+8	NLV	NLV	NLV	NLV	ID	ID	ID	ID	NA
Nitrobenzene (I)	98953	NA	330 (M)	330 (M)	3,600 (X)	2.2E+5	4.9E+5 (C)	4.6E+6	4.6E+6	4.6E+6	1.5E+9	4.9E+5 (C)	4.9E+5 (C)	4.9E+5 (C)	4.9E+5
2-Nitrophenol	88755	NA	400	1,200	ID	1.6E+6	NLV	NLV	NLV	NLV	ID	3.1E+6	5.6E+6	4.1E+6	NA
n-Nitroso-di-n-propylamine	621647	NA	330 (M)	330 (M)	NA	7,200	NLV	NLV	NLV	NLV	2.0E+6	6,300	15,000	11,000	1.5E+6
N-Nitrosodiphenylamine	86306	NA	5,400	22,000	NA	7.0E+5	NLV	NLV	NLV	NLV	ID	1.2E+7	2.2E+7	1.6E+7	NA
Oxamyl	23135220	NA	4,000	4,000	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	4.3E+7	7.6E+7	5.5E+7	NA
Oxo-hexyl acetate	88230357	NA	1,500	4,200	NA	ID	ID	ID	ID	ID	2.4E+9	1.0E+7 (C)	1.0E+7 (C)	1.0E+7 (C)	1.0E+7
Pendimethalin	40487421	NA	1.1E+6	1.1E+6	NA	1.1E+8	NLV	NLV	NLV	NLV	ID	1.8E+8	4.6E+8	2.7E+8	NA
Pentachlorobenzene	608935	NA	29,000	81,000	NA	1.9E+5 (C)	ID	ID	ID	ID	ID	1.9E+5 (C)	1.9E+5 (C)	1.9E+5 (C)	1.9E+5
Pentachloronitrobenzene	82688	NA	37,000	37,000	NA	37,000	2.2E+5	2.8E+5	2.8E+5	2.8E+5	1.5E+8	8.4E+6	1.5E+7	1.1E+7	NA
Pentachlorophenol	87865	NA	22	22	(G,X)	4,300	NLV	NLV	NLV	NLV	1.3E+8	3.9E+5	1.7E+6	6.5E+5	NA
Pentane	109660	NA	ID	ID	NA	ID	2.4E+5 (C)	4.4E+7	ID	ID	5.2E+11	ID	ID	ID	2.4E+5
2-Pentene (I)	109682	NA	ID	ID	NA	ID	ID	ID	ID	ID	ID	ID	ID	ID	2.2E+5
Phenanthrene	85018	NA	56,000	1.6E+5	2,300	1.1E+6	3.3E+6	11,000	37,000	37,000	2.9E+6	8.0E+6	1.4E+7	1.0E+7	NA

ATTACHMENT A
SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number →		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria	Industrial and Commercial Drinking Water Protection Criteria	Groundwater Surface Water Interface Protection Criteria	Groundwater Contact Protection Criteria	Soil Volatilization to Indoor Air Inhalation Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
Phenol	108952	NA	88,000	2.6E+5	4,200	1.2E+7 (C)	NLV	NLV	NLV	NLV	1.8E+10	1.2E+7 (C,AD)	1.2E+7 (C,AD)	1.2E+7 (C,AD)	1.2E+7
Phosphorus (total)	7723140	NA	1.3E+6	4.8E+6	NA	ID	NLV	NLV	NLV	NLV	ID	1.0E+9 (D)	1.0E+9 (D)	1.0E+9 (D)	NA
Phthalic acid	88993	NA	2.8E+5	8.0E+5	NA	1.7E+8 (C)	NLV	NLV	NLV	NLV	ID	1.7E+6 (C)	1.7E+6 (C)	1.7E+6 (C)	1.7E+6
Phthalic anhydride	85449	NA	3.0E+5	8.8E+5	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	ID	1.1E+6 (C)	1.1E+8 (C)	1.7E+8 (C)	1.1E+6
Picloram	1918021	NA	10,000	10,000	NA	8.6E+6	NLV	NLV	NLV	NLV	ID	7.8E+7	1.4E+8	1.0E+8	NA
Piperidine	110894	NA	64	180	NA	6.8E+5	NLV	NLV	NLV	NLV	4.1E+9	4.9E+5	8.8E+5	6.4E+5	1.2E+8
Polybrominated biphenyls (J)	67774327	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	6,600	17,000	9,600	NA
Polychlorinated biphenyls (PCBs) (J,T)	1336363	NA	NLL	NLL	NLL	NLL	1.6E+7	8.1E+5	2.8E+7	2.8E+7	6.5E+6	(T)	(T)	(T)	NA
Prometon	1610180	NA	4,900	14,000	NA	5.5E+6	NLV	NLV	NLV	NLV	ID	2.5E+7	4.4E+7	3.2E+7	NA
Propachlor	1918167	NA	1,900	5,400	NA	8.8E+6	NLV	NLV	NLV	NLV	ID	1.5E+7	2.6E+7	1.9E+7	NA
Propazine	139402	NA	4,000	11,000	NA	1.7E+5	NLV	NLV	NLV	NLV	ID	3.0E+7	5.4E+7	3.9E+7	NA
Propionic acid	79094	NA	2.4E+5	7.0E+5	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	8.8E+9	1.1E+8 (C)	1.1E+8 (C)	1.1E+8 (C)	1.1E+8
Propyl alcohol (I)	71238	NA	28,000	60,000	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	2.1E+10	1.1E+8 (AD)	1.1E+8 (C,AD)	1.1E+8 (C,AD)	1.1E+8
n-Propylbenzene (I)	103651	NA	1,600	4,600	NA	3.0E+5	ID	ID	ID	ID	5.9E+8	1.0E+7 (C)	1.0E+7 (C)	1.0E+7 (C)	1.0E+7
Propylene glycol	57556	NA	3.0E+6	8.4E+6	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	1.8E+11	1.1E+8 (C)	1.1E+8 (C)	1.1E+8 (C)	1.1E+8
Pyrene	129000	NA	4.8E+5	4.8E+5	ID	4.8E+5	1.0E+9 (D)	7.8E+8	7.7E+8	7.7E+8	2.9E+9	1.1E+8	2.9E+8	1.7E+8	NA
Pyridine (I)	110861	NA	330 (M)	420	NA	37,000 (C)	2,000	9,800	40,000	97,000	1.0E+8	37,000 (C)	37,000 (C)	37,000 (C)	37,000
Selenium (B)	7782492	410	4,000	4,000	400	7.8E+7	NLV	NLV	NLV	NLV	5.9E+7	1.8E+7	2.1E+7	1.9E+7	NA
Silver (B)	7440224	1,000	4,500	13,000	500 (M)	2.0E+8	NLV	NLV	NLV	NLV	2.9E+6	1.7E+7	1.9E+7	1.8E+7	NA
Silvex (2,4,5-TP)	93721	NA	3,600	3,600	NA	3.1E+8	NLV	NLV	NLV	NLV	ID	8.4E+6	1.5E+7	1.1E+7	NA
Simazine	122349	NA	80	80	NA	90,000	NLV	NLV	NLV	NLV	ID	5.8E+6	1.0E+7	7.6E+6	NA
Sodium	7440235	NA	2.5E+6	7.0E+6	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	1.0E+9 (D)	1.0E+9 (D)	1.0E+9 (D)	NA
Strontium (B)	7440246	NA	92,000	2.6E+5	15,000	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	1.0E+9 (D)	1.0E+9 (D)	1.0E+9 (D)	NA
Styrene	100425	NA	2,700	2,700	2,200	2.7E+5	5.2E+5 (C)	3.3E+8	3.3E+6	4.2E+6	6.9E+9	5.2E+5 (C)	5.2E+5 (C)	5.2E+5 (C)	5.2E+5
Sulfate	14808798	NA	5.0E+6	5.0E+6	NA	ID	NLV	NLV	NLV	NLV	ID	ID	ID	ID	NA
Tebuthiuron	34014181	NA	10,000	30,000	NA	5.0E+7	NLV	NLV	NLV	NLV	ID	4.0E+7 (AD)	8.2E+7 (AD)	5.5E+7 (AD)	NA
2,3,7,8-Tetrabromodibenzo-p-dioxin (O)	50585416	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	(O)	(O)	(O)	(O)	NA
1,2,4,5-Tetrachlorobenzene	95943	NA	1.5E+6	1.5E+6	3,400 (X)	1.5E+6	ID	ID	ID	ID	ID	3.8E+8 (D)	6.8E+8	5.0E+8	NA
2,3,7,8-Tetrachlorodibenzo-p-dioxin (O)	1746016	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	89 (O)	0.99 (O)	1.4 (O)	2.9 (O)	NA
1,1,1,2-Tetrachloroethane	630206	NA	1,500	6,400	NA	4.4E+5 (C)	33,000	1.2E+5	2.1E+5	3.3E+5	5.3E+8	4.4E+5 (C)	4.4E+5 (C)	4.4E+5 (C)	4.4E+5
1,1,2,2-Tetrachloroethane	79345	NA	170	700	1,600 (X)	94,000	23,000	34,000	34,000	34,000	6.8E+7	3.7E+5	6.7E+5	4.9E+5	8.7E+5

ATTACHMENT A
SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number →		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria	Industrial and Commercial Drinking Water Protection Criteria	Groundwater Surface Water Interface Protection Criteria	Groundwater Contact Protection Criteria	Soil Volatilization to Indoor Air Inhalation Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
Tetrachloroethylene	127184	NA	100	100	900 (X)	88,000 (C)	60,000	6.0E+5	1.4E+6	3.3E+6	6.6E+9	88,000 (C)	88,000 (C)	88,000 (C)	88,000
Tetrahydrofuran	109999	NA	1,900	5,400	2.2E+5 (X)	3.2E+7	2.4E+6	1.5E+7	ID	ID	1.7E+11	1.5E+7	2.6E+7	1.9E+7	1.2E+8
Thallium (B)	7440280	NA	2,300	2,300	4,200 (X)	1.5E+7	NLV	NLV	NLV	NLV	ID	2.4E+5	2.8E+5	2.6E+5	NA
Toluene (I)	108883	NA	16,000	16,000	2,800	2.5E+5 (C)	2.5E+5 (C)	3.3E+6	3.6E+7	3.6E+7	1.2E+10	2.5E+5 (C)	2.5E+5 (C)	2.5E+5 (C)	2.5E+5
o-Toluidine	106490	NA	660 (M)	1,200	NA	4.8E+5	NLV	NLV	NLV	NLV	1.3E+8	6.7E+5	1.2E+6 (C)	8.7E+5	1.2E+6
Toxaphene	8001352	NA	24,000	24,000	860	3.6E+5	NLV	NLV	NLV	NLV	1.2E+7	1.2E+5	2.9E+5	1.7E+5	NA
Tralate	2303175	NA	95,000	2.5E+5 (C)	NA	2.5E+5 (C)	ID	ID	ID	ID	ID	2.5E+5 (C)	2.5E+5 (C)	2.5E+5 (C)	2.5E+5
Tributylamine	102829	NA	7,800	23,000	ID	1.8E+6	1.1E+6	7.2E+5	ID	ID	2.1E+8	3.7E+6 (C)	3.7E+6 (C)	3.7E+6 (C)	3.7E+6
1,2,4-Trichlorobenzene	120821	NA	4,200	4,200	1,800	1.1E+6	1.1E+6 (C)	3.4E+7	3.4E+7	3.4E+7	1.1E+10	1.1E+6 (C,AD)	1.1E+6 (C,AD)	1.1E+6 (C,AD)	1.1E+6
1,1,1-Trichloroethane	71556	NA	4,000	4,000	4,000	4.6E+5 (C)	4.6E+5	4.5E+6	1.5E+7	3.1E+7	2.9E+10	4.6E+5 (C)	4.6E+5 (C)	4.6E+5 (C)	4.6E+5
1,1,2-Trichloroethane	79005	NA	100	100	6,600 (X)	4.2E+5	24,000	57,000	57,000	1.2E+5	2.5E+8	9.2E+5 (C)	9.2E+5 (C)	9.2E+5 (C)	9.2E+5
Trichloroethylene	79016	NA	100	100	4,000 (X)	5.0E+5 (C)	37,000	2.6E+5	4.4E+5	1.1E+6	2.3E+9	5.0E+5 (C)	5.0E+5 (C)	5.0E+5 (C)	5.0E+5
Trichlorofluoromethane	75694	NA	52,000	1.5E+5	NA	5.6E+5 (C)	5.6E+5 (C)	1.1E+8	1.4E+11	1.4E+11	1.7E+12	5.6E+5 (C)	5.6E+5 (C)	5.6E+5 (C)	5.6E+5
2,4,5-Trichlorophenol	95954	NA	39,000	1.1E+5	NA	9.1E+6	NLV	NLV	NLV	NLV	1.0E+10	1.1E+8	2.0E+8	1.5E+8	NA
2,4,6-Trichlorophenol	88062	NA	2,400	9,400	330 (M)	2.0E+5	NLV	NLV	NLV	NLV	1.3E+9	5.0E+6	9.0E+6	6.6E+6	NA
1,2,3-Trichloropropane	96184	NA	840	2,400	NA	8.3E+5 (C)	ID	ID	ID	ID	ID	8.3E+5 (C)	8.3E+5 (C)	8.3E+5 (C)	8.3E+5
1,1,2-Trichloro-1,2,2-trifluoroethane	76131	NA	5.5E+5 (C)	5.5E+5 (C)	NA	5.5E+5 (C)	5.5E+5 (C)	2.1E+8	8.9E+8	2.1E+9	2.3E+12	5.5E+5 (C)	5.5E+5 (C)	5.5E+5 (C)	5.5E+5
Triethanolamine	102716	NA	74,000	2.0E+5	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	1.5E+9	1.1E+8 (C)	1.1E+8 (C)	1.1E+8 (C)	1.1E+8
Triethylene glycol	112276	NA	1.1E+5 (C)	1.1E+5 (C)	NA	1.1E+5 (C)	NLV	NLV	NLV	NLV	ID	1.1E+5 (C,AD)	1.1E+5 (C,AD)	1.1E+5 (C,AD)	1.1E+5
3-Trifluoromethyl-4-nitrophenol	88302	NA	1.1E+5	3.1E+5	NA	1.2E+8	NLV	NLV	NLV	NLV	ID	3.5E+8 (AD)	7.3E+8 (AD)	4.8E+8 (AD)	NA
Trifluralin	1582098	NA	1.9E+5	5.7E+5	NA	1.2E+7	ID	ID	ID	ID	ID	7.8E+6	2.0E+7	1.1E+7	NA
2,2,4-Trimethyl pentane	540841	NA	ID	ID	NA	ID	ID	ID	ID	ID	ID	ID	ID	ID	19,000
2,4,4-Trimethyl-2-pentene (I)	107404	NA	ID	ID	NA	ID	ID	ID	ID	ID	ID	ID	ID	ID	56,000
1,2,4-Trimethylbenzene (I)	95636	NA	2,100	2,100	ID	1.1E+5 (C)	1.1E+5 (C)	2.5E+7	6.0E+8	6.0E+8	3.6E+10	1.1E+5 (C)	1.1E+5 (C)	1.1E+5 (C)	1.1E+5
1,3,5-Trimethylbenzene (I)	108678	NA	1,800	1,800	ID	94,000 (C)	94,000 (C)	1.9E+7	4.6E+8	4.6E+8	3.6E+10	94,000 (C)	94,000 (C)	94,000 (C)	94,000
Triphenyl phosphate	115866	NA	1.1E+5 (C)	1.1E+5 (C)	NA	1.1E+5 (C)	NLV	ID	ID	ID	ID	1.1E+5 (C)	1.1E+5 (C)	1.1E+5 (C)	1.1E+5
tris(2,3-Dibromopropyl)phosphate	126727	NA	66	270	NA	27,000 (C)	27,000 (C)	60,000	60,000	60,000	7.4E+6	27,000 (C)	27,000 (C)	27,000 (C)	27,000
Urea	57136	NA	ID (N)	ID (N)	NA	ID	NLV	NLV	NLV	NLV	ID	ID	ID	ID	NA
Vanadium	7440622	NA	72,000	9.9E+5	1.9E+5	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	1.0E+7	1.2E+7	1.1E+7	NA
Vinyl acetate (I)	108054	NA	13,000	36,000	NA	2.4E+6 (C)	1.5E+6	2.0E+6	2.7E+6	5.9E+6	5.9E+9	2.4E+6 (C,AD)	2.4E+6 (C,AD)	2.4E+6 (C,AD)	2.4E+6
Vinyl chloride	75014	NA	40	40	300	11,000	150	1,500	9,000	22,000	4.7E+7	29,000	51,000	37,000	4.9E+5

ATTACHMENT A
SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number →		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria	Industrial and Commercial Drinking Water Protection Criteria	Groundwater Surface Water Interface Protection Criteria	Groundwater Contact Protection Criteria	Soil Volatilization to Indoor Air Inhalation Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
White phosphorus (R)	12185103	NA	2.2	6.0	NA	58,000	NLV	NLV	NLV	NLV	ID	30,000 (AD)	37,000 (AD)	33,000 (AD)	NA
Xylenes (I)	1330207	NA	5,600	5,600	700	1.5E+5 (C)	1.5E+5 (C)	5.4E+7	6.5E+7	1.3E+8	1.3E+11	1.5E+5 (C)	1.5E+5 (C)	1.5E+5 (C)	1.5E+5
Zinc (B)	7440666	47,000	2.4E+6	5.0E+6	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	1.0E+9 (D)	1.0E+9 (D)	1.0E+9 (D)	NA

FOOTNOTES

{A} Criterion is the State of Michigan Drinking Water Standard established pursuant to Section 5 of the Safe Drinking Water Act, Act No. 399 of the Public Acts of 1976.

{B} Background, as defined in Rule 299.5701(c), may be substituted if higher than the calculated cleanup criteria. Background levels may not exceed criteria for all inorganic compounds.

{C} Value presented is a screening level based on the chemical-specific generic soil saturation concentration (Csat) since the calculated risk-based criterion is greater than Csat. Concentrations greater than Csat are acceptable cleanup criteria for this pathway where a site-specific demonstration indicates that free-phase contaminant is not present. Consult the Generic Soil Saturation Concentrations: Technical Support Document (August 31, 1998) for further guidance on development of site-specific Csat values. Risk-based criteria are available by contacting an ERD toxicologist.

{D} Calculated criterion exceeds 100%, hence it is reduced to 100% (i.e., 1.0E+9 ppb). Evaluation of free phase contaminant, environmental impacts, adverse aesthetics and acute or local toxicity is required.

{E} Criterion is the aesthetic drinking water value, as required by Sec. 20120(1)(5). A Notice of Aesthetic Impact may be employed as an institutional control mechanism where groundwater concentrations exceed the aesthetic DWC, but do not exceed the applicable health-based DWC. Health-based DWC are provided in the table below.

Hazardous Substance	CAS #	Residential Health-Based DWC	Industrial-Commercial Health-Based DWC
Aluminum	7429905	300	4,100
Chloride	16887006	ID	ID
Copper	7440508	1,400	4,000
Diethyl ether	60297	3,700	10,000
Ethylbenzene	100414	700	700
Iron	7439896	2,000	5,600
Manganese	7439965	860	2,500
Methyl-tert-butyl ether (MTBE)	1634044	240	690
Sulfate	14808798	ID	ID
Toluene	108883	1,000	1,000
1,2,4-Trimethylbenzene	95636	1,000	2,900
1,3,5-Trimethylbenzene	108678	1,000	2,900
Xylenes	1330207	10,000	10,000

{F} Criterion is based on adverse impacts to plant life (i.e., phytotoxicity).

{G} GSI criterion is pH or water hardness dependent. The Final Chronic Value (FCV) for the protection of aquatic life must be calculated based on the pH or hardness of the receiving surface water. Where water hardness exceeds 400 mg $CaCO_3$/L, use 400 mg $CaCO_3$/L for the FCV calculation. The FCV formula provides values in units of ug/L (ppb). The generic GSI criterion is the lesser of the calculated FCV, the wildlife value (WV) and the surface water human non-drinking water value (HNDV). The soil GSI protection criteria for these hazardous substances are the greater of the 20 X GSI and the GSI soil-water partition values using the GSI criteria developed with the procedure described in this footnote.

Hazardous Substance	FCV Formula ug/L	FCV Conversion Factor (CF)	WV ug/L	HNDV ug/L
Barium[⊗]	EXP(1.0629*(LnH)+1.1869)	NA	NA	1.6E+5
Beryllium	EXP(2.5279*(LnH)-10.7689)	NA	NA	1,200
Cadmium[⊗]	(EXP(0.7852*(LnH)-2.715))*CF	1.101672-((LnH)*0.04184)	NA	130
Chromium (III) [⊗]	(EXP(0.819*(LnH)+0.6848))*CF	0.86	NA	9,400
Copper	(EXP(0.8545*(LnH)-1.702)) *CF	0.96	NA	64,000
Lead[⊗]	(EXP(1.273*(LnH)-3.296))*CF	1.46203-((LnH)*0.14571)	NA	190
Manganese	EXP(0.8784*(LnH)+2.226)	NA	NA	59,000

Hazardous Substance	FCV Formula ug/L	FCV Conversion Factor (CF)	WV ug/L	HNDV ug/L
Nickel	(EXP(0.846*(LnH)+0.0584))*CF	0.997	NA	2.1E+5
Pentachlorophenol®	EXP(1.005*(pH)-5.134)	NA	NA	2.8
Zinc	(EXP(0.8473*(LnH)+0.884))*CF	0.986	NA	22,000

Where,

EXP(x) = The base of the natural logarithm raised to power x (e^x).
LnH = The natural logarithm of water hardness in mg $CaCO_3$/L.
SS = Total suspended solids in mg/L
* = The multiplication symbol.
® = The GSI criterion developed here may not be protective for surface water that is used as a drinking water source. Refer to footnote {X} for further guidance.

A spreadsheet that may be used to calculate GSI and GSI PC for {G} footnoted hazardous substances is available at http://www.deq.state.mi.us/erd.

{H} Valence-specific chromium data (Cr III and Cr VI) must be compared to the corresponding valence-specific cleanup criteria. If both Cr III and Cr VI are present in groundwater, the total concentration of both cannot exceed the DWC of 100 ug/l. If analytical data are provided for "total" chromium only, then values for Cr VI must be applied as the cleanup criteria. Cr III cleanup criterion for protection of drinking water can only be used at sites where groundwater is prevented from being used as a public water supply, currently and in the future.

{I} Hazardous substance may exhibit the characteristic of ignitability as defined in 40 CFR 261.21.

{J} Hazardous substance may be present in several isomer forms. Isomer-specific concentrations must be added together for comparison to criteria.

{K} Hazardous substance may be flammable and/or explosive.

{L} Reserved

{M} Calculated criterion is below the analytical Target Detection Limit (TDL), therefore, the criterion defaults to the TDL.

{N} The concentrations of all potential sources of nitrate-nitrogen (e.g., ammonia-N, nitrite-N, nitrate-N) in groundwater used as a source of drinking water must not, when added together, exceed the nitrate DWC of 10,000 ug/L. Where leaching to groundwater is a relevant pathway, soil concentrations of all potential sources of nitrate-nitrogen must not, when added together, exceed the nitrate DWPC of 2.0E+5 ug/Kg.

{O} All polychlorinated and polybrominated dibenzodioxins and dibenzofurans are considered as one hazardous substance. The concentration of all isomers present at a facility, expressed as an equivalent concentration of 2,3,7,8-tetrachlorodibenzo-p-dioxin based upon their relative potency, must be added together and compared to the criteria for 2,3,7,8-tetrachlorodibenzo-p-dioxin. The generic criteria revisions have not been incorporated into the criteria for 2,3,7,8-tetrachlorodibenzo-p-dioxin, therefore the criteria listed is the same as shown in the May 28, 1999 criteria tables.

{P} Amenable or Method OIA-1677 analysis are used to quantify cyanide concentrations for compliance with all groundwater criteria. Total, amenable, or Method OIA-1677 analysis may be used to quantify cyanide concentrations for compliance with soil criteria. Industrial/commercial DCC may not be protective of the potential for release of hydrogen cyanide (HCN) gas. Additional

land use restrictions may be necessary to protect for the acute inhalation concerns associated with HCN.

{Q} Criteria for carcinogenic polycyclic aromatic hydrocarbons (PAHs) were developed using "relative potential potencies" (RPPs) to benzo(a)pyrene.

{R} Hazardous substance may exhibit the characteristic of reactivity as defined in 40 CFR 261.23.

{S} Criterion defaults to the chemical-specific water solubility limit.

{T} Refer to the Toxic Substances Control Act (TSCA), 40 CFR 761, Subparts D and G, as amended, to determine the applicability of TSCA cleanup standards. Alternatives to compliance with the standards listed below are possible under Subpart D. New releases may be subject to the standards identified in Subpart G. Use Part 201 soil direct contact criteria in the table below where TSCA standards are not applicable.

LAND USE CATEGORY	TSCA, Subpart D	PART 201
Residential & Commercial I	1,000 ppb, or 10,000 ppb if capped	4,000 ppb
Industrial & Commercial II	1,000 ppb, or 10,000 ppb if capped	20,000 ppb
Commercial III	1,000 ppb, or 10,000 ppb if capped	62,000 ppb
Commercial IV	1,000 ppb, or 10,000 ppb if capped	32,000 ppb

{U} Hazardous substance may exhibit the characteristic of corrosivity as defined in 40 CFR 261.22.

{V} Criterion is the aesthetic drinking water value (secondary maximum contaminant level), as required by Sec. 20120(a)(5). Higher concentrations (up to 200 ug/L) may be acceptable on a case-by-case basis.

{W} Concentrations of trihalomethanes in groundwater must be added together to determine compliance with the State of Michigan Drinking Water Standard of 100 ug/L. Concentrations of trihalomethanes in soil must be added together to determine compliance with the DWPC of 2,000 ug/kg.

{X} The GSI criterion shown is not protective for surface water that is used as a drinking water source. For groundwater discharges to the Great Lakes and their connecting waters or discharges in close proximity to water supply intake(s) in inland surface waters, the generic GSI criterion is the Surface Water Human Drinking Water Value (HDV) listed in the table below except for those HDV indicted with an asterisk. For HDV with an asterisk, the generic GSI criterion is the lesser of the HDV, the WV and the calculated FCV (see formulas in footnote {G}). Soil protection criteria based on the HDV are listed below except for those values with an asterisk. Soil GSI protection criteria based on the HDV are listed below except for those values with an asterisk. Soil GSI protection criteria for compounds with an asterisk are the greater of the 20 X GSI and the GSI soil-water partition values using the GSI criteria developed with the procedure described in this footnote.

Hazardous Substance	Chemical Abstract Service Number	Surface Water Human Drinking Water Values (HDV) (ug/L)	Soil GSI Protection Criteria for HDV (ug/Kg)
Acrylonitrile	107131	0.87	17
Alachlor	15972608	3.5	70
Arsenic	7440382	50	16,000

Hazardous Substance	Chemical Abstract Service Number	Surface Water Human Drinking Water Values (HDV) (ug/L)	Soil GSI Protection Criteria for HDV (ug/Kg)
Atrazine	1912249	4.3	86
Barium	7440393	1,900*	*
Benzene	71432	12	240
Butyl benzyl phthalate	85687	6.9	1,300
Cadmium	7440439	2.5*	*
Carbon tetrachloride	56235	5.6	110
Chloride	16887006	50,000	1.0E+6
Chloroform	67663	77	1,500
Chromium (III)	16065831	120*	*
Cyanazine	21725462	10 {M}	200
3,3'-Dichlorobenzidine	91941	0.3 {M}	500
1,2-Dichloroethane	107062	6	120
1,1-Dichloroethylene	75354	24	480
1,2-Dichloropropane	78875	9.1	180
N,N-Dimethylacetamide	127195	700	14,000
1,4-Dioxane	123911	34	680
Ethylene glycol	107211	56,000	1.1E+6
Hexachloroethane	67721	5.3	1,500
Isophorone	78591	310	6,200
Lead	7439921	14*	*
Methyl-tert-butyl ether (MTBE)	1634044	120	2,400
Methylene chloride	75092	47	940
Molybdenum	7439987	120	2,400
Nitrobenzene	98953	4.7	94
Pentachlorophenol	87865	1.8*	*
1,2,4,5-Tetrachlorobenzene	95943	2.8	3,300
1,1,2,2-Tetrachloroethane	79345	3.2	64
Tetrachloroethylene	127184	11	220
Tetrahydrofuran	109999	350	7,000
Thallium	7440280	1.2	910
1,1,2-Trichloroethane	79005	12	240
Trichloroethylene	79016	29	580

{Y} Source size modifiers for Soil Inhalation Criteria (SIC) for Ambient Air. Consult the Technical Support Document (TSD) for the SIC if further guidance is needed.

Source Size sq. feet or acres	Modifier
400 sq feet	3.17
1000 sq feet	2.2
2000 sq feet	1.76
1/2 acre	1
1 acre	0.87
5 acre	0.66
10 acre	0.6
32 acre	0.5
100 acre	0.43

{Z} The current TDL for mercury is 0.2 ppb, however, a TDL of 5.0E-4 using U.S. EPA Method 1631, will be required after September 30, 2000.

{AA} Filtered groundwater samples must be collected for appropriate comparison to the GCC, since these hazardous substances are likely to be adsorbed to particulates rather than dissolved in water.

{AB} The state drinking water standard for asbestos is in units of fibers per milliliter of water (f/mL) longer than 10 millimicrons. Soil concentrations of asbestos are determined by polarized light microscopy (PLM).

{AC} The GSI criteria for unionized ammonia are 29 ug/L and 53 ug/L for coldwater and warmwater streams, respectively. The unionized ammonia concentration for comparison to the GSI is calculated from the measured total ammonia concentration based on pH and temperature for the receiving surface water and the discharge plume. The soil GSI PC are 580 ug/Kg and 1,100 ug/Kg for coldwater and warmwater streams, respectively.

{AD} Hazardous substance causes developmental effects. Residential and Commercial I DCC are protective of both prenatal and postnatal exposure. Industrial and Commercial II, III and IV DCC are protective for an adult pregnant receptor.

{AE} The following are applicable generic GSI criteria as allowed for under Sec. 20120a(15).

Hazardous Substance	GSI (ug/L)	Notes
Phosphorus	1,000	If the discharge is to an inland lake or a surface water with a designated phosphorus waste load allocation, consult the ERD Field Operation Section for further guidance.
Total dissolved solids (TDS)	5.0E+5	If TDS data are not available, the TDS criterion may be used a screening level for the sum of the concentrations of the following substances: Calcium, Chlorides, Iron, Magnesium, Potassium, Sodium, Sulfate.
Dissolved Oxygen (DO): Cold receiving waters Warm receiving waters	≥ 7,000 ≥ 5,000	DO criteria are not applicable if groundwater Carbonaceous Biochemical Oxygen Demand (CBOD) is less than 10,000 ug/L and groundwater ammonia concentration is less than 2,000 ug/L. Consult the ERD Field Operation Section for further guidance if needed.

ID = *Inadequate data* to develop criterion.

IP = Development of generic GSI value *in process*. This notation is used for those hazardous substances on the Rule 57 Water Quality Values table where the NLS (no literature search) notation is indicated for one or more of the endpoints required for development of a generic GSI. Additional work needed to address these endpoints may either be underway, or not yet initiated by the Surface Water Quality Division.

NA = Criterion or value is *not available* or, as is the case for Csat, *not applicable*.

NLL = Hazardous substance is *not likely to leach* under most soil conditions.

NLV = Hazardous substance is *not likely to volatilize* under most conditions.

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MATERIAL SAFETY DATA SHEET

R 5/05/89

CODE 16350

SECTION 1

Manufacturer's Name MacDermid Incorporated	EMERGENCY TELEPHONE 203-575-5700
ADDRESS (Number, Street, City, State, Zip Code) 526 Huntingdon Avenue Waterbury, CT. 06720	MFSA EMERGENCY 24 HOU HOTLINE: (313) - 644 - 5626
CFR-49 - DOT Proper Shipping Name Non-regulated	
CHEMICAL NAME AND SYNONYMS N/A	TRADE NAME AND SYNOM Proquel-B
CHEMICAL FAMILY Organic	FORMULA Mixture

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVE & SOLVENTS	% N/A	TLV (UNITS)	ALLOYS & METALLIC COATINGS	% N/A	TLV (UNIT
PIGMENTS	"		BASE METAL	"	
CATALYST	"		ALLOYS	"	
VEHICLE	"		METALLIC COATINGS	"	
SOLVENTS	"		FILLER METAL PLUS OR CORE FLUX	"	
ADDITIVES	"		OTHERS	"	
OTHERS	"				

HAZARDOUS MIXTURES OR OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (UNIT
Trifluoroacetic acid (76-05-1)	<4	not listed

SECTION III - PHYSICAL DATA

BOILING POINT (F)	> 212	SPECIFIC GRAVITY (H_2O = 1)	1.(
VAPOR PRESSURE (MM. HG.)	Unknown	PERCENT VOLATILE BY VOLUME (%)	Unknou
VAPOR DENSITY (AIR = 1)	Unknown	EVAPORATION RATE (= 1)	Unknou
SOLUBILITY IN WATER	Appreciable	pH (5% solution)	6.6 - 7

APPEARANCE AND ODOR
Brown liquid

SECTION IV = FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED) Non-flammable	FLAMMABLE LIMITS N/A	LEL	U

EXTINGUISHING MEDIA
As appropriate for surrounding material

SPECIAL FIRE FIGHTING PROCEDURES
Always wear self-contained breathing apparatus when fighting fires involving chemicals.

UNUSUAL FIRE AND EXPLOSION HAZARDS
Unknown

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE
Not established for product.

EFFECTS OF OVEREXPOSURE-UNLESS OTHERWISE STATED, CHRONIC OR LONG-TERM HEALTH EFFECTS UNKNOW
Will cause irritation and possible burns to eyes, skin and mucous membranes.

EMERGENCY AND FIRST AID PROCEDURES
EYES - Flush with water for 15 minutes. Contact physician.
SKIN - Flush with water.
INGESTION - Give water, induce vomiting. Contact physician.
INHALATION - Remove to fresh air.

SECTION VI - REACTIVITY DATA

		CONDITIONS TO AVOID
UNSTABLE		N/A
STABLE	X	

INCOMPATIBILITY (MATERIALS TO AVOID)
Strong oxidizing agents, strong acids

HAZARDOUS DECOMPOSITION PRODUCTS
Unknown

HAZARDOUS POLYMERIZATION		CONDITIONS TO AVOID
MAY OCCUR		N/A
WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Soak up with adsorbent material - flush residue to chemical drain with water.

WASTE DISPOSAL METHOD
Dilute with water and discard to waste treatment system.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (SPECIFY TYPE)
Not normally required. If respiratory irritation occurs, use a NIOSH-approved respirator for organic vapors.

VENTILATION	LOCAL EXHAUST	SPECIAL
	N/A	N/A
	MECHANICAL (GENERAL)	OTHER
	X	N/A

PROTECTIVE GLOVES	EYE PROTECTION
Rubber	Eye goggles/face shield

OTHER PROTECTIVE EQUIPMENT
Rubber apron/boots

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING
Store in tightly closed containers in cool, dry area.

OTHER PRECAUTIONS
Unknown

PREPARED BY: MacDermid Incorporated

DATE: 5/05/89
16350

McGEAN-ROHCO, INC.
MATERIAL SAFETY DATA SHEET

PRODUCT NAME: REFLECTA MAINTENANCE

MSDS No.: 11305
REVISION: 4
PREPARED BY: DIR OF ENV AFFAIRS ISSUE DATE:03/01/85 EFFECTIVE DATE: 05/01/97

SECTION A. MATERIAL IDENTIFICATION.

MANUFACTURER: McGEAN-ROHCO, INC.

CHEMTREC:
TELEPHONE #: 800-424-9300

2910 HARVARD AVE.
CLEVELAND OH 44105
TELEPHONE: 216-441-4900

SECTION B. INGREDIENTS AND HAZARDS.

INGREDIENT: SACCHARIN

4.0%
CAS NUMBER: 81-07-2
EXPOSURE LIMIT: TWA: NONE ESTABLISHED
SUSPECT CARCINOGEN: YES

SECTION C. PHYSICAL DATA.

APPEARANCE: STRAW COLORED LIQUID
ODOR: MILD
SPECIFIC GRAVITY: 1.04
pH: 4-5

EVAPORATION RATE: <BUTYL ACETATE

BOILING POINT: >100 C
FREEZING POINT: UK
VAPOR PRESSURE: UK
VAPOR DENSITY: UK
% VOLATILE BY VOLUME: NA
SOLUBILITY IN WATER: 100%

SECTION D. FIRE AND EXPLOSION HAZARD DATA.

FLASH POINT: NONE
TEST METHOD: NA

LIMITS: LEL: NA
UEL: NA

HAZARD SYMBOL CODES

	NFPA	HMIS
HEALTH:	0	0
FLAMMABILITY:	0	0
REACTIVITY:	0	0
SPECIAL:		

EXTINGUISHING MEDIA: NOT FLAMMABLE

SPECIAL FIRE FIGHTING PROCEDURES: NONE

UNUSUAL FIRE OR EXPLOSION HAZARDS: NONE

PRODUCT NAME: REFLECTA MAINTENANCE MSDS No.: 11305
REVISION: 4
PREPARED BY: DIR OF ENV AFFAIRS ISSUE DATE:03/01/85 EFFECTIVE DATE: 05/01/97

SECTION E. REACTIVITY DATA.

MATERIAL IS STABLE.
HAZARDOUS POLYMERIZATION WILL NOT OCCUR.

CONDITIONS TO AVOID: NA

CHEMICAL INCOMPATIBILITIES: NONE KNOWN

HAZARDOUS DECOMPOSITION PRODUCTS: NONE KNOWN

SECTION F. HEALTH HAZARD DATA.

SUMMARY OF RISKS: SARA CHRONIC

MEDICAL CONDITIONS WHICH MAY BE AGGRAVATED BY CONTACT: NONE KNOWN

TARGET ORGANS: BLADDER

PRIMARY ENTRY ROUTES: THROUGH CONTACT

ACUTE EFFECTS: POSSIBLE SLIGHT IRRITATION OF SKIN OR EYES.

CHRONIC EFFECTS: SACCHARIN SUSPECT CANCER AGENT

SIGNS & SYMPTOMS OF OVEREXPOSURE:
EYE CONTACT: POSSIBLE IRRITATION.

SKIN CONTACT: NONE TO POSSIBLE SLIGHT IRRITATION.

INHALATION: NONE KNOWN

INGESTION: ANOREXIA, NAUSEA, VOMITING, DIARRHEA.

MSDS No.: 11305
REVISION: 4
PRODUCT NAME: REFLECTA MAINTENANCE
PREPARED BY: DIR OF ENV AFFAIRS ISSUE DATE:03/01/85 EFFECTIVE DATE: 05/01/97

EMERGENCY & FIRST AID PROCEDURES:

EYE CONTACT: FLUSH WITH WATER FOR 15 MINUTES. IF ANY IRRITATION PERSISTS, SEE A PHYSICIAN.

SKIN CONTACT: WASH WITH SOAP AND WATER.

INHALATION: NOT EXPECTED TO BE A PROBLEM.

INGESTION: IF CONSCIOUS, GIVE SEVERAL GLASSES OF WATER AND INDUCE VOMITING. GET MEDICAL ATTENTION.

SECTION G. SPILL, LEAK AND DISPOSAL PROCEDURES.

SPILL/LEAK PROCEDURES: FLUSH WITH WATER.

WASTE MANAGEMENT & DISPOSAL PROCEDURES: FLUSH WITH WATER TO SEWER. FOLLOW ALL LOCAL, STATE, AND FEDERAL REGULATIONS.

RCRA # (IF DISPOSED AS RECEIVED): NONE

SECTION H. SPECIAL PROTECTION INFORMATION

PERSONAL PROTECTIVE EQUIPMENT:

GOGGLES: CHEMICAL GOGGLES.
GLOVES: RUBBER.
RESPIRATOR: NOT NORMALLY REQUIRED.
OTHER: SUFFICIENT TO PREVENT SKIN CONTACT.

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: REFLECTA MAINTENANCE

MSDS No.: 11305
REVISION: 4

PREPARED BY: DIR OF ENV AFFAIRS ISSUE DATE:03/01/85 EFFECTIVE DATE: 05/01/97

WORKPLACE CONSIDERATIONS:
VENTILATION: NORMAL.
SAFETY STATIONS: EYE WASH
OTHER: SAFETY SHOWER.

SECTION I. SPECIAL PRECAUTIONS.

SPECIAL HANDLING & STORAGE PROCEDURES: NORMAL HANDLING AND STORAGE.

D.O.T. CLASS: NONE UN REGISTER: NONE
IMCO CLASS: NONE UN REGISTER: NONE

EXPLANATION OF SYMBOLS
NA = NOT APPLICABLE UK = UNKNOWN

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10337 (81)

McGean-Rohco, Inc

1250 Terminal Tower, Cleveland, Ohio 44113, 216/621-6425

MATERIAL SAFETY DATA SHEET

Product Name: RODIP-0-0 PART-A		Emergency Phone No.: 216/441-4900
Plant Address: 2910 Harvard Avenue	Cleveland, OH 44109	Chemtrec Phone No.: 800/424-9300
Prepared By: TSCA Coordinator	Issue Date: 1/80	Revised Date: 4th 2/89

INGREDIENTS AND HAZARDOUS COMPONENTS

Material	%	TLV	C.A.S. #	Suspect Carcinogen
Chromic Acid SARA 313 Chemical	10	0.1	7738-94-5	YES
Sodium Chromate SARA 313 Chemical	25	* 0.05	7775-11-3	YES
Nitric Acid SARA 313 Chemical	5	5	7697-37-2	NO
		Mg/M3		
* As Cr				

PHYSICAL DATA

Boiling Point: >100°C.	Freezing Point: UK	Specific Gravity: 1.13	pH: strongly acidic
Vapor Pressure at 20° C: UK	Vapor Density (Air = 1): UK	% Volatiles by Volume: 80	Odor: slight
Evaporation Rate (Butyl Acetate = 1) <1		Solubility in Water: complete	
Appearance and Form: Orange - Red Liquid			

FIRE AND EXPLOSION HAZARD DATA

Flash Point: NA	Flammable Limits in Air: % By Volume Upper: NA Lower:
Test Method: NA	
Extinguishing Media: NA	
Special Fire Fighting Procedures: If involved in fire, use self contained breathing apparatus.	
Unusual Fire and Explosion Hazards: Oxides of nitrogen could be given off.	
DOT Classification: corrosive UN-1760	Note: UK = Unknown NA = Not Applicable

HEALTH HAZARD DATA

Effects of Exposure and Primary Entries to Body:

Primary entry through skin and inhalation of mists.
Acute: Can cause severe burns to skin and eyes.
Chronic: Can cause ulceration of mucous membranes. Toxic, can cause liver and kidney damage. Symptoms: Redness and burning sensation.
Conditions Aggravated: Kidney ailments.

Emergency and First Aid Procedures:

Flush skin and eyes with water for at least 15 minutes.
Get medical attention.

REACTIVITY DATA

☒ Stable ☐ Unstable Conditions to Avoid:

Incompatability — Materials to Avoid:

Oxidizable materials

Hazardous Decomposition Products:

NA

Hazardous Polymerization: ☐ May Occur ☒ Will Not Occur

SPILL OR LEAK PROCEDURES

Spills:

Absorb on suitable material. Place in compatible container for transfer to waste treating dept.

Waste Disposal Methods:

Reduce to chromium +3 using reducing agents such as sodium sulfite or ferrous sulfate. Raise pH to 7.5 and precipitate the chrome +3. The precipitate may be disposed of in an EPA approved landfill.

Follow all local, state and Federal regulations

SPECIAL PROTECTION INFORMATION

Respirator: Use only NIOSH or MSHA approved respirator.

Ventilation: Mechanical - sufficient to keep below TLV limits

Gloves:	Eye and Face:	Other:
Rubber	chemical goggles & face shield	Sufficient to prevent skin and clothing contact.

Handling and Storage:

Store in a well ventilated area away from combustibles.

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T 1980 McGean-Rohco, Inc.
Date

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McGean-Rohco, Inc.

1250 Terminal Tower, Cleveland, Ohio 44113, 216/621-6425

MATERIAL SAFETY DATA SHEET

Product Name: ROOIP-O-D PART B	Emergency Phone No.: 216/441-4900
Plant Address: 2910 Harvard Avenue Cleveland, OH 44109	Chemtrec Phone No. 800/424-9300
Prepared By: TSCA Coordinator	Issue Date: 1/80 — Revised Date: 2nd 3/87

INGREDIENTS AND HAZARDOUS COMPONENTS

Material	%	TLV	C.A.S. #	Suspect Carcinogen
Formic Acid	55	9	64-18-6	NO

PHYSICAL DATA

Boiling Point: >100°C	Freezing Point: UK	Specific Gravity: 1.13	pH: 1
Vapor Pressure at 20°C: UK	Vapor Density (Air = 1): UK	% Volatiles by Volume: 100	Odor: puncent
Evaporation Rate (Butyl Acetate = 1) <1		Solubility in Water: complete	
Appearance and Form: clear liquid			

FIRE AND EXPLOSION HAZARD DATA

Flash Point: NA	Flammable Limits in Air: % By Volume — Upper: NA — Lower:
Test Method: NA	
Extinguishing Media: NA	
Special Fire Fighting Procedures: If involved in a fire, use self-contained breathing apparatus.	
Unusual Fire and Explosion Hazards: NA	
Classification: Corrosive UN-1779	Note: UK = Unknown NA = Not Applicable

HEALTH HAZARD DATA

Effects of Exposure and Primary Entries to Body:
Primary entry through skin contact and inhalation of vapors.
Acute: Corrosive to skin and eyes. Vapors irritate upper respiratory tract.
Chronic: None known.
Symptoms: Burning sensation. Can cause coughing, difficulty in breathing.
Conditions aggravated: None known.

Emergency and First Aid Procedures:
Wash skin with soap and water. If any irritation persists, see a physician. Flush eyes with water for at least 15 minutes. Get medical attention. For inhalation remove to fresh air. Get medical attention.

REACTIVITY DATA

☒ Stable ☐ Unstable Conditions to Avoid:

Incompatability — Materials to Avoid:
oxidizing agents

Hazardous Decomposition Products:
NA

Hazardous Polymerization: ☐ May Occur ☒ Will Not Occur

SPILL OR LEAK PROCEDURES

Spills:
Neutralize with soda ash. Flush to sewer

Waste Disposal Methods:
If allowed, neutralize with soda ash and flush to sewer. Can be destroyed with hydrogen peroxide. Add flammable solvent and incinerate.

Follow all Local, State and Federal regulations.

SPECIAL PROTECTION INFORMATION

Respirator: Use only NIOSH or MSHA approved respirator. See NIOSH publication #80-144

Ventilation: Mechanical - sufficient to keep below TLV

Gloves:	Eye and Face:	Other:
rubber	chemical goggles	sufficient to prevent skin contact.

Handling and Storage:
Store in a cool, well-ventilated area away from direct sunlight.
Store away from oxidizing agents.

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MATERIAL SAFETY DATA SHEET

PRODUCT NAME: ROGARD SUPREME SEAL 500 MSDS No.: 13406
REVISION: 1
PREPARED BY: TSCA COORDINATOR ISSUE DATE: 07/01/92 REVISION DATE: 11/16/92

SECTION A. MATERIAL IDENTIFICATION.

MANUFACTURER: McGEAN-ROHCO, INC.

38521 SCHOOLCRAFT AVE.
LIVONIA MI 48150
TELEPHONE: 313-872-1800

CHEMTREC:
TELEPHONE #: 800-424-9300

SECTION B. INGREDIENTS AND HAZARDS.

INGREDIENT: ALKALINE SILICATE

CAS NUMBER: NA 30.0 - 40.0%
EXPOSURE LIMIT: TWA: NONE ESTABLISHED
SUSPECT CARCINOGEN: NO

SECTION C. PHYSICAL DATA.

APPEARANCE: COLORLESS TO PALE YELLOW LIQ.
ODOR: NONE

BOILING POINT: UK
FREEZING POINT: UK

SPECIFIC GRAVITY: 1.35-1.45
pH: 11-12

VAPOR PRESSURE: UK
VAPOR DENSITY: UK
% VOLATILE BY VOLUME: NA
SOLUBILITY IN WATER: COMPLETE

EVAPORATION RATE: <BUTYL ACETATE

SECTION D. FIRE AND EXPLOSION HAZARD DATA.

FLASH POINT: NONE
TEST METHOD: NA

LIMITS: LEL: NA
UEL: NA

HAZARD SYMBOL CODES

	NFPA	HMIS
HEALTH:	2	2
FLAMMABILITY:	0	0
REACTIVITY:	0	0
SPECIAL:		

EXTINGUISHING MEDIA: NOT FLAMMABLE.

SPECIAL FIRE FIGHTING PROCEDURES: SKIN AND EYE PROTECTION SHOULD BE WORN.

UNUSUAL FIRE OR EXPLOSION HAZARDS: NONE

PRODUCT NAME: ROGARD SUPREME SEAL 500 MSDS No.: 13406
REVISION: 1
PREPARED BY: TSCA COORDINATOR ISSUE DATE: 07/01/92 REVISION DATE: 11/16/92

SECTION E. REACTIVITY DATA.

MATERIAL IS STABLE.
HAZARDOUS POLYMERIZATION WILL NOT OCCUR.

CONDITIONS TO AVOID: NA

CHEMICAL INCOMPATIBILITIES: ACIDS CAN CAUSE GELLING.

HAZARDOUS DECOMPOSITION PRODUCTS: NONE KNOWN.

SECTION F. HEALTH HAZARD DATA.

SUMMARY OF RISKS: SARA-ACUTE

MEDICAL CONDITIONS WHICH MAY BE AGGRAVATED BY CONTACT: NONE KNOWN.

TARGET ORGANS: SKIN, EYES.

PRIMARY ENTRY ROUTES: THROUGH CONTACT.

ACUTE EFFECTS: STRONGLY IRRITATING TO SKIN AND EYES.

CHRONIC EFFECTS: NONE KNOWN.

SIGNS & SYMPTOMS OF OVEREXPOSURE:

EYE CONTACT: BURNING-STINGING SENSATION.

SKIN CONTACT: IRRITATION, BURNING. MAY BE DELAYED.

INHALATION: MIST COULD CAUSE SNEEZING, COUGHING, IRRITATION OF THE RESPIRATORY TRACT.

INGESTION: SEVERE IRRITATION AND POSSIBLE TISSUE DAMAGE TO MUCOUS MEMBRANES OF MOUTH, THROAT, ESOPHAGUS, AND STOMACH.

PRODUCT NAME: ROGARD SUPREME SEAL 500 MSDS No.: 13406
REVISION: 1
PREPARED BY: TSCA COORDINATOR ISSUE DATE:07/01/92 REVISION DATE: 11/16/92

EMERGENCY & FIRST AID PROCEDURES:

EYE CONTACT: FLUSH WITH WATER FOR 15 MINUTES. GET MEDICAL ATTENTION.

SKIN CONTACT: FLUSH WITH WATER FOR 15 MINUTES. IF ANY IRRITATION PERSISTS, GET MEDICAL ATTENTION.

INHALATION: REMOVE TO FRESH AIR.

INGESTION: IF CONSCIOUS,GIVE A LARGE QUANTITY OF WATER AND GET MEDICAL ATTENTION. DO NOT INDUCE VOMITING.

SECTION G. SPILL, LEAK AND DISPOSAL PROCEDURES.

SPILL/LEAK PROCEDURES: ABSORB ON SUITABLE ABSORBANT SUCH AS VERMICULITE. FLOOR MAY BE SLIPPERY. WASH WITH SOAP AND WATEE UNTIL NO LONGER SLIPPERY.

WASTE MANAGEMENT & DISPOSAL PROCEDURES: DILUTE AT LEAST 10-1. ADJUST pH TO WITHIN POTW DISCHARGE LIMITS AND SEWER. FOLLOW ALL LOCAL,STATE,AND FEDERAL REGULATIONS.

RCRA # (IF DISPOSED AS RECEIVED): NONE

SECTION H. SPECIAL PROTECTION INFORMATION

PERSONAL PROTECTIVE EQUIPMENT:

GOGGLES: CHEMICAL GOGGLES.
GLOVES: RUBBER
RESPIRATOR: NOT NORMALLY REQUIRED.

OTHER: SUFFICIENT TO PREVENT SKIN CONTACT.

PRODUCT NAME: ROGARD SUPREME SEAL 500 MSDS No.: 13406
REVISION: 1
PREPARED BY: TSCA COORDINATOR ISSUE DATE: 07/01/92 REVISION DATE: 11/16/92

WORKPLACE CONSIDERATIONS:
VENTILATION: NORMAL.
SAFETY STATIONS: EYE WASH.
OTHER: SAFETY SHOWER.

SECTION I. SPECIAL PRECAUTIONS.

SPECIAL HANDLING & STORAGE PROCEDURES: DO NOT USE ALUMINUM FITTINGS OR TRANSFER LINES. KEEP AWAY FROM ACIDS. STORE AT 40-90F.

D.O.T. CLASS: NONE UN REGISTER: NONE
IMCO CLASS: NONE UN REGISTER: NONE

EXPLANATION OF SYMBOLS
NA = NOT APPLICABLE UK = UNKNOWN

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Sodium Bicarbonate

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MATERIAL SAFETY DATA SHEET

I PRODUCT IDENTIFICATION

MANUFACTURER'S NAME	Church & Dwight Co, Inc	REGULAR TELEPHONE NO.	(201) 885-1220
ADDRESS	PO Box 369, 20 Kingsbridge Road, Piscataway, NJ 08854	EMERGENCY TELEPHONE NO.	(201) 885-1220
CHEMICAL NAME AND SYNONYMS	Baking Soda, Bicarbonate of Soda, Carbonic Acid Mono Sodium Salt	CAS NO. / UN NO.	144-55-8
TRADE NAME AND SYNONYMS	Sodium Bicarbonate USP		
CHEMICAL FAMILY	Carbonates	FORMULA	$NaHCO_3$
SHIPPING NAME: DOT:	Sodium Bicarbonate 28-123-16	IATA:	Sodium Bicarbonate

II HAZARDOUS INGREDIENTS

MATERIAL OR COMPONENT	CAS NO. UN NO.	%	HAZARD DATA
NOTH			

III PHYSICAL DATA

BOILING POINT, 760 mm Hg	None	MELTING POINT	Decomposes
BULK DENSITY / SPECIFIC GRAVITY (H_2O=1)	60 lbs/cu ft	VAPOR PRESSURE (mm Hg at °C)	NA
VAPOR DENSITY (AIR=1)	NA	SOLUBILITY IN H_2O, % BY WT. Gr/100 ml	6.9 @ 0°C 16.4 @ 60°C
% VOLATILES BY VOL.	NA	EVAPORATION RATE	NA
APPEARANCE AND ODOR	White Crystalline Powder; No Odor	pH (AS IS) pH AT 1% Solution	8.3

IV FIRE AND EXPLOSION DATA

FLASH POINT (TEST METHOD)	None	AUTO IGNITION TEMPERATURE: None	FLAMMABLE LIMITS IN AIR, % BY VOL.: Non-Flammable LOWER: UPPER:
EXTINGUISHING MEDIA			
SPECIAL FIRE FIGHTING PROCEDURES	None Required		
UNUSUAL FIRE AND EXPLOSION HAZARD	None		

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HEALTH HAZARD INFORMATION

HEALTH HAZARD DATA	HAZARD CLASSIFICATION	BASIS FOR CLASSIFICATION	SOURCE
ROUTES OF EXPOSURE			
INHALATION	None		
SKIN CONTACT	None	Human Patch	16 CFR 1500.3
SKIN ABSORPTION	None	Dermal Toxicity	16 CFR 1500.4
EYE CONTACT	None	Draize	16 CFR 1500.42
INGESTION	None	LD_{50} 6-8 g/kg	16 CFR 1500.3

EFFECTS OF OVEREXPOSURE	
ACUTE OVEREXPOSURE	None
CHRONIC OVEREXPOSURE	None

EMERGENCY AND FIRST AID PROCEDURES	
EYES	None Required
SKIN	None Required
INHALATION	None Required
INGESTION	None Required

NOTE TO PHYSICIAN	
	Overdosing can lead to systemic alkalosis.

VI REACTIVITY DATA

NTRIBUTING TO INSTABILITY

temperature exposure causes decomposition to sodium carbonate, water and on dioxide.

TIBILITY (MATERIALS TO AVOID)

eacts with acid to form salt, water and carbon dioxide.

ARDOUS DECOMPOSITION PRODUCTS

Gaseous carbon dioxide.

DITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION

None

VII SPILL OR LEAK PROCEDURES

PS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

Sweep up dry and dispose.

UTRALIZING CHEMICALS

None Required.

WASTE DISPOSAL METHOD OF SPILL OR LEAK

Dry land fill.

VIII SPECIAL PROTECTION INFORMATION

ENTILATION REQUIREMENTS

None

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY (SPECIFY IN DETAIL) None

EYE None

GLOVES None

OTHER CLOTHING AND EQUIPMENT

None

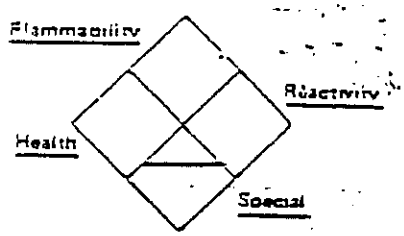
IX SPECIAL PRECAUTIONS

LABELING INFORMATION AND WARNINGS

None

DATA FOR HAZARDS INFORMATION LABEL

Hazard Code
4 = Extreme
3 = High
2 = Moderate
1 = Slight
0 = Insignificant



OTHER HANDLING AND STORAGE REQUIREMENTS

Store in clean, cool, dry place.

Shipped in multi-walled Kraft paper bags, air-slide rail cars, and bulk hopper trucks.

X DISPOSAL

WASTE DISPOSAL METHOD

Dry land fill.

AQUATIC TOXICITY (eg. 96 hr TLM): None

XI GOVERNMENT REGULATIONS

REFERENCE TO APPLICABLE GOVERNMENT REGULATIONS	REGULATION HIGHLIGHTS
FEDERAL None	
FDA	21 CFR GRAS for humans and animals
USDA	9 CFR
STATE	
OTHER	

PREPARED BY: M. Stephen Lajoie, Director of R&D Services — COMPANY: Church & Dwight Co, Inc

ADDRESS: PO Box 369, 20 Kingsbridge Road, Piscataway, NJ 08854 — TEL. NO.: (201) 885-1220

DATE PREPARED: /sr — LATEST REVISION DATE: 4/12/82

MATERIAL SAFETY DATA SHEET

(102)

Diamond Shamrock Chemicals Company

MSDS NUMBER: M105

MSDS DATE: 06-09-86

PRODUCT NAME: SODIUM CHROMATE ANHYDROUS

24 HOUR EMERGENCY PHONE: (214) 922-2700

I. PRODUCT IDENTIFICATION

3 HEALTH HAZARD, 0 FIRE HAZARD, & 1 REACTIVITY rating based on NIOSH "Identification System for Occupationally Hazardous Materials" (1974)

MANUFACTURER'S NAME AND ADDRESS: Diamond Shamrock Chemicals Company. Soda Products, 351 Phelps Court, Irving, Texas 75015-2300

CHEMICAL NAME: Sodium Chromate

CAS NUMBER: 7775-11-3

SYNONYMS/COMMON NAMES: Sodium Chromate Powder

RECEIVED

CHEMICAL FORMULA: Na_2CrO_4

DATE 7/17/86

DOT PROPER SHIPPING NAME: Sodium Chromate

INITIALS

DOT HAZARD CLASS: ORM-E

DOT I.D. NUMBER: NA9143

HAZARDOUS SUBSTANCE: ~~RQ-1000~~

II. HAZARDOUS INGREDIENTS

MATERIAL OR COMPONENT	HAZARD DATA	CAS NUMBER	%
Sodium Chromate Anhydrous	PEL = 0.1 mg/m^3 as CrO_3 8 hr. TWA TLV = 0.05 mg/m^3 as Cr 8 hr. TWA (See Section V)	7775-11-3	100

NIOSH Exposure Limit = 0.025 mg/m^3 as Cr VI 8 hr. TWA
NIOSH Exposure Limit = 0.050 mg/m^3 as Cr VI Ceiling

This material is listed on the TSCA inventory. Chromium and certain forms of chromium compounds are listed as carcinogen by: IARC Yes NTP Yes OSHA No ACGIH Yes Other Yes

III. PHYSICAL DATA

BOILING POINT @ 760 mm Hg: N/A

MELTING POINT: 792°C; (1458°F)

VAPOR PRESSURE: N/A

BULK DENSITY: 104 lbs/ft^3

SOLUBILITY IN H_2O % BY WT: 44% @ 20°C

APPEARANCE AND ODOR: Yellow, no odor

pH: 8.4 to 9.2 (Depending on concentration of solution)

VAPOR DENSITY (Air=1): N/A

% VOLATILES BY VOL.: None

EVAPORATION RATE (BuAc=1): N/A

SPECIFIC GRAVITY (H_2O=1): 2.7

CAS = Chemical Abstract Service Number
PEL = OSHA Permissible Exposure Limit
TLV = TLV®, ACGIH Threshold Limit Value, Current

N/A = No relevant information found or not available
NA = Not applicable

Diamond Shamrock Chemicals Company - A subsidiary of Diamond Shamrock Corporation

This Material Safety Data Sheet was prepared in accordance with 29 CFR 1910.1200. All information, recommendations and suggestions appearing herein concerning our product are based upon tests and data believed to be reliable, however, it is the user's responsibility to determine the safety, toxicity and suitability for his own use of the product described herein. Since the actual use by others is beyond our control, no guarantee expressed or implied is made by Diamond Shamrock as to the effects of such use the results to be obtained or the safety and toxicity of the product nor does Diamond Shamrock assume any liability arising out of use by others of the product referred to herein. Nor is the information herein to be construed as absolutely complete since additional information may be necessary or desirable when particular or exceptional conditions or circumstances exist or because of applicable laws or government regulations.

IV. FIRE AND EXPLOSION DATA

FLASH POINT: Not combustible

AUTOIGNITION TEMPERATURE: Not combustible

FLAMMABLE LIMITS IN AIR, % BY VOLUME- UPPER: NA
LOWER: NA

EXTINGUISHING MEDIA:
Product is not combustible. Water fog, dry chemical or carbon dioxide may be used in areas where product is stored.

SPECIAL FIRE FIGHTING PROCEDURES:
Pressure-demand, self-contained breathing apparatus should be provided for fire fighters in buildings or confined spaces where this product is stored.

UNUSUAL FIRE AND EXPLOSION HAZARD:
Oxidizer. Avoid contact with organic materials (see Section VI).

V. HEALTH HAZARD INFORMATION

HEALTH HAZARD DATA:

Oral LD_{50}	(rat)	= 51.91 ± 7.22	mg/kg	(both sexes)
Dermal LD_{50}	(rabbit)	= 1.60 ± 0.27	g/kg	(both sexes)
Acute inhalation LC_{50}	(rat)	= 104.14 ± 24.37	mg/m^3	(both sexes)

Corrosion to skin:

	Dry Solid 4 hours	Moistened 4 hours	Dry 24 hours	Moistened 24 hours
Erythema	0/6	6/6		
Edema	0/6	5/6		
Necrosis	0/6	0/6		
Corrosion	0/6	0/6	0/1	1/1

NTP and IARC have determined that there is sufficient evidence for the carcinogenicity of chromium and certain chromium compounds both in humans and experimental animals. However, the chromium compounds responsible (for human carcinogenicity) cannot be specified.

There is laboratory evidence that Aqueous Sodium Bichromate administered directly into the lung, at the highest tolerated dose, over the lifetime of rats, causes a significant increased incidence of lung cancer. Sodium Chromate (Anhydrous), tested in the same manner would be expected to produce a similar response.

ROUTES OF EXPOSURE

INHALATION:
Inhalation of dust or mist may cause irritation of the nasal septum and respiratory tract. Prolonged or repeated exposure may cause ulceration and perforation of the nasal septum. In rare instances an allergic asthma may be produced.

SKIN CONTACT:
Contact with broken skin may lead to formation of firmly marginated "chrome sores". May rarely cause allergic contact dermatitis.

SKIN ABSORPTION:
Massive overexposure could lead to kidney failure and death.

EYE CONTACT:
Overexposure will cause severe irritation and potential permanent damage to the eyes. Exposure to low level concentrations may cause moderate irritation or conjunctivitis.

INGESTION:
Can cause severe tissue destruction. Kidney failure may follow and result in death.

V. HEALTH HAZARD INFORMATION

...continued

EFFECTS OF OVEREXPOSURE

ACUTE:
Causes severe irritation to eyes, and may cause blindness. May cause deep, penetrating ulcers on skin. May cause severe irritation of the respiratory tract and nasal septum and possible perforation. Ingestion may result in kidney failure.

CHRONIC:
Prolonged or repeated eye contact may cause conjunctivitis. Prolonged or repeated skin contact, especially with broken skin, may cause "chrome sores".
Prolonged or repeated inhalation of Sodium Chromate dust and mist may cause ulceration and perforation of the nasal septum. Epidemiological studies indicate that long term exposure to high levels of dust and mist in the Chromate producing industry is associated with increases in respiratory tract cancer in man; the causative agent is not known. Thus far, epidemiological studies have not demonstrated any increased risk of lung cancer at levels below current TLV.

EMERGENCY AND FIRST AID PROCEDURES

EYES:
Immediately flush eyes with plenty of water for at least 15 minutes holding eyelids apart to ensure flushing of entire eye surface. Washing eyes within several seconds is essential to achieve maximum effectiveness. Seek medical attention immediately.

SKIN:
Wash contaminated areas with plenty of soap and water for at least 15 minutes. Remove contaminated clothing and footwear and wash clothing before reuse. Discard footwear which cannot be decontaminated. Seek medical attention immediately.

INHALATION:
Get person out of contaminated area to fresh air. If breathing has stopped, artificial respiration should be started. Oxygen may be administered, if readily available. If conscious, irrigate nasal passages and mouth with water. Seek medical attention immediately.

INGESTION:
Never give anything by mouth to an unconscious person. Have conscious patient drink several glasses of water and then induce vomiting by having patient tickle back of throat with finger. Keep airway clear. Seek medical attention immediately.

NOTES TO PHYSICIAN:
Massive overexposure to solutions of this product could lead to kidney failure and death. Death has been avoided in several such cases through the use of early renal dialysis. It has been reported that ascorbic acid administered intravenously is an effective antidote in preventing renal failure. Skin ulcers may be treated by removal from exposures, daily cleansing and debridement, and application of antibiotic cream and dressing.

VI. REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY:
Under normal use conditions, this product is stable.

INCOMPATIBILITY:
This product is mildly oxidizing in solution, but becomes strongly oxidizing in strong acid solution. Avoid contact with organic materials, oils, greases, and any oxidizing materials.

HAZARDOUS DECOMPOSITION PRODUCTS:
None.

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION:
Material is not known to polymerize.

VII. ENVIRONMENTAL PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED.
Stop leaks. Remove as much as possible (e.g. vacuum truck). Then treat the spill area with a reducing agent to convert the hexavalent chromium to the trivalent form and neutralize with a weak base. Following neutralization, soak up with inert absorbent material (e.g. sand), place in a closed, labelled container and store in a safe place to await disposal. NEVER FLUSH TO SEWER. Significant spills should be reported to appropriate agencies.

NEUTRALIZING CHEMICALS:
Reduce hexavalent chromium with sodium bisulfite, sodium sulfite, ferrous sulfate or ferrous chloride. Neutralize with sodium bicarbonate, soda ash, or lime.

WASTE DISPOSAL METHOD:
Hexavalent chromium in solution, may be reduced to trivalent chromium by reducing agents, such as sodium bisulfite, sodium sulfite, sulfur dioxide, ferrous sulfate or ferrous chloride. The reduced chromium may then be precipitated as the chromic oxide by neutralizing to a pH 7.5 with soda ash, caustic soda, or lime. The solid material may be disposed of via an approved chemical waste landfill. Shipments should be manifested. Dispose of in accordance with all federal, state and local health pollution requirements.

VIII. INDUSTRIAL HYGIENE CONTROL MEASURES

VENTILATION REQUIREMENTS:
Good industrial hygiene practice dictates that the work area be isolated and contained and be provided with adequate local exhaust ventilation or other controls where dust or fumes may be generated (see Section II for applicable control levels). The number of persons exposed should be minimized.
Certain processes like chrome pigment production, high temperature welding or cutting, etc., may form materials more hazardous to humans than this product. These materials may be the formation of slightly soluble salts (barium, zinc, calcium or other chromates) or fumes of chromium/chromium oxide, respectively which are known to be human carcinogens. Engineering controls and local exhaust ventilation is required to ensure that worker exposure is below current TLV.

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY:
Use a NIOSH/MSHA approved respirator following manufacturer's recommendations where vapors, dust, mist, fumes or spray may be generated.

EYE:
Face shield and goggles or chemical goggles should be worn.

GLOVES:
Industrial grade rubber or plastic gloves should be worn.

OTHER CLOTHING AND EQUIPMENT:
Protective clothing should be worn when handling this product. Protective clothing should be changed at least daily. Wash contaminated clothing with soap and water and dry before reuse. Advise the laundry of the material contaminating the clothing. Shower and eyewash facilities should be accessible.

MONITORING EXPOSURE

PERSONAL/AREA:
Use NIOSH Analytical method 7600 & 7024.

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Keep container tightly closed. Store in cool, dry area away from heat or open flame. Do not drop onto, or slide across, sharp projections. Do not store on side. Avoid creasing or impacting of side walls.
OTHER PRECAUTIONS: Do not get in eyes. Avoid contact with skin. Wash thoroughly after handling. Wash contaminated clothing before re-use. Do not re-use container for any purpose.
Stannous Sulfate contains a small amount of residual sulfuric acid and should be handled and stored accordingly.
Aqueous solutions of stannous sulfate are acidic and should be treated similarly to dilute sulfuric acid. Use only in corrosion-resistant vessels.

THIS MATERIAL SAFETY DATA SHEET IS OFFERED SOLELY FOR YOUR INFORMATION, CONSIDERATION AND INVESTIGATION.

AMERICHEM PROVIDES NO WARRANTIES, EITHER EXPRESS OR IMPLIED, AND ASSUMES NO RESPONSIBILITY FOR THE ACCURACY OR COMPLETENESS OF THE DATA CONTAINED HEREIN.

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: For inorganic Tin Chemicals as a class: TWA - 2 mg/cu.m. STEL - 4 mg/cu.m.
EFFECTS OF OVEREXPOSURE: EYES: Burns or irritation may occur upon contact. SKIN: Irritation may occur upon contact. INHALATION: Irritation of mucous membranes may result from inhalation of dust.
EMERGENCY AND FIRST AID PROCEDURES: SKIN: Remove contaminated clothing. Wash skin thoroughly with soap and water. Obtain medical attention if skin irritation occurs. Wash contaminated clothing before re-use. EYES: Flush eyes with running water for at least 15 minutes. Call a physician immediately. INHALATION: Move individual to a well-ventilated area. If breathing is difficult, administer oxygen. Keep individual quiet and maintain normal body temperature. Call a physician immediately. INGESTION: Call a physician immediately.

SECTION VI - REACTIVITY DATA

STABILITY: UNSTABLE: STABLE: X
INCOMPATABILITY (MATERIALS TO AVOID): Contact with strong oxidizing agents or alkalis will generate heat and fumes.
HAZARDOUS DECOMPOSITION PRODUCTS: NA
HAZARDOUS POLYMERIZATION: MAY OCCUR: WILL NOT OCCUR: X
CONDITIONS TO AVOID: NA

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Sweep up spilled material. Place in corrosion-resistant container. Contact manufacturer for information on return of material for recovery of tin values. Flush spill area with large volumes of water. Neutralize, using sola ash or lime. May be injurious to aquatic life if released to open waters.
WASTE DISPOSAL METHOD: Contact manufacturer for information on return of material for recovery of tin values. Neutralize spilled material as described above. Disposal of material, container, and washings must be in compliance with all Federal, State, and Local regulations.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (SPECIFY TYPE): Approved respirator for dust or fumes.
VENTILATION: Local exhaust as needed to control exposures to below TLV level.
PROTECTIVE GLOVES: Rubber or neoprene
EYE PROTECTION: Required for fumes, dust or heat.
OTHER PROTECTIVE EQUIPMENT: Acid-proof apron recommended.

CONTINUED ON PAGE 3

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U.S. DEPARTMENT OF LABOR
OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
AMERICHEM MATERIAL SAFETY DATA SHEET #1006

May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910, 1200
Standard must be consulted for specific requirements.

SECTION I

MANUFACTURER'S NAME: Various
(Americhem as Distributor)
ADDRESS: 5129 Unruh Avenue,
Philadelphia, PA 19135

EMERGENCY TELEPHONE NUMBER:
Chemtrec — 800-424-9300
Americhem - 215-335-0990

CHEMICAL NAME AND SYNONYMS:
Stannous Sulfate

TRADE NAME AND SYNONYMS:
Tin Sulfate

CHEMICAL FAMILY: Inorganic Tin Compound

FORMULA: $SnSO_4$

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES AND SOLVENTS	% (UNITS)	TLV	ALLOYS AND METALLIC COATINGS	% (UNITS)	TLV
PIGMENTS:	NA		BASE METAL:		
CATALYST:	NA		ALLOYS:	NA	
VEHICLE:	NA		METALLIC COATINGS:	NA	
SOLVENTS:	NA		FILLER METAL PLUS COATING OR CORE FLUX:	NA	
ADDITIVES:	NA		OTHERS:	NA	
OTHERS:	NA				

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS OR GASES: NA

SECTION III - PHYSICAL DATA

BOILING POINT (°C):	NA	SPECIFIC GRAVITY (H_2O=1):	NA
VAPOR PRESSURE (mm Hg.):	NA	PERCENT, VOLATILE BY VOLUME (%):	NA
VAPOR DENSITY (AIR=1):	NA	EVAPORATION RATE (_____)=1:	NA
SOLUBILITY IN WATER:	33%	FORMULA WEIGHT:	214.8
MELTING POINT (Decomposes)	360°C	DENSITY (g/cc):	1.35

APPEARANCE AND ODOR: White to slightly yellow, heavy, crystalline powder; odorless.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED): Non-flammable FLAMMABLE LIMITS: NA
EXTINGUISHING MEDIA: Media appropriate to nature of fire.
SPECIAL FIRE FIGHTING PROCEDURES: If material is released or spilled in the presence of fire, avoid skin and eye contact; do not breathe fumes or dust.
UNUSUAL FIRE AND EXPLOSION HAZARDS: NA

 (CONTINUED ON PAGE 2)

RECEIVED

VIII. REACTIVITY DATA

X	Stable	CONDITIONS TO AVOID: Stable under normal conditions. See Incompatibility information.
	Unstable	

INCOMPATABILITY (Materials to avoid): Oxidizers, free radical generators.

HAZARDOUS DECOMPOSITION PRODUCTS: In a fire, oxides of sulfur and carbon.

HAZARDOUS POLYMERIZATION		May occur	CONDITIONS TO AVOID: NA
	X	Will not occur	

IX. ADDITIONAL INFORMATION

This product contains one or more chemicals which are subject to the reporting requirements of SARA, TITLE III, Section 313 (40 CFR 372). The chemical(s) are listed in Section II, HAZARDOUS INGREDIENTS, along with the CAS (Chemical Abstract Service) # and the ingredient concentration which will be within 5% of the figure stated. This notice must be included in any subsequent copying of this MSDS.

This Material Safety Data Sheet may be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Enthone-OMI Inc. furnishes the data contained herein in good faith at customer's request without liability or legal responsibility for same whatsoever, and no warranty or guarantee, express or implied, is made with respect to such data; nor does Enthone-OMI Inc. grant permission, recommendation, or inducement to infringe any patent whether owned by Enthone-OMI Inc. or others. The data is offered solely for your information and consideration. Since conditions of use are beyond Enthone-OMI's control, user assumes all responsibility and risk.

VI. PRECAUTIONS FOR SAFE HANDLING AND USE

SPILL PROCEDURES:
Avoid contact with skin, eyes and clothing. Wear protective equipment (see Section VII). Do not breathe mist or vapors. Contain spill and soak up in suitable absorbent. Shovel into plastic lined steel containers. Dilute residual material with copious amounts of water and neutralize. Dispose of in accordance with Local, State and Federal regulations.

STORAGE AND HANDLING PRECAUTIONS:
Store in a cool, dry place. Keep away from oxidizers, free radical generators, U.V. radiation, heat, sparks, and open flame. Loosen cover cautiously when opening.

ADDITIONAL INFORMATION:
Wash thoroughly after handling.

VII. CONTROL MEASURES

VENTILATION: Local exhaust recommended.

RESPIRATOR: Use NIOSH approved respirator when air concentration is greater than the TLV or PEL.
Use cartridge filter for organic vapors.

EYE PROTECTION: [ ] Safety glasses [X] Chemical safety goggles [X] Face shield

PROTECTIVE GLOVES: [X] Neoprene [X] Natural rubber Other:

OTHER PROTECTIVE CLOTHING OR EQUIPMENT:
Chemically resistant coveralls, hat, and shoes or boots.

WORK/HYGENIC PRACTICES:
Emergency eye wash and safety shower should be available. Wash thoroughly after handling.

ADDITIONAL INFORMATION:
For waste disposal of spilled or contaminated product follow Enthone-OMI Waste Disposal Procedures. If necessary, consult Enthone-OMI for disposal assistance. Dispose of in accordance with Local, State and Federal regulations.

CAS = Chemical Abstract Service
NI = No relevant information available
NA = Not applicable
Trade Secret = Claimed as allowed under 29 CFR 1910.1200

PEL = OSHA Permissible Exposure Limit
TLV = ACGIH Threshold Limit Value
NTP = National Toxicology Program
IARC = Int'l Agency for Research on Cancer

V. HEALTH HAZARD DATA

EFFECTS OF ACUTE EXPOSURE:

INHALATION: Mist or vapor may irritate respiratory tract.

INGESTION: Can cause irritation to mouth, throat, esophagus, and stomach.

SKIN: Can cause irritation.

EYES: Can cause severe irritation; damage to eyes.

EFFECTS OF CHRONIC EXPOSURE:

General discomfort, irritation and possible sensitization.

CARCINOGEN: Not listed by NTP, IARC, OSHA.

REFERENCE:

EMERGENCY AND FIRST AID PROCEDURES

INHALATION: Remove person from contaminated area. If breathing has stopped, resuscitate and administer oxygen if available.
Seek immediate medical attention.

INGESTION: Never give anything by mouth to an unconscious person, obtain immediate medical attention. If vomiting occurs spontaneously, keep airway clear. If swallowed give large amounts of water and INDUCE VOMITING.
Seek immediate medical attention.

SKIN: Immediately wash contaminated skin with plenty of water. Remove contaminated clothing and footwear. Wash clothing before reuse. Discard footwear if it cannot be decontaminated. If irritation continues, seek medical attention.

EYES: Immediately flush eyes with plenty of water for at least 15 minutes holding lids apart to ensure flushing of entire surface. Washing eyes within several seconds of exposure is essential to minimize damage.
Seek immediate medical attention.

Enthone-OMI Inc.

a subsidiary of ASARCO

MATERIAL SAFETY DATA SHEET

SEL-REX

SOLDEREX® TB-HS

P.O. BOX 1900
NEW HAVEN, CT 06508

(203) 934-8611

24 HOUR EMERGENCY PHONE NUMBER
CHEMTREC 800-424-9300

NON-EMERGENCY PHONE NUMBER
(203) 934-8611
8:30 a.m. - 5 p.m. (EST)

PRODUCT CODE#: CJL3
DATE ISSUED: 3/20/95
SUPERCEDES: 10/22/90Enth.Tin4793HSR
PREPARER: L.T.Horbal

II. HAZARDOUS INGREDIENTS

COMPONENT	COMMON NAME	CAS NO.	OSHA-PEL	ACGIH-TLV	%
Water		7732-18-5	NI	NI	<70
Acrylic acid		79-10-7	30mg/m3	5.9mg/m3	<5
1-Propanol	n-Propyl alcohol	71-23-8	500mg/m3	500mg/m3	<10

Other ingredients not considered hazardous.

III. PHYSICAL PROPERTIES

SPECIFIC GRAVITY (WATER =1)	0.998	BOILING POINT, °F	210
EVAP.RATE (BUTYL ACETATE=1)	NI	MELTING POINT, °F	20
VAPOR PRESSURE, mmHg	NI	SOLUBILITY IN WATER	complete
VAPOR DENSITY (AIR=1)	NI	APPEARANCE	pale yellow liquid
pH (AS IS)	6	ODOR	pungent

IV. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT, °F	105	FLAMMABLE LIMITS (AIR)	NI	LEL	NI	UEL

EXTINGUISHING MEDIA

[ ] Not Combustible [X] Water fog or spray [X] Carbon Dioxide [X] Dry Chemical [ ] Alcohol Foam [X] Foam [ ] Sand or Earth

SPECIAL FIRE FIGHTING PROCEDURES

Wear NIOSH approved full protective clothing and self-contained breathing apparatus. Keep containers cool to prevent rupture and release of material.

UNUSUAL FIRE AND EXPLOSION HAZARDS

Product vapors are heavier than air and may travel along the ground or may be moved by ventilation and then ignited by sources of ignition distant from material handling location.

Never expose drums (even empty) to sources of ignition because product or product residue/vapors can ignite explosively.

Printed on recycled paper

VIII. REACTIVITY DATA

X	Stable	CONDITIONS TO AVOID:	Stable under normal conditions. See Incompatibility information.
	Unstable		

INCOMPATABILITY (Materials to avoid): Strong acids

HAZARDOUS DECOMPOSITION PRODUCTS: Toxic oxides of carbon and nitrogen.

HAZARDOUS POLYMERIZATION		May occur	CONDITIONS TO AVOID: NA
	X	Will not occur	

IX. ADDITIONAL INFORMATION

This product does not contain any chemicals subject to the reporting requirements of SARA, TITLE III, Section 313 (40CFR372) or known to the State of California to cause cancer or birth defects (to comply with California Statute [Section 25249.6]).

This Material Safety Data Sheet may be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Enthone-OMI Inc. furnishes the data contained herein in good faith at customer's request without liability or legal responsibility for same whatsoever, and no warranty or guarantee, express or implied, is made with respect to such data; nor does Enthone-OMI Inc. grant permission, recommendation, or inducement to infringe any patent whether owned by Enthone-OMI Inc. or others. The data is offered solely for your information and consideration. Since conditions of use are beyond Enthone-OMI's control, user assumes all responsibility and risk.

VI. PRECAUTIONS FOR SAFE HANDLING AND USE

SPILL PROCEDURES:
Avoid contact with skin, eyes, and clothing. Wear protective equipment (see Section VII). Do not breathe mist or vapors. Contain spill and soak up in suitable absorbent. Shovel up into plastic-lined steel containers and cover. Dispose of in accordance with Local, State, and Federal regulations.

STORAGE AND HANDLING PRECAUTIONS:
Store in a cool dry place. Loosen cover cautiously when opening.

ADDITIONAL INFORMATION:
Store above freezing temperature.

VII. CONTROL MEASURES

VENTILATION: Local exhaust recommended.

RESPIRATOR: Use NIOSH approved respirator when air concentration is greater than the TLV or PEL.
Not ordinarilly required

EYE PROTECTION: [X] Safety glasses [X] Chemical safety goggles [ ] Face shield

PROTECTIVE GLOVES: [ ] Neoprene [X] Natural rubber Other:

OTHER PROTECTIVE CLOTHING OR EQUIPMENT:
Chemically resistant coveralls, hat, and shoes or boots.

WORK/HYGENIC PRACTICES:
Emergency eye wash and safety shower should be available. Wash thoroughly after handling.

ADDITIONAL INFORMATION:
For waste disposal of operating solutions consult Enthone-OMI Waste Disposal Procedures. For major spills consult Enthone-OMI for disposal assistance. Dispose of in accordance with Local, State, and Federal regulations.

CAS = Chemical Abstract Service
NI = No relevant information available
NA = Not applicable
Trade Secret = Claimed as allowed under 29 CFR 1910.1200

PEL = OSHA Permissible Exposure Limit
TLV = ACGIH Threshold Limit Value
NTP = National Toxicology Program
IARC = Int'l Agency for Research on Cancer

V. HEALTH HAZARD DATA

EFFECTS OF ACUTE EXPOSURE:

INHALATION: Mist or vapor may irritate respiratory tract.

INGESTION: May cause irritation.

SKIN: Can cause irritation.

EYES: May cause irritation.

EFFECTS OF CHRONIC EXPOSURE:

Chronic exposure effects not established.

CARCINOGEN: Not listed by NTP, IARC, OSHA

REFERENCE:

EMERGENCY AND FIRST AID PROCEDURES

INHALATION: Remove person from contaminated area. If breathing has stopped, resuscitate and administer oxygen if available.
Seek immediate medical attention.

INGESTION: Never give anything by mouth to an unconscious person, obtain immediate medical attention. If vomiting occurs spontaneously, keep airway clear. If swallowed give large amounts of water and INDUCE VOMITING.
Seek immediate medical attention.

SKIN: Immediately wash contaminated skin with plenty of water. Remove contaminated clothing and footwear. Wash clothing before reuse. Discard footwear if it cannot be decontaminated. If irritation continues, seek medical attention.

EYES: Flush eyes with plenty of water, holding lids apart to ensure flushing of entire surface to prevent or relieve irritation.
If irritation persists, seek medical attention.

Enthone-OMI Inc.

a subsidiary of ASARCO

MATERIAL SAFETY DATA SHEET

SEL-REX

SOLDEREX® TB-FB

P.O. BOX 1900
NEW HAVEN, CT 06508

(203) 934-8611

24 HOUR EMERGENCY PHONE NUMBER
CHEMTREC 800-424-9300

NON-EMERGENCY PHONE NUMBER
(203) 934-8611
8:30 a.m. - 5 p.m. (EST)

PRODUCT CODE#: CJL6
DATE ISSUED: 3/20/95
SUPERCEDES: 6/10/88(Entho.Tin 01.8918
PREPARER: L.T. Horvat

II. HAZARDOUS INGREDIENTS

COMPONENT	COMMON NAME	CAS NO.	OSHA-PEL	ACGIH-TLV	%
Water		7732-18-5	NI	NI	>95

Balance of ingredients
not considered hazardous.

III. PHYSICAL PROPERTIES

SPECIFIC GRAVITY (WATER =1)	0.996	BOILING POINT, °F	210
EVAP.RATE (BUTYL ACETATE=1)	NI	MELTING POINT, °F	40
VAPOR PRESSURE, mmHg	NI	SOLUBILITY IN WATER	complete
VAPOR DENSITY (AIR=1)	NI	APPEARANCE	clear liquid
pH (AS IS)	3.7	ODOR	none

IV. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT, °F	None	FLAMMABLE LIMITS (AIR)	NA	LEL	NA	UEL

EXTINGUISHING MEDIA

[ ] Not Combustible [X] Water fog or spray [X] Carbon Dioxide [ ] Dry Chemical [ ] Alcohol Foam [X] Foam [ ] Sand or Earth

SPECIAL FIRE FIGHTING PROCEDURES

Wear NIOSH approved full protective clothing and self-contained breathing apparatus. Keep containers cool to prevent rupture and release of material.

UNUSUAL FIRE AND EXPLOSION HAZARDS

None known.

Printed on recycled paper

VIII. REACTIVITY DATA

X	Stable	CONDITIONS TO AVOID: Stable under normal conditions. See Incompatibility information.
	Unstable	

INCOMPATABILITY (Materials to avoid): Strong alkalis

HAZARDOUS DECOMPOSITION PRODUCTS: Toxic oxides of carbon and nitrogen; amines.

HAZARDOUS POLYMERIZATION		May occur	CONDITIONS TO AVOID: NA
	X	Will not occur	

IX. ADDITIONAL INFORMATION

This product contains one or more chemicals which are subject to the reporting requirements of SARA, TITLE III, Section 313 (40 CFR 372). The chemical(s) are listed in Section II, HAZARDOUS INGREDIENTS, along with the CAS (Chemical Abstract Service) # and the ingredient concentration which will be within 5% of the figure stated. This notice must be included in any subsequent copying of this MSDS.

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VI. PRECAUTIONS FOR SAFE HANDLING AND USE

SPILL PROCEDURES:
Avoid contact with skin, eyes, and clothing. Wear protective equipment (see Section VII). Do not breathe mist or vapors. Contain spill and soak up in suitable absorbent. Shovel up into plastic-lined steel containers and cover. Dispose of in accordance with Local, State, and Federal regulations.

STORAGE AND HANDLING PRECAUTIONS:
Store in a cool dry place. Loosen cover cautiously when opening.

ADDITIONAL INFORMATION:
Store above freezing temperature.

VII. CONTROL MEASURES

VENTILATION: Local exhaust recommended.

RESPIRATOR: Use NIOSH approved respirator when air concentration is greater than the TLV or PEL. Use cartridge filter for acid mist.

EYE PROTECTION: [ ] Safety glasses [X] Chemical safety goggles [X] Face shield

PROTECTIVE GLOVES: [X] Neoprene [X] Natural rubber Other:

OTHER PROTECTIVE CLOTHING OR EQUIPMENT:
Chemically resistant coveralls, hat, and shoes or boots.

WORK/HYGENIC PRACTICES:
Emergency eye wash and safety shower should be available. Wash thoroughly after handling.

ADDITIONAL INFORMATION:
For waste disposal of operating solutions consult Enthone-OMI Waste Disposal Procedures. For major spills consult Enthone-OMI for disposal assistance. Dispose of in accordance with Local, State, and Federal regulations.

CAS = Chemical Abstract Service
NI = No relevant information available
NA = Not applicable
Trade Secret = Claimed as allowed under 29 CFR 1910.1200

PEL = OSHA Permissible Exposure Limit
TLV = ACGIH Threshold Limit Value
NTP = National Toxicology Program
IARC = Int'l Agency for Research on Cancer

V. HEALTH HAZARD DATA

EFFECTS OF ACUTE EXPOSURE:

INHALATION: Mist or vapor may irritate respiratory tract.

INGESTION: Can cause irritation to mouth, throat, esophagus, and stomach.

SKIN: Can cause irritation.

EYES: Can cause irritation.

EFFECTS OF CHRONIC EXPOSURE:

Chronic exposure effects not established.

CARCINOGEN: Not listed by NTP, IARC, OSHA

REFERENCE:

EMERGENCY AND FIRST AID PROCEDURES

INHALATION: Remove person from contaminated area. If breathing has stopped, resuscitate and administer oxygen if available.
Seek immediate medical attention.

INGESTION: Never give anything by mouth to an unconscious person, obtain immediate medical attention. If vomiting occurs spontaneously, keep airway clear. If swallowed, give large amounts of water and INDUCE VOMITING.
Seek immediate medical attention.

SKIN: Immediately wash contaminated skin with plenty of water. Remove contaminated clothing and footwear. Wash clothing before reuse. Discard footwear if it cannot be decontaminated. If irritation continues, seek medical attention.

EYES: Flush eyes with plenty of water, holding lids apart to ensure flushing of entire surface to prevent or relieve irritation.
If irritation persists, seek medical attention.

Enthone-OMI Inc.

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MATERIAL SAFETY DATA SHEET

SEL-REX

SOLDEREX® TB-FA

P.O. BOX 1900
NEW HAVEN, CT 06508

(203) 934-8611

24 HOUR EMERGENCY PHONE NUMBER
CHEMTREC 800-424-9300

NON-EMERGENCY PHONE NUMBER
(203) 934-8611
8:30 a.m. - 5 p.m. (EST)

PRODUCT CODE#: CJL5
DATE ISSUED: 3/20/95
SUPERCEDES: 7/20/89(Entho.Tin C).891A
PREPARER: L.T. Horbal

II. HAZARDOUS INGREDIENTS

COMPONENT	COMMON NAME	CAS NO.	OSHA-PEL	ACGIH-TLV	%
Sulfuric acid		7664-93-9	1mg/m3	1mg/m3	<5
Water		7732-18-5	NI	NI	>80

Balance of materials not considered hazardous

III. PHYSICAL PROPERTIES

SPECIFIC GRAVITY (WATER =1)	1.021	BOILING POINT, °F	210
EVAP.RATE (BUTYL ACETATE=1)	NI	MELTING POINT, °F	38
VAPOR PRESSURE, mmHg	NI	SOLUBILITY IN WATER	complete
VAPOR DENSITY (AIR=1)	NI	APPEARANCE	clear liquid
pH (AS IS)	6.5	ODOR	none

IV. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT, °F	>200	FLAMMABLE LIMITS (AIR)	NI	LEL	NI	UEL

EXTINGUISHING MEDIA

[ ] Not Combustible [X] Water fog or spray [X] Carbon Dioxide [ ] Dry Chemical [ ] Alcohol Foam [X] Foam [ ] Sand or Earth

SPECIAL FIRE FIGHTING PROCEDURES

Wear NIOSH approved full protective clothing and self-contained breathing apparatus. Keep containers cool to prevent rupture and release of material.

UNUSUAL FIRE AND EXPLOSION HAZARDS

Thermal decomposition may yield toxic oxides of carbon, sulfur or nitrogen.

Printed on recycled paper

VIII. REACTIVITY DATA

X	Stable	CONDITIONS TO AVOID: Stable under normal conditions. See Incompatibility information.
	Unstable	

INCOMPATABILITY (Materials to avoid): Oxidizing Agents, Alkalis.

HAZARDOUS DECOMPOSITION PRODUCTS: In a fire, oxides of sulfur and carbon.

HAZARDOUS POLYMERIZATION		May occur	CONDITIONS TO AVOID: NA
	X	Will not occur	

IX. ADDITIONAL INFORMATION

This product contains one or more chemicals which are subject to the reporting requirements of SARA, TITLE III, Section 313 (40 CFR 372). The chemical(s) are listed in Section II, HAZARDOUS INGREDIENTS, along with the CAS (Chemical Abstract Service) # and the ingredient concentration which will be within 5% of the figure stated. This notice must be included in any subsequent copying of this MSDS.

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VI. PRECAUTIONS FOR SAFE HANDLING AND USE

SPILL PROCEDURES:

Avoid contact with skin, eyes, and clothing. Wear protective equipment (see Section VII). Do not breathe mist or vapors. Contain spill and soak up in suitable absorbent. Shovel up into plastic-lined steel containers and cover. Dispose of in accordance with Local, State, and Federal regulations.

STORAGE AND HANDLING PRECAUTIONS:

Store in a cool, dry place. Keep away from alkalies and oxidizers. Loosen cover cautiously when opening.

ADDITIONAL INFORMATION:

Store above freezing temperature.

VII. CONTROL MEASURES

VENTILATION: Local exhaust recommended.

RESPIRATOR: Use NIOSH approved respirator when air concentration is greater than the TLV or PEL. Use cartridge filter for acid mist.

EYE PROTECTION: [ ] Safety glasses [X] Chemical safety goggles [X] Face shield

PROTECTIVE GLOVES: [X] Neoprene [X] Natural rubber Other:

OTHER PROTECTIVE CLOTHING OR EQUIPMENT:

Chemically resistant coveralls, hat, and shoes or boots.

WORK/HYGENIC PRACTICES:

Emergency eye wash and safety shower should be available. Wash thoroughly after handling.

ADDITIONAL INFORMATION:

For waste disposal of operating solutions consult Enthone-OMI Waste Disposal Procedures. For major spills consult Enthone-OMI for disposal assistance. Dispose of in accordance with Local, State, and Federal regulations.

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PEL = OSHA Permissible Exposure Limit
TLV = ACGIH Threshold Limit Value
NTP = National Toxicology Program
IARC = Int'l Agency for Research on Cancer

V. HEALTH HAZARD DATA

EFFECTS OF ACUTE EXPOSURE:

INHALATION: Mist or vapor may irritate respiratory tract.

INGESTION: Can cause irritation to mouth, throat, esophagus, and stomach.

SKIN: Can cause irritation.

EYES: Can cause severe irritation, damage to eyes.

EFFECTS OF CHRONIC EXPOSURE:

Repeated or prolonged exposure may cause severe irritation.

CARCINOGEN: Not listed by NTP, IARC, OSHA.

REFERENCE:

EMERGENCY AND FIRST AID PROCEDURES

INHALATION: Remove person from contaminated area. If breathing has stopped, resuscitate and administer oxygen if available.
Seek immediate medical attention.

INGESTION: Never give anything by mouth to an unconscious person, obtain immediate medical attention. If vomiting occurs spontaneously, keep airway clear. If swallowed give large amounts of water and INDUCE VOMITING.
Seek immediate medical attention.

SKIN: Immediately wash contaminated skin with plenty of water for 15 minutes. Remove contaminated clothing and footwear. Wash clothing before reuse. Discard footwear if it cannot be decontaminated.
Seek immediate medical attention.

EYES: Immediately flush eyes with plenty of water for at least 15 minutes holding lids apart to ensure flushing of entire surface. Washing eyes within several seconds of exposure is essential to minimize damage.
Seek immediate medical attention.

Enthone-OMI Inc.

a subsidiary of ASARCO

MATERIAL SAFETY DATA SHEET

SEL-REX

SOLDEREX® TB-A

P.O. BOX 1900
NEW HAVEN, CT 06508

(203) 934-8611

24 HOUR EMERGENCY PHONE NUMBER
CHEMTREC 800-424-9300

NON-EMERGENCY PHONE NUMBER
(203) 934-8611
8:30 a.m. - 5 p.m. (EST)

PRODUCT CODE#: CJL1
DATE ISSUED: 3/20/95
SUPERCEDES: 10/30/89(Entho.Tin 4793A
PREPARER: L.T. Horbal

II. HAZARDOUS INGREDIENTS

COMPONENT	COMMON NAME	CAS NO.	OSHA-PEL	ACGIH-TLV	%
Water		7732-18-5	NI	NI	>65
Sulfuric Acid		7664-93-9	1mg/m3	1mg/m3	<2
Mixture of non-hazardous surfactants					<30

III. PHYSICAL PROPERTIES

SPECIFIC GRAVITY (WATER =1)	1.03	BOILING POINT, °F	210
EVAP.RATE (BUTYL ACETATE=1)	NI	MELTING POINT, °F	25
VAPOR PRESSURE, mmHg	NI	SOLUBILITY IN WATER	complete
VAPOR DENSITY (AIR=1)	NI	APPEARANCE	clear, amber liquid
pH (AS IS)	5.5	ODOR	soapy

IV. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT, °F	>200	FLAMMABLE LIMITS (AIR)	NI	LEL	NI	UEL

EXTINGUISHING MEDIA

[X] Not Combustible [X] Water fog or spray [X] Carbon Dioxide [X] Dry Chemical [ ] Alcohol Foam [ ] Foam [ ] Sand or Earth

SPECIAL FIRE FIGHTING PROCEDURES

Wear NIOSH approved full protective clothing and self-contained breathing apparatus. Keep containers cool to prevent rupture and release of material.

UNUSUAL FIRE AND EXPLOSION HAZARDS

None known.

Printed on recycled paper

ENVIRONMENTAL

BIODEGRADABILITY/AQUATIC TOXICITY

OCTANOL/WATER PARTITION COEFFICIENT: N.D.

Aquatic Toxicity:
120 ppm/24, 48, & 96 hr/mosquito fish/TL_m/fresh water — Reference (b)
(converting bisulfite figure to metabisulfite basis).

EPA HAZARDOUS SUBSTANCES? (CLEAN WATER ACT SECT. 311) [X] YES [ ] NO — IF SO, REPORTABLE QUANTITY: 5000 # (As Sodium Bisulfite) — 40 CFR 116-117

WASTE DISPOSAL METHODS (DISPOSER MUST COMPLY WITH FEDERAL, STATE AND LOCAL DISPOSAL OR DISCHARGE LAWS)

Users should review their operations in terms of any applicable federal, state and local laws and regulations, then consult with appropriate regulatory agencies before discharging or disposing of waste material. If regulations permit, waste may be disposed of by burial in an approved chemical wastes landfill or removed by a licensed waste disposal contractor.

RCRA STATUS OF UNUSED MATERIAL IF DISCARDED: Not a "hazardous waste".

HAZARDOUS WASTE NUMBER: (IF APPLICABLE) — 40 CFR 261

REFERENCES

PERMISSIBLE CONCENTRATION REFERENCES

"Threshold Limit Values for Chemical Substances..." ACGIH, 1993-94.

REGULATORY STANDARDS

D.O.T. CLASSIFICATION: Not Regulated — 49 CFR 173

FDA regulations apply to use food and NF grades (21 CFR).
Food use in meats or in food recognized as a source of vitamin B1 is prohibited (21 CFR 132.3766).

GENERAL

(a) ACGIH, Documentation of the Threshold Limit Values, 4th ED., 1981, Am. Conf. of Governmental Industrial Hygienists, Cincinnati 45202 — a review for this material with 4 references.

(b) Coast Guard CHRIS system form covering Sodium Bisulfite and Metabisulfite, "SBS", October 1978.

ADDITIONAL INFORMATION

This product is not for food or drug use unless material is labeled "food grade" or "NF grade," as applicable.

For food grade product, the following applies:

(1) Effective August 8, 1987, the F.D.A. has banned the use of "Sulfiting Agents" or "Sulfites" on fruits and vegetables intended to be served raw or sold raw to consumers.

(2) Effective January 9, 1987, the F.D.A. is requiring when a sulfite is present in a detectable amount in a finished food, regardless of whether it has been directly or indirectly added via one or more of the food ingredients, it must be declared on the label. The regulation defines a "detectable amount" of sulfite to be 10 ppm.

(3) Sulfiting agents or sulfites are not to be used on foods or meats recognized as source of Vitamin B1.

PSDS FILE No. GC-3057

THIS MATERIAL SAFETY DATA SHEET IS OFFERED SOLELY FOR YOUR INFORMATION, CONSIDERATION AND INVESTIGATION.

GENERAL CHEMICAL CORPORATION PROVIDES NO WARRANTIES, EITHER EXPRESS OR IMPLIED, AND ASSUMES NO RESPONSIBILITY FOR THE ACCURACY OR COMPLETENESS OF THE DATA CONTAINED HEREIN.

F. PHYSICAL DATA

MATERIAL IS (AT NORMAL CONDITIONS): ☐ LIQUID ☒ SOLID ☐ GAS ☐	APPEARANCE AND ODOR: Fine, white granular product. Pungent sulfur dioxide gas odor.	
BOILING POINT: Decomposes rapidly above (150°C) °C MELTING POINT	SPECIFIC GRAVITY (H_2O = 1): 1.48	VAPOR DENSITY (AIR = 1): Not applicable.
SOLUBILITY IN WATER (% by Weight): 39% at 16°C	pH: 1% Solution, pH = 4.3 (approx.)	VAPOR PRESSURE (mm Hg at 20°C) ☐ (PSIG) ☐: Not applicable.
EVAPORATION RATE (Butyl Acetate = 1) ☐ (Ether = 1) ☐: Not applicable.	% VOLATILES BY VOLUME (At 20°C): Not applicable.	

G. REACTIVITY DATA

STABILITY: ☐ UNSTABLE ☒ STABLE	CONDITIONS TO AVOID: Avoid elevated temperatures. Temperatures above 150°C cause the rapid evolution of toxic and corrosive gas (sulfur dioxide).

INCOMPATIBILITY (MATERIALS TO AVOID)

Oxidizers may cause strong exothermic reactions.
Acids, water and ice yield sulfur dioxide gas, which is toxic, corrosive, and potentially deadly.
Water and/or ice speeds the production of sulfur dioxide gas.

HAZARDOUS DECOMPOSITION PRODUCTS

Sulfur dioxide gas: see above comments.
Sodium sulfide residue: flammable, dangerous fire risk, strong irritant to skin and tissue, incompatible with acids.

HAZARDOUS POLYMERIZATION: ☐ MAY OCCUR ☒ WILL NOT OCCUR	CONDITIONS TO AVOID: Not applicable.

H. HAZARDOUS INGREDIENTS (Mixtures Only)

MATERIAL OR COMPONENT / C.A.S. #	WT. %	HAZARD DATA (SEE SECT. J)
Not Applicable		

C. HAZARDS (Cont.)

FIRE AND EXPLOSION

FLASH POINT	AUTO IGNITION TEMPERATURE	FLAMMABLE LIMITS IN AIR (% BY VOL.)
Not Flammable °C ☐ OPEN CUP ☐ CLOSED CUP	°C Not applicable	LOWER — Not applicable UPPER — Not applicable

UNUSUAL FIRE AND EXPLOSION HAZARDS

See Hazardous Decomposition Products, Section G.

D. PRECAUTIONS/PROCEDURES

FIRE EXTINGUISHING AGENTS RECOMMENDED

Not applicable.

FIRE EXTINGUISHING AGENTS TO AVOID

Not applicable.

SPECIAL FIRE FIGHTING PRECAUTIONS

Wear NIOSH-approved self-contained breathing apparatus.

VENTILATION

Local exhaust if dusty or misty condition prevails. The TLV may be exceeded without visual warning. Do not use in unventilated spaces, e.g., the holds of fishing boats, walk-in coolers or confined spaces.

NORMAL HANDLING

Avoid contact with skin, eyes, clothing. Avoid breathing dust or mist. Use normal personal hygiene and housekeeping. Keep away from water, ice, acids, or heat.

STORAGE

Cool, dry, well-ventilated space away from water, ice, acids and oxidizing agents. (Dry to avoid tendency of product to cake.) Releases sulfur dioxide gas slowly at ambient temperatures — (see odor, Section F.)

SPILL OR LEAK (ALWAYS WEAR PERSONAL PROTECTIVE EQUIPMENT — SECTION E)

Promptly sweep up with minimum dusting and shovel into an empty container and close. Cautiously spray residue with plenty of water. Provide ventilation to clear sulfur dioxide fumes which may be generated as a result of water contact. See Hazards Information (Section C) for information on the hazards of this product when mixed with water.

SPECIAL PRECAUTIONS/PROCEDURES/LABEL INSTRUCTIONS — SIGNAL WORD - WARNING!

Avoid contact with water, ice, acid, and oxidizers. Use of this product in confined spaces may cause suffocation leading to death.

E. PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY PROTECTION

Where required, use a NIOSH-approved respirator for dust, mist, and/or sulfur dioxide gas, as conditions indicate. Some exposures may require NIOSH-approved self-contained breathing apparatus or supplied-air respirator.

EYES AND FACE

Wear hard hat (or other head covering) and chemical safety goggles. Do not wear contact lenses.

HANDS, ARMS, AND BODY

For handling dry material, wear cotton gloves and full work-clothing, including long-sleeved shirt and trousers. When handling solutions and there is prolonged or repeated contact, wear impervious gloves, clothing and boots.

OTHER CLOTHING AND EQUIPMENT

Eye-wash/safety shower facility.

General Chemical

PRODUCT SAFETY DATA SHEET — SODIUM METABISULFITE

A. GENERAL INFORMATION

TRADE NAME (COMMON NAME)	[X] C.A.S. No.	[ ] GENERAL PRODUCT CODE
SODIUM METABISULFITE (anhydrous sodium bisulfite, ABS, sodium pyrosulfite)	7681-57-4	

CHEMICAL NAME AND/OR SYNONYM: Sodium Metabisulfite

FORMULA	MOLECULAR WEIGHT
$Na_2S_2O_5$	190.11

ADDRESS (No., STREET, CITY, STATE AND ZIP CODE)

General Chemical Corporation
90 E. Halsey Road
Parsippany, NJ 07054-0389

CONTACT	PHONE NUMBER	LAST ISSUE DATE	CURRENT ISSUE DATE
Manager, Product Safety	(201) 515-1840	May, 1992	May, 1994

B. FIRST AID MEASURES

EMERGENCY PHONE NUMBER: (800) 631-8050

EYES: Immediately flush with plenty of water, for at least 15 minutes. Get medical attention.

SKIN: Immediately wash with plenty of soap and water. Remove contaminated clothing and wash before reuse.

INHALATION: Remove to fresh air. Get immediate medical attention if signs of suffocation, irritation or other symptoms develop.

INGESTION: Give plenty of water or milk to drink. If conscious, induce vomiting by touching finger to back of throat. Get immediate medical attention. Never give anything by mouth to an unconscious person.

C. HAZARDS INFORMATION

HEALTH

INHALATION

Contact with acids, water and/or ice, releases sulfur dioxide gas which may be harmful or deadly if inhaled. May cause severe or deadly allergic reactions in some asthmatics and sulfite sensitive individuals. Inhalation of dust or mist can irritate the respiratory tract. Possible signs and symptoms of allergic reactions include bronchoconstriction, sweating, flushing, hives, rapid heart rate; decreased blood pressure and anaphylaxis.

INGESTION

May irritate gastrointestinal tract. Very large doses cause death, violent colic, diarrhea and depression. Reference (b). May cause severe or deadly allergic reaction in some asthmatics and sulfite sensitive individuals.

SKIN

Repeated or prolonged contact with dust may cause irritation. Contact with solution will irritate. See pH, Section F.

EYES

Dust or mist may irritate or burn eyes. Solutions will irritate or burn. See pH, Section F.

PERMISSIBLE CONCENTRATION: AIR (SEE SECTION J)

ACGIH/TLV: 5 mg/M³
OSHA/TWA: 5 mg/M³

BIOLOGICAL: None established.

UNUSUAL CHRONIC TOXICITY

Medical conditions aggravated by exposure: May cause severe or deadly allergic reactions if inhaled or in some asthmatics and sulfite sensitive individuals. See hazard information for inhalation and ingestion.

CONDITIONS CONTRIBUTING TO INSTABILITY	*Solutions of Sodium Hypochlorite are fairly stable in concentrations below 1%. Stability decreases with concentration, heat, light exposure, decrease in pH, and contamination with heavy metals, such as, nickel, cobalt, copper, and iron.*
COMPATIBILITY	*Avoid contamination with heavy metals (act as catalysts) reducing agents, organics, ether, ammonia, acids.*
HAZARDOUS DECOMPOSITION PRODUCTS	*Hypochlorous acid (HOCL), chlorine, hydrochloric acid. Composition depends upon temperature and decrease in pH. Additional decomposition products, which depend upon pH, temperature and time, are sodium chloride, sodium chlorate, and oxygen.*

VII. DISPOSAL, SPILL OR LEAK PROCEDURES

AQUATIC TOXICITY (E.G., 96 HR. TLM)	*Not established, but if not dilute may seriously affect aquatic life. Do not allow spilled material to enter sewers or streams.*
WASTE DISPOSAL METHOD	*Reduce with chemicals listed below: Keep on alkaline side and dilute with copious quantities of water. Main end product is salt water. (NaCL)*
HANDLING SPILLS	*Flush with water to dilute as much as possible, avoid heat and contamination with acid materials. Do not use combustible materials such as sawdust to absorb hypochlorite.*
NEUTRALIZING CHEMICALS	*Reducing agents such as bisulfites or ferrous salt solutions; some heat will be produced.*

VIII. SPECIAL PROTECTION INFORMATION

VENTILATION REQUIREMENTS	*No special ventilation required unless bleach is exposed to decomposition conditions; i.e., spills or acidic conditions.*
SPECIFIC PERSONAL PROTECTIVE EQUIPMENT	
RESPIRATORY	*When fumes are present use NIOSH approved respirator with acid type canister.*
EYES	*Use goggles when dispensing solutions stronger than household bleach. (7%)*
GLOVES	*Use rubber or plastic gloves when exposed to solutions stronger than household bleach. (7%)*
OTHER	*Use rubber apron, etc. to protect body from any splashing conditions. Use rubber protective shoes if spills occur. Safety showers and eyewash fountains should be available in storage and handling areas.*

IX. SPECIAL PRECAUTIONS

PRECAUTIONARY STATEMENTS	*Normal handling of household bottled bleach requires safety requirements as stated on the labels. Full protection should be provided when handling bulk shipments of concentrated, industrial bleach solutions.*
PROPER HANDLING AND STORAGE REQUIREMENTS	*Store in vented, closed, clean, non-corrosive containers in a cool, dry location, away from direct sunlight and adjacent to chemicals which may react with the bleach if spillage occurs. If shipped, must comply with DOT, etc. shipping regulations. If closed containers become heated, the containers should be vented to release decomposition products (mainly oxygen under normal decomposition). Do not mix or contaminate with ammonia, hydrocarbons, acids, alcohols, ethers.*
NATIONAL REGULATORY CONCERNS	*EPA Pesticide regulations applicable and registration as a pesticide required when used for disinfection purposes.*

THIS PRODUCT IS LISTED ON THE TOXIC SUBSTANCES CONTROL (TSCA) INVENTORY OF CHEMICAL SUBSTANCES.

MATERIAL SAFETY DATA SHEET

SODIUM HYPOCHLORITE

High-Po-Chlor, Inc. 3773 E. Morgan Rd. Ypsilanti, MI. 48197

EMERGENCY TELEPHONE No. (313) 4341710

I. PRODUCT IDENTIFICATION

CHEMICAL NAME *Sodium Hypochlorite*

TRADE NAME AND SYNONYMS *Soda Bleach*

CHEMICAL FAMILY *Oxidizing Agent (Hypochlorite)*

FORMULA *NaOCL*

CAS No. *7681-52-9*

MOLECULAR WEIGHT *74.45*

SHIPPING NAME AND HAZARD CLASS-(DOT) *A. "Hypochlorite solution containing more than 7% available chlorine by weight."-Corrosive Material*

II. HAZARDOUS INGREDIENTS

MATERIAL OR COMPONENT

Sodium Hydroxide CAS# 1310-73-2 16.4%
Sodium Chloride CAS# 7647-14-5 13.1%
Water CAS# 7732-18-5 70.5%
Industrial bleach contains 7% - 15% available (6.67 - 13.06 weight % NaOCL) with about 0.05 - 0.85% excess NaOH for stability control.

III. PHYSICAL DATA

BOILING POINT *110° C for 15% NaOCL*

SPECIFIC GRAVITY (H_2O=1)
50 gpl - 1.08
100 gpl - 1.14
140 gpl - 1.21

VAPOR PRESSURE *v.p. of water plus decomposition product v.p.*

% VOLATILE BY VOLUME *Variable-water vapor plus products of decomposition.*

VAPOR DENSITY *NA*

EVAPORATION RATE *NA*

COLOR *Light Yellow-Green*

ODOR *Pungent like chlorine*

pH *Approximately 12*

SOLUBILITY IN WATER *Complete*

IV. FIRE AND EXPLOSION DATA

FLASHPOINT *Nonflammable*

SPECIAL FIRE FIGHTING PROCEDURES *Avoid fumes from spilled or exposed liquid, dilute copiously, ventilate, and be prepared to use respiratory protection if needed. Acid contamination will produce very irritating fumes similar to chlorine.*

UNUSUAL FIRE AND EXPLOSION HAZARDS *Bleach decomposes when heated; decomposition products may cause containers to rupture or explode. Vigorous reaction possible with organic materials or oxidizing agents; may result in fire.*

V. HEALTH HAZARD INFORMATION

HEALTH HAZARD DATA

INHALATION *Fumes from spills are very irritating to mucous membranes. Very little hazard from properly stored solution.*

SKIN CONTACT *Irritant, reddening of skin, skin damage.*

EYE CONTACT *Severe irritation*

INGESTION *Causes irritation of membranes of the mouth, throat, and stomach pain and possible ulceration. LD_{50} (oral, rat) for 5.25% NaOCL is approximately 13g/kg body weight and for 12.5% NaOCL is approximately 5g/kg body weight.*

EFFECTS OF OVEREXPOSURE

ACUTE *Irritating effects increase with strength of solution and time of exposure.*

CHRONIC *Constant irritant to eyes, throat.*

EMERGENCY AND FIRST AID PROCEDURES

EYES *Copious eye wash with water for at least 15 minutes. Consult an eye specialist immediately.*

INHALATION *Remove person to fresh air.*

INGESTION *If accidently swallowed, drink water, milk and obtain medical attention.* DO NOT USE BAKING SODA OR ACIDIC ANTIDOTES.

Not listed as a potential carcinogen. NTP ACIGH

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FOR SPILL ..... Add non-reactive dry, absorbent such as diatomaceous earth. Shovel or sweep up and place in an approved DOT container and seal. Flush contaminated area and neutralize with dilute acid.

WASTE DISPOSAL METHOD..... Dispose of spilled or waste product, contaminated soil and other contaminated materials in licensed landfill or treatment facility in accordance with all federal, state and local regulations.

SECTION VIII - SPECIAL PROTECTION

RESPIRATORY PROTECTION..... Supplied air or self contained breathing apparatus with full face piece.

VENTILATION..... To maintain vapors below limits.

PROTECTIVE GLOVES..... Rubber or other impervious materials.

EYE PROTECTION..... Chemical splash proof goggles.

OTHER PROTECTIVE EQUIPMENT.... A safety shower and eye bath should be available. For operations where spills or splashing may occur, use an impervious boc covering and boots.

HANDLING AND STORAGE..... Store in cool, dry, well ventilated area. Keep containers closed when not in use.

SECTION IX - SPECIAL PRECAUTIONS

HAZARD CLASS..... Corrosive Material

DOT SHIPPING NAME..... SODIUM HYDROXIDE, LILQUID

UN NUMBER..... UN1824

REPORTABLE QUANTITY (RQ)..... 2000 lbs.

REFERENCES HMIS: H-3,F-0,R-1

SODHYDOX

SPECIAL FIRE FIGHTING PROCEDURES... Wear NIOSH/MSHA approved self contained breathing apparatus and full protective equipment when this material is involved in a fire.

UNUSUAL FIRE HAZARD..... In solution caustic can react with amphoteric metals generating hydrogen which is flammable and/or explosive if ignited.

SECTION V - HEALTH HAZARD DATA

CARCINOGENICITY..... None
NTP..... No
IARC..... no
OVER EXPOSURE EFFECTS..... Redness of Exposed Tissues with possible burns resulting in deep ulceration.
PRIMARY ROUTE(S) OF ENTRY..... Skin Contact
FIRST AID PROCEDURES..... If inhaled: Remove to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Get medical attention.

In case of contact: Immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse.

Ingestion: Do not induce vomiting. If conscious, dilute by giving several glasses of water. Call a Physician Immediately.

EXPOSURE AGGRAVATED MEDICAL CONDITIONS None Currently Known

SECTION VI - REACTIVITY DATA

CHEMICAL STABILITY..... Stable
CONDITIONS TO AVOID..... Not Applicable
INCOMPATIBLE MATERIALS..... Acids
DECOMPOSITION PRODUCTS..... None Currently Known
HAZARDOUS POLYMERIZATION..... Will Not Occur
POLYMERIZATION AVOID..... Not Applicable

SECTION VII - SPILL OR LEAK PROCEDURE

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MATERIAL SAFETY DATA SHEET

SODIUM HYDROXIDE 50%
INDUSTRIAL GRADE

SECTION I - IDENTIFICATION

MANUFACTURER'S NAME..... Haviland Products Company
ADDRESS (STREET,CITY,STATE,ZIP) 421 Ann St., N.W., Grand Rapids, MI 49504
PHONE NUMBER..... (616) 361-6691
EMERGENCY PHONE NUMBER..... CHEMTREC (800) 424-9300
EFFECTIVE DATE..... 6/18/91
TRADE NAME..... SODIUM HYDROXIDE 50%
INDUSTRIAL GRADE
CHEMICAL FAMILY..... Alkali, Base

SECTION II - HAZARDOUS INGREDIENTS

HAZARDOUS COMPONENTS	OSHA/PEL	ACGIH/TLV (Units)	PROD. CAS #
Sodium Hydroxide (Caustic Soda). (48.5-51.0% by wt)	2 mg/m³ TWA	2 mg/m³ TWA	1310-73-2
Sodium Chloride (0.8-1.3% by wt)	Not Established	Not Established	7647-14-5
Water (Balance)	Not Established	Not Established	7732-18-5

SECTION III - PHYSICAL DATA

BOILING POINT..... 293°F (145°C)
FREEZING POINT ..... 60°F (15.6°C)
VAPOR PRESSURE (mm Hg)..... 1.5 @ 20°C
VAPOR DENSITY (Air=1)..... No Information Available
SOLUBILITY IN H2O..... Completely
APPEARANCE/ODOR..... Clear, Colorless Liquid; Odorless
SPECIFIC GRAVITY (H2O=1)..... 1.52
PH..... Not Established

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT..... Not Flammable
LOWER EXPLOSIVE LIMIT (% by Volume) Not Applicable
UPPER EXPLOSIVE LIMIT (% by Volume) Not Applicable
EXTINGUISH MEDIA..... As for Surrounding Fires

ADDITIONAL INFORMATION AND REFERENCES

STORAGE CONDITIONS

Store in properly labeled containers in dry, ventilated, secured areas. Keep containers closed and contents dry. Do not store with acids or acid salts, containers with water or weak alkalis, or oxidizing agents. Do not handle or store food, beverages, or tobacco in cyanide areas. Do not store near combustibles or flammables because of cyanide solution runoff from water used for fire fighting.

NPCA-HMIS RATINGS

Health (Acute)	3
Flammability	0
Reactivity	1
Personal Protection	–

NFPA RATINGS

Health	3
Flammability	0
Reactivity	1
Unusual Hazards	–

Personal Protection rating to be supplied by user depending on use conditions.

SARA/TITLE III HAZARD CATEGORIES AND LISTS

Product Hazard Categories:

Chronic Health	No
Acute Health	Yes
Fire Hazard	No
Pressure Hazard	No
Reactivity Hazard	Yes

Lists:

Extremely Hazardous Substance	Yes
CERCLA Hazardous Substance	Yes
Toxic Chemicals	Yes

For further information, see Du Pont Sodium Cyanide Storage and Handling Bulletin.

Sodium cyanide is a TSCA 8(d) chemical.

DATE OF LATEST REVISION/REVIEW: 4/91

PERSON RESPONSIBLE FOR MSDS:

W. J. Brock
Du Pont Chemicals
Chestnut Run Plaza
P.O. Box 80709
Wilmington, DE 19880-0709
(302) 999-4946

HEALTH HAZARD INFORMATION (cont'd)

For most accidental poisoning, complete recovery occurs within 1–2 hours. If cyanide exposure was severe, watch patient continuously for 24–48 hours. If there is any return of symptoms during this period, consider repeating this treatment using one half the amounts of sodium nitrite and sodium thiosulfate solutions. Blood chemistry should be monitored during prolonged treatment. Caution should be used to prevent overuse of medical treatment chemicals as the prescribed dose is about 1/3 the lethal dose for an average individual. The nitrite converts hemoglobin to methemoglobin which reduces the oxygen carrying capacity of the blood. This is done purposely as methemoglobin attracts cyanide away from the body cells, but nitrite use must be limited to prevent hemoglobin deficiency. Du Pont has not experienced nitrite overdose problems; but being alert to this is important information to medical personnel.

If signs of excess methemoglobinemia develop (i.e., blue skin and mucous membranes, vomiting, shock and coma), 1% methylene blue solution should be given intravenously. Administering up to a 1 to 2 mg/kg of body weight over a period of five to ten minutes should be considered and repeated in one hour if necessary. *NOTE:* **This procedure can free cyanide from cyanomethemoglobin. The free cyanide can again bind with cytochrome oxidase and, therefore, repoison the patient. If methylene blue is used, it must be used very carefully. It is best to avoid overuse of nitrite so corrective action is not needed. Historically, Du Pont has not had to use methylene blue to counter excess nitrite use. In addition, oxygen inhalation will be helpful. Transfusion of whole fresh blood may be considered if there has been mechanical injury with external or internal bleeding and simultaneous cyanide exposure.**

When handling potential cyanide poisoning emergencies, keep in mind:

1. Cyanide acts rapidly, usually within seconds once it enters the bloodstream. Delayed effects would only be expected during brief periods (e.g., up to about 20 minutes) when (a) cyanide was absorbed into the bloodstream from the stomach after ingestion or (b) absorption through the skin occurred prior to skin washing, but entry into the blood was not complete. In treatment, therefore, treat what you see; don't overreact. It's rare when "preventive" use of the antidotes would be warranted. If you can converse normally with the patient, cyanide intake is limited and no action is called for other than to closely monitor the patient and keep him calm by reassurance of his condition during the following 20–30 minute period.
2. The half-life of cyanide in the body is estimated at 20–90 minutes. The body routinely destroys cyanides from foods, cigarette smoke, etc. so cyanide is not a cumulative poison. In case of accidental cyanide intake, normal body action quickly begins cyanide destruction. In diagnosis and monitoring as mentioned in item 1, the critical period is therefore short. Normally what happens in the initial few minutes after exposure will indicate the degree of poisoning.

Du Pont's experience in treating cyanide poison cases is that first aid procedures using oxygen and amyl nitrite were effective and the only treatment needed in most cases. Medical treatment, using intravenous injections, was used in a few cases. Both procedures have been successful. (Reread paragraph 1 of FIRST AID).

PROTECTION INFORMATION

GENERALLY APPLICABLE CONTROL MEASURES

Good general ventilation should be provided to keep dust, mist, and HCN gas below exposure limits.

PERSONAL PROTECTIVE EQUIPMENT

Recommended Minimum Protection—chemical splash goggles and rubber gloves (butyl or neoprene preferred).

Have available and use as appropriate: face shields; rubber suits, aprons, and boots; disposable toxic dust and mist respirators; self-contained breathing air supply (in case of emergency); HCN detector; first aid and medical treatment supplies, including oxygen resuscitators.

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DISPOSAL INFORMATION

AQUATIC TOXICITY

The compound is highly toxic. 96-hour LC_{50} values range from 0.05–1.7 mg/L (several species). Based on cyanide concentrations (air versus water), cyanide appears to be more toxic to aquatic life than terrestrial life.

SPILL, LEAK OR RELEASE

Sweep up and shovel into a covered container or plastic bag, pending transfer, to secure the spill. Cover and keep spillage dry. Flush spill area with a dilute solution of sodium hypochlorite or calcium hypochlorite to destroy the cyanide. Comply with Federal, State, and local regulations on reporting releases. The EPA Reportable Quantity is 10 lb.

DISPOSAL

This material may be a RCRA Hazardous Waste. Do not flush cyanide into sewers which may contain an acid. Detoxify with sodium hypochlorite, hydrogen peroxide, or calcium hypochlorite. Comply with Federal, State, and local regulations on disposal methods used to achieve the constituent based treatment standard, if permitted; or transfer to a licensed disposal contractor.

SHIPPING INFORMATION

DOT (172.101)

PROPER SHIPPING NAME
Sodium Cyanide, Solid

HAZARD CLASS
Poison B

UN NO.
1689

DOT LABEL(S)
Poison

DOT/IMO (172.102)

PROPER SHIPPING NAME
Sodium Cyanide

HAZARD CLASS
Poison B, 6.1

UN NO.
1689

DOT/IMO LABEL
Poison

PACKAGING GROUP
I

REPORTABLE QUANTITY
10 lb/4.54 kg

SHIPPING CONTAINERS
CYANO-DOL® railcars and trucks; hopper railcars; FLO-BINS® (3,000 lb net); 2,000 lb. bag in a box; 100 kilo, 100 lb, and 200 lb steel drums.

HEALTH HAZARD INFORMATION (cont'd)

3. Swallowing Cyanide

   a. *Conscious:* Immediately give patient one pint of 1% sodium thiosulfate solution (or plain water) by mouth and induce vomiting by having patient stick finger into the throat. Repeat until vomit fluid is clear. Never give anything by mouth to an unconscious person. Call a physician. Give oxygen.

   b. *Unconscious:* Follow first aid procedures as in sections 1b and 1c of FIRST AID (and/or medical procedures in MEDICAL TREATMENT section) and call a physician. When the patient revives, proceed with section 3a of FIRST AID.

4. Eye or Skin Contact (Skin Absorption)

   a. *Eye Contact:* Immediately flush eyes with plenty of water, remove contaminated clothing, and keep patient quiet and warm. Call a physician.

   b. *Skin Contact:* Wash skin promptly to remove the cyanide while removing all contaminated clothing, including shoes. Do not delay. Skin absorption can occur from cyanide dust, solutions, or HCN vapor. Absorption is slower than inhalation, usually measured in minutes compared to seconds for inhalation. HCN is absorbed much faster than metal cyanides from solutions such as sodium, potassium, or copper cyanide solutions.

   Follow first aid procedures in FIRST AID section if treatment is needed, but even severe skin contact usually will not require treatment if (1) no inhalation or swallowing has occurred and (2) the cyanide is promptly washed from the skin and contaminated clothing and shoes are removed. If skin contact is prolonged, cyanide poisoning may occur with nausea, unconsciousness; death is possible if the source of cyanide is not removed and treatment provided. Even after washing the skin, the patient should be watched for at least 1 to 2 hours because absorbed cyanide can continue to work into the bloodstream. Wash clothing before reuse and destroy contaminated shoes.

MEDICAL TREATMENT

Medical treatment is normally provided by a physician, but might be provided by a professionally trained "qualified medical person" where a need exists and where State and local laws permit. Specific training for handling cyanide poisoning emergencies is essential, as well as being "in practice" for giving intravenous injections. Du Pont trains all personnel working with cyanide to use the first aid procedures, but not the medical treatment procedure.

While preparing for sodium nitrite and sodium thiosulfate injections, use amyl nitrite and oxygen as outlined in paragraph 1 of FIRST AID. When ready and if the patient is not responding to first aid, first inject the solution of sodium nitrite (10 mL of a 3% solution) intravenously at the rate of 2.5 mL/minute, then immediately inject the sodium thiosulfate (50 mL of a 25% solution) at the same rate, taking care to avoid extravasation. This is a fairly lengthy treatment (24 minutes) since a total of 10 + 50, or 60 mL, is injected at a rate of 2.5 mL per minute.

Consideration should be given to the size and condition of the patient as treatment is proceeding. The above sodium nitrite injection is about 1/3 of a lethal dose (see below), so care should be taken to avoid excessive use. It is not essential that full quantities be given, just because treatment was started. Injections can be stopped at any point if recovery is evident, but be sure to keep track of quantities administered in case treatment needs to be restarted. Relapse is abnormal if cyanide intake is not continuing, unless a large intake from swallowing occurred.

Don't overreact. While prompt treatment is essential where poisoning has occurred, treatment of a lucid, conscious patient would rarely be necessary. The effects of cyanide poisoning are immediate, not delayed, and a conscious person that can communicate does not have significant cyanide poisoning.

5. One stomach tube.
6. One dozen gauze pads.
7. A set of cyanide instructions on first aid and medical treatment.

NOTE: Amyl Nitrite Ampules and "Medical Treatment Kits" can be purchased through local pharmacies with a physician's prescription. As a help, you can inform the pharmacist that Eli Lilly and Co. produces the kit.

FIRST AID

1. **Directions for Giving Amyl Nitrite Antidote and Oxygen**

   a. *Conscious:* For inhalation and/or absorption if the patient is alert, oxygen may be all that is needed. But if the patient is not fully conscious or shows signs of poisoning, follow section 1b below. For swallowing, see section 3 of FIRST AID, "Swallowing Cyanide."

   b. *Unconscious but Breathing:* Break an amyl nitrite ampule in a cloth and hold lightly under the patient's nose for 15 seconds, then take away for 15 seconds. Repeat 5–6 times. If necessary, use a fresh ampule every 3 minutes until the patient regains consciousness (usually 1–4 ampules). Give oxygen simultaneously to aid recovery. Where more severe poisoning has occurred, consider holding the amyl nitrite under the nose continuously for the first ampule or more.

   c. *Not Breathing:*

      1. Give artificial respiration (100% oxygen), preferably with an oxygen resuscitator. Give amyl nitrite antidote by placing a broken ampule inside the resuscitator face piece, being careful that the ampule does not enter the patient's mouth and cause choking. Give oxygen simultaneously.
      2. If using manual artificial respiration, give amyl nitrite antidote as in section 1b of FIRST AID above, except keep the first amyl nitrite ampule under the nose with replacement every 3 minutes.

   d. *Amyl Nitrite Notes:*

      1. Amyl nitrite is highly volatile and flammable; do not smoke or use around source of ignition.
      2. If treating patient in a windy or drafty area, provide something—a rag, shirt, wall, drum, cupped hand, etc.—to prevent the amyl nitrite vapors from being blown away. Keep the ampule upwind from the nose. The objective is to get amyl nitrite into the patient's lungs.
      3. Rescuers should avoid amyl nitrite inhalation so they won't become dizzy and lose competence.
      4. Lay the patient down for treatment to maintain a good blood supply to the patient's head. Since amyl nitrite dilates the blood vessels and lowers blood pressure, lying down will help prevent unconsciousness.
      5. Do not overuse; excessive use might put the patient in shock. This has not occurred in practice at Du Pont plants and we are not aware of any death or serious aftereffects from treatment with amyl nitrite. (See MEDICAL TREATMENT section.)

2. **Inhalation of Cyanide**

   Carry patient to fresh air. Lay patient down. Administer oxygen and amyl nitrite (section 1 of FIRST AID). Keep patient quiet and warm. Even with inhalation poisoning, thoroughly check clothing and skin to assure no cyanide is present. If cyanide is found on clothing or skin, proceed as in section 4b of FIRST AID. Call a physician. Rescuers of patients in an HCN environment should wear SCBA equipment.

HEALTH HAZARD INFORMATION-(cont'd)

Always have on hand the materials listed below in sections FIRST AID and MEDICAL TREATMENT KITS. Actions to be taken in case of cyanide exposure should be planned and practiced before beginning work with cyanides. In most cases, cyanide poisoning causes a deceptively healthy pink to red skin color; however, if a physical injury or lack of oxygen is involved, the skin color may be bluish. Reddening of the eyes and pupil dilation are also symptoms of cyanide poisoning. Workers should be trained to provide immediate first aid using oxygen and amyl nitrite resuscitators.

In case of cyanide poisoning, start first aid treatment immediately, then call a physician.

FIRST AID SUPPLIES

Adequate first aid supplies for cyanide poisoning should be conveniently placed throughout cyanide areas and should be immediately accessible at all times. They should be routinely inspected (typically daily) by people who would use them in an emergency. The total number of each item listed below should be adequate to handle the largest number of exposure cases reasonably anticipated, taking into account that some supplies may be wasted, destroyed, or inaccessible in the emergency.

1. Oxygen Resuscitators—The Flynn Series III Model by O-Two Systems (800-387-3405) has performed well in Du Pont use. It is lightweight, rugged, and easy to use.
2. Amyl Nitrite Ampules (antidote)—One box of one dozen ampules per station is usually satisfactory. Locate stations throughout the cyanide area.

   CAUTION: Amyl Nitrite is not stable and must be replaced every 1 to 2 years. Store in the original dated box, away from heat. A common Du Pont practice is to use the resuscitator as the storage point for the amyl nitrite ampules. Avoid storage on vehicles where temperatures can reach 140–150°F or more.
3. A set of cyanide first aid instructions should be located at each amyl nitrite storage location. Workers should be fully trained since in a real emergency there will be insufficient time to "read the book."
4. Two 1-pint bottles of 1% sodium thiosulfate solution for use in case of cyanide ingestion or plain water can be used.

MEDICAL TREATMENT KITS

Medical Treatment Kits for cyanide poisoning should be conveniently located for easy access by medical people. Materials for intravenous injection are intended for use only by a physician or fully qualified medical personnel. The location of kits should be carefully planned as part of the emergency preplan. Suggested locations for kits include:

- in or near the cyanide area
- plant medical station
- entrance guard house
- local hospital
- doctor's office and residence

CAUTION: Do not store amyl nitrite or Medical Treatment Kits on vehicles as heat build-up may ruin the amyl nitrite.

Kits and amyl nitrite should be accessible but secured against tampering. They should be inspected regularly and the amyl nitrite ampules replaced every 1–2 years. Medical Treatment Kits should contain the following:

1. One box containing one dozen amyl nitrite ampules.
2. Two sterile ampules of sodium nitrite solution (10 mL of a 3% solution in each).
3. Two sterile ampules of sodium thiosulfate solution (50 mL of a 25% solution in each).
4. One 10 mL sterile syringe. One 50 mL sterile syringe. Two sterile intravenous needles. One tourniquet.

HEALTH HAZARD INFORMATION

ANIMAL DATA:

Oral LD_{50}: 15 mg/kg in rats

The compound is a skin and eye irritant in tests with laboratory animals.

Toxic effects described in animals from exposure by inhalation, ingestion, or skin contact include asphyxia, dyspnea, ataxia, tremors, coma, and lethality by disrupting oxidative metabolism. Tests in bacterial and mammalian cell cultures demonstrate no mutagenic activity. Tests for embryotoxicity in animals have shown an embryotoxic or teratogenic effect only at exposure levels very nearly lethal to the maternal animals. Observance of the established exposure limits and prevention of skin contact with sodium cyanide solutions should be adequate to prevent adverse health effects on anyone in the workplace, including the conceptus (fetus).

HUMAN HEALTH EFFECTS:

Human health effects of overexposure by inhalation, ingestion, or skin or eye contact may include skin irritation with discomfort or rash, eye irritation or burns with discomfort, tearing, or blurring of vision, and possible permanent eye damage; and nonspecific discomfort such as nausea, headache, dizziness, vomiting, and weakness.

Higher exposures may lead to rapid respiration, lowered blood pressure, unconsciousness, convulsions, or fatality. Evidence suggests that significant skin permeation can occur.

Individuals with preexisting diseases of the central nervous system may have increased susceptibility to the toxicity of excessive exposures.

CARCINOGENICITY

Not listed as a carcinogen by IARC, NTP, OSHA, or ACGIH.

EXPOSURE LIMITS [PEL (OSHA), TLV (ACGIH), AEL (DU PONT), ETC.]

The OSHA 8-hour Time Weighted Average (TWA) and ACGIH TLV®-TWA are 5 mg/m³, as CN. Both carry a "skin" notation indicating that cyanide may penetrate the skin (especially if the skin is broken). Control of vapor, dust, and mist inhalation alone may not be sufficient to prevent absorption of an excessive dose.

SAFETY PRECAUTIONS

Emergency pre-planning and training are needed before beginning to work with sodium cyanide since prompt treatment is essential in cases of cyanide poisoning. Always have Cyanide Antidote Kits on hand.

Do not breath dust, mist, or HCN gas. Do not get in eyes. Avoid contact with skin and clothing. Do not carry foodstuffs, beverages, or tobacco where contamination with cyanide is possible. Wash thoroughly after handling. Wash contaminated clothing before reuse.

FIRST AID AND MEDICAL TREATMENT

Treatment for cyanide poisoning can be provided in two ways, "First Aid" and "Medical Treatment." Both require immediate action to prevent further harm or death. First aid using oxygen and amyl nitrite is generally given by a layman before trained medical help arrives. Medical treatment is aggressive treatment involving intravenous injections of sodium nitrite and sodium thiosulfate, and must be administered by qualified medical personnel. Even if a doctor or nurse is present, the need for fast treatment dictates using first aid treatment with oxygen and amyl nitrate while medical treatment materials for intravenous injection are being prepared. Experience shows that first aid given promptly is usually the only treatment needed for typical accidental poisonings. Larger cyanide intake increases the need for medical treatment.

Medical treatment is given if the patient does not respond to first aid. It provides a large quantity of antidote including sodium thiosulfate to chemically destroy cyanide in the body. However, even under optimum conditions, amyl nitrite can be administered faster and should be used even if medical treatment follows.

HAZARDOUS COMPONENTS

MATERIAL(S)	CAS NO.	APPROXIMATE %
Sodium Cyanide*	143-33-9	100

* Regulated as a Toxic Chemical under Section 313 of Title III/SARA, and 40 CFR Part 372.

HAZARDOUS REACTIVITY

INSTABILITY
Very stable when dry.

INCOMPATIBILITY
Large amounts of poisonous, flammable hydrogen cyanide (HCN) gas will be evolved from contact with acids. Reacts violently with strong oxidizing agents. Water or weak alkaline solution can produce dangerous amounts of HCN in confined areas.

DECOMPOSITION
Moisture will cause slow decomposition, releasing poisonous HCN and ammonia gas.

POLYMERIZATION
Will not occur.

FIRE AND EXPLOSION DATA

FLASH POINT
Will not burn

FLAMMABLE LIMITS IN AIR, % BY VOL.
LOWER Not applicable.
UPPER Not applicable.

AUTOIGNITION TEMPERATURE
Not applicable.

FIRE AND EXPLOSION HAZARDS
Will not burn. Sodium cyanide will not be destroyed in an ordinary fire involving combustible materials such as paper or wood. Follow appropriate National Fire Protection Association (NFPA) codes.

EXTINGUISHING MEDIA
Use water on fires near sodium cyanide, but minimize amount of water if containers are opened or burned (see "Incompatibility", above). Also, judgment should be used in light of runoff problems (see Fire Fighting Instructions, below). In some cases it may be desirable to let a fire burn out by itself. *DO NOT* use carbon dioxide (CO_2) which reacts with sodium cyanide to produce hydrogen cyanide if moisture is present.

SPECIAL FIRE FIGHTING INSTRUCTIONS
Sodium cyanide dissolves readily in water; therefore, cyanide solution runoff may occur if containers are opened or burned. Runoff should be contained to avoid environmental or safety problems. Contained cyanide solution can be detoxified with hypochlorite.

HEALTH HAZARD INFORMATION

PRINCIPAL HEALTH HAZARDS (Including Significant Routes, Effects, Symptoms of Overexposure, and Medical Conditions Aggravated by Exposure)

May be fatal if inhaled, swallowed, or absorbed through skin. Contact with acids or weak alkalis liberates poisonous gas. Causes eye burns and may irritate skin.

DU PONT

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

NAME
Sodium Cyanide

GRADE
CYANOBRIK*; CYANOGRAN*; CYANO-DOL*; Compounders Grade

SYNONYMS
Cyanide of Sodium; Prussiate of Soda

CAS NAME
Sodium Cyanide

I.D. NOS./CODES
NIOSH Registry No. VZ7525000

MANUFACTURER/DISTRIBUTOR
Du Pont Company

ADDRESS
Wilmington, DE 19898

CHEMICAL FAMILY
Alkali Metal Cyanide

FORMULA
NaCN

CAS REGISTRY NO.
143-33-9

TSCA INVENTORY STATUS
Reported/Included

SARA/TITLE III STATUS
See ADDITIONAL INFORMATION and HAZARDOUS COMPONENTS sections

PRODUCT INFORMATION PHONE
800-441-9442

MEDICAL EMERGENCY PHONE
800-441-3637

TRANSPORTATION EMERGENCY PHONE
Du Pont Cyanide HOTLINE
(For emergencies only) (901) 357-1546
CHEMTREC 800-424-9300

PHYSICAL DATA

BOILING POINT, 760 mmHg
1496° C (2725° F)

SPECIFIC GRAVITY
1.6

VAPOR DENSITY
Not volatile

pH INFORMATION
11.3 to 11.7 (Typical for 5 to 25% solutions with no pH adjustment)

FORM
Solid

COLOR
White

MELTING POINT
564° C (1047° F)

VAPOR PRESSURE
Negligible

SOLUBILITY IN WATER
37% at 20° C (68° F)

EVAPORATION RATE (Butyl Acetate = 1)
Not applicable

APPEARANCE
Granular or Briquettes

ODOR
None (but can have slight ammonia and/or HCN odor if damp)

* Reg. U.S. Pat. & Tm. Off., Du Pont Company. CYANOBRIK®, CYANOGRAN®, and CYANO-DOL® Sodium Cyanide are made only by Du Pont.

The data in this Material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process

DIAMOND SHAMROCK CHEMICALS COMPANY
MSDS NUMBER: M1051
PRODUCT NAME: SODIUM CHROMATE ANHYDROUS

IX. SPECIAL PRECAUTIONS

SIGNAL WORDS:
DANGER!
POISON!
POSSIBLE CANCER HAZARD!

STATEMENT OF HAZARDS:
MAY BE FATAL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN
CAUSES BURNS TO SKIN AND EYES - MAY CAUSE EXTERNAL ULCERS
PROLONGED OR REPEATED BREATHING MAY CAUSE ULCERATION OR PERFORATION OF NASAL MEMBRANES
OVEREXPOSURE MAY CREATE CANCER RISK
STRONG OXIDIZER

PRECAUTIONARY STATEMENTS:
Do not breathe dust or mist.
Do not get in eyes, on skin, on clothing.
Wear respirator, chemical goggles, rubber gloves, and protective clothing when handling.
Keep container closed.
Use only with adequate engineering controls and ventilation where dust, mist, spray and hazardous by-products may be generated (see Sections II and VIII of the Material Safety Data Sheet for control levels and further information).
Wash thoroughly after handling (take shower after work using plenty of soap; use fresh clothing daily).
Store in tightly closed containers away from combustible materials.
Container, when EMPTY, remains hazardous: dispose in accordance with applicable laws and regulations.

FIRST AID:
IN CASE OF CONTACT:
For eyes:
Immediately flush eyes with plenty of water for at least 15 minutes. Washing eyes within several seconds after exposure is essential to achieve maximum effectives. Hold lids apart to ensure flushing of entire surface. SEEK MEDICAL ATTENTION.
For skin:
Immediately flush skin with plenty of soap and water for at least 15 minutes. Remove contaminated clothing and wash before reuse. Discard footwear which cannot be decontaminated. SEEK MEDICAL ATTENTION.

IF INHALED:
Move to fresh air. If conscious: irrigate nasal passages and mouth with water. If breathing has stopped, apply artificial respiration; administer oxygen if readily available. SEEK MEDICAL ATTENTION.
IF SWALLOWED:
If conscious, give several glasses of water to drink and induce vomiting by having patient tickle back of throat with finger. Never give anything by mouth to an unconscious person. SEEK MEDICAL ATTENTION.

NOTES TO PHYSICIAN:
See Material Safety Data Sheet (MSDS), for more detailed information for first aid and safe handling.

IN CASE OF SPILL OR LEAK:
Follow precautionary statements. Shovel or soak up spilled material into a plastic or steel container and reuse or remove to approved chemical waste disposal area. Treat residue with reducing agent (e.g. sodium bisulfite), then neutralize with soda ash or lime; remove to approved chemical waste disposal area. Flush area with water, directing runoff to appropriate treatment or disposal container. NEVER FLUSH TO SEWER. Major spills should be reported according to regulations.

STORAGE AND DISPOSAL

STORAGE:
Do not store in close proximity to combustible materials as chromic acid is an oxidizing agent (yellow label). Store in tightly closed containers away from sources of heat.

LABEL 060986M1051

FOR INDUSTRIAL USE ONLY

— Reactivity Data

Unstable		Conditions to Avoid N/A
Stable	X	

ility (Materials to Avoid)
act with: chlorine, hypochlorous acid, hypochlorites, cyanides or sulfides.

mposition or Byproducts
ition with heat (209°C.) to release sulfur dioxide, sulfur trioxide,

May Occur		Conditions to Avoid N/K /nitrogen, water and ammonia gas.
Will Not Occur	X	

— Health Hazard Data

	Inhalation?	Skin?	Ingestion?
	X	X	X

(Acute and Chronic)
may result in irritation of skin, eyes, and respiratory tract as well
nic upset.

	NTP?	IARC Monographs?	OSHA Regulated?
	nown to be carcinogenic.		

mptoms of Exposure
Irritation of eyes, skin, with possible gastric upset.

itions
gravated by Exposure N/K

d First Aid Procedures
Flush with water for 15 min. SKIN: Wash skin thoroughly with soap
r. INGESTION: Give copious quantities of fluids, seek medical attention

— Precautions for Safe Handling and Use

en in Case Material is Released or Spilled
ny spillage of material with water and flush away with plenty of water
e water treatment system. It may be neutralized with alkalies.

Method
lize with alkalies, comply with all local, state and federal regulations.

e Taken in Handling and Storing
contact with skin and eyes. Store in cool dry place. Do not store with
, sulfides, chlorine, hypochlorous acid or hypochlorites.
s

— Control Measures

rotection (Specify Type)
Respirator with dust filter.

Local Exhaust	X	Special	
Mechanical (General)		Other	
Rubber gloves		Eye Protection	Chemical splash goggles.

ive Clothing or Equipment
Apron suggested.

actices
Avoid contact directly with skin and eyes.

SULFAMIC ACID

Material Safety Data Sheet

May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY (As Used on Label and List): SULFAMIC ACID

Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

Section I

Manufacturer's Name: Imported by: AERCHEM, INC.

Address (Number, Street, City, State, and ZIP Code): 1542 Barclay Blvd. Buffalo Grove, Il 60089

Emergency Telephone Number: 800-424-9300

Telephone Number for Information: 708-215-1287

Date Prepared: 11-92

Signature of Preparer (optional):

Section II — Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
Sulfamic Acid HSO_3NH_2	CAS NO. 5329-14-5			
Amidosulfonic Acid				
Aminosulfonic Acid	Dot Class: UN2967		IMCO 8	

Section III — Physical/Chemical Characteristics

Boiling Point	Decomposes	Specific Gravity (H_2O = 1)	2.126
Vapor Pressure (mm Hg.)	N/A	Melting Point	205° C.
Vapor Density (AIR = 1)	N/A	Evaporation Rate (Butyl Acetate = 1)	N/A

Solubility in Water: Moderately soluble in water and organic solvents.

Appearance and Odor: White crystalline with no odor.

Section IV — Fire and Explosion Hazard Data

Flash Point (Method Used)	N/A	Flammable Limits	LEL	UEL

Extinguishing Media: Water, Chemical foam, carbon dioxide, dry chemical.

Special Fire Fighting Procedures: Wear self-contained breathing apparatus.

Unusual Fire and Explosion Hazards: Sulfur dioxide, sulfur trioxide and Ammonia gas may be released in fire.

MARSULEX INC.

MATERIAL SAFETY DATA SHEET (90)

Sulfuric Acid

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name: Sulfuric Acid
Chemical Name: Sulfuric Acid
Formula: H_2SO_4
Chemical Family: Inorganic Acid
Molecular Weight: 98.08
CAS# 7664-93-9
Synonyms: Sulphuric Acid, Oil of Vitriol, Battery Acid
Product Use: Used in manufacture of fertilizers, explosives, other acids, metal pickling and petroleum processing.

MARSULEX Inc.
111 Gordon Baker Road
Suite 300
North York, ONT
M2H 3R1
(416) 496-9655

MARSULEX Inc.
40 Richards Avenue
P.O. Box 5453
Norwalk, CT
06856-5453
(203) 854-0300

EMERGENCY TELEPHONE NUMBER
(800) 263-9502

Prepared by MARSULEX Technical Section (416) 496-4164.

2. COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous Ingredients	% by Wt.	CAS Number
Sulfuric Acid	70-100%	7664-93-9
Non-Hazardous Ingredients		
Water	0-30%	7732-18-5

3. HAZARD INFORMATION

EMERGENCY OVERVIEW:

Danger! Extremely corrosive. Causes severe burns. Reacts violently with water. Highly reactive and capable of igniting combustible materials on contact. Not flammable, but reacts with most metals to form explosive hydrogen gas.

Sulfuric Acid is a colorless to amber, clear to slightly cloudy, oily liquid.

National Fire Protection Association (NFPA) Rating
Hazardous Materials Identification System (HMIS) Rating

	NFPA	HMIS
HEALTH	3	3
FIRE	0	0
REACTIVITY	2	2
SPECIAL	W	

4 = Extreme/Severe
3 = High/Serious
2 = Moderate
1 = Slight
0 = Minimum
W = Water Reactive

3. HAZARD INFORMATION (continued)

POTENTIAL HEALTH EFFECTS:

Exposure Limits:

	ACGIH (TLV)	OSHA (PEL)
Sulfuric Acid	1 mg/m^3 (TWA) 3 mg/m^3 (STEL)	1 mg/m^3 (TWA)

In contact with the skin: Concentrated solution may cause pain and severe burns to the skin and brownish or yellow stains. Prolonged and repeated exposure to dilute solutions may cause irritation, redness, pain and drying and cracking of the skin.

In contact with the eyes: Immediate pain, severe burns and corneal damage which may result in blindness.

Inhaled: Mists and vapors may cause irritation of the eyes, nose and respiratory tract. May cause increased pulmonary resistance, transient cough and bronchoconstriction. Severe overexposure may result in lung collapse and pulmonary edema which can be fatal.

Ingested: Severe burning and pain in the mouth, throat and abdomen. Vomiting, diarrhea and perforation of the esophagus and stomach lining may occur.

Long Term Exposure:
Repeated exposure may produce erosion and discoloration of teeth.

Although no direct link has been established between exposure to sulfuric acid, itself, and cancer in man, the World Health Organization (WHO) International Agency for Research on Cancer (IARC) have concluded that occupational exposure to strong inorganic acid mists containing sulfuric acid is carcinogenic to man, causing cancer of the larynx (the voice box) and, to a lesser extent, the lung. Exposure to any mist or aerosol during the use of this product should be avoided and, in any case, keep exposures below the occupational exposure limit for sulfuric acid.

Corrosive effects on the skin and eyes may be delayed, and damage may occur without the sensation or onset of pain. Repeated overexposure may lead to contact dermatitis, may cause bronchitis with cough, phlegm, shortness of breath and emphysema, can cause chronic runny nose, tearing of the eyes, nosebleeds and stomach upsets. Strict adherence to first aid measures following **any** exposure is essential.

Existing Medical Conditions Possibly Aggravated By Exposure: Skin irritation may be aggravated in individuals with existing skin lesions. Breathing of vapors or sprays (mists) may aggravate acute or chronic asthma and chronic pulmonary disease such as emphysema and bronchitis.

Carcinogenicity Data: Although there are reports linking exposure to sulfuric acid to cancer, this product is not classified by NTP (National Toxicology Program), not regulated as carcinogenic by OSHA (Occupational Safety and Health Administration), and has not been evaluated by IARC (International Agency for Research on Cancer) or ACGIH (American Conference of Governmental Industrial Hygienists). (See also, Long Term Exposure).

4. FIRST AID MEASURES

Prompt removal of this material from contact with the body is of utmost importance. START FIRST AID AT ONCE.

▲ **Precaution:** Persons attending the victim should avoid direct contact with heavily contaminated clothing and vomitus. Wear impervious gloves while decontaminating skin and hair.

In contact with the skin: Flush skin with running water for a **minimum** of 20 minutes. Start flushing while removing contaminated clothing. If irritation persists, repeat flushing. Obtain medical attention IMMEDIATELY. Do not transport victim unless the recommended flushing period is completed or flushing can be continued during transport.

▲ While the patient is being transported to a medical facility, apply compresses of iced water. If medical treatment must be delayed, immerse the affected area in iced water. If immersion is not practical, compresses of iced water can be applied. Avoid freezing tissues.

▲ Discard heavily contaminated clothing and shoes in a manner which limits further exposure. Otherwise, wash clothing separately before reuse.

In contact with the eyes: Immediately flush eyes with running water for a **minimum** of 20 minutes. Hold eyelids open during flushing. If irritation persists, repeat flushing. Obtain medical attention IMMEDIATELY. Do not transport victim until the recommended flushing period is completed unless flushing can be continued during transport.

Inhaled: Move victim to fresh air. Give artificial respiration ONLY if breathing has stopped. Give Cardiopulmonary Resuscitation (CPR) if there is no breathing AND no pulse. Obtain medical attention IMMEDIATELY.

Ingested: If victim is alert and not convulsing, rinse mouth and give ½ to 1 glass of water to dilute material. If spontaneous vomiting occurs, have victim lean forward with head down to avoid breathing in of vomitus, rinse mouth and administer more water. IMMEDIATELY contact local poison control center. Vomiting may need to be induced but should be directed by a physician or a poison control center. IMMEDIATELY transport victim to an emergency facility.

▲ **Note to Physician:** All treatments should be based on observed signs and symptoms of distress in the patient. Medical conditions that may be aggravated by exposure include asthma, bronchitis, emphysema and other lung diseases and chronic nose, sinus or throat conditions. Severity of the burn is generally determined by the concentration of the solution and the duration of exposure. In the event of skin or eye contact, immediate and thorough flushing is essential. Continued washing of the effected area with cold or iced water will be helpful in removing the last traces of sulfuric acid. Cream or ointments should not be applied before or during the washing phase of the treatment.

5. FIRE FIGHTING MEASURES

Flash Point (method): Not applicable, product is non-flammable
Autoignition Temperature: Not combustible
Flammability Limits in air(%): **UEL:** Not applicable **LEL:** Not applicable

5. FIRE FIGHTING MEASURES (continued)

Fire Extinguishing Media: For small fires use dry chemical or carbon dioxide. For large fires, flood fire area with water from a distance. Expect violent reaction with water. Do not get solid stream of water on spilled material.

Special Fire Fighting Procedures: Wear a NIOSH/MSHA approved self-contained breathing apparatus if vapors or mists are present and full protective clothing. For fighting fires in close proximity to spill or vapors, use acid-resistant personal protective equipment. Evacuate residents who are downwind of fire. Prevent unauthorized entry to fire area. Dike area to contain runoff and prevent contamination of water sources. Neutralize runoff with lime, soda ash or other suitable neutralizing agents (see Deactivating Chemicals, Section 6). Cool containers that are exposed to flame with streams of water until fire is out.

Other Fire or Explosion Hazards: Not flammable but highly reactive. Capable of igniting finely divided combustible materials on contact. Reacts violently with water and organic materials with evolution of heat. Extremely hazardous in contact with many materials, particularly carbides, chlorates, fulminates, nitrates and picrates. Sulfuric acid reacts with most metals, especially when dilute to give flammable, potentially explosive hydrogen gas. Hydrogen gas can accumulate to explosive concentrations inside confined spaces. Follow appropriate NFPA codes.

6. ACCIDENTAL RELEASE MEASURES

▲ **Steps to be taken in the event of a spill or leak:** Remove all ignition sources. Ventilate area. Use appropriate Personal Protection Equipment. Prevent liquid from entering sewers or waterways. Dike with inert material (sand, earth, etc.). Stop or reduce leak if safe to do so. Collect into containers for reclamation or disposal only if container is suitable to withstand the material. Consider insitu neutralization and disposal. Ensure adequate decontamination of tools and equipment following clean up. Comply with Federal, Provincial/State and local regulations on reporting releases.

Deactivating Chemicals: Lime, limestone, sodium carbonate (soda ash), sodium bicarbonate, dilute sodium hydroxide, dilute aqua ammonia.

Waste Disposal Methods: Dispose of waste material at an approved waste treatment/disposal facility, in accordance with applicable regulations. Do not dispose of waste with normal garbage or to sewer systems.

▲ Note - Clean-up material may be a RCRA Hazardous Waste on disposal.
- Spills are subject to CERCLA reporting requirements: RQ = 1000 lbs.

7. HANDLING AND STORAGE

Precautions: Wear appropriate Personal Protection Equipment. Do not breath sprays or mists. Do not ingest. Do not get in eyes, on skin or on clothing. Keep ignition sources away from sulfuric acid storage, handling and transportation equipment.

Handling Procedures and Equipment: Carbon steel or stainless steel materials are suitable for use for acid concentrations equal to or greater than 93%. However, the effect of lower concentrations on the materials of construction can be very complex. Contact product supplier for specific recommendations when handling sulfuric acid at strengths less than 77%.

7. HANDLING AND STORAGE (continued)

Storage Temperature: Store above freezing point (Section 9). Elevated temperatures will increase the corrosion rate of most metals.

Storage Requirements: Store packaged acid in a dry, well, ventilated location away from combustibles, oxidizers, bases, or metallic powders. Storage tanks should be protected from water ingress, be well ventilated, and maintained structurally in a safe and reliable condition.

Other Precautions: Sulfuric acid will attack some forms of plastics and coatings. Always add acid to water - not water to acid. If kept in upper floors of building, floors should be acid proof with drains to a recovery tank.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Recommendations listed in this section indicate the type of equipment which will provide protection against over exposure to this product. Conditions of use, adequacy of engineering or other control measures, and actual exposures will dictate the need for specific protective devices at your workplace.

Engineering Controls: Local exhaust ventilation required.

Respiratory Protection: A NIOSH/MSHA approved air-purifying respirator equipped with acid gas/fume, dust, mist cartridges for concentrations up to 10 mg/m^3. An air-supplied respirator if concentrations are higher or unknown.

Skin Protection: Impervious (i.e., neoprene, PVC) gloves, coveralls, boots and/or other acid resistant protective clothing.

Eye Protection: Tight-fitting chemical goggles and face shield.

Other Personal Protective Equipment: Where there is a danger of spilling or splashing, acid resistant aprons or suits should be worn. Trouser legs should be worn outside (not tucked in) rubber boots. Safety showers and eyewash fountains should be installed in storage and handling areas.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Liquid

Appearance and Odor: Sulfuric acid is a clear to amber, heavy, oily liquid which may have a sharp penetrating odor.

Odor Threshold: No data

▲ **Boiling Point:** 77.67%: 193°C (380°F); 93.19%: 276°C (529°F); 98%: 330°C (626°F)

▲ **Melting/Freezing Point:** 77.67%: -11.2°C (+11.6°F); 93.19%: -29.5°C (-21.1°F); 98%: -1.1°C (30°F)

▲ **Vapor Pressure at 40°C (102°F):** 77.67%: 1.2 mmHg; 93.19%: 0.0016 mmHg; 98%: 0.002 mmHg

▲ **Specific Gravity at 15°C (60°F):** 77.67%: 1.7059; 93.19%: 1.8354; 98%: 1.8437

▲ **Vapor Density: (Air=1):** 3.4 sulfuric acid component

Bulk Density: Not applicable (see specific gravity)

9. PHYSICAL AND CHEMICAL PROPERTIES (continued)

Evaporation Rate: Not applicable
Solubility: Miscible in all proportions in water. Also soluble in alcohol.
pH: 0.3 (1N solution at 25°C/78°F)

10. STABILITY AND REACTIVITY

Stability:
Under Normal Conditions: Stable, but reacts violently with water and organic materials with evolution of heat.
Under Fire Conditions: Decomposes to form sulfur oxides(SO_x).

Conditions to Avoid: Temperatures which may have a negative effect on the materials of construction used in equipment.

Materials to Avoid: Contact with organic materials (such as chlorates, carbides, fulminates and picrates) may cause fire and explosions. Contact with metals may produce flammable hydrogen gas. When diluting, add acid to water. Do NOT add water to the acid.

Hazardous Decomposition or Combustion Products: Toxic gases and vapors (e.g. sulfur dioxide, sulfuric acid vapors/mists and sulfur trioxide) may be released when sulfuric acid decomposes.

Hazardous Polymerization: Will not occur

11. TOXICOLOGICAL INFORMATION

Toxicological Data: LD_{50} (oral, rat) = 2140 mg/kg
LC_{50} (inhalation, rat) = 510 mg/m^3 for 2 hrs
Skin effects (rabbit): Severe Irritation
Eye effects (rabbit): Severe irritation

Carcinogenicity Data: Although there are reports linking exposure to sulfuric acid to cancer, this product is not classified by NTP (National Toxicology Program), not regulated as carcinogenic by OSHA (Occupational Safety and Health Administration), and has not been evaluated by IARC (International Agency for Research on Cancer) or ACGIH (American Conference of Governmental Industrial Hygienists). See Section 3. Hazard Information, regarding Potential Health Effects (Long Term Exposure) for further discussion.

Reproductive Effects: No information is available and no adverse reproductive effects are anticipated.

Mutagenicity Data: No information is available and no adverse mutagenic effects are anticipated.

Teratogenicity Data: No information is available and no adverse teratogenic effects are anticipated.

Synergistic Materials: None known

12. ECOLOGICAL INFORMATION

Ecotoxic Effects: Harmful to aquatic life in very low concentrations. May be dangerous if it enters water intake; Fish toxicity critical concentration = 10 mg/L; 7.34 mg/L/48 hrs - Lymneae Palustris - 0-100% mortality.

13. DISPOSAL CONSIDERATIONS

- Responsibility for proper waste disposal is with the owner of the waste. Work with the appropriate regulatory bodies to ensure compliance with regulations.
- Consider the collection of residual sulfuric acid into containers for reclamation or disposal only if the container is suitable to withstand the material.
- Consider insitu neutralization and disposal.
- Clean-up material may be a RCRA Hazardous Waste on disposal.
- Provincial/State or local regulations or restrictions are complex and may differ from Federal regulations.
- The information applies to the material as manufactured; processing, neutralizing, use or contamination may make the information inappropriate, inaccurate or incomplete.

14. TRANSPORT INFORMATION

U.S. (Under DOT)

Shipping Name: RQ Sulfuric acid
Hazard Class or Division: 8
Product Identification No. (PIN): UN1830
Packing Group: II

Canada (Under TC)

Shipping Name: Sulphuric acid
Classification(s): Class 8 (9.2)
Product Identification No. (PIN): UN1830
Packing Group: II

15. REGULATORY INFORMATION

U.S.A.

SARA Title III HAZARD CATEGORIES AND LISTS

Product Hazard Categories	
Acute (Immediate) Health:	Yes
Chronic (Delayed) Health:	Yes
Fire:	No
Reactivity:	Yes
Sudden Release of Pressure:	No

Lists	
Extremely Hazardous Substance (40 CFR 355, SARA Title III Section 302)	Yes
CERCLA Hazardous Substance (40 CFR 302.4)	Yes
Toxic Chemical (40 CFR 372.65, SARA Title III Section 313)	Yes

15. REGULATORY INFORMATION (continued)

Reportable Quantity (RQ) under U.S. EPA CERCLA: RQ=1000 lb

TSCA Inventory Status: Reported/Included

CANADA

Workplace Hazardous Materials Information System (WHMIS)

WHMIS Classification(s): Class E - Corrosive
Class D1A - Very Toxic

WHMIS Health Effects Index: Acute Lethality - very toxic - immediate
Corrosive to animal skin

WHMIS Ingredient Disclosure List: Confirmed A; Meets criteria for disclosure at 1% or greater.

Reportable Quantity (RQ) under Transport Canada - TDG:
RQ=5 litres (or Kg) if it represents a danger to health, life, property or the environment.

16. OTHER INFORMATION

Additional Information and References

1. Enviro-TIPS Manual, "Sulphuric Acid and Oleum", Environment Canada, February 1984.
2. Weast, R.C. (Ed.), "CRC Handbook of Chemistry and Physics", 60th Edition (1980)
3. Sax, N.I., "Dangerous Properties of Industrial Materials", 7th Edition (1989)
4. ACGIH, "Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices", 1991-92
5. Sittig, Marshall, "Handbook of Toxic and Hazardous Chemicals and Carcinogens", 2nd Edition, 1985

Revision Indicators:

▲ In the left margin indicates a revision or addition of information since the previous issue.

16. OTHER INFORMATION (continued)

Legend:

CAS #	- Chemical Abstracts Service Registry Number
CERCLA	- Comprehensive Environmental Response, Compensatión, and Liability Act
CFR	- Code of Federal Regulations
DOT	- Department of Transportation
EPA	- Environmental Protection Agency
LC_{50}	- The concentration of material in air expected to kill 50% of a group of test animals
LD_{50}	- Lethal Dose expected to kill 50% of a group of test animals
LEL	- Lower Explosive Limit
MSHA	- Mine Safety and Health Administration
NIOSH	- National Institute for Occupational Safety and Health
PEL	- Permissible Exposure Limit
PVC	- Polyvinyl chloride
RCRA	- Resource Conservation and Recovery Act
SARA	- Superfund Amendments and Reauthorization Act of the U.S. EPA
STEL	- Short Term Exposure Limit
TC	- Transport Canada
TDG	- Transportation of Dangerous Goods Act/Regulations
TLV	- Threshold Limit Value
TSCA	- Toxic Substances Control Act
TWA	- Time-Weighted Average
UEL	- Upper Explosive Limit

The information contained herein has been prepared by MARSULEX Inc. and is offered only as a guide to the handling of this specific material and has been prepared in good faith by technically knowledgeable personnel. It is not intended to be all-inclusive and the manner and conditions of use and handling may involve other and additional considerations. No warranty of any kind is given or implied and MARSULEX Inc. will not be liable for any damages, losses, injuries or consequential damages which may result from the use or reliance of any information contained herein.

MATERIAL SAFETY
DATA SHEET

M&T* CHEMICALS INC.
PO BOX 1104
RAHWAY, NJ 07065

EMERGENCY TELEPHONE
NUMBERS --
8:30 AM - 4:30 PM
(201) 499-2403
AFTER HOURS
(201) 499-2445

NAME USED ON LABEL: PURE TIN EXTRUDED STAR ANODES
CHEMICAL NAME (IF SINGLE SUBSTANCE): TIN
CHEMICAL FAMILY: PLATING
FORMULA: SN

INGREDIENTS

IDENTITY	CAS NO.	%	TLV
TIN	7440-31-5	>99	2 MG/M3

PHYSICAL DATA

BOILING POINT: N/A
SPECIFIC GRAVITY: 7.29 @ 20 C
VAPOR DENSITY: N/A
% VOLATILES: NONE
MOLECULAR WEIGHT: 118.69
FREEZING POINT: N/A
VAPOR PRESSURE @ 20 C: N/A
SOLUBILITY IN WATER: INSOLUBLE
EVAPORATION RATE: N/A
OTHER:
APPEARANCE AND ODOR: SILVER-WHITE DUCTILE SOLID

FIRE AND EXPLOSION DATA

FLASH POINT (TEST METHOD)
N/A
AUTOIGNITION TEMPERATURE
N/A
FLAMMABLE LTS.
LEL= UEL=
EXTINGUISHING MEDIA: WATER SPRAY

SPECIAL FIRE FIGHTING PROCEDURES: N/A

UNUSUAL FIRE AND EXPLOSION HAZARDS: N/A

MATERIAL SAFETY
DATA SHEET

M&T* CHEMICALS INC.
RAHWAY, NJ 07065

NAME USED ON LABEL: PURE TIN EXTRUDED STAR ANODES

****
ENVIRONMENTAL INFORMATION
****

SPILL RESPONSE: PICK UP MATERIAL AND PLACE IN A SUITABLE CONTAINER FOR REUSE OR SALE AS SCRAP MATERIAL.

RECOMMENDED DISPOSAL: SELL MATERIAL AS SCRAP. FOLLOW ALL CHEMICAL POLLUTION CONTROL REGULATIONS.

EPA HAZ. WASTE DESIGNATION (FOR VIRGIN PRODUCT): NONE
OTHER:

****
HEALTH HAZARD DATA
****

EYE CONTACT: N/A

SKIN CONTACT: N/A

INHALATION: N/A

CHRONIC TOXICITY: N/A

SUGGESTED FIRST AID:
EYES: N/A

SKIN: N/A

INHALATION: N/A

INGESTION: N/A

NAME USED ON LABEL: PURE TIN EXTRUDED STAR ANODES

REACTIVITY DATA

STABILITY: STABLE
CONDITIONS TO AVOID: N/A
INCOMPATIBILITY (MATERIALS TO AVOID): N/A
HAZARDOUS POLYMERIZATION: WILL NOT OCCUR
CONDITIONS TO AVOID: N/A
HAZARDOUS DECOMPOSITION PRODUCTS: N/A

SPECIAL PROTECTION INFORMATION

VENTILATION: LOCAL EXHAUST IS RECOMMENDED.
MECHANICAL (GENERAL) IS REQUIRED.
RESPIRATORY PROTECTION: N/A

EYE AND FACE PROTECTION: N/A

OTHER CLOTHING AND EQUIPMENT: N/A

SPECIAL PRECAUTIONS

PRECAUTIONARY LABEL INFORMATION: USE PROPER HANDLING AND LIFTING TECHNIQUES.

STORAGE AND HANDLING: NORMAL WAREHOUSE STORAGE.

M&T# CHEMICALS INC.
RAHWAY, NJ 07065

NAME USED ON LABEL: PURE TIN EXTRUDED STAR ANODES

TRANSPORTATION

DEPARTMENT OF TRANSPORTATION (DOT)
DOT PROPER SHIPPING NAME: NONE REQUIRED
DOT HAZARD CLASS: NONE REQUIRED
DOT LABEL: NONE REQUIRED
DOT ID #: NONE REQUIRED

MISCELLANEOUS

FOR INDUSTRIAL USE ONLY. READ TECHNICAL DATA BULLETIN ABOUT THIS PRODUCT PRIOR TO USE.

REVISION(S)

1. UPDATED ENTIRE MSDS USING SPELL MODE.

PREPARED BY SAFETY & ENVIRONMENTAL AFFAIRS

ISSUED: 05/17/89
SUPERSEDES: 04/24/89

THE INFORMATION SET FORTH HEREIN HAS BEEN GATHERED FROM STANDARD REFERENCE MATERIALS AND/OR M&T CHEMICALS INC. TEST DATA AND IS TO THE BEST KNOWLEDGE AND BELIEF OF M&T CHEMICALS INC. ACCURATE AND RELIABLE. SUCH INFORMATION IS OFFERED SOLELY FOR YOUR CONSIDERATION, INVESTIGATION AND VERIFICATION, AND IT IS NOT SUGGESTED OR GUARANTEED THAT THE HAZARD PRECAUTIONS OR PROCEDURES MENTIONED ARE THE ONLY ONES WHICH EXIST. M&T CHEMICALS INC. MAKES NO WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO THE USE OF SUCH INFORMATION OR THE USE OF THE SPECIFIC MATERIAL IDENTIFIED HEREIN IN COMBINATION WITH ANY OTHER MATERIAL OR PROCESS, AND ASSUMES NO RESPONSIBILITY THEREFOR.

al Safety Data Sheet
ed to comply with
ard Communication Standard,
0.1200. Standard must be
e specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

TY(As used on Label and List) ULTRASORB, OPTISORB,
P FINES and FLOSAFE

on I

Emergency Telephone Number
1-901-755-5666

ers Name
IAN COMPANY

Telephone Number for Information
1-800-264-5826

umber, Street, City, State, and ZIP CODE)
Moltan Drive

Date Prepared
March 1, 1994

lis, TN 38115

Signature of Preparer (Optional)

n II - Hazardous Ingredients/Identity Information

Components (Specific Chemical Identity; Common Name(s))	Approximate Concentration %	OSHA TWA	ACGIH TLV	Other Limits Recommended
Amorphous No. 61790-53-2	>98.0%	6.0 mg/ m^3	6.0 mg/ m^3	
crystalline (quartz) No. 14808-60-7	<1.0%	0.10 mg/m^3	0.10 mg/m^3	
crystalline (cristobalite) No. 14464-46-1	<1.0%	0.05mg/m^3	0.05mg/m^3	

ight percent by bulk testing, using X-Ray Diffraction.

n III - Physical/Chemical Characteristics

	N/A	Specific Gravity (H_2O = 1)	2.0-2.2
	N/A	Melting Point	N/A
	N/A	Evaporation Rate (Butyl Acetate=1)	N/A

ity (Air = 1)

ity in Water 2.0%

and Odor Buff to off-white, odorless; granular.

ion IV - Fire and Explosion Hazard Data

Non-flammable Flammable Limits Non-flammable LEL N/A UEL N/A

Not Applicable (also meant when N/A is used elsewhere)

Fire Fighting Procedures None

ion Hazards None

OSHA 174, Sept. 1985

Unstable

Stable X None

ibility (Materials to Avoid) Hydrofluoric Acid

s Decomposition or Byproducts None

us May Occur Conditions to Avoid

ization

Will Not Occur X None

on VI - Health Hazard Data

) of Entry: Inhalation? YES Skin? No Ingestion? No

Hazards (Acute and Chronic) Chronic: Years of continuous exposure above the TWA/PEL may cause

osis. IARC has classified crystalline silica as a probable carcinogen based on limited human evidence.

genicity NTP? Respirable IARC Monographs? 2A OSHA Regulated? Yes

nd Symptoms of Exposure Breathing of dust can cause cough and shortness of breath

l Conditions

lly Aggravated by Exposure Asthma or other airway disease.

ency and Fire Aid Procedures If symptoms occur, remove to fresh air and consult physician.

ion VII - Precautions for Safe Handling and Use

o Be Taken in Case Material Is Released or Spilled: Use clean-up procedures suitable for any inert dry product, i.e. sweep-up

acuum. If spill is on a wet, oily or icy surface, personal safety may be enhanced by leaving the spilled material to

rb liquids and to improve traction. Avoid creating dust.

Disposal Method:

quids have been absorbed, dispose in accordance with current Federal, State or local laws for the mixture.

tions to Be Taken in Handling and Storing:

e in a dry covered area. When dispensing, control airborne concentrations or use respiratory protection.

Precautions None

tion VIII - Control Measures

[illegible] (Specify Type) Use NIOSH approved dust respirator when excessive dust concentrations are evident.

ation Local Exhaust YES Special None

Mechanical (General) N/A Other None

[illegible] None Eye Protection Minimum - Safety Glasses

[illegible] Clothing or Equipment None

[illegible] Practices Minimize dust when using.

[illegible] to [illegible] of information herein for purchase [illegible] necessarily purchaser's responsibility. Therefore, although reasonable care has been taken [illegible]

[illegible] information MOLTAN COMPANY extends no warranties, makes no representations, and assumes no responsibility as to accuracy or suitability of such

[illegible] to purchaser's intended purposes or for consequences of its use.

SAFETY DEPARTMENT

PURCHASE ORDER NO.

AMAX Zinc Company, Inc.

P.O. BOX 2347, EAST ST. LOUIS, ILLINOIS 62202

AMAX USE ONLY: 117

Annual Quantity Used:

Location:

Used For:

MATERIAL SAFETY DATA SHEET

The information requested will be kept confidential and disclosed only as necessary to meet requirements of the Occupational Safety and Health Act of 1970 or as required by any other federal, state or local regulations.

SECTION I

ACTURER OR VENDOR'S NAME: AMAX ZINC COMPANY, INC. TELEPHONE NO.: 618-274-5000

RT. 3 AT MONSANTO AVE., P.O. BOX 2347 EAST ST. LOUIS, ILL. 62202

NAME & NYMS: ZINC

TRADE NAME & SYNONYMS: SPECIAL HIGH GRADE ZINC BALLS

CAL: PRIMARY METALS

FORMULA: ZN.

SECTION II – HAZARDOUS INGREDIENTS

ERIAL OR NENTS	%	TLV UNITS	MATERIAL OR COMPONENTS	%	TLV UNITS	MATERIAL OR COMPONENTS	%	TLV UNITS
(NH3)			LEAD (Pb)	.0003		TOTAL SULPHUR (S)		
(As)			MANGANESE (Mn)			WATER		
			MERCURY (Hg)			CHLORINATED HYDROCARBONS (SPECIFY)		
			NICKEL (Ni)					
M (Be)			PHOSPHATE (PO_4)			ALIPHATIC HYDROCARBONS (SPECIFY)		
Cd)	.0003		SELENIUM (Se)					
DE (Cl)			SILICA (Crystalline)					
(Cr)			SILICA (Total)			AROMATIC HYDROCARBONS (SPECIFY)		
			SULPHATE (SO_4)					
E (CN)			TOLUENE			ISOCYANATES (SPECIFY)		
(F)			ZINC (Zn)	99.99				

OTHER HAZARDOUS INGREDIENTS	%	TLV UNITS

SECTION III – PHYSICAL DATA

OINT (°F)	1664.6°F	SPECIFIC GRAVITY (H_2O = 1)	7.14
ESSURE (mmHg)	1mm AT 487°C	PERCENT VOLATILE BY VOLUME (%) AT 70° F	
DENSITY (AIR=1)	7.133 AT 25°C	EVAPORATION RATE (Butyl Acetate or Ether = 1)	
Y IN WATER (By Weight)	NONE	MELTING POINT	787°F
A..CE AND ODOR			

SECTION IV – FIRE AND EXPLOSION HAZARD DATA

T OF (Method Used): AUTOIGNITION TEMPERATURE:

BLE LIMITS IN AIR, % BY VOLUME: L.E.L. U.E.L.

HING MEDIA: CLASS D FIRE EXTINGUISHING AGENT

FIGHTING PROCEDURES:

ND EXPLOSION HAZARDS: FIRE HAZARD MODERATE IN THE FORM OF DUST WHEN HEAT OR FLAME. EXPLOSION HAZARD SLIGHT IN THE FORM OF EXPOSED TO FLAME.

ATERIAL SAFETY DATA SHEET (Cont.)

SECTION V – HEALTH HAZARD INFORMATION

SHOLD LIMIT VALUE: None in Solid State. TWA 5 Mg/m³ in oxide state.

TES OF EXPOSURE: (X Appropriate Routes)

INHALATION

SKIN CONTACT

SKIN ABSORPTION

EYE CONTACT

☐ INGESTION

COMMENTS: Inhalation of Zinc Oxide when heated to 930°F or above.

ECTS OF OVEREXPOSURE:

ACUTE: Slight Possibility of Metal Fume Fever from inhalation of Zn. Oxide. Chills, Fever, Nausea, Poss. of Vomiting, Fatigue, Weakness, Aching Head, Body

CHRONIC: Not Known to have Chronic Effects.

RGENCY AND FIRST AID PROCEDURES: (Eyes, Skin, Inhalation, Ingestion): Remove Victim from Exposure. Conditions Last one Day and has Never been Known to be Fatal

SECTION VI – REACTIVITY DATA

DITIONS CONTRIBUTING TO INSTABILITY:

OMPATABILITY (Materials to Avoid): Releases Flammable Hydrogen Gas when contacted by Acids

ZARDOUS DECOMPOSITION PRODUCTS:

DITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION:

SECTION VII – SPILL OR LEAK PROCEDURES

EPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:

UTRALIZING CHEMICALS:

STE DISPOSAL METHOD:

SECTION VIII – SPECIAL PROTECTION INFORMATION

SPIRATORY PROTECTION (Specify Type): Cartridge Type Respirator. Fume & Oxide Cartridges.

NTILATION:

☑ LOCAL EXHAUST

☐ MECHANICAL (General)

☐ SPECIAL

☐ OTHER

MMENTS: Zinc Oxide Emitted when heated to 930°F or above.

OTECTIVE GLOVES

EYE PROTECTION

HER PROTECTIVE EQUIPMENT

SECTION IX – SPECIAL PRECAUTIONS

ECAUTIONS TO BE TAKEN IN HANDLING, USAGE AND STORAGE:

PRECAUTIONS:

BY: David C. Volkman

Safety Director

ADDRESS: P.O. Box 2347, East St. Louis

DATE: 9/10/80

ZACLON INCORPORATED

MATERIAL SAFETY DATA SHEET

DATA SHEET
DATA SHEET
DATA SHEET

IDENTIFICATION

NAME
Zinc Chloride - Solution

GRADE
50%; 65° Bé; 70° Bé; 72° Bé; 56%

CAS NAME
Zinc Chloride, Solution

I.D. NOS./CODES
NIOSH Registry No: 2H 1404000

MANUFACTURER/DISTRIBUTOR
Zaclon, Inc.

ADDRESS
2981 Independence Road
Cleveland, Ohio 44115

SARA/TITLE III STATUS
See ADDITIONAL INFORMATION and HAZARDOUS COMPONENTS Sect. Pg 2

CHEMICAL FAMILY
Metal Salt Solution

FORMULA
$ZnCl_2$ (in water)

CAS REGISTRY NO.
7646-85-7

TRANSPORTATION EMERGENCY PHONE
CHEMTREC (800) 424-9300

PRODUCT INFORMATION PHONE
(800) 356-7327

PHYSICAL DATA

BOILING POINT, 760 MM Hg
120 to 157° C (248 to 315° F)

SPECIFIC GRAVITY
1.55 to 2.0

VAPOR DENSITY
Vapor is water.

pH INFORMATION
<1 to 2.5

FORM
Liquid

COLOR
Clear, water-white solution

MELTING POINT
Not applicable.

VAPOR PRESSURE
Not determined.

SOLUBILITY IN WATER
100%

EVAPORATION RATE (BUTYL ACETATE=1)
<1 to >1

APPEARANCE
Clear

ODOR
Odorless

The data in this Material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process.

HAZARDOUS COMPONENTS

MATERIAL(S)	CAS NO.	APPROXIMATE %
Zinc Chloride*	7646-85-7	50 to 71

* Regulated as a Toxic Chemical under Section 313 of Title III/SARA, and 40 CFR Part 372.

NONHAZARDOUS COMPONENTS

Water	7732-18-5	29 to 50

PHYSICAL PROPERTIES

	50%	65° Bé	70° Bé	72° Bé
Boiling Point (760 mm Hg)	120°C 248°F	134°C 273°F	146°C 295°F	157°C 315°F
Specific Gravity	1.576	1.814	1.933	1.985
pH	2.01	<1.0	<1.0	<1.0
Evaporation Rate (Butyl Acetate=1)	>1	<1	<1	<1
% Zinc Chloride	50	63	69	71

HAZARDOUS REACTIVITY

INSTABILITY
Stable

INCOMPATIBILITY
Incompatible with cyanides (may release toxic HCN gas) and sulfide salts (may release toxic H_2S gas).

DECOMPOSITION
Will not occur except at high temperatures.

POLYMERIZATION
Will not occur.

FIRE AND EXPLOSION DATA

FLASH POINT Will not burn.

FLAMMABLE LIMITS IN AIR % BY VOL.
LOWER Not applicable.
UPPER Not applicable.

AUTOIGNITION TEMPERATURE
Not available.

FIRE AND EXPLOSION HAZARDS
May release zinc oxide fumes, zinc chloride fumes, and hydrogen chloride gas in a fire.

EXTINGUISHING MEDIA
As appropriate for combustibles in area.

SPECIAL FIRE FIGHTING INSTRUCTIONS
Keep personnel removed and upwind of fire. Wear self-contained breathing apparatus. Wear full protective equipment. Cool tank/container with water spray.

HEALTH HAZARD INFORMATION

PRINCIPAL HEALTH HAZARDS (Including Significant Routes, Effects, Symptoms of Over-Exposure, and Medical Conditions Aggravated by Exposure)

Causes skin and eye burns: Fumes, dust from dried-down product, or mist may cause injury to the respiratory tract. Severe exposure may cause lung damage.

Oral LD50 for zinc chloride: 1100 mg/kg in rats.

The compound in either solid or solution form, is corrosive to the eyes and skin. Toxic effects described in animals from short exposure include corrosion of mucosal surfaces, liver effects, and kidney effects. Toxic effects in animals occurring only with inhalation exposures, are lower respiratory irritation with pulmonary edema. Tests in bacterial or mammalian cell cultures demonstrate mutagenic activity. Tests in some animals indicate that the compound may have embryotoxic activity.

Human health effects of overexposure may initially include: eye irritation with discomfort, tearing, or blurring of vision; skin irritation with discomfort or rash; or irritation of the upper respiratory passages. Higher exposures may lead to these effects: skin burns or ulceration; eye irritation with discomfort, tearing, or blurring of vision; temporary lung irritation effects with cough, discomfort, difficulty breathing, or shortness of breath; possibly modest initial symptoms, followed in hours by severe shortness of breath, requiring prompt medical attention; or fatality from gross overexposure by fume inhalation or by significant ingestion. There are inconclusive or unverified reports of human sensitization. Individuals with preexisting diseases of the lungs may have increased susceptibility to the toxicity of excessive exposures.

CARCINOGENICITY

Not listed as a carcinogen by IARC, NTP, OSHA, or ACGIH.

EXPOSURE LIMITS [PEL (OSHA), TLV (ACGIH), ETC.]

The OSHA 8-hour Time Weighted Average (TWA) and ACGIH TLV®-TWA for zinc chloride are 1 mg/m^3 (as fume).

SAFETY PRECAUTIONS

Do not get in eyes, on skin, on clothing.
Avoid breathing fumes, dust from dried-down product, or mist.
Wash thoroughly after handling.

FIRST AID

<u>In case of contact</u>: Flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash clothing before reuse and discard shoes.

<u>If inhaled</u>: Remove to fresh air immediately. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call a physician.

If swallowed: Do not induce vomiting. Give large quantities of water or milk. Call a physician. Never give anything by mouth to an unconscious person.

PROTECTION INFORMATION

GENERALLY APPLICABLE CONTROL MEASURES

Good general ventilation should be provided to keep concentrations below the exposure limit.

PERSONAL PROTECTIVE EQUIPMENT

Coverall chemical splash goggles and rubber gloves. Where contact with concentrated zinc chloride is likely, a full-length face shield, rubber apron, pants, jacket, and shoes may be desirable.

DISPOSAL INFORMATION

SPILL, LEAK OR RELEASE

Sweep up spillage. Flush spill area with plenty of water to an approved chemical sewer. Comply with Federal, State, and local regulations on reporting releases.

WASTE DISPOSAL

Comply with Federal, State, and local regulations. If approved, may be transferred to a licensed contractor, or flushed to sewer to waste treatment system.

SHIPPING INFORMATION

DOT/IMO

PROPER SHIPPING NAME
Zinc Chloride, Solution

HAZARD CLASS
8, Corrosive Material

I.D. NUMBER
UN NO. 1840

PACKING GROUP:
P.G. III

REPORTABLE QUANTITY
1,000 Lbs.

OTHER INFORMATION

SHIPPING CONTAINERS
Tank cars, tank trucks, 30-gallon & 55-gallon PE drums.

STORAGE CONDITIONS
Keep drums in upright position; do not roll drums on side. Keep containers closed. Store in a well ventilated area.

NPCA-HMIS RATINGS

Health	3
Flammability	0
Reactivity	1
Personal Protection	

Personal protection rating to be supplied by the user depending on use conditions.

TITLE III HAZARD CLASSIFICATION

ACUTE:	Yes
CHRONIC:	Yes
FIRE:	No
REACTIVITY:	No
PRESSURE:	No

ADDITIONAL INFORMATION AND REFERENCES
For further information see Zaclon "Zinc Chloride" Data Sheet.

DATE OF LATEST REVISION/REVIEW: 3/93

PERSON RESPONSIBLE FOR MSDS:

J.L. Busovicki
Zaclon, Inc.
2981 Independence Road
Cleveland, Ohio 44115

800-356-7327
216-271-1601

GUIDE 60

POTENTIAL HAZARDS

HEALTH HAZARDS

Contact causes burns to skin and eyes.
If inhaled, may be harmful.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

FIRE OR EXPLOSION

Some of these materials may burn, but none of them ignites readily.
Flammable/poisonous gases may accumulate in tanks and hopper cars.
Some of these materials may ignite combustibles (wood, paper, oil, etc.).

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry.
Stay upwind; keep out of low areas.
Positive pressure self-contained breathing apparatus (SCBA) and structu
firefighters' protective clothing will provide limited protection.
CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTAI
If water pollution occurs, notify the appropriate authorities.

FIRE

Some of these materials may react violently with water.
Small Fires: Dry chemical, CO_2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
Apply cooling water to sides of containers that are exposed to flames un
well after fire is out. Stay away from ends of tanks.

SPILL OR LEAK

Do not touch or walk through spilled material; stop leak if you can do it
without risk.
Small Spills: Take up with sand or other noncombustible absorbent
material and place into containers for later disposal.
Small Dry Spills: With clean shovel place material into clean, dry
container and cover loosely; move containers from spill area.
Large Spills: Dike far ahead of liquid spill for later disposal.

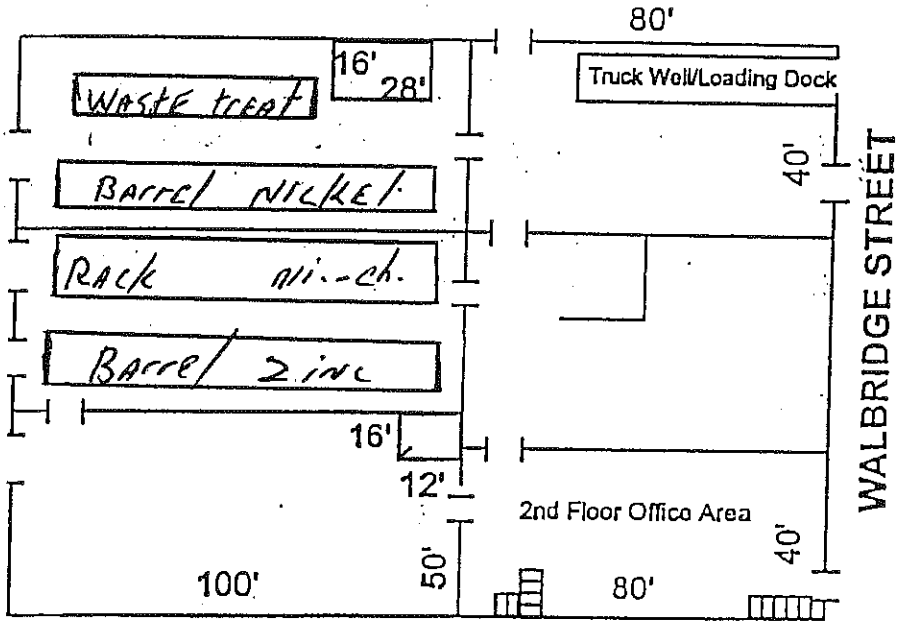
FIRST AID

Move victim to fresh air; call emergency medical care.
In case of contact with material, immediately flush skin or eyes with runr
water for at least 15 minutes.
Remove and isolate contaminated clothing and shoes at the site.
Keep victim quiet and maintain normal body temperature.

APPENDIX F

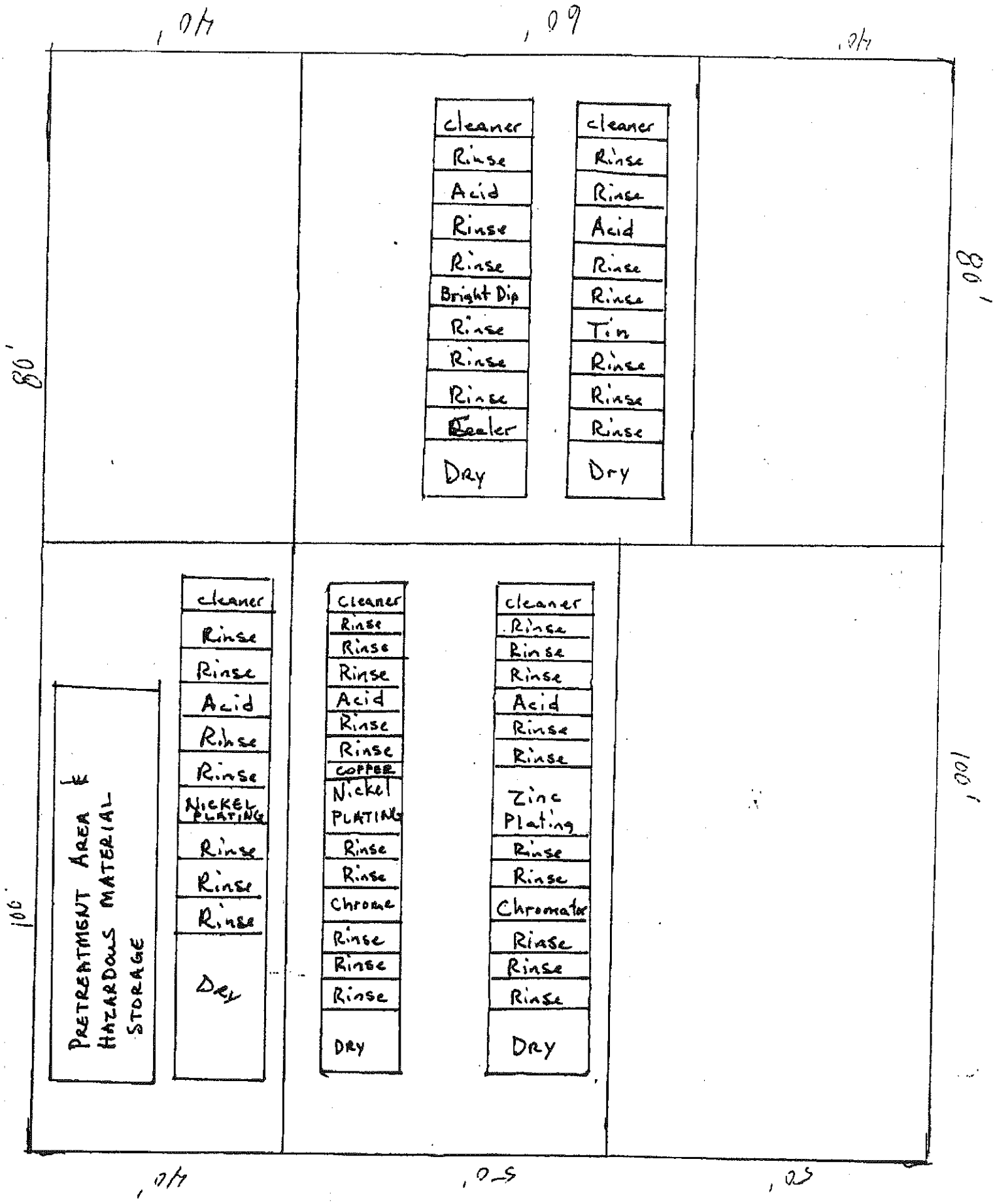
DIAGRAM OF PROCESS AREA

423 WALBRIDGE STREET
CITY OF KALAMAZOO, MICHIGAN



(Main Floor Layout)

Apendix B


Wallbridge Street
cleaner
Rinse
Acid
Rinse
Rinse
Bright Dip
Rinse
Rinse
Rinse
Sealer
Dry
cleaner
Rinse
Rinse
Acid
Rinse
Rinse
Tin
Rinse
Rinse
Rinse
Dry
80'
80'
PRETREATMENT AREA
HAZARDOUS MATERIAL
STORAGE
cleaner
Rinse
Rinse
Acid
Rinse
Rinse
NICKEL PLATING
Rinse
Rinse
Rinse
Dry
Cleaner
Rinse
Rinse
Rinse
Acid
Rinse
Rinse
COPPER
Nickel PLATING
Rinse
Rinse
Chrome
Rinse
Rinse
Rinse
DRY
cleaner
Rinse
Rinse
Rinse
Acid
Rinse
Rinse
Zinc Plating
Rinse
Rinse
Chromate
Rinse
Rinse
Rinse
DRY
100'
100'

APPENDIX G

SOIL PROBE LOGS

SOIL AND MATERIALS ENGINEERS, INC

JOB NAME: 423 WALBRIDGE
JOB LOCATION: KALAMAZOO, MICHIGAN
OWNER:

A/E:
BY: DO DATE: 06/13/00
JOB NUMBER: KE36281

PROBE SP1
SHEET: 1

WELL DIAGRAM

DRILLER: BEST | RIG: DP

DEPTH (FEET) | SYMBOLIC PROFILE | PROFILE DESCRIPTION | SAMPLE TYPE, NUMBER & INTERVAL | STANDARD PENETRATION - (BLOWS/FOOT) | CONCENTRATION (ppm)

GROUND SURFACE ELEVATION =

LEGEND: O- PID

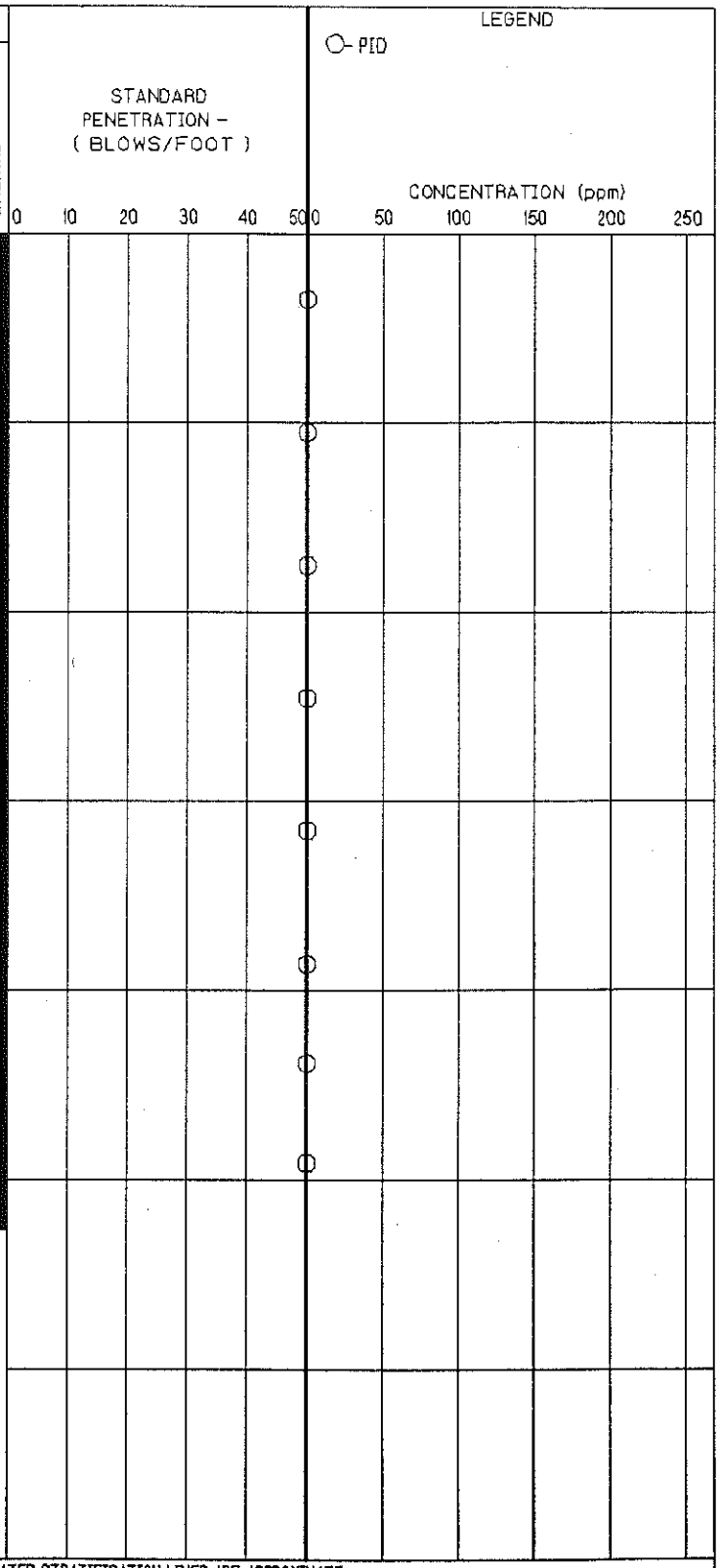
Fine to Medium Sand- Trace Slag, Cinders, Gravel, Brick and Silt- Brown to Black- Moist (SP/Fill)

Fine to Medium Sand- Trace Silt and Gravel- Occasional Silt and Clay Layers- Light Brown to Brown- Moist to Wet at 10.5 Feet (SP)

Silty Clay- Trace Sand- Gray (CL)

END OF PROBE AT 15 FEET.

NOTES:
1. Temporary monitoring well installed- screened from 10 to 15 feet.
2. Probe backfilled with bentonite.



WATER LEVEL OBSERVATIONS
▼ GROUNDWATER ENCOUNTERED DURING DRILLING
▽ GROUNDWATER 0 HOURS AFTER DRILLING

NOTES:
1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. PROBE BACKFILLED WITH NATURAL SOILS UNLESS OTHERWISE NOTED.

SOIL AND MATERIALS ENGINEERS, INC

JOB NAME: 423 WALBRIDGE
JOB LOCATION: KALAMAZOO, MICHIGAN
OWNER:

A/E:
BY: DO DATE: 06/13/00
JOB NUMBER: KE36281

PROBE SP2
SHEET: 1

WELL DIAGRAM

DRILLER: BEST | RIG: DP

DEPTH (FEET) | SYMBOLIC PROFILE | PROFILE DESCRIPTION | SAMPLE TYPE, NUMBER & INTERVAL | STANDARD PENETRATION - (BLOWS/FOOT) | CONCENTRATION (ppm)

GROUND SURFACE ELEVATION =

LEGEND: O- PID

0 10 20 30 40 50 | 0 50 100 150 200 250

5 10 15

S1 S2 S3 S4 S5 S6 S7 S8

Fine to Medium Sand- Trace Brick, Coal, Gravel, Organics and Concrete- Brown to Black- Moist (SP/Fill)

Fine to Medium Sand- Trace Gravel and Silt- Light Brown to Brown- Moist to Wet at 13.5 Feet (SP)

END OF PROBE AT 15 FEET.

NOTES:
1. Temporary monitoring well installed- screened from 11 to 15 feet.
2. Probe backfilled with bentonite.

WATER LEVEL OBSERVATIONS
▼ GROUNDWATER ENCOUNTERED DURING DRILLING
▽ GROUNDWATER 0 HOURS AFTER DRILLING

NOTES:
1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. PROBE BACKFILLED WITH NATURAL SOILS UNLESS OTHERWISE NOTED.

SOIL AND MATERIALS ENGINEERS, INC

JOB NAME: 423 WALBRIDGE
JOB LOCATION: KALAMAZOO, MICHIGAN
OWNER:

A/E:
BY: DO DATE: 06/13/00
JOB NUMBER: KE38281

PROBE SP3
SHEET: 1

DRILLER: BEST RIG: DP

WELL DIAGRAM | DEPTH (FEET) | SYMBOLIC PROFILE | PROFILE DESCRIPTION | SAMPLE TYPE, NUMBER & INTERVAL | STANDARD PENETRATION - (BLOWS/FOOT) | CONCENTRATION (ppm)

GROUND SURFACE ELEVATION =

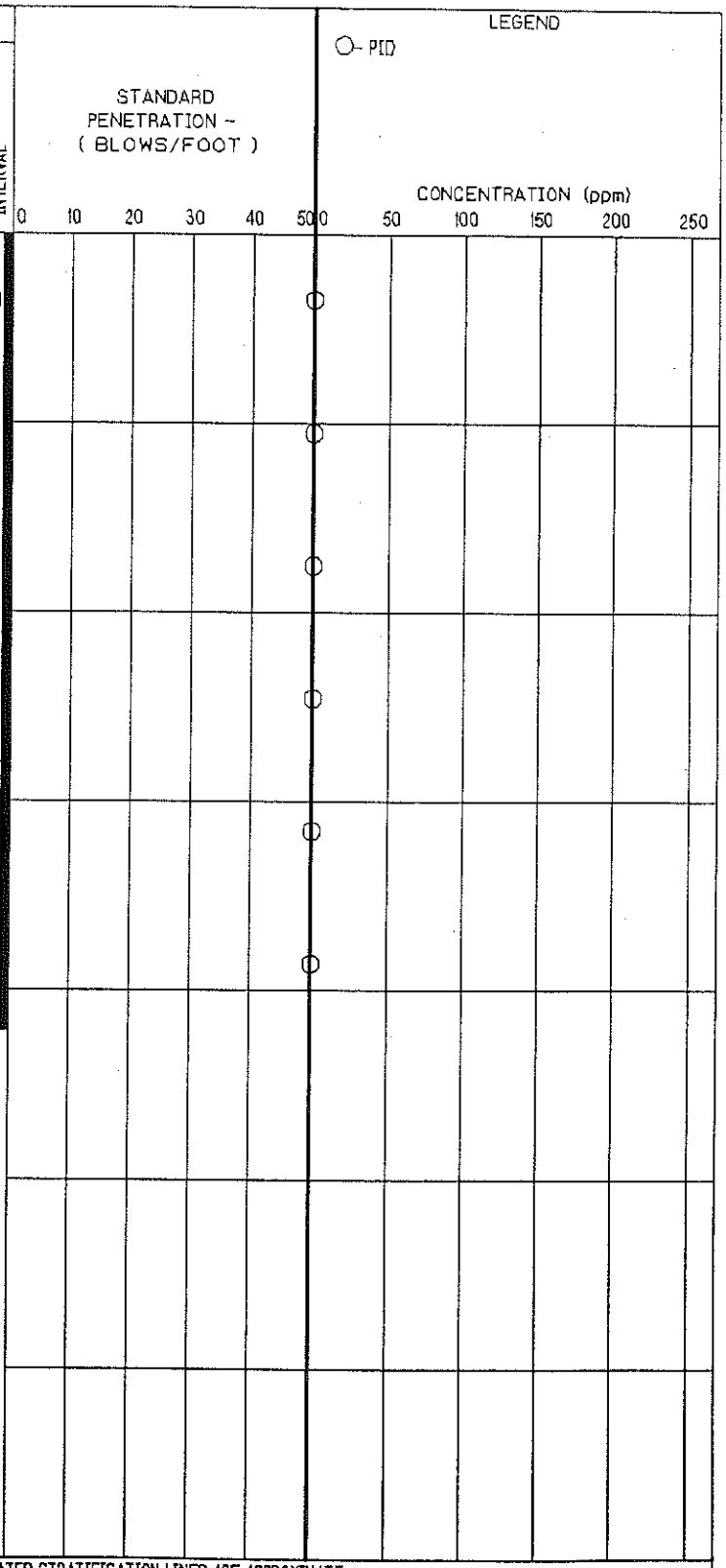
LEGEND: O- PID

Fine to Medium Sand- Trace Silt, Slag, Cinders, Brick, Gravel and Silt- Brown to Black- Moist to Wet at 10 Feet (SP/Fill)

Fine to Medium Sand- Trace Silt and Gravel- Occasional Silt and Clay Layers- Light Brown to Brown- Wet (SP)

END OF PROBE AT 12 FEET.

NOTE:
1. Probe backfilled with bentonite.



WATER LEVEL OBSERVATIONS
▼ GROUNDWATER ENCOUNTERED DURING DRILLING

NOTES:
1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. PROBE BACKFILLED WITH NATURAL SOILS UNLESS OTHERWISE NOTED.

SOIL AND MATERIALS ENGINEERS, INC

JOB NAME: 423 WALBRIDGE
JOB LOCATION: KALAMAZOO, MICHIGAN
OWNER:

A/E:
BY: DO DATE: 06/13/00
JOB NUMBER: KE36281

PROBE SP4
SHEET: 1

WELL DIAGRAM

DRILLER: BEST | RIG: DP

DEPTH (FEET) | SYMBOLIC PROFILE | PROFILE DESCRIPTION | SAMPLE TYPE, NUMBER & INTERVAL | STANDARD PENETRATION - (BLOWS/FOOT) | CONCENTRATION (ppm)

GROUND SURFACE ELEVATION =

LEGEND: O- PID

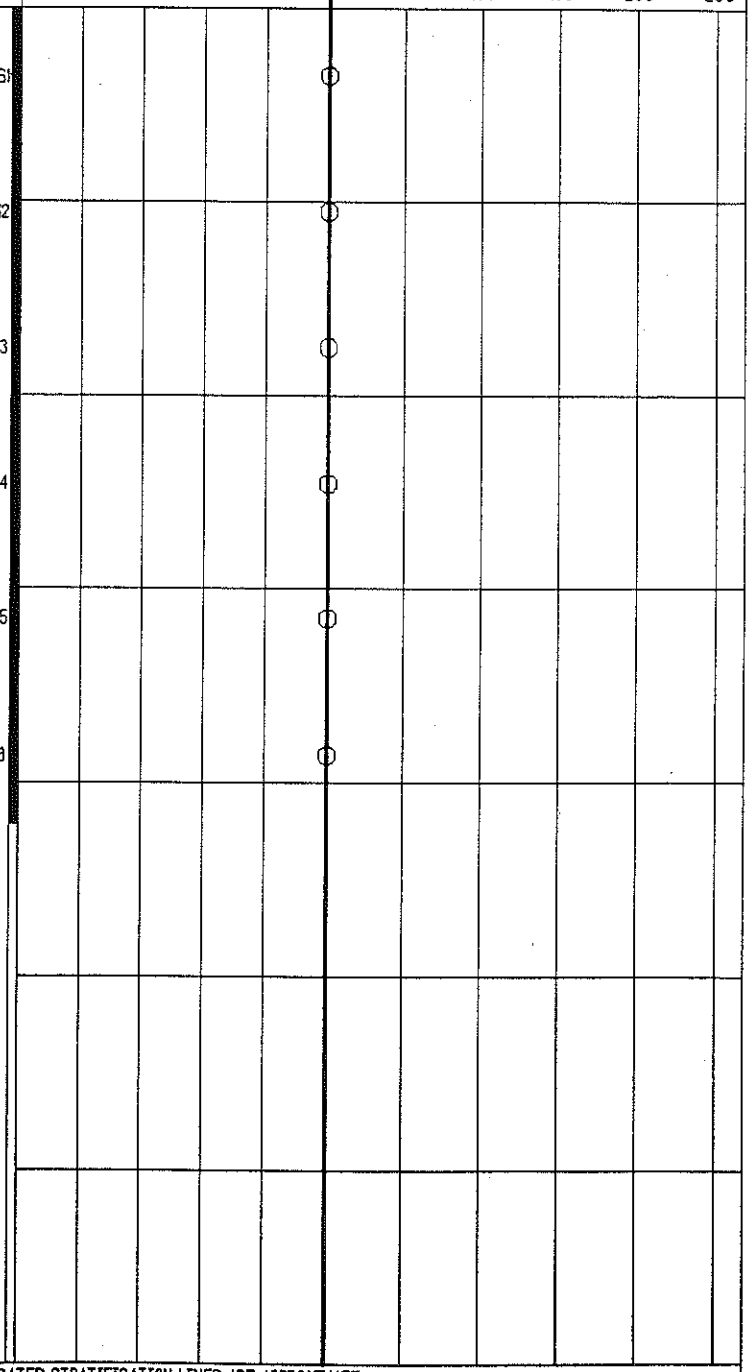
Three Inches of Asphaltic Concrete

Fine to Medium Sand- Trace Slag, Cinders, Brick, Gravel and Silt- Brown to Black- Moist (SP/Fill)

Fine to Medium Sand- Trace to Some Gravel- Trace Silt- Occasional Silt and Clay Layers- Gray to Brown- Moist to Wet at 8 Feet (SP)

END OF PROBE AT 12 FEET.

NOTES:
1. Temporary monitoring well installed- screened from 7 to 12 feet.
2. Probe backfilled with bentonite.



WATER LEVEL OBSERVATIONS
▼ GROUNDWATER ENCOUNTERED DURING DRILLING

NOTES:
1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. PROBE BACKFILLED WITH NATURAL SOILS UNLESS OTHERWISE NOTED.

SOIL AND MATERIALS ENGINEERS, INC

JOB NAME: 423 WALBRIDGE
JOB LOCATION: KALAMAZOO, MICHIGAN
OWNER:

A/E:
BY: DO DATE: 06/13/00
JOB NUMBER: KE36281

PROBE SP5
SHEET: 1

DRILLER: BEST | RIG: DP

WELL DIAGRAM

DEPTH (FEET) | SYMBOLIC PROFILE | PROFILE DESCRIPTION | SAMPLE TYPE, NUMBER & INTERVAL | STANDARD PENETRATION - (BLOWS/FOOT) | CONCENTRATION (ppm)

GROUND SURFACE ELEVATION =

LEGEND: O- PID

Six Inches of Cement Concrete

Fine to Medium Sand- Trace Silt and Gravel- Black- Moist (SP/Fill)

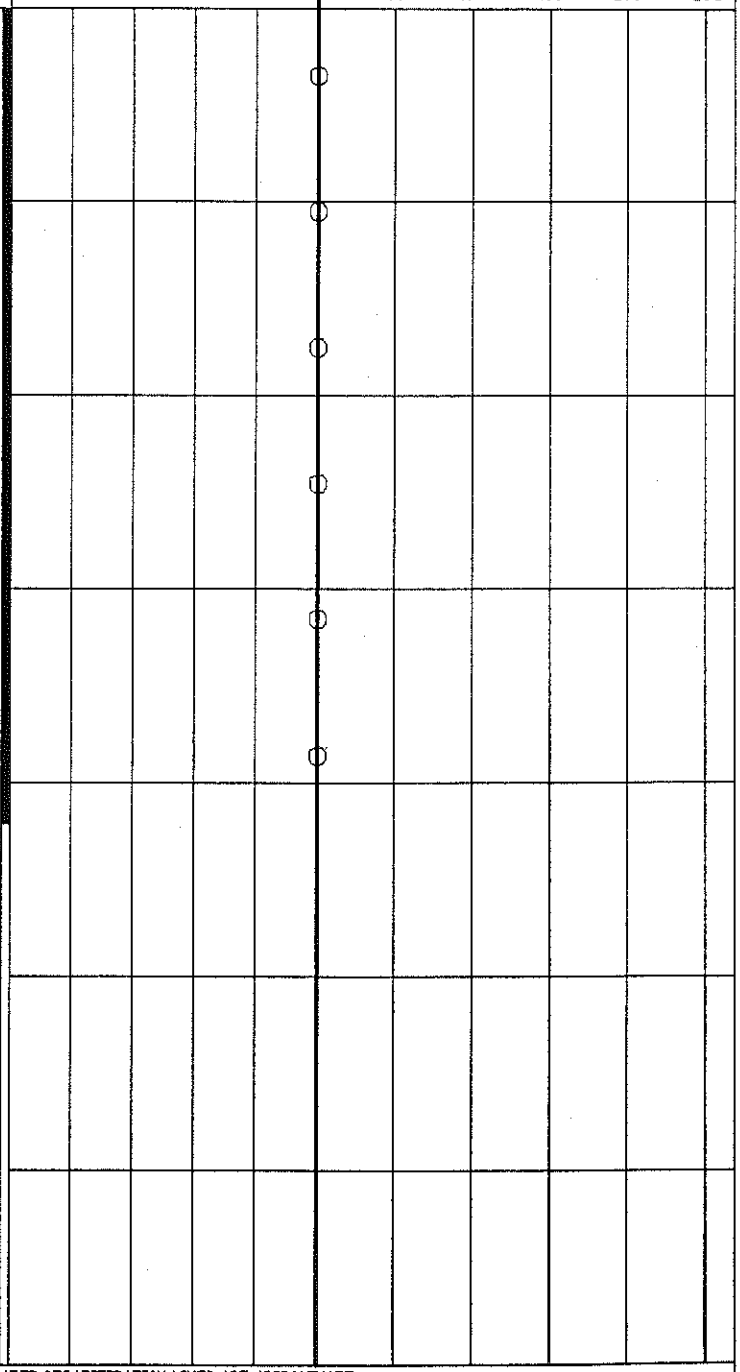
Sandy Clay- Some Silt- Brown (CL)

Fine to Medium Sand- Some Gravel- Trace Silt- Light Brown to Brown- Moist (SP)

Silty Clay- Occasional Fine to Medium Sand Layers- Light Brown to Brown (CL)

END OF PROBE AT 12 FEET.

NOTES:
1. Temporary monitoring well installed- screened from 7 to 12 feet.
2. Probe backfilled with bentonite.



WATER LEVEL OBSERVATIONS
▼ GROUNDWATER ENCOUNTERED DURING DRILLING

NOTES:
1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. PROBE BACKFILLED WITH NATURAL SOILS UNLESS OTHERWISE NOTED.

SOIL AND MATERIALS ENGINEERS, INC

JOB NAME: 423 WALBRIDGE
JOB LOCATION: KALAMAZOO, MICHIGAN
OWNER:

A/E:
BY: DO DATE: 06/13/00
JOB NUMBER: KE36281

PROBE SP6
SHEET: 1

WELL DIAGRAM

DRILLER: BEST | RIG: DP

DEPTH (FEET) | SYMBOLIC PROFILE | PROFILE DESCRIPTION | SAMPLE TYPE, NUMBER & INTERVAL | STANDARD PENETRATION - (BLOWS/FOOT) | CONCENTRATION (ppm)

GROUND SURFACE ELEVATION =

LEGEND: O- PID

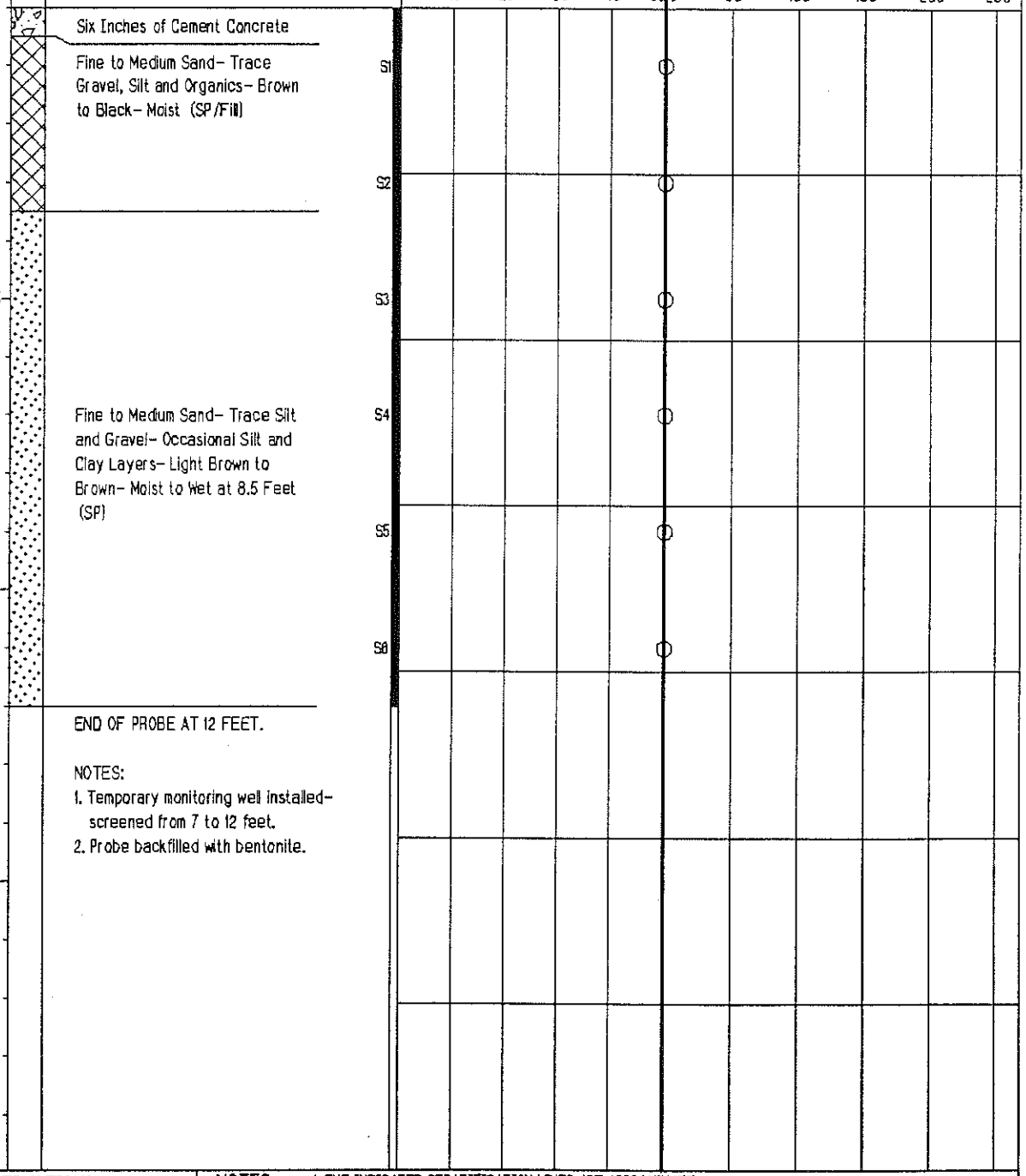
Six Inches of Cement Concrete

Fine to Medium Sand- Trace Gravel, Silt and Organics- Brown to Black- Moist (SP/Fill)

Fine to Medium Sand- Trace Silt and Gravel- Occasional Silt and Clay Layers- Light Brown to Brown- Moist to Wet at 8.5 Feet (SP)

END OF PROBE AT 12 FEET.

NOTES:
1. Temporary monitoring well installed- screened from 7 to 12 feet.
2. Probe backfilled with bentonite.



WATER LEVEL OBSERVATIONS
▼ GROUNDWATER ENCOUNTERED DURING DRILLING

NOTES:
1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. PROBE BACKFILLED WITH NATURAL SOILS UNLESS OTHERWISE NOTED.

SOIL AND MATERIALS ENGINEERS, INC

JOB NAME: 423 WALBRIDGE
JOB LOCATION: KALAMAZOO, MICHIGAN
OWNER:

A/E:
BY: DO DATE: 06/13/00
JOB NUMBER: KE36281

PROBE SP7
SHEET: 1

WELL DIAGRAM

DRILLER: BEST | RIG: DP

DEPTH (FEET) | SYMBOLIC PROFILE | PROFILE DESCRIPTION | SAMPLE TYPE, NUMBER & INTERVAL | STANDARD PENETRATION - (BLOWS/FOOT) | CONCENTRATION (ppm)

GROUND SURFACE ELEVATION =

LEGEND: O- PID

0 10 20 30 40 50 0 50 100 150 200 250

Four Inches of Cement Concrete

Fine to Medium Sand- Trace Silt, Gravel and Cinders- Brown to Black- Moist (SP/Fill)

S1 S2 S3 S4 S5 S6

5

Fine to Medium Sand- Trace Silt and Gravel- Occasional Silt and Clay Layers- Light Brown to Brown- Moist to Wet at 8 Feet (SP)

10

END OF PROBE AT 12 FEET.

NOTES:
1. Temporary monitoring well installed- screened from 7 to 12 feet.
2. Probe backfilled with bentonite.

15

WATER LEVEL OBSERVATIONS
▼ GROUNDWATER ENCOUNTERED DURING DRILLING

NOTES:
1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. PROBE BACKFILLED WITH NATURAL SOILS UNLESS OTHERWISE NOTED.

SOIL AND MATERIALS ENGINEERS, INC

JOB NAME: 423 WALBRIDGE
JOB LOCATION: KALAMAZOO, MICHIGAN
OWNER:

A/E:
BY: DO DATE: 06/13/00
JOB NUMBER: KE36281

PROBE SP8
SHEET: 1

WELL DIAGRAM

DRILLER: BEST | RIG: DP

DEPTH (FEET) | SYMBOLIC PROFILE | PROFILE DESCRIPTION | SAMPLE TYPE, NUMBER & INTERVAL | STANDARD PENETRATION - (BLOWS/FOOT) | CONCENTRATION (ppm)

GROUND SURFACE ELEVATION =

LEGEND: O- PID

Six Inches of Cement Concrete

Fine to Medium Sand- Trace Silt, Gravel and Cinders- Brown to Black- Moist (SP/Fill)

S1

S2

END OF PROBE AT 4 FEET.

NOTES:
1. Groundwater was not encountered.
2. Probe backfilled with bentonite.

5

10

15

STANDARD PENETRATION (BLOWS/FOOT): 0 10 20 30 40 50

CONCENTRATION (ppm): 0 50 100 150 200 250

WATER LEVEL OBSERVATIONS

NOTES:
1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. PROBE BACKFILLED WITH NATURAL SOILS UNLESS OTHERWISE NOTED.

APPENDIX H

ANALYTICAL LABORATORY DATA

KAR *Laboratories, Inc.*

4425 Manchester Road
Kalamazoo, MI 49001
Phone 616 381-9666
Fax 616 381-9698
www.karlabs.com

Soil & Materials Engineers, Inc.
4460 Commercial Ave., Suite B
Kalamazoo, MI 49002

Attn : ***Mr. Tom Stolz***

KAR Project No. :	***002874***
Date Reported :	***06/28/00***
Date Activated :	***06/14/00***
Date Due :	***06/28/00***
Date Validated :	***06/28/00***

Project Description : ***Analysis of 11 samples from 423 Walbridge (SME #KE36281).***

Dear Client,

Your laboratory data is presented to you in this report. Unless otherwise stated under the "Comments" heading, all tests were performed within the maximum allowable holding times, have met or exceeded QC requirements and the result represents the sample as it was received.

If you wish to contact us about this work please mention KAR Project No. 002874. To arrange additional sampling or testing please contact our Client Services Department. If you have a question regarding quality assurance please contact William Rauch.

Thank you for the opportunity to serve you. Please do not hesitate to call if we can provide additional assistance.

Respectfully submitted,

Michael J. Jaeger
Director of Laboratories

KAR Laboratories, Inc. maintains Full Certification status for Bacteriology, Inorganics, Regulated Organics and Synthetic Organics through USEPA, Michigan Department of Public Health and Indiana State Department of Health.

POSITIVE RESULTS SUMMARY REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No.: *002874*

Date Reported: *06/28/2000*

Project Description: *Analysis of 11 samples from 423 Walbridge (SME #KE36281).*

Sample Description: ***"SP-1 @ 3'"***

Test	Positive Result Concentration	Units
Arsenic, total, low level	7.7	mg/kg dry sample
Barium, total, low level	95	mg/kg dry sample
Cadmium, total, low level	0.34	mg/kg dry sample
Chromium, total, low level	11.9	mg/kg dry sample
Copper, total	29	mg/kg dry sample
Lead, total	247	mg/kg dry sample
Zinc, total	148	mg/kg dry sample

Sample Description: ***"SP-2 @ 1'-3'"***

Test	Positive Result Concentration	Units
Arsenic, total, low level	5.2	mg/kg dry sample
Barium, total, low level	105	mg/kg dry sample
Cadmium, total, low level	0.43	mg/kg dry sample
Chromium, total, low level	10	mg/kg dry sample
Copper, total	256	mg/kg dry sample
Lead, total	393	mg/kg dry sample
Mercury, total, low level	0.3	mg/kg dry sample
Zinc, total	131	mg/kg dry sample

Sample Description: ***"SP-2 GW"***

Test	Positive Result Concentration	Units
Selenium, dissolved	0.015	mg/L

Sample Description: ***"SP-3 @ 2'"***

Test	Positive Result Concentration	Units
Arsenic, total, low level	89.9	mg/kg dry sample
Barium, total, low level	354	mg/kg dry sample
Cadmium, total, low level	1.69	mg/kg dry sample
Chromium, total, low level	24.6	mg/kg dry sample
Copper, total	78	mg/kg dry sample
Lead, total	3850	mg/kg dry sample
Mercury, total, low level	1.2	mg/kg dry sample
Selenium, total, low level	6.6	mg/kg dry sample
Zinc, total	760	mg/kg dry sample

Sample Description: ***"SP-4 @ 3'"***

Test	Positive Result Concentration	Units
Arsenic, total, low level	9.9	mg/kg dry sample
Barium, total, low level	59	mg/kg dry sample
Cadmium, total, low level	0.37	mg/kg dry sample

This Positive Results Summary Report provides an overview of the sample set and CONTAINS ONLY RESULTS ABOVE THE REPORTING LIMIT. It should not be used as a substitute for the attached detail report.

POSITIVE RESULTS SUMMARY REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No.: *002874*

Date Reported: *06/28/2000*

Project Description: *Analysis of 11 samples from 423 Walbridge (SME #KE36281).*

Sample Description: ***"SP-4 @ 3'"***

Test	Positive Result Concentration	Units
Chromium, total, low level	7.5	mg/kg dry sample
Copper, total	18	mg/kg dry sample
Lead, total	1040	mg/kg dry sample
Mercury, total, low level	0.4	mg/kg dry sample
Selenium, total, low level	1.2	mg/kg dry sample
Zinc, total	48	mg/kg dry sample

Sample Description: ***"SP-4 GW"***

Test	Positive Result Concentration	Units
1,1,1-Trichloroethane	3.4	ug/L
Benzene	1.4	ug/L
M-and/or p-xylene	3.6	ug/L
O-Xylene	2.3	ug/L
Toluene	4.6	ug/L

Sample Description: ***"SP-5 GW"***

Test	Positive Result Concentration	Units
Barium, dissolved	0.11	mg/L
Selenium, dissolved	0.006	mg/L

Sample Description: ***"SP-7 @ 2'"***

Test	Positive Result Concentration	Units
Arsenic, total, low level	26.7	mg/kg dry sample
Barium, total, low level	503	mg/kg dry sample
Cadmium, total, low level	1.91	mg/kg dry sample
Chromium, total, low level	34.9	mg/kg dry sample
Copper, total	150	mg/kg dry sample
Lead, total	1030	mg/kg dry sample
Mercury, total, low level	0.9	mg/kg dry sample
Selenium, total, low level	1.6	mg/kg dry sample
Silver, total	0.7	mg/kg dry sample
Zinc, total	977	mg/kg dry sample

Sample Description: ***"SP-8 @ 1.5'"***

Test	Positive Result Concentration	Units
Arsenic, total, low level	5.1	mg/kg dry sample
Barium, total, low level	213	mg/kg dry sample
Cadmium, total, low level	0.19	mg/kg dry sample
Chromium, total, low level	15.7	mg/kg dry sample
Copper, total	15	mg/kg dry sample

This Positive Results Summary Report provides an overview of the sample set and CONTAINS ONLY RESULTS ABOVE THE REPORTING LIMIT. It should not be used as a substitute for the attached detail report.

POSITIVE RESULTS SUMMARY REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No.: *002874*

Date Reported: *06/28/2000*

Project Description: *Analysis of 11 samples from 423 Walbridge (SME #KE36281).*

Sample Description: *"SP-8 @ 1.5'"*

Test	Positive Result Concentration	Units
Lead, total	348	mg/kg dry sample
Mercury, total, low level	0.8	mg/kg dry sample
Zinc, total	100	mg/kg dry sample

This Positive Results Summary Report provides an overview of the sample set and CONTAINS ONLY RESULTS ABOVE THE REPORTING LIMIT. It should not be used as a substitute for the attached detail report.

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *002874*
Date Reported : *06/28/00*

Project
Desc. : *Analysis of 11 samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-1 @ 3'"*
Sampled By : *DKO of SME*
Sample Date : *06/13/2000*
Sample Time : *9:00am*

Date Received : *06/14/2000*
Sample Type : *soil*
KAR Sample No. : *002874-01*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, Hg	Completed		EPA 7471A	06/19/00	MTM	
Prep, metals	Completed		EPA 30xx,200.x	06/16/00	MTM	
Arsenic, total, low level	7.7	mg/kg dry sample	EPA 6020	06/22/00	DBL	
Barium, total, low level	95	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Cadmium, total, low level	0.34	mg/kg dry sample	EPA 6020	06/22/00	DBL	
Chromium, total, low level	11.9	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Copper, total	29	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Lead, total	247	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Mercury, total, low level	<0.4	mg/kg dry sample	EPA 7471A	06/20/00	DBL	
Selenium, total, low level	<0.8	mg/kg dry sample	EPA 6020	06/22/00	DBL	Elevated detection limit due to sample matrix interference.
Silver, total	<0.5	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Zinc, total	148	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Dry weight solids	84.55	% by weight	SM(18) 2540B mod	06/15/00	KAL	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *002874*
Date Reported : *06/28/00*

Project Desc. : *Analysis of 11 samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-1 GW"*
Sampled By : *DKO of SME*
Sample Date : *06/13/2000*
Sample Time : *9:25am*

Date Received : *06/14/2000*
Sample Type : *aqueous*
KAR Sample No. : *002874-02*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
MDNR Scan 1 & 2	See below		EPA 8260	06/20/00	JAR	
Prep, VOA	Completed		EPA 5030	06/20/00	JAR	
1,1,1-Trichloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,1,2,2-Tetrachloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,1,2-Trichloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,1-Dichloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,1-Dichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
1,2-Dichloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,2-Dichloropropane	<1	ug/L	EPA 8260	06/20/00	JAR	
Benzene	<1	ug/L	EPA 8260	06/20/00	JAR	
Bromodichloromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Bromoform	<1	ug/L	EPA 8260	06/20/00	JAR	
Bromomethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Carbon tetrachloride	<1	ug/L	EPA 8260	06/20/00	JAR	
Chlorobenzene	<1	ug/L	EPA 8260	06/20/00	JAR	
Chloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Chloroform	<1	ug/L	EPA 8260	06/20/00	JAR	
Chloromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Cis-1,2-Dichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Cis-1,3-Dichloropropene	<1	ug/L	EPA 8260	06/20/00	JAR	
Dibromochloromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Ethylbenzene	<1	ug/L	EPA 8260	06/20/00	JAR	
M-and/or p-xylene	<2	ug/L	EPA 8260	06/20/00	JAR	
Methylene chloride	<5	ug/L	EPA 8260	06/20/00	JAR	
O-Xylene	<1	ug/L	EPA 8260	06/20/00	JAR	
Tetrachloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Toluene	<1	ug/L	EPA 8260	06/20/00	JAR	
Trans-1,2-Dichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Trans-1,3-Dichloropropene	<1	ug/L	EPA 8260	06/20/00	JAR	
Trichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Trichlorofluoromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Vinyl chloride	<1	ug/L	EPA 8260	06/20/00	JAR	
MDNR Scan 7	See below		EPA 8270	06/27/00	KTL	
Prep, SV BN	Completed		EPA 3510	06/15/00	SAS	
2-Methylnaphthalene	<5	ug/L	EPA 8270	06/27/00	KTL	
Acenaphthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Acenaphthylene	<5	ug/L	EPA 8270	06/27/00	KTL	
Anthracene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(a)anthracene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(a)pyrene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(b)fluoranthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(ghi)perylene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(k)fluoranthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Chrysene	<5	ug/L	EPA 8270	06/27/00	KTL	
Dibenzo(ah)anthracene	<5	ug/L	EPA 8270	06/27/00	KTL	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *002874*
Date Reported : *06/28/00*

Project
Desc. : *Analysis of 11 samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-1 GW"*
Sampled By : *DKO of SME*
Sample Date : *06/13/2000*
Sample Time : *9:25am*

Date Received : *06/14/2000*
Sample Type : *aqueous*
KAR Sample No. : *002874-02*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Fluoranthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Fluorene	<5	ug/L	EPA 8270	06/27/00	KTL	
Indeno(123cd)pyrene	<5	ug/L	EPA 8270	06/27/00	KTL	
Naphthalene by Method 8270	<5	ug/L	EPA 8270	06/27/00	KTL	
Phenanthrene	<5	ug/L	EPA 8270	06/27/00	KTL	
Pyrene	<5	ug/L	EPA 8270	06/27/00	KTL	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *002874*
Date Reported : *06/28/00*

Project Desc. : *Analysis of 11 samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-2 @ 1'-3'"*
Sampled By : *DKO of SME*
Sample Date : *06/13/2000*
Sample Time : *10:00am*

Date Received : *06/14/2000*
Sample Type : *soil*
KAR Sample No. : *002874-03*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, Hg	Completed		EPA 7471A	06/19/00	MTM	
Prep, metals	Completed		EPA 30xx,200.x	06/16/00	MTM	
Arsenic, total, low level	5.2	mg/kg dry sample	EPA 6020	06/22/00	DBL	Sample is not homogeneous; result is approximate.
Barium, total, low level	105	mg/kg dry sample	EPA 6010B	06/19/00	PML	Sample is not homogeneous; result is approximate. Average of four replicates: 159, 71, 92, and 99 mg/kg dry sample.
Cadmium, total, low level	0.43	mg/kg dry sample	EPA 6020	06/22/00	DBL	
Chromium, total, low level	10	mg/kg dry sample	EPA 6010B	06/21/00	PML	
Copper, total	256	mg/kg dry sample	EPA 6010B	06/19/00	PML	Sample is not homogeneous; result is approximate. Average of four replicates: 114, 256, 360, and 296 mg/kg dry sample.
Lead, total	393	mg/kg dry sample	EPA 6010B	06/19/00	PML	Sample is not homogeneous; result is approximate. Average of four replicates: 266, 501, 366, and 439 mg/kg dry sample.
Mercury, total, low level	0.3	mg/kg dry sample	EPA 7471A	06/20/00	DBL	
Selenium, total, low level	<0.8	mg/kg dry sample	EPA 6020	06/22/00	DBL	Elevated detection limit due to sample matrix interference.
Silver, total	<0.5	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Zinc, total	131	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Dry weight solids	89.80	% by weight	SM(18) 2540B mod	06/15/00	KAL	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *002874*
Date Reported : *06/28/00*

Project Desc. : *Analysis of 11 samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-2 GW"*
Sampled By : *DKO of SME*
Sample Date : *06/13/2000*
Sample Time : *10:45am*

Date Received : *06/14/2000*
Sample Type : *aqueous*
KAR Sample No. : *002874-04*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, Hg	Completed		EPA 245.2	06/15/00	DBL	
Prep, diss. metals	Completed		Client	06/13/00	CLI	
Arsenic, dissolved	<0.02	mg/L	EPA 200.8	06/21/00	DBL	
Barium, dissolved	<0.1	mg/L	EPA 200.8	06/21/00	DBL	
Cadmium, diss., low level	<0.0005	mg/L	EPA 200.8	06/21/00	DBL	
Chromium, diss., low level	<0.005	mg/L	EPA 200.8	06/21/00	DBL	
Copper, dissolved	<0.025	mg/L	EPA 200.8	06/21/00	DBL	
Lead, dissolved	<0.003	mg/L	EPA 200.8	06/21/00	DBL	
Mercury, diss., low level	<0.0002	mg/L	EPA 245.2	06/16/00	DBL	
Selenium, dissolved	0.015	mg/L	EPA 200.8	06/21/00	DBL	
Silver, diss., low level	<0.0005	mg/L	EPA 200.8	06/21/00	DBL	
Zinc, dissolved	<0.02	mg/L	EPA 200.8	06/21/00	DBL	
MDNR Scan 1 & 2	See below		EPA 8260	06/20/00	JAR	
Prep, VOA	Completed		EPA 5030	06/20/00	JAR	
1,1,1-Trichloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,1,2,2-Tetrachloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,1,2-Trichloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,1-Dichloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,1-Dichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
1,2-Dichloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,2-Dichloropropane	<1	ug/L	EPA 8260	06/20/00	JAR	
Benzene	<1	ug/L	EPA 8260	06/20/00	JAR	
Bromodichloromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Bromoform	<1	ug/L	EPA 8260	06/20/00	JAR	
Bromomethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Carbon tetrachloride	<1	ug/L	EPA 8260	06/20/00	JAR	
Chlorobenzene	<1	ug/L	EPA 8260	06/20/00	JAR	
Chloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Chloroform	<1	ug/L	EPA 8260	06/20/00	JAR	
Chloromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Cis-1,2-Dichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Cis-1,3-Dichloropropene	<1	ug/L	EPA 8260	06/20/00	JAR	
Dibromochloromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Ethylbenzene	<1	ug/L	EPA 8260	06/20/00	JAR	
M-and/or p-xylene	<2	ug/L	EPA 8260	06/20/00	JAR	
Methylene chloride	<5	ug/L	EPA 8260	06/20/00	JAR	
O-Xylene	<1	ug/L	EPA 8260	06/20/00	JAR	
Tetrachloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Toluene	<1	ug/L	EPA 8260	06/20/00	JAR	
Trans-1,2-Dichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Trans-1,3-Dichloropropene	<1	ug/L	EPA 8260	06/20/00	JAR	
Trichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Trichlorofluoromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Vinyl chloride	<1	ug/L	EPA 8260	06/20/00	JAR	
MDNR Scan 7	See below		EPA 8270	06/27/00	KTL	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *002874*
Date Reported : *06/28/00*

Project
Desc. : *Analysis of 11 samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-2 GW"*
Sampled By : *DKO of SME*
Sample Date : *06/13/2000*
Sample Time : *10:45am*

Date Received : *06/14/2000*
Sample Type : *aqueous*
KAR Sample No. : *002874-04*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, SV BN	Completed		EPA 3510	06/15/00	SAS	
2-Methylnaphthalene	<5	ug/L	EPA 8270	06/27/00	KTL	
Acenaphthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Acenaphthylene	<5	ug/L	EPA 8270	06/27/00	KTL	
Anthracene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(a)anthracene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(a)pyrene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(b)fluoranthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(ghi)perylene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(k)fluoranthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Chrysene	<5	ug/L	EPA 8270	06/27/00	KTL	
Dibenzo(ah)anthracene	<5	ug/L	EPA 8270	06/27/00	KTL	
Fluoranthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Fluorene	<5	ug/L	EPA 8270	06/27/00	KTL	
Indeno(123cd)pyrene	<5	ug/L	EPA 8270	06/27/00	KTL	
Naphthalene by Method 8270	<5	ug/L	EPA 8270	06/27/00	KTL	
Phenanthrene	<5	ug/L	EPA 8270	06/27/00	KTL	
Pyrene	<5	ug/L	EPA 8270	06/27/00	KTL	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *002874*
Date Reported : *06/28/00*

Project
Desc. : *Analysis of 11 samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-3 @ 2'"*
Sampled By : *DKO of SME*
Sample Date : *06/13/2000*
Sample Time : *11:25am*

Date Received : *06/14/2000*
Sample Type : *soil*
KAR Sample No. : *002874-05*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, Hg	Completed		EPA 7471A	06/19/00	MTM	
Prep, metals	Completed		EPA 30xx,200.x	06/16/00	MTM	
Arsenic, total, low level	89.9	mg/kg dry sample	EPA 6020	06/22/00	DBL	
Barium, total, low level	354	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Cadmium, total, low level	1.69	mg/kg dry sample	EPA 6020	06/22/00	DBL	
Chromium, total, low level	24.6	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Copper, total	78	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Lead, total	3850	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Mercury, total, low level	1.2	mg/kg dry sample	EPA 7471A	06/20/00	DBL	
Selenium, total, low level	6.6	mg/kg dry sample	EPA 6020	06/22/00	DBL	
Silver, total	<0.5	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Zinc, total	760	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Dry weight solids	78.62	% by weight	SM(18) 2540B mod	06/15/00	KAL	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *002874*
Date Reported : *06/28/00*

Project Desc. : *Analysis of 11 samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-4 @ 3'"*
Sampled By : *DKO of SME*
Sample Date : *06/13/2000*
Sample Time : *11:45am*

Date Received : *06/14/2000*
Sample Type : *soil*
KAR Sample No. : *002874-06*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, Hg	Completed		EPA 7471A	06/19/00	MTM	
Prep, metals	Completed		EPA 30xx,200.x	06/16/00	MTM	
Arsenic, total, low level	9.9	mg/kg dry sample	EPA 6020	06/22/00	DBL	
Barium, total, low level	59	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Cadmium, total, low level	0.37	mg/kg dry sample	EPA 6020	06/22/00	DBL	
Chromium, total, low level	7.5	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Copper, total	18	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Lead, total	1040	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Mercury, total, low level	0.4	mg/kg dry sample	EPA 7471A	06/20/00	DBL	
Selenium, total, low level	1.2	mg/kg dry sample	EPA 6020	06/22/00	DBL	
Silver, total	<0.5	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Zinc, total	48	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Dry weight solids	84.48	% by weight	SM(18) 2540B mod	06/15/00	KAL	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *002874*
Date Reported : *06/28/00*

Project Desc. : *Analysis of 11 samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-4 GW"*
Sampled By : *DKO of SME*
Sample Date : *06/13/2000*
Sample Time : *12:05pm*

Date Received : *06/14/2000*
Sample Type : *aqueous*
KAR Sample No. : *002874-07*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
MDNR Scan 1 & 2	See below		EPA 8260	06/20/00	JAR	
Prep, VOA	Completed		EPA 5030	06/20/00	JAR	
1,1,1-Trichloroethane	3.4	ug/L	EPA 8260	06/20/00	JAR	
1,1,2,2-Tetrachloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,1,2-Trichloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,1-Dichloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,1-Dichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
1,2-Dichloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,2-Dichloropropane	<1	ug/L	EPA 8260	06/20/00	JAR	
Benzene	1.4	ug/L	EPA 8260	06/20/00	JAR	
Bromodichloromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Bromoform	<1	ug/L	EPA 8260	06/20/00	JAR	
Bromomethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Carbon tetrachloride	<1	ug/L	EPA 8260	06/20/00	JAR	
Chlorobenzene	<1	ug/L	EPA 8260	06/20/00	JAR	
Chloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Chloroform	<1	ug/L	EPA 8260	06/20/00	JAR	
Chloromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Cis-1,2-Dichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Cis-1,3-Dichloropropene	<1	ug/L	EPA 8260	06/20/00	JAR	
Dibromochloromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Ethylbenzene	<1	ug/L	EPA 8260	06/20/00	JAR	
M-and/or p-xylene	3.6	ug/L	EPA 8260	06/20/00	JAR	
Methylene chloride	<5	ug/L	EPA 8260	06/20/00	JAR	
O-Xylene	2.3	ug/L	EPA 8260	06/20/00	JAR	
Tetrachloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Toluene	4.6	ug/L	EPA 8260	06/20/00	JAR	
Trans-1,2-Dichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Trans-1,3-Dichloropropene	<1	ug/L	EPA 8260	06/20/00	JAR	
Trichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Trichlorofluoromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Vinyl chloride	<1	ug/L	EPA 8260	06/20/00	JAR	
MDNR Scan 7	See below		EPA 8270	06/27/00	KTL	
Prep, SV BN	Completed		EPA 3510	06/15/00	SAS	
2-Methylnaphthalene	<5	ug/L	EPA 8270	06/27/00	KTL	
Acenaphthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Acenaphthylene	<5	ug/L	EPA 8270	06/27/00	KTL	
Anthracene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(a)anthracene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(a)pyrene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(b)fluoranthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(ghi)perylene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(k)fluoranthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Chrysene	<5	ug/L	EPA 8270	06/27/00	KTL	
Dibenzo(ah)anthracene	<5	ug/L	EPA 8270	06/27/00	KTL	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *002874*
Date Reported : *06/28/00*

Project
Desc. : *Analysis of 11 samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-4 GW"*
Sampled By : *DKO of SME*
Sample Date : *06/13/2000*
Sample Time : *12:05pm*

Date Received : *06/14/2000*
Sample Type : *aqueous*
KAR Sample No. : *002874-07*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Fluoranthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Fluorene	<5	ug/L	EPA 8270	06/27/00	KTL	
Indeno(123cd)pyrene	<5	ug/L	EPA 8270	06/27/00	KTL	
Naphthalene by Method 8270	<5	ug/L	EPA 8270	06/27/00	KTL	
Phenanthrene	<5	ug/L	EPA 8270	06/27/00	KTL	
Pyrene	<5	ug/L	EPA 8270	06/27/00	KTL	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *002874*
Date Reported : *06/28/00*

Project Desc. : *Analysis of 11 samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-5 GW"*
Sampled By : *DKO of SME*
Sample Date : *06/13/2000*
Sample Time : *1:40pm*

Date Received : *06/14/2000*
Sample Type : *aqueous*
KAR Sample No. : *002874-08*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, Hg	Completed		EPA 245.2	06/15/00	DBL	
Prep, diss. metals	Completed		Client	06/13/00	CLI	
Arsenic, dissolved	<0.02	mg/L	EPA 200.8	06/21/00	DBL	
Barium, dissolved	0.11	mg/L	EPA 200.8	06/21/00	DBL	
Cadmium, diss., low level	<0.0005	mg/L	EPA 200.8	06/21/00	DBL	
Chromium, diss., low level	<0.005	mg/L	EPA 200.8	06/21/00	DBL	
Copper, dissolved	<0.025	mg/L	EPA 200.8	06/21/00	DBL	
Lead, dissolved	<0.003	mg/L	EPA 200.8	06/21/00	DBL	
Mercury, diss., low level	<0.0002	mg/L	EPA 245.2	06/16/00	DBL	
Selenium, dissolved	0.006	mg/L	EPA 200.8	06/21/00	DBL	
Silver, diss., low level	<0.0005	mg/L	EPA 200.8	06/21/00	DBL	
Zinc, dissolved	<0.02	mg/L	EPA 200.8	06/21/00	DBL	
MDNR Scan 1 & 2	See below		EPA 8260	06/20/00	JAR	
Prep, VOA	Completed		EPA 5030	06/20/00	JAR	
1,1,1-Trichloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,1,2,2-Tetrachloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,1,2-Trichloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,1-Dichloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,1-Dichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
1,2-Dichloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,2-Dichloropropane	<1	ug/L	EPA 8260	06/20/00	JAR	
Benzene	<1	ug/L	EPA 8260	06/20/00	JAR	
Bromodichloromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Bromoform	<1	ug/L	EPA 8260	06/20/00	JAR	
Bromomethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Carbon tetrachloride	<1	ug/L	EPA 8260	06/20/00	JAR	
Chlorobenzene	<1	ug/L	EPA 8260	06/20/00	JAR	
Chloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Chloroform	<1	ug/L	EPA 8260	06/20/00	JAR	
Chloromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Cis-1,2-Dichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Cis-1,3-Dichloropropene	<1	ug/L	EPA 8260	06/20/00	JAR	
Dibromochloromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Ethylbenzene	<1	ug/L	EPA 8260	06/20/00	JAR	
M-and/or p-xylene	<2	ug/L	EPA 8260	06/20/00	JAR	
Methylene chloride	<5	ug/L	EPA 8260	06/20/00	JAR	
O-Xylene	<1	ug/L	EPA 8260	06/20/00	JAR	
Tetrachloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Toluene	<1	ug/L	EPA 8260	06/20/00	JAR	
Trans-1,2-Dichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Trans-1,3-Dichloropropene	<1	ug/L	EPA 8260	06/20/00	JAR	
Trichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Trichlorofluoromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Vinyl chloride	<1	ug/L	EPA 8260	06/20/00	JAR	
MDNR Scan 7	See below		EPA 8270	06/27/00	KTL	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *002874*
Date Reported : *06/28/00*

Project Desc. : *Analysis of 11 samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-5 GW"*
Sampled By : *DKO of SME*
Sample Date : *06/13/2000*
Sample Time : *1:40pm*

Date Received : *06/14/2000*
Sample Type : *aqueous*
KAR Sample No. : *002874-08*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, SV BN	Completed		EPA 3510	06/15/00	SAS	
2-Methylnaphthalene	<5	ug/L	EPA 8270	06/27/00	KTL	
Acenaphthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Acenaphthylene	<5	ug/L	EPA 8270	06/27/00	KTL	
Anthracene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(a)anthracene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(a)pyrene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(b)fluoranthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(ghi)perylene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(k)fluoranthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Chrysene	<5	ug/L	EPA 8270	06/27/00	KTL	
Dibenzo(ah)anthracene	<5	ug/L	EPA 8270	06/27/00	KTL	
Fluoranthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Fluorene	<5	ug/L	EPA 8270	06/27/00	KTL	
Indeno(123cd)pyrene	<5	ug/L	EPA 8270	06/27/00	KTL	
Naphthalene by Method 8270	<5	ug/L	EPA 8270	06/27/00	KTL	
Phenanthrene	<5	ug/L	EPA 8270	06/27/00	KTL	
Pyrene	<5	ug/L	EPA 8270	06/27/00	KTL	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *002874*
Date Reported : *06/28/00*

Project Desc. : *Analysis of 11 samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-6 GW"*
Sampled By : *DKO of SME*
Sample Date : *06/13/2000*
Sample Time : *2:35pm*

Date Received : *06/14/2000*
Sample Type : *aqueous*
KAR Sample No. : *002874-09*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, Hg	Completed		EPA 245.2	06/15/00	DBL	
Prep, diss. metals	Completed		Client	06/13/00	CLI	
Arsenic, dissolved	<0.02	mg/L	EPA 200.8	06/21/00	DBL	
Barium, dissolved	<0.1	mg/L	EPA 200.8	06/21/00	DBL	
Cadmium, diss., low level	<0.0005	mg/L	EPA 200.8	06/21/00	DBL	
Chromium, diss., low level	<0.005	mg/L	EPA 200.8	06/21/00	DBL	
Copper, dissolved	<0.025	mg/L	EPA 200.8	06/21/00	DBL	
Lead, dissolved	<0.003	mg/L	EPA 200.8	06/21/00	DBL	
Mercury, diss., low level	<0.0002	mg/L	EPA 245.2	06/16/00	DBL	
Selenium, dissolved	<0.005	mg/L	EPA 200.8	06/21/00	DBL	
Silver, diss., low level	<0.0005	mg/L	EPA 200.8	06/21/00	DBL	
Zinc, dissolved	<0.02	mg/L	EPA 200.8	06/21/00	DBL	
MDNR Scan 1 & 2	See below		EPA 8260	06/20/00	JAR	
Prep, VOA	Completed		EPA 5030	06/20/00	JAR	
1,1,1-Trichloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,1,2,2-Tetrachloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,1,2-Trichloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,1-Dichloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,1-Dichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
1,2-Dichloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
1,2-Dichloropropane	<1	ug/L	EPA 8260	06/20/00	JAR	
Benzene	<1	ug/L	EPA 8260	06/20/00	JAR	
Bromodichloromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Bromoform	<1	ug/L	EPA 8260	06/20/00	JAR	
Bromomethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Carbon tetrachloride	<1	ug/L	EPA 8260	06/20/00	JAR	
Chlorobenzene	<1	ug/L	EPA 8260	06/20/00	JAR	
Chloroethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Chloroform	<1	ug/L	EPA 8260	06/20/00	JAR	
Chloromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Cis-1,2-Dichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Cis-1,3-Dichloropropene	<1	ug/L	EPA 8260	06/20/00	JAR	
Dibromochloromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Ethylbenzene	<1	ug/L	EPA 8260	06/20/00	JAR	
M-and/or p-xylene	<2	ug/L	EPA 8260	06/20/00	JAR	
Methylene chloride	<5	ug/L	EPA 8260	06/20/00	JAR	
O-Xylene	<1	ug/L	EPA 8260	06/20/00	JAR	
Tetrachloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Toluene	<1	ug/L	EPA 8260	06/20/00	JAR	
Trans-1,2-Dichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Trans-1,3-Dichloropropene	<1	ug/L	EPA 8260	06/20/00	JAR	
Trichloroethene	<1	ug/L	EPA 8260	06/20/00	JAR	
Trichlorofluoromethane	<1	ug/L	EPA 8260	06/20/00	JAR	
Vinyl chloride	<1	ug/L	EPA 8260	06/20/00	JAR	
MDNR Scan 7	See below		EPA 8270	06/27/00	KTL	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *002874*
Date Reported : *06/28/00*

Project
Desc. : *Analysis of 11 samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-6 GW"*
Sampled By : *DKO of SME*
Sample Date : *06/13/2000*
Sample Time : *2:35pm*

Date Received : *06/14/2000*
Sample Type : *aqueous*
KAR Sample No. : *002874-09*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, SV BN	Completed		EPA 3510	06/15/00	SAS	
2-Methylnaphthalene	<5	ug/L	EPA 8270	06/27/00	KTL	
Acenaphthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Acenaphthylene	<5	ug/L	EPA 8270	06/27/00	KTL	
Anthracene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(a)anthracene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(a)pyrene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(b)fluoranthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(ghi)perylene	<5	ug/L	EPA 8270	06/27/00	KTL	
Benzo(k)fluoranthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Chrysene	<5	ug/L	EPA 8270	06/27/00	KTL	
Dibenzo(ah)anthracene	<5	ug/L	EPA 8270	06/27/00	KTL	
Fluoranthene	<5	ug/L	EPA 8270	06/27/00	KTL	
Fluorene	<5	ug/L	EPA 8270	06/27/00	KTL	
Indeno(123cd)pyrene	<5	ug/L	EPA 8270	06/27/00	KTL	
Naphthalene by Method 8270	<5	ug/L	EPA 8270	06/27/00	KTL	
Phenanthrene	<5	ug/L	EPA 8270	06/27/00	KTL	
Pyrene	<5	ug/L	EPA 8270	06/27/00	KTL	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *002874*
Date Reported : *06/28/00*

Project
Desc. : *Analysis of 11 samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-7 @ 2'"*
Sampled By : *DKO of SME*
Sample Date : *06/13/2000*
Sample Time : *3:05pm*

Date Received : *06/14/2000*
Sample Type : *soil*
KAR Sample No. : *002874-10*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, Hg	Completed		EPA 7471A	06/19/00	MTM	
Prep, metals	Completed		EPA 30xx,200.x	06/16/00	MTM	
Arsenic, total, low level	26.7	mg/kg dry sample	EPA 6020	06/22/00	DBL	
Barium, total, low level	503	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Cadmium, total, low level	1.91	mg/kg dry sample	EPA 6020	06/22/00	DBL	
Chromium, total, low level	34.9	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Copper, total	150	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Lead, total	1030	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Mercury, total, low level	0.9	mg/kg dry sample	EPA 7471A	06/20/00	DBL	
Selenium, total, low level	1.6	mg/kg dry sample	EPA 6020	06/22/00	DBL	
Silver, total	0.7	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Zinc, total	977	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Dry weight solids	82.00	% by weight	SM(18) 2540B mod	06/15/00	KAL	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *002874*
Date Reported : *06/28/00*

Project Desc. : *Analysis of 11 samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-8 @ 1.5'"*
Sampled By : *DKO of SME*
Sample Date : *06/13/2000*
Sample Time : *3:45pm*

Date Received : *06/14/2000*
Sample Type : *soil*
KAR Sample No. : *002874-11*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, Hg	Completed		EPA 7471A	06/19/00	MTM	
Prep, metals	Completed		EPA 30xx,200.x	06/16/00	MTM	
Arsenic, total, low level	5.1	mg/kg dry sample	EPA 6020	06/22/00	DBL	
Barium, total, low level	213	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Cadmium, total, low level	0.19	mg/kg dry sample	EPA 6020	06/22/00	DBL	
Chromium, total, low level	15.7	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Copper, total	15	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Lead, total	348	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Mercury, total, low level	0.8	mg/kg dry sample	EPA 7471A	06/20/00	DBL	
Selenium, total, low level	<0.8	mg/kg dry sample	EPA 6020	06/22/00	DBL	Elevated detection limit due to sample matrix interference.
Silver, total	<0.5	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Zinc, total	100	mg/kg dry sample	EPA 6010B	06/19/00	PML	
Dry weight solids	81.53	% by weight	SM(18) 2540B mod	06/15/00	KAL	

KAR Laboratories, Inc. (616-381-9666)

(Client must complete shaded areas)

Soil and Materials Engineers, Inc.
4460 Commercial Ave., Suite B
Kalamazoo, MI 49002

Attn: Mr. ~~Nick Larabel~~ TOM STOLZ

Phone: (616) 323-3555 Fax: (616) 323-3553

Project Name: 423 WALBRIDGE

Project # KE36281

P.D. #

Sampled by: ☐ KAR ☒ Client Initials DKO

Turnaround Time: ☒ 10-day ☐ 5-day (x 1.5) ☐ 3-day (x 2.0) ☐ Emergency (quote) ☐ Monthly

Samples rec'd cold: (Y) N ___ °C intact: (Y) N

KAR use only: Proj#: 002874 Date: 6/14/00 Login: 6/14/00
c-of-c (Y) N
labels (Y) N
LDOs (Y) N
contain (Y) N
headspace Y (N)
amount (Y) N
hold time ~~Y~~ ~~N~~
rush cost ~~Y~~ ~~N~~

#	Sample Identification	Sample Info Date	Time	Matrix	Sample Containers Type	Size	#	MICHIGAN 10 METALS	VOCs (Scan 1&2)	PNAs							Remarks
-01	SP-1 @ 3'	6-13	9:00	SOIL		4oz	1	X									
-02	SP-1 GW	6-13	9:25	WATER		AMBER VOAs	2		X	X							
-03	SP-2 @ 1'-3'	6-13	10:00	SOIL		4oz	1	X									
-04	SP-2 GW	6-13	10:45	WATER		AMBER ZERO HL VOAs	2	X	X	X							
-05	SP-3 @ 2'	6-13	11:25	SOIL		4oz	1	X									
-06	SP-4 @ 3'	6-13	11:45	SOIL		4oz	1	X									
-07	SP-4 GW	6-13	12:05	WATER		AMBER VOAs	2		X	X							
-08	SP-5 GW	6-13	1:40	WATER		AMBER ZERO HL VOAs	4	X	X	X							
-09	SP-6 GW	6-13	2:35	WATER		" "	4	X	X	X							
-10	SP-7 @ 2'	6-13	3:05	SOIL		4oz	1	X									
-11	SP-8 @ 1.5'	6-13	3:45	SOIL		4oz	1	X									

Relinquished By: [illegible]

Received By: Hope Starley

Date/Time: 6-14-00 @ 9:03

Received By:

Date/Time:

Notes: part 201

KAR *Laboratories, Inc.*

4425 Manchester Road
Kalamazoo, MI 49001
Phone 616 381-9666
Fax 616 381-9698
www.karlabs.com

Soil & Materials Engineers, Inc.
4460 Commercial Ave., Suite B
Kalamazoo, MI 49002

Attn : ***Mr. Nick Larabel***

KAR Project No. :	***003482***
Date Reported :	***07/21/00***
Date Activated :	***07/14/00***
Date Due :	***07/21/00***
Date Validated :	***07/21/00***

Project Description : ***Analysis of 14 soil samples from 423 Walbridge (SME #KE36281).***

Dear Client,

Your laboratory data is presented to you in this report. Unless otherwise stated under the "Comments" heading, all tests were performed within the maximum allowable holding times, have met or exceeded QC requirements and the result represents the sample as it was received.

If you wish to contact us about this work please mention KAR Project No. 003482. To arrange additional sampling or testing please contact our Client Services Department. If you have a question regarding quality assurance please contact William Rauch.

Thank you for the opportunity to serve you. Please do not hesitate to call if we can provide additional assistance.

Respectfully submitted,

Michael J. Jaeger
Director of Laboratories

KAR Laboratories, Inc. maintains Full Certification status for Bacteriology, Inorganics, Regulated Organics and Synthetic Organics through USEPA, Michigan Department of Public Health and Indiana State Department of Health.

POSITIVE RESULTS SUMMARY REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No.: *003482*

Date Reported: *07/21/2000*

Project Description: *Analysis of 14 soil samples from 423 Walbridge (SME #KE36281).*

Sample Description: ***"SP-9 @ 2'"***

Test	Positive Result Concentration	Units
Lead, total	615	mg/kg dry sample

Sample Description: ***"SP-10 @ 2'"***

Test	Positive Result Concentration	Units
Lead, total	465	mg/kg dry sample

Sample Description: ***"SP-11 @ 1'"***

Test	Positive Result Concentration	Units
Chromium, total, low level	11.2	mg/kg dry sample
Copper, total	6	mg/kg dry sample
Lead, total	5	mg/kg dry sample
Nickel, total	8	mg/kg dry sample
Zinc, total	21	mg/kg dry sample

Sample Description: ***"SP-12 @ 1'"***

Test	Positive Result Concentration	Units
Chromium, total, low level	9.5	mg/kg dry sample
Copper, total	8	mg/kg dry sample
Lead, total	40	mg/kg dry sample
Nickel, total	7	mg/kg dry sample
Zinc, total	54	mg/kg dry sample

Sample Description: ***"SP-13 @ 1'"***

Test	Positive Result Concentration	Units
Chromium, total, low level	17.9	mg/kg dry sample
Copper, total	87	mg/kg dry sample
Lead, total	476	mg/kg dry sample
Nickel, total	9	mg/kg dry sample
Zinc, total	276	mg/kg dry sample

Sample Description: ***"SP-14 @ 1'"***

Test	Positive Result Concentration	Units
Chromium, total, low level	5.7	mg/kg dry sample
Copper, total	3	mg/kg dry sample
Lead, total	14	mg/kg dry sample
Nickel, total	4	mg/kg dry sample
Zinc, total	19	mg/kg dry sample

This Positive Results Summary Report provides an overview of the sample set and CONTAINS ONLY RESULTS ABOVE THE REPORTING LIMIT. It should not be used as a substitute for the attached detail report.

POSITIVE RESULTS SUMMARY REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No.: *003482*

Date Reported: *07/21/2000*

Project Description: *Analysis of 14 soil samples from 423 Walbridge (SME #KE36281).*

Sample Description: ***"SP-15 @ 1'"***

Test	Positive Result Concentration	Units
Chromium, total, low level	7.7	mg/kg dry sample
Copper, total	25	mg/kg dry sample
Lead, total	67	mg/kg dry sample
Nickel, total	8	mg/kg dry sample
Zinc, total	71	mg/kg dry sample

Sample Description: ***"SP-16 @ 1'"***

Test	Positive Result Concentration	Units
Chromium, total, low level	20.7	mg/kg dry sample
Copper, total	202	mg/kg dry sample
Lead, total	507	mg/kg dry sample
Nickel, total	33	mg/kg dry sample
Zinc, total	371	mg/kg dry sample

Sample Description: ***"SP-17 @ 1'"***

Test	Positive Result Concentration	Units
Chromium, total, low level	36.3	mg/kg dry sample
Copper, total	523	mg/kg dry sample
Lead, total	1180	mg/kg dry sample
Nickel, total	26	mg/kg dry sample
Silver, total	0.8	mg/kg dry sample
Zinc, total	1230	mg/kg dry sample

Sample Description: ***"SP-18 @ 1'"***

Test	Positive Result Concentration	Units
Chromium, total, low level	16.1	mg/kg dry sample
Copper, total	42	mg/kg dry sample
Lead, total	178	mg/kg dry sample
Nickel, total	12	mg/kg dry sample
Zinc, total	134	mg/kg dry sample

Sample Description: ***"SP-19 @ 1'"***

Test	Positive Result Concentration	Units
Chromium, total, low level	12.0	mg/kg dry sample
Copper, total	84	mg/kg dry sample
Lead, total	245	mg/kg dry sample
Nickel, total	10	mg/kg dry sample
Zinc, total	113	mg/kg dry sample

This Positive Results Summary Report provides an overview of the sample set and CONTAINS ONLY RESULTS ABOVE THE REPORTING LIMIT. It should not be used as a substitute for the attached detail report.

POSITIVE RESULTS SUMMARY REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No.: *003482*

Date Reported: *07/21/2000*

Project Description: *Analysis of 14 soil samples from 423 Walbridge (SME #KE36281).*

Sample Description: *"SP-20 @ 1'"*

Test	Positive Result Concentration	Units
Chromium, total, low level	14.8	mg/kg dry sample
Copper, total	134	mg/kg dry sample
Lead, total	452	mg/kg dry sample
Nickel, total	13	mg/kg dry sample
Zinc, total	724	mg/kg dry sample

Sample Description: *"SP-21 @ 1'"*

Test	Positive Result Concentration	Units
Chromium, total, low level	69.7	mg/kg dry sample
Copper, total	67	mg/kg dry sample
Lead, total	992	mg/kg dry sample
Nickel, total	18	mg/kg dry sample
Zinc, total	382	mg/kg dry sample

Sample Description: *"SP-22 @ 1'"*

Test	Positive Result Concentration	Units
Chromium, total, low level	18.4	mg/kg dry sample
Copper, total	24	mg/kg dry sample
Lead, total	877	mg/kg dry sample
Nickel, total	18	mg/kg dry sample
Zinc, total	113	mg/kg dry sample

This Positive Results Summary Report provides an overview of the sample set and CONTAINS ONLY RESULTS ABOVE THE REPORTING LIMIT. It should not be used as a substitute for the attached detail report.

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *003482*
Date Reported : *07/21/00*

Project
Desc. : *Analysis of 14 soil samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-9 @ 2'"*
Sampled By : *DKO of SME*
Sample Date : *07/13/2000*
Sample Time : *10:45am*

Date Received : *07/14/2000*
Sample Type : *soil*
KAR Sample No. : *003482-01*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, metals	Completed		EPA 30xx,200.x	07/17/00	MTM	
Lead, total	615	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Dry weight solids	84.04	% by weight	SM(18) 2540B mod	07/14/00	KAL	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *003482*
Date Reported : *07/21/00*

Project
Desc. : *Analysis of 14 soil samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-10 @ 2'"*
Sampled By : *DKO of SME*
Sample Date : *07/13/2000*
Sample Time : *10:55am*

Date Received : *07/14/2000*
Sample Type : *soil*
KAR Sample No. : *003482-02*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, metals	Completed		EPA 30xx,200.x	07/17/00	MTM	
Lead, total	465	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Dry weight solids	84.25	% by weight	SM(18) 2540B mod	07/14/00	KAL	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *003482*
Date Reported : *07/21/00*

Project Desc. : *Analysis of 14 soil samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-11 @ 1'"*
Sampled By : *DKO of SME*
Sample Date : *07/13/2000*
Sample Time : *11:45am*

Date Received : *07/14/2000*
Sample Type : *soil*
KAR Sample No. : *003482-03*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, metals	Completed		EPA 30xx,200.x	07/17/00	MTM	
Chromium, total, low level	11.2	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Copper, total	6	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Lead, total	5	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Nickel, total	8	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Silver, total	<0.5	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Zinc, total	21	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Dry weight solids	93.40	% by weight	SM(18) 2540B mod	07/14/00	KAL	
Prep, 8000	Completed		EPA 8015	07/14/00	GMB	
Methanol	<4.4	mg/kg dry sample	EPA 8015	07/14/00	GMB	
Extraction, Method 8315	Completed		EPA 8315	07/17/00	DRA	
Prep, aldehydes	Completed		EPA 8315	07/19/00	MJY	
Formaldehyde by HPLC	<2000	ug/kg dry sample	EPA 8315	07/19/00	GMB	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *003482*
Date Reported : *07/21/00*

Project
Desc. : *Analysis of 14 soil samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-12 @ 1'"*
Sampled By : *DKO of SME*
Sample Date : *07/13/2000*
Sample Time : *12:05pm*

Date Received : *07/14/2000*
Sample Type : *soil*
KAR Sample No. : *003482-04*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, metals	Completed		EPA 30xx,200.x	07/17/00	MTM	
Chromium, total, low level	9.5	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Copper, total	8	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Lead, total	40	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Nickel, total	7	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Silver, total	<0.5	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Zinc, total	54	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Dry weight solids	82.06	% by weight	SM(18) 2540B mod	07/14/00	KAL	
Prep, 8000	Completed		EPA 8015	07/14/00	GMB	
Methanol	<4.4	mg/kg dry sample	EPA 8015	07/14/00	GMB	
Extraction, Method 8315	Completed		EPA 8315	07/17/00	DRA	
Prep, aldehydes	Completed		EPA 8315	07/19/00	MJY	
Formaldehyde by HPLC	<2000	ug/kg dry sample	EPA 8315	07/19/00	GMB	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *003482*
Date Reported : *07/21/00*

Project Desc. : *Analysis of 14 soil samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-13 @ 1'"*
Sampled By : *DKO of SME*
Sample Date : *07/13/2000*
Sample Time : *12:40pm*

Date Received : *07/14/2000*
Sample Type : *soil*
KAR Sample No. : *003482-05*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, metals	Completed		EPA 30xx,200.x	07/17/00	MTM	
Chromium, total, low level	17.9	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Copper, total	87	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Lead, total	476	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Nickel, total	9	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Silver, total	<0.5	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Zinc, total	276	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Dry weight solids	87.35	% by weight	SM(18) 2540B mod	07/14/00	KAL	
Prep, 8000	Completed		EPA 8015	07/14/00	GMB	
Methanol	<4.4	mg/kg dry sample	EPA 8015	07/14/00	GMB	
Extraction, Method 8315	Completed		EPA 8315	07/17/00	DRA	
Prep, aldehydes	Completed		EPA 8315	07/19/00	MJY	
Formaldehyde by HPLC	<2000	ug/kg dry sample	EPA 8315	07/19/00	GMB	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *003482*
Date Reported : *07/21/00*

Project Desc. : *Analysis of 14 soil samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-14 @ 1'"*
Sampled By : *DKO of SME*
Sample Date : *07/13/2000*
Sample Time : *3:00pm*

Date Received : *07/14/2000*
Sample Type : *soil*
KAR Sample No. : *003482-06*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, metals	Completed		EPA 30xx,200.x	07/17/00	MTM	
Chromium, total, low level	5.7	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Copper, total	3	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Lead, total	14	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Nickel, total	4	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Silver, total	<0.5	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Zinc, total	19	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Dry weight solids	91.41	% by weight	SM(18) 2540B mod	07/14/00	KAL	
Prep, 8000	Completed		EPA 8015	07/14/00	GMB	
Methanol	<4.4	mg/kg dry sample	EPA 8015	07/14/00	GMB	
Extraction, Method 8315	Completed		EPA 8315	07/17/00	DRA	
Prep, aldehydes	Completed		EPA 8315	07/19/00	MJY	
Formaldehyde by HPLC	<2000	ug/kg dry sample	EPA 8315	07/19/00	GMB	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *003482*
Date Reported : *07/21/00*

Project Desc. : *Analysis of 14 soil samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-15 @ 1'"*
Sampled By : *DKO of SME*
Sample Date : *07/13/2000*
Sample Time : *3:10pm*

Date Received : *07/14/2000*
Sample Type : *soil*
KAR Sample No. : *003482-07*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, metals	Completed		EPA 30xx,200.x	07/17/00	MTM	
Chromium, total, low level	7.7	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Copper, total	25	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Lead, total	67	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Nickel, total	8	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Silver, total	<0.5	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Zinc, total	71	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Dry weight solids	92.44	% by weight	SM(18) 2540B mod	07/14/00	KAL	
Prep, 8000	Completed		EPA 8015	07/14/00	GMB	
Methanol	<4.4	mg/kg dry sample	EPA 8015	07/14/00	GMB	
Extraction, Method 8315	Completed		EPA 8315	07/17/00	DRA	
Prep, aldehydes	Completed		EPA 8315	07/19/00	MJY	
Formaldehyde by HPLC	<2000	ug/kg dry sample	EPA 8315	07/19/00	GMB	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *003482*
Date Reported : *07/21/00*

Project
Desc. : *Analysis of 14 soil samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-16 @ 1'"*
Sampled By : *DKO of SME*
Sample Date : *07/13/2000*
Sample Time : *3:20pm*

Date Received : *07/14/2000*
Sample Type : *soil*
KAR Sample No. : *003482-08*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, metals	Completed		EPA 30xx,200.x	07/17/00	MTM	
Chromium, total, low level	20.7	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Copper, total	202	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Lead, total	507	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Nickel, total	33	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Silver, total	<0.5	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Zinc, total	371	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Dry weight solids	92.69	% by weight	SM(18) 2540B mod	07/14/00	KAL	
Prep, 8000	Completed		EPA 8015	07/14/00	GMB	
Methanol	<4.4	mg/kg dry sample	EPA 8015	07/14/00	GMB	
Extraction, Method 8315	Completed		EPA 8315	07/17/00	DRA	
Prep, aldehydes	Completed		EPA 8315	07/19/00	MJY	
Formaldehyde by HPLC	<2000	ug/kg dry sample	EPA 8315	07/19/00	GMB	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *003482*
Date Reported : *07/21/00*

Project
Desc. : *Analysis of 14 soil samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-17 @ 1'"*
Sampled By : *DKO of SME*
Sample Date : *07/13/2000*
Sample Time : *3:25pm*

Date Received : *07/14/2000*
Sample Type : *soil*
KAR Sample No. : *003482-09*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, metals	Completed		EPA 30xx,200.x	07/17/00	MTM	
Chromium, total, low level	36.3	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Copper, total	523	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Lead, total	1180	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Nickel, total	26	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Silver, total	0.8	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Zinc, total	1230	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Dry weight solids	79.20	% by weight	SM(18) 2540B mod	07/14/00	KAL	
Prep, 8000	Completed		EPA 8015	07/14/00	GMB	
Methanol	<4.4	mg/kg dry sample	EPA 8015	07/14/00	GMB	
Extraction, Method 8315	Completed		EPA 8315	07/17/00	DRA	
Prep, aldehydes	Completed		EPA 8315	07/19/00	MJY	
Formaldehyde by HPLC	<2000	ug/kg dry sample	EPA 8315	07/20/00	GMB	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *003482*
Date Reported : *07/21/00*

Project Desc. : *Analysis of 14 soil samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-18 @ 1'"*
Sampled By : *DKO of SME*
Sample Date : *07/13/2000*
Sample Time : *3:30pm*

Date Received : *07/14/2000*
Sample Type : *soil*
KAR Sample No. : *003482-10*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, metals	Completed		EPA 30xx,200.x	07/17/00	MTM	
Chromium, total, low level	16.1	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Copper, total	42	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Lead, total	178	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Nickel, total	12	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Silver, total	<0.5	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Zinc, total	134	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Dry weight solids	85.56	% by weight	SM(18) 2540B mod	07/14/00	KAL	
Prep, 8000	Completed		EPA 8015	07/14/00	GMB	
Methanol	<4.4	mg/kg dry sample	EPA 8015	07/14/00	GMB	
Extraction, Method 8315	Completed		EPA 8315	07/17/00	DRA	
Prep, aldehydes	Completed		EPA 8315	07/19/00	MJY	
Formaldehyde by HPLC	<2000	ug/kg dry sample	EPA 8315	07/20/00	GMB	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *003482*
Date Reported : *07/21/00*

Project
Desc. : *Analysis of 14 soil samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-19 @ 1'"*
Sampled By : *DKO of SME*
Sample Date : *07/13/2000*
Sample Time : *3:40pm*

Date Received : *07/14/2000*
Sample Type : *soil*
KAR Sample No. : *003482-11*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, metals	Completed		EPA 30xx,200.x	07/17/00	MTM	
Chromium, total, low level	12.0	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Copper, total	84	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Lead, total	245	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Nickel, total	10	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Silver, total	<0.5	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Zinc, total	113	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Dry weight solids	88.41	% by weight	SM(18) 2540B mod	07/14/00	KAL	
Prep, 8000	Completed		EPA 8015	07/14/00	GMB	
Methanol	<4.4	mg/kg dry sample	EPA 8015	07/14/00	GMB	
Extraction, Method 8315	Completed		EPA 8315	07/17/00	DRA	
Prep, aldehydes	Completed		EPA 8315	07/19/00	MJY	
Formaldehyde by HPLC	<2000	ug/kg dry sample	EPA 8315	07/20/00	GMB	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *003482*
Date Reported : *07/21/00*

Project
Desc. : *Analysis of 14 soil samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-20 @ 1'"*
Sampled By : *DKO of SME*
Sample Date : *07/13/2000*
Sample Time : *3:45pm*

Date Received : *07/14/2000*
Sample Type : *soil*
KAR Sample No. : *003482-12*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, metals	Completed		EPA 30xx,200.x	07/17/00	MTM	
Chromium, total, low level	14.8	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Copper, total	134	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Lead, total	452	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Nickel, total	13	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Silver, total	<0.5	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Zinc, total	724	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Dry weight solids	90.41	% by weight	SM(18) 2540B mod	07/14/00	KAL	
Prep, 8000	Completed		EPA 8015	07/14/00	GMB	
Methanol	<4.4	mg/kg dry sample	EPA 8015	07/14/00	GMB	
Extraction, Method 8315	Completed		EPA 8315	07/17/00	DRA	
Prep, aldehydes	Completed		EPA 8315	07/19/00	MJY	
Formaldehyde by HPLC	<2000	ug/kg dry sample	EPA 8315	07/20/00	GMB	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *003482*
Date Reported : *07/21/00*

Project
Desc. : *Analysis of 14 soil samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-21 @ 1'"*
Sampled By : *DKO of SME*
Sample Date : *07/13/2000*
Sample Time : *3:55pm*

Date Received : *07/14/2000*
Sample Type : *soil*
KAR Sample No. : *003482-13*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, metals	Completed		EPA 30xx,200.x	07/17/00	MTM	
Chromium, total, low level	69.7	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Copper, total	67	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Lead, total	992	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Nickel, total	18	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Silver, total	<0.5	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Zinc, total	382	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Dry weight solids	82.10	% by weight	SM(18) 2540B mod	07/14/00	KAL	
Prep, 8000	Completed		EPA 8015	07/14/00	GMB	
Methanol	<4.4	mg/kg dry sample	EPA 8015	07/14/00	GMB	
Extraction, Method 8315	Completed		EPA 8315	07/17/00	DRA	
Prep, aldehydes	Completed		EPA 8315	07/19/00	MJY	
Formaldehyde by HPLC	<2000	ug/kg dry sample	EPA 8315	07/20/00	GMB	

LABORATORY DETAIL REPORT

Client: *Soil & Materials Engineers, Inc.*

KAR Project No. : *003482*
Date Reported : *07/21/00*

Project Desc. : *Analysis of 14 soil samples from 423 Walbridge (SME #KE36281).*

Sample ID : *"SP-22 @ 1'"*
Sampled By : *DKO of SME*
Sample Date : *07/13/2000*
Sample Time : *4:00pm*

Date Received : *07/14/2000*
Sample Type : *soil*
KAR Sample No. : *003482-14*

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Prep, metals	Completed		EPA 30xx,200.x	07/17/00	MTM	
Chromium, total, low level	18.4	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Copper, total	24	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Lead, total	877	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Nickel, total	18	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Silver, total	<0.5	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Zinc, total	113	mg/kg dry sample	EPA 6010B	07/18/00	PML	
Dry weight solids	86.73	% by weight	SM(18) 2540B mod	07/14/00	KAL	
Prep, 8000	Completed		EPA 8015	07/14/00	GMB	
Methanol	<4.4	mg/kg dry sample	EPA 8015	07/14/00	GMB	
Extraction, Method 8315	Completed		EPA 8315	07/17/00	DRA	
Prep, aldehydes	Completed		EPA 8315	07/19/00	MJY	
Formaldehyde by HPLC	<2000	ug/kg dry sample	EPA 8315	07/20/00	GMB	

KAR Laboratories, Inc. (616-381-9666)

(Client must complete shaded areas)

Client: SOIL AND MATERIALS, ENGINEERS

Attn: NICK LARABEL

Phone: (616) 323-3555 Fax: (616) 323-3553

Project Name: 423 WALBRIDGE

Project #: KE 36281

P.D. #:

Sampled by: ☒ KAR ☐ Client Initials: DKO

Turnaround Time: ☐ 10-day ☒ 5-day (x ~~1.5~~) ☐ 3-day (x 2.0) ☐ Emergency (quote) ☐ Monthly

Samples rec'd: cold: (Y) N ___ °C intact: (Y) N

KAR use only: Proj#: 003482 Login: [illegible] Date: 7/14/00
c-of-c (Y) N
labels (Y) N
LDDs (Y) N
contain (Y) N
headspace (Y) N
amount (Y) N
hold time Y (N)
rush cost Y (N)

#	Sample Identification	Sample Info: Date	Time	Matrix	Sample Containers: Type	Size	#	COPPER	NICKEL	CHROMIUM	SILVER	ZINC	LEAD	METHANOL	FORMALDEHYDE		Remarks
01	SP-9 @ 2'	7-13-00	10:45	SOIL	GLASS	4oz	1						X				
02	SP-10 @ 2'		10:55				1						X				
03	SP-11 @ 1'		11:45				2	X	X	X	X	X	X	X	X	X	
04	SP-12 @ 1'		12:05				2	X	X	X	X	X	X	X	X	X	
05	SP-13 @ 1'		12:40				2	X	X	X	X	X	X	X	X	X	
06	SP-14 @ 1'		3:00				2	X	X	X	X	X	X	X	X	X	
07	SP-15 @ 1'		3:10				2	X	X	X	X	X	X	X	X	X	
08	SP-16 @ 1'		3:20				2	X	X	X	X	X	X	X	X	X	
09	SP-17 @ 1'		3:25				2	X	X	X	X	X	X	X	X	X	
10	SP-18 @ 1'		3:30				2	X	X	X	X	X	X	X	X	X	
11	SP-19 @ 1'		3:40				2	X	X	X	X	X	X	X	X	X	
12	SP-20 @ 1'		3:45				2	X	X	X	X	X	X	X	X	X	

Relinquished By: TAVIN KOGANA Received By: [illegible] Date/Time: JULY 14, 2000

Relinquished By: Received By: Date/Time:

Notes: * PER GARRETT, 5-DAY TURNAROUND WILL BE ISSUED FOR ALL PARAMETERS EXCEPT FORMALDEHYDE WHICH REQUIRES MORE TIME TO ANALYZE

KAR Laboratories, Inc. (616-381-9666)

(Client must complete shaded areas)

Client: SME

Attn: NICK LARABEL

Phone: (616) 323-3555 Fax: (616) 323-3553

Project Name: 423 WALBRIDGE

Project #: KE 36281

P.O. #:

Sampled by: ☒ KAR ☐ Client Initials: DKO

Turnaround Time:
☐ 10-day ☐ Emergency (quote)
☒ 5-day ~~(x 1.5)~~
☐ 3-day (x 2.0) ☐ Monthly

Samples rec'd
cold: (Y) N ___ °C intact: (Y) N

Requested Analyses

KAR use only
Proj#: 003482
Login: [illegible]
Date: 7/14/00
c-of-c (Y) N
labels (Y) N
LDDs (Y) N
contain (Y) N
headspace (Y) N
amount (Y) N
hold time Y (N)
rush cost Y (N)

#	Sample Identification	Sample Info Date	Time	Matrix	Sample Containers Type	Size	#	COPPER	NICKEL	CHROMIUM	SILVER	ZINC	LEAD	METHANOL	FORMALDEHYDE		Remarks
13	SP-21 @ 1'	7-13-00	3:55	SOIL	GLASS	4oz	2	X	X	X	X	X	X	X	X		
14	SP-22 @ 1'	7-13-00	4:00	SOIL	GLASS	4oz	2	X	X	X	X	X	X	X	X		

Relinquished By: [signature] Received By: [signature] Date/Time: JULY 14, 2000

Relinquished By: Received By: Date/Time:

Notes: * 5-DAY TURN ON ALL PARAMETERS EXCEPT FORMALDEHYDE - PER GARRETT

APPENDIX I

TABLES

TABLE 1
SOIL ANALYTICAL RESULTS FOR THE 10 MICHIGAN METALS
423 WALBRIDGE STREET
KALAMAZOO, MICHIGAN
SME PROJECT NO. KE36281

Sample ID	Sample Depth (ft)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Zinc (mg/kg)
SP1	3	**7.7**	95	0.34	11.9	29	247	<0.4	<0.8	<0.5	148
SP2	1-3	5.2	105	0.43	10	256	393	0.3	<0.8	<0.5	131
SP3	2	**89.9**	**354**	1.69	24.6	78	**3,850**	1.2	**6.6**	<0.5	760
SP4	3	**9.9**	59	0.37	7.5	18	**1,040**	0.4	1.2	<0.5	48
SP7	2	**26.7**	**503**	1.91	**34.9**	150	**1,030**	0.9	1.6	0.7	977
SP8	1.5	5.1	**213**	0.19	15.7	15	348	0.8	<0.8	<0.5	100
SP9	2	NA	NA	NA	NA	NA	**615**	NA	NA	NA	NA
SP10	2	NA	NA	NA	NA	NA	**465**	NA	NA	NA	NA
Part 201 Direct Contact Criteria		**7.6**	**37,000**	**550**	**2,500**	**20,000**	**400**	**160**	**2,600**	**2,500**	**170,000**
Part 201 Residential Drinking Water Protection Criteria		**23**	**130**	**6**	**30**	**5,800**	**700**	**1.7**	**4**	**4.5**	**2,400**

Notes:
1. Concentrations reported in milligrams per kilogram (mg/kg).
2. MDEQ cleanup criteria taken from integrated table Soil: Residential and Commercial, Part 201 Generic Cleanup Criteria and Screening Levels, dated June 7, 2000.
3. Shaded concentrations exceed Part 201 Residential Drinking Water Protection Criteria and/or Part 201 Direct Contact Criteria.

H:\larabel\tables\wal1.xls

TABLE 2
GROUNDWATER ANALYTICAL RESULTS FOR VOCs AND PNAS
423 WALBRIDGE STREET
KALAMAZOO, MICHIGAN
SME PROJECT NO. KE36281

Sample ID	Sample Depth (ft)	VOCs (ug/L)	Benzene (ug/L)	Toluene (ug/L)	Xylenes (ug/L)	1,1,1-Trichloroethane (ug/L)	PNAs (ug/L)
SP1	10.5-15	<1	<1	<1	<3	<1	<5
SP2	13.5-15	<1	<1	<1	<3	<1	<5
SP4	8-12	Note #3	1.4	4.6	5.9	3.4	<5
SP5	8-12	<1	<1	<1	<3	<1	<5
SP6	8.5-12	<1	<1	<1	<3	<1	<5
Part 201 Residential Drinking Water Criteria		**Note #4**	**5**	**790**	**280**	**200**	**Note #4**
Part 201 Groundwater Contact Criteria		**Note #4**	**11,000**	**530,000**	**190,000**	**1,300,000**	**Note #4**

Notes:

1. Concentrations reported in micrograms per liter (ug/L).
2. MDEQ cleanup criteria taken from integrated table Groundwater: Residential and Industrial-Commercial, Part 201 Generic Cleanup Criteria and Screening Levels, dated June 7, 2000.
3. With the exception of benzene, toluene, xylenes and 1,1,1-trichloroethane in the groundwater sample from SP4, volatile organic compounds were not detected above the laboratory method detection levels. The benzene, toluene, xylenes and 1,1,1-trichloroethane concentrations are listed under each respective heading.
4. VOCs and PNAs have various applicable cleanup criteria, and since VOCs and PNAs were not detected, criteria were not provided.

h:\larabel\tables\wal2.xls

TABLE 3
GROUNDWATER ANALYTICAL RESULTS FOR 10 MICHIGAN METALS
423 WALBRIDGE STREET
KALAMAZOO, MICHIGAN
SME PROJECT NO. KE36281

Sample ID	Sample Depth (ft)	Arsenic (mg/L)	Barium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Lead (mg/L)	Mercury (mg/L)	Selenium (mg/L)	Silver (mg/L)	Zinc (mg/L)
SP2	13.5-15	<0.02	<0.1	<0.0005	<0.005	<0.025	<0.003	<0.0002	0.015	<0.0005	<0.02
SP5	8-12	<0.02	0.11	<0.0005	<0.005	<0.025	<0.003	<0.0002	0.006	<0.0005	<0.02
SP6	8.5-12	<0.02	<0.1	<0.0005	<0.005	<0.025	<0.003	<0.0002	<0.005	<0.0005	<0.02
Part 201 Residential & Commercial I Drinking Water Criteria		**0.05**	**2**	**0.005**	**0.1**	**1**	**0.004**	**0.002**	**0.05**	**0.034**	**2.4**
Part 201 Groundwater Contact Criteria		**4.3**	**14,000**	**190**	**460**	**7,400**	**ID**	**0.056**	**970**	**1,500**	**110,000**

Notes:
1. Concentrations reported in milligrams per liter (mg/L).
2. MDEQ cleanup criteria taken from integrated table Groundwater: Residential and Industrial-Commercial, Part 201 Generic Cleanup Criteria and Screening Levels, dated June 7, 2000.
3. ID - Inadequate data to develop criterion.

h:\larabel\tables\wal3.xls

TABLE 4
SOIL ANALYTICAL RESULTS FOR METALS, FORMALDEHYDE AND METHANOL
PROCESS AREA INSIDE BUILDING
423 WALBRIDGE STREET
KALAMAZOO, MICHIGAN
SME PROJECT NO. KE36281

Sample ID	Sample Depth (ft)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Nickel (mg/kg)	Silver (mg/kg)	Zinc (mg/kg)	Formaldehyde (ug/kg)	Methanol (mg/kg)
SP11	1	11.2	6	5	8	<0.5	21	<2,000	<4.4
SP12	1	9.5	8	40	7	<0.5	54	<2,000	<4.4
SP13	1	17.9	87	**476**	9	<0.5	276	<2,000	<4.4
SP14	1	5.7	3	14	4	<0.5	19	<2,000	<4.4
SP15	1	7.7	25	67	8	<0.5	71	<2,000	<4.4
SP16	1	20.7	202	**507**	33	<0.5	371	<2,000	<4.4
SP17	1	**36.3**	523	**1,180**	26	0.8	1,230	<2,000	<4.4
SP18	1	16.1	42	178	12	<0.5	134	<2,000	<4.4
SP19	1	12	84	245	10	<0.5	113	<2,000	<4.4
SP20	1	14.8	134	**452**	13	<0.5	724	<2,000	<4.4
SP21	1	**69.7**	67	**992**	18	<0.5	382	<2,000	<4.4
SP22	1	18	24	**877**	18	<0.5	113	<2,000	<4.4
Part 201 Direct Contact Criteria		**2,500**	**20,000**	**400**	**40,000**	**2,500**	**170,000**	**41,000,000**	**3,100**
Part 201 Residential Drinking Water Protection Criteria		**30**	**5,800**	**700**	**100**	**4.5**	**2,400**	**26,000**	**74**

Notes:
1. Concentrations reported in milligrams per kilogram (mg/kg) or micrograms per kilogram (ug/kg).
2. MDEQ cleanup criteria taken from integrated table Soil: Residential and Commercial, Part 201 Generic Cleanup Criteria and Screening Levels, dated June 7, 2000.
3. Shaded concentrations exceed Part 201 Residential Drinking Water Protection Criteria and/or Part 201 Direct Contact Criteria.

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APPENDIX J

EQP 4476 – NOTICE REGARDING DISCARDED OR ABANDONED CONTAINERS

FOR DEQ USE ONLY
ITS#_____
Site ID#_____

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL RESPONSE DIVISION

NOTICE REGARDING DISCARDED OR ABANDONED CONTAINERS (FORM EQP4476)

(Under the authority of Part 201, 1994 Act 451, as amended, and the Rules promulgated thereunder)

Use this form to disclose information related to underground storage tanks (UST) and discarded or abandoned containers required in a Baseline Environmental Assessment (BEA) pursuant to the Part 9 Rules. Submission of this form in a BEA also satisfies the notification requirements of Rule 1015(1) of the Part 10 Rules. This form may also be used, NOT in conjunction with a BEA, to satisfy the notification requirements of Rule 1015(1) of the Part 10 Rules.

All persons providing this notice must complete Section I. Section II must be completed by only those persons who are submitting this form NOT in conjunction with a BEA.

SECTION I

1. Name and Address of person subject to Section 7a:
   Lawrence Industries, Inc.
   P.O. Box 141
   Plainwell, Michigan 49080

2. Address/location of property where containers are located:
   423 Walbridge Street
   Kalamazoo, Michigan 49001

   County: Kalamazoo

3. What is your status relative to the property?

	Current	Prospective
Owner	☐	☒
Operator	☐	☐

4. Provide a scaled map or drawing of the property that identifies the property boundaries and surrounding property uses. Depict the approximate location(s) of all known discarded or abandoned containers on the drawing. Refer to the locations when completing the attached table.

5. Provide photographs, if practical, that depict the location and general condition of the containers.

6. Complete the attached table.

7. If this form is being submitted in conjunction with a BEA, skip Section II and go to Signature section.

SECTION II

8. Did you previously submit a BEA to the DEQ for this property? Yes ☐ No ☒ If yes, provide the following information:
   8a. Provide the date the BEA was submitted. _____
   8b. Provide the BEA Disclosure or Petition Number, if available. _____

9. Do you anticipate submitting a BEA for the property? Yes ☒ No ☐

10. Provide the date you became the owner or operator of this property. August 13, 2000

11. When did you first acquire knowledge of the UST(s) or discarded or abandoned container(s)? April 19, 2000

With my signature below, I certify that the information provided herein is true and accurate to the best of my knowledge and belief. I understand that intentionally submitting false information to the DEQ is a felony and may result in fines of up to $25,000 for each violation.

Ruth Murphy — 8-2-00
Signature of owner or operator or person legally authorized by owner or operator — Date

RUTH MURPHY — PRESIDENT
Name (typed or printed) — Title (typed or printed)

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL RESPONSE DIVISION

NOTICE REGARDING UNDERGROUND STORAGE TANKS AND DISCARDED OR ABANDONED CONTAINERS

A LOCATION	B CONTAINER SIZE AND TYPE	UMBER OF CONTAINERS	D VOLUME OF HAZARDOUS SUBSTANCE(S)	E CONTENTS	F CONDITION OF CONTAINER	G PHOTOS PROVIDED
Central portion of building	55-gallon, steel	Four	220 gallons	Unknown	Good	Phase I ESA, Appendix B
East-central portion of building	1-gallon, plastic	Twenty-four	Less than 24 gallons	Miscellaneous engine fluids (i.e., oil, antifreeze)	Good	Phase I ESA, Appendix B
South-central portion of property	55-gallon, steel	One	55 gallons	Unknown	Good	Phase I ESA, Appendix B
East-central portion of building	1-gallon, plastic	Twelve	Less than 12 gallons	Cleaning solvents	Good	Phase I ESA, Appendix B
Southwest corner of building	250-gallons, steel	One	Empty	Formerly Fuel	Good	Phase I ESA, Appendix B
West side of building	250-gallons, steel	One	Empty	Former contents unknown	Good	Phase I ESA, Appendix B

TABLE 7
EXAMPLE* OF MATRIX SPIKE, MATRIX SPIKE DUPLICATE, AND LABORATORY FORTIFIED BLANK ACCEPTABLE RECOVERY AND PERCENT DIFFERENCE WINDOWS

SPIKED COMPOUND WINDOWS	WATER MS % RECOVERY WINDOWS	WATER PRECISION WINDOWS	WATER LFB % RECOVERY WINDOWS	SOIL MS % RECOVERY WINDOWS	SOIL PRECISION WINDOWS	SOIL LFB % RECOVERY WINDOWS
Acenaphthene	36-117	15	37-116	30-117	17	32-110
4-Chloro-3-methylphenol	43-117	19	46-117	40-126	21	44-113
2-Chlorophenol	39-116	22	43-117	44-119	20	49-112
1,4-Dichlorobenzene	43-118	22	43-116	42-112	35	45-108
2,4-Dinitrotoluene	45-116	18	46-115	34-123	19	37-114
N-nitroso-di-n-propylamine	38-128	20	47-118	38-124	22	48-110
Naphthalene	40-124	17	55-115	46-122	20	51-111
4-Nitrophenol	1-69	53	4-55	21-129	33	34-113
Pentachlorophenol ~~X~~ RL 4/22/99	1-140	24	17-132	1-129	36	15-118
Phenol	2-60	44	9-55	34-134	23	39-126
Pyrene	35-129	18	39-123	37-122	21	36-114
1,2,4-Trichlorobenzene	43-113	21	47-109	42-114	23	46-107

* This Table is provided as an example only. Actual windows are updated periodically and may be different at the time samples are run.

Approved By: [signature] 12/14/98
QA Manager

Approved By: [signature] 12/14/98
Area Manager

TABLE 8

METHOD DETECTION LIMIT STUDY EXAMPLE*

Parameter / Compound	Date Analyzed	Reference Citation	Units	Amount Spiked	Rep. #1	Rep. #2	Rep. #3	Rep. #4	Rep. #5	Rep. #6	Rep. #7	Average Amount Found	Average Percent Recovery	Standard Deviation	Calculated MDL
Pyridine	3/20/98	8270	ug/L	0.100	0.032	0.009	0.017	0.013	0.029	0.026	0.020	0.021	21%	0.009	0.027
Phenol	3/20/98	8270	ug/L	0.100	0.033	0.049	0.044	0.050	0.037	0.027	0.034	0.039	39%	0.009	0.027
Aniline	3/20/98	8270	ug/L	0.100	0.028	0.021	0.012	0.014	0.013	0.021	0.020	0.018	18%	0.006	0.018
Bis(2-Chloroethyl)Ether	3/20/98	8270	ug/L	0.100	0.091	0.080	0.079	0.088	0.091	0.109	0.090	0.090	90%	0.010	0.031
2-Chlorophenol	3/20/98	8270	ug/L	0.100	0.068	0.081	0.083	0.085	0.078	0.078	0.076	0.078	78%	0.006	0.017
1,3-Dichlorobenzene	3/20/98	8270	ug/L	0.100	0.070	0.077	0.078	0.078	0.080	0.076	0.065	0.075	75%	0.005	0.017
1,4-Dichlorobenzene	3/20/98	8270	ug/L	0.100	0.072	0.077	0.076	0.074	0.078	0.073	0.065	0.074	74%	0.004	0.014
Benzyl Alcohol	3/20/98	8270	ug/L	0.100	0.075	0.062	0.078	0.089	0.058	0.089	0.105	0.079	79%	0.016	0.052
1,2-Dichlorobenzene	3/20/98	8270	ug/L	0.100	0.066	0.078	0.078	0.073	0.078	0.074	0.062	0.073	73%	0.006	0.020
2-Methylphenol	3/20/98	8270	ug/L	0.100	0.066	0.084	0.077	0.071	0.057	0.049	0.057	0.066	66%	0.012	0.039
Bis(2-Chloroisopropyl)Ether	3/20/98	8270	ug/L	0.100	0.080	0.094	0.054	0.056	0.092	0.089	0.091	0.079	79%	0.017	0.054
4-Methylphenol	3/20/98	8270	ug/L	0.100	0.062	0.088	0.081	0.068	0.048	0.050	0.061	0.065	65%	0.015	0.047
n-Nitroso-di-n-propylamine	3/20/98	8270	ug/L	0.100	0.106	0.106	0.120	0.102	0.110	0.095	0.119	0.108	108%	0.009	0.028
Hexachloroethane	3/20/98	8270	ug/L	0.100	0.090	0.089	0.100	0.097	0.100	0.095	0.082	0.093	93%	0.007	0.021
Nitrobenzene	3/20/98	8270	ug/L	0.100	0.123	0.126	0.113	0.118	0.138	0.141	0.113	0.125	125%	0.011	0.036

* This spreadsheet is provided as an EXAMPLE of the style spreadsheet used for calculating MDLs.

Approved By: 12/14/98
QA Manager

Approved By: 12/14/98
Area Manager

TABLE 9
Analyst Certification Example*

TARGET	AMT SPK ug/L	#1 AMT FND ug/L	#2 AMT FND ug/L	#3 AMT FND ug/L	#4 AMT FND ug/L	AVG REC ug/L	TABLE 6 RECOVERY RANGE in ug/L	PASS/ FAIL REC	STD DEV	STD DEV LIMIT	STD DEV PASS/ FAIL	OVERALL PASS/FAIL
Acenaphthene	100	85.4	90.1	88.0	88.1	87.9	60.1 -132.3	PASS	1.9	27.6	PASS	PASS
Acenaphthylene	100	88.5	91.6	89.8	90.5	90.1	53.5 -126.0	PASS	1.3	40.2	PASS	PASS
Anthracene	100	95.3	99.2	99.7	96.5	97.7	43.4 -118.0	PASS	2.1	32.0	PASS	PASS
Benzo (a) anthracene	100	94.5	97.6	99.3	97.2	97.2	41.8 -133.0	PASS	2.0	27.6	PASS	PASS
Benzo (b) fluoranthene	100	94.5	94.9	97.3	96.2	95.7	42.0 -140.4	PASS	1.3	38.8	PASS	PASS
Benzo (k) fluoranthene	100	94.5	94.9	97.3	96.2	95.7	25.2 -145.7	PASS	1.3	32.3	PASS	PASS
Benzo (a) pyrene	100	93.4	94.5	96.7	95.8	95.1	31.7 -148.0	PASS	1.4	39.0	PASS	PASS
Benzo (g,h,i) perylene	100	96.0	94.4	97.3	97.2	96.2	0.0 -195.0	PASS	1.4	58.9	PASS	PASS
Butyl benzyl phthalate	100	88.9	95.1	92.0	91.4	91.9	0.0 -139.9	PASS	2.5	23.4	PASS	PASS
bis- (2-chloroethyl) ether	100	78.7	85.1	79.0	81.6	81.1	42.9 -126.0	PASS	3.0	55.0	PASS	PASS
bis- (2-chloroethoxy) methane	100	87.1	93.8	86.1	89.2	89.1	49.2 -164.7	PASS	3.4	34.5	PASS	PASS
bis- (2-chloroisopropyl) ether	100	61.7	88.5	80.5	85.6	79.1	62.8 -138.6	PASS	12.0	46.3	PASS	PASS
bis- (2-ethylhexyl) phthalate	100	91.4	97.9	96.7	94.1	95.0	28.9 -136.8	PASS	2.9	41.1	PASS	PASS
Bromophenyl phenyl ether, 4-	100	94.7	99.9	97.7	99.5	98.0	64.9 -114.4	PASS	2.4	23.0	PASS	PASS
Chloronaphthalene, 2-	100	86.2	92.4	87.2	88.2	88.5	64.5 -113.5	PASS	2.7	13.0	PASS	PASS
Chlorophenyl phenyl ether, 4-	100	87.7	93.1	90.9	93.6	91.3	38.4 -144.7	PASS	2.7	33.4	PASS	PASS
Chrysene	100	96.4	102.2	95.1	97.4	97.8	44.1 -139.9	PASS	3.1	48.3	PASS	PASS

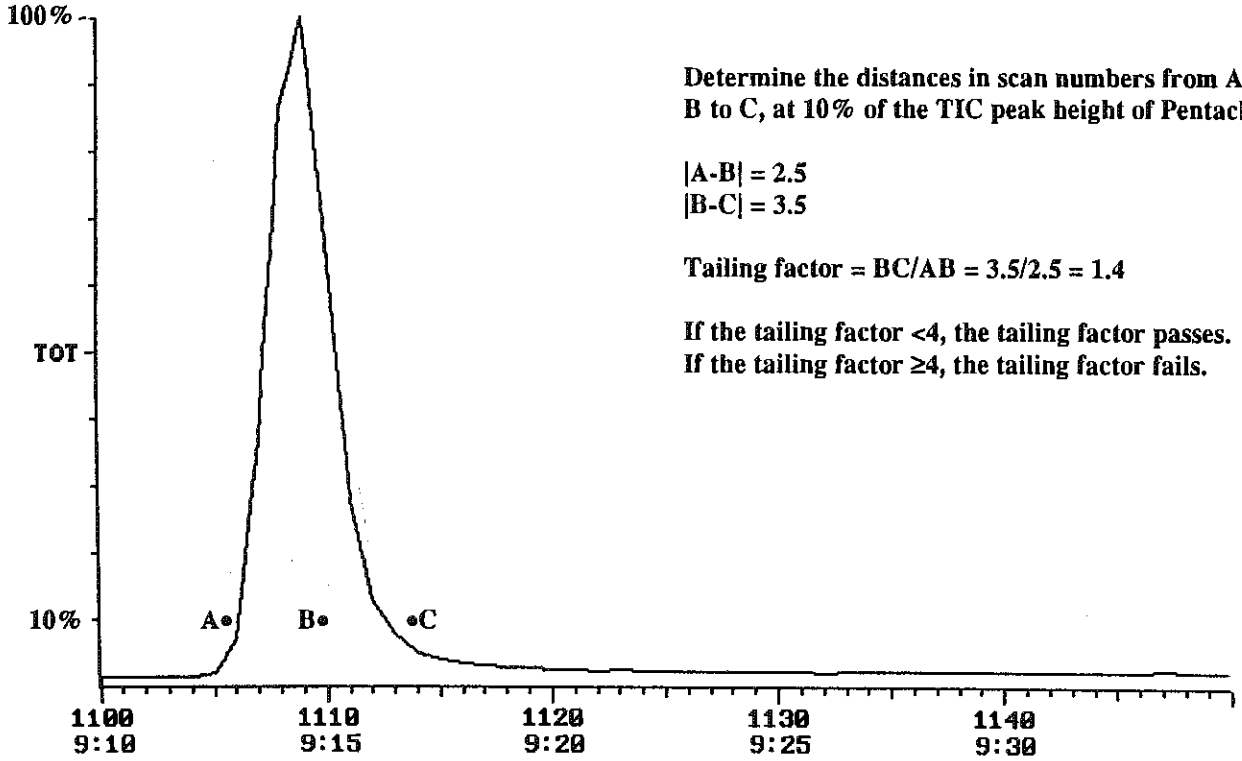
* This spreadsheet is provided as an EXAMPLE of the style spreadsheet used for calculating analyst certifications only.

Approved By: 12/14/98
QA Manager

Approved By: 12/14/98
Area Manager

FIGURE #1
TAILING FACTOR OF PENTACHLOROPHENOL

Chromatogram Plot C:\SATURN\DATA\DFT1210E Date: 12/10/98 21:08:21
Comment: INSTRUMENT 138
Scan: 1150 Seg: 1 Group: 0 Retention: 9:35 RIC: 138853 Masses: 40-356
Plotted: 1100 to 1150 Range: 1 to 2016 100% = 17694537



Determine the distances in scan numbers from A to B, and B to C, at 10% of the TIC peak height of Pentachlorophenol.

|A-B| = 2.5
|B-C| = 3.5

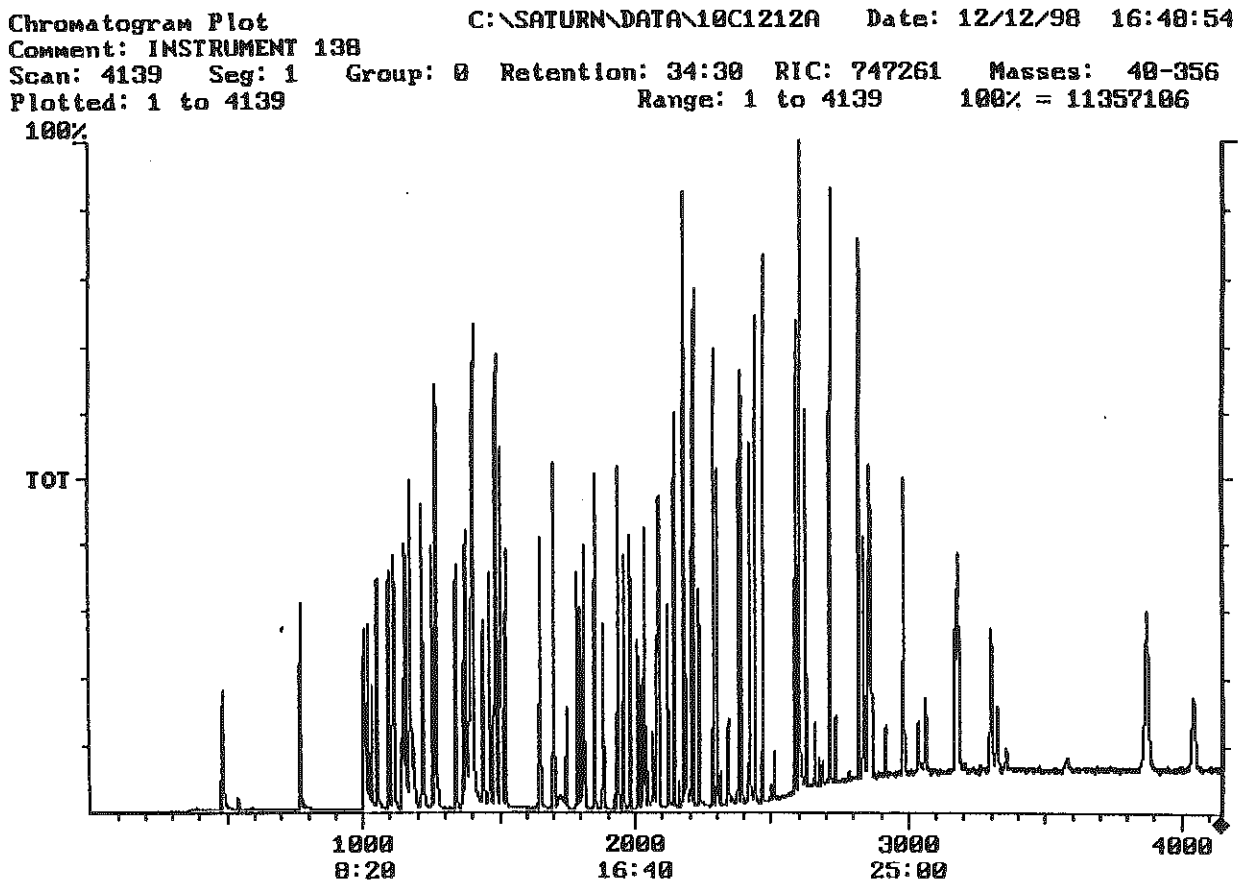
Tailing factor = BC/AB = 3.5/2.5 = 1.4

If the tailing factor <4, the tailing factor passes.
If the tailing factor ≥4, the tailing factor fails.

Approved By: 12/14/98
QA Manager

Approved By: 12/14/98
Area Manager

FIGURE #2
10 ppm BNA 8270C CONTINUING CALIBRATION STANDARD
TOTAL ION CHROMATOGRAM



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QA Manager

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Area Manager

FIGURE #3
COMPLETED ANALYTICAL BENCHSHEET

24-NOV-98 Type: REG RC1 RC2 RMS FRACTION BENCHSHEET SEMI-VOLATILE LAB PAGE 9

Test #: 1308. 1- 50. 2
Parameter: SEMI-VOL'S 8270 TCL LIST
Method: SEMI-VOL/MS/SOL
Ref. cit.: USEPA-8270 Unit: mg/kg dry

Client [redacted]
Project: 34715 [redacted]
Proj Chem: JLR
Submittal: 9 Nov 15-19, 1998 Samples
Sample: 212140 L107C-04

Hold date: 25-DEC-1998 QC: LV5 COC:
Lab due date: 04-DEC-1998
Client due date: 08-DEC-1998 C=1 F=1 H=1 R=1
Received date: 24-NOV-1998

Benchsheet ID: 214616
Analyst: [signature]
Date Run: 12-1-98
Instrument #: 138
Stock Std: SVA1-22.9
Rack#:
Reviewed by: [signature]
QC Batch Number: 936569-123

Initial wt./vol.: 30.2
Final volume: 10 ml
% Solids: 78
Dilution factor: 1
Batch Number:
Batch Owner: 138
Batch Opened Date: 12-1-98
Batch Seq: 1

Parameter	ODL/Spk	Result	Percent	LCL	UCL	Parameter	ODL/Spk	Result	Percent	LCL	UCL
4 ACENAPHTHENE		<0.33				43 4-CHLOROPHENYL PHENYL ETH		<0.33			
5 ACENAPHTHYLENE		<0.33				44 CHRYSENE		<0.33			
12 ANTHRACENE		<0.33				51 DI-N-BUTYL PHTHALATE		<0.33			
16 BENZO (A) ANTHRACENE		<0.33				52 DI-N-OCTYLPHTHALATE		<0.33			
17 BENZO (A) PYRENE		<0.33				53 DIBENZO (A,H) ANTHRACENE		<0.33			
19 BENZO (B) FLUORANTHENE		<0.33				54 DIBENZOFURAN		<0.33			
20 BENZO (G,H,I) PERYLENE		<0.33				56 1,2-DICHLOROBENZENE		<0.33			
21 BENZO (K) FLUORANTHENE		<0.33				57 1,3-DICHLOROBENZENE		<0.33			
26 BIS (2-CHLOROETHYL) ETHER		<0.33				58 1,4-DICHLOROBENZENE		<0.33			
27 BIS (2-CHLOROISOPROPYL)E		<0.33				59 3,3'-DICHLOROBENZIDINE		<2			
28 BIS (2-ETHYL HEXYL) PHTHA		<0.33				60 2,4-DICHLOROPHENOL		<0.33			
29 BIS(2CHLOROETHOXY)METHANE		<0.33				64 DIETHYLPHTHALATE		<0.33			
30 4-BROMOPHENYL PHENYL ETHE		<0.33				66 DIMETHYL PHTHALATE		<0.33			
32 BUTYL BENZYL PHTHALATE		<0.33				70 2,4-DIMETHYLPHENOL		<0.33			
35 CARBAZOLE		<0.33				71 4,6-DINITRO-2METHYLPHENOL		<1.7			
37 4-CHLORO-3-METHYLPHENOL		<0.33				73 2,4-DINITROPHENOL		<1.7			
40 4-CHLOROANILINE		<1.3				74 2,6-DINITROTOLUENE		<0.33			
41 2-CHLORONAPHTHALENE		<0.33				75 2,4-DINITROTOLUENE		<0.33			
42 2-CHLOROPHENOL		<0.33				90 FLUORANTHENE		<0.33			

(LC)

* - Result < corresponding ODL

TRIMATRIX LABORATORIES, INC

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QA Manager

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Area Manager

FIGURE #4
COMPLETED QUALITY CONTROL BENCHSHEET

26-OCT-98 FRACTION BENCHSHEET ** QC ** SEMI-VOLATILE LAB PAGE 9

Test #: 381. 11- 50.02
Parameter: QC SEMI'S 8270-SOIL(FULL)
Method: SEMI-VOL/MS/SOL
Ref. cit.: USEPA-8270 Unit: mg/kg dry

QC Type: MPB

Analyst: [illegible]
Date run: 12-3-98
Instrument #: 133
Stock std #: 5VA1-22-2
Rack #:
Reviewed by: [illegible]
QC Batch Number: 13SCS-102

Initial wt./vol.: 30.0
Final volume: 10 ml
% Solids: –
Dilution factor: 1
Batch Number: 136887
Batch Owner: 133
Batch Opened Date: 12-3-98
Batch Seq: 1

Seq	Parameter	ODL	Orig conc	Result	Spike qty	% rec	LCL	UCL	EXC
4.	ACENAPHTHENE	0.33		✓	XXXXX				
5.	ACENAPHTHYLENE	0.33			XXXXX				
11.	ANILINE	1.7			XXXXX				
12.	ANTHRACENE	0.33			XXXXX				
15.	BENZIDINE	5			XXXXX				
16.	BENZO (A) ANTHRACENE	0.33			XXXXX				
17.	BENZO (A) PYRENE	0.33			XXXXX				
18.	BENZO (B&K) FLUORANTHENE	0.33			XXXXX				
20.	BENZO (G,H,I) PERYLENE	0.33			XXXXX				
22.	BENZOIC ACID	3.3			XXXXX				
24.	BENZYL ALCOHOL	1.3			XXXXX				
26.	BIS (2-CHLOROETHYL) ETHER	0.33			XXXXX				
27.	BIS (2-CHLOROISOPROPYL)E	0.33		✓	XXXXX				
28.	BIS (2-ETHYL HEXYL) PHTHA	0.33		0.320 J	XXXXX				
29.	BIS(2CHLOROETHOXY)METHANE	0.33		✓	XXXXX				
30.	4-BROMOPHENYL PHENYL ETHE	0.33			XXXXX				
32.	BUTYL BENZYL PHTHALATE	0.33			XXXXX				
37.	4-CHLORO-3-METHYLPHENOL	0.33		✓	XXXXX				

* - Result C corresponding ODL

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QA Manager

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Area Manager

FIGURE #5
COMPLETED QUALITY CONTROL BENCHSHEET

26-OCT-98 FRACTION BENCHSHEET ** QC** SEMI-VOLATILE LAB PAGE 8

Test #: 381. 3- 50.02
Parameter: QC, SEMI'S B/N/A 8270-SOIL
Method: SEMI-VOL/MB/SOL
Ref. cit.: USEPA-8270 Unit: mg/kg dry

QC Type: MPB LFB

Analyst: [illegible]
Date run: 16-J-98
Instrument #: 133
Stock std #: SVA 1.66.6
Rack #:
Reviewed by: [illegible]
QC Batch Number: [illegible]

Initial wt./vol.: 10.0 g
Final volume: 10 ml
% Solids:
Dilution Factor: 1
Batch Number:
Batch Owner: 133
Batch Opened Date: 16-J-98
Batch Seq: 1

Seq	Parameter	DDL	MPB Result	SUR (MPB) spike qty	LFB Result	LFB/SUR spike qty	MPB %	LFB %	LFB LCL	LFB UCL	EXC
4.	ACENAPHTHENE	0.33		XXXXX	1.39	3.33		71.8	37	116	
37.	4-CHLORO-3-METHYLPHENOL	0.33		XXXXX	5.10	6.67		76.6	45	118	
42.	2-CHLOROPHENOL	0.33		XXXXX	5.04	↓		75.7	46	112	
58.	1,4-DICHLOROBENZENE	0.33		XXXXX	2.58	3.33		77.5	41	107	
75.	2,4-DINITROTOLUENE	0.33		XXXXX	2.67	↓		80.2	40	117	
124	N-NITROSODI-N-PROPYLAMINE	0.33		XXXXX	2.48	↓		74.5	38	114	
132	NAPHTHALENE	0.33		XXXXX	2.70	↓		81.1	45	114	
141	4-NITROPHENOL	1.7		XXXXX	4.31	6.67		64.7	37	121	
159	PENTACHLOROPHENOL	1.7		XXXXX	3.75	↓		56.3	20	126	
163	PHENOL	0.33		XXXXX	4.69	↓		70.4	42	128	
168	PYRENE	0.33		XXXXX	3.36	3.33		70.9	33	131	
182	1,2,4-TRICHLOROBENZENE	0.33		XXXXX	2.87	↓		86.2	40	109	
1.	2-FLUOROBIPHENYL-SUR	XXXXX			80.6	100		81	30	124	
2.	2-FLUOROPHENOL-SUR	XXXXX			145	200		74	3	129	
3.	D5-NITROBENZENE-SUR	XXXXX			67.4	100		67	15	132	
4.	D6-PHENOL-SUR	XXXXX			168	200		84	12	133	
5.	D-TERPHENYL-SUR	XXXXX			71.7	100		72	26	128	
6.	2,4,6-TRIBROMOPHENOL-SUR	XXXXX			185	200		92	5	132	

* - Result < corresponding DDL

TRIMATRIX LABORATORIES, INC.

Approved By: [illegible] 12/14/98
QA Manager

Approved By: [illegible] 12/14/98
Area Manager

FIGURE #6
COMPLETED QUALITY CONTROL BENCHSHEET

31-AUG-98 FRACTION BENCHSHEET ** QC ** SEMI-VOLATILE LAB PAGE 14

Test #: 381. 3- 50.02
Parameter: QC SEMI'S B/N/A 8270-SOIL
Method: SEMI-VOL/MS/SOL
Ref. cit.: USEPA-8270 Unit: mg/kg dry

Sample Number: 212141 QC
QC Type: SPK; MSD Range 1; MSD Range 2
Range 1: SPK1 (= 10 x ODL
Range 2: SPK1) 10 x ODL

Analyst: [illegible]
Date run: 12-1-98
Instrument #: 111
Stock std #: 5ug/ml-L
Rack #:
Reviewed by: [illegible]
QC Batch Number: 981569-102

Initial wt./vol.: 30.5 g
Final volume: 10 ml
% Solids: 81
Dilution factor:
Batch Number: L
Batch Owner: 111
Batch Opened Date: 12-1-98
Batch Seq: 1

Seq	Parameter	ODL	Orig Conc.	SPK1 Result	Spike qty	SPK2 Result	SPK1 %	SPK2 %	SPK LCL	SPK UCL	MSD % Dif	MSD 1 UCL	MSD 2 UCL	EXC
4	ACENAPHTHENE	0.33	*	2.34	3.33	2.16	70.3	64.9	33	132	8.0	16	17	
17	4-CHLORO-3-METHYLPHENOL	0.33		5.33	6.67	5.02	80.0	75.4	43	130	6.0	21	18	
40	2-CHLOROPHENOL	0.33		5.30		5.01	79.6	75.2	32	119	5.6	17	20	
50	1,4-DICHLOROBENZENE	0.33		2.60	3.33	2.77	78.1	83.2	37	113	6.3	24	35	
72	2,4-DINITROTOLUENE	0.33		2.66		2.49	79.9	74.8	25	134	6.6	17	19	
124	N-NITROSODI-N-PROPYLAMINE	0.33		2.52		2.58	75.7	77.5	37	121	2.4	22	19	
152	NAPHTHALENE	0.33		2.66		2.65	79.9	79.6	48	120	<1	20	19	
141	4-NITROPHENOL	1.7		4.98	6.67	4.39	74.8	71.9	33	126	3.9	17	33	
159	PENTACHLOROPHENOL	1.7		3.52		3.52	52.8	52.8	4	129	0	24	33	
163	PHENOL	0.33	*	5.06		4.86	76.0	73.0	35	137	4.0	18	23	
153	PYRENE	0.33	0.15 J	2.70	3.33	2.50	76.6	70.6	43	138	7.7	16	21	
162	1,2,4-TRICHLOROBENZENE	0.33	*	3.03		2.80	91.0	84.1	37	118	7.9	23	12	
1	2-FLUORODIPHENYL-SUR	XXXXX	XXXXX	83.0	100	83.8	83	84	30	124	XXXXX			
2	2 FLUOROPHENOL-SUR	XXXXX	XXXXX	143	200	139	72	70	3	129	XXXXX			
3	D5-NITROBENZENE-SUR	XXXXX	XXXXX	58.9	100	59.8	59	60	15	132	XXXXX			
4	D6-PHENOL-SUR	XXXXX	XXXXX	178	200	166	89	83	12	139	XXXXX			
5	D-TERPHENYL-SUR	XXXXX	XXXXX	73.0	100	71.0	73	71	23	128	XXXXX			
6	2,4,6-TRIBROMOPHENOL-SUR	XXXXX	XXXXX	202	200	185	101	92	5	152	XXXXX			

* - Result < corresponding ODL

TRIMATRIX LABORATORIES, INC.

Approved By: [illegible] 12/14/98
QA Manager

Approved By: [illegible] 12/14/98
Area Manager

FIGURE #7
STANDARD LOGBOOK

ORGANICS STOCK STANDARDS

STOCK STD #: SVOL.21.0
STOCK STD NAME: 8270 BNA STD.
PREPARED BY/DATE: JMH 10/9/98
MATH CHECKED BY:
SOLVENT USED: MeCl2
LOT NUMBER:
FINAL VOLUME: 10ml
EXPIRATION DATE: 10/9/99
CHECKED TO STD #:
CHECKED BY/DATE:
USING INSTRUMENT #:
STORAGE AREA: 270 #23

ANALYTE, STD # or PURCHASED STD	VENDOR (IF BOUGHT)/ NAME (IF MADE)	LOT #	% PURITY	EXPIRATION DATE	DENSITY or STD CONC	WT /VOL USED	CONCENTRATION
Phenols	Absolute	032798		032801	2000mg/L	1ml	200ppm
PAH mix		010498		010901			
Benzidines		052998		053001			
Base/Neutral Mix #1		082897		082900			
Toxic Substances #1		042098		042101			
Base/Neutrals #2		072198		072201			
Toxic Substances #2	Absolute	060598		060903	2000mg/L	1ml	200ppm
B/N SVOC MS127	In house			060299	4000mg/L	500ml	200ppm
Acid SVOC MS128				060299	4000mg/L	500ml	200ppm
Pyridine SVOL.200				100999	2132mg/L	1ml	213ppm

STDPRPOD.XLS
TriMatrix Laboratories, Inc.
page #: 21A of 50

Approved By: 12/14/98
QA Manager

Approved By: 12/14/98
Area Manager

FIGURE #8
ANALYTICAL RUN LOGBOOK

Instrument ID: Saturn GC/MS Instrument #133 Date: 12/11/98 Taped: _____ Disk ID: _____ Analyst: [illegible]

Instrument Settings	Acquisition Information	Temperature Program					Miscellaneous
Multiplier: 2775	Scan Range: 40-450 amu	GC	Temp. (C)	Rate (C/min)	Time (min)	Total (min)	New Column Date: 12/11/98
AGC 10000	Seconds/Scan: 0.500	Step #1	45	0.0	1.5	1.5	New Septa: Yes / No
Interface Temp: 250C	Filament Delay: 3.5 min.	Step #2	200	10	15.5	17.0	Working Std. #: SUC1,22,2
Source Temp: 190C	Threshold: 2 counts	Step #3	315	25	4.6	21.6	Int Std. #: SUC1,10,0
Head Pressure: 8 psi	Mass Defect: 0	Step #4	315	0.0	16.4	38	Tune Std. #: LOL 389
	Background Mass: 35 amu	Inject.	45	0.0	0.5	0.5	Inj. Vol.: 1 uL
	Curve Date: 10/9/98	Inject.	300	100	2.55	3.5	DFTPP Area 198: 715361
		Inject.	300	0.0	15	15.05	DDT Breakdown: none

Sample / File ID	Client	Inj Time	Dil	Matrix	Fraction	Method	Notes
DFT1211L		16:26	Str		DFTPP	8270	DFTPP passes
10C1211A		16:53	Str		BNA	8270	Cont. cal std., CLLA, SPLLA pass
10A91211		17:53	Str		APPK	8270	
10P1211A		18:46	Str		APPKPost	8270	
MPB107W	ETB	19:37	Str	Wtr	APPKAID PST	8270	BLK 12/11/98 ETB
LFB107W		20:29	Str	Wtr	BNA	8270	
212644		21:12			APPKAID PST	8270	
212645		22:02					
212646		22:58					
212647		23:37					
212646MS		00:40			BNA	8270	

Approved By: [signature] 12/14/98
QA Manager

Approved By: [signature] 12/14/98
Area Manager

TriMatrix Laboratories, Inc.

STANDARD OPERATING PROCEDURE

GAS CHROMATOGRAPHY ANALYSES OF POLYCHLORINATED BIPHENYLS (PCBs)

METHOD 8082

UNCONTROLLED DOCUMENT

APPROVALS:

Organic Manager: _____ Date: 4/1/99
Jeff P. Glaser

QA Manager: _____ Date: 4/1/99
Rick D. Wilburn

Laboratory Manager: _____ Date: 4/1/99
Douglas E. Kriscunas

Procedure Number: GR-03-128
Revision Number: 1.0

Date Initiated: 4/2/98
Effective Date: 4/1/99

Date Revised: 4/1/99
Pages Revised: all

By: Jeff P. Glaser

Total Number of Pages: 29

1.0 SCOPE AND APPLICATION

1.1 This method is used to determine the concentrations of polychlorinated biphenyls (PCBs) as Aroclors in extracts from both solid and aqueous matrices.

1.2 A second analytical technique (different column or GC/MS) must be utilized to confirm any positive results.

1.3 The minimum reporting limits (RL) are 0.10 ug/L for waters and wastewaters, 0.01 mg/kg for soils, and 1.0 mg/kg for waste samples. Reporting limits are very matrix dependent, and the minimum RL may not be achievable on all samples. See Attachment 1 for a reporting limit listing by analyte.

1.4 The linear range of this method begins at the above reporting limits and increases 32 fold. These ranges may be extended by dilution.

1.5 This method is restricted for use by, or under the supervision of, analysts experienced in gas chromatographic analyses, and in the interpretation of chromatograms.

2.0 PRINCIPLE METHOD REFERENCES

2.1 *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition*, Final Update III, Revision 0, December, 1996, Method 8082, "Polychlorinated Biphenyls (PCBs) by Gas Chromatography".

3.0 SUMMARY OF PROCEDURE

3.1 Water samples will be extracted following Method 3510, and soils following Method 3550. All samples are cleaned up with acid and copper following Methods 3665A and 3660B prior to analysis. Extremely dirty samples are also cleaned up with Florisil following Method 3620B. Extracted samples are injected into a GC system equipped with an electron capture detector (ECD). Concentration of samples is determined by comparing responses of samples to the responses of the standards in a 6 point calibration curve or single point calibration standard. 1 or 2 uL of extract is injected for all extracts.

4.0 PARAMETER OR COMPOUND LIST

4.1 Analytes available for analysis by Method 8082 are listed below in Table 1. Other analytes may be run by this method provided they have been developed following this SOP.

TABLE 1

Compound	CAS Registry No.
Aroclor 1016	12674-11-2
Aroclor 1221	11104-28-2
Aroclor 1232	11141-16-5
Aroclor 1242	53469-21-9
Aroclor 1248	12672-29-6
Aroclor 1254	11097-69-1
Aroclor 1260	11096-82-5

5.0 REFERENCED SOPs

5.1 TriMatrix Laboratories SOP number GR-03-101, *Semi-Volatile Laboratory Gas Chromatography Corrective Actions*, most current version.

5.2 TriMatrix Laboratories SOP number GR-09-105, *Waste Dilution Preparation Method for PCBs and Pesticides*, most current version.

5.3 TriMatrix Laboratories SOP number GR-09-107, *Extraction of Organochlorine Pesticides and PCBs in Water*, most current version.

5.4 TriMatrix Laboratories SOP number GR-09-108, *Extraction of PCBs/Pesticides in Soil, Sludge, and Wastes*, most current version.

5.5 TriMatrix Laboratories SOP number GR-09-109, *Sulfur Cleanup*, most current version.

5.6 TriMatrix Laboratories SOP number GR-09-110, *Sulfuric Acid Cleanup*, most current version.

5.7 TriMatrix Laboratories SOP number GR-09-111, *Florisil Column Cleanup*, most current version.

6.0 INTERFERENCES AND CORRECTIVE PROCEDURES

6.1 Samples often contain materials that interfere with the response of an electron capture detector. Many samples also contain substances which cause chromatographic interferences when analyzed on capillary columns. To reduce the occurrence of interferences, all samples are cleaned up with acid and copper following Methods 3665A and 3660B prior to analysis. Extremely dirty samples are also cleaned up with Florisil following Method 3620B.

6.2 Solvents, when concentrated, can introduce levels of oxygenates and sulfur compounds which will provide a response on an ECD. These interferences may co-elute with target analytes. It is imperative that the cleanest solvents, reagents and glassware be used at all times. Solvents should be periodically concentrated and analyzed to monitor for contamination.

7.0 SAFETY PRECAUTIONS

7.1 The analyst must comply with all standard operating procedures for health and safety as outlined in the TriMatrix Laboratory Safety Manual.

7.2 PCBs can cause irritation upon contact and are cancer suspect agents. Take appropriate precautions when handling. Wear protective clothing and gloves. Open and dispense only under a fume hood.

7.3 Solvents used in the extraction and concentration of samples are highly toxic. Avoid contact with skin, vapor inhalation, or solvent ingestion. Open solvent containers under a fume hood. Use protective clothing and gloves.

7.4 All analyzed sample extracts and expired standards must be disposed of correctly.

7.5 If a PCB or solvent spill occurs, contact the safety person on your shift, begin cleaning up the spill as outlined in the Safety Manual, and notify the area manager. Methylene chloride and most of the target analytes, surrogates, and spikes, are highly toxic and cancer suspects. Wear appropriate protective clothing and gloves to avoid contact. Prepare standards and samples under a fume hood.

8.0 SAMPLE SIZE, COLLECTION, PRESERVATION AND HANDLING PROCEDURES

8.1 Waters, wastewaters and leachate samples are collected in unpreserved 1000 mL amber glass containers with Teflon septum lined lids, and stored at 4°C until time of analysis. At least two 1000 mL aliquots of aqueous sample should be collected in order to meet reporting limit requirements and allow for reanalysis when necessary. If matrix spikes are needed, collect two additional 1000 mL aliquots of sample.

8.2 Wastes, sludges, and soils are collected in inert bottles with no preservative added. At least 30 g of solid sample are needed to achieve the reporting limits specified in this SOP. Additional sample should be obtained for possible reanalysis, matrix spikes, and percent solids determination.

8.3 Extraction of waters must be performed within 7 days, and soils within 14 days of sample collection. Analysis of the extracts must be completed within 40 days of sample extraction.

9.0 INSTRUMENTATION, APPARATUS, AND MATERIALS

9.1 Gas chromatograph equipped with at least one Ni63 electron capture detector and flow valves capable of accurately delivering very low flow rates (i.e. 10 mL/min).

9.1.1 Typical Instrument Set-up:

- Injector Temperature: 250°C isothermal
- Detector Temperature: 250°C

- Oven Temperature: Initial temperature at 120°C (no hold), ramp to 200°C at 9°C/min (no hold), ramp to 320°C at 12°C/min, hold 4 minutes.

9.2 PE Nelson Turbochrom software and hardware operated on a personal computer workstation possessing the ability to archive all acquired data.

9.3 Columns:

9.3.1 Column A: DB-35ms or equivalent (RTX CLP2), 30m length, 0.53mm ID, 0.5um film thickness.

9.3.2 Column B: DB-5 or equivalent, 30m length, 0.53mm ID, 0.50um film thickness.

9.4 Various size microsyringes

9.5 1.5 mL autosampler vials with Teflon faced silicone septa

9.6 100 mL amber bottles with Teflon lined caps

9.7 Volumetric flasks

10.0 ROUTINE PREVENTIVE MAINTENANCE

10.1 Septum Replacement

10.1.1 Direct injection gas chromatographs are equipped with silicone septa (Supelco Thermogreen or equivalent) which eventually core and leak. These must be replaced to avoid contaminating the inlet sleeve with rubber particles and to eliminate column bleed. Replace septa after approximately 100 injections.

10.2 Inlet Sleeve Cleaning and/or Replacement

10.2.1 Inlet sleeves can become a source of contamination and flow restriction as they accumulate left over sample debris and septum particles. Sleeves used for PCB analysis must be replaced periodically to prevent loss of peak resolution.

10.3 Column Clipping/Replacement

10.3.1 In addition to sleeve replacement, when conditions merit about 6" should be clipped off the front of the guard column. When the guard column becomes too short to clip, it must be replaced. If resolution is lost after the guard column is replaced the analytical column must be clipped or replaced.

10.4 ECD Wipe Test and Ni63 Foil Cleaning/Replacement

10.4.1 Electron capture detectors may begin to bleed radioactive particles as they age. Wipe tests should be conducted every two years to ensure that bleed is within accepted levels. In addition, certain sample components and constant use at high temperatures will deplete the Ni63 foil inside the detector. This raises the baseline noise and decreases the linear range of the detector. When this happens, the detector must be sent in for cleaning or re-foiling. NEVER at any time may an unlicensed person tamper with the Ni63 foil or any internal ECD parts. This must be done by a licensed professional taking adequate precautions against radiation.

11.0 CHEMICALS AND REAGENTS

11.1 Analytes

11.1.1 PCB standards are purchased as pre-made dilutions packaged in ampules from Ultra-Scientific, Restek, or other certified manufacturers.

11.2 Hexane, Fisher HPLC Grade or equivalent

11.3 Helium carrier gas, ultra high purity

11.4 Nitrogen makeup gas, filtered for oxygen, hydrocarbons and moisture

12.0 STANDARDS PREPARATION

12.1 Stock Standards

12.1.1 Stock standards are purchased as certified solutions, which are diluted to concentration in hexane. Stock standards are stored in 100 mL amber screw-cap bottles at 4°C protected from light. Each PCB standard is prepared separately, except for 1221/1254 and 1016/1260, which are combined due to their dissimilar elution times.

12.1.2 All stock standards must be replaced after one year, or sooner if comparison with check standards indicates a problem.

12.2 Intermediate Standards

12.2.1 Intermediate standards are generally made by diluting the stock standard 1:100 in hexane.

12.3 Working Standards

12.3.1 Working standards are made by diluting the intermediate standards to concentration. The Aroclor 1016/1260 mix is diluted to the following six concentrations used in the initial calibration curve: 0.05, 0.10, 0.20, 0.40, 0.80, and 1.6 mg/L. All other Aroclor single point standards are made up at 0.50 mg/L.

12.4 The stock standards must be labeled with the following information:

- initials of preparer
- date of preparation
- concentration
- name of parameter
- standard log number as it appears in the standard logbook
- expiration date (no later than 6 months after preparation for intermediate and working standards and 1 year after preparation for stock standards)
- solvent used

12.5 All standard preparations must be recorded in the appropriate bound standard logbook, and identified with a unique ID number. See Attachment 2 for an example of the standard preparation logbook.

13.0 SAMPLE PREPARATION

13.1 Water samples are extracted following Method 3510, and soils following Method 3550. All samples are cleaned up at a minimum with acid and copper prior to analysis. For detailed extraction and clean-up procedures, please refer to the appropriate Extraction Lab SOPs referenced in section 5.0.

14.0 CALIBRATION PROCEDURES

14.1 Initial Calibration

14.1.1 Following a clean hexane daily blank, a six point curve is run for Aroclors 1016/1260 at 0.05, 0.10, 0.20, 0.40, 0.80 and 1.6 mg/L. A single point calibration is used for all other Aroclors by analyzing a single standard at 0.50 mg/L.

14.1.2 Calibration Factors (CF) for each PCB are calculated using the following formula:

$$CF = \frac{\text{Sum of the Significant Peak Heights}}{\text{Concentration of the Aroclor in mg/L}}$$

14.1.3 The Percent Relative Standard Deviation (%RSD) is now calculated for Aroclors 1016/1260 using the following formula:

$$\%RSD = \frac{\text{Standard Deviation}}{\text{Average CF}} \times 100$$

The %RSD must be ≤ 20 percent to be acceptable.

14.1.4 If the %RSD is >20 percent perform instrument maintenance and run the curve again.

14.1.5 Sample analyses may not begin without an acceptable curve for Aroclors 1016/1260.

14.1.6 For an example calibration curve for Aroclor 1260, see Attachment 3.

14.2 Initial Calibration Verification

14.2.1 On non-curve days, one mid point Initial Calibration Verification (ICV) of the 0.40 mg/L Aroclor 1016/1260 standard is analyzed. The concentration is quantitated using the following formula:

$$\text{Concentration in ng/uL} = \frac{\text{Height Counts of the Analyte}}{\text{Average CF}}$$

14.2.2 The percent difference between the quantitated value of the analyte in the standard and the true value of the analyte in the standard must be ≤ ±15 percent for the ICV to be acceptable. Sample analyses cannot begin until this criteria is met. Calculate the percent difference using the following equation:

$$\text{Percent Difference} = \frac{R1 - R2}{R1} \times 100$$

where: R1 = True Value
R2 = Quantitated Value

14.2.3 Initial calibration verification analysis is not required on the remaining Aroclors. However, if an Aroclor other than 1016/1260 is identified in a sample, the sample must be re-analyzed with the identified standard being included as an additional ICV. Because of this the analyst may prefer to routinely analyze all of the Aroclors as ICVs and CCVs. Quantitate the standard using a sum of the height of the chosen peaks vs. the same peaks from the single point standards analyzed with the 1016/1260 curve. The same ≤ ±15 recovery percent difference requirement applies.

15.0 ANALYTICAL PROCEDURE

15.1 The analysis sequence begins with a hexane (BLK) followed by the 0.40 mg/L Aroclor 1016/1260 ICV. Additional Aroclor ICVs at 0.50 mg/L are analyzed at this time, if necessary based on confirmation analysis, or analyst preference (section 14.2.3).

15.2 After every 10 sample injections, the 0.40 mg/L 1016/1260 is also analyzed as a Continuing Calibration Verification (CCV) standard to verify the instrument is still in control. The two Aroclors in the CCV must have a ± 15 percent difference from the curve. If either Aroclor is outside of the 15 percent criteria on the low side (i.e. less than the true value), all samples run before and after the failing CCV must be re-injected for that analyte on a system that is in control. If either Aroclor is outside of the 15 percent criteria on the high side (i.e. greater than the true value), only those samples that have positive results must be re-injected on a system that is in control.

15.3 Identify the parameters in the sample by comparing the retention times of the peaks in the sample chromatogram with those of the peaks in the standard chromatograms. For a positive identification, the retention time of the analyte in the sample must also elute within the calculated retention time window on both columns. However, for multi-response analytes like PCBs, the analyst should rely primarily on pattern recognition

15.4 Retention Time Windows

15.4.1 Make three injections of each Aroclor over a 72 hour period. Choose one major peak and calculate the standard deviation of the retention time from the three injections. The retention time window is calculated by multiplying the standard deviation by 3. For a positive identification, the analyte must elute within the absolute retention time of the ICV ± the retention time window. All samples, quality control samples, and standards run after the ICV must have the analyte pass the retention time window criteria. Any samples run after a standard that fails the retention time window criteria must be re-analyzed.

15.4.2 Retention time windows must be re-run whenever a new column is installed.

15.5 Example chromatograms showing Aroclor patterns on the DB-35ms column are provided in Attachments 4 and 5.

15.6 All positive results must be confirmed either on a confirmation column, or if the concentration of the analyte permits, by mass spectrometry. The confirmation run must follow all SOP criteria.

15.7 If the response for a peak exceeds the working range of the system, prepare a dilution of the sample and re-analyze. All dilutions should be made at a strength sufficient to keep the analyte response in the upper half of the curve. Do not over dilute the sample.

16.0 CALCULATIONS AND DATA HANDLING

16.1 PCB quantitation is performed by comparison with the corresponding Aroclor standard identified in the sample.

16.2 When quantitating PCBs, the sample response is compared to the response of 5 major peaks in the appropriate Aroclor standard. The concentration of Aroclor 1016 or 1260 is calculated using the average CF from the sum of the same 5 peak heights in the standard curve. The remaining Aroclors are quantitated using the single point standard analyzed the day the curve was analyzed.

16.3 If there are interfering peaks or mixtures of Aroclors present in the sample, some of the peaks may need to be omitted. However, a minimum of three peaks must be used for quantitation. Any peaks dropped from the sample must also be dropped in the standards. A new average or initial concentration factor must then be calculated to use for quantitation. The ICV and CCV standards must also be re-quantitated using the new peaks, and the percent difference re-verified.

16.4 The sample concentration in the extract is quantitated using the equation below:

$$ng/uL = \frac{\text{Area of peak(s)}}{CF}$$

16.5 Next, calculate the amount in the sample itself by multiplying the ng/uL in the extract by the result of the following equation:

Water Samples:

$$\text{Sample Concentration (in ug/L)} = \frac{(ng/uL)(Ve)(DF)}{(Vw)}$$

Wipes:

$$\text{Wipe Concentration (in total ug)} = (ng/uL)(Ve)(DF)$$

Soil Samples:

$$\text{Sample Concentration (in mg/kg)} = \frac{(ng/uL)(Ve)(DF)}{(Vs)(PS)} \times 1000$$

where:

Ve = total volume of extract (uL)
DF = post extraction dilution factor
Vw = initial volume of water sample in mL
Vs = initial volume of soil sample, in g
PS = soil percent solids in decimal form (i.e. 0.98, not 98%)

17.0 DATA REPORTING AND DELIVERABLES

17.1 The analyst running a set of samples is responsible not only for the quality of the data results themselves, but also for filling out the correct documentation. It is important to document the analyses by correctly filling out, turning in, and filing the correct paperwork.

17.2 LIMS Reporting

17.2.1 When the analyst has finished running a set of samples the data must be turned into LIMS. The benchsheets must be filled in completely to ensure that the results are reported correctly and the data is associated with the right batch QC. It is important that the quality control batch number from the extraction summary, and the analytical batch information from the analytical shift, are both filled in correctly. The dilution factor must also be added so reporting limits are elevated accordingly. All positive results should be entered by crossing out the default reporting limit and recording the final result on the right hand side of the printed default reporting limit. This is the result that has already been through all necessary calculations, including multiplication by any dilution factor. If a dilution was made to the sample and there was a positive result, the new elevated reporting limit should be recorded to

the left of the normal reporting limit. Surrogate results are reported in amounts found in the extract, amount spiked in the extract, and percent recoveries. Attachment 6 provides examples of a sample benchsheet.

17.2.2 When spikes are analyzed, the appropriate quality control benchsheets must also be turned in. In addition to the requirements listed in section 17.2.1, quality control benchsheets need the spiked amounts, percent recoveries, and percent differences reported when applicable. If out of control results are present due to extraction or severe matrix problems, the exclude (EXC) box should be checked to prevent the data from biasing the recovery window statistics. Attachments 7-9 provide examples of quality control benchsheets.

17.2.3 An extracted method preparation blank (MPB) must be turned in for every extraction batch. A daily blank (BLK) must be turned in with every analytical shift. When the MPB is run, the MPB is also the BLK and both sets of benchsheets are turned in. It is important to remember that a Laboratory Fortified Blank (LFB) cannot be turned in without first having turned in the associated MPB.

17.2.4 If internal chain-of-custody is required, it is very important that the COC sheet is filled out correctly and returned to the storage racks.

17.2.5 All LIMS benchsheets (including the COC sheets) are placed in either the red (rush benchsheets), manila (normal benchsheets), or blue (BLK benchsheets), and turned into data entry. The blue folders containing the BLK benchsheets should also have the BLK quantitation reports and chromatograms included.

17.3 Laboratory Required Paperwork

17.3.1 All run, maintenance, CD archival, and standard logbooks must be filled in completely and correctly. Corrections are to be made with a lineout, not a writeover, and blank lines in the run logbook must be Z'd out. See Attachment 10 for a run logbook example.

17.3.2 All ICV and CCV standard runs must be archived in their correct storage boxes.

17.3.3 All analysis documentation (except for sample and quality control benchsheets), and the raw data (except for blanks, ICVs, and CCVs) should be placed in the correct folder and turned into the Semi-Volatile Laboratory technician who will record the date and time, they were turned in. Sample and quality control benchsheets that were turned in for entry, are returned to the folder after data review and approval are complete.

17.4 Rounding and Significant Figures

17.4.1 Rounding is performed on the final quantitated result only. All non-quality control results are rounded to 2 significant figures, quality control results are rounded to 3 significant figures, and percent recoveries are reported as whole numbers up to 3 significant figures.

18.0 QUALITY ASSURANCE

Approved By: RF 4/1/99 QA Manager Approved By: JO 4/1/99 Area Manager

18.1 In addition to previously covered sections, the following items must be included:

18.2 Blank

18.2.1 Before a curve, ICV, or any samples have been run, a blank must be analyzed to demonstrate the analytical system is free from interferences and contamination. This blank will be either a Method Preparation Blank (MPB) or hexane (BLK). The MPB is the preparation blank prepared with a set of samples. The MPB will be run when available, and the BLK will be run when the MPB has already been analyzed. See Section 17.2.3 for blank reporting requirements. At a minimum a blank is run at the beginning of every analytical shift. A blank will be run more frequently if contamination is suspected from a high level sample or if laboratory contamination is in question. MPBs should be carried through the same stages of preparation that the samples were, including any cleanups.

18.3 Surrogates

18.3.1 All samples must be spiked with the surrogate decachlorobiphenyl. Until thirty samples of a given matrix have been analyzed, the recovery windows used will be 50-150. Once thirty samples of a given matrix have been analyzed, in house recovery windows will be generated (Section 18.3.2) and used. Attachment 11 provides examples of in house generated surrogate recovery windows. These are examples only. At a minimum surrogate recovery limits will be updated annually on a matrix by matrix basis.

18.3.2 Calculate the upper and lower control limit for each surrogate standard. This should be done as follows:

$$\text{Upper Control Limit (UCL)} = p + 3s$$
$$\text{Lower Control Limit (LCL)} = p - 3s$$

where:

p = average percent recovery
s = standard deviation of the percent recovery

18.3.3 If recovery is not within limits, the Corrective Action SOP (TriMatrix SOP number GR-03-101) outlines if, or how, the data is to be qualified. If many samples are out of control for no apparent reason, the gas chromatograph needs to be inspected for malfunctions and corrections must be made, as appropriate. When corrections are made, re-analysis of samples analyzed while the system was malfunctioning are necessary.

18.3.4 If a CCV shows a surrogate recovery outside the 85-115 window, and surrogate recovery in all the samples are in control, no sample requires re-analysis, and the instrument does not require re-calibration. However, if a CCV shows a high surrogate recovery, and any of the samples have a surrogate recovery out of control high, the out of control samples must be re-run with the surrogate in calibration. Similarly, if a CCV shows a low recovery and a surrogate in a

sample is below the lower control limit, the sample must be re-run once the instrument is back in control.

18.4 Matrix and Method Spikes

18.4.1 To assess accuracy, the laboratory must extract a matrix spike and a matrix spike duplicate, at a minimum once for every 20 samples extracted per matrix. If only one to ten samples are extracted in a month, at least one matrix spike, one matrix spike duplicate must be extracted. A laboratory fortified blank is extracted every shift samples are extracted, regardless of the number of samples.

18.4.2 Until 15-20 matrix spikes, matrix spike duplicates, and laboratory fortified blanks have been analyzed, the recoveries of the matrix spike, matrix spike duplicate, and laboratory fortified blank will be validated against default windows of 50-150, and a precision window of 40%.

18.4.3 Calculate the average percent recovery (R) and the standard deviation of the percent recovery (SD) per matrix. Express the accuracy assessment as a percent recovery interval from R - 3SD to R + 3SD. If, for example, R = 90 percent and SD = 10 percent, the accuracy interval is expressed as 60-120. Another set of limits will be calculated the same way for the laboratory fortified blank windows. Precision windows will be calculated by taking the average of the percent differences ±3 standard deviations. Windows will be updated at least annually.

18.4.4 Calculate the percent recovery as follows:

$$\text{Percent Recovery} = \frac{(\text{Aspk} - \text{Asmp})}{\text{SPK}} \times 100$$

where:

Aspk = actual concentration found in the spiked sample, in ug/L
Asmp = amount found in non-spiked sample, in ug/L
SPK = amount spiked, in ug/L [(concentration of spike standard in ug/mL x mL spiked) / initial sample volume]

18.4.5 Calculate the relative percent difference as follows:

$$\text{Percent Relative Standard Deviation (\%RSD)} = \frac{(\text{SPK1} - \text{SPK2})}{\left[\frac{(\text{SPK1} + \text{SPK2})}{2}\right]} \times 100$$

where:

SPK1 = Matrix Spike
SPK2 = Matrix Spike Duplicate

18.4.6 If recovery or precision is not within limits, the Corrective Action SOP will determine if, or how, the data is to be qualified.

18.4.7 If the laboratory fortified blank (LFB) is out of control, the problem must be immediately identified and corrected before any further samples for that analyte can be run. The purpose of the LFB is to verify that out-of-control compounds in the MS or MSD are the result of matrix interferences rather than extraction or system errors. Failure of any part of an LFB will require some sort of corrective action, depending on the failed parameter. Every effort will be made to determine the reason for the failure (mis-spiked, mis-extracted, etc.) and appropriate actions will be taken. The Corrective Action SOP details how to proceed when a LFB fails.

18.4.8 Spiking compounds and precision and accuracy windows are provided in Attachment 12. The Aroclor used for spiking is changed periodically throughout the year.

18.5 Method Detection Limit Studies

18.5.1 A Method Detection Limit (MDL) study must be performed for each Aroclor. MDL studies must be performed on all gas chromatographs involved in the analysis of samples by this method, on both the primary and confirmation columns. Results obtained for analytes for which an MDL has not been calculated must be considered estimated. The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the value is above zero. Reporting limits (RLs) are derived from the MDL study. Provided that the MDL study passed, RLs are equal to the concentration spiked in the MDL study. The RL actually achieved in any given analysis will vary depending on instrument sensitivity, matrix effects, and dilutions.

18.5.2 The procedure followed for a MDL study is based on the method given in the Federal Register, Part 136, Appendix B, latest revision. All Method 8082 quality control procedures governing the analyses must be followed. Sulfur, acid, and Florisil cleanups must be performed on each MDL extract.

18.5.3 For each Aroclor, seven replicate analyses are performed using reagent water or clean sand spiked at the estimated RL concentration.

18.5.4 If a blank measurement is required to calculate the measured level of an analyte, seven separate blanks should be run, one after each of the seven MDL samples. The average blank measurement is subtracted from all seven MDL runs.

18.5.5 The standard deviation of the amount found (blank-subtracted if necessary) for each analyte of the seven runs is calculated and multiplied by 3.143. The resulting number is the calculated MDL.

18.5.6 If the amount spiked is ≥ the calculated MDL and ≤ 5 times the calculated MDL, and there are no zero percent recoveries in the set of seven, the MDL result is acceptable. If not, the MDL must be re-run, but only for the compounds that did not pass. If the study needs to be re-run at a different concentration, the entire set of seven needs to be re-run. If the study does not pass due to poor reproducibility on one of the samples, only that run needs to be re-analyzed. All seven runs do not need to be run in the same analytical shift.

18.5.7 If at any time the MDL level is above a client's or state's desired reporting limit, the "Calculated MDL" may be used as the reporting limit, provided it is narrated accordingly. The narration needs to state that the reporting limit is based on a "Calculated MDL" value, and when the particular compound is spiked at that level it is not observed.

18.5.8 The curve on the instrument being used to conduct the analysis must have as its low point the vial concentration of a sample spiked at the reporting limit. A curve starting above this number can lead to large potential errors. For example: If the concentration of a sample spiked at 0.10 ug/L is extracted as the MDL was extracted (i.e. 1000 mL to 2 mL, or a 500x concentration), the vial concentration will be 0.05 mg/L. This should also be the concentration of the low curve point. Consequently, assuming the MDL passed, 0.10 ug/L is the lowest DL reportable without narrating the results with the qualifier mentioned in 18.5.7.

18.5.9 Attachment 13 shows an example of a MDL spreadsheet used to calculate and verify MDLs and RLs.

19.0 ANALYST CERTIFICATION/METHOD VALIDATION

19.1 Before the analyses of any actual samples, each analyst must demonstrate the ability to generate acceptable accuracy and precision by running a one-time analyst certification. While the analyst certification is not instrument dependent, this certification is required on every instrument and every column used in running samples, to demonstrate the ability of each instrument to generate acceptable accuracy and precision.

19.2 Spike 1 mL of the LFB spiking standard into each of four, 1 liter aliquots of water and extract as usual. Cleanups are not necessary for the analyst certification samples. The spiking standard used must be prepared independently from the standard used for quantitation.

19.3 Analyze the four 1 mL samples following the SOP.

19.4 Calculate the average percent recovery (x), and the standard deviation of the recovery, for each analyte using the four results.

19.4.1 For each analyte compare s and x with the acceptance criteria for precision and accuracy listed below. If s and x for all analytes meet the acceptance criteria, the analyst certification is good. The analyst and the system are now authorized to run samples by this method. If any individual s exceeds the precision limit or any individual x falls outside the range for accuracy, then the system performance is unacceptable for that analyte.

Range for x: 70-130% Upper limit for s: 20%

19.4.2 When one or more of the analytes tested fail at least one of the acceptance criteria, the analyst must proceed according to 19.5.

19.5 Locate and correct the source of the problem and repeat the test for all analytes that failed to meet the criteria. Repeated failure, however, will confirm a general problem with the pre-treatment or

measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds beginning with Section 19.2 or 19.3. Samples may not be analyzed by any analyst or on any instrument until the analyst certification has been successfully completed.

20.0 REFERENCES

20.1 *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods* (SW-846, 3rd Edition), Methods 8000B, 8082, 3510C, 3550B, 3580A, 3660B, 3665A, and 3620B.

20.2 *40 Code of Federal Regulations*, most current edition, Pt. 136, section 1, Appendix B, July 1, 1997, Definition and Procedure for the Determination of the Method Detection Limit, revision 1.11.

21.0 ATTACHMENTS/APPENDICES

21.1 Attachment 1 - Default Reporting Limits

21.2 Attachment 2 - Sample Page of Standard Logbook

21.3 Attachment 3 - Sample of a Calibration curve for PCB 1260

21.4 Attachment 4 - Sample Aroclor Chromatograms on a DB-35ms Column

21.5 Attachment 5 - Additional Sample Aroclor Chromatograms on a DB-35ms Column

21.6 Attachment 6 - Sample Benchsheet

21.7 Attachment 7 - Sample BLK Benchsheet

21.8 Attachment 8 - Sample MPB/LFB Benchsheet

21.9 Attachment 9 - Sample MS/MSD Benchsheet

21.10 Attachment 10 - Sample Page of Instrument Run Logbook

21.11 Attachment 11 - Surrogate Percent Recovery Windows

21.12 Attachment 12 - Spiking Compounds and Percent Recovery Windows

21.13 Attachment 13 - Method Detection Limit Study Example

Attachment 1
Default Reporting Limits

Compound	Water (ug/L)	Soil (mg/kg)
PCB-1016	0.10	0.33
PCB-1221	0.10	0.33
PCB-1232	0.10	0.33
PCB-1242	0.10	0.33
PCB-1248	0.10	0.33
PCB-1254	0.10	0.33
PCB-1260	0.10	0.33

Attachment 2
Sample Page of Standard Logbook

TRIMATRIX STANDARDS LOGBOOK

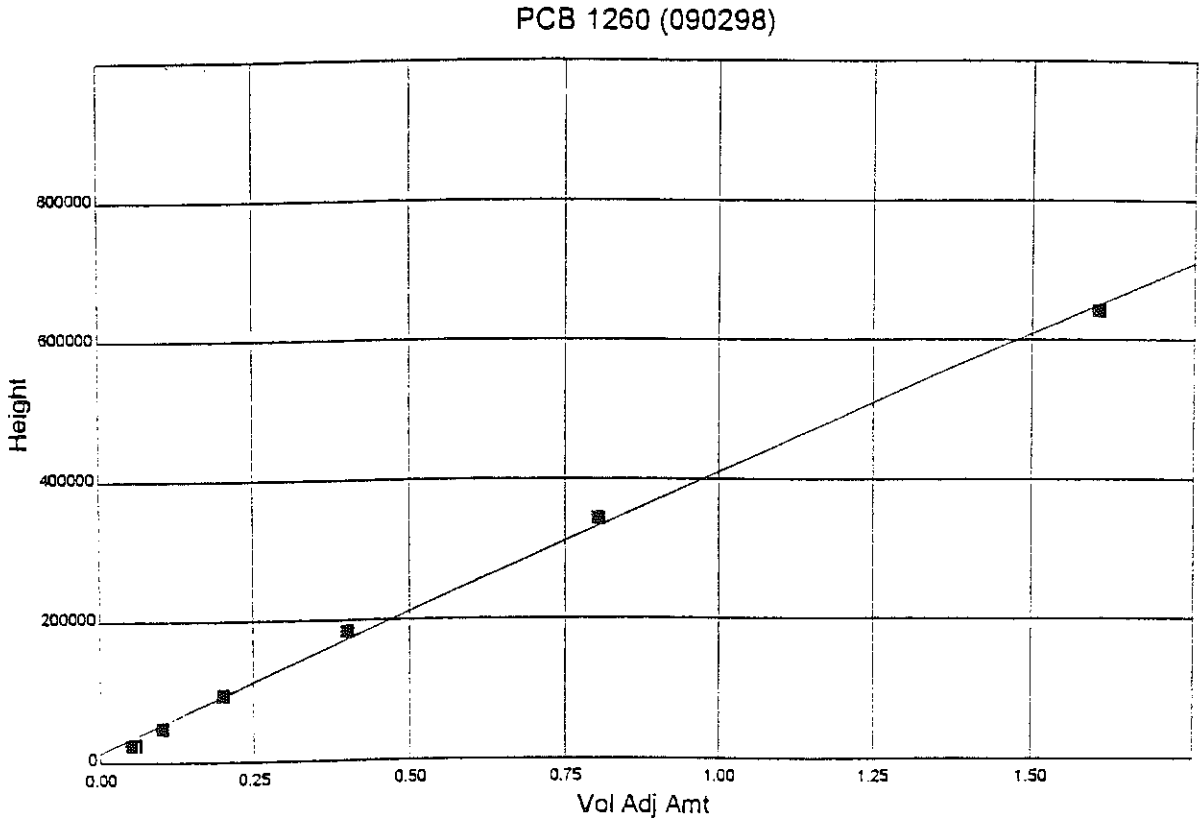
STD #	STANDARD NAME	FINAL CONC.	SOLVENT	STD.SOURCE/LOT#	SOURCE CONC.	AMT ADDED	FINAL VOLUME	DATE	INITIALS	DISPOSAL DATE
S-1368	8330 SOILS STD B CONC.4	4 ug/mL	Acetonitrile	S-1367	8 ug/mL	5mL	10mL	7/10/98	DLV	8/10/98
S-1369	" " " " " 3	2		S-1368	4					
S-1370	" " " " " 2	1		S-1369	2					
S-1371	" " " " " 1	0.5		S-1370	1					
S-1372	TOXAPHENE + SURR.	4/0.2 ug/mL	Hexane	S-1159 / ABS STD 060115	5000/200 ug/mL	40/50 mL	50mL	7/10/98	DLV	1/10/99
S-1373	TOXAPHENE + SURR	2/0.1 ug/mL		S-1372	4.0/0.2	25mL				
S-1374	TOXAPHENE + SURR	1/0.05		S-1373	2.0/0.1					
S-1375	TOXAPHENE + SURR	0.5/0.025		S-1374	1.0/0.05					
S-1376	TOXAPHENE + SURR	0.25/0.0125		S-1375	0.5/0.025					
S-1377	4,4'-DDE	1 mg/mL	HEXANE	SUPELCO LOT# LA110140	NEAT	0.0401 g	40mL	7/15/98	JRO	7/15/99
S-1378	Chlordane Conc.5 + Surr	0.4/0.2 ug/mL	Hexane	ABS. STD LA45766 / RESTEK 003879	2000/200 ug/mL	10mL/50mL	50mL	7/16/98	DLV	1/16/99
S-1379	Chlordane Conc.4 + Surr	0.2/0.1		S-1378	0.4/0.2 ug/mL	25mL		7/16/98		
S-1380	Chlordane Conc.3 + Surr	0.1/0.05		S-1379	0.2/0.1			7/16/98		
S-1381	Chlordane Conc.2 + Surr	0.05/0.025		S-1380	0.1/0.05					
S-1382	Chlordane Conc.1 + Surr	0.025/0.0125		S-1381	0.05/0.025					
S-1383	EAE MIX CONC.5	SEE BELOW	HEXANE	SEE BELOW	SEE BELOW	SEE BELOW	10mL	JRO	7/16/98	1/16/99
	HEXABROMOBENZENE	0.20 ug/mL		S-1279	1mg/mL	2µl				
	HEXABROMOBIPHENYL	0.50 ug/mL		S-891	0.5mg/mL	10µl				
S-1384	EAE MIX CONC.4	.25/.10 ug/mL	HEXANE	S-1383		5mL	10mL	JRO	7/16/98	1/16/99
S-1385	EAE MIX CONC.3	.125/.05 ug/mL		S-1384						
S-1386	EAE MIX CONC.2	.0625/.025 ug/mL		S-1385						
S-1387	EAE MIX CONC.1	.0312/.0125 ug/mL		S-1386						
S-1388	BIG PEST STD CONC.6	SEE BELOW	HEXANE	SEE BELOW	SEE BELOW	SEE BELOW	40mL	7/17/98	JRO	1/17/99
	18 COMPONENT PEST MIX	0.20 ug/mL		SUPELCO LOT# LA44099	2000 ug/mL	4µl				
	ALPHA CHLORDANE			S-1794	2000 ug/mL	4µl				
	GAMMA CHLORDANE			S-1795	2000 ug/mL	4µl				
	TCMX			RESTEK LOT# A003879	200 ug/mL	40µl				
	DCB			RESTEK LOT# A002988	200 ug/mL	40µl				
	HEXABROMOBENZENE			S-1279	1000 ug/mL	8µl				
	HEXABROMOBIPHENYL			S-891	500 ug/mL	16µl				

Approved By: [signature] 4/1/99 QA Manager

Approved By: [signature] 4/1/99 Area Manager

Attachment 3
Sample of a Calibration Curve for PCB 1260

Curve #1 : 1st Order
Weighting Factor = 1.0 (No Weighting) r^2 = 0.998375
Calibration Curve = (14411.534447) + (397779.552469)X



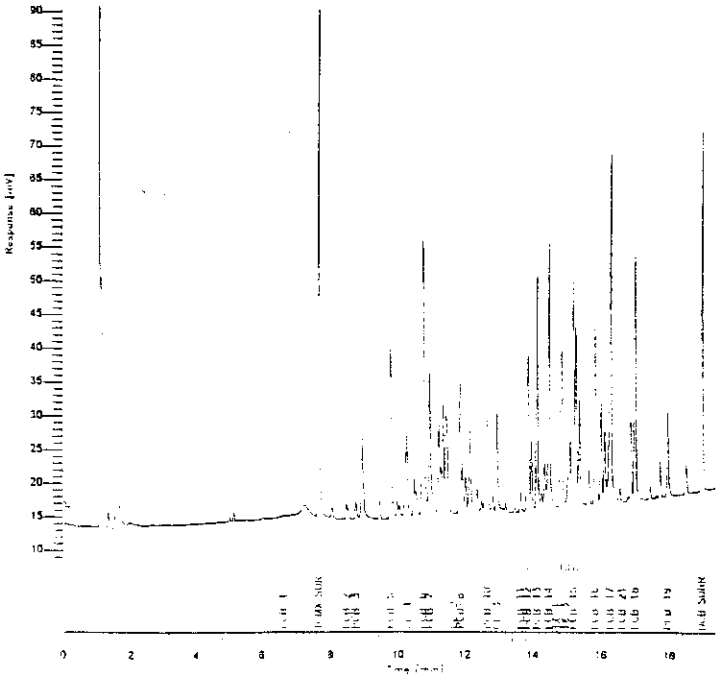
Level Name	Observed X-Value	Calculated X-Value	Delta	%Diff.	Observed Y-Value	Calculated Y-Value
16/60 1	0.050000	0.025450	0.024550	96.464	24535.031377	34300.51171
16/60 2	0.100000	0.085425	0.014575	17.062	48391.914149	54189.49218
16/60 3	0.200000	0.202281	-0.002281	-1.127	94874.503714	93967.44531
16/60 4	0.400000	0.427594	-0.027594	-6.453	184499.580430	173523.35937
16/60 5	0.800000	0.829512	-0.029512	-3.558	344374.384070	332635.18750
16/60 6	1.600000	1.579739	0.020261	1.283	642799.283223	650858.31250

Approved By: 4/1/99 QA Manager

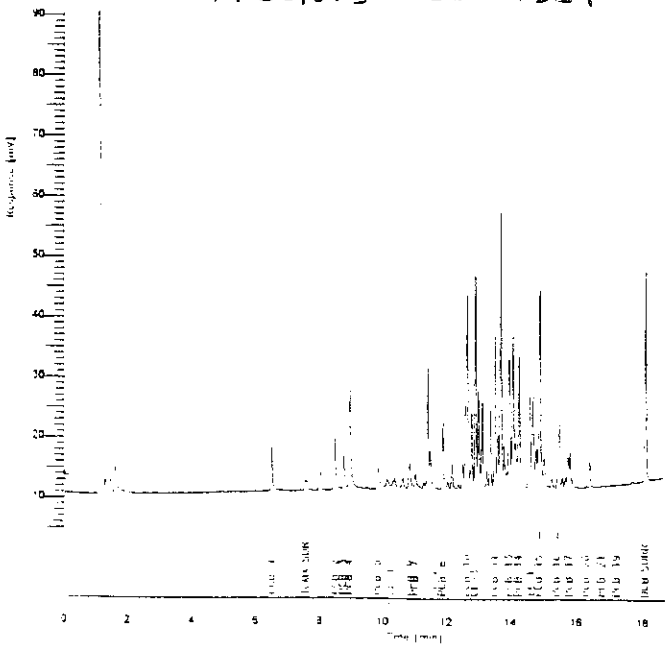
Approved By: 4/1/99 Area Manager

Attachment 4
Sample Aroclor Chromatograms on a DB-35ms Column

Aroclors 1016 / 1260



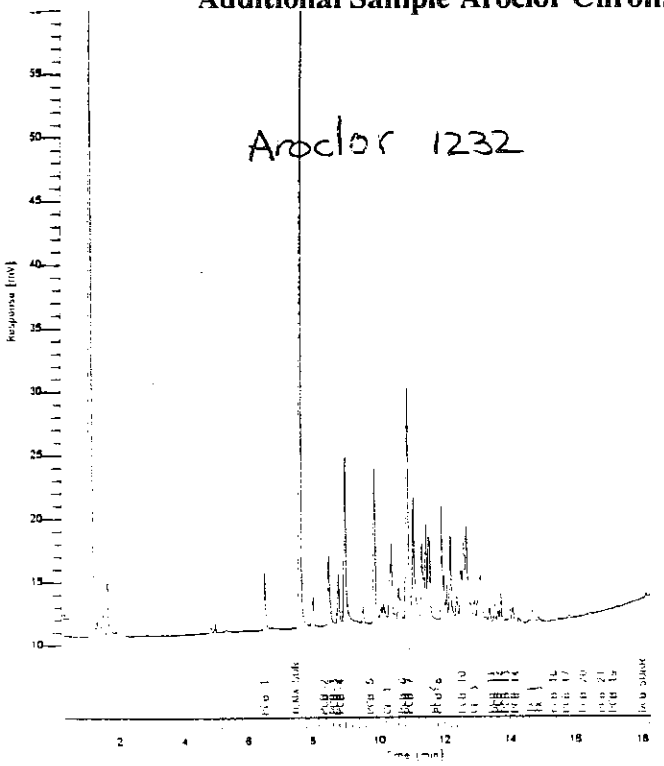
Aroclors 1221/1254

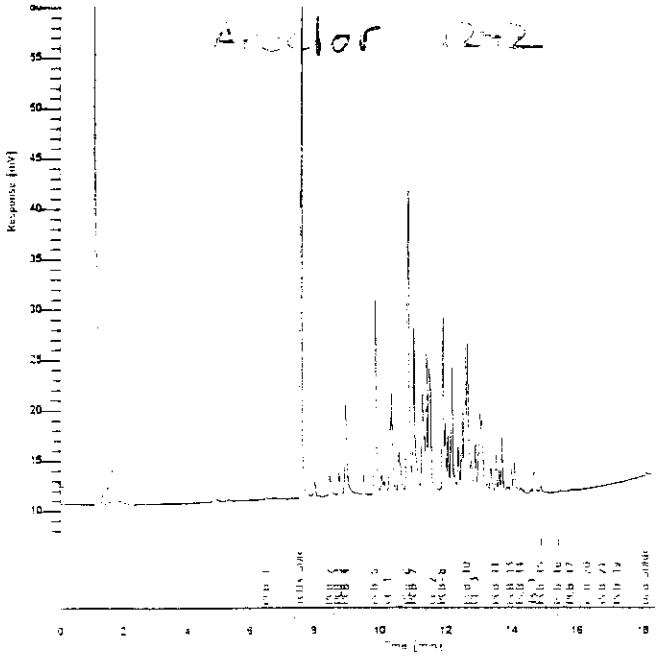


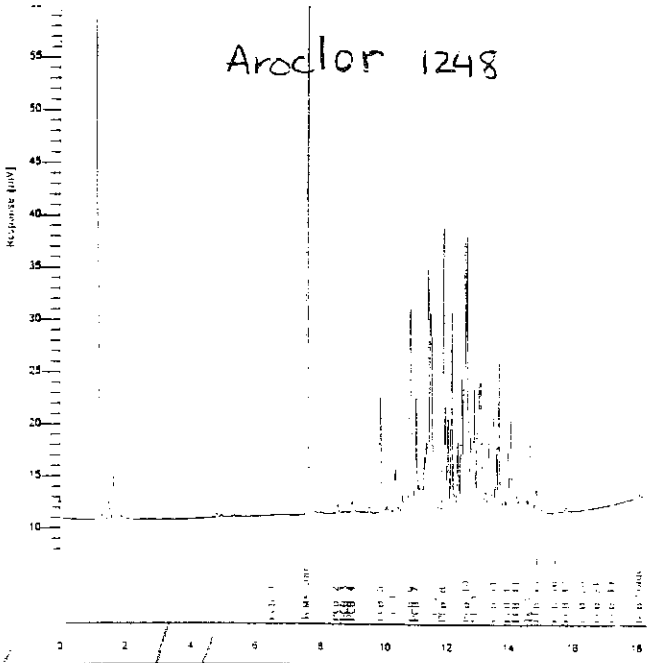
Approved By: 4/1/99
QA Manager

Approved By: 4/1/99
Area Manager

Attachment 5
Additional Sample Aroclor Chromatograms on a DB-35ms Column







Approved By: [signature] 4/1/99 QA Manager

Approved By: [signature] 4/1/99 Area Manager

Attachment 6
Sample Benchsheet

14-SEP-98 Type: REG RC1 RC2 RMS FRACTION BENCHSHEET SEMI-VOLATILE LAB PAGE 5

Test #: 502. 208- 39.21
Parameter: GC PCBS METHOD 8081
Method: GC/ECD/P&P/WTR
Ref. cit.: USEPA-8081 Unit: ug/L

Client: [redacted]
Project: 34820 [redacted]
Proj Chem: RDW
Submittal: 1 September 11, 1998 Samples
Sample: 207191 [redacted]

Hold date: 20-OCT-1998 QC: LV5 COC:
Lab due date: 24-SEP-1998
Client due date: 28-SEP-1998 C=1 F=1 H=1 R=1
Received date: 14-SEP-1998

Benchsheet ID: 210965
Analyst: DLV
Date Run: 9-18-98
Instrument #: 158
Stock Std: S-1330
Rack#:
Reviewed by: [illegible]
QC Batch Number: 134022-116

Initial wt./vol.: 1000ml
Final volume: 2ml
% Solids:
Dilution Factor:
Batch Number:
Batch Owner: 158
Batch Opened Date: 9-18-98
Batch Seq: 1

Parameter	ODL/Spk	Result	Percent	LCL	UCL
24 CHLORDANE (TECHNICAL)	*	<0.02			
25 TOXAPHENE	*	<0.10			
26 PCB-1016	*	<0.2			
27 PCB-1221	*	<0.2			
28 PCB-1232	*	<0.4			
29 PCB-1242	*	<0.2			
30 PCB-1248	*	<0.2			
31 PCB-1254	*	<0.2			
32 PCB-1260	*	<0.2			
1 TETRACHLORO-M-XYLENE-SUR	0.100	0.102	102 %	48	124
2 DECACHLOROBIPHENYL-SUR	↓	0.0771	77 %	4	142

* - Result < corresponding ODL

TRIMATRIX LABORATORIES, INC.

Approved By: [signature] 4/1/99 QA Manager
Approved By: [signature] 4/1/99 Area Manager

Attachment 7
Sample BLK Benchsheet

24-SEP-98 FRACTION BENCHSHEET ** QC ** SEMI-VOLATILE LAB PAGE 1

Test #: 502. 25- 39.21
Parameter: QC PCB'S 8081-307 (WTR)
Method: GC/ECD/P&P/WTR
Ref. cit.: USEPA-8081 Unit: ug/L

QC Type: BLK

Analyst: JRD
Date run: 10/1/98
Instrument #: 158
Stock std #: S-1330
Rack #:
Reviewed by: DLV
QC Batch Number:

Initial wt./vol.:
Final volume:
% Solids:
Dilution factor:
Batch Number: 134715
Batch Owner: 158
Batch Opened Date: 10/1/98
Batch Seq: 01

Seq	Parameter	ODL	Orig conc	Result	Spike qty	% rec	LCL	UCL	EXC
26.	PCB-1016	0.2		*	XXXXX				
27.	PCB-1221	0.2			XXXXX				
28.	PCB-1232	0.4			XXXXX				
29.	PCB-1242	0.2			XXXXX				
30.	PCB-1248	0.2			XXXXX				
31.	PCB-1254	0.2			XXXXX				
32.	PCB-1260	0.2			XXXXX				
1.	TETRACHLORO-M-XYLENE-SUR	XXXXX	XXXXX	0.0754	0.100	75%	48	124	
2.	DECACHLOROBIPHENYL-SUR	XXXXX	XXXXX	0.0779		78%	4	142	

* - Result < corresponding ODL

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Approved By: 4/1/99 Area Manager

Attachment 8
Sample MPB/LFB Benchsheet

14-SEP-98 FRACTION BENCHSHEET ** QC ** SEMI-VOLATILE LAB PAGE 3

Test #: 502. 25- 39.21
Parameter: QC PCB'S 8081-307 (WTR)
Method: GC/ECD/P&P/WTR
Ref. cit.: USEPA-8081 Unit: ug/L

QC Type: MPB LFB

Analyst: DLV
Date run: 9-18-98
Instrument #: 158
Stock std #: S-1330
Rack #:
Reviewed by:
QC Batch Number: 134022-116

Initial wt./vol.: 1000mL
Final volume: 2mL
% Solids:
Dilution Factor:
Batch Number:
Batch Owner: 158
Batch Opened Date: 9-18-98
Batch Seq: 1

Seq	Parameter	ODL	MPB Result	SUR (MPB) spike qty	LFB Result	LFB/SUR spike qty	MPB %	LFB %	LFB LCL	LFB UCL	EXC
26.	PCB-1016	0.2	*	XXXXX	@	@			80	120	
27.	PCB-1221	0.2		XXXXX	↓	↓			80	120	
28.	PCB-1232	0.4		XXXXX	1.12	1.00			80	120	
29.	PCB-1242	0.2		XXXXX	@	@			44	130	
30.	PCB-1248	0.2		XXXXX					31	159	
	PCB-1254	0.2		XXXXX					38	133	
32.	PCB-1260	0.2		XXXXX					69	119	
1.	TETRACHLORO-M-XYLENE-SUR	XXXXX	0.0918	0.100	0.100	0.100	92	100	48	124	
2.	DECACHLOROBIPHENYL-SUR	XXXXX	0.0840	↓	0.0905	↓	84	90	4	142	

* - Result < corresponding ODL

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Approved By: 4/1/99 Area Manager

Attachment 9
Sample MS/MSD Benchsheet

14-SEP-98 FRACTION BENCHSHEET ** QC ** SEMI-VOLATILE LAB PAGE 5

Test #: 502. 25- 39.21
Parameter: QC PCB'S 8081-307 (WTR)
Method: GC/ECD/P&P/WTR
Ref. cit.: USEPA-8081 Unit: ug/L

Sample Number: 207188
QC Type: SPK: MSD Range 1: MSD Range 2
Range 1: SPK1 <= 10 x ODL
Range 2: SPK1 > 10 x ODL

Analyst: DLV
Date run: 9-18-98
Instrument #: 158
Stock std #: S-1330
Rack #:
Reviewed by: JD
QC Batch Number: 134022-116

Initial wt./vol.: 1000mL
Final volume: 2mL
% Solids:
Dilution factor:
Batch Number:
Batch Owner: 158
Batch Opened Date: 9-18-98
Batch Seq: 1

Seq	Parameter	ODL	Orig Conc.	SPK1 Result	Spike qty	SPK2 Result	SPK1 %	SPK2 %	SPK LCL	SPK UCL	MSD % Dif	MSD 1 UCL	MSD 2 UCL	EXC
26.	PCB-1016	0.2		@ 0.0946	@				80	120		40	20	
27.	PCB-1221	0.2		@	↓				80	120		40	20	
28.	PCB-1232	0.4		1.02	1.00	1.00	102	100	80	120		40	20	
29.	PCB-1242	0.2		@	@				58	143		40	29	
30.	PCB-1248	0.2		↓	↓				39	141		40	27	
31.	PCB-1254	0.2							53	134		13	33	
32.	PCB-1260	0.2							51	139		17	15	
1.	TETRACHLORO-M-XYLENE-SUR	XXXXX	XXXXX	0.0945	0.100	0.0947	94	95	48	124	XXXXX			
2.	DECACHLOROBIPHENYL-SUR	XXXXX	XXXXX	0.0563	↓	0.0595	56	60	4	142	XXXXX			

* - Result < corresponding ODL

TRIMATRIX LABORATORIES, INC.

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Approved By: 4/1/99 Area Manager

Attachment 10
Sample Page of Instrument Run Logbook

Instrument ID: HP 5890 #144	Date: 5/4/98	Sequence #: AB63.SEQ	Date Archived, Disk ID

Instrument Settings/Injection Vol.	Aquisition Information	Temperature Settings				Routine Maintenance Items
Range: SIGNAL-A 3	Curve Date:	GC	Prog 1	Prog 2	Prog 3	New Column Date:
SIGNALB 2	Curve Type: Regression or Avg. CF	Initial:	80°			Column Clipped: Yes / No
Column Type: FRONT RTX CLP2 BACK DB5	DDT % Breakdown:	Hold:	2min			
Head Pressure: 12PSI for 5min 10PSI/min/5PSI	Endrin % Breakdown	Final:	320°			New Inj. Port Liner: Yes / No
Sample Rate:	Total % Breakdown <20%: Pass / Fail	Rate:	15°/min			New Septa: Yes / No
Volts:	Quantitated By: Curve / Continuing	Hold:	3min			New Syringe: Yes / No
Injection Volume: 2µl SPLIT to 2 columns		Inj/Det:	205/350			

Analyst	Run ID	File ID	Inj. Time	Method	Client	Matrix	Dilution	ICV/CCV Check (85-115)	Sample Notes, Std. Numbers, Anal. Batch Info, etc.
gl0	INS.BLK	AB63_073	16:45	HB04AB	QC	QC			S-1035
	CONC.1 [redacted]	-074	17.12						S-1271
	CONC.2 [redacted]	-075	17:38						S-1270
	CONC.3 [redacted]	-076	18:04						S-1269
	CONC.4 [redacted]	-077	18:30						S-1268
	CONC.5 [redacted]	-078	18:56						S-1267
	CONC.6 [redacted]	-079	19.23						S-1266
	LCS#1	-080	19:49						S-1177
	LCS#2	-081	20:15						S-1113
	194540	-082	20:41		[redacted]	H20	40x		
	129033 MB3129	-083	21:08						
	129033 LFB129	-084	21:34						
	194878	-085	22:00						
	194879	-086	22:26						

144_RUN.XLS

Approved By: RF 4/1/99 QA Manager

Approved By: JC 4/1/99 Area Manager

Attachment 11
Surrogate Percent Recovery Windows

Waters

Parameter	ng on Col.	Accuracy Window
Decachlorobiphenyl	0.10	4-142

Soils

Parameter	ng on Col.	Accuracy Window
Decachlorobiphenyl	0.10	38-135

Note: The limits presented in this table are calculated from an on-going statistical program and are subject to change.

Attachment 12
Spiking Compounds and Percent Recovery Windows

Laboratory Fortified Blank (LFB)

Waters

Parameter	Spk. Conc. (ug/L)	Accuracy Window
PCB-1016	1.00	80-120
PCB-1221	1.00	80-120
PCB-1232	1.00	80-120
PCB-1242	1.00	44-130
PCB-1248	1.00	31-159
PCB-1254	1.00	68-128
PCB-1260	1.00	69-119

Soils

Parameter	Spk. Conc. (mg/kg)	Accuracy Window
PCB-1016	0.167	68-111
PCB-1221	0.167	60-140
PCB-1232	0.167	60-140
PCB-1242	0.167	43-137
PCB-1248	0.167	30-150
PCB-1254	0.167	78-111
PCB-1260	0.167	57-135

Approved By: RF 4/1/99 QA Manager

Approved By: 4/1/99 Area Manager

Attachment 12 (con't)
Spiking Compounds and Percent Recovery Windows

Matrix Spikes (SPK1, SPK2) and Matrix Spike Duplicates (MSD)

Waters

Parameter	Spk. Conc. (ug/L)	Accuracy Window Range	Precision Window Upper Limit
PCB-1016	1.00	41-124	12
PCB-1221	1.00	50-150	40
PCB-1232	1.00	50-150	40
PCB-1242	1.00	33-157	26
PCB-1248	1.00	3-158	42
PCB-1254	1.00	50-143	31
PCB-1260	1.00	29-143	31

Soils

Parameter	Spk. Conc. (mg/kg)	Accuracy Window Range	Precision Window Upper Limit
PCB-1016	0.167	41-124	12
PCB-1221	0.167	50-150	40
PCB-1232	0.167	50-150	40
PCB-1242	0.167	33-157	26
PCB-1248	0.167	3-158	42
PCB-1254	0.167	50-143	31
PCB-1260	0.167	29-143	31

Note: The limits presented in this table are calculated from an on-going statistical program and are subject to change.

Attachment 13
Method Detection Limit Study Example*

SEMIVOLATILE LABORATORY
INSTRUMENT # 158 1998 WATER
METHOD DETECTION LIMIT STUDIES

Parameter / Compound	Date Analyzed	Reference Citation	Units	Amount Spiked	Rep. #1	Rep. #2	Rep. #3	Rep. #4	Rep. #5	Rep. #6	Rep. #7	Average Amount Found	Average Percent Recovery	Standard Deviation	Calculated MDL
AROCLOR 1248	2/11/98	USEPA 8082	UG/L	0.05	0.069	0.071	0.[illegible]0	0.068	0.070	0.068	0.066	0.069	137%	0.002	**0.005**
AROCLOR 1232	2/12/98	USEPA 8082	UG/L	0.05	0.102	0.094	0.095	0.123	0.125	0.104	0.107	0.107	214%	0.012	**0.039**
AROCLOR 1016	2/12/98	USEPA 8082	UG/L	0.10	0.134	0.143	0.150	0.145	0.146	0.162	0.172	0.150	150%	0.013	**0.040**
AROCLOR 1260	2/12/98	USEPA 8082	UG/L	0.10	0.138	0.133	0.136	0.128	0.134	0.136	0.131	0.134	134%	0.004	**0.011**
AROCLOR 1242	2/20/98	USEPA 8082	UG/L	0.05	0.072	0.088	0.072	0.071	0.068	0.070	0.071	0.073	146%	0.007	**0.021**
AROCLOR 1254	2/23/98	USEPA 8082	UG/L	0.05	0.059	0.062	0.064	0.061	0.064	0.064	0.065	0.063	125%	0.002	**0.007**
AROCLOR 1221	1/5/98	USEPA 8082	UG/L	0.10	0.064	0.057	0.126	0.114	0.117	0.117	0.117	0.102	102%	0.028	**0.089**

*This spreadsheet is provided as an EXAMPLE of the style spreadsheet used for calculating MDL studies only. It is not an example of current reporting limits.

Approved By: 4/1/99
QA Manager

Approved By: 4/1/99
Area Manager

TRIMATRIX LABORATORIES, INC.

SAMPLE PREPARATION METHODS

TriMatrix Laboratories, Inc.

STANDARD OPERATING PROCEDURE

ACID DIGESTION OF AQUEOUS SAMPLES AND EXTRACTS FOR TOTAL METALS FOR ANALYSIS BY FLAA OR ICP SPECTROSCOPY

METHOD 3010A

UNCONTROLLED DOCUMENT

APPROVALS:

Inorganic Manager: _____ Date: 11/24/98
Douglas E. Kriscunas

QA Manager: _____ Date: 11/24/98
Rick D. Wilburn

Laboratory Manager: _____ Date: 11/24/98
Douglas E. Kriscunas

Procedure Number: GR-01-121
Revision Number: 3.0

Date Initiated: 11/17/96
Effective Date: 8/4/98

Date Revised: 11/24/98
Pages Revised: All

By: Marge Scott

Total Number of Pages: 9

1.0 SCOPE AND APPLICATION

1.1 This method is an acid digestion procedure used to prepare aqueous samples for analysis by flame atomic absorption (FLAA) or by inductively coupled plasma (ICP).

2.0 PRINCIPLE METHOD REFERENCES

2.1 *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition,* Final Update III, Revision 1, July, 1992, "Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by FLAA and ICP Spectroscopy".

3.0 SUMMARY OF PROCEDURE

3.1 A representative sample is refluxed in nitric acid until the solution is light in color, or the color of the solution remains stable. The digestate is then refluxed with hydrochloric acid and diluted to a predetermined volume.

3.2 This method has been modified. The initial sample volume has been reduced from 100 ml to 25 ml. The acid amounts have been reduced proportionally to the sample size reduction.

4.0 PARAMETER OR COMPOUND LIST

FLAA or ICP

Aluminum	Magnesium
*Arsenic	Manganese
Barium	Molybdenum
Beryllium	Nickel
Boron	Potassium
Cadmium	*Selenium
Calcium	Silicon
Chromium	Silver
Cobalt	Sodium
Copper	Strontium
Iron	Thallium
Lead	Vanadium
Lithium	Zinc
Tin	
Titanium	

Approved By: 11/24/98 **Approved By:** 11/24/98

QA Manager **Area Manager**

*Analysis by ICP.

5.0 REFERENCED SOPs

5.1 None Referenced.

6.0 INTERFERENCES AND CORRECTIVE PROCEDURES

6.1 Silver precipitation can be avoided by adding an excess of HCl.

6.2 All samples must be at room temperature before the analysis is started.

7.0 SAFETY PRECAUTIONS

7.1 See the "Laboratory Safety Manual" for routine precautions. Gloves and safety glasses must be worn at all times when handling acids. A plastic apron is also recommended. Nitric and hydrochloric acid fumes can burn and therefore respirators are available for use. Rinse all pipet tips, beakers, etc. prior to disposal.

8.0 SAMPLE SIZE, COLLECTION, PRESERVATION AND HANDLING PROCEDURES

8.1 To ensure enough sample for QC and/or repeats collect at least 500 ml of material to be tested. Preserve to pH <2.0 with trace metal nitric acid.

9.0 INSTRUMENTATION, APPARATUS, AND MATERIALS

9.1 Eppendorf Pipettor (capable of delivering 250 ul).

9.2 Adjustable pump-type dispenser capable of dispensing 0.75 ml of reagent. This pump is for the concentrated HNO_3.

9.3 Adjustable pump-type dispenser capable of dispensing 2.5 ml of reagent. This pump is for the 1:1 HCl.

9.4 Corning hot Plates (setting #4). Model #PC-500.

9.5 Griffin beakers, 150 ml capacity minimum.

9.6 Ribbed watchglasses.

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9.7 Non-ribbed watchglasses.

9.8 Class A volumetric flasks.

9.9 Whatman 41 filter paper.

9.10 Plastic funnels.

9.11 Plastic specimen containers.

9.12 Class A Volumetric pipets.

9.13 Graduated cylinder (50 ml).

10.0 ROUTINE PREVENTIVE MAINTENANCE

10.1 Calibrate all pipettors once per week.

10.2 Daily clean all hot plates and counters.

11.0 CHEMICALS AND REAGENTS

11.1 Distilled deionized water (ASTM Type II).

11.2 Concentrated nitric acid, trace metal grade (HNO_3).

11.3 Concentrated hydrochloric acid, trace metal grade (HCl).

11.4 Milli-Q water (ASTM Type I).

11.5 1:1 HNO_3 for cleaning filters. Into 500 ml ASTM Type II water, place 500 ml concentrated HNO_3. Always use a suitable container capable of withstanding the heat generated by the exothermic dilution of the acid.. Always add acid to water (failure to do so could result in a violent explosion of acid as the water boils).

11.6 1:1 HCl. Into 500 ml ASTM Type II water, place 500 ml concentrated HCl. Always use a suitable container capable of withstanding the heat generated by the exothermic dilution of the acid.. Always add acid to water (failure to do so could result in a violent explosion of acid as the water boils).

12.0 STANDARDS PREPARATION

Approved By: RA 11/24/98 QA Manager

Approved By: 11/24/98 Area Manager

12.1 FLAA/ICP spiking solutions (see Appendix A).

12.2 GFAA spiking solutions. 10,000 ppb single-element furnace standards are used for this procedure. Please refer to Appendix B for standard preparation.

13.0 DETAILED PROCEDURE

13.1 Run a pretreatment benchsheet to determine analyses needed (see Appendix F).

13.2 Rinse 25 ml pipets with ASTM Type II water.

13.3 Label a 150 ml griffin beaker with the sample number, client name, and any dilution information that is pertinent.

13.4 Rinse the pipette with the sample, discarding the rinsate. Transfer a 25-ml aliquot of the well-mixed sample into the 150 ml griffin beaker

13.5 We must perform 5% matrix spikes and matrix spike duplicates. If this sample has been designated as needing matrix QC (MS/MSD), then repeat steps 13.3 and 13.4 with two more aliquots of the sample. Label the first aliquot's beaker with "SPK", and the second one as "MSD". **Note:** Shake the sample prior to taking each aliquot.

13.6 Repeat steps 13.2 through 13.5 until there are 20 samples in the batch, or until there are no more samples to be prepared.

13.7 Label 1 beaker as MPB (method preparation blank) and 1 beaker as LFB (laboratory fortified blank). Add 25 ml of ASTM Type II water to each of these beakers using a 50 ml graduated cylinder.

13.8 Spiking FLAA/ICP. Using an Eppendorf pipette, spike the following solutions into each beaker labeled with "SPK", "MSD", or "LFB":

SSW/ 1.0
SSW/SSS 2.0

13.9 In a hood, add 0.75 ml of trace metal grade HNO_3. Cover with a ribbed watchglass and place on a hot plate to evaporate. Adjust the temperature on the hotplate so that a beaker of water in the middle of the hotplate reaches 95°C. Do not allow samples to boil.

13.10 Evaporate the samples to a volume of less than 5 ml. Do not allow samples to boil. Do not allow the samples to go dry. If a sample evaporates to dryness, the sample must be discarded and reprepped in another batch.

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QA Manager Area Manager

13.11 Cool the samples.

13.12 Add another 0.75 ml portion of HNO_3 to the samples. Cover the samples with a non-ribbed watchglass and return to the hotplate. Increase the temperature of the hotplate so that a gentle reflux action occurs. Do not let the samples boil. Do not let the samples go to dryness. If a sample evaporates to dryness, the sample must be discarded and reprepped in another batch.

13.13 Continue heating the samples, adding additional 0.75 ml increments of HNO_3 as necessary until the digestion is complete, which will be indicated by the digestate appearing light in color, or not changing in color with additional refluxing. Uncover the beakers, or use a ribbed watchglass, and evaporate to about 3 ml. Do not let any portion of the beaker go dry.

13.14 Cool the samples.

13.15 Add 2.5 ml of 1:1 HCl to the samples. Cover the beakers and reflux for an additional 15 minutes to dissolve any precipitate that may have formed during the digestion.

13.16 Rinse enough 25 ml volumetric flasks for all of the beakers in the digestion batch with ASTM Type II water 3 times.

13.17 For each sample, rinse down the sides of the beaker and the watchglass into the beaker. If there is a significant amount of particulate matter left in the beaker, then either filtration or centrifugation may be employed to remove the substances that could prevent nebulization of the samples.

13.17.1 If the amount of particulate matter will not cause analysis problems, then simply pour the contents of the beaker into a 50 ml volumetric flask. Rinse the beaker walls and bottom with ASTM Type II water into the volumetric flask. Repeat the rinsing 2 more times, collecting each rinse in the volumetric flask. Dilute the flask to volume with ASTM Type II water and mix well. Go to Step 13.18.

13.17.2 If the particulate matter will cause analytical problems, the sample may be centrifuged. Pour the contents of the beaker into a volumetric flask. Rinse the beaker walls and bottom with ASTM Type II water into the volumetric flask. Repeat the rinsing 2 more times, collecting each rinse in the volumetric flask. Dilute the flask to volume with ASTM Type II water and mix well. Pour the contents of the flask into a 50 ml centrifuge tube. Centrifuge the sample until the sediment has settled into the bottom of the tube (see the centrifuge operating manual for loading and operation of the centrifuge). Go to Step 13.18.

13.17.3 If centrifugation is not possible, or does not work, then the sample may be filtered. Prepare a plastic funnel with Whatman 41 filter paper. Rinse the funnel and filter paper with dilute HNO_3, followed by several rinsings of ASTM Type II water. Discard the rinsate. Place the funnel and filter paper in a 50 ml volumetric flask. Pour the contents of the beaker into the

funnel. Rinse the beaker walls and bottom with ASTM Type II water into the funnel. Repeat the rinsing 2 more times, collecting each rinse in the funnel. Rinse the filter paper and funnel with several rinsings of ASTM Type II water Dilute the flask to volume with ASTM Type II water and mix well. Go to Step 13.18

13.18 Pour the contents of the volumetric flask (or centrifuge tube) into a plastic sample cup labeled with the client name, LIMS samples number, and any digestion dilution information. Place the empty volumetric flasks and beakers in a plastic tub dedicated to dirty glassware.

13.19 Fill out the LIMS pretreatment benchsheet and enter the information into LIMS (see Appendix C). Place the batch number on the pretreatment benchsheet.

13.20 Place the lid on the sample cup and set aside. When all of the samples have been placed in cups, place the batch number of the digestion (see step 13.19) on top of each sample cup in the digestion batch. Place the samples in the appropriate vented cabinet in the metals analysis room.

13.21 Completely fill out the metals digestion logbook and analyst notebook (see Appendix D).

13.22 Clean up the area of any spilled material or debris.

14.0 REPORTING AND DELIVERABLES

14.1 All samples that require a digestion must be pretreated on LIMS after digestion. A group of samples digested together using the same digestion method are given a LIMS batch number. This batch number is used by the analysts when analyzing the samples in the metals lab to identify groups of samples. The batch number will also be used in data entry to identify the MPB and LFB for a group of samples. See metals laboratory SOP Appendix C for a detail step by step procedure for this process.

15.0 QUALITY ASSURANCE

15.1 One MPB is carried through the entire process to monitor contamination.

15.2 One LFB is carried through the entire process to monitor method accuracy.

15.3 5% matrix spikes/matrix spike duplicates are performed to determine matrix accuracy and precision.

15.4 If a sample is evaporated to dryness, some metals may be volatilized. If any portion of the bottom of the sample container is allowed to go dry, then the sample must be re-pretreated in another digestion batch.

15.5 Samples must not be allowed to boil. If a sample begins to boil, immediately remove it from the heat and turn the temperature down on the hotplate. Excessive boiling of samples will cause loss of analyte. Samples that have been boiled excessively must be repeated in another digestion batch.

Approved By: 11/24/98 QA Manager Approved By: 11/24/98 Area Manager

15.6 Ensure that the spiking solution being used is within the expiration date. If the standard has expired, do not use the solution. Find another spiking solution that has not expired.

16.0 ANALYST CERTIFICATION/METHOD VALIDATION

16.1 Before the analysis of any actual samples, each analyst must demonstrate the ability to generate acceptable accuracy and precision by running a one time analyst certification. While the analyst certification is not instrument/apparatus dependent, this certification is required on every instrument/apparatus that will be running samples to demonstrate instrument ability to generate acceptable accuracy and precision.

16.2 Prepare a quality control check sample spiking standard at a level which will give concentrations suitable for this procedure (a concentration when analyze will fall within 30 – 70 % range of the analytical curve).

16.3 Digest all four check samples following the procedures outlined in this SOP.

16.4 Submit samples to the metals laboratory for the appropriate analysis.

16.5 Calculate the average recovery (x) and the standard deviation of the recovery (s) in the applicable units for each analyte using the four results.

16.5.1 For each analyte x must be in the range 70-130% and s must be less than or equal to 20%. If s and x for all analytes meet the acceptance criteria, the analyst certification is considered acceptable. The analyst and the system are now authorized to run samples by this method. If any individual s exceeds the precision limit or any individual x falls outside the range for accuracy, then the system performance is unacceptable for that analyte.

16.5.2 When one or more of the analytes tested fail at least one of the acceptance criteria, the analyst must proceed according to 16.4.

16.6 Locate and correct the source of the problem and repeat the test for all analytes that failed to meet the criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds beginning with Section 16.1. Samples may not be analyzed by any analyst or on any instrument until the analyst certification has been successfully completed. Copies of the successful analyst certifications/method validation spreadsheet and raw data should be given to the Quality Assurance Manager.

17.0 REFERENCES

17.1 Instruction manuals for pipettors.

Approved By: 11/24/98 QA Manager

Approved By: 11/24/98 Area Manager

17.2 SOP on pipet calibration and monitoring.

17.3 USEPA SW846, Method 3010A Revision 1, July 1992

18.0 ATTACHMENTS/APPENDICES

18.1 Example Benchsheets.

Approved By: RA 11/24/98 QA Manager

Approved By: DR 11/24/98 Area Manager

TriMatrix Laboratories, Inc.

STANDARD OPERATING PROCEDURE

ACID DIGESTION OF SOLID WASTE, SLUDGES, AND SOILS FOR FLAME ATOMIC ABSORPTION, INDUCTIVELY COUPLED PLASMA, OR FURNACE ATOMIC ABSORPTION

USEPA METHOD 3050B, MODIFIED

UNCONTROLLED DOCUMENT

APPROVALS:

Inorganic Manager: _____ Date: 11/24/98
Douglas E. Kriscunas

QA Manager: _____ Date: 11/24/98
Rick D. Wilburn

Laboratory Manager: _____ Date: 11/24/98
Douglas E. Kriscunas

Procedure Number: GR-01-103
Revision Number: 3.0

Date Initiated: 2/1/96
Effective Date: 11/24/98

Date Revised: 11/24/98
Pages Revised: All

By: Marge Scott

Total Number of Pages: 9

1.0 SCOPE AND APPLICATION

1.1 This method is an acid digestion procedure used to prepare sludges, solid waste, and soil samples for analysis by flame atomic absorption (FLAA), inductively coupled plasma (ICP), or by graphite furnace atomic absorption (GFAA) as indicated by Section 2.0.

2.0 PRINCIPLE METHOD REFERENCES

2.1 *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition,* Final Update III, Revision 2, December, 1996, "Acid Digestion of Sediments, Sludges, and Soils".

3.0 SUMMARY OF PROCEDURE

3.1 A representative sample is digested in nitric acid and hydrogen peroxide. The digestate is then refluxed with hydrochloric acid if the digestate is to be analyzed by FLAA or ICP. If the digestate is to be analyzed for GFAA, then the sample is refluxed with nitric acid. The final digestate is then filtered and diluted to a predetermined volume.

4.0 PARAMETER OR COMPOUND LIST

FLAA or ICP		GFAA
Aluminum	Molybdenum	Arsenic
Arsenic [1,2]	Nickel	Beryllium
Barium	Osmium	Cadmium
Beryllium	Phosphorus [1,2]	Chromium
Boron [1,2]	Potassium	Cobalt
Cadmium	Selenium [1,2]	Iron
Calcium	Silicon [1,2]	Lead
Chromium	Silver	Molybdenum
Cobalt	Sodium	Selenium
Copper	Strontium [1,2]	Silver
Iron	Thallium	Thallium
Lead	Tin [1,2]	Vanadium
Lithium [1,2]	Titanium [1,2]	
Magnesium	Vanadium	
Manganese	Zinc	

1) This analyte is not covered for digestion in SW-846. Its inclusion in this procedure is due to clients' request for this metal.
2) This metal may only be analyzed by ICP.

Approved By: 11/24/98 QA Manager

Approved By: 11/24/98 Area Manager

5.0 REFERENCED SOPs

5.1 None Referenced.

6.0 INTERFERENCES AND CORRECTIVE PROCEDURES

6.1 Silver precipitation can be avoided by adding an excess of HCl.

6.2 This digestion may not be applicable to all types of solid waste material due to insolubility in the acids and/or water. If the sample superheats during the digestion procedure, an alternative method may have to be used (such as USEPA 3051).

6.3 This digestion will not totally dissolve most matrices. If a total dissolution procedure is required for the sample, the analyst should seek the advice of the metals lab supervisor.

6.4 Contamination is always a major consideration in the analysis of metals. Make sure that the preparation area is free of dust, dirt, etc. before beginning this procedure.

7.0 SAFETY PRECAUTIONS

7 .1 The analyst must comply with all standard operating procedures for health and safety as outlined in the "TriMatrix Laboratory Safety Manual".

7.2 Concentrated acids are used in the preparation of samples for analysis. Gloves and safety glasses must be worn at all times when handling concentrated acids. Gloves must also be worn when handling digested samples.

8.0 SAMPLE SIZE, COLLECTION, PRESERVATION AND HANDLING PROCEDURES

8.1 To ensure enough sample for QC and/or repeats collect at least 30 grams of material to be tested. Sample preservation is not required. Samples must be digested and analyzed within 180 days of collection.

9.0 INSTRUMENTATION, APPARATUS, AND MATERIALS

9.1 Eppendorf Pipettor (capable of delivering 500 ul).

9.2 Adjustable pump-type dispenser capable of dispensing 2.5 ml of reagent. This pump is for the concentrated HNO_3.

9.3 Adjustable pump-type dispenser capable of dispensing 5.0 ml of reagent. Concentrated HCl.

9.4 Corning hot Plates . Model #PC-500.

9.5 Griffin beakers (identified for 3050-soils).

9.6 Ribbed watch glasses.

9.7 Class A volumetric flasks.

9.8 Whatman 41 filter paper (or equivalent).

9.9 Plastic funnels.

9.10 Plastic specimen containers.

9.11 Balance (capable of weighing to 0.01 grams).

9.13 Spatulas.

9.14 Alcohol thermometers capable of reading 95*C.

10.0 ROUTINE PREVENTIVE MAINTENANCE

10.1 Calibrate all pipettors once per week.

10.2 Clean hot plates and counters daily.

11.0 CHEMICALS AND REAGENTS

11.1 Deionized/Distilled water (ASTM Type I).

11.2 Concentrated nitric acid, trace metal grade (HNO_3).

11.3 Concentrated hydrochloric acid, trace metal grade (HCl).

11.4 Hydrogen peroxide (30%) (H_2O_2).

11.4 Milli-Q water (ASTM Type I).

11.5 1:1 HNO_3 for cleaning filters. Into 500 ml ASTM Type II water, add 500 ml concentrated HNO_3. Always use a suitable container capable of withstanding the heat generated by the exothermic dilution of

the acid. Always add acid to water (failure to do so could result in a violent explosion of acid as the water boils).

12.0 STANDARDS PREPARATION

12.1 FLAA/ICP spiking solutions (see Appendix A).

12.2 GFAA spiking solutions. 10,000 ppb single-element furnace standards are used for this procedure. Please refer to Appendix B for standard preparation.

13.0 DETAILED PROCEDURE

13.1 Determine whether samples need to be digested for ICP/FLAA or GFAA.

13.2 Run a pretreatment benchsheet to determine analyses needed (see Appendix F).

12.3 Dry and grind the samples (see Appendix M).

13.4 Label a 150 ml griffin beaker with the sample number, client name, and any dilution factor.

13.5 We must perform 5% matrix spikes and matrix spike duplicates. If this sample has been designated as needing matrix QC (MS/MSD), then repeat step 13.4 with two more aliquots of the sample. Label the first aliquot's beaker with "SPK", and the second one as "MSD".

13.6 Repeat steps 13.4 through 13.5 until there are 20 samples in the batch, or until there are no more samples to be prepared.

13.7 Label 1 beaker as MPB (method preparation blank) and 1 beaker as LFB (laboratory fortified blank). Set aside for now.

13.8 Weigh out the samples.

13.8.1 For FLAA/ICP, weigh 2.50 grams of each remaining sample into 150 ml soil beakers. Record the weight to the nearest 0.01 g. If this sample has been designated for matrix QC, then weigh approximately 10 grams of the mixed sample into a weigh boat and mix again. From the weigh boat, weigh 2.50 g into each of 3-150 ml soil beakers. Record the exact weight to the nearest 0.01 g.

13.8.2 For GFAA, weigh 0.40 grams of each remaining sample into 150 ml soil beakers. Record the weight to the nearest 0.01 g. If this sample has been designated for matrix QC, then weigh approximately 5 grams of the mixed sample into a weigh boat and mix again. From the weigh boat, weigh 0.40 g into each of 3-150 ml soil beakers. Record the exact weight to the nearest 0.01 g.

13.9 Repeat step 13.8 until there are 20 samples in the batch or until there are no more samples to be prepared.

13.10 For ICP/FLAA, add 10 ml of ASTM Type I water to all the beakers, including the MPB and LFB. For GFAA, add 10 ml of ASTM Type I water to all the beakers, including the MPB and LFB.

13.11 All of the samples labeled as SPK, MSD, or LFB must be spiked appropriately before digestion.

13.11.1 For ICP/FLAA, see Appendix A. The final solution volume will be 50 ml.

13.11.2 For GFAA, see Appendix B. The final volume will be 50 ml.

13.12 Add the nitric acid (HNO_3)

13.12.1 For ICP/FLAA, add 2.5 ml of trace metal HNO_3, cover with a ribbed watch glass. Heat the samples to 95°C and reflux for 15 minutes. Do not allow samples to boil or go dry.

13.12.2 For GFAA, add 2.5 ml of trace metal HNO_3, cover with a ribbed watch glass. Heat the samples to 95°C and reflux for 15 minutes. Do not allow samples to boil or go dry.

13.13 Allow the sample to cool. Repeat Step 13.12, refluxing for 30 minutes this time. Do not allow samples to boil or go dry.

13.14 Repeat Step 13.13 to ensure complete oxidation of the sample.

13.15 Reflux the sampled until the volume is reduced to approximately 5 ml. Do not allow samples to boil or go dry.

13.16 If the samples are being prepared for ICP/FLAA, cool, add 2 ml ASTM Type II Water and 10 ml of 30% H_2O_2 very slowly to every beaker in 1 ml increments. If the samples are being prepared for GFAA, cool, add 2 ml ASTM Type II H_2O and 5 ml of 30 H_2O_2 very slowly to every beaker in 1 ml increments. Be sure that the reaction does not cause the sample to boil out of the beaker! Cover the beaker with a watch glass and return the beaker to the hotplate. Warm on a hot plate until the reaction stops. Cool. NOTE: This step may result in a vigorous reaction due to the peroxide. Be sure that the sample does not effervesce over the side of the beaker. If any of the sample is spilled due to this step, the sample must be discarded and reprepped in another digestion batch.

13.17 Continue to add peroxide in 1 ml aliquots with warming until the samples do not change in appearance, the effervescence is minimal, or until 10 ml of peroxide has been added for ICP/FLAA. For GFAA until 5 ml of peroxide has been added.

13.18 Cool the samples.

13.19 If the samples are being prepared for ICP/FLAA, then add 5 ml concentrated trace metal HCl. Cover the beaker and warm for 15 minutes or volume = 10 ml on the hotplate. Cool. Go to Step 13.21.

13.20 If the samples are being prepared for GFAA, then cover the beaker and reflux until the volume has been reduced to about 5 ml. Cool. Go to Step 13.21.

13.21 Rinse 50 ml volumetric flasks with ASTM Type II water 3 times.

13.22 Rinse watch glass into the beaker with ASTM Type II water. Pour the samples in to 50 ml volumetric flasks. Rinse the contents of the beaker into the flask with ASTM Type II water. Rinse the beaker several times with ASTM Type II water. Dilute the samples, LFB, and MPB to 50 ml with ASTM Type II water.

13.23 The samples may now be allowed to settled, centrifuged, or filtered.

13.23.1 Filtration - Rinse Whatman 41 filter paper which has been inserted into a funnel several times with 1:1 HNO_3 followed by several rinsings with ASTM Type II water. Pour the sample through the filter and collect the filtrate into a centrifuge tube or plastic cup. NOTE: If any of the samples within the batch are filtered, all of the samples within the batch must be filtered.

13.24 Label all of the sample containers with the client name, sample number, dilution information, and any other information that may be useful during the analysis. Place the LIMS batch number on the top of the container.

13.25 Pretreat on LIMS to get a batch # (see Appendix C).

13.26 Place samples in appropriate cabinet in metals instrument lab.

13.27 Fill out the pretreatment and lab notebooks (see Appendix D).

14.0 REPORTING AND DELIVERABLES

14.1 All samples that require a digestion must be pretreated on LIMS after digestion. A group of samples digested together using the same digestion method are given a LIMS batch number. This batch number is used by the analysts when analyzing the samples in the metals lab to identify groups of samples. The batch number will also be used in data entry to identify the MPB and LFB for a group of samples. See metals laboratory SOP Appendix C for a detail step by step procedure for this process.

15.0 QUALITY ASSURANCE

Approved By: 11/24/98 QA Manager

Approved By: 11/24/98 Area Manager

15.1 An MPB is carried through the entire process to monitor contamination. One MPB is required for each digestion batch (up to 20 samples).

15.2 An LFB is carried through the entire process to monitor digestion and spiking accuracy. One LFB is required for each digestion batch (up to 20 samples).

15.3 5% matrix spikes must be performed to determine accuracy and check for interferences.

15.4 5% matrix spike duplicates must be performed to determine precision and check for interferences.

15.5 Monitor and document all digestion temperatures as specified section 14.8.

16.0 ANALYST CERTIFICATION/METHOD VALIDATION

16.1 Before the analysis of any actual samples, each analyst must demonstrate the ability to generate acceptable accuracy and precision by running a one time analyst certification. While the analyst certification is not instrument/apparatus dependent, this certification is required on every instrument/apparatus that will be running samples to demonstrate instrument ability to generate acceptable accuracy and precision.

16.2 Prepare a quality control check sample spiking standard at a level which will give concentrations suitable for this procedure (a concentration when analyze will fall within 30 – 70 % range of the analytical curve).

16.3 Digest all four check samples following the procedures outlined in this SOP.

16.4 Submit samples to the metals laboratory for the appropriate analysis.

16.5 Calculate the average recovery (x) and the standard deviation of the recovery (s) in the applicable units for each analyte using the four results.

16.5.1 For each analyte x must be in the range 70-130% and s must be less than or equal to 20%. If s and x for all analytes meet the acceptance criteria, the analyst certification is considered acceptable. The analyst and the system are now authorized to run samples by this method. If any individual s exceeds the precision limit or any individual x falls outside the range for accuracy, then the system performance is unacceptable for that analyte.

16.5.2 When one or more of the analytes tested fail at least one of the acceptance criteria, the analyst must proceed according to 16.4.

16.6 Locate and correct the source of the problem and repeat the test for all analytes that failed to meet the criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds beginning with Section 16.1. Samples may not be analyzed by any analyst or on any instrument until the analyst

certification has been successfully completed. Copies of the successful analyst certifications/method validation spreadsheet and raw data should be given to the Quality Assurance Manager.

17.0 REFERENCES

17.1 Instruction manuals for pipettors.

17.2 SOP on pipet calibration and monitoring.

17.3 SW846, November 1986 Third Edition. USEPA Method 3050B Revision 2, Date December 1996.

18.0 ATTACHMENTS/APPENDICES

18.1 Example Benchsheets.

Approved By: 11/24/98
QA Manager

Approved By: 11/24/98
Area Manager

02-NOV-1998 08:11 METALS DIGESTION BENCHSHEET PAGE 1

Method: D/ICP/3050B/SOL USEPA-3050B
Test: 2.2-2.8

Date run: 11-2-98
Analyst: MSS
Hours:
Stock Std: ELAN

Batch 135712

Lab Due... Submittal	Client..... COC	QC	Bottles	C F H R	Sample Parameters	Digested?
09-NOV 30620-	[redacted] 18	LV1	1@16	1 0 1 1	210183 AgT AsT CdT SeT	✓
09-NOV 30620-	[redacted] 18	LV1	1@16	1 0 1 1	210184 AgT AsT CdT SeT	✓
09-NOV 30620-	[redacted] 18	LV1	1@16	1 0 1 1	210185 AgT AsT CdT SeT	✓
09-NOV 30620-	[redacted] 18	LV1	1@16	1 0 1 1	210186 AgT AsT CdT SeT	✓
09-NOV 30620-	[redacted] 18	LV1	1@16	1 0 1 1	210187 AgT AsT CdT SeT	✓
09-NOV 30620-	[redacted] 18	LV1	1@16	1 0 1 1	210188 AgT AsT CdT SeT	✓
09-NOV 30620-	[redacted] 18	LV1	1@16	1 0 1 1	210189 AgT AsT CdT SeT	✓
09-NOV 30620-	[redacted] 18	LV1	1@16	1 0 1 1	210190 AgT AsT CdT SeT	✓

DWG
11-06-98

HNO_3 118010
H_2O_2 982191

02-NOV-98

METALS PRETREATMENT BENCHSHEET

Test #: 2.02- 2.08
Parameter: METALS PRETREAT-SOL 3050B
Method: D/ICP/3050B/SOL
Ref. cit.: USEPA-3050B

Est anal hrs: 4
Act anal hrs:
Stock std #: ELAN1

Owner: NSS
Date run: 11-2-98
Supervisor:
QC Batch #: 135712

Comments:

Client Submittal Location	Sample	COC	QC	Anl.	Date Treated	Initial wt/vol	Final wt/vol	Conc. Spiking Solution	SPK STK #	Volume Spiked	Final Spike Conc.	Qu
[redacted] 30620- 18 SS-17 (0-1	210183		LV1	NSS	11-2-98	0.14g	50ml		ELAN1	4500		
[redacted] 30620- 18 SS-17 (4'-	210184		LV1									
[redacted] 30620- 18 SS-18 (0'-	210185		LV1									
[redacted] 30620- 18 SS-18 (7'-	210186		LV1									
[redacted] 30620- 18 SS-19 (0'-	210187		LV1									
[redacted] 30620- 18 SS-19 (6'-	210188		LV1									
[redacted] 30620- 18 SS-20 (0'-	210189		LV1									
[redacted] 30620- 18 SS-20 (6'-	210190		LV1									
MPB: 1												
LFB: Stk 2												
SPK1: Stk	Smp 210183								ELAN1	4500		
SPK2: Stk	Smp											
DUP:	Smp											

15m7 J66t15m7 J66t

Batch #	Opened	Owner	Seq	Complete	Control	Common name	Application	Ref cit	Qty samp	ICB	ICV	LCS	CCB	CCV
135712	02-NOV-98	MSS	2	YES	YES	D/FLIC/3050/SOL	SOIL	USEPA-3050A	0	0	0	0	0	0

	Seq	Sur-seq	QC bat	Run date	Anal	Sample	Appli	Det lim	Init conc	Final conc	Spike	Parameter	Type	%	LCL	UCL	QC	E	D	Ref cit
v	1.000	-		11/02/98	MSS	210183	SOIL					METALS PRETREAT-SOL 3050B	REG- 1							USEPA-3050B
v	2.000	-		11/02/98	MSS	210184	SOIL					METALS PRETREAT-SOL 3050B	REG- 1							USEPA-3050B
v	3.000	-		11/02/98	MSS	210185	SOIL					METALS PRETREAT-SOL 3050B	REG- 1							USEPA-3050B
v	4.000	-		11/02/98	MSS	210186	SOIL					METALS PRETREAT-SOL 3050B	REG- 1							USEPA-3050B
v	5.000	-		11/02/98	MSS	210187	SOIL					METALS PRETREAT-SOL 3050B	REG- 1							USEPA-3050B
v	6.000	-		11/02/98	MSS	210188	SOIL					METALS PRETREAT-SOL 3050B	REG- 1							USEPA-3050B
v	7.000	-		11/02/98	MSS	210189	SOIL					METALS PRETREAT-SOL 3050B	REG- 1							USEPA-3050B
v	8.000	-		11/02/98	MSS	210190	SOIL					METALS PRETREAT-SOL 3050B	REG- 1							USEPA-3050B

TriMatrix Laboratories, Inc.

STANDARD OPERATING PROCEDURE

CYANIDE

PRELIMINARY MIDI-DISTILLATION

USEPA METHOD 335.4
USEPA METHOD 9012A
STANDARD METHODS 4500-CN⁻ B.

UNCONTROLLED DOCUMENT

APPROVALS:

Inorganic Manager: _____ Date: 1/20/99
Douglas E. Kriscunas

QA Manager: _____ Date: 1/20/99
Rick D. Wilburn

Laboratory Manager: _____ Date: 1/20/99
Douglas E. Kriscunas

Procedure Number: GR-18-109
Revision Number: 2.0

Date Initiated: 7/23/93
Effective Date: 1/20/99

Date Revised: 1/20/99
Pages Revised: All

By: Jodi L. Blouw

Total Number of Pages: 13

1.0 SCOPE AND APPLICATION

1.1 This method is applicable to the distillation of inorganic cyanides, present as either simple soluble salts or complex radicals, in both water and wastewater.

1.2 The applicable range for this method is 0.005 to 1.0 mg/L.

1.3 The reporting limit for this method is 0.005 mg/L.

2.0 PRINCIPAL METHOD REFERENCES

2.1 *Methods for the Determination of Inorganic Substances in Environmental Samples*, August, 1993, "Determination of Total Cyanide by Semi-Automated Colorimetry", Method 335.4, Revision 1.0, August, 1993.

2.2 *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition*, Final Update III, Revision 1, December, 1996, Method 9012A, "Total and Amenable Cyanide (Automated Colorimetric, with Off-Line Distillation)".

2.3 *Standard Methods for the Examination of Water and Wastewater, 19th Edition, 1995*, 4500-CN⁻ Cyanide, B. Preliminary Treatment of Samples.

3.0 SUMMARY OF PROCEDURE

3.1 The cyanide present in the sample is released as a gas (HCN) upon the addition of sulfuric acid. The HCN is collected in a NaOH scrubbing solution. The NaOH scrubbing solution is then analyzed for cyanide following TriMatrix SOP number GR-02-100. This distillation SOP has one major modification from the published method. Due to safety and waste considerations, the SOP uses the bismuth nitrate specified in method 9012A to eliminate sulfide interferences, rather than the cadmium carbonate specified in methods 335.4 and 4500-CN⁻ B.

4.0 PARAMETER OR COMPOUND LIST

4.1 Cyanide, Distillation

5.0 REFERENCED SOPs

5.1 TriMatrix SOP number GR-02-100, *Cyanide, Total, Lachat Autoanalyzer*, most current version.

6.0 INTERFERENCES AND CORRECTIVE PROCEDURES

6.1 Most interfering substances are removed in the distillation process.

6.2 Sulfides adversely affect the colorimetric procedure. Sulfides are removed by the addition of bismuth nitrate solution prior to distillation. See section 13.2.

6.3 High results may be obtained for samples that contain nitrate and or nitrite. Dnring the distillation nitrate and nitrite will form nitrous acid which will react with some organic componnds to form oximes. These compounds will decompose under test conditions to generate HCN. The interference of nitrate and nitrite is eliminated by pretreatment with sulfamic acid. See section 13.19.

6.4 Oxidizing agents can cause a negative interference by destroying cyanide containing compounds. This interference is removed by treating with ascorbic acid. See section 13.3.

7.0 SAFETY PRECAUTIONS

7.1 The analyst must comply with all standard operating procedures for health and safety as outlined in the TriMatrix Laboratory Safety Manual.

7.2 The heating block is hot during use. Avoid skin contact to prevent burns.

7.3 This method involves acidifying samples that could potentially contain high levels of cyanide. The distillation procedure must be carried out under a fume hood.

7.4 Avoid skin contact with sulfuric acid, sodium hydroxide, and their solutions. Always wear safety glasses, gloves and protective clothing.

7.5 Potassium cyanide (KCN) is a violent poison. Avoid skin contact. Do not breath dust or vapor. Always open the container and dilute all solutions in a fume hood. Keep potassium cyanide away from acids.

8.0 SAMPLE SIZE, COLLECTION, PRESERVATION AND HANDLING PROCEDURES

8.1 Waters and wastewaters are to be collected in opaque brown, inert plastic bottles and preserved with sodium hydroxide to a pH of 12 to 12.5. Analysis must be performed within 14 days of sample collection.

8.2 All samples should be stored at 4°C until the time of analysis.

8.3 Waters and wastewaters must be homogenized by shaking just prior to removing a sample aliquot.

9.0 INSTRUMENTATION, APPARATUS, AND MATERIALS

9.1 Reflux distillation apparatus as shown in diagram (see attachment 18.1)

9.2 Heating mantle or block

9.3 Volumetric flasks

9.4 Volumetric pipets

9.5 Mettler balance, readable to 0.01 g

9.6 Graduated cylinders

10.0 ROUTINE PREVENTIVE MAINTENANCE

10.1 Wipe down the midi distillation heating block after each use.

11.0 CHEMICALS AND REAGENTS

11.1 Reagent Water, ASTM Type II, Milli-Q

11.2 Sodium Hydroxide (NaOH)

11.2.1 Fisher NF/FCC grade pellets, or equivalent

11.3 Bismuth Nitrate, 5-Hydrate ($Bi(NO_3)\bullet 5H_2O$)

11.3.1 J.T. Baker reagent grade powder, or equivalent

11.4 Concentrated Sulfuric Acid (H_2SO_4)

11.4.1 J.T. Baker reagent grade or equivalent

11.5 Sulfuric Acid Solution: 50/50 (V/V)

11.5.1 Slowly add 500 mL of concentrated H_2SO_4 to 500 mL of reagent water. Allow to cool before use.

11.6 Potassium Cyanide (KCN)

11.6.1 J.T. Baker reagent grade granules or equivalent

11.7 Magnesium Chloride, 6-Hydrate ($MgCl_2\bullet 6H_2O$)

11.7.1 J.T. Baker reagent grade crystals, or equivalent

11.8 Sulfamic Acid (NH_2SO_3H)

11.8.1 J.T. Baker reagent grade powder, or equivalent

11.9 L-Ascorbic Acid

11.9.1 Fisher reagent grade powder, or equivalent

11.10 Potassium iodide - starch test paper

11.11 Sodium Hydroxide Solution, 0.25N

11.11.1 Dissolve 10.0 g of sodium hydroxide pellets and dilute to 1.0 liter in reagent water. May be stored in an inert plastic container at room temperature indefinitely.

11.12 Bismuth Nitrate Solution

11.12.1 Dissolve 30.0 g of $Bi(NO_3)_3$ in 100 mL reagent water. While stirring, add 250 mL of glacial acetic acid. Stir until dissolved. Dilute to 1 liter with reagent water. May be stored in an inert plastic container at room temperature for up to 6 months.

11.13 Magnesium Chloride Solution

11.13.1 Weigh 510 g of $MgCl_2 \bullet 6H_20$ into a 1,000 mL flask, dissolve, and dilute to 1 liter with reagent water. May be stored in an inert plastic container at room temperature for up to 6 months.

11.14 Sulfamic Acid Solution

11.14.1 Dissolve 40 g of sulfamic acid in reagent water. Dilute to 1 liter. May be stored in an inert plastic container at room temperature for up to 6 months.

11.15 Glacial Acetic Acid

11.15.1 J.T. Baker Reagent grade, or equivalent

11.16 Anhydrous Sodium Acetate

11.16.1 J.T. Baker Reagent grade, or equivalent

11.17 Acetate Buffer Solution, pH = 4.0

11.17.1 In a 50 mL volumetric flask, dissolve 7.3 g anhydrous sodium acetate in about 20 mL reagent water. Add 24 g glacial acetic acid and dilute to volume with reagent water.

11.17.2 May be stored in an inert plastic bottle at room temperature indefinitely.

12.0 STANDARDS PREPARATION

12.1 Any samples treated with bismuth nitrate for sulfide interferences (section 13.18) must be quantitated using a calibration curve run with standards that have also been treated with bismuth nitrate. Standards preparation is covered in TriMatrix SOP number GR-02-100, section 12.0

13.0 DETAILED PROCEDURE

13.1 Measure 50 mL of sample and add it to a reflux/absorber tube along with 2 or 3 boiling stones.

13.2 Use lead acetate paper to check the sample for the presence of sulfide. A positive test is indicated by a black color on the paper. Samples will be treated for the presence of sulfide using bismuth nitrate, in section 13.18.

13.3 Use a strip of potassium iodide starch test paper that has been dampened with an acetate buffer at a pH of 4.0 to test for the presence of interference causing oxidizing agents. If the test paper turns blue, add ~ 0.2 g ascorbic acid powder, stir, and test again. Repeat this process until the paper no longer turns blue, then add ~ 0.05 g additional ascorbic acid powder.

13.4 Place the reflux tube containing the sample into the left most open heat block hole.

13.5 Add 50 mL of 0.25N NaOH to a reflux/absorber tube and place the tube into the lower left most hole of the block. Add 1 to 2 drops of antifoam.

13.6 Place a reflux impinger with the gas exit tube facing the rear of the distillation block into the reflux sample tube in the heat block.

13.7 Place an absorber impinger with the gas inlet tube facing the rear of the distillation block into the absorber tube.

13.8 Connect the absorber impinger gas inlet tube to the reflux impinger gas outlet tube.

13.9 Connect the absorber impinger vacuum tube to the valve tube.

13.10 Place a Cold Finger Condenser with water ports facing the rear into the reflux impinger tube.

13.11 Connect the Cold Finger water tubes to the water manifold QD adapters on the rear of the unit. The lower tube connects to the forward manifold (water outlet) and the upper tube connects to the rear manifold (water inlet).

13.12 Repeat 13.1-13.11 for each sample. Up to 10 samples may be loaded at one time.

13.13 Turn off each vacuum valve.

13.14 Check to make sure an excess gas trap is loaded and connected to the vacuum line connected to the distillation block.

13.15 Turn on cooling water and adjust to 6 GPH for each sample position, i.e. if 4 samples are present, adjust the flow to 24 GPH (6 x 4).

UNDER NO CIRCUMSTANCES OPERATE COOLING WATER UNLESS COLD FINGER CONDENSERS ARE CONNECTED TO THE WATER MANIFOLD. IMPROPER USE MAY DAMAGE COLD FINGER CONDENSERS AND/OR RUPTURE TUBING.

13.16 Turn on the vacuum to the unit and adjust each valve to give a flow of three bubbles per second in each reflux tube.

13.17 Allow vacuum to draw for 5 minutes.

13.18 If the sample tested positive for sulfide (section 13.2), add 10 mL bismuth nitrate solution at this time.

13.19 Add 5 mL of sulfamic acid through the air inlet of each reflux impinger.

13.20 Inject 5 mL of 50% [v/v] H_2SO_4 through the air inlet of each reflux impinger.

13.21 Allow the vacuum to draw for 5 minutes.

13.22 Inject 2 mL magnesium chloride solution through the air inlet of each reflux impinger. Inject another 2 mL if excessive foaming occurs.

13.23 Turn unit on. The red rocker switch light will glow when the unit is on.

13.24 Turn on timer. Green timer light and amber heat lights will glow. The timer allows for 15 minutes heat up time and 90 minutes of refluxing time. Heat block is factory preset to 125°C.

13.25 Timer will automatically turn off heat block after time has expired. Vacuum draw and cooling water are unaffected. If the timer is not being used, turn unit off after 105 minutes.

13.26 Allow the unit to cool 15 minutes before turning off cooling water and vacuum.

13.27 Close each valve and disconnect absorber gas inlet tube from the reflux impinger.

13.28 Starting from the right, open valve to draw all solutions from the absorber impinger frit. Close the valve and remove the impinger frit from the solution.

13.29 Disconnect the impinger vacuum tube and remove the absorber impinger from the unit.

13.30 Pour the distillate from the absorber tube into a labeled plastic storage cup. Label and cap the storage cup until analysis.

13.31 Repeat 13.28-13.30 for each sample position.

14.0 REPORTING AND DELIVERABLES

14.1 The following data is to be put on the pretreatment benchsheet for each batch distilled:

- Volume of water or wastewater sample in mL
- Final volume of diluted distillate
- Volume and concentration of all stock standards used as spikes
- Analyst initials
- Date

14.2 See attached copy of pretreatment benchsheet and pretreatment batch detail report (attachments 18.2 and 18.3).

15.0 QUALITY ASSURANCE

15.1 Method and matrix QC must be distilled for each batch. A batch consists of a maximum of 20 samples per matrix, and may be left open for 2 weeks.

15.1.1 The LFB is an aliquot for a separate stock standard spiked into reagent water, distilled, and analyzed like a sample. Both a low and a high level LFB are distilled for each batch.

15.1.1.1 To prepare the high LFB, place 50 mL of reagent water into a distillation tube. Add 100 uL of the 100 mg/L separate source stock standard (see section 12.7 of TriMatrix SOP number GR-02-100) and proceed with the distillation. The LFB spike concentration is 0.2 mg/L cyanide.

15.1.1.2 To prepare the low LFB, place 50 mL of reagent water into a distillation tube. Add 50 uL of the 100 mg/L separate source stock standard (see section 12.7 of TriMatrix SOP number GR-02-100) and proceed with the distillation. The LFB spike concentration is 0.02 mg/L cyanide.

15.1.2 The MPB is a 50 mL aliquot of reagent water distilled like a sample. Add 50 mL of reagent water to a distillation tube and proceed with the distillation.

15.1.3 A low level LFB, a high level LFB, and a MPB are distilled every time a new batch is opened. A MPB and a low or a high LFB are additionally distilled every day samples are distilled for that batch.

15.2 Matrix QC consists of two matrix spikes, SPK1 and SPK2. Matrix spikes are performed at a frequency of 1 set per 20 samples per matrix.

15.2.1 To prepare the spikes, place 50 mL of sample in two separate distillation tubes. Add 100 uL of the 100 mg/L separate source stock standard (see section 12.7 of TriMatrix SOP number GR-02-100) and proceed with the distillation. Spike concentration for the spikes is 0.2 mg/L.

15.2.2 Note: If the sample concentration is high, sample dilution and adjustment to the spike quantity may be necessary.

16.0 ANALYST CERTIFICATION/METHOD VALIDATION

16.1 Before the analysis of any actual samples, each analyst must demonstrate the ability to generate acceptable accuracy and precision by running a one time analyst certification. While the analyst certification is not instrument dependent, this certification is required on every instrument that will be running samples to demonstrate instrument ability to generate acceptable accuracy and precision.

16.2 Prepare a LFB at a level that will give a concentration of approximately 0.20 mg/L.

16.3 Analyze the LFB four times following the SOP.

16.4 Calculate the average percent recovery, and the standard deviation of the percent recoveries, using the four results.

16.4.1 Each recovery must be in the range 70-130 percent and the standard deviation must be less than or equal to 20. If both these criteria are met, the analyst certification is acceptable. The analyst and the system are now authorized to run samples by this method.

16.5 If either criteria are not met, locate and correct the source of the problem and repeat the test. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds beginning with section 16.2. Samples may not be analyzed by any analyst or on any instrument until the analyst certification has been successfully completed. Copies of the successful analyst certifications/method validations spreadsheet and raw data should be given to the Quality Assurance Manager.

17.0 REFERENCES

17.1 *Methods for the Determination of Inorganic Substances in Environmental Samples*, August, 1993, "Determination of Total Cyanide by Semi-Automated Colorimetry", Method 335.4, Revision 1.0, August, 1993.

17.2 *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition*, Final Update III, Revision 1, December, 1996, Method 9012A, "Total and Amenable Cyanide (Automated Colorimetric, with Off-Line Distillation)".

17.3 *Standard Methods for the Examination of Water and Wastewater, 19th Edition, 1995*, 4500-CN⁻ Cyanide, B. Preliminary Treatment of Samples.

17.4 Midi-Vap Model MC-100 Instruction Manual.

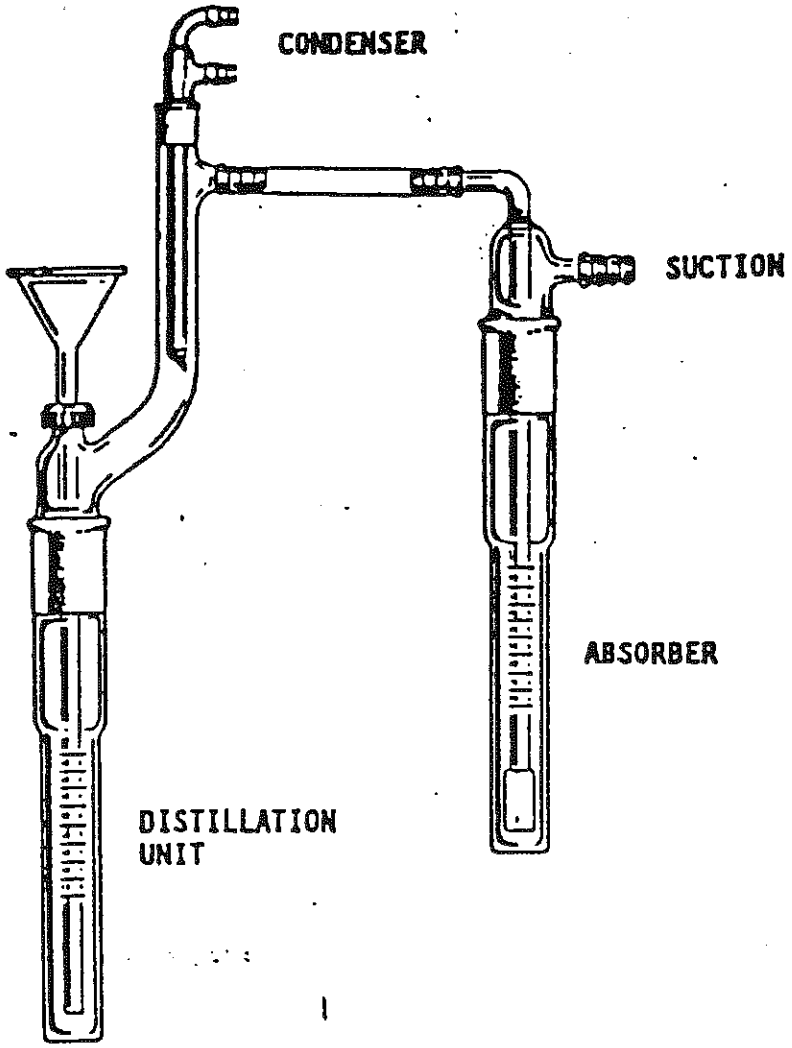
18.0 ATTACHMENTS/APPENDICES

18.1 Diagram of reflux distillation apparatus.

18.2 Benchsheet, pretreatment example.

18.3 Batch Detail Report, pretreatment example.

Attachment 18.1
Diagram of Reflux Distillation Apparatus



MIDI DISTILLATION APPARATUS

Attachment 18.2
Pre-treatment Benchsheet Example

Due: 1/13

08-JAN-99 WET CHEM PRETREATMENT BENCHSHEET PAGE 1

Test #: 394.01- 252.02
Parameter: INORGANIC PRETREATMENT
Method: CN/MAN-DIST/WW
Ref. cit.: SDM 4500-CN C

Est anal hrs: 4
Act anal hrs:
Stock std #: 1528.20.4

Owner: JMB
Date run: 1/8/99
Supervisor: [illegible]
QC Batch #: [illegible]-108

Comments: Checked for Interferences

Client Submittal Location	Sample	COC	QC	Anl.	Date Treated	Initial wt/vol	Final wt/vol	Conc. Spiking Solution	~~SPK~~ STK #	Volume Spiked	Final Spike Conc.	Qu
PTOS - Paw Paw												
32451- 252 Paw Paw P1	214515		LV1			50 ml	50 ml					
Sterling Plant												
32718- 648 SL #1 Grab	214397		LV2									
AlliedSignal, Inc.												
34168- 19 Cr Water 1	214459		LV2									
CONESTOGA-ROVERS & ASSOC. INC.												
1721- 49 967 010	214406 *		LV3									
ock Semiconductor Corp.												
887- 10 Wastewater	214454		LV2									
Lowell Engineering Corporation												
34793- 9 Era Wash 1	214458		LV1									
Sterling Plant												
32718- 649 SL #1 Grab	214485 *		LV2									
PTOS - Paw Paw												
32451- 252 Paw Paw P1	214516		LV1			50 ml	50 ml					
MPR:						50 ml	50 ml					
LFB: Stk 1528.20.4						50 ml	50 ml	100 ppm		100 ml	0.2 ppm	
SPK1: Stk ____ Smp ____												
SPK2: Stk ____ Smp ____												
DUP: ____ Smp ____												

TRIMATRIX LABORATORIES, INC

Approved By: [signature] 1/20/99
QA Manager

Approved By: [signature] 1/20/99
Area Manager

Attachment 18.3
Pre-treatment Batch Detail Report Example

15m7 J66t15m7 J66t

1999-JAN-12 14:35 BATCH DETAIL REPORT -- INORGANIC LABORATORY ANALYTICAL BATCH # 137762 PAGE 1 OF 1

Batch #	Opened	Owner	Seq	Complete	Control	Common name	Application	Ref cit	Qty samp	ICB	ICV	LCS	CCB	CCV
137762	29-DEC-98	JMB	1	NO	YES	CN/MAN-DIST/WTR	WATER	USEPA-335.2	0	0	0	0	0	0

	Seq	Sur-seq	QC bat	Run date	Anal	Sample	Appli	Det lim	Init conc	Final conc	Spike	Parameter	Type	%	LCL	UCL	QC	E	D	Ref cit
v	9.000	-		01/08/99	JMB	214515	WW					INORGANIC PRETREATMENT	REG-108							SDM 4500-CN C
v	10.000	-		01/08/99	JMB	214397	WW					INORGANIC PRETREATMENT	REG-108							SDM 4500-CN C
v	11.000	-		01/08/99	JMB	214459	WW					INORGANIC PRETREATMENT	REG-108							SDM 4500-CN C
v	12.000	-		01/08/99	JMB	214406	WW					INORGANIC PRETREATMENT	REG-108							SDM 4500-CN C
v	13.000	-		01/08/99	JMB	214454	WW					INORGANIC PRETREATMENT	REG-108							SDM 4500-CN C
v	14.000	-		01/08/99	JMB	214458	WW					INORGANIC PRETREATMENT	REG-108							SDM 4500-CN C
v	15.000	-		01/08/99	JMB	214485	WW					INORGANIC PRETREATMENT	REG-108							SDM 4500-CN C
v	16.000	-		01/08/99	JMB	214516	WW					INORGANIC PRETREATMENT	REG-108							SDM 4500-CN C

Approved By: 1/20/99
QA Manager

Approved By: 1/20/99
Area Manager

TriMatrix Laboratories, Inc.

STANDARD OPERATING PROCEDURE

CYANIDE, TOTAL

PRELIMINARY MACRO-DISTILLATION

USEPA METHOD 9010B
STANDARD METHODS 4500-CN⁻ B.
STANDARD METHODS 4500-CN⁻ C.

UNCONTROLLED DOCUMENT

APPROVALS:

Inorganic Manager: _____ Date: 2/1/99
Douglas E. Kriscunas

QA Manager: _____ Date: 2/1/99
Rick D. Wilburn

Laboratory Manager: _____ Date: 2/1/99
Douglas E. Kriscunas

Procedure Number: GR-18-106
Revision Number: 2.0

Date Initiated: 5/12/93
Effective Date: 2/1/99

Date Revised: 2/1/99
Pages Revised: All

By: Jodi Blouw

Total Number of Pages: 13

1.0 SCOPE AND APPLICATION

1.1 This method is applicable to the determination of cyanide in soil, sludge, and waste. If necessary, this method may be used for water and wastewater, using 250 mL of sample, and 250 mL of reagent water for distillation.

1.2 The method detects inorganic cyanides that are present as either simple soluble salts or complex radicals.

1.3 The applicable range for this method is 0.05 to 10 mg/kg.

1.4 The nominal reporting limit for this method is 0.05 mg/kg, but this varies for solids and soils based on percent solids. Wastes are reported on an "as received" basis.

2.0 PRINCIPAL METHOD REFERENCES

2.1 *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition,* Final Update III, Revision 2, December, 1996, Method 9010B, "Total and Amenable Cyanide: Distillation".

2.2 *Standard Methods for the Examination of Water and Wastewater, 19th Edition, 1995,* 4500-CN⁻ Cyanide, B. Preliminary Treatment of Samples.

2.3 *Standard Methods for the Examination of Water and Wastewater, 19th Edition, 1995,* 4500-CN⁻ Cyanide, C. Total Cyanide After Distillation.

3.0 SUMMARY OF PROCEDURE

3.1 The cyanide present in the sample is released as a gas (HCN) upon the addition of sulfuric acid. The HCN is collected in a NaOH scrubbing solution. The NaOH scrubbing solution is then analyzed for cyanide using TriMatrix SOP number GR-02-100, EPA Method 335.4/9012A.

4.0 PARAMETER OR COMPOUND LIST

4.1 Cyanide, Total.

5.0 REFERENCED SOPs

5.1 TriMatrix SOP number GR-02-100, *Cyanide, Total, Lachat Autoanalyzer*, most current version.

6.0 INTERFERENCES AND CORRECTIVE PROCEDURES

6.1 Most interfering substances are removed in the distillation process.

6.2 Sulfides adversely affect the colorimetric procedure. Sulfides are removed by the addition of bismuth nitrate solution prior to distillation.

6.3 High results may be obtained for samples that contain nitrate and/or nitrite. During the distillation nitrate and nitrite will form nitrous acid which will react with some organic compounds to form oximes. These compounds formed will decompose under test conditions to generate HCN. The interference of nitrate and nitrite is eliminated by pretreatment with sulfamic acid.

6.4 Oxidizing agents can cause a negative interference by destroying cyanide containing compounds. This interference is removed by treating with ascorbic acid.

7.0 SAFETY PRECAUTIONS

7.1 The analyst must comply with all standard operating procedures for health and safety as outlined in the TriMatrix Laboratories, Inc. Laboratory Safety Manual.

7.2 The heating mantles are hot during use. Avoid skin contact to prevent burns.

7.3 This method involves acidifying samples that potentially contain high levels of cyanide. The distillation procedure must be carried out under a fume hood.

7.4 Avoid skin contact with sulfuric acid, sodium hydroxide, and their solutions. Always wear safety glasses, gloves, and protective clothing.

7.5 Potassium cyanide (KCN) is a violent poison. Avoid skin contact. Do not breath dust or vapor. Always open the container and perform all dilutions in a fume hood. Keep potassium cyanide away from acids.

8.0 SAMPLE SIZE, COLLECTION, PRESERVATION AND HANDLING PROCEDURES

8.1 Wastes, sludges, and soils are to be collected in inert bottles with no preservative added.

8.2 All samples should be stored at 4°C until time of analysis.

8.3 Wastes, sludges, and soils must be homogenized thoroughly prior to analysis.

9.0 INSTRUMENTATION, APPARATUS, AND MATERIALS

9.1 Reflux distillation apparatus as shown in diagram (see Attachment 18.1). The boiling flask should be of 1 liter size with inlet tube and provision for condenser. The gas absorber is a Fisher-Milligan scrubber, or equivalent.

9.2 Volumetric flasks.

9.3 Volumetric pipets.

9.4 Mettler balance, readable to 0.01 g.

9.5 Graduated cylinders.

10.0 ROUTINE PREVENTIVE MAINTENANCE

10.1 After each batch, wipe all distillation heating mantles and counter areas clean.

11.0 CHEMICALS AND REAGENTS

11.1 Reagent Water, ASTM Type II, Milli-Q

11.2 Sodium Hydroxide (NaOH)

11.2.1 Fisher NF/FCC grade pellets, or equivalent

11.3 Bismuth Nitrate, 5-Hydrate ($Bi(NO_3)\bullet 5H_2O$)

11.3.1 J.T. Baker reagent grade powder, or equivalent

11.4 Concentrated Sulfuric Acid (H_2SO_4)

11.4.1 J.T. Baker reagent grade or equivalent

11.5 Potassium Cyanide (KCN)

11.5.1 J.T. Baker reagent grade granules or equivalent

11.6 Magnesium Chloride, 6-Hydrate ($MgCl_2\bullet 6H_2O$)

11.6.1 J.T. Baker reagent grade crystals, or equivalent

11.7 Sulfamic Acid (NH_2SO_3H)

11.7.1 J.T. Baker reagent grade powder, or equivalent

11.8 Potassium iodide – starch test paper

11.9 Sodium Hydroxide Solution, 1.25N

11.9.1 Dissolve 50.0 g of sodium hydroxide pellets into a 1000 mL volumetric flask partially filled with reagent water. Dilute to volume with reagent water. May be stored in an inert plastic container at room temperature indefinitely.

11.10 Bismuth Nitrate Solution

11.10.1 Dissolve 30.0 g of $Bi(NO3)_3$ into a 1000 mL volumetric flask filled with approximately 100 mL reagent water. Stir until dissolved. While stirring, add 250 mL of glacial acetic acid. Dilute to volume with reagent water. May be stored in an inert plastic container at room temperature for up to 6 months.

11.11 Magnesium Chloride Solution

11.11.1 Weigh 510 g of $MgCl_2 \bullet 6H_2O$ into a 1000 mL volumetric flask partially filled with reagent water. Stir to dissolve, then dilute to volume with reagent water. May be stored in an inert plastic container at room temperature for up to 6 months.

11.12 Sulfamic Acid Solution

11.12.1 Dissolve 40 g of sulfamic acid in a 1000 mL volumetric flask partially filled with reagent water. Dilute to volume with reagent water. May be stored in an inert plastic container at room temperature for up to 6 months.

11.13 Glacial Acetic Acid

11.13.1 J.T. Baker Reagent grade, or equivalent

11.14 Anhydrous Sodium Acetate

11.14.1 J.T. Baker Reagent grade, or equivalent

11.15 Acetate Buffer Solution, pH = 4.0

11.15.1 Dissolve 7.3 g anhydrous sodium acetate in a 50 mL volumetric flask filled with approximately 20 mL reagent water. Add 24 g glacial acetic acid and dilute to volume with reagent water. May be stored in an inert plastic bottle at room temperature indefinitely.

12.0 STANDARDS PREPARATION

12.1 Any samples treated with bismuth nitrate for sulfide interferences (section 13.5) must be quantitated using a calibration curve run with standards that have also been treated with bismuth nitrate. Standards preparation is covered in TriMatrix SOP number GR-02-100, section 12.0

13.0 DETAILED PROCEDURE

13.1 Weigh 25 g of a sample in a round bottom flask. Add 500 mL reagent water to the flask. Note: Larger sample aliquots are sometimes needed to achieve reporting limits for soils and sludges. See attachments 18.2 and 18.3.

13.2 Use lead acetate paper to check the sample for the presence of sulfide. A positive test is indicated by a black color on the paper. If positive, treat the sample by adding 50 mL of bismuth nitrate solution as instructed in section 13.5.

13.3 Use a strip of potassium iodide starch test paper that has been dampened with an acetate buffer at a pH of 4.0 to test for the presence of interference causing oxidizing agents. If the test paper turns blue, add ~ 0.2 g ascorbic acid powder, stir, and test again. Repeat this process until the paper no longer turns blue, then add ~ 0.05 g additional ascorbic acid powder.

13.4 Place flask in the heating unit and connect the distillation set-up. Add 50 mL of 1.25N NaOH to the scrubber assembly. Turn on the vacuum and adjust the bubble action in the gas dispersion tube. The flow rate should be 1-2 bubbles per second through the inlet tube. If a back up occurs, increase the bubble rate accordingly.

13.5 If sample tested positive for sulfides, treat the sample by adding 50 mL of bismuth nitrate solution through the air inlet tube after the air rate is set.

13.6 Add 50 mL of sulfamic acid solution through the inlet tube using a graduated cylinder. Mix for 3 minutes prior to the addition of H_2SO_4.

13.7 Slowly add 25 mL of concentrated H_2SO_4 through the inlet tube. Rinse the tube with reagent water.

13.8 After 3 minutes, add 20 mL of magnesium chloride reagent through the inlet tube. Again wash down the inlet tube.

13.9 Turn on the heating element and heat to a rapid boil. After the sample begins to boil, heat for one hour.

13.10 After one hour turn off heat but continue vacuum flow. Cool 20 minutes under vacuum before turning vacuum off and disassembling.

13.11 Pour the contents of the scrubber into a 250 mL volumetric flask. Dilute to volume using reagent water.

14.0 REPORTING AND DELIVERABLES

14.1 The following data is to be put on the pretreatment benchsheet for each batch distilled:

- Weight of each sample in grams.
- Final volume of diluted distillate.
- Volume and concentration of all stock standards used as spikes.
- Analyst initials

- Date
- Batch number

14.2 See attached copy of pretreatment benchsheet (Attachment 18.4).

15.0 QUALITY ASSURANCE

15.1 Method and matrix QC must be distilled for each batch. A batch consists of a maximum of 20 samples per matrix, and may be left open for 2 weeks.

15.1.1 Method QC consists of 2 LFBs (Laboratory Fortified Blanks) and a MPB (Method Preparation Blank).

15.1.1.1 The LFB is an aliquot of a separate stock standard spiked into reagent water, distilled, and analyzed like a sample. Both a low and a high level LFB are distilled for each batch.

15.1.1.1.1 To prepare the low LFB, place 500 mL of reagent water into a one liter distillation flask. Add 50 uL of the 1000 mg/L separate stock standard (see section 12.7 TriMatrix SOP number GR-02-100) and proceed with the distillation. The concentration of the LFB is 0.2 mg/L cyanide.

15.1.1.1.2 To prepare the high LFB, place 500 mL of reagent water into a one liter distillation flask. Add 100 uL of the 1000 mg/L separate stock standard (see section 12.7 TriMatrix SOP number GR-02-100) and proceed with the distillation. The concentration of the LFB is 0.4 mg/L cyanide.

15.1.1.2 The MPB is a 500 mL aliquot of reagent water that is distilled like a sample. Place 500 mL of reagent water into a one liter distillation flask and proceed with the distillation.

15.1.3 A low level LFB, a high level LFB, and a MPB are distilled every time a new batch is opened. A MPB and a low or a high LFB are additionally distilled every day samples are distilled for that batch.

15.2 Matrix QC consists of two matrix spikes, SPK1 and SPK2. Matrix spikes are performed at a frequency of 1 set per 20 samples per matrix.

15.2.1 To prepare the spikes, weigh out two aliquots of the sample into two separate one liter flasks. The grams of sample used should be the same for the SPK1, SPK2, and the regular sample. Add 500 mL of reagent water and 100 uL of the 1000 mg/L separate stock (see section 12.7 TriMatrix SOP number GR-02-100) and proceed with the distillation. Spike concentration is 0.4 mg/L.

15.2.2 Note: If the sample concentration is high, adjustment to the grams of sample and spike quantity may be necessary.

16.0 ANALYST CERTIFICATION/METHOD VALIDATION

16.1 Before the analysis of any actual samples, each analyst must demonstrate the ability to generate acceptable accuracy and precision by running a one time analyst certification. While the analyst certification is not instrument dependent, this certification is required on every instrument that will be running samples to demonstrate instrument ability to generate acceptable accuracy and precision.

16.2 Prepare a LFB at a level that will give a concentration of approximately 0.20 mg/L.

16.3 Analyze the LFB four times following the SOP.

16.4 Calculate the average percent recovery, and the standard deviation of the percent recoveries, using the four results.

16.4.1 Each recovery must be in the range 70-130 percent and the standard deviation must be less than or equal to 20. If both these criteria are met, the analyst certification is acceptable. The analyst and the system are now authorized to run samples by this method.

16.5 If either criteria are not met, locate and correct the source of the problem and repeat the test. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds beginning with section 16.2. Samples may not be analyzed by any analyst or on any instrument until the analyst certification has been successfully completed. Copies of the successful analyst certifications/method validations spreadsheet and raw data should be given to the Quality Assurance Manager.

17.0 REFERENCES

17.1 *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition,* Final Update III, Revision 2, December, 1996, Method 9010B, "Total and Amenable Cyanide: Distillation".

17.2 *Standard Methods for the Examination of Water and Wastewater, 19th Edition, 1995,* 4500-CN⁻ Cyanide, B. Preliminary Treatment of Samples.

17.3 *Standard Methods for the Examination of Water and Wastewater, 19th Edition, 1995,* 4500-CN⁻ Cyanide, C. Total Cyanide After Distillation.

18.0 ATTACHMENTS/APPENDICES

18.1 Reflux Distillation Apparatus Diagram.

18.2 Grams Needed for Variable Percent Solids, 0.5 mg/kg.

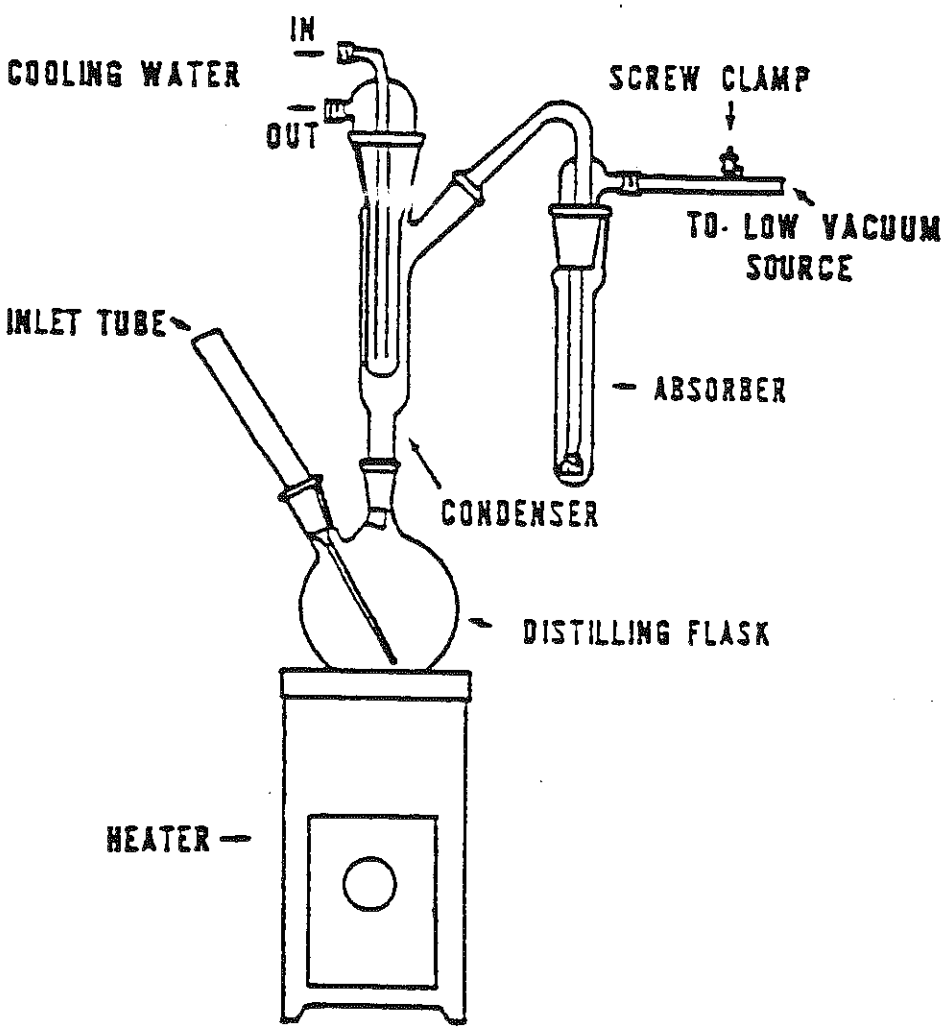
Approved By: 2/1/99 **QA Manager** **Approved By:** 2/1/99 **Area Manager**

18.3 Grams Needed for Variable Percent Solids, 0.1 mg/kg (Act 201).

18.4 Pretreatment Benchsheet Example.

Attachment 18.1
Reflux Distillation Apparatus Diagram

REFLUX DISTILLATION APPARATUS DIAGRAM



Approved By: _____ 2/1/99 QA Manager

Approved By: _____ 2/1/99 Area Manager

Attachment 18.2
Grams Needed for Variable Percent Solids, 0.5 mg/kg

GRAMS NEEDED FOR VARIABLE % SOLIDS

DETECTION LIMIT = 0.5 mg/kg

% Solid	Minimum Grams Sample Needed Per 250 ml
1	250.
2	125.
3	84.
4	63.
5	50.
6	42.
7	36.
8	32.
9	28.
10	25.
11	23.
12	21.
13	20.
14	18.
15	17.
16	16.
17	15.
18-19	14.
20	13.
21-22	12.
23-24	11.
25-27	10.
28-31	9.
32-35	8.
36-41	7.
42-49	6.
50-62	5.
63-83	4.
84-100	3.

Approved By: 2/1/99 QA Manager

Approved By: 2/1/99 Area Manager

Attachment 18.3
Grams Needed for Variable Percent Solids, 0.1 mg/kg (Act 201)

GRAMS NEEDED FOR VARIABLE % SOLIDS

DETECTION LIMIT = 0.1 mg/kg (Act 307)

% Solid	Minimum Grams Sample Needed Per 250 ml	% Solid	Minimum Grams Sample Needed Per 250 ml
1	1250.	35	36.
2	625.	36	35.
3	417.	37	34.
4	313.	38-39	33.
5	250.	40	32.
6	209.	41	31.
7	179.	42-43	30.
8	157.	44	29.
9	139.	45-46	28.
10	125.	47-48	27.
11	114.	49	26.
12	105.	50-52	25.
13	97.	53-54	24.
14	90.	55-56	23.
15	84.	57-59	22.
16	79.	60-62	21.
17	74.	63-65	20.
18	70.	66-69	19.
19	66.	70-73	18.
20	63.	74-78	17.
21	60.	79-83	16.
22	57.	84-89	15.
23	55.	90-96	14.
24	53.	97-100	13.
25	50.		
26	49.		
27	47.		
28	45.		
29	44.		
30	42.		
31	41.		
32	40.		
33	38.		
34	37.		

Attachment 18.4
Pre-treatment Benchsheet Example

28-JAN-99 WET CHEM PRETREATMENT BENCHSHEET PAGE 1

Test #: 394.01- 252.03
Parameter: INORGANIC PRETREATMENT
Method: CN/MAN-DIST/SOL
Ref. cit.: USEPA-9012 Mod.

Est anal hrs: 12
Act anal hrs:
Stock std #:

Owner: JLB
Date run: 1/28/99
Supervisor:
QC Batch #: 138528-128

Comments:

Client Submittal Location	Sample	COC	OC	Anl.	Date Treated	Initial wt/vol	Final wt/vol	Conc. Spiking Solution	SPK STK # (90soil)	Volume Spiked	Final Spike Conc.	Gu
Barr Engineering Company 34900- F1-1	8 215593		LV3			17.0g	250ml		94			
Barr Engineering Company 34900- F1-2	8 215594		LV3			16.3			94			
Barr Engineering Company 34900- F1-3	8 215595		LV3			16.9			95			
Barr Engineering Company 34900- F2-1	8 215596		LV3			16.4			77			
Barr Engineering Company 34900- F2-2	9 215597		LV3			18.1			78			
Barr Engineering Company 900- -3	9 215598		LV3			16.7			88			
Barr Engineering Company 34900- F3-1	8 215599		LV3			16.6			89			
Barr Engineering Company 34900- F3-2	8 215600		LV3			19.4			92			
Barr Engineering Company 34900- F3-3	8 215601		LV3			17.4g	250ml		91			
MPB:						250ml	250ml					
LFB: Stk 1528.20						250ml	250ml	1000ppm		0.1ml	0.4ppm	
SPK1: Stk 1528.20	Smp 215598					18.2g	250ml	1000ppm		0.1ml	0.4ppm	
SPK2: Stk 1528.20	Smp 015598					18.2g	250ml	1000ppm		0.1ml	0.4ppm	
DUP:	Smp											

TRIMATRIX LABORATORIES, INC.

Approved By: [signature] 2/1/99 QA Manager

Approved By: [signature] 2/1/99 Area Manager

TriMatrix Laboratories, Inc.

STANDARD OPERATING PROCEDURE

CLOSED-SYSTEM PURGE-AND-TRAP AND EXTRACTION FOR VOLATILE ORGANICS IN SOIL AND WASTE

USEPA METHOD 5035

UNCONTROLLED DOCUMENT

APPROVALS:

Organic Manager: Jeff Glaser — Date: 4/30/98

QA Manager: Rick D. Wilburn — Date: 4/30/98

Laboratory Manager: Douglas E. Kriscunas — Date: 4/30/98

Procedure Number: GR-04-105
Revision Number: 0.0

Date Initiated: 4/30/98
Effective Date: 4/30/98

Date Revised: New
Pages Revised: New

By: Jeff Glaser

Total Number of Pages: 25

1.0 SCOPE AND APPLICATION

1.1 This method describes a closed-system purge-and-trap process for the analysis of volatile organic compounds (VOCs) in solid materials (e.g., soils, sediments, and solid waste). While the method is designed for use on samples containing low levels of VOCs, procedures are also provided for collecting and preparing solid samples containing high concentrations of VOCs and for oily wastes. For these high concentration and oily materials, sample collection and preparation are performed using the procedures described here, and sample introduction is performed using the aqueous purge-and-trap procedure in Method 5030B. These procedures may be used in conjunction with any appropriate determinative gas chromatographic procedure, including, but not limited to, Methods 8015, 8021B, and 8260B.

1.2 Procedures are included for preparing high concentration samples (samples containing VOC levels of >1 mg/kg) for purging by Method 5030B. Procedures are also included for addressing oily wastes that are soluble in a water-miscible solvent (also purged using Method 5030B). The closed-system purge-and-trap equipment employed for low concentration samples is NOT appropriate for soil samples preserved in the field with methanol. Such samples should be analyzed using Method 5030B.

1.3 Method 5035 can be used for most volatile organic compounds that have boiling points below 200°C and that are insoluble or slightly soluble in water. Volatile, water-soluble compounds can be included in this analytical technique. However, quantitation limits (by GC or GC/MS) are approximately ten times higher because of poor purging efficiency.

1.4 Method 5035, in conjunction with Method 8015 (GC/FID), may be used for the analysis of the aliphatic hydrocarbon fraction in the light ends of total petroleum hydrocarbons, e.g., gasoline. For the aromatic fraction (BTEX), use Method 5035 and Method 8021B (GC/PID). A total determinative analysis of gasoline fractions may be obtained using Method 8021B in series with Method 8015.

1.5 As with any preparative method for volatiles, samples should be screened to avoid contamination of the purge-and-trap system by samples that contain very high concentrations of purgeable material above the calibration range of the low concentration method. In addition, because the sealed sample container cannot be opened to remove a sample aliquot without compromising the integrity of the sample, multiple sample aliquots should be collected to allow for screening and reanalysis.

1.6 This method is restricted to use by or under the supervision of trained analysts. Each analyst must demonstrate the ability to generate acceptable results with this method.

2.0 PRINCIPLE METHOD REFERENCES

2.1 *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition*, Update III, Revision 2, December 1996, Method 5035.

3.0 SUMMARY OF PROCEDURE

3.1 Low concentration soil method - generally applicable to soils and other solid samples with VOC concentrations in the range of 0.0005 to 1 mg/kg. Volatile organic compounds (VOCs) are determined by collecting approximately a 5 g sample, weighed in the field at the time of collection, and placing it in a pre-weighted 40 ml VOA vial with a septum-sealed screw-cap that already contains a stirring bar and a sodium bisulfate preservative solution. The vial is sealed and shipped to the laboratory or appropriate analysis site. The entire vial is then placed, unopened, onto the autosampler. Immediately before analysis, organic-free reagent water, surrogates, and internal standards (if applicable) are automatically added without opening the sample vial. The vial containing the sample is heated to 40°C, the sample is magnetically stirred, and the volatiles are purged onto an appropriate trap using helium gas. When purging is complete, the trap is heated and backflushed with helium to desorb the trapped sample components into a gas chromatograph for analysis by an appropriate determinative method.

3.2 High concentration soil method - generally applicable to soils and other solid samples with VOC concentrations greater than 1 mg/kg. The sample introduction technique described above is not applicable to all samples, particularly those containing high concentrations of VOCs which may overload either the volatile trapping material or exceed the working range of the determinative instrument system (e.g., GC/MS, GC/FID, GC/PID, etc.). In such instances, this method describes two sample collection options and the corresponding sample purging procedures.

3.2.1 The first option is to collect a bulk sample in a 60 or 125 ml glass container without the use of the sodium bisulfate preservative solution. A 10 gram portion of that sample is removed from the container in the laboratory and is added to 10 ml of methanol to dissolve the volatile organic constituents. An aliquot of the solution is added to 5 ml of reagent water in a purge tube. Surrogates and internal standards (if applicable) are added to the solution, purged using Method 5030B, and analyzed by an appropriate determinative method. This is the least desirable option as the procedure involves opening the vial and removing a portion of the soil, which will cause the loss of some of the volatile constituents.

3.2.2 The second option is to collect approximately a 25 g sample in a pre-weighed vial with a septum-sealed screw-cap that contains 25 ml of methanol. At the time of analysis, surrogates are added to the vial, then an aliquot of the solvent is removed from the vial, purged using Method 5030B, and analyzed by an appropriate determinative method.

3.3 High concentration oily waste method - generally applicable to oily samples with VOC concentrations greater than 0.20 mg/kg that can be diluted in a water-miscible solvent (samples that contain oily materials that are not soluble in water-miscible solvents must be prepared according to Method 3585). After demonstrating that a test aliquot of the sample is soluble in methanol or polyethylene glycol (PEG), a separate aliquot of the sample is spiked with surrogates and diluted in the appropriate solvent. An aliquot of the solution is added to 5 ml of reagent water in a purge tube, taking care to ensure that a floating layer of oil is not present in the purge tube. Internal standards (if applicable) are added to the solution which is then purged using Method 5030B and analyzed by an appropriate determinative method.

4.0 PARAMETER OR COMPOUND LIST

4.1 See determinative method for parameter list.

5.0 REFERENCED SOPs

5.1 TriMatrix SOP number GR-03-124, *Volatile Organic Compounds By Purge And Trap Capillary Column Gas Chromatography/Mass Spectrometry*, most current version.

5.2 TriMatrix SOP number GR-03-105, Volatile Organic Compounds By Purge And Trap Capillary Column Gas Chromatography With Photoionization And Electrolytic Conductivity Detectors in Series, most current version.

5.3 TriMatrix SOP number GR-03-121, *Method for The Determination of Gasoline Range Organics*, most current version.

5.4 TriMatrix SOP number GR-03-124, *Volatile Organic Laboratory Corrective Actions*, most current version.

6.0 INTERFERENCES AND CORRECTIVE PROCEDURES

6.1 Whether purged or injected directly on column, interferences naturally present in the samples can cause elevated detection limits and interfere with the analysis. Naturally occurring interferences can vary considerably from site to site.

6.2 Sample contamination can also cause raised detection limits or false positives, and can come from a variety of sources. Improper sampling techniques can contaminate the sample at the job site. During shipment and storage, volatile organics (particularly methylene chloride and fluorocarbons) can diffuse through the septum and into the sample. A trip blank prepared from reagent water and carried through the sampling and handling protocol will serve as a check on such contamination.

6.3 During analysis, contamination can come from impurities in the purge gas, or from organic compounds outgassing from the plumbing ahead of the trap where they were deposited by a previously analyzed high level sample. To reduce this, the use of non-Teflon plastic tubing, non-Teflon thread sealants, and flow controllers with rubber components in the purging device have been eliminated where possible.

6.4 Contamination by carryover can occur whenever high level and low level samples are sequentially analyzed. To reduce carryover, the purging device is rinsed with reagent water between samples. When practical, samples with unusually high concentrations of analytes should be followed by an analysis of organic-free reagent water to check for cross-contamination. If compounds present in high concentrations are also present in subsequent samples, the analyst must demonstrate that the compounds are not due to

carryover. However, if the compounds are not present in subsequent samples, then reanalysis is not necessary.

6.5 The trap and other parts of the system are also subject to contamination; therefore, frequent bakeout and purging of the entire system may be required. If the contamination is persistent, the complete purge and trap system should be purged first with 100°C reagent water, then, if necessary, with methanol. If methanol is used, either disconnect the trap or install a blank trap, as the methanol will adversely affect the trap's performance.

6.6 For samples containing large amounts of water-soluble materials, suspended solids, high boiling compounds or high organohalide levels, it may be necessary to wash out the purging device with a detergent solution, rinse it with distilled water, and then dry it in a 105°C oven between analyses.

6.7 The laboratory where volatile analysis is performed should be completely free of solvents. The analytical and sample storage area should be isolated from all atmospheric sources of methylene chloride and other solvents, otherwise random background levels will result. Since methylene chloride will permeate through PTFE tubing, all GC carrier gas lines and purge gas plumbing should be constructed of stainless steel or copper tubing. Laboratory workers' clothing previously exposed to methylene chloride fumes during common liquid/liquid extraction procedures can contribute to sample contamination.

6.8 For corrective actions, see TriMatrix SOP number GR-03-124, *Volatile Organic Laboratory Corrective Actions*, most current version.

7.0 SAFETY PRECAUTIONS

7.1 The analyst must comply with all standard operating procedures for health and safety as outlined in the TriMatrix Laboratories, Inc. Laboratory Safety Manual.

7.2 The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of material safety data sheets should also be made available to all personnel involved in the chemical analysis.

7.3 The following method analytes have been tentatively classified as known or suspected human or mammalian carcinogens: benzene, carbon tetrachloride, 1,4-dichlorobenzene, 1,2-dichloroethane, hexachlorobutadiene, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, chloroform, 1,2-dibromomethane, tetrachloroethene, trichloroethene, and vinyl chloride. Pure standard materials and stock standard solutions of these compounds should be handled in a hood. A NIOSH/MESA approved toxic gas respirator should be worn when the analyst handles high concentrations of these toxic compounds.

8.0 SAMPLE SIZE, COLLECTION, PRESERVATION AND HANDLING PROCEDURES

8.1 Preparation of Sample Vials

8.1.1 The specific sample containers required will depend on the purge-and-trap system to be employed. TriMatrix Laboratories currently employs the needle sparger type purging device for all low level soils. These systems utilize standard 40-ml borosilicate glass VOA vials. Some systems employ 40-ml clear vials with a special frit and equipped with two PTFE-faced silicone septa. Consult the purge-and-trap system manufacturer's instructions regarding the suitable specific vials, septa, caps, and mechanical agitation devices.

8.1.2 The specific preparation procedures for sample vials depend on the expected concentration range of the sample, with separate preparation procedures for low concentration soil samples and high concentration soil and solid waste samples. Sample vials should be prepared in a laboratory or other controlled environment, sealed, and shipped to the field location. Gloves should be worn during the preparation steps.

8.1.3 Low concentration soil samples: The following steps apply to the preparation of vials used in the collection of low concentration soil samples to be analyzed by the closed-system purge-and-trap equipment described in Method 5035.

8.1.3.1 Add a clean magnetic stirring bar to each clean vial.

8.1.3.2 Add approximately 1 g of sodium bisulfate preservative to each vial. If samples markedly smaller or larger than 5 g are to be collected, adjust the amount of preservative added to correspond to approximately 0.2 g of preservative for each 1 g of sample. Enough sodium bisulfate should be present to ensure a sample pH of ≤2.

8.1.3.3 Add 5 ml of organic-free reagent water to each vial. The water and the preservative will form an acid solution that will reduce or eliminate the majority of the biological activity in the sample, thereby preventing biodegradation of the volatile target analytes.

8.1.3.4 Seal the vial with the screw-cap and septum seal. If the double-ended, fritted vials are used, seal both ends as recommended by the manufacturer.

8.1.3.5 Affix a label to each vial. This eliminates the need to label the vials in the field and assures that the tare weight of the vial includes the label.

8.1.3.6 Weigh the prepared vial to the nearest 0.01 g, record the tare weight, and write it on the label.

8.1.3.7 Because volatile organics will partition into the headspace of the vial from the aqueous solution and will be lost when the vial is opened, surrogates, matrix spikes, and internal standards (if applicable) should only be added to the vials after the sample has been added to the vial. These standards should be introduced back in the laboratory, either manually by puncturing the septum with a small gauge needle or automatically by the sample introduction system, just prior to analysis.

8.1.4 High concentration soil samples collected without a preservative: When high concentration samples are collected without a preservative, a variety of sample containers may be employed, including 60-ml glass vials with septum seals. This collection technique should only be used when the solubility of the sample in methanol is questionable.

8.1.5 High concentration soil samples collected and preserved in the field: The following steps apply to the preparation of vials used in the collection of high concentration soil samples to be preserved in the field with methanol and analyzed by the aqueous purge-and-trap equipment described in Method 5030B.

8.1.5.1 60 or 125 ml jars with screw cap lids and teflon liners are purchased pre-tared or tared by TriMatrix. A label is affixed to the jar prior to weighing, and the weight is taken with the lid and liner in place. The weight of the jar is recorded on the label (the weight of the ink is negligible) to the nearest 0.01 g.

8.1.5.2 Purchased 25 ml ampules of purge and trap methanol are included for each sample container. If the samples are insoluble in methanol but are soluble in PEG, PEG will be provided in place of the methanol.

8.1.6 Oily waste samples: When oily waste samples are known to be soluble in methanol or PEG, sample vials may be prepared as described in Sec. 8.1.5, using the appropriate solvent. However, when the solubility of the waste is unknown, the sample should be collected without the use of a preservative, in a vial such as that described in Sec. 8.1.4.

8.2 Sample Collection

8.2.1 Collect the sample according to the procedures outlined in the sampling plan. As with any sampling procedure for volatiles, care must be taken to minimize the disturbance of the sample in order to minimize the loss of the volatile components. Several techniques may be used to transfer a sample to the relatively narrow opening of the low concentration soil vial. These include devices such as the EnCore™ sampler, the Purge-and-Trap Soil Sampler™, and a cut plastic syringe. Always wear gloves whenever handling the tared sample vials.

8.2.2 Low Concentration Soil Samples

8.2.2.1 Using an appropriate sample collection device, collect approximately 5 g of sample as soon as possible after the surface of the soil or other solid material has been exposed to the atmosphere: generally within a few minutes at most. Carefully wipe the exterior of the sample collection device with a clean cloth or towel.

8.2.2.2 Using the sample collection device, add about 5 g (2 - 3 cm) of soil to the sample vial containing the preservative solution. Quickly brush any soil off the vial threads and immediately seal the vial with the septum and screw-cap. Store samples on ice at 4°C.

NOTE: Soil samples that contain carbonate minerals (either from natural sources or applied as an amendment) may effervesce upon contact with the acidic preservative solution in the low concentration sample vial. If the amount of gas generated is very small (i.e., several ml), any loss of volatiles as a result of such effervescence may be minimal if the vial is sealed quickly. However, if larger amounts of gas are generated, not only may the sample lose a significant amount of analyte, but the gas pressure may shatter the vial when the sample vial is sealed. Therefore, when samples are known or suspected to contain high levels of carbonates, a test sample should be collected, added to a vial, and checked for effervescence. If a rapid or vigorous reaction occurs, discard the sample and collect low concentration samples in vials that do not contain the preservative solution. This must be noted on the chain-of-custody.

8.2.2.3 When practical, use a portable balance to weigh the sealed vial containing the sample to ensure that 5.0 ± 0.5 g of sample were added. The balance should be calibrated in the field using an appropriate Class S weight for the sample containers employed. Record the weight of the sealed vial containing the sample to the nearest 0.01 g.

8.2.2.4 Alternatively, collect several trial samples with plastic syringes. Weigh each trial sample and note the length of the soil column in the syringe. Use this data to determine the length of soil in the syringe that corresponds to 5.0 ± 0.5 g. Discard each trial sample.

8.2.2.5 As with the collection of aqueous samples for volatiles, collect <u>at least</u> two replicate samples. This will allow the laboratory an additional sample for reanalysis. The second sample should be taken from the same soil stratum or the same section of the solid waste being sampled, and within close proximity to the location from which the original sample was collected.

8.2.2.6 In addition, since the soil vial cannot be opened without compromising the integrity of the sample, at least one additional aliquot of sample must be collected for screening, dry weight determination, and high concentration analysis (if

necessary). This third aliquot may be collected in a 60-ml glass vial or a third 40-ml soil sample vial. However, this third vial *must not* contain the sample preservative solution, as an aliquot will be used to determine dry weight.

8.2.2.7 If samples are known or expected to contain target analytes over a wide range of concentrations, thereby requiring the analyses of multiple sample aliquots, it may be advisable and practical to take an additional sample aliquot in a low concentration soil vial containing the preservative, but collecting only 1-2 g instead of the 5 g collected in Secs. 8.2.2.1 and 8.2.2.2. This aliquot may be used for those analytes that exceed the instrument calibration range in the 5 g analysis.

8.2.2.8 The EnCore™ sampler has not been thoroughly evaluated by EPA as a sample storage device. While preliminary results indicate that storage in the EnCore™ device may be appropriate for up to 48 hours, samples collected in this device should be transferred to soil sample vials as soon as possible, or analyzed within 48 hours.

8.2.2.9 The collection of low concentration soil samples in vials that contain methanol is not appropriate for samples analyzed with the closed-system purge-and-trap equipment described in this method.

8.2.3 High concentration soil samples preserved in the field: The collection of soil samples in vials that contain methanol has been suggested by some as a combined preservation and extraction procedure. However, this procedure is not appropriate for use with the low concentration soil procedure described in this method.

NOTE: The use of methanol preservation has not been formally evaluated by EPA and analysts must be aware of two potential problems. First, the use of methanol as a preservative and extraction solvent introduces a significant dilution factor that will raise the method quantitation limit beyond the operating range of the low concentration direct purge-and-trap procedure (0.0005-1.0 mg/kg). The exact dilution factor will depend on the masses of solvent and sample, but generally exceeds 50, and may make it difficult to demonstrate compliance with regulatory limits or action levels for some analytes. Because the analytes of interest are volatile, the methanol extract cannot be concentrated to overcome the dilution problem. Thus, for samples of unknown composition, it may still be necessary to collect an aliquot for analysis by this closed-system procedure and another aliquot preserved in methanol and analyzed by other procedures. The second problem is that the addition of methanol to the sample is likely to cause the sample to fail the ignitability characteristic, thereby making the unused sample volume a hazardous waste.

8.2.3.1 When samples are known to contain volatiles at concentrations high enough that the dilution factor will not preclude obtaining results within the calibration range

of the appropriate determinative method, a sample may be collected and immediately placed in a sample vial containing purge-and-trap grade methanol.

8.2.3.2 Using an appropriate sample collection device, collect approximately 5 g of sample as soon as possible after the surface of the soil or other solid material has been exposed to the atmosphere: generally within a few minutes at most. Carefully wipe the exterior of the sample collection device with a clean cloth or towel.

8.2.3.3 Using the sample collection device, add about 25 g (4 - 6 cm) of soil to the sample vial containing 25 ml of methanol. Quickly brush any soil off the vial threads and immediately seal the vial with the septum and screw-cap. Store samples on ice at 4°C.

8.2.3.4 When practical, use a portable balance to weigh the sealed vial containing the sample to ensure that 25.0 ± 0.5 g of sample were added. The balance should be calibrated in the field using an appropriate Class S weight for the sample containers employed. Record the weight of the sealed vial containing the sample to the nearest 0.01 g.

8.2.3.5 Alternatively, collect several trial samples with plastic syringes. Weigh each trial sample and note the length of the soil column in the syringe. Use these data to determine the length of soil in the syringe that corresponds to 25.0 ± 0.5 g. Discard each trial sample.

8.2.3.6 Other sample weights and volumes of methanol may be employed, provided that the analyst can demonstrate that the sensitivity of the overall analytical procedure is appropriate for the intended application.

8.2.3.7 The collection of at least one additional sample aliquot is required for the determination of the dry weight, as described in Sec. 8.2.2.6. Samples collected in methanol should be shipped as described in Sec. 8.4.1, and must be clearly labeled as containing methanol, so that the samples are not analyzed using the closed-system purge-and-trap equipment described in this procedure.

8.2.4 High concentration soil sample not preserved in the field: The collection of high concentration soil samples that are not preserved in the field generally follows similar procedures as for the other types of samples described in Secs. 8.2.2 and 8.2.3, with the obvious exception that the sample vials contain neither the aqueous preservative solution nor methanol. However, when field preservation is not employed, it is better to collect a larger volume sample, filling the sample container as full as practical in order to minimize headspace. Such collection procedures generally do not require the collection of a separate aliquot for dry weight determination, but it may be advisable to collect a second sample aliquot for screening

purposes, in order to minimize the loss of volatiles in either aliquot. This collection technique should only be used when the solubility of the sample in methanol is questionable.

8.2.5 Oily waste samples: The collection procedures for oily samples depend on knowledge of the waste and its solubility in methanol or other solvents.

8.2.5.1 When an oily waste is known to be soluble in methanol or PEG, the sample may be collected in a vial containing such a solvent (see Sec. 8.1.6), using procedures similar to those described in Sec. 8.2.3.

8.2.5.2 When the solubility of the oily waste is not known, the sample should either be collected in a vial without a preservative, as described in Sec. 8.2.4, or the solubility of a trial sample should be tested in the field, using a vial containing solvent. If the trial sample is soluble in the solvent, then collect the oily waste sample as described in Sec. 8.2.3. Otherwise, collect an unpreserved sample as described in Sec. 8.2.4.

8.3 Trip Blanks

8.3.1 Trip blanks should accompany each sample set into the field and back. A sample set is composed of the samples collected from the same general sample site at approximately the same time. At the laboratory, fill trip blank sample bottles with reagent water, seal, and ship to the sampling site along with empty sample bottles. Wherever a set of samples is shipped and stored, it is accompanied by the trip blanks.

8.3.2 Follow Sec. 8.1.3 and 8.1.5 to add preservative to trip blanks.

8.4 Sample Handling and Shipment

8.4.1 All samples for volatiles analysis should be cooled by approximately 4°C, packed in appropriate containers, and shipped to the laboratory on ice, as described in the sampling plan.

8.5 Sample Storage

8.5.1 Once in the laboratory, store samples at 4°C until analysis. The sample storage area should be free of organic solvent vapors.

8.5.2 All samples should be analyzed as soon as practical, and within the designated holding time from collection. Samples not analyzed within the designated holding time must be noted, the data estimated, and considered minimum values.

8.5.3 When the low concentration samples are strongly alkaline or highly calcareous in nature, the sodium bisulfate preservative solution may not be strong enough to reduce the pH of the

soil/water solution to below 2. Therefore, when low concentration soils to be sampled are known or suspected to be strongly alkaline or highly calcareous, additional steps may be required to preserve the samples. Such steps include: addition of larger amounts of the sodium bisulfate preservative to non-calcareous samples, storage of low concentration samples at -10°C (taking care not to fill the vials so full that the expansion of the water in the vial breaks the vial), or significantly reducing the maximum holding time for low concentration soil samples. Whichever steps are employed, they should be clearly described in the sampling and QA project plans and distributed to both the field and laboratory personnel. See Sec. 8.2.2.2 for additional information.

9.0 INSTRUMENTATION, APPARATUS, AND MATERIALS

9.1 Sample Containers: Either 40-ml clear vials with a special frit and two PTFE-faced silicon septa screw-caps, or regular 40-ml clear vials with PTFE-faced silicon septa screw-caps.(See Sec. 8.1.1)

9.2 Purge-and-Trap System: consisting of a unit that automatically adds water, surrogates, and internal standards (if applicable) to a vial containing the sample, purges the VOCs using an inert gas stream while agitating the contents of the vial, and also traps the released VOCs for subsequent desorption into the gas chromatograph. Such systems are commercially available from several sources and shall meet the following specifications. The following descriptions are for informative purposes only. The specific apparatus and conditions used are specified in the determinative SOPs.

9.2.1 The purging device should be capable of accepting a vial sufficiently large to contain a 5 g soil sample plus a magnetic stirring bar and 10 ml of water. The device must be capable of heating a soil vial to at least 40°C and holding it at that temperature while the inert purge gas is allowed to pass through the sample. The device should also be capable of introducing at least 5 ml of organic-free reagent water along with surrogate and internal standards into the sample vial while trapping the displaced headspace vapors. It must also be capable of agitating the sealed sample during purging, (e.g., using a magnetic stirring bar added to the vial prior to sample collection). The analytes being purged must be quantitatively transferred to an absorber trap. The trap must be capable of transferring the absorbed VOCs to the gas chromatograph (see Sec. 9.2.2).

9.2.2 A variety of traps and trapping materials may be employed with this method. The choice of trapping material depends on the analytes of interest. Whatever trap is employed, it must demonstrate sufficient adsorption and desorption characteristics to meet the quantitation limits of all the target analytes for a given project and the QC requirements in Method 8000 and the determinative method. The most difficult analytes are generally the gases, especially dichlorodifluoromethane. The trap must also be capable of desorbing the late eluting target analytes.

9.2.2.1 The trap used to develop this method was 25 cm long, with an inside diameter of 0.105 inches, packed with Carbopack/Carbosieve (Supelco, Inc.).

9.2.2.2 The standard trap used in other EPA purge-and-trap methods is also acceptable. That trap is 25 cm long and has an inside diameter of at least 0.105 inches. Starting from the inlet, the trap contains the equal amounts of the adsorbents listed below. It is recommended that 1.0 cm of methyl silicone-coated packing (35/60 mesh, Davison, grade 15 or equivalent) be inserted at the inlet to extend the life of the trap. If the analysis of dichlorodifluoromethane or other fluorocarbons of similar volatility is not required, then the charcoal can be eliminated and the polymer increased to fill 2/3 of the trap. If only compounds boiling above 35°C are to be analyzed, both the silica gel and charcoal can be eliminated and the polymer increased to fill the entire trap.

9.2.2.2.1 2,6-Diphenylene oxide polymer - 60/80 mesh, chromatographic grade (Tenax GC or equivalent).

9.2.2.2.2 Methyl silicone packing - OV-1 (3%) on Chromosorb-W, 60/80 mesh or equivalent.

9.2.2.2.3 Coconut charcoal - Prepare from Barnebey Cheney, CA-580-26, or equivalent, by crushing through 26 mesh screen.

9.2.2.3 Trapping materials other than those listed above also may be employed, provided that they meet the specifications in Sec. 9.2.3, below.

NOTE: Check the responses of the brominated compounds when using alternative charcoal traps (especially Vocarb 4000), as some degradation has been noted when higher desorption temperatures (especially above 240 - 250°C) are employed. 2-Chloroethyl vinyl ether is degraded on a Vocarb 4000 trap, but performs adequately when a Vocarb 3000 trap is used. The primary criterion, as stated above, is that all target analytes meet the sensitivity requirements for a given project.

9.2.3 The desorber for the trap must be capable of rapidly heating the trap to the temperature recommended by the trap material manufacturer, prior to the beginning of the flow of desorption gas. Several commercial desorbers (purge-and-trap units) are available.

9.2.4 Purge and Traps to be utilized by TriMatrix Laboratories with this method are listed below:

9.2.4.1 Dynatech PTA 30 W/S Autosampler/OI Analytical Model 4560 Concentrator

9.2.4.2 Dynatech Dynatrap Purge and Trap Autosampler/Concentrator

9.2.4.3 Dynatech PTA 30 W/S Autosampler/Tekmar Model LSC 2000 Concentrator

9.2.4.4 O.I. Analytical 4552 Autosampler/Tekmar Model LSC 2000 Concentrator

9.3 Syringes and Syringe Valves

9.3.1 5 and 25-ml glass hypodermic syringes with Luer-Lok (or equivalent) tip

9.3.2 2-way syringe valves with Luer ends

9.3.3 25-ul micro syringe with a 2 inch x 0.006 inch ID, 22° bevel needle (Hamilton #702N or equivalent)

9.3.4 Micro syringes - 2.0, 10, 25, 50, and 100-ul

9.3.5 Syringes - 0.5, 1.0, and 5-ml, gas tight with shut-off valve

9.4 Miscellaneous

9.4.1 Glass vials

9.4.1.1 60-ml, septum-sealed, to collect samples for screening, dry weight determination

9.4.1.2 40-ml, screw-cap, PTFE-lined septum-sealed. Examine each vial prior to use to ensure that the vial has a flat, uniform sealing surface

9.4.2 Top-loading balance - capable of accurately weighing to 0.01 g

9.4.3 Glass scintillation vials - 20-ml, with screw-caps and PTFE liners, or glass culture tubes with screw-caps and PTFE liners, for dilution of oily waste samples

9.4.4 Volumetric flasks - Class A, 10-ml, 50-ml, and 100-ml, with ground glass stoppers

9.4.5 2-ml glass vials, for GC autosampler - used for oily waste samples extracted with methanol or PEG

9.4.6 Spatula, stainless steel - narrow enough to fit into a sample vial

9.4.7 Disposable Pasteur pipets

9.4.8 Magnetic stirring bars - PTFE- or glass-coated, of the appropriate size to fit the sample vials. Consult manufacturer's recommendation for specific stirring bars. Stirring bars may be reused, provided that they are thoroughly cleaned between uses. Consult the manufacturers of the purging device and the stir bars for suggested cleaning procedures.

9.5 Field Sampling Equipment

9.5.1 Purge-and-Trap Soil Sampler - model 3780PT (Associated Design and Manufacturing Company, 814 North Henry Street, Alexandria, VA 22314), or equivalent.

9.5.2 EnCore™ sampler - (En Chem, Inc., 1795 Industrial Drive, Green Bay, WI 54302), or equivalent.

9.5.3 Alternatively, disposable plastic syringes with a barrel smaller than the neck of the soil vial may be used to collect the sample. The syringe end of the barrel is cut off prior to sampling. One syringe is needed for each sample aliquot to be collected.

9.5.4 Portable balance - For field use, capable of weighing to 0.01g.

9.5.5 Balance weights - Balances employed in the field should be checked against an appropriate Class S reference weight at least once daily, prior to weighing any samples, or as described in the sampling plan. The specific weights used will depend on the total weight of the sample container, sample, stirring bar, reagent water added, cap, and septum.

10.0 ROUTINE PREVENTIVE MAINTENANCE

10.1 Gas Chromatograph

10.1.1 Change septa weekly or as needed

10.1.2 Change gas scrubber traps as needed

10.1.3 Clip or replace capillary column as needed

10.1.4 Check column head pressure daily

10.1.5 Check cylinder gas tank pressure daily, and change tank if necessary

10.2 Detectors

10.2.1 Check detector signals daily

10.2.2 Clean or replace detector parts as needed (PID lamps, FID jets, MS source, etc.)

10.3 Purge and Trap System

10.3.1 Bake out trap daily prior to use

10.3.2 Check and record purge flow weekly

10.3.3 Check and fill surrogate and internal standard modules daily

10.3.4 Check concentrator pressure daily

10.3.5 Empty waste bottle and fill rinse bottle daily

11.0 CHEMICALS AND REAGENTS

11.1 Organic-free reagent water

11.2 Methanol, CH_3OH - purge-and-trap quality or equivalent. Store away from other solvents

11.3 Polyethylene glycol (PEG), $H(OCH_2CH_2)_nOH$ - free of interferences at the detection limit of the target analytes

11.4 Low concentration sample preservative

11.4.1 Sodium bisulfate, $NaHSO_4$ - ACS reagent grade or equivalent

11.4.2 The preservative should be added to the vial prior to shipment to the field, and must be present in the vial prior to adding the sample

11.5 See the determinative method for guidance on internal standards and surrogates to be employed in this procedure.

12.0 STANDARDS PREPARATION

12.1 See the determinative method for standards preparation procedures.

13.0 SAMPLE PREPARATION

13.1 Sample Screening

13.1.1 It is highly recommended that all samples be screened prior to the purge-and-trap GC or GC/MS analysis. Samples may contain higher than expected quantities of purgeable organics that will contaminate the purge-and-trap system, thereby requiring extensive cleanup and instrument maintenance. The screening data are used to determine which is the appropriate sample preparation procedure for the particular sample, the low concentration closed-system direct purge-and-trap method (Sec. 15.1), the high concentration (methanol extraction) method

(Sec. 15.2), or the nonaqueous liquid (oily waste) methanol or PEG dilution procedure (Sec. 15.3).

13.1.2 The analyst may employ any appropriate screening technique. Two suggested screening techniques employing SW-846 methods are:

13.1.2.1 Automated headspace (Method 5021) using a gas chromatograph (GC) equipped with a photoionization detector (PID) and an electrolytic conductivity detector (ELCD) in series.

13.1.2.2 Extraction of the sample with hexadecane (Method 3820), and analysis of the extract using a GC equipped with a FID and/or an ECD.

13.1.3 The analyst may inject a calibration standard containing the analytes of interest at a concentration equivalent to the upper limit of the calibration range of the low concentration soil method. The results from this standard may be used to determine when the screening results approach the upper limit of the low concentration soil method. There are no linearity or other performance criteria associated with the injection of such a standard, and other approaches may be employed to estimate sample concentrations.

13.1.4 Use the low concentration closed-system purge-and-trap method (Sec. 15.1) if the estimated concentration from the screening procedure falls within the calibration range of the selected determinative method. If the concentration exceeds the calibration range of the low concentration soil method, then use either the high concentration soil method (Sec. 15.2), or the oily waste method (Sec. 15.3).

14.0 CALIBRATION PROCEDURES

14.1 Initial Calibration for Low Concentration Method

14.1.1 Assemble a purge-and-trap device that meets the specifications in Sec. 9.2 and that is connected to a gas chromatograph or a gas chromatograph/mass spectrometer system.

14.1.2 Before initial use, a Carbopack/Carbosieve trap should be conditioned overnight at 245°C by backflushing with an inert gas flow of at least 20 ml/minute. If other trapping materials are substituted for the Carbopack/Carbosieve, follow the manufacturers recommendations for conditioning. Vent the trap effluent to the hood, not to the analytical column. Prior to daily use, the trap should be conditioned for 10 minutes at 245°C with backflushing. The trap may be vented to the analytical column during daily conditioning; however, the column must be run through the temperature program prior to analysis of samples.

14.1.3 If the standard trap in Sec. 9.2.2.2 is employed, prior to initial use, the trap should be conditioned overnight at 180°C by backflushing with an inert gas flow of at least 20

ml/minute, or according to manufacturer's recommendations. Vent the trap effluent to the hood, not the hood, not to the analytical column. Prior to daily use, the trap should be conditioned for 10 minutes at 180°C with backflushing.

14.1.4 Establish the purge-and-trap instrument operating conditions. Adjust the instrument to inject 5 ml of water, and pre-heat the sample to 40°C for 1.5 minutes before commencing the purge process.

14.1.5 Prepare a minimum of five (5) initial calibration standards containing all the analytes of interest and surrogates, as described in the appropriate analytical method. The calibration standards are prepared in organic-free reagent water. **The volume of organic-free reagent water used for calibration must be the same volume used for sample analysis (normally 5 ml added to the vial before shipping it to the field plus the organic-free reagent water added by the instrument). The calibration standards should also contain approximately the same amount of the sodium bisulfate preservative as the sample (e.g., ~1 g), as the presence of the preservative will affect the purging efficiencies of the analytes. The internal standard solution must be added automatically, by the instrument, in the same fashion as used for samples.** Place the soil vial containing the solution in the instrument carousel. In order to calibrate the surrogates using standards at five (5) concentrations, it will be necessary to disable the automatic addition of surrogates to each vial containing a calibration standard. **Prior to purging, pre-heat the sample vial to 40°C for 1.5 minutes.**

14.1.6 Carry out the purge-and-trap procedure as outlined in Sec. 15.0

14.1.7 Calculate calibration factors (CF) or response factors (RF) for each analyte of interest using the procedures described in the appropriate method. Evaluate the linearity of the calibration data, or choose another calibration model, as described in the specific determinative method.

14.1.8 For GC/MS analysis, a system performance check must be made before this calibration curve is used (see Method 8260B). If the purge-and-trap procedure is used with Method 8021B, evaluate the response for the following four compounds: chloromethane, 1,1-dichloroethane, bromoform, and 1,1,2,2-tetrachloroethane. They are used to check for proper purge flow and to check for degradation caused by contaminated lines or active sites in the system.

14.1.8.1 Chloromethane is the most likely compound to be lost if the purge flow is too fast.

14.1.8.2 Bromoform is one of the compounds most likely to be purged very poorly if the purge flow is too slow. Cold spots and/or active sites in the transfer lines may adversely affect response.

14.1.8.3 Tetrachloroethane and 1,1-dichloroethane are degraded by contaminated transfer lines in purge-and-trap systems and/or active sites in trapping materials.

14.1.9 When analyzing for very late eluting compounds with Method 8021B (i.e., hexachlorobutadiene, 1,2,3-trichlorobenzene, etc.), cross-contamination and memory effects from a high concentration sample or even the standard are a common problem. Extra rinsing of the purge chamber after analysis normally corrects this. The newer purge-and-trap systems often overcome this problem with better bakeout of the system following the purge-and-trap process. Also, the charcoal traps retain less moisture and decrease the problem.

14.1.10 **NOTE: THE ADDITION OF THE SODIUM BISULFATE PRESERVATIVE WILL DEGRADE THE PRESENCE OF 2-CHLOROETHYL VINYL ETHER IN BOTH STANDARDS AND SAMPLES. IT HAS BEEN DEMONSTRATED BY TRIMATRIX LABORATORIES THAT THIS COMPOUND IS UNABLE TO PRODUCE ACCEPTABLE RESULTS USING THIS METHOD.**

14.2 Calibration verification: Refer to the specific method for details on calibration verification. A single standard near the mid-point of calibration range is used for verification. **This standard should also contain approximately 1 g of sodium bisulfate.**

14.3 When analyzing samples by methods other than the closed-system low-concentration purge-and-trap method, calibration should be performed as indicated in the determinative methods.

15.0 ANALYTICAL PROCEDURE

15.1 Low concentration soil method (approximate concentration range of 0.0005 to 1 mg/kg - dependent upon the determinative method and the sensitivity of each analyte).

15.1.1 This method is designed for a 5 g sample size, but smaller sample sizes may be used. The soil vial is hermetically sealed at the sampling site, and MUST remain so in order to guarantee the integrity of the sample. Gloves must be worn when handling the sample vial since the vial has been tared. If any soil is noted on the exterior of the vial or cap, it must be carefully removed prior to weighing. **Weigh the vial and contents to the nearest 0.01 g, even if the sample weight was determined in the field, and record this weight.** This second weight provides a check on the field sampling procedures and provides additional assurance that the reported sample weight is accurate. **Data users should be advised on significant discrepancies between the field and laboratory weights.**

15.1.2 Remove the sample vial from storage and allow it to warm to room temperature. Shake the vial gently, to ensure that the contents move freely and that stirring will be effective. Place the sample vial in the instrument carousel according to the manufacturer's instructions.

15.1.3 Without disturbing the hermetic seal on the sample vial, add 7 ml of organic-free reagent water, the internal standards, and the surrogate compounds. This is carried out using the automated sampler. Other volumes of organic-free reagent water may be used, however, **it is imperative that all samples, blanks, and calibration standards have exactly the same final**

volume of organic-free reagent water. Prior to purging, heat the sample to 40°C for 1.5 minutes.

15.1.4 For the sample selected for matrix spiking, add the matrix spiking solution described in the appropriate method. The concentration of spiking solution and the amount added will vary by method and by instrument detector linearity.

15.1.5 Purge the sample with helium at a flow rate up to 45 ml/minute (the flow rate may vary from 30 to 50 ml/min., depending on the target analyte group) for 11 minutes while the sample is being agitated with the magnetic stirring bar. The purged analytes are allowed to flow out of the vial through a glass-lined transfer line to a trap packed with suitable sorbent materials.

15.1.6 Sample Desorption

15.1.6.1 After the 11 minute purge, place the purge-and-trap system in the desorb mode and preheat the trap to 245°C without a flow of desorption gas. Start the flow of desorption gas at 20 ml/minute for two minutes. Begin the temperature program of the gas chromatograph and start data acquisition.

15.1.7 After desorbing the sample, recondition the trap by baking out the purge-and-trap system at 245°C (or other temperature recommended by the manufacturer of the trap packing materials). After approximately 10 minutes, turn off the trap heater and halt the purge flow through the trap. When the trap is cool, analysis of the next sample can begin.

15.1.8 Perform qualitative and quantitative analysis following the guidance given in the determinative method. If the concentration of any target analyte exceeds the calibration range of the instrument, it will be necessary to reanalyze the sample by the high concentration method. Such reanalyses need only address those analytes for which the concentration exceeded the calibration range of the low concentration method. Alternatively, if a sample aliquot of 1-2 g was also collected (see Sec. 8.2.2.7), it may be practical to analyze that aliquot for the analytes that exceeded the instrument calibration range in the 5 g analysis.

15.2 High concentration method for soil samples with concentrations generally greater than 1 mg/kg.

15.2.1 The high concentration method for soil is based on a solvent extraction. A solid sample is either extracted or diluted, depending on sample solubility in a water-miscible solvent. An aliquot of the extract is added to organic-free reagent water containing surrogates and, if applicable, internal and matrix spiking standards. The sample is then purged according to Method 5030B, and analyzed by an appropriate determinative method. Wastes that are insoluble in methanol (i.e., petroleum and coke wastes) are diluted with hexadecane (see Sec. 15.2.10).

15.2.2 The specific sample preparation steps depend on whether or not the sample was preserved in the field. Samples that were <u>not</u> preserved in the field are prepared using the steps below,

beginning at Sec. 15.2.3. If solvent preservation was employed in the field, then the preparation begins with Sec. 15.2.6.

15.2.3 When the high concentration sample is not preserved in the field, the sample consists of the entire contents of the sample container. Do not discard any supernatant liquids. Whenever practical, mix the contents of the sample container by shaking or other mechanical means without opening the vial. When shaking is not practical, quickly mix the contents of the vial with a narrow metal spatula and immediately reseal the vial.

15.2.3.1 Samples received as specified in 15.2.3 will be preserved within 24 hours of receipt by the laboratory, provided the sample was not received late on Friday. When samples are received late on Friday, the samples will be preserved Monday morning. Sample preservation will be done following the procedure beginning in section 15.2.4.

15.2.4 If the sample is from an unknown source, perform a solubility test before proceeding. Remove several grams of material from the sample container. Quickly reseal the container to minimize the loss of volatiles. Weigh 1 g aliquots of the sample into several test tubes or other suitable containers. Add 10 ml of methanol to the first tube, 10 ml of PEG to the second, and 10 ml of hexadecane to the third. Swirl the sample and determine if it is soluble in the solvent. Once the solubility has been evaluated, discard these test solutions. If the sample is soluble in either methanol or PEG, proceed with Sec. 15.2.5. If the sample is only soluble in hexadecane, proceed with Sec. 15.2.10

15.2.5 For soil and solid waste samples that are soluble in methanol, add 9.0 ml of methanol and 1.0 ml of the surrogate spiking solution to a tared 20-ml vial. Using a top-loading balance, weigh 10 g (wet weight) of sample into the vial. Quickly cap the vial and re-weigh the vial. Record the weight to 0.1 g. Shake the vial for 2 min. If the sample was not soluble in methanol, but was soluble in PEG, employ the same procedure described above, but use 9.0 ml of PEG in place of the methanol. Proceed with Sec. 15.2.7.

NOTE: The steps in Secs. 15.2.3, 15.2.4, and 15.2.5 must be performed rapidly and without interruption to avoid loss of volatile organics. These steps must be performed in a laboratory free from solvent fumes.

15.2.6 For soil and solid waste samples that were collected in methanol or PEG (see Sec. 8.2.3), add the surrogate spiking solution to the vial by injecting it through the septum, shake for 2 min., as described above, and proceed with Sec. 15.2.7.

15.2.7 After the soil has settled, pipet approximately 1 ml of the extract from either Sec. 15.2.5 or 15.2.6 into a GC vial for storage, using a disposable pipet, and seal the vial. The remainder of the extract may be discarded. Add approximately 1 ml of methanol or PEG to a separate GC vial for use as the method blank for each set of samples extracted with the same solvent.

15.2.8 The extracts must be stored at 4°C in the dark, prior to analysis. Add an appropriate aliquot of the extract (see Table 1) to 5.0 ml of organic-free reagent water and analyze by Method 5030B in conjunction with the appropriate determinative method.

15.2.9 If results are to be reported on a dry weight basis, the dry weight may be determined from a separate aliquot of the sample after the sample extract has been transferred to a GC vial and the vial sealed.

15.2.10 For solids that are not soluble in methanol or PEG (including those samples consisting primarily of petroleum or coking waste), dilute or extract the sample with hexadecane using the procedures in Method 3585.

15.3 High concentration method for oily waste samples

15.3.1 This procedure for the analysis of oily waste samples involves the dilution of the sample in methanol or PEG. However, care must be taken to avoid introducing any of the floating oil layer into the instrument. A portion of the diluted sample is then added to 5.0 ml of organic-free reagent water, purged according to Method 5030B, and analyzed using an appropriate determinative method.

15.3.2 For oily samples that are not soluble in methanol or PEG (including those samples consisting primarily of petroleum or coking waste), dilute or extract with hexadecane using the procedures in Method 3585.

15.3.3 The specific sample preparation steps depend on whether or not the sample was preserved in the field. Samples that were <u>not</u> preserved in the field are prepared using the steps below, beginning at Sec. 15.3.4. If methanol preservation was employed in the field, then the preparation begins with Sec. 15.3.6.

15.3.4 If the waste was <u>not</u> preserved in the field and it is soluble in methanol or PEG, weigh 1 g (wet weight) of the sample into a tared 10-ml volumetric flask, a tared scintillation vial, or a tared culture tube. If a vial or tube is used instead of a volumetric flask, it must be calibrated prior to use. This operation <u>must</u> be performed prior to opening the sample vial and weighing out the aliquot for analysis.

15.3.4.1 To calibrate the vessel, pipet 10.0 ml of methanol or PEG into the vial or tube and mark the bottom of the meniscus.

15.3.4.2 Discard this solvent, and proceed with weighing out the 1 g sample aliquot.

15.3.5 Quickly add 1.0 mI of surrogate spiking solution to the flask, vial, or tube, and dilute to 10.0 ml with the appropriate solvent (methanol or PEG). Swirl the vial to mix the contents and then shake vigorously for 2 minutes.

15.3.6 If the sample was collected in the field in a vial containing methanol or PEG, add the surrogate spiking solution to the vial by injecting it through the septum. Swirl the vial to mix the contents, shake vigorously for 2 minutes, and proceed with Sec. 15.3.7.

15.3.7 Regardless of how the sample was collected, the target analytes are extracted into the solvent along with the majority of the oily waste (i.e., some of the oil may still be floating on the surface). If oil is floating on the surface, transfer 1 to 2 ml of the extract to a clean GC autosampler vial using a Pasteur pipet. Ensure that no oil is transferred to the vial.

15.3.8 Add 10 - 50 ul of the methanol extract to 5 ml of organic-free reagent water for purge-and-trap analysis, using Method 5030B.

15.3.9 Prepare a matrix spike sample by adding 10 - 50 ul of the matrix spike standard dissolved in methanol to a 1 g aliquot of the oily waste. Shake the vial to disperse the matrix spike solution throughout the oil. Then add 10 ml of extraction solvent and proceed with the extraction and analysis, as described in Secs. 15.3.5 - 15.3.8. Calculate the recovery of the spiked analytes as described in appropriate method. If the recovery is not within the acceptance limits for the application, use the hexadecane dilution technique in Method 3585.

16.0 CALCULATIONS AND DATA HANDLING

16.1 See the determinative method for calculations and data handling.

17.0 DATA REPORTING AND DELIVERABLES

17.1 See the determinative method for data reporting and deliverable requirements.

18.0 QUALITY ASSURANCE

18.1 See the determinative method for quality assurance procedures.

19.0 ANALYST CERTIFICATION/METHOD VALIDATION

19.1 See the determinative method for analyst certification and method validation requirements.

20.0 REFERENCES

20.1 *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition*, Update III, Revision 3, December 1996, Methods 5035, 5030B, 8000B, 8021B, and 8260B.

21.0 ATTACHMENTS/APPENDICES

21.1 Table 1: Quantity of Methanol Extract Required for Analysis of High Concentration Soils/Sediments

Approved By: 4/30/98 **Approved By:** 4/30/98

QA Manager **Area Manager**

TABLE 1
QUANTITY OF METHANOL EXTRACT REQUIRED FOR ANALYSIS OF HIGH CONCENTRATION SOILS/SEDIMENTS

Approximate Concentration Range	Volume of Methanol Extract[a]
0.50 - 10 mg/kg	100 ul
1 - 20 mg/kg	50 ul
5 - 100 mg/kg	10 ul
25 - 500 mg/kg	100 ul of 1:50 dilution[b]

Calculate appropriate dilution factor for concentrations exceeding those in this table.

a The volume of methanol added to 5 ml of water being purged should be kept constant. Therefore, add to the 5-ml syringe whatever volume of methanol is necessary to maintain a total volume of 100 ul of methanol.

b Dilute an aliquot of the methanol extract and then take 100 ul for analysis.

Approved By: 4/30/98 Approved By: 4/30/98

QA Manager Area Manager

TriMatrix Laboratories, Inc.

STANDARD OPERATING PROCEDURE

THE EXTRACTION OF BNAs IN WATER

UNCONTROLLED DOCUMENT

APPROVALS:

Organic Manager: _____ Date: 7/31/00
Jeff P. Glaser

QA Manager: _____ Date: 7/31/00
Rick D. Wilburn

Laboratory Manager: _____ Date: 7/31/00
Douglas E. Kriscunas

Procedure Number: GR-09-101
Revision Number: 2.0

Date Initiated: 1/18/96
Effective Date: 8/3/00

Date Revised: 7/31/00
Pages Revised: All

By: Rick D. Wilburn

Total Number of Pages: 15

1.0 SCOPE AND APPLICATION

1.1 This procedure describes a method for the extraction and concentration of water insoluble and slightly water soluble semi-volatile base/neutral acid organics from aqueous samples.

2.0 PRINCIPLE METHOD REFERENCES

2.1 *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition.* Final Update III, Revision 3, December 1996, Method 3510C, "Separatory Funnel Liquid-Liquid Extraction".

3.0 SUMMARY OF PROCEDURE

3.1 A measured volume of sample, usually 1 liter, is serially extracted with methylene chloride at an acidic then basic pH using a separatory funnel. The extract is dried, concentrated to a final volume of 1 or 10 mL, and analyzed by gas chromatography/mass spectrometry.

4.0 PARAMETER OR COMPOUND LIST

4.1 See TriMatrix SOP GR-04-103, *Semi-Volatile Laboratory Ion Trap Mass Spectrometry Analysis of Base/Neutral/Acid Compounds;* Method 8270B/625, latest revision.

5.0 REFERENCED SOPs

5.1 GR-04-103, *Semi-Volatile Laboratory Ion Trap Mass Spectrometry Analysis of Base/Neutral/Acid Compounds;* Method 8270B/625, latest revision.

5.2 GR-09-106, *Semi-Volatile Extract Vial Calibration*, latest revision.

5.3 GR-15-109, *Laboratory Waste Disposal*, latest revision.

6.0 INTERFERENCES AND CORRECTIVE PROCEDURES

6.1 Method interferences may be caused by contaminants in solvents, reagents, glassware, and other sample processing hardware. Rinsing all glassware with pesticide quality methylene chloride prior to use, as well as the use of high purity reagents and solvents helps to minimize interference problems.

6.2 Phthalate esters contaminate many types of products commonly found in the laboratory. Plastics in particular must be avoided as phthalates are commonly used as plasticizers and are easily extracted from plastic materials. Serious phthalate contamination may result at any time if consistent quality control is not practiced.

6.3 Matrix interferences from either the sample itself or from laboratory equipment may affect the recovery of spikes or specific analytes. Re-extraction of a sample or spike may be necessary if any spike or surrogate compound fails to pass the appropriate recovery limits.

7.0 SAFETY PRECAUTIONS

7.1 All extraction personnel must wear lab coats and safety glasses when in the lab. In addition, nitrile gloves are to be worn when samples or solvents are handled.

7.2 For proper spill response, as well as sample, spike, and waste storage, see the latest edition of the TriMatrix Laboratory Waste Disposal SOP.

7.3 Perform extractions and prepare standards in a fume hood. Avoid the inhalation of samples and solvents.

8.0 SAMPLE SIZE, COLLECTION, PRESERVATION AND HANDLING PROCEDURES

8.1 Samples are to be collected in 1000 mL screw cap amber glass jars, with Teflon lined caps. No preservative is required.

8.2 All samples must be extracted within 7 days of the collection date.

8.3 When not in use, samples should be stored in the walk-in cooler at 4° C.

8.4 Analysts should use care when handling samples to avoid breakage.

9.0 INSTRUMENTATION, APPARATUS, AND MATERIALS

9.1 1 L graduated cylinders

9.2 100 mL graduated cylinders

9.3 2 liter glass separatory funnels with Teflon stopcocks

9.4 250 or 500 mL Erlenmeyer flasks

9.5 500 mL graduated Kuderna-Danish evaporative flasks

9.6 10 mL graduated Kuderna-Danish concentrator tubes

9.7 three-ball macro Snyder columns

9.8 three-ball micro Snyder columns

9.9 pH strips

9.10 100 mm filtering funnels

9.11 250 mL ribbed filtering funnels

9.12 Fisher P8 qualitative filter paper

9.13 glass wool

9.14 2 mL disposable, glass Pasteur pipettes

9.15 variable temperature steam bath

9.16 variable temperature hot plate

9.17 800 mL beaker

9.18 100 mL beakers

9.19 Teflon boiling chips

9.20 1 liter Volumetric

9.21 40 mL amber vials

9.22 1500 Erlenmeyer flasks

9.23 100 uL and 1000 uL gas tight spiking syringes

9.24 Teflon centrifuge tubes (if necessary)

9.25 centrifuge (if necessary)

9.26 vials: 1.7 mL glass auto-sampler vials with Teflon lined screw cap lids calibrated to 1 mL

9.27 vials: 14 mL with glass Teflon lined screw cap lids calibrated to 10 mL

9.28 balance, top loading, capable of accurately weighting to the nearest 0.0001 g

10.0 ROUTINE PREVENTIVE MAINTENANCE

10.1 None required

11.0 CHEMICALS AND REAGENTS

11.1 Reagent water

11.1.1 Reagent water is defined as water in which no interferences are present at the method reporting limits.

11.2 Methylene chloride: pesticide grade or equivalent

11.3 Sodium sulfate (ACS granular)

11.3.1 Prior to use, the sodium sulfate must be baked for 4 hours at 400° C or rinsed with methylene chloride.

11.4 Base solution: (10 N sodium hydroxide solution): Carefully add 400g NaOH to 1L reagent grade water. **Caution**: This solution will generate significant heat energy. Add NaOH pellets slowly, and allow to cool prior to use.

11.5 Acid solution: (1:1 v/v H_2SO_4) solution: Carefully add 500 mL concentrated (sp. gr. 1.84) H_2SO_4 to 500 mL reagent grade water. **Caution**: This solution will generate significant heat energy. Add H_2SO_4 slowly, allow to cool prior to use. **NEVER ADD WATER TO ACID. ALWAYS ADD THE ACID TO THE WATER.**

11.6 All chemicals used must be of reagent grade quality.

12.0 STANDARDS PREPARATION

12.1 For surrogate or spiking standard preparation, use only pesticide grade MeOH or equivalent.

12.2 All extraction lab standards must be logged into the standards logbook. Every new standard prepared is given a unique identifier. Numbers are assigned using the book number, page number, line number system. For example, a prep laboratory standard made in book 1, page 18, line 5 would be named PL1.18-5.

12.3 The default shelf life of surrogate and spiking standards is 6 months for working standards and 1 year for stocks. Manufacturers expiration dates that precede the laboratory assigned expiration date must be accounted for. No laboratory assigned expiration date can exceed that of the manufacturers assigned expiration date. For multi-component standards, the earliest manufacturers assigned expiration date should be used. Once a standard (surrogate or spiking) and/or chemical has expired, it should be disposed of accordingly. Monitor the expiration date of all standards. To avoid costly expedited shipping fees, it is important to promptly order more standard material as it is consumed.

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12.4 All surrogate/spiking standards are stored in 40 mL narrow mouth jars which are labeled with the following information: Standard Name, Standard Number, Date Made, Analyst Initials, Solvent, Concentration, and Expiration Date. The surrogate/spiking standards are stored in the prep lab refrigerator at 4° C. Once the bottle contains 5 mL or less, the standard should be disposed of to eliminate possible contamination and concentration of the spiking compounds.

12.5 Before a standard is used the calculations must be checked by a second party, and the actual standard analyzed and verified by an analyst. A dilution of the spiking standard should be provided to the respective analyst to check the concentration prior to use by the extraction lab. Only after verification by the analyst can the standard be used.

12.6 Purchased Standards

12.6.1 All vendor prepared stock standards are purchased as certified standards. Stock standards are typically serially diluted to prepare the working standards. The equations shown below demonstrate how to make a 1 ppm standard from a 10,000 ppm stock standard using a serial dilution:

$$10{,}000\ \text{mg/L} \times \frac{1\ \text{mL stock standard}}{100\ \text{mL final volume}} = 100\ \text{mg/L}$$

$$100\ \text{mg/L} \times \frac{1\ \text{mL stock standard}}{100\ \text{mL final volume}} = 1.0\ \text{mg/L}$$

12.6.1.1 Using a syringe, inject the stock standard into a volumetric flask approximately half full of the appropriate solvent. For all prep lab standards, use only pesticide grade or equivalent solvents. Make sure the tip of the syringe is below the surface of the solvent. Invert enough times to mix thoroughly. All surrogate and spiking standards are stored in 40 mL amber jars with Teflon lined lids. All standards are labeled with the following information: Standard Name, Standard Number, Date Made, Analyst Initials, Solvent, Concentration, and Expiration Date. The surrogate and spiking standards are stored with minimal headspace in the prep lab refrigerator at 4° C.

12.7 Neat Standard Preparation

12.7.1 The purity or grade of neat compounds should be the ACS grade. If the purity is below 96% the weight must be adjusted accordingly or the purity accounted for. Check the expiration date of all compounds! Remember, if you use the last amount of a compound, please re-order more.

12.7.2 Use the analytical balance located in the hood, capable of weighing out to 0.0001 g. Make sure the balance has been calibrated that day.

12.7.3 Obtain appropriate glassware and materials listed for each surrogate and/or spike (i.e. volumetric flasks, spatulas).

12.7.4 Collect and label all necessary glassware.

12.7.5 For solids: Weigh compounds to the nearest 0.0001 g. Once the compound is weighed into the volumetric flask and the weight recorded, dilute to volume. Invert at least 3 times to mix thoroughly. NOTE: If the compound does not appear to dissolve, place it in a small sonicator bath to aid in mixing. Closely monitor the standard during sonication as the ultrasonic bath will warm the standard. Remove the standard from the sonication bath as soon as the compound has gone into solution. Mix well and discard the volume of standard present in the neck of the flask. Pour into pre-labeled jars and store at 4° C.

12.7.6 For liquids: Weigh into a tared volumetric flask half full of the appropriate solvent. Using a Pasteur pipet, slowly drip the compound into the solvent. Be careful not to touch the sides of the flask. Record the weight and dilute to volume. Mix well and discard the volume of standard present in the neck of the flask. Pour into pre-labeled jars and store at 4° C.

12.7.7 Serial dilute standards as necessary following the procedure in section 12.6.1.

13.0 DETAILED PROCEDURE

13.1 Rinse all glassware with methylene chloride prior to use. Label separatory funnel, Erlenmeyer flasks, Kuderna-Danish Flask (K-D), and concentrator tube with the entire sample number, test method, and final target volume. Sample should be received in an unpreserved 1 liter brown amber glass container with a Teflon lined lid. Although separatory funnel extraction assumes sample volume to be 1 liter, always measure the exact volume of sample by pouring into a 1 liter graduated cylinder. If the volume of sample received is ≥500 mL, proceed with extraction. If there is <500 mL of sample sent, consult the project chemist to see if the client wishes to proceed with the extraction, as reporting limits may be elevated.

13.1.1 When performing the extraction procedure on a TCLP leachate, 500 mL of leachate is extracted. The project chemist must be consulted if ~~<100~~ 500 mL of leachate is available, as reporting limits will be elevated.

13.2 For an 8270 extraction, the sample to be extracted should be as free as possible from the silt and sediment sometimes found in sample jars. Decant the sample into a graduated cylinder, record the volume, and transfer the sample to a 2 liter separatory funnel. The solids remaining in the sample container should be shaken out and discarded. If a large amount of solid material remains in the sample container, rinse sparingly with reagent water, cap the bottle and shake to loosen the solids from the container. Discard these sediments and the rinse water. Do not discard the empty sample bottle or wash the graduated cylinder, as they must be rinsed with solvent to collect any residual sample.

13.2.1 For 625 BNAs, the entire sample, including all the sediments, must be included in the extraction. After decanting the sample into the graduated cylinder, do not rinse out and discard any sediment left in the container.

13.3 Surrogate is added to all samples, Method Preparation Blanks (MPB), Matrix Spikes, and Laboratory Fortified Blanks (LFB). Spike 100 uL of the surrogate spiking solution per every 1 mL of final extract volume. Final sample volumes are dependent on the reporting limits required. These volumes are either 1 mL or 10 mL. Use a 100 uL or 1 mL gas tight syringe dedicated to the BNA surrogate for spiking. Spike the surrogate standard into the separatory funnel containing the sample. Do not submerge the syringe into the sample. Slowly add surrogate from approximately 1 inch above the sample. Avoid splashing sample onto the syringe. If splashing occurs, rinse syringe externally and internally with methanol.

13.4 Add 100 uL per each 1 mL of final extract volume of the matrix spiking standard to each sample chosen for the matrix spike, matrix spike duplicate, and the LFB. Use a 100 uL or 1 mL gas tight syringe dedicated to the BNA for spiking. Spike the standard into the separatory funnel containing the sample. Do not submerge the syringe into the sample. Slowly add the spike from approximately 1 inch above the sample. Avoid splashing sample onto the syringe. If splashing occurs, rinse syringe externally and internally with methanol. MPBs and LFBs are prepared using laboratory reagent water.

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13.5 Add approximately 1 mL of 1:1 H_2SO_4 to the sample with a 2 mL disposable Pasteur pipet. Mix well by swirling and/or shaking. Check the pH using a pH strip by drawing a few drops of sample out of the separatory funnel with a fresh disposable pipette. Do not dip the pH strip directly into the sample. The pH should be <2. If it is not, add increments of approximately 1 mL 1:1 acid until a pH of <2 is attained. Only add up to 1 percent of the initial sample volume (10 mL for a 1000 mL initial volume) as larger volumes constitute a dilution of the sample. If a larger volume of acid is required, consult with the project chemist prior to proceeding.

13.6 The sample container must now be rinsed with methylene chloride.

13.6.1 Add 60 mL of methylene chloride to the sample container, replace the lid (very important), and shake. Vent as necessary. Transfer this methylene chloride into the graduated cylinder that previously contained the sample and swirl to rinse the sides. Transfer this methylene chloride into the separatory funnel that contains the acidified, spiked sample.

13.7 Place lid on separatory funnel and invert. Immediately open stopcock to release the pressure. Close stopcock, shake, and vent. Repeat process until there is no evidence of pressure. Hand shake the funnel for 2 minutes. Allow the organic layer to separate from the water phase for a minimum of 10 minutes.

13.7.1 If an emulsion forms, place the separatory funnel on the rack and let the sample settle for 15-30 minutes. Rattle the separatory funnel on the rack periodically. Drain entire emulsion and the CH_2Cl_2 into a CH_2Cl_2 rinsed 125 mL separatory funnel. If a separation occurs, drain the CH_2Cl_2 into a 500 mL Erlenmeyer flask and drain the water back into the 2L separatory funnel. If a separation does not occur, drain the emulsion into Teflon lined centrifuge tubes. Centrifuge for 5 minutes at 4500 rpm. Once centrifuged, drain the water layer (including any heavy emulsions) back into the 2L separatory funnel, pour the methylene chloride (bottom) layer into a 100 mm filtering funnel plugged with glass wool and containing 50 g of sodium sulfate. Collect the filtrate in the 500 mL Erlenmeyer flask. Rinse the funnel with approximately 20 mL methylene chloride also into the 500 mL flask. The entire organic portion of the first shake should be in the 500 mL Erlenmeyer.

13.8 Drain the methylene chloride (bottom layer) into a 500 mL Erlenmeyer flask. Repeat extraction process 2 more times with 60 mL methylene chloride each, repeating section 13.7.1 as necessary. With the exception of the graduated cylinder, follow the container rinsing procedure described in section 13.6.1 prior to the second extraction. It is not necessary prior to the third extraction. Depending on the rinses required if an emulsion formed, a total of approximately 180 mL of methylene chloride will be collected in the 500 mL Erlenmeyer flask. Remove the tag from the empty sample container and discard both.

13.9 Add approximately 1 mL of 10 N NaOH to the sample with a 2 mL disposable Pasteur pipet. Mix well by swirling and/or shaking. Check the pH using a pH strip by drawing a few drops of sample out of the separatory funnel with a fresh disposable pipette. Do not dip the pH strip directly into the sample. The pH should be >11. If it is not, add increments of approximately 1 mL 1:1 base until a pH of >11 is attained. Only add up to 1 percent of the initial sample volume (10 mL for a 1000 mL initial volume) as larger volumes constitute a dilution of the sample. If a larger volume of base is required, consult with the project chemist prior to proceeding.

13.10 Add 60 mL methylene chloride to the separatory funnel and repeat section 13.7. If an emulsion forms repeat section 13.7.1 as necessary.

13.11 Drain the methylene chloride (bottom layer) into the 500 mL Erlenmeyer flask containing the acid extract. Repeat extraction process 2 more times with 60 mL methylene chloride each, repeating section 13.7.1 as necessary. A total of approximately 180 mL of methylene chloride will be collected in the 500 mL Erlenmeyer flask to bring the total volume to approximately 360 mL.

13.12 Dry the sample by adding enough sodium sulfate to cover the bottom of the flask. Swirl the extract.

13.13 Pour the methylene chloride extract through a methylene chloride solvent rinsed funnel containing #4 filter paper, and about 1 inch of sodium sulfate. Collect the extract in a Kuderna-Danish concentrator. Rinse the flask with methylene chloride and pour the methylene chloride and the sodium sulfate into the funnel. Rinse the funnel and the sodium sulfate with 20-30 mL of methylene chloride to complete the transfer.

13.14 Remove funnel, dump filter paper and sodium sulfate into a container to air out (in a hood), and add one or two boiling chips to the K-D concentrator. Attach a three-ball Snyder column. Pre-wet the Snyder column by adding approximately 1 mL of methylene chloride to the top. Place the K-D apparatus on a hot water bath (60-70°C) so that the concentrator tube is partially immersed in the hot water and the entire lower rounded surface of the flask is bathed with hot vapor. At the proper rate of distillation, the balls of the column will actively chatter but the chambers will not flood with condensed solvent. When the apparent volume of liquid reaches 1 mL (usually about 10 to 15 minutes), remove the K-D apparatus and allow it to drain and cool for at least 10 minutes. Remove the Snyder column and rinse the lower joint into the concentrator tube with 2-3 mL of methylene chloride.

13.15 Due to possible analyte loss using the N-Evap nitrogen blowdown technique, the micro-Snyder column is used when a final volume of 1 mL is required. The N-Evap nitrogen Blowdown may be used to adjust the final volume to 10 mL.

13.15.1 Micro-Snyder Technique: Add another clean boiling chip to the concentrator tube and attach a 2-3 ball Micro-Snyder column Pre-wet the column with 0.5 mL methylene chloride. Place concentrator tube in water bath so tube is partially immersed in the hot water. The water temperature should be around 60-70° C. Care should be taken to avoid bumping of extract or flooding of column chambers. When apparent volume of extract reaches 1 mL, remove concentrator tube from water bath. Allow to cool for 10 minutes. Remove column and rinse lower joint with 0.2 mL methylene chloride. Transfer the sample to a pre-calibrated 1 mL vial using a clean, disposable, Pasteur pipet. Rinse the concentrator tube with approximately 200 uL of CH_2Cl_2 and transfer to the 1 mL vial. Adjust final volume to 1 mL.

13.15.2 Nitrogen Blowdown Technique: Place the concentrator tube on the N-Evap, and with a gentle stream of nitrogen, concentrate sample to approximately 5 mL. Transfer the sample with a clean, disposable Pasteur pipette to a 10 mL calibrated vial. Rinse the concentrator tube with approximately 2 mL clean methylene chloride, and transfer to the vial. Adjust the final volume to 10 mL.

13.16 The final extracts are stored in the GC/MS sample refrigerator at 4° C.

14.0 REPORTING AND DELIVERABLES

14.1 The analyst extracting a set of samples is responsible for the quality of the data and for filling out the correct documentation. It is important to document the preparation by correctly filling out, turning in, and filing the correct paperwork. This is required for quality control purposes, and in order to provide the client with defensible data.

14.2 LIMS Reporting

14.2.1 When the analyst has finished extracting a set of samples the data must be turned into the Laboratory Information Management Systems (LIMS). The benchsheets must be filled in completely to insure that the results are reported correctly, and the data is associated with the right quality control batch.

14.2.2 If internal chain-of-custody is required it is very important that all information is accurate.

14.2.3 All LIMS benchsheets (including the COC sheets) are to be placed in the correctly colored folders and turned into the data entry person responsible for entering the results.

14.3 Laboratory Required Paperwork

14.3.1 All logbooks must be filled in completely and correctly. All corrections are to be made in indelible ink. There are no erasures or "white outs" allowed. Corrections are to be made with a single line through the error, which is then dated and initialed. The new result is placed near the incorrect result. The erroneous result must remain legible. Blank lines in the logbook should be Z'd out.

15.0 QUALITY ASSURANCE

15.1 The extraction chemist must extract a Blank and a LFB on a daily basis, or once per shift, to demonstrate that interferences from the extraction process are under control. A Matrix Spike and a Matrix Spike Duplicate (provided enough sample was received) will be extracted at a minimum once every 20 samples or once per week, whichever comes first.

15.1.1 Make sure the correct spiking solution is chosen. The spikes are method, and sometimes client, dependent. 625 wastewater samples must be spiked with the full list 625 spike.

16.0 ANALYST CERTIFICATION/METHOD VALIDATION

16.1 Before the preparation of any actual samples, each analyst must demonstrate the ability to generate acceptable accuracy and precision by extracting a one-time analyst certification.

16.2 Prepare a spiking standard at a level that will give extract concentrations in the mid-range of the calibration curve. The spiking standard used must be prepared independently from the standard used for quantitation. Spike 1 mL of the quality control check sample spiking standard into each of four, 1 liter aliquots. Process the samples through the entire sample preparation process described in this SOP.

16.3 Have the instrument analyst analyze the four 1 mL samples following the determinative SOP.

16.4 Calculate the average recovery (x) in ug/L, and the standard deviation of the recovery (s) in ug/L, for each analyte using the four results.

16.4.1 For each analyte x must recover within the current LIMS precision limits, and s must be less than or equal to 20. If s and x for all analytes meet the acceptance criteria, the analyst certification is good. The analyst is now authorized to extract samples by this method. If any individual s exceeds the precision limit or any individual falls outside the range for accuracy, then the system performance is unacceptable for that analyte.

16.4.2 When one or more of the analytes tested fail at least one of the acceptance criteria, the analyst must proceed according to 16.5.

16.5 Locate and correct the source of the problem and repeat the test for all analytes that failed to meet the criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds beginning with section 16.2 or 16.3. Samples may not be prepared by any analyst until the analyst certification has been successfully completed.

17.0 REFERENCES

17.1 *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition,* Final Update III, Revision 3, December, 1996, Method 3510C, "Separatory Funnel Liquid-Liquid Extraction".

18.0 ATTACHMENTS/APPENDICES

18.1 BNA Surrogate Preparation

18.2 BNA 8270 Spiking Standard Preparation

18.3 Full list BNA spike preparation

18.4 8270 BNA TCLP Spike preparation

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Attachment 18.1
BNA Surrogate Preparation

Base/Neutral Surrogate Stock

Compound	Weight Used	Solvent	Amount Solvent	Final Concentration
o-Terphenyl	0.5000 g	MeOH	250 mL	2000 ppm
2-Fluorobiphenyl	0.5000 g	MeOH	250 mL	2000 ppm
D_5-Nitrobenzene	0.5000 g	MeOH	250 mL	2000 ppm

Acid Surrogate Stock

Compound	Weight Used	Solvent	Amount Solvent	Final Concentration
2,4,6-Tribromophenol	1.000 g	MeOH	250 mL	4000 ppm
2-Fluorophenol	1.000 g	MeOH	250 mL	4000 ppm
D_6-Phenol	1.000 g	MeOH	250 mL	4000 ppm

Add 50 mL of acid surrogate stock and 50 mL B/N surrogate stock to a IL volumetric filled approximately halfway with MeOH. Dilute to volume with MeOH. Bottle in 40 mL amber vials. The final concentration will be 200/100 ppm, acid surrogates/base surrogates.

Each standard is made independently in 250 mL MeOH, and is checked independently by giving the GC/MS laboratory dilutions of each surrogate. If each surrogate is within acceptable limits (85-115%), then they are diluted in a 1:1 ratio with each other (the extraction chemist will have 4L of BNA surrogate to use). Save the remaining 50 mL of each base neutral and acid stock to use in the 8270 semi-volatile quantitation standard.

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Attachment 18.2
BNA 8270 Spiking Standard Preparation

Compound	Conc. in Ampule/ Amt. Added	Solvent/Amt.	Concentration in Spiking Std
Acid (Ampule #1)			
4-Chloro-3- methylphenol	7500 ppm/5.33 mL	Methanol/200 mL	200 ppm
2-Chlorophenol			
4-Nitrophenol			
Pentachlorophenol			
Phenol			
Base/Neutral (Ampule #2)			
Acenaphthene	5000 ppm/4 mL	Methanol/200 mL	100 ppm
1,4-Dichlorobenzene			
2,4-Dinitrotoluene			
N-Nitrosodi-n-propylamine			
Pyrene			
1,2,4-Trichlorobenzene			

Compound	Amount	Solvent/Amt.	Int. Conc.	Spiking Std. Conc.
Naphthalene	1.0 g	CH_2Cl_2/100 mL	10,000 ppm	100 ppm

The base neutral and acid spikes are purchased as independent mixes. Naphthalene is made from neat. 2 mL of the 10,000 ppm naphthalene spike is added to a 200 mL volumetric flask half full of MeOH. 5.3 mL of the acid spiking mix and 4 mL of the base neutral spiking mix are added to the same 200 mL volumetric flask. The standard in then brought up to volume.

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Attachment 18.3
Full list BNA spike preparation

This spike is received prepared from NSI (Catalog # C-397) at 100 ppm. The standard is used as received. There are no dilutions necessary.

Attachment 18.4
8270 BNA TCLP Spike preparation

BNA 8270 Spike - Made from a purchased ampule from Ultra Scientific

Compound	Conc. in Ampule/ Amt. Added	Solvent/Amt.	Concentration in Spiking Std
o-cresol	2000 ppm/1.25 mL	Methanol/25 mL	100 ppm
m-cresol			
p-cresol			
1,4-dichlorobenzene			
2,4-dinitrotoluene			
hexachlorobenzene			
hexachlorobutadiene			
hexachloroethane			
nitrobenzene			
pentachlorophenol			
pyridine			
2,4,5-trichlorophenol			
2,4,6-trichlorophenol			

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Approved By: JB 7/31/00 Area Manager

TriMatrix Laboratories, Inc.

STANDARD OPERATING PROCEDURE

EXTRACTION OF SEMI-VOLATILE BNA'S IN SOIL, SEDIMENT AND SLUDGE

USEPA METHOD 3550 Modified

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APPROVALS:

Prep Lab Supervisor: Randy Scott Date: 1/18/96

QA/QC Supervisor: Scott [illegible] Date: 1-23-96

Laboratory Manager: [illegible] Date: 1/18/96

Procedure Number: GR-09-103

Revision Number: 1.0 By: Randy Scott Effective Date: 1/18/96

Total Number of Pages: 9 Pages Revised: All

1.0 METHOD SUMMARY

1.1 Low/Medium Concentration Method

A 30 g sample is mixed with anhydrous sodium sulfate to form a free flowing powder. The sample is serially sonicated with 1:1 methylene chloride/acetone, and concentrated to a 1 ml volume. The extract is analyzed by GC/MS. This method is for the extraction of low to medium concentration of analytes. If past data or poor sample matrix shows the sample(s) to be inappropriate for this method then final extract volumes may be greater than 1 ml or the high concentration method will be used (see 1.2).

1.2 High Concentration/Poor Sample Matrix Method

This method is intended for samples that have a history of high analyte concentrations and/or poor sample matrices that typically contain high concentrations of hydrocarbons. The amount of sample that is sonicated varies between 2 and 10 g depending on the individual sample. The extraction analyst will use his/her professional experience (and past history data for the sample if available) to determine the initial amount to extract. The extraction procedure will be the same as the low/medium method with the exception of initial weights, using only methylene chloride as the solvent and possibly final volumes. The final volume will depend on the sample matrix.

2.0 SAFETY PRECAUTIONS

2.1 For extractions and surrogate/spike standard preparation, follow the safety procedures as outlined in the latest edition of the Laboratory Safety Manual.

2.2 For proper sample and spike waste storage and disposal, or spill response, see the latest edition of the Laboratory Waste Disposal SOP.

3.0 APPARATUS

3.1 600 ml heavy duty Pyrex beaker.

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3.2 Sonicator:
1. Tekmar Sonic Disrupter Model number TM500 or TM600, with 3/4 inch horn.
2. Fisher Model No. 550 with 3/4 inch horn.

3.3 500 ml Kuderna-Danish flask.

3.4 10 ml graduated concentrator tube.

3.5 3-ball macro Snyder column.

3.6 Variable temperature steam bath.

3.7 Top loading balance, capable of accurately weighing to the nearest .01 g.

3.8 N-EVAP or similar nitrogen blowdown device.

3.9 Whatman # 4, 24 mm filter paper (or equivalent).

3.10 Stainless steel spatula.

3.11 1 ml disposable glass Pasteur pipets.

3.12 Boiling chips - solvent rinsed, approximately 10 mesh (silicon carbide or equivalent) (Hengar micro granules).

3.13 2 ml auto-sampler vials calibrated to 1 ml, with Teflon lined silicon septa and screw cap lids.

3.14 1 ml syringe.

3.15 Grinder, or alternative size reduction tools.

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3.16 Mortar & pistal

4.0 CHEMICALS AND REAGENTS

4.1 1:1 mix of Methylene Chloride/Acetone - pesticide quality or equivalent.

4.2 Methylene chloride - pesticide grade or equivalent.

4.3 Anhydrous Sodium sulfate (ACS granular). Baked @ 400°C for 4 hours.

4.4 See Appendix A for surrogate and/or spiking standard preparation.

5.0 PROCEDURE

5.1 Sonication

5.1.1 Tuning the Sonicator(s)

5.1.1.1 The sonicator(s) must be tuned prior to use at the beginning of the analysts shift.

5.1.1.2 Follow the tuning instructions starting at sec. 5.1.1.2.1 for the Tekmar TM500 or TM600. For the Fisher model 550 follow the instructions starting at sec. 5.1.1.2.9.

5.1.1.2.1 **Tuning (Tekmar TM500 and TM600)**
Tune the power supply in accordance with the following procedure each time the sonicator is used.

5.1.1.2.2 Ensure that the horn is not immersed in liquid and that it does not come in contact with anything.

5.1.2.2.3 If using two converters simultaneously, disconnect one

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converter from the power supply.

5.1.2.2.4 Set the tuning select switch to the down position if the remaining converter is connected to connector ; and to the up position, if the remaining converter is connected to connector .

5.1.2.2.5 Set TIMER to HOLD.

5.1.2.2.6 Set OUTPUT CONTROL to 10 (to 5 when using a microtip).
CAUTION: When using a micro tip, never allow the tip to vibrate in air for more than 10 seconds and do not permit the OUTPUT CONTROL setting to exceed number 5. Ignoring these instructions could cause the microtip to fracture.

5.1.2.2.7 Momentarily hold down ON/OFF/TUNE switch to TUNE and rotate the tuning control clockwise or counterclockwise until a minimum (not maximum) reading is obtained on the loading meter . If the tuning control strikes the limit stops before the meter reads minimum and starts to rise again, the power supply is not tuned. If minimum reading (sometimes referred to as a null) cannot be obtained, the horn, coupler section, tip, micro tip, or lower section is out of resonance or the power supply and converter require servicing.
NOTE: If minimum reading cannot be obtained and another horn is available, check unit with new horn to ascertain whether the power supply or horn is at fault.

5.1.2.2.8 Release ON/OFF/TUNE switch. The sonicator is now tuned. Record the tuning information in the TUNE logbook.

5.1.1.2.9 **Tuning Instructions for the Fisher Model 550 Sonicator**

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QA/QC Supervisor **Area Supervisor**

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5.1.1.2.10 Turn OUTPUT CONTROL knob counterclockwise to zero.

5.1.1.2.11 Press POWER SWITCH to ON (up) position. The switch will illuminate.

5.1.1.2.12 When the prompt appears, press TUNE key. Screen will read: [TUNING - - - PROBE ACTIVE].

5.1.1.2.13 Turn the OUTPUT CONTROL knob towards setting 10 (5 if using a microtip).
(a) Note the position of the Bar Graph on the ICD Display Screen. Do NOT exceed 70%.
(b) Rotate the Tuning Knob clockwise or counterclockwise until a minimum (not maximum) reading is obtained. Note: If a reading of less than 15% can not be obtained there is a problem with teh sonicator and it must be fixed before it can be used.

5.1.1.2.14 Press the TUNE key to display prompt for programmed or continuous operation and set the sonicator for programmed operation.

5.1.1.2.15 The sonicator is not tuned. Record all tuning information in TUNE logbook.

5.1.1.2 The sonicator(s) must be tuned prior to use at the beginning of the analyst shift.

5.1.2 Decant and discard any water layer and any foreign objects such as sticks, leaves, and rocks from the soil sample. Mix sample thoroughly, especially composite samples. The sample should be able to pass through a 1 mm sieve. If it appears that the sample will not, then it must be size reduced using a mortar and pistal or

mechanical grinder.

5.1.3 If the sample is gummy, fibrous, or an oily type sample then it should be size reduced to allow for the maximum surface area exposure to the solvent. Material such as paper or fabric need not be size reduced. The analyst needs to use their professional judgment to determine the proper handling of the sample.

5.1.4 Label all glassware with complete sample number and other necessary information (i.e. MS, MSD, LFB, etc.).

5.1.5 The following steps should be performed rapidly to avoid loss of the more volatile compounds. For sandy to dry samples, weigh 30 ±0.1g of sample into a 600 ml beaker and add ~20-25 g of anhydrous sodium sulfate. For samples that are of a wet to gummy nature, add ~60 g of anhydrous sodium sulfate to the 30 ± 0.1 g of sample. Mix well. The sample should have a sandy texture at this point. Add more anhydrous sodium sulfate as necessary to achieve this consistency. Add 1.0 ml BNA surrogate to the samples, blanks and spikes. For matrix spikes and laboratory fortified blanks, also add 1.0 ml of spiking standard. Immediately add 100 ml of the 1:1 methylene chloride/acetone mix.

5.1.6 Place the 3/4 inch tipped sonication probe about 1/2 inch below the surface of the solvent but above the soil layer.

5.1.7 Sonicate for 3 minutes at full power (output control knob set at 10 and percent-duty cycle knob set at 50%). Do not use a micro tip probe.

5.1.8 Assemble the K-D apparatus. Insert a 100 mm filtering funnel lined with 24 mm # 4 filter paper. Add ~3/4 to 1 inch of the anhydrous sodium sulfate into the funnel. Rinse filter paper and sodium sulfate with methylene chloride.

5.1.9 Decant the solvent into the filtering funnel.

5.1.10 Repeat the sonication two more times with two additional 100 ml portions of 1:1

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methylene chloride-acetone, decanting off the solvent after each sonication. If, after the third extraction, there is no noticeable color change in the extract, additional sonications may be needed. Record the exact number of sonications in the soil log book, if additional sonications were needed. On the final ultrasonic extraction, pour the entire sample into the filtering funnel and rinse with methylene chloride.

5.2 Concentration

5.2.1 Add one or two clean boiling chips to the evaporative flask and attach a three-ball Snyder column. Pre-wet the Snyder column by adding ~1 ml methylene chloride to the top. Place the K-D apparatus on a hot water bath (80-90°C) so that the concentrator tube is partially immersed in the hot water and the entire lower rounded surface of the flask is bathed with hot vapor. At the proper rate of distillation, the balls of the column will actively chatter but the chambers will not flood with condensed solvent. When the apparent volume of liquid reaches 1 ml (usually about 10 to 15 minutes), remove the K-D apparatus and allow it to drain and cool for at least 10 minutes.

5.2.2 Place the concentrator tube in the N-EVAP (water bath ~35°C) and evaporate the solvent volume to 1 ml using a gentle stream of clean, dry nitrogen.

CAUTION: When the volume of solvent is reduced below 1 ml, semivolatile analytes may be lost. If the extract is allowed to concentrate to, or near dryness, the entire extraction must be repeated.

5.3 Transfer the extract into a 1.7 ml auto-sampler vial which has been calibrated to 1 ml, (see SOP for vial calibration) making sure to rinse the concentrator tube and side walls 2-3 times with a total of ~ 500 µl methylene chloride.

5.4 Place the auto-sampler vial in the N-EVAP (water bath ~35°C) and evaporate the solvent volume to 1 ml using a gentle stream of clean, dry nitrogen.

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QA/QC Supervisor **Area Supervisor**

5.5 Cap the vial with the screw cap lids and Teflon lined silicon septa,and place the 1 ml extract in the GC/MS refrigerator at 4°C.

6.0 FLOW CHART

Not Available.

7.0 QUALITY ASSURANCE

7.1 A method blank must be extracted at the start of each working shift. The blank is defined by weighing 30g of sodium sulfate and extracting it using the same procedure that will be used for the samples. The method blank that is extracted at the start of every shift may be used to start a QC batch including a LFB, MS, MSD or may be placed within an open QC batch with less than 20 samples in it.

7.2 A quality control set consisting of a method blank, matrix spike, matrix spike duplicate (provided enough sample was received), and laboratory fortified blank will be extracted at a minimum of every 20 samples per matrix to evaluate laboratory data quality. Performance records are maintained to document the quality of the data that is generated.

7.3 Matrix spikes are prepared by adding 1 ml of the spike standard in addition to the 1 ml of BNA surrogate standard to the sample, and extracting the sample as outlined beginning in Section 5.1.

7.4 Laboratory fortified blanks are prepared by adding 1 ml of the spike standard in addition to the 1 ml of BNA surrogate standard to 30 g of anhydrous sodium sulfate, and extracting the sample as outlined beginning in Section 5.1.

7.5 Interferences

7.5.1 Method interferences may be caused by contaminants in solvents, reagents, glassware, and other sample processing hardware. Rinsing all washed glassware with pesticide quality methylene chloride prior to use, as well as the use of high

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purity reagents and solvents helps to minimize interference problems.

7.6 Matrix interferences from either the sample itself, or from laboratory induced contamination may effect the recovery of both analytes and spiked compounds. Re-extraction of a sample or spike may be necessary if any of the surrogate or spike compounds fail to pass the appropriate recovery limits.

8.0 RESPONSIBILITIES

The extraction chemist is responsible for all standard preparation, sample set-up and extraction, surrogate spiking and standard additions, and sample drying, concentration, and storage. The extraction chemist must also maintain a detailed laboratory notebook and fill out all appropriate benchsheets. The extraction chemist is also responsible for proper waste disposal of all spent solvents from extractions, and appropriate spill response procedures.

9.0 REFERENCES

Test methods for ultrasonic extraction: SW-846 Method 3550A, September 1994, Rev. 1.

10.0 APPENDIXES

Appendix A: Surrogate/Spiking standard preparation for GC/MS and GC laboratories.

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QA/QC Supervisor **Area Supervisor**

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STANDARD OPERATING PROCEDURE

EXTRACTION OF ORGANOCHLORINE PESTICIDES AND PCBs IN WATER

METHOD 3510C

UNCONTROLLED DOCUMENT

APPROVALS:

Organic Manager: _____ Date: 5/4/99
Jeff P. Glaser

QA Manager: _____ Date: 5/4/99
Rick D. Wilburn

Laboratory Manager: _____ Date: 5/4/99
Douglas E. Kriscunas

Procedure Number: GR-09-107
Revision Number: 4.0

Date Initiated: 3/30/94
Effective Date: 5/4/99

Date Revised: 5/4/99
Pages Revised: All

By: Jeff P. Glaser

Total Number of Pages: 11

1.0 SCOPE AND APPLICATION

1.1 This procedure describes a method for isolating organic compounds from aqueous samples. The procedure also describes concentration techniques suitable for preparing the extract for the appropriate determinative methods.

1.2 This procedure is applicable to the isolation and concentration of water insoluble and slightly water-soluble organochlorine pesticides and PCBs in preparation for a variety of chromatographic procedures.

2.0 PRINCIPLE METHOD REFERENCES

2.1 *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition*, Final Update III, Revision 3, December, 1996, Method 3510C, "Separatory Funnel Liquid-Liquid Extraction".

3.0 SUMMARY OF PROCEDURE

3.1 A measured volume of sample, usually 1 liter, is serially extracted at a neutral pH with methylene chloride using a separatory funnel. The extract is dried and concentrated. A solvent exchange with hexane is performed and the extract is re-concentrated to a final volume of 2 mL.

4.0 PARAMETER OR COMPOUND LIST

4.1 See TriMatrix SOPs GR-03-120 (8081A) and GR-03-128 (8082) for parameter lists.

5.0 REFERENCED SOPs

5.1 GR-03-128, *Semi-Volatile Laboratory Gas Chromatography Analyses of Polychlorinated Biphenyls (PCBs)*; Method 8082, latest revision.

5.2 GR-03-120, *Semi-Volatile Laboratory Gas Chromatography Analyses of Organochlorine Pesticides*; Method 8081A, latest revision.

5.3 GR-09-109, *Sulfur Cleanup*; Method 3660B, latest revision.

5.4 GR-09-110, *Sulfuric Acid Cleanup*; Method 3665A, latest revision.

5.5 GR-09-111, *Florisil Column Cleanup*; Method 3620B, latest revision.

6.0 INTERFERENCES AND CORRECTIVE PROCEDURES

6.1 Method interferences may be caused by contaminants in solvents, reagents, glassware, and other sample processing hardware. Rinsing all washed glassware with pesticide quality methylene chloride prior to use, as well as the use of high purity reagents and solvents, helps to minimize interference problems.

6.2 Matrix interferences from either the sample itself, or from laboratory induced contamination, may effect the recovery of both analytes and spiked compounds. Re-extraction of a sample or spike may be necessary if any of the surrogate or spike compounds fail to pass the appropriate recovery limits.

7.0 SAFETY PRECAUTIONS

7.1 All extraction personnel must wear lab coats and safety glasses when in the prep lab. In addition, nitrile gloves are to be worn whenever samples or reagents are handled.

7.2 For extractions and surrogate/spike standard preparation, follow the safety procedures as outlined in the latest edition of the Laboratory Safety Manual.

7.3 For proper spill response, and sample, spike, and waste storage and disposal procedures, see the latest edition of the TriMatrix Laboratory Waste Disposal SOP.

8.0 SAMPLE SIZE, COLLECTION, PRESERVATION AND HANDLING PROCEDURES

8.1 Samples are to be collected in 1000 mL screw-cap amber glass jars with Teflon-lined caps. No preservative is required.

8.2 All samples must be extracted within 7 days of the collection date.

8.3 When not in use samples should be stored in the walk-in cooler.

8.4 The analyst should use care when handling samples to avoid breakage.

9.0 INSTRUMENTATION, APPARATUS, AND MATERIALS

9.1 300 mL Erlenmeyer flask

9.2 2 liter glass separatory funnel with Teflon stopcock

9.2.1 shaking apparatus for the 2 liter separatory funnels

9.3 100 mm filtering funnel

9.4 Whatman #4 filter paper

9.5 500 mL Kuderna-Danish evaporative flask

9.6 10 mL graduated Kuderna-Danish concentrator tube

9.7 three ball macro Snyder column

9.8 2-3 ball micro Snyder column

9.9 3.7 mL auto-sampler vials with Teflon-lined screw cap lids, pre-calibrated to 2 mL

9.10 methylene chloride rinsed boiling chips

9.11 pH paper

9.12 forceps

9.13 nitrogen evaporation bath

9.14 1 mL disposable Pasteur glass pipets

9.15 variable temperature water bath

9.16 2-5 mL syringes

9.17 1 Liter graduated cylinders

10.0 ROUTINE PREVENTIVE MAINTENANCE

10.1 None required.

11.0 CHEMICALS AND REAGENTS

11.1 Reagent water

11.1.1 Reagent water is defined as water in which no interferences are present at the method reporting limits.

11.2 Methylene chloride and hexane: pesticide grade or equivalent.

11.3 Sodium sulfate (ACS granular) baked at 400°C for a minimum of 4 hours.

11.4 Base solution (10M sodium hydroxide solution): Carefully add 400g NaOH to 1 liter reagent grade water. CAUTION: This solution will generate significant heat energy. Add NaOH pellets slowly and allow to cool prior to use.

11.5 Acid solution (1:1 H_2SO_4 solution): Carefully add 500 mL concentrated H_2SO_4 to 500 mL liter reagent grade water. CAUTION: This solution will generate significant heat energy. Add H_2SO_4 slowly and allow to cool prior to use. NEVER add the water to acid. Always add the acid to the water.

12.0 STANDARDS PREPARATION

12.1 All stock standards are purchased as certified standards. Stock standards are typically serially diluted to prepare the working standards. The equations shown below show how to make a 1 ppm standard from a 10,000 ppm stock standard using a serial dilution:

$$10{,}000\,\text{mg/L} \times \frac{1\,\text{mL stock standard}}{100\,\text{mL final volume}} = 100\,\text{mg/L}$$

$$100\,\text{mg/L} \times \frac{1\,\text{mL stock standard}}{100\,\text{mL final volume}} = 1.0\,\text{mg/L}$$

12.2 Using a syringe, inject the stock standard into a volumetric flask approximately half full of the appropriate solvent. For all prep lab standards, use only pesticide grade or equivalent solvents. Make sure the tip of the syringe is below the surface of the solvent. Invert enough times to mix thoroughly. All surrogate and spiking standards are stored in 40 mL amber jars with Teflon lined lids. All standards are labeled with the following information: name, surrogate number/spike number, date made, analyst initials, solvent, concentration, and expiration date. The surrogate and spiking standards are stored in the prep lab refrigerator at 4°C.

12.2.1 Record all prep information on an Extraction Standards Log Sheet. The standards are labeled with a prefix of GC or MS followed by a number depending on if they are for the GC or the GC/MS lab.

12.2.2 All extraction lab standards must be logged into the standards logbook on the proper form. Every new standard prepared is given a unique identifier. Check the logbook contents page to find the next available number. For example, if preparing a GC spiking standard and the last line used on the contents page was GC-17, the new standard will be called GC-18. Every dilution made from this standard will be recorded on a separate dilutions form. The first dilution of GC-18 will be called GC-18.1. The second dilution will be called GC-18.2. If a dilution of a dilution is made the standard will be given another extension. For example if GC-18.1 was used to make up another standard, the new standard will be labeled GC-18.1.1.

12.3 The shelf-life of surrogate and spiking standards is 6 months for working standards and 1 year for stocks. Once a standard (surrogate or spiking) and/or chemical has expired, it should be disposed of accordingly. Monitor the expiration date of all standards. To avoid costly expedited shipping fees, it is important to promptly order more standard material as it is consumed.

12.4 Before a standard is used the calculations must be checked by a second party and the actual standard analyzed and verified by an analyst. A dilution of the spiking standards is required by both GC/MS and

GC laboratories to check the concentration prior to use by the extraction lab. Only after verification by the analyst can the standard be used.

12.5 PCB/Pesticides surrogate standard

Compound(s)	Initial Ampule Concentration	Dilution	Solvent	Final Spike Concentration
2,4,5,6-Tetrachloro-m-xylene	200 mg/L*	1:2000	Acetone	0.10 mg/L
Decachlorobiphenyl	200 mg/L*	1:2000	Acetone	0.10 mg/L

* The surrogate standard is made from a purchased standard mix containing both compounds at 200 mg/L. The samples are spiked with an amount of surrogate standard equal to that of the final volume of the extract. Typically 2 mL is spiked into 1 L of sample and concentrated to a final volume of 2 mL putting the surrogates at a concentration of 0.10 mg/L in the sample extract.

12.6 Pesticide Spike

12.6.1 The following compounds are diluted to 0.20 mg/L in MeOH

Aldrin	a-Endosulfan
a-BHC	b-Endosulfan
b-BHC	Endosulfan Sulfate
d-BHC	Endrin
g-BHC	Endrin Aldehyde
4,4-DDD	Endrin Ketone
4,4-DDE	Heptachlor
4,4-DDT	Heptachlor Epoxide
Dieldrin	Methoxychlor

12.7 PCB Spikes (1221, 1242, 1248, 1254, 1260)

12.7.1 Each PCB is brought in an individual ampule at 1000 ppm. A 1:1000 dilution is made with acetone to obtain a 1.0 mg/L spike.

13.0 DETAILED PROCEDURE

13.1 Rinse all glassware with methylene chloride prior to use. Label separatory funnel, Erlenmeyer flasks, K.D., and concentrator tube with entire sample number. Sample should be received in a 1L brown amber glass container with a Teflon-lined lid. Although separatory funnel extraction assumes sample volume to be 1 liter, always measure the exact volume of sample by pouring into a 1 liter graduated cylinder. If the volume of sample received is ≥ 500 mL, proceed with extraction. If there is <500 mL of sample sent, consult the project chemist to see if the client wishes to proceed with the extraction, as reporting limits may be elevated.

13.2 The sample to be extracted should be as free as possible from the silt and sediment sometimes found in sample jars. Decant the sample into a graduated cylinder and record the volume. The remainder of the sample should be shaken out of the sample container and discarded. If a large amount of solid material remains in the sample container, rinse sparingly with reagent water to remove. Discard this rinse water. After the volume has been recorded, transfer the sample to the separatory funnel. Do not yet discard the sample bottle, or wash the graduated cylinder as they must be rinsed with solvent to collect any remaining sample.

13.3 The extraction of pesticide/PCB samples must be done at a pH range of 5-9. Check the pH of the sample using wide range pH paper by transferring a small portion of the sample onto the pH strip using a Pasteur pipet. Adjust the sample as necessary using the concentrated base or acid solutions.

13.4 Add 2.0 mL of PCB/Pest surrogate standard solution to the sample with a 2.5 mL syringe. Surrogate is added to all samples, blanks, and spikes. Do not submerge syringe into sample, slowly add surrogate approximately 1 inch above sample. Avoid splashing sample onto syringe. If splashing occurs, rinse syringe internally and externally with methanol.

13.5 The following spiking standards are added to all appropriate spikes:

13.5.1 PCBs: Add 1 mL of PCB spiking standard to matrix spike, matrix spike duplicate, and a laboratory fortified blank.

13.5.2 Pesticides: Add 1 mL of Pesticide spiking standard to matrix spike, matrix spike duplicate and laboratory fortified blank.

13.6 The sample container must now be rinsed with methylene chloride.

13.6.1 Add 60 mL of methylene chloride to the sample container, replace the lid (very important), and shake. Vent as necessary. Pour this methylene chloride into the graduated cylinder that previously contained the sample and swirl to rinse the sides. Transfer this methylene chloride into the separatory funnel which contains the sample.

13.7 Place lid on separatory funnel and invert. Immediately open stopcock to release the pressure. Close stopcock and shake, vent. Repeat process until there is no evidence of pressure. By hand or in a shaker box set at 120-140 shakes per minute, shake the funnel for 2 minutes. Remove the separatory funnel from the shaker box and place on rack. Allow the methylene chloride layer to separate from the water layer.

13.7.1 If an emulsion layer forms, drain the layer and the methylene chloride into a methylene chloride rinsed 125 mL separatory funnel. If a separation occurs, drain the methylene chloride into a 300 mL Erlenmeyer flask and drain the water back into the 2 liter separatory funnel. If the separation does not occur, drain the emulsion into a Teflon centrifuge tube. Centrifuge for 4 minutes at 4500 rpm. Once centrifuged, drain the water layer (and any heavy emulsions which are in the top layer), back into the 2L separatory funnel, and pour the bottom methylene chloride layer into a 300 mL Erlenmeyer flask.

13.8 Drain the methylene chloride (bottom layer) into a 300 mL Erlenmeyer flask. Repeat extraction process 2 more times with 60 mL methylene chloride each, repeating section 13.7.1 as necessary. With the

exception of the graduated cylinder, follow the container rinsing procedure described in section 13.6.1 prior to the second extraction. It is not necessary prior to the third extraction. A total of 180 mL of methylene chloride will be collected in the 300 mL Erlenmeyer flask.

13.9 Pour the methylene chloride through a methylene chloride solvent rinsed funnel containing #4 filter paper, and about 1 inch of sodium sulfate. After collecting the extract in a Kuderna-Danish concentrator, rinse the flask with methylene chloride and pour through the funnel. Rinse the funnel and the sodium sulfate with 20-30 mL of methylene chloride to complete the transfer.

13.10 Add one or two clean boiling chips to the evaporative flask and attach a three-ball Snyder column. Pre-wet the Snyder column by adding approximately 1 mL of methylene chloride to the top. Place the K-D apparatus on a hot water bath (80-90°C) so that the concentrator tube is partially immersed in the hot water and the entire lower rounded surface of the flask is bathed with hot vapor. At the proper rate of distillation, the balls of the column will actively chatter but the chambers will not flood with condensed solvent. When the apparent volume of liquid reaches 1 mL (usually about 10 to 15 minutes), remove the K-D apparatus and allow it to drain and cool for at least 10 minutes.

13.11 Add approximately 60 mL of hexane and tilt the K.D. so the methylene chloride and hexane mix. Place the K-D apparatus on the hot water bath (85-95°C) so that the concentrator tube is partially immersed in the hot water and the entire lower rounded surface of the flask is bathed with hot vapor. At the proper rate of distillation, the balls of the column will actively chatter but the chambers will not flood with condensed solvent. When the apparent volume of liquid reaches 1 mL (usually about 10 to 15 minutes), remove the K-D apparatus and allow it to drain and cool for at least 10 minutes. The volume in the ampule after cooling should be approximately 8 mL.

13.12 Either the Micro-Snyder column technique or nitrogen blowdown technique is used to adjust the final volume to 2 mL. Due to possible analyte loss using the nitrogen blowdown technique the Micro-Snyder technique is the preferred method of concentration.

13.12.1 Micro-Snyder Technique: Add another clean boiling chip to the concentrator tube and attach a 2-3 ball Micro-Snyder column. Pre-wet the column with 0.5 mL hexane. Place concentrator tube in water bath so tube is partially immersed in the hot water. The water temperature should be around 80-90°F. Care should be taken to avoid bumping of extract or flooding of column chambers. When apparent volume of extract reaches 1 mL, remove concentrator tube from water bath. Allow to cool for 10 min. Remove column and rinse lower joint with 0.2 mL hexane. Transfer the sample to a pre-calibrated 2 mL vial using a clean, disposable, Pasteur pipet. Rinse the concentrator tube approximately 800 uL of hexane and transfer to the 2 mL vial. Adjust final volume to 2 mL if necessary.

13.12.2 Nitrogen blowdown Technique: Place on a N-EVAP, and with a gentle stream of nitrogen, concentrate sample to 1 mL. Transfer the sample with a clean, disposable Pasteur pipette to a 2 mL calibrated vial. Rinse the concentrator tube with 1 mL clean hexane, rinse the tube and transfer to the vial to complete the 2 mL transfer.

13.13 Place the 2 mL extract in the prep lab clean-up refrigerator (4°C).

13.14 Pesticide Extracts

13.14.1 If necessary, the pesticide extracts are cleaned-up using disposable Florisil columns (1000 mg) or large (approximately 20 g) Florisil columns. See the Florisil column clean-up SOP, GR-09-111.

13.15 PCB Extracts

13.15.1 All PCB extracts are cleaned-up using sulfuric acid and/or Florisil column clean-up. See the Florisil column clean-up SOP, GR-09-111, and the sulfuric acid clean-up SOP, GR-09-110. Copper powder is also added to each sample extract vial to remove any elemental sulfur. See the SOP for sulfur clean-up of PCBs, GR-09-109.

13.16 The final extracts will then be stored in the GC refrigerator at 4°C.

14.0 REPORTING AND DELIVERABLES

14.1 The analyst extracting a set of samples is responsible for the quality of the data and for filling out the correct documentation. It is important to document the preparation by correctly filling out, turning in, and filing the correct paperwork. This is required for quality control purposes, and in order to provide the client with defensible data.

14.2 LIMS Reporting

14.2.1 When the analyst has finished extracting a set of samples the data must be turned in to LIMS. The benchsheets must be filled in completely to insure that the results are reported correctly, and the data is associated with the right quality control batch.

14.2.2 If internal chain-of-custody is required it is very important that the COC sheet is filled out correctly.

14.2.3 All LIMS benchsheets (including the COC sheets) are to be placed in the correctly colored folders and turned into the data entry person responsible for entering the results. The blue folders containing the BLKs also should have the blank raw data quantitation reports and chromatograms included.

14.3 Laboratory Required Paperwork

14.3.1 All logbooks must be filled in completely and correctly. Corrections are to be made with a lineout, not a writeover, and blank lines in the logbook should be Z'd out.

14.3.2 All LIMS documentation should be turned into the Semi-Volatile Laboratory technician who will record the date, time, and contents that were turned in.

15.0 QUALITY ASSURANCE

15.1 The extraction chemist must extract a blank and a LFB on a daily basis, or once per shift, to demonstrate that interferences from the extraction process are under control.

15.2 A matrix spike and a matrix spike duplicate (provided enough sample was received) will be extracted at a minimum once every 20 samples or once per week, whichever comes first. Performance records are maintained to document the quality of the data that is generated.

15.3 Matrix spikes are prepared by adding 1 mL of the spike standard in addition to the 2 mL of PCB/pest surrogate standard to 1 L of sample, and extracting the sample as outlined beginning in section 13.

15.4 Laboratory fortified blanks are prepared by adding 1 mL of the appropriate PCB or pesticide spike standard in addition to the 2 mL of PCB/pest surrogate standard to 1 L of deionized water, and extracting the sample as outlined beginning in section 13.

15.5 Matrix interferences from either the sample itself, of from laboratory induced contamination may effect the recovery of both analytes and spiked compounds. Re-extraction of a sample or spike may be necessary if any of the surrogate or spike compounds fail to pass the appropriate recovery limits.

16.0 ANALYST CERTIFICATION/METHOD VALIDATION

16.1 Before the preparation of any actual samples, each analyst must demonstrate the ability to generate acceptable accuracy and precision by extracting a one time analyst certification.

16.2 Prepare a quality control check sample spiking standard at a level which will give extract concentrations in the mid-range of the calibration curve. The spiking standard used must be prepared independently from the standard used for quantitation. Spike 1 mL of the quality control check sample spiking standard into each of four, 1 liter aliquots of water and extract as usual. The check samples must then be cleaned up using all applicable cleanup methods for this type of analysis.

16.3 Have the instrument analyst analyze the four 1 mL samples following the determinative SOP.

16.4 Calculate the average recovery (x) in ug/L, and the standard deviation of the recovery (s) in ug/L, for each analyte using the four results.

16.4.1 For each analyte x must be in the range 70-130% and s must be less than or equal to 20. If s and x for all analytes meet the acceptance criteria, the analyst certification is good. The analyst is now authorized to extract samples by this method. If any individual s exceeds the precision limit or any individual falls outside the range for accuracy, then the system performance is unacceptable for that analyte.

16.4.2 When one or more of the analytes tested fail at least one of the acceptance criteria, the analyst must proceed according to 16.5.

16.5 Locate and correct the source of the problem and repeat the test for all analytes that failed to meet the criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds beginning with section 16.2 or 16.3. Samples may not be prepared by any analyst until the analyst certification has been successfully completed.

17.0 REFERENCES

17.1 *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition*, Final Update III, Revision 3, December, 1996, Method 3510C, "Separatory Funnel Liquid-Liquid Extraction".

18.0 ATTACHMENTS/APPENDICES

18.1 None attached.

Approved By: 5/4/99
QA Manager

Approved By: 5/4/99
Area Manager

TriMatrix Laboratories, Inc.

STANDARD OPERATING PROCEDURE

EXTRACTION OF ORGANOCHLORINE PESTICIDES AND PCBs IN SOIL, SLUDGE, AND WASTES

METHOD 3550B

UNCONTROLLED DOCUMENT

APPROVALS:

Organic Manager: _____ Date: 5/4/99
Jeff P. Glaser

QA Manager: _____ Date: 5/4/99
Rick D. Wilburn

Laboratory Manager: _____ Date: 5/4/99
Douglas E. Kriscunas

Procedure Number: GR-09-108
Revision Number: 3.0

Date Initiated: 3/30/94
Effective Date: 5/4/99

Date Revised: 5/4/99
Pages Revised: All

By: Jeff P. Glaser

Total Number of Pages: 12

1.0 SCOPE AND APPLICATION

1.1 Method 3550B is a procedure for extracting non-volatile and semi-volatile organic compounds from solids such as soils, sludges and wastes. The ultrasonic process ensures complete contact of the sample with the extraction solvent.

1.2 It is highly recommended that the extracts be cleaned up prior to analysis.

1.3 This method is not appropriate for applications where high extraction efficiencies of analytes at very low concentrations is necessary.

2.0 PRINCIPLE METHOD REFERENCES

2.1 *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition*, Final Update III, Revision 2, December, 1996, Method 3550B, "Ultrasonic Extraction".

3.0 SUMMARY OF PROCEDURE

3.1 Low Concentration Method: A 30 g sample is mixed with anhydrous sodium sulfate to form a free flowing powder. The sample is serially sonicated with 1:1 methylene chloride/acetone. The sample is concentrated down to a 5 mL final volume, followed by a solvent exchange to hexane. The final volume is then reduced to 10 mL. The extract is cleaned-up and ready to be analyzed.

3.2 Medium/High Concentration Method: A 2 g sample is mixed with anhydrous sodium sulfate. This is solvent extracted once using ultrasonic extraction with hexane. After extraction, a portion of the extract is removed for cleanup and/or analysis.

4.0 PARAMETER OR COMPOUND LIST

4.1 See TriMatrix SOPs GR-03-120 (8081A) and GR-03-128 (8082) for parameter lists.

5.0 REFERENCED SOPs

5.1 GR-03-128, *Semi-Volatile Laboratory Gas Chromatography Analyses of Polychlorinated Biphenyls (PCBs)*; Method 8082, latest revision.

5.2 GR-03-120, *Semi-Volatile Laboratory Gas Chromatography Analyses of Organochlorine Pesticides*; Method 8081A, latest revision.

5.3 GR-09-109, *Sulfur Cleanup*; Method 3660B, latest revision.

5.4 GR-09-110, *Sulfuric Acid Cleanup*; Method 3665A, latest revision.

5.5 GR-09-111, *Florisil Column Cleanup*; Method 3620B, latest revision.

6.0 INTERFERENCES AND CORRECTIVE PROCEDURES

6.1 Method interferences may be caused by contaminants in solvents, reagents, glassware, and other sample processing hardware. Rinsing all washed glassware with pesticide quality methylene chloride prior to use, as well as the use of high purity reagents and solvents helps to minimize interference problems.

6.2 Matrix interferences from either the sample itself, or from laboratory induced contamination may effect the recovery of both analytes and spiked compounds. Re-extraction of a sample or spike may be necessary if any of the surrogate or spike compounds fail to pass the appropriate recovery limits.

7.0 SAFETY PRECAUTIONS

7.1 All extraction personnel must wear lab coats and safety glasses when in the prep lab. In addition, nitrile gloves are to be worn whenever samples or reagents are handled.

7.2 For extractions and surrogate/spike standard preparation, follow the safety procedures as outlined in the latest edition of the Laboratory Safety Manual.

7.3 For proper sample and spike waste storage and disposal, or spill response, see the latest edition of the Laboratory Waste Disposal SOP.

8.0 SAMPLE SIZE, COLLECTION, PRESERVATION AND HANDLING PROCEDURES

8.1 Collect all solid samples in 60, 125, or 250 mL wide-mouth glass jars with Teflon-lined caps.

8.2 All samples must be extracted within 14 days of the collection date.

8.3 Samples should be handled with care to avoid breakage. Samples shonld be stored in walk-in cooler at 4°C when not in use.

9.0 INSTRUMENTATION, APPARATUS, AND MATERIALS

9.1 600 mL heavy duty Pyrex beaker

9.2 sonicator

- Tekmar sonic disrupter model number TM600, with 3/4 inch horn
- Fisher model number 550 with 3/4 inch horn
- 1/8 inch tapered microtip horn. For use dnring the high concentration method

- Sonabox - recommended for use with sonicators to reduce cavitation sound

9.3 500 mL Kuderna-Danish flask

9.4 10 mL graduated concentrator tube

9.5 3-ball macro Snyder column

9.6 2-3 ball micro Snyder column

9.7 variable temperature steam bath

9.8 top loading balance, capable of accurately weighing to the nearest .01 g

9.9 N-EVAP or similar nitrogen blowdown device

9.10 Whatmnan #4, 24 mm filter paper

9.11 Stainless steel spatula

9.12 1 mL disposable glass Pasteur pipets

9.13 methylene chloride rinsed boiling chips, approximately 10/40 mesh (silicon carbide or equivalent)

9.14 3.7 and 14 mL vials with Teflon lined screw cap lids, pre-calibrated to 2 and 10 mL respectively

9.15 1 mL and 2.5 mL syringes

9.16 grinder or alternative size reduction tools

9.17 mortar & pestle

9.18 filtration apparatus

9.18.1 500 mL side-arm filter flask

9.18.2 Buchner funnel

9.18.3 stopper

9.18.4 glass-fiber filter paper for clay samples, or samples with very fine particulates

9.19 Powder funnel for filtering standard samples

10.0 ROUTINE PREVENTIVE MAINTENANCE

10.1 Sonicators should be tuned before every shift. Sonicating probes should be cleaned before use with each new sample. A thorough cleaning should also be done at the end of each shift.

11.0 CHEMICALS AND REAGENTS

11.1 1:1 mix of methylene chloride/acetone - pesticide quality or equivalent

11.2 methylene chloride - pesticide quality or equivalent

11.3 hexane - pesticide quality or equivalent

11.4 sodium sulfate (ACS granular)

12.0 STANDARDS PREPARATION

12.1 All stock standards are purchased as certified standards. Stock standards are typically serially diluted to prepare the working standards. The equations shown below show how to make a 1 ppm standard from a 10,000 ppm stock standard using a serial dilution:

$$10{,}000\ \text{mg/L} \times \frac{1\ \text{mL stock standard}}{100\ \text{mL final volume}} = 100\ \text{mg/L}$$

$$100\ \text{mg/L} \times \frac{1\ \text{mL stock standard}}{100\ \text{mL final volume}} = 1.0\ \text{mg/L}$$

12.2 Using a syringe, inject the stock standard into a volumetric flask approximately half full of the appropriate solvent. For all prep lab standards, use only pesticide grade or equivalent solvents. Make sure the tip of the syringe is below the surface of the solvent. Invert enough times to mix thoroughly. All surrogate and spiking standards are stored in 40 mL amber jars with Teflon lined lids. All standards are labeled with the following information: name, surrogate number/spike number, date made, analyst initials, solvent, concentration, and expiration date. The surrogate and spiking standards are stored in the prep lab refrigerator at 4°C.

12.2.1 Record all prep information on an Extraction Standards Log Sheet. The standards are labeled with a prefix of GC or MS followed by a number depending on if they are for the GC or the GC/MS lab.

12.2.2 All extraction lab standards must be logged into the standards logbook on the proper form. Every new standard prepared is given a unique identifier. Check the logbook contents page to find the next available number. For example, if preparing a GC spiking standard and the last line used on the contents page was GC-17, the new standard will be called GC-18. Every dilution made from this standard will be recorded on a separate dilutions form. The first

dilution of GC-18 will be called GC-18.1. The second dilution will be called GC-18.2. If a dilution of a dilution is made the standard will be given another extension. For example if GC-18.1 was used to make up another standard, the new standard will be labeled GC-18.1.1.

12.3 The shelf-life of surrogate and spiking standards is 6 months for working standards and 1 year for stocks. Once a standard (surrogate or spiking) and/or chemical has expired, it should be disposed of accordingly. Monitor the expiration date of all standards. To avoid costly expedited shipping fees, it is important to promptly order more standard material as it is consumed.

12.4 Before a standard is used the calculations must be checked by a second party and the actual standard analyzed and verified by an analyst. A dilution of the spiking standards is required by both GC/MS and GC laboratories to check the concentration prior to use by the extraction lab. Only after verification by the analyst can the standard be used.

12.5 PCB/Pesticides surrogate standard

Compound(s)	Initial Ampule Concentration	Dilution	Solvent	Final Spike Concentration
2,4,5,6-Tetrachloro-m-xylene	200 mg/L*	1:200	Acetone	1.0 mg/L
Decachlorobiphenyl	200 mg/L*	1:200	Acetone	1.0 mg/L

* The surrogate standard is made from a purchased standard mix containing both compounds at 200 mg/L. The samples are spiked with an amount of surrogate standard equal to that of the final volume of the extract. Typically 1 mL is spiked into 30 g of sample and concentrated to a final volume of 10 mL putting the surrogates at a concentration of 0.33 ug/kg in the sample extract.

12.6 Pesticide Spike

12.6.1 The following compounds are diluted to 0.20 mg/L in MeOH

Aldrin	a-Endosulfan
a-BHC	b-Endosulfan
b-BHC	Endosulfan Sulfate
d-BHC	Endrin
g-BHC	Endrin Aldehyde
4,4-DDD	Endrin Ketone
4,4-DDE	Heptachlor
4,4-DDT	Heptachlor Epoxide
Dieldrin	Methoxychlor

12.7 PCB Spikes (1221, 1242, 1248, 1254, 1260)

12.7.1 Each PCB is brought in an individual ampule at 1000 ppm. A 1:100 dilution is made with acetone to obtain a 10 mg/L spike.

13.0 DETAILED PROCEDURE

13.1 The sonicator(s) must be tuned prior to use at the beginning of the analyst's shift. Follow the tuning instructions beginning at section 13.1.1 for the Tekmar TM600. For the Fisher model 500 follow the instructions beginning at section 13.1.2.

13.1.1 Tuning (Tekmar TM600)

13.1.1.1 Ensure that the horn is not immersed in liquid and that it does not come in contact with anything.

13.1.1.2 Set **DUTY CYCLE** to 50%.

13.1.1.3 Set **OUTPUT CONTROL** to 10 (to 5 when using a microtip).

CAUTION: When using a microtip, never allow the tip to vibrate in air for more than 10 seconds and do not permit the **OUTPUT CONTROL** setting to exceed number 5. Ignoring these instructions could cause the microtip to fracture.

13.1.1.4 Hold down the **TUNE SWITCH** and rotate the tuning control clockwise or counterclockwise until a minimum (not maximum) reading is obtained on the loading meter. If the tuning control strikes the limit stops before the meter reads minimum and starts to rise again, the power supply is not tuned. If a minimum reading (sometimes referred to as a null) cannot be obtained, the horn, coupler section, tip, microtip, or lower section is out of resonance or the power supply and converter require servicing.

NOTE: If minimum reading cannot be obtained and another horn is available, check unit with new horn to ascertain whether the power supply or horn is at fault.

13.1.1.5 Release the **TUNE SWITCH**. The sonicator is now tuned. Record the tuning information in the tuning logbook.

13.1.2 Tuning Instructions for the Fisher Model 550 Sonicator

13.1.2.1 Turn **OUTPUT CONTROL** knob counterclockwise to zero.

13.1.2.2 Press **POWER SWITCH** to **ON** (up) position. The switch will illuminate.

13.1.2.3 When the prompt appears, press **TUNE** key. Screen will read: [**TUNING - - - PROBE ACTIVE**].

13.1.2.4 Turn the **OUTPUT CONTROL** knob towards setting 10 (5 if using a microtip).

13.1.2.4.1 (a) Note the position of the Bar Graph on the ICD Display Screen. Do NOT exceed 70 percent

13.1.2.4.2 b) Rotate the Tuning Knob clockwise or counterclockwise until a minimum (not maximum) reading is obtained. Note: If a reading of less than 20 percent can not be obtained there is a problem with the sonicator and it must be fixed before it can be used.

13.1.2.5 Press the **TUNE** key to display prompt for programmed or continuous operation and set the sonicator for programmed operation.

13.1.2.6 The sonicator is now tuned. Record all tuning information in Sonicator tuning logbook.

13.2 Extraction method for samples expected to contain low concentrations of organics (less than or equal to 20 mg/kg).

13.2.1 Decant and discard any water layer and any foreign objects such as sticks, leaves, and rocks from the soil sample. Mix the sample thoroughly, especially composite samples. Waste and other gummy, fibrous materials should be ground, cut, shredded or otherwise reduced in size so that it passes through a 1 mm hole.

13.2.2 Label all glassware with complete sample number and other necessary information (i.e. MS, MSD, LFB, etc.).

13.2.3 The following steps should be performed rapidly to avoid loss of the more volatile compounds. For sandy to dry samples, weigh 30 ±0.1 g of sample into a 600 mL beaker and add approximately 20-25 g of anhydrous sodium sulfate. For samples that are of a wet to gummy nature, add approximately 60 g of anhydrous sodium sulfate to the 30 ±0.1 g of sample. Mix well. The sample should have a sandy texture at this point. Add additional anhydrous sodium sulfate as necessary to achieve this consistency. Slowly add 1 mL of the pesticide/PCB surrogate to the samples, blanks and spikes. For matrix spikes and laboratory fortified blanks, also add 200 uL of the pesticide or 1 mL of the PCB spiking standard, whichever is appropriate. Immediately add 100 mL of 1:1 methylene chloride/acetone mix.

13.2.4 Place the sonication probe about 1/2 inch below the surface of the solvent but above the soil layer.

13.2.5 Sonicate for 3 minutes at full power (output control knob set at 10 and percent-duty cycle knob set at 50 percent). Do not use a micro tip probe.

13.2.6 Assemble the K-D apparatus. Insert a 100 mm filtering funnel lined with 24 mm #4 filter paper. Add approximately 3/4 to 1 inch of the anhydrous sodium sulfate into the funnel. Rinse filter paper and sodium sulfate with methylene chloride.

13.2.7 Decant the solvent into the filtering funnel.

13.2.8 Repeat the sonication process two more times, each time again using 100 mL of the 1:1 methylene chloride-acetone. Decant off the solvent after each sonication. If, after the third extraction, there is no noticeable color change in the extract, repeat the sonication process until there is a noticeable color change. Record the exact number of sonications in the soil logbook. On the final ultrasonic extraction, pour the entire sample into the filtering funnel and rinse with methylene chloride.

13.2.9 If the sample contains very fine particulates, either before, or after sonication, a glass fiber filter can be used to prevent the soil from passing through the filter paper.

13.2.9.1 Assemble a vacuum filtration apparatus, consisting of a 500 mL side-arm filter flask, a 90 mm Buchner funnel, and a vacuum pump.

13.2.9.2 Filter the sample using the vacuum, and collect each of the sonication solvents.

13.2.9.3 Upon completion, transfer the extract to a KD apparatus and concentrate as in section 13.3.

13.3 Concentration

13.3.1 Add one or two clean boiling chips to the evaporative flask and attach a three-ball Snyder column. Pre-wet the Snyder column by adding approximately 1 mL methylene chloride to the top. Place the K-D apparatus on a hot water bath (80-90°C) so that the concentrator tube is partially immersed in the hot water and the entire lower rounded surface of the flask is bathed with hot vapor. At the proper rate of distillation, the balls of the column will actively chatter but the chambers will not flood with condensed solvent. When the apparent volume of liquid reaches 1 mL (usually about 10 to 15 minutes), remove the K-D apparatus and allow it to drain and cool for at least 10 minutes.

13.4 Solvent Exchange

13.4.1 Add approximately 60 mL of hexane and tilt the K.D. so the methylene chloride and hexane mix. Place the K-D apparatus on a hot water bath (80-90°C) so that the concentrator tube is partially immersed in the hot water and the entire lower rounded surface of the flask is bathed with hot vapor. At the proper rate of distillation, the balls of the column will actively chatter but the chambers will not flood with condensed solvent. When the apparent volume of liquid reaches 1 mL (usually about 10 to 15 minutes), remove the K-D apparatus and allow it to drain and cool for at least 10 minutes. The volume in the ampule after cooling should be approximately 8 mL.

13.5 Transfer the extract into a 14 mL vial calibrated to 10 mL, making sure to rinse the concentrator tube and side walls 2-3 times with a total of approximately 2 mL hexane. Bring up to volume if necessary.

13.6 Sample Clean-Up

13.6.1 Pesticide Extracts: All of the pesticide extracts are cleaned-up using disposable Florisil columns (1000 mg) or large (approximately 20g) Florisil columns. See the Florisil column clean-up SOP, TriMatrix number GR-09-111).

13.6.2 PCB Extracts: All of the PCB extracts are cleaned-up using sulfuric acid and/or Florisil column clean-up. See the Florisil column clean-np SOP, TriMatrix number GR-09-111 and the sulfuric acid clean-up SOP, TriMatrix number GR-09-110. Copper powder is also added to each sample extract vial to remove any elemental sulfur, TriMatrix SOP number GR-09-109.

13.7 The final, cleaned up extract will then be stored in the GC refrigerator at 4°C.

13.8 Extraction method for samples expected to contain high concentrations of organics (greater than 20 mg/kg).

13.8.1 Decant and discard any water layer and any foreign objects such as sticks, leaves, and rocks from the soil sample. Mix sample thoroughly, especially composite samples.

13.8.2 Label all glassware with complete sample number and other necessary information (i.e. MS, MSD, LFB, etc.).

13.8.3 Weigh 2 ±0.1 g of sample into a 20 mL vial.

13.8.4 Add 2 g anhydrous sodium sulfate to sample, mix well.

13.8.5 Add 1 mL surrogate to all samples, blanks and spikes. Add 1 mL of the pesticide or PCB spike, whichever is appropriate, to matrix spikes and laboratory fortified blanks.

13.8.6 Bring total volume, including surrogates and spikes, of solvent up to 10 mL using hexane.

13.8.7 Sonicate the sample using a 1/8" tapered micro tip probe for 2 minute at output control setting 5 in pulse mode and percent duty cyele set at 50 percent.

13.8.8 Loosely pack a small funnel with glass wool. Rinse with hexane. Filter the sample extract through the glass wool and collect into another 14 mL vial.

13.8.9 The sample is now ready for cleanup or analysis.

14.0 REPORTING AND DELIVERABLES

14.1 The analyst extracting a set of samples is responsible for the quality of the data and for filling out the correct documentation. It is important to document the preparation by correctly filling out, turning in, and filing the correct paperwork. This is required for quality control purposes, and in order to provide the client with defensible data.

14.2 LIMS Reporting

14.2.1 When the analyst has finished extracting a set of samples the data must be turned in to LIMS. The benchsheets must be filled in completely to insure that the results are reported correctly, and the data is associated with the right quality control batch.

14.2.2 If internal chain-of-custody is required it is very important that the COC sheet is filled out correctly.

14.2.3 All LIMS benchsheets (including the COC sheets) are to be placed in the correctly colored folders and turned into the data entry person responsible for entering the results. The blue folders containing the BLKs also should have the blank raw data quantitation reports and chromatograms included.

14.3 Laboratory Required Paperwork

14.3.1 All logbooks must be filled in completely and correctly. Corrections are to be made with a lineout, not a writeover, and blank lines in the logbook should be Z'd out.

14.3.2 All LIMS documentation should be turned into the Semi-Volatile Laboratory technician who will record the date, time, and contents that were turned in.

15.0 QUALITY ASSURANCE

15.1 The extraction chemist must extract a blank and a LFB on a daily basis, or once per shift, to demonstrate that interferences from the extraction process are under control.

15.2 A matrix spike, and a matrix spike duplicate (provided enough sample was received), will be extracted at a minimum once every 20 samples or once per week, whichever comes first. Performance records are maintained to document the quality of the data that is generated.

15.3 Matrix spikes are prepared by adding the appropriate amount of the spike standard in addition to the pesticide/PCB surrogate standard to 30 g of sample, and extracting the sample as outlined beginning in section 13.

15.4 Laboratory fortified blanks are prepared by adding 1 mL of the appropriate PCB or pesticide spike standard in addition to 1 mL of the surrogate standard to 30 g of anhydrous sodium sulfate, and extracting the sample as outlined beginning in Section 13.

15.5 Matrix interferences from either the sample itself, of from laboratory induced contamination may effect the recovery of both analytes and spiked compounds. Re-extraction of a sample or spike may be necessary if any of the surrogate or spike compounds fail to pass the appropriate recovery limits.

16.0 ANALYST CERTIFICATION/METHOD VALIDATION

Approved By: RA 5/4/99
QA Manager

Approved By: JA 5/4/99
Area Manager

16.1 Before the preparation of any actual samples, each analyst must demonstrate the ability to generate acceptable accuracy and precision by extracting a one time analyst certification.

16.2 Prepare a quality control check sample spiking standard at a level which will give extract concentrations in the mid-range of the calibration curve. The spiking standard used must be prepared independently from the standard used for quantitation. Spike 1 mL of the quality control check sample spiking standard into each of four, 30 g sodium sulfate samples and extract as usual. The check samples must then be cleaned up using all applicable cleanup methods for this type of analysis.

16.3 Have the instrument analyst analyze the four 1 mL samples following the determinative SOP.

16.4 Calculate the average recovery (x) in mg/kg, and the standard deviation of the recovery (s) in mg/kg, for each analyte using the four results.

16.4.1 For each analyte x must be in the range 70-130% and s must be less than or equal to 20. If s and x for all analytes meet the acceptance criteria, the analyst certification is good. The analyst is now authorized to extract samples by this method. If any individual s exceeds the precision limit or any individual falls outside the range for accuracy, then the system performance is unacceptable for that analyte.

16.4.2 When one or more of the analytes tested fail at least one of the acceptance criteria, the analyst must proceed according to 16.5.

16.5 Locate and correct the source of the problem and repeat the test for all analytes that failed to meet the criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds beginning with Section 16.2 or 16.3. Samples may not be prepared by any analyst until the analyst certification has been successfully completed.

17.0 REFERENCES

17.1 *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition*, Final Update III, Revision 2, December, 1996, Method 3550B, "Ultrasonic Extraction".

18.0 ATTACHMENTS/APPENDICES

18.1 None attached.

Approved By: 5/4/99 QA Manager

Approved By: 5/4/99 Area Manager

TRIMATRIX LABORATORIES, INC.

PREVENTIVE MAINTENANCE PROCEDURES

PREVENTIVE MAINTENANCE PROCEDURES AND SCHEDULES

Instrument	Maintenance Procedures/Schedule	Spare Parts in Stock
Gas Chromatograph/ Spectrometer (GC/MS)	1. Replace pump oil as needed. 2. Change septa weekly or as often as needed. 3. Replace electron multiplier as often as needed. 4. Replace gas jet separator as needed. 5. Replace GC injector glass liner weekly or as often as needed. 6. Replace GC column as needed. 7. Check to ensure that gas supply is sufficient for the day's activity.	1. Syringes 2. Septa 3. Various electronic components 4. Glass jet separator 5. GC column 6. Glass liner
Gas Chromatograph	1. Change septa weekly or as often as needed. 2. Replace GC injector glass liner weekly or as often as needed. 3. Replace GC column as needed. 4. Clean/replace GC detector as needed. 5. Check to ensure that gas supply is sufficient for the day's activity.	1. Syringes 2. Septa 3. Detectors 4. Glass liner 5. GC column
Purge and Trap Sample Concentrator	1. Replace trap as needed. 2. Decontaminate the system after running high concentration samples or as required by blank analysis. 3. Leak check system daily and as often as needed. 4. Check to ensure the gas supply is sufficient for the day's activity.	1. Spare traps 2. Spare sparger 3. Various electronic components/ circuits 4. Plumbing supplies-tubing fitting

PREVENTIVE MAINTENANCE PROCEDURES AND SCHEDULES

Instrument	Maintenance Procedures/Schedule	Spare Parts in Stock
Gas Chromatograph/ Spectrometer (GC/MS)	1. Replace pump oil as needed. 2. Change septa weekly or as often as ueeded. 3. Replace electrou multiplier as often as needed. 4. Replace gas jet separator as needed. 5. Replace GC injector glass liner weekly or as often as ueeded. 6. Replace GC column as needed. 7. Check to ensure that gas supply is sufficient for the day's activity.	1. Syringes 2. Septa 3. Various electronic components 4. Glass jet separator 5. GC column 6. Glass liner
Gas Chromatograph	1. Change septa weekly or as ofteu as needed. 2. Replace GC injector glass liner weekly or as ofteu as needed. 3. Replace GC column as needed. 4. Clean/replace GC detector as needed. 5. Check to ensure that gas supply is sufficient for the day's activity.	1. Syringes 2. Septa 3. Detectors 4. Glass liner 5. GC column
Purge and Trap Sample Concentrator	1. Replace trap as needed. 2. Decontaminate the system after running high concentration samples or as required by blank analysis. 3. Leak check system daily and as often as needed. 4. Check to ensure the gas supply is sufficient for the day's activity.	1. Spare traps 2. Spare sparger 3. Various electronic components/ circuits 4. Plumbing supplies-tubing fitting

PREVENTIVE MAINTENANCE PROCEDURES AND SCHEDULES (cont.)

Instrument	Maintenance Procedures/Schedule	Spare Parts in Stock
Graphite Furnace Atomic Spectrophotometer (GFAA)	1. Change graphite contact rings and tubes 2. Clean quartz window as necessary. 3. Check to ensure the gas supply is sufficient for the day's activity. 4. Change gas and instrument filters as needed.	1. Contact rings and tubes as needed.
Mercury Analyzer	1. Clean tubing and quartz cell as often as needed. 2. Check to ensure the gas supply is sufficient for the day's activity. 3. Change gas and instrument filters as needed.	1. Quartz cells
ICP	1. Change peristaltic tubing every daily. 2. Change gas and instrument filters as needed. 3. Check to ensure the gas supply is sufficient for the days activities. 4. Rebuild sample introduction system every 6-8 weeks.	1. Pump tubes. 2. O-rings
ICP/MS	1. Change peristaltic tubing every daily. 2. Change gas and instrument filters as needed. 3. Check to ensure the gas supply is sufficient for the days activities. 4. Clean sample and skimmer cones as needed. 5. Change pump oil as needed. 6. Rebuild sample introduction system every	1. Pump tubes. 2. O-Rings 3. Sample & Skimmer cones. 4. Pump oil.

6-8 weeks.

PREVENTIVE MAINTENANCE PROCEDURES AND SCHEDULES (cont.)

Lachat Quik Chem AE	1. Inspect pump tnbes. 2. Run instrument self diagnostics - correct problems as needed. 3. Wipe instrument to clean and dry after use. 4. Lubricate gears and rollers	1. Reagent and Air Tubes 2. Glass joints

TRIMATRIX LABORATORIES, INC.

INSPECTION/ACCEPTANCE REQUIREMENTS

FOR SUPPLIES AND CONSUMABLES

Reagent Water Systems

Laboratory water originates from the Grand Rapids potable water distribution system. At the laboratory the water is softened and then passed through an activated carbon filter to remove residual chlorine. The water is then introduced to a reverse osmosis system where approximately 90% of the dissolved constituents are removed. This water is now stored in a 120 gallon tank prior to distribution to the laboratory. This eapacity tank provides an ample supply of water for a full day of laboratory operations. On demand, a mechanical pump forces the stored water out of the holding tank and through two mixed bed deionizing canisters. This supply now meets the requirements of ASTM Type II, and is utilized for glassware cleaning and as a feed water to a variety of polishing systems.

The polishing systems in place are comprised of a distillation units and a Milli-Q 4 Bowl System. Distilled RO-Deionized water is used primarily for BOD and metals analyses. Mill-Q water, whieh is equivalent to an ASTM Type I designation is used primarily for the preparation of standard solutions and reagents.

Each water system is periodically monitored for specific quality requirements. Monthly, heterotrophic plate count and total residual chlorine analyses are performed. Weekly, the water system itself is checked for operational readiness and a hardness test is performed. Daily, additional readiness checks are performed and a conductivity test is performed.

Responsibility for monitoring the TriMatrix reagent water systems is carried out by personnel in the inorganic wet chemistry laboratory, who perform the checks and tests, and fill out the reagent water monitoring logbook.

Glassware

For each analysis, only glassware that will provide the required accuracy is used for that particular analytical procedure. TriMatrix purchases pipets, burets, and volumetric flasks, usually Class A, to meet the required accuracy. A standard operating procedure is utilized for cleaning each type of glassware. Cleaning of glassware is performed according to the analysis being conducted and the sample matrix involved, but certain general rules apply to all the glassware washing procedures.

- Use hot water to wash away water-soluble substances.
- Use detergent, dichromate solution, organic solvent, nitric acid, or aqua regia to remove other materials according to the specific glassware cleaning procedures.

- Avoid using detergents on glassware to be used for phosphate determinations.
- Use ammonia-free water for ammonia and kjeldahl nitrogen analyses.

For all analyses, it is advisable to rinse glassware with tap water followed by deionized water immediately after use, as matrix materials allowed to dry on glassware are more difficult to remove.

Compressed Air

Compressed air must be free of dirt, water, and oil. Compressed air purchased from vendors, will be high purity grade (breathing air). Compressed air produced in the laboratory uses filters at the compressor to keep water from moving into the compressed air delivery system. For certain instruments, such as gas chromatographs and atomic absorption spectrophotometers, additional filters are located on the instrument to remove any oil from the compressed air supply.

Chemical Procurement / Reception / Storage and Inventory

Reagents, Solvents, and Gases

The purchasing of reagents, solvents, and gases are carefully controlled through a purchase order system so that a minimum quality level is maintained for the use of these raw materials in the testing process. The manager of each laboratory area in conjunction with the Quality Assurance Manager will define the suitable grades of materials. The Area Manager or his designate will verify upon receipt that the incoming materials meet the requirements specified in each analytical method. Material certificates of analysis are to be provided by the vendor and stored in laboratory files. Each area manager, or his designate, is to oversee the receipt, proper storage, and removal of reagents, solvents, and gases when their shelf-life has expired. All consumable reagents and chemicals must be labeled with the date received for purposes of insuring a first-in first-out (FIFO) system of use.

Reagents, solvents, and gases are available from vendors in a broad range of purity, from technical to ultra pure grade. The type of analysis, as well as the sensitivity and specificity of the method must be considered in choosing a grade of material. The analytical reagent (AR) grade is suitable for most inorganic analyses. Trace organic analyses frequently require a special ultra pure grade. AR grade is the minimum for reagents and solvents used in organic analysis. The absence of certain impurities is required for some GC detectors - notably sulfur and phosphorus in the FID detector. Trace metals analyses including atomic emission and atomic absorption spectroscopy usually requires spectro-quality reagents and solvents, although AR grade may be suitable in some cases. In sample cleanup procedures involving Florisil, silica gel, and alumina as absorbents, these substances must be checked for interfering components and pre-activated according to the analytical method. Compressed gases are available in various purities, usually expressed as a percent (e.g. 99.999). Gases should be filtered in the laboratory delivery lines to remove moisture, oil,

and other contaminants. Refer to the analytical methods and the instrument manufacturers operating manual for gas purity requirements.

Shelf life of raw chemicals purchased from vendors is based on the following guidelines (unless otherwise specified by the manufacturer or derived from other information such as the analytical procedure):

Inorganics

Liquids - 5 years

Solids - 5 years

Organics

Liquids - 2 years

Solids - 5 years

Unpreserved Ethers generally are to have an expiration date of 34 days due to the potential for peroxide formation.

Certified Standards

The purity and traceability of standards used in the analytical process is crucial to the quality of data being generated. Only high quality standards certified by established vendors are to be utilized. Calibration reference standards must be of the designated purity required for a particular analysis.

Chemical reference standards obtained from established commercial vendors should be National Institute of Standards and Technology (NIST) traceable. Write the date received on the standard container label.

Stock and working standards must have a label containing the standard number, the compound name, concentration, date prepared, name of preparer, and expiration date.

All calibration standards are validated against a second source Laboratory Control Sample (LCS). A LCS is analyzed whenever a calibration curve is run. The LCS is quantitated using the curve and its response/recovery is compared to laboratory established limits. The LCS recovery must fall within these laboratory established limits for the curve and standard to be considered acceptable. Stock and working standards are also monitored for signs of deterioration (i.e., precipitates, change in color, change in concentration).

In a situation where standard reference materials are not commercially available for an analysis, use compounds of certified high purity to prepare calibration standards and thoroughly document the procedure.

Vendor expiration dates for purchased stock standards are not to be exceeded. Establish expiration dates for laboratory prepared standards based on guidelines in the analytical method, generally 6 months for working, and 1 year for stock standards.

Sample Containers and Materials Procurement

TriMatrix utilizes only virgin bottle ware for all sample collection kits. Plastic ware is typically Nalge brand NDPE, while glassware is I-CHEM Series 200 (or equivalent) with the exception of the volatile containers. All volatile vials are purchased as Level 300.

I-CHEM Series 300 (or equivalent) bottleware is available for other sample analyses upon request, generally at an additional cost.

Preparation of Containers

All sample containers utilized for the collection and preservation of environmental samples are prepared by the bottle prep group. The staff

members of this group focus their activities exclusively in the area of sample container procurement, preparation, and shipping. The procedures utilized in performing these activities are outlined in the TriMatrix SOP for bottle preparation.

TriMatrix has developed a unique color coded bottle tagging system for the purposes of defining and differentiating the various sample bottle types and the chemical additives that are required for proper sample preservation.

In conjunction with the color coded tagging system, a form was developed to display the coding system, identify chemical preservatives and provide a means of listing the exact quantity, bottle type and preservatives required for each sample location in a tabular format. An example of the TriMatrix Sample Inventory and Master Bottle Packing List form was provided in Appendix U. An example of the TriMatrix sample bottle tagging system was presented in Figure 4-2. This illustration shows both sides (front and back) of a bottle tag as it appears on a prepared sample container, upon completion of the login process.

TRIMATRIX LABORATORIES, INC.

DATA REDUCTION, VALIDATION, AND REPORTING

TriMatrix Laboratories, Inc.

STANDARD OPERATING PROCEDURE

GENERAL GUIDELINES FOR DATA GENERATION, VALIDATION, APPROVAL, AND REPORTING

UNCONTROLLED DOCUMENT

APPROVALS:

QA Manager: _____ Date: 6/9/98
Rick D. Wilburn

Laboratory Manager: _____ Date: 6/9/98
Douglas E. Kriscunas

Procedure Number: GR-10-103
Revision Number: 2.0

Date Initiated: 2/28/96
Effective Date: 5/22/98

Date Revised: 5/22/98
Pages Revised: All

By: Douglas E. Kriscunas

Total Number of Pages: 7

1.0 SUMMARY OF PROCEDURE

1.1 An accurate, consistent and thorough review of all data is an integral part of the quality assurance procedures at TriMatrix. All employees need to follow strict procedures not only in the generation of data but also the review and approval of that data. This SOP provides an overview of the activities involved in the review and approval process of data generated at TriMatrix Laboratories. Additional information can be found in the specific analytical SOPs.

2.0 DETAILED PROCEDURE

2.1 Upon completion of an analysis, the analyst will reduce and record all sample results, associated quality control results, batch information, qualifiers and narratives on the appropriate LIMS benchsheets (Attachment 1).

2.2 All completed benchsheets are forwarded to a peer analyst or group leader for review and validation. Each package must include all raw data print-outs, chromatograms or any other pertinent information related to the analysis. The peer reviewer or group leader is responsible for validating all results, sample and batch information, and any other related qualifications or narratives that are part of the analytical reporting batch. All reviewed materials are initialed and dated at the time of review. Any changes to the original results are properly recorded, initialed, and discussed with the original analyst.

2.3 Data packages are then sent to the data entry department for entry into the LIMS system. All results (both analytical and QC), qualifiers and narratives are entered following a double blind entry process. Results are entered by the first data entry technician, and then completely re-entered (verified) by a second technician. All entered results must agree during the verification process or LIMS alerts the technician to the discrepancy. Unless an obvious data entry error has been made, the technician performing verification will confer with the analyst for guidance as to the correct entry.

2.4 At the completion of the verification step, batch detail reports summarizing the values now stored in LIMS are generated. These reports and the data are submitted to the laboratory area manager or his designate (Attachment 2).

2.4.1 The laboratory area manager or designate is responsible for the final review of the data generated by their respective laboratory area. This review not only includes a re-check of the computed/reported analytical results, but also entails the review of all QC recoveries, qualifications and narratives. Upon completion of this final review, the area manager or designate must approve all results within the LIMS system.

2.5 When all results requested for the submittal have been approved by each laboratory area, a preliminary report is automatically compiled and printed out on the system line printer. Except for cosmetic differences, this preliminary report is an exact replicate of the final report document, including the report format and the quality control deliverables.

2.5.1 The compiled report is forwarded to the appropriate project chemist for final review and approval. Accompanying this report, are all chain-of-custody forms, field notes, sample delivery receipts, and any correspondence associated with the project and submittal.

2.5.2 Once the project chemist has reviewed and validated the completeness of the report, the submittal is approved within the LIMS system.

2.6 Final reports are generated by a project technician and sent back to the project chemist for final signature.

2.7 All signed reports are forwarded to the laboratory secretary for distribution and archiving.

3.0 REPORTING AND DELIVERABLES

3.1 Examples of all reporting and deliverable requirements are covered in the Attachment/Appendixes section of this SOP, and in the associated analytical SOPs.

4.0 QUALITY ASSURANCE

4.1 All laboratory quality assurance activities as outlined in the TriMatrix Quality Assurance Manual, and as specified in any related Standard Operating Procedures, must be followed.

4.2 Responsibilities for all aspects of the generation, review, and data reporting process are specified in Attachment 3.

5.0 REFERENCES

5.1 not applicable

6.0 ATTACHMENTS/APPENDICES

6.1 Benchsheet Example

6.2 Batch Detail Report Example

6.3 Data Reporting Process/Responsibilities

Attachment 1
Benchsheet Example

01-MAY-98 Type: REG RC1 RC2 RMS FRACTION BENCHSHEET VOLATILE ORGANIC LAB PAGE 1

Test #: 592. 1- 33. 3
Parameter: VOL'S GC/MS-624 + XYLENE
Method: VOL/P&T/MS/WW
Ref. cit.: USEPA-624 Unit: ug/L

Client: [redacted]
Project: 29795 [redacted]
Proj Chem: RDW
Submittal: 174 April 30, 1998 Sample
Sample: 195312 Well 4

Hold date: 14-MAY-1998 QC: LV2 COC:
Lab due date: 13-MAY-1998
Client due date: 15-MAY-1998 C=1 F=1 H=1 R=1
Received date: 01-MAY-1998

Benchsheet ID: 204691
Analyst: MSD
Date Run: 5-12-98
Instrument #: 132
Stock Std: A70-1
Rack#:
Reviewed by: TAB
QC Batch Number: 042898.132.01/111

Initial wt./vol.:
Final volume:
% Solids:
Dilution factor:
Batch Number: 129581 5/13
Batch Owner: 132
Batch Opened Date: 5-11-98
Batch Seq: 01

	Parameter	ODL/Spk	Result	Percent	LCL	UCL
2	CHLOROMETHANE		<1.0			
4	VINYL CHLORIDE		<1.0			
5	BROMOMETHANE		<1.0			
6	CHLOROETHANE		<1.0			
7	TRICHLOROFLUOROMETHANE		<1.0			
11	1,1-DICHLOROETHYLENE		~~<1.0~~ 3.6			
17	METHYLENE CHLORIDE		<1.0			
22	1,1-DICHLOROETHANE		~~<1.0~~ 2.9			
25	1,2-DCE (TOTAL)		<2.0			
30	CHLOROFORM		<1.0			
31	1,1,1-TRICHLOROETHANE		~~<1.0~~ 6.4			
32	CARBON TETRACHLORIDE		<1.0			
34	BENZENE		<1.0			
35	1,2-DICHLOROETHANE		<1.0			
38	TRICHLOROETHYLENE		~~<1.0~~ 65			
39	1,2-DICHLOROPROPANE		<1.0			
41	DICHLOROBROMOMETHANE		<1.0			
42	2-CHLOROETHYL VINYL ETHER		<10			
44	CIS-1,3-DICHLOROPROPYLENE		<1.0			
48	TOLUENE		<1.0			
49	TRANS-1,3-DICHLOROPROPENE		<1.0			
50	1,1,2-TRICHLOROETHANE		<1.0			
52	TETRACHLOROETHYLENE		<1.0			
54	CHLORODIBROMOMETHANE		<1.0			
56	CHLOROBENZENE		<1.0			
59	ETHYLBENZENE		<1.0			
60	XYLENE (TOTAL)		<3.0			
64	BROMOFORM		<1.0			
65	1,1,2,2-TETRACHLOROETHANE		<1.0			
67	1,3-DICHLOROBENZENE		<1.0			
68	1,4-DICHLOROBENZENE		<1.0			
69	1,2-DICHLOROBENZENE		<1.0			
1	DIBROMOFLUOROMETHANE-SUR	40.0	38.0	%	81	122
2	D8-TOLUENE-SUR	↓	38.1	%	88	117
3	4-BFB (HALL)-SUR	↓	37.3	%	87	116

* - Result < corresponding ODL

TRIMATRIX LABORATORIES, INC.

Approved By: Rdw 6/9/98
QA Manager

Approved By: [signature] 6/9/98
Area Manager

Attachment 2
Batch Detail Report Example

1998-JUN-09 11:13 BATCH DETAIL REPORT -- VOLATILE ORGANIC LAB ANALYTICAL BATCH # 129584 PAGE 4 OF 5

	Seq	Sur-seq	QC bat	Run date	Anal	Sample	Appli	Det lim	Init conc	Final conc	Spike	Parameter	Type	%	LCL	UCL	QC	E	D	Ref cit
a	12.001	REG- 11	042898	05/12/98	MSD	195399	WW	1.00		44.8	40.0	DIBROMOFLUOROMETHANE-SUR	SUR-111	112	81	122				USEPA-624
a	12.002	REG- 11	042898	05/12/98	MSD	195399	WW	1.00		41.0	40.0	D8-TOLUENE-SUR	SUR-111	103	88	117				USEPA-624
a	12.003	REG- 11	042898	05/12/98	MSD	195399	WW	1.00		41.2	40.0	4-BFB (HALL)-SUR	SUR-111	103	87	116				USEPA-624
a	13.000	-	042898	05/12/98	MSD	195400	WW					DOW ECS CONTRACT VOL-624	REG-111							USEPA-624
a	13.002	-	042898	05/12/98	MSD	195400	WW	10		580		CHLOROMETHANE	REG-111							USEPA-624
a	13.032	-	042898	05/12/98	MSD	195400	WW	10		<10		CARBON TETRACHLORIDE	REG-111							USEPA-624
a	13.034	-	042898	05/12/98	MSD	195400	WW	10		42		BENZENE	REG-111							USEPA-624
a	13.048	-	042898	05/12/98	MSD	195400	WW	10		1200		TOLUENE	REG-111							USEPA-624
a	13.059	-	042898	05/12/98	MSD	195400	WW	10		42		ETHYLBENZENE	REG-111							USEPA-624
a	13.060	-	042898	05/12/98	MSD	195400	WW	30		120		XYLENE (TOTAL)	REG-111							USEPA-624
a	14.000	REG- 13	042898	05/12/98	MSD	195400	WW					SURROGATE	SUR-111							USEPA-624
a	14.001	REG- 13	042898	05/12/98	MSD	195400	WW	1.00		43.8	40.0	DIBROMOFLUOROMETHANE-SUR	SUR-111	110	81	122				USEPA-624
a	14.002	REG- 13	042898	05/12/98	MSD	195400	WW	1.00		38.0	40.0	D8-TOLUENE-SUR	SUR-111	95	88	117				USEPA-624
a	14.003	REG- 13	042898	05/12/98	MSD	195400	WW	1.00		38.7	40.0	4-BFB (HALL)-SUR	SUR-111	97	87	116				USEPA-624
a	15.000	-	042898	05/12/98	MSD	195312	WW					VOL'S GC/MS-624 + XYLENE	REG-111							USEPA-624
a	15.002	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		CHLOROMETHANE	REG-111							USEPA-624
a	15.004	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		VINYL CHLORIDE	REG-111							USEPA-624
a	15.005	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		BROMOMETHANE	REG-111							USEPA-624
a	15.006	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		CHLOROETHANE	REG-111							USEPA-624
a	15.007	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		TRICHLOROFLUOROMETHANE	REG-111							USEPA-624
a	15.011	-	042898	05/12/98	MSD	195312	WW	1.0		3.6		1,1-DICHLOROETHYLENE	REG-111							USEPA-624
a	15.017	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		METHYLENE CHLORIDE	REG-111							USEPA-624
a	15.022	-	042898	05/12/98	MSD	195312	WW	1.0		2.9		1,1-DICHLOROETHANE	REG-111							USEPA-624
a	15.025	-	042898	05/12/98	MSD	195312	WW	2.0		<2.0		1,2-DCE (TOTAL)	REG-111							USEPA-624
a	15.030	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		CHLOROFORM	REG-111							USEPA-624
a	15.031	-	042898	05/12/98	MSD	195312	WW	1.0		6.4		1,1,1-TRICHLOROETHANE	REG-111							USEPA-624
a	15.032	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		CARBON TETRACHLORIDE	REG-111							USEPA-624
a	15.034	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		BENZENE	REG-111							USEPA-624
a	15.035	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		1,2-DICHLOROETHANE	REG-111							USEPA-624
a	15.038	-	042898	05/12/98	MSD	195312	WW	1.0		65		TRICHLOROETHYLENE	REG-111							USEPA-624
a	15.039	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		1,2-DICHLOROPROPANE	REG-111							USEPA-624
a	15.041	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		DICHLOROBROMOMETHANE	REG-111							USEPA-624
a	15.042	-	042898	05/12/98	MSD	195312	WW	10		<10		2-CHLOROETHYL VINYL ETHER	REG-111							USEPA-624
a	15.044	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		CIS-1,3-DICHLOROPROPYLENE	REG-111							USEPA-624
a	15.048	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		TOLUENE	REG-111							USEPA-624
a	15.049	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		TRANS-1,3-DICHLOROPROPENE	REG-111							USEPA-624
a	15.050	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		1,1,2-TRICHLOROETHANE	REG-111							USEPA-624

Approved By: 6/9/98
QA Manager

Approved By: 6/9/98
Area Manager

Attachment 2
Batch Detail Report Example (con't)

1998-JUN-09 11:13 BATCH DETAIL REPORT -- VOLATILE ORGANIC LAB ANALYTICAL BATCH # 129584 PAGE 5 OF 5

	Seq	Sur-seq	QC bat	Run date	Anal	Sample	Appli	Det lim	Init conc	Final conc	Spike	Parameter	Type	%	LCL	UCL	QC	E	D	Ref cit
a	15.052	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		TETRACHLOROETHYLENE	REG-111							USEPA-624
a	15.054	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		CHLORODIBROMOMETHANE	REG-111							USEPA-624
a	15.056	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		CHLOROBENZENE	REG-111							USEPA-624
a	15.059	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		ETHYLBENZENE	REG-111							USEPA-624
a	15.060	-	042898	05/12/98	MSD	195312	WW	3.0		<3.0		XYLENE (TOTAL)	REG-111							USEPA-624
a	15.064	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		BROMOFORM	REG-111							USEPA-624
a	15.065	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		1,1,2,2-TETRACHLOROETHANE	REG-111							USEPA-624
a	15.067	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		1,3-DICHLOROBENZENE	REG-111							USEPA-624
a	15.068	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		1,4-DICHLOROBENZENE	REG-111							USEPA-624
a	15.069	-	042898	05/12/98	MSD	195312	WW	1.0		<1.0		1,2-DICHLOROBENZENE	REG-111							USEPA-624
a	16.000	REG- 15	042898	05/12/98	MSD	195312	WW					SURROGATE	SUR-111							USEPA-624
a	16.001	REG- 15	042898	05/12/98	MSD	195312	WW	1.00		38.0	40.0	DIBROMOFLUOROMETHANE-SUR	SUR-111	95	81	122				USEPA-624
a	16.002	REG- 15	042898	05/12/98	MSD	195312	WW	1.00		38.1	40.0	D8-TOLUENE-SUR	SUR-111	95	88	117				USEPA-624
a	16.003	REG- 15	042898	05/12/98	MSD	195312	WW	1.00		37.3	40.0	4-BFB (HALL)-SUR	SUR-111	93	87	116				USEPA-624
a	17.000	-	042898	05/12/98	MSD	195401	WW					DOW ECS CONTRACT VOL-624	REG-111							USEPA-624
a	17.002	-	042898	05/12/98	MSD	195401	WW	10		910		CHLOROMETHANE	REG-111							USEPA-624
a	17.032	-	042898	05/12/98	MSD	195401	WW	10		<10		CARBON TETRACHLORIDE	REG-111							USEPA-624
a	17.034	-	042898	05/12/98	MSD	195401	WW	10		37		BENZENE	REG-111							USEPA-624
a	17.048	-	042898	05/12/98	MSD	195401	WW	10		1500		TOLUENE	REG-111							USEPA-624
a	17.059	-	042898	05/12/98	MSD	195401	WW	10		58		ETHYLBENZENE	REG-111							USEPA-624
a	17.060	-	042898	05/12/98	MSD	195401	WW	30		160		XYLENE (TOTAL)	REG-111							USEPA-624
a	18.000	REG- 17	042898	05/12/98	MSD	195401	WW					SURROGATE	SUR-111							USEPA-624
a	18.001	REG- 17	042898	05/12/98	MSD	195401	WW	1.00		45.4	40.0	DIBROMOFLUOROMETHANE-SUR	SUR-111	114	81	122				USEPA-624
a	18.002	REG- 17	042898	05/12/98	MSD	195401	WW	1.00		41.7	40.0	D8-TOLUENE-SUR	SUR-111	104	88	117				USEPA-624
a	18.003	REG- 17	042898	05/12/98	MSD	195401	WW	1.00		43.2	40.0	4-BFB (HALL)-SUR	SUR-111	108	87	116				USEPA-624

****
****
****

| THE FOLLOWING RESULTS EXCEEDED A CONTROL LIMIT, AND NEED TO BE INVESTIGATED/QUALIFIED. |

****
****
****

Seq	Sur-seq	QC bat	Run date	Anal	Sample	Appli	Det lim	Init conc	Final conc	Spike	Parameter	Type	%	LCL	UCL	QC	E	D	Ref cit
a 3.036	-	1	042898	05/11/98	MSD	WATER	10.0	<	62.8	40.0	2-CHLOROETHYL VINYL ETHER	LFB-111	157	44	147	CH			USEPA-624

Approved By: 6/9/98
QA Manager

Approved By: 6/9/98
Area Manager

Attachment 3
Data Reporting Process/Responsibilities

Completion of LIMS Benchsheets (Analyst)

↓

Initial Review of Benchsheets (Peer Analyst/Group Leader)

↓

Initial Data Entry Entry-LIMS (1st. Data Entry Technician)

↓

Second Data Entry Verification-LIMS (2nd. Data Entry Technician)

↓

Analytical Batch Approval-LIMS (Area Manager/Designate)

↓

Preliminary Report Generation/Review (Project Chemist)

↓

Final Report Approval-LIMS (Project Chemist)

↓

Cover Letter Signature (Project Chemist)

↓

Report Dissemination Mail/FED-X/FAX (Laboratory Secretary)

TRIMATRIX LABORATORIES, INC.

PERFORMANCE EVALUATION STUDIES

Summary Results for Major Performance Evaluation Studies 1995 – 1999					
PE Study/Program Description	Study No.	Study Year	Total Usable Data Points	Total Unacceptable	% Acceptable
APG "Real World" PE Study	1995-1	1995	117	0	100.0
	1995-2	1995	43	0	100.0
	1996-1	1996	133	2	98.5
Wisconsin Proficiency Testing	ER-95	1995	77	0	100.0
	ER-96	1996	94	0	100.0
	1997-1	1997	111	1	99.1
	1997-2	1997	1	0	100.0
	1998-1	1998	110	3	97.3
	1998-2	1998	1	0	100.0
	1999-1	1999	105	0	100.0
	1999-2	1999	5	0	100.0
ASI Double Blind PE Audit	EPA-0396	1996	29	2	93.1
	EPA-0596	1996	31	4	87.1
	EPA-0696	1996	54	7	87.0
	EPA-0996	1996	16	0	100.0
	EPA-0597	1997	82	3	96.3
	ELP-025	1997	82	1	98.8
	ELP-026	1998	87	2	97.7
	ELP-027	1998	85	2	97.6
	ELP-028	1998	88	3	96.6
	ELP-029	1999	91	4	95.6
	ELP-030	1999	89	3	96.6
ASI Blind Soil	SW-004	1997	62	2	96.8
	SW-006	1998	93	5	94.6
	SW-007	1999	107	0	100.0
USEPA Water Pollution - WP	WP034	1995	146	1	99.3
	WP035	1995	147	3	98.0
	WP036	1996	76	3	96.1
	WP037	1997	76	2	97.4
	WP038	1997	76	0	100.0
	WP039	1998	75	2	97.3
	WP040	1999	76	1	98.7
	WP050	1999	97	4	95.9
	WP055	1999	132	5	96.2
USEPA Water Supply - WS	WS035	1995	76	4	94.7
	WS036	1995	70	2	97.1
	WS037	1996	82	1	98.8
	WS038	1997	77	1	98.7
	WS039	1997	86	19	77.9
	WS040	1998	87	6	93.1
	WS041	1998	82	5	93.9
	WS032	1999	93	8	91.4
	WS037	1999	92	6	93.5
5 Year Totals / Averages			**3,439**	**117**	**96.5%**

TriMatrix Laboratories, Inc.

TriMatrix Laboratories, Inc.

2000 Performance Evaluation Study Summary

Performance Evaluation Program	Month Results Received	Wet Chemistry			Metals			GC Volatiles			GC Semi-Volatiles			GC/MS Volatiles			GC/MS Semi-Volatiles			Lab Wide Average % Acceptable by Program	Lab Wide Monthly Average % Acceptable
		Total # Analyzed	Total # Accept	% Accept	Total # Analyzed	Total # Accept	% Accept	Total # Analyzed	Total # Accept	% Accept	Total # Analyzed	Total # Accept	% Accept	Total # Analyzed	Total # Accept	% Accept	Total # Analyzed	Total # Accept	% Accept		
Wisconsin 2000-1	March	16	16	100.0%	28	26	100.0%	8	8	100.0%	17	17	100.0%	10	10	100.0%	33	33	100.0%	100.0%	
ASI ELP-031	March	26	26	100.0%	29	28	96.6%	1	1	100.0%	17	17	100.0%	10	10	100.0%	10	10	100.0%	98.9%	
ERA MI-138 Soils	March				28	28	100.0%				13	12	92.3%	22	22	100.0%	19	19	100.0%	98.8%	
Army	March				46	45	97.8%				13	13	100.0%	35	35	100.0%	45	44	97.8%	98.6%	
Army Explosives	March										28	25	89.3%							89.3%	98.5%
ERA WS-43 Micro	April	20	20	100.0%																100.0%	
ERA WS-43	April	13	12	92.3%	33	31	93.9%	57	52	91.2%				57	55	96.5%				93.8%	94.4%
ERA WP-82	May	23	22	95.7%	27	25	92.6%				30	30	100.0%	49	49	100.0%	76	76	100.0%	98.5%	
GE	May	1	1	100.0%	18	17	94.4%				1	1	100.0%	21	21	100.0%	6	6	100.0%	97.9%	98.4%
ERA WP-65	August	31	30	96.8%	46	45	97.8%				46	46	100.0%	49	49	100.0%	76	76	100.0%	99.2%	99.2%
Yearly Total Number of Programs Received		Yearly Number Analyzed	Yearly Number Accept	Yearly Total % Accept	Yearly Number Analyzed	Yearly Number Accept	Yearly Total % Accept	Yearly Number Analyzed	Yearly Number Accept	Yearly Total % Accept	Yearly Number Analyzed	Yearly Number Accept	Yearly Total % Accept	Yearly Number Analyzed	Yearly Number Accept	Yearly Total % Accept	Yearly Number Analyzed	Yearly Number Accept	Yearly Total % Accept	Lab Wide Yearly Average % Acceptable	
10		130	127	97.7%	253	245	96.8%	66	61	92.4%	165	161	97.6%	253	251	99.2%	265	264	99.6%	98.0%	

Analytes spiked at concentrations less than our reported detection limit have not been included.

file: GM00.USregion.PEsummary002.xls

TriMatrix Laboratories, Inc.

PERFORMANCE EVALUATION SAMPLE RESULT SUMMARY TABLE

Source: ERA

Program: Water Pollution

Study No: WP-65

Date Results Received: 8/10/00

Lab Area	Number of tests Reported	Number of usable Results	Percent of usable Results	# Outside Warning Limits	% Outside Warning Limits	# Outside Control Limits	% Outside Control Limits	Number Acceptable Results	Percent Acceptable Results**
Inorganic	31	31	100.0%	2	6.5%	1	3.2%	30	96.8%
Metals	46	46	100.0%	2	4.3%	1	2.2%	45	97.8%
SV Lab	105	105	100.0%	0	0.0%	0	0.0%	105	100.0%
VO Lab	125	125	100.0%	0	0.0%	0	0.0%	125	100.0%
Prep Lab*	105	105	100.0%	0	0.0%	0	0.0%	105	100.0%
Totals =	**307**	**307**	**100.0%**	**4**	**1.3%**	**2**	**0.7%**	**305**	***99.3%***

Notes: ** All parameters requiring sample extraction.* *** Percentage is calculated on usable results only.*

wp065era.XLS

ENVIRONMENTAL
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Study: **WP65**

ERA Laboratory Code: **E0051-01W**

Laboratory Name: **TRIMATRIX LABS**

Report Type: **Customer**

Report Method: **Method A**

5540 Marshall St., Arvada, CO 80002 1-800-372-0122 fax 303-421-0159 info@eraqc.com www.eraqc.com

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WP-65 Final Customer Report

ERA Laboratory Code: E0051-01W EPA ID: MI00005 State ID: **Report Issued: 08/10/00**

ERA Standard	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Warning Limits	Performance Evaluation	Method Description
Minerals	Total Solids at 105°C	mg/l	232	225	188 - 260		Acceptable	EPA 160.3
	Total Dissolved Solids	mg/l	212	220	162 - 278	181 - 259	Acceptable	EPA 160.1
	Alkalinity as CaCO3	mg/l	33.8	33.7	29.0 - 39.1	30.7 - 37.5	Acceptable	EPA 310.1
	Conductivity at 25°C	µmhos	310	351	324 - 378	333 - 369	Not Acceptable	EPA 120.1
	Chloride	mg/l	73.3	69.4	62.5 - 76.0	64.7 - 73.8	Acceptable	EPA 325.2
	Fluoride	mg/l	2.18	2.10	1.82 - 2.35	1.91 - 2.27	Acceptable	EPA 340.2
	Potassium	mg/l	17.4	16.7	14.3 - 19.2	15.1 - 18.4	Acceptable	EPA 200.7
	Sodium	mg/l	60.0	59.8	53.9 - 65.7	55.9 - 63.8	Acceptable	EPA 200.7
	Sulfate	mg/l	14.5	15.0	11.3 - 18.3	12.5 - 17.2	Acceptable	EPA 375.4
pH	pH	S.U.	6.06	6.10	5.96 - 6.24	6.01 - 6.20	Acceptable	EPA 150.1
Hardness	Total Suspended Solids	mg/l	90.5	90.1	70.0 - 97.4	74.5 - 92.8	Acceptable	EPA 160.2
	Calcium	mg/l	89.9	85.0	76.1 - 96.2	79.5 - 92.8	Acceptable	EPA 200.7
	Magnesium	mg/l	5.37	5.27	4.54 - 5.99	4.78 - 5.75	Acceptable	EPA 200.7
	Calcium hardness (CaCO3)	mg/l	224	212	180 - 244		Acceptable	EPA 200.7
	Total Hardness (CaCO3)	mg/l	247	234	214 - 255	221 - 248	Acceptable	EPA 130.2
mand	BOD	mg/l	87.1	79.7	40.2 - 119	53.4 - 106	Acceptable	EPA 405.1
	CBOD	mg/l	93.9	68.6	30.8 - 106	43.4 - 93.9	Acceptable	EPA 405.1
	COD	mg/l	107	129	97.7 - 149	106 - 140	Acceptable	EPA 410.4
	TOC	mg/l	56.8	51.0	42.6 - 58.8	45.3 - 56.1	Check for Error	EPA 415.1
Nutrients - Simple	Ammonia as N	mg/l	17.1	16.4	12.8 - 19.9	13.9 - 18.7	Acceptable	EPA 350.1
	Nitrate as N	mg/l	19.6	18.8	14.9 - 22.3	16.1 - 21.1	Acceptable	EPA 353.2
	Ortho-phosphate as P	mg/l	3.68	3.63	3.10 - 4.20	3.28 - 4.01	Acceptable	EPA 365.2
Nutrients - Complex	Total phosphorus as P	mg/l	2.52	2.51	1.91 - 2.97	2.08 - 2.79	Acceptable	EPA 365.1
	Total kjeldahl nitrogen	mg/l	7.18	6.96	4.85 - 8.94	5.53 - 8.26	Acceptable	EPA 351.2
Cyanide	Cyanide, total	mg/l	0.456	0.473	0.325 - 0.611	0.373 - 0.563	Acceptable	EPA 335.3
Phenolics	Phenolics, total	mg/l	1.89	1.49	0.822 - 2.16	1.04 - 1.93	Acceptable	EPA 420.2
Grease & Oil	Grease & Oil (Gravimetric)	mg/l	36.4	37.5	24.5 - 43.1	27.6 - 40.0	Acceptable	EPA 1664
	Grease & Oil (Infrared)	mg/l		45.0	30.1 - 50.9	33.6 - 47.4		
TRC	Total Residual Chlorine	mg/l	0.95	1.06	0.823 - 1.30	0.902 - 1.22	Acceptable	HACH 8167

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WP-65 Final Customer Report

ERA Laboratory Code: E0051-01W EPA ID: MI00005 State ID: **Report Issued: 08/10/00**

ERA Standard	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Warning Limits	Performance Evaluation	Method Description
Hexavalent Chromium	Hexavalent Chromium	µg/l	172	178	145 - 205		Acceptable	SM 3500 Cr D.
Trace Metals	Aluminum	µg/l	2020	1920	1650 - 2180	1740 - 2090	Acceptable	EPA 200.7
	Antimony	µg/l	541	527	369 - 635	413 - 590	Acceptable	EPA 200.7
	Arsenic	µg/l	430	439	367 - 515	392 - 490	Acceptable	EPA 200.7
	Barium	µg/l	276	271	237 - 312		Acceptable	EPA 200.7
	Beryllium	µg/l	184	185	156 - 209	165 - 200	Acceptable	EPA 200.7
	Boron	µg/l	574	548	400 - 714		Acceptable	EPA 200.7
	Cadmium	µg/l	100	106	89.7 - 121	95.0 - 116	Acceptable	EPA 200.7
	Chromium	µg/l	570	559	487 - 632	511 - 608	Acceptable	EPA 200.7
	Cobalt	µg/l	326	312	273 - 350	286 - 337	Acceptable	EPA 200.7
	Copper	µg/l	131	128	113 - 143	118 - 138	Acceptable	EPA 200.7
	Iron	µg/l	323	316	276 - 362	290 - 348	Acceptable	EPA 200.7
	Lead	µg/l	256	249	213 - 284	225 - 272	Acceptable	EPA 200.7
	Manganese	µg/l	1680	1670	1500 - 1860	1560 - 1800	Acceptable	EPA 200.7
	Molybdenum	µg/l	79.0	79.1	65.5 - 91.7	69.8 - 87.3	Acceptable	EPA 200.7
	Nickel	µg/l	1310	1280	1160 - 1430	1200 - 1380	Acceptable	EPA 200.7
	Selenium	µg/l	103	111	84.4 - 130	92.0 - 122	Acceptable	EPA 200.7
	Silver	µg/l	108	128	109 - 147	116 - 141	Not Acceptable	EPA 200.7
	Strontium	µg/l	71.1	72.2	61.1 - 83.2	64.8 - 79.5	Acceptable	EPA 200.7
	Thallium	µg/l	335	328	263 - 382	283 - 362	Acceptable	EPA 200.7
	Vanadium	µg/l	544	521	468 - 572	485 - 554	Acceptable	EPA 200.7
	Zinc	µg/l	229	222	193 - 254	203 - 243	Acceptable	EPA 200.7
Mercury	Mercury	µg/l	7.78	9.48	7.06 - 11.9	7.86 - 11.1	Check for Error	EPA 245.2
Tin and Titanium	Titanium	µg/l		82.1	69.5 - 93.7	73.5 - 89.6		
	Tin	µg/l		2130	1680 - 2590			

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WP-65 Final Customer Report

ERA Laboratory Code: E0051-01W EPA ID: MI00005 State ID: **Report Issued: 08/10/00**

ERA Standard	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Warning Limits	Performance Evaluation	Method Description
Coliforms	Total Coliforms (MF)	CFU		40	1 - 65			
	Fecal Coliforms - E.coli (MF)	CFU		30	1 - 51			
	Total Coliforms (MPN)	CFU	7	40	5 - 105		Acceptable	40 CFR Part 141
	Fecal Coliforms - E.coli (MPN)	CFU	2	30	1 - 129		Acceptable	40 CFR Part 141

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WP-65 Final Customer Report

ERA Laboratory Code: E0051-01W EPA ID: MI00005 State ID: **Report Issued: 08/10/00**

ERA Standard	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Warning Limits	Performance Evaluation	Method Description
Volatiles	Acetone	µg/l	< 50	< 5.00			Acceptable	EPA 624
	Acetonitrile	µg/l	< 10	< 5.00			Acceptable	EPA 624
	Acrylonitrile	µg/l	< 1.0	< 5.00			Acceptable	EPA 624
	Acrolein	µg/l	< 5.0	< 5.00			Acceptable	EPA 624
	Benzene	µg/l	15.0	14.6	10.2 - 19.2	11.7 - 17.7	Acceptable	EPA 624
	Bromodichloromethane	µg/l	71.3	63.6	45.2 - 82.7	51.4 - 76.4	Acceptable	EPA 624
	Bromoform	µg/l	39.0	38.4	24.7 - 52.6	29.3 - 48.0	Acceptable	EPA 624
	Bromomethane	µg/l	< 1.0	< 5.00			Acceptable	EPA 624
	2-Butanone (MEK)	µg/l	< 50	< 5.00			Acceptable	EPA 624
	Carbon disulfide	µg/l	< 5.0	< 5.00			Acceptable	EPA 624
	Carbon tetrachloride	µg/l	33.6	32.0	19.9 - 45.2	24.1 - 41.0	Acceptable	EPA 624
	Chlorobenzene	µg/l	30.2	27.9	20.0 - 35.4	22.6 - 32.8	Acceptable	EPA 624
	Chlorodibromomethane	µg/l	24.9	25.1	16.5 - 33.3	19.3 - 30.5	Acceptable	EPA 624
	Chloroethane	µg/l	< 1.0	< 5.00			Acceptable	EPA 624
	2-Chloroethylvinylether	µg/l	< 10	< 5.00			Acceptable	EPA 624
	Chloroform	µg/l	37.4	35.6	24.8 - 45.8	28.3 - 42.3	Acceptable	EPA 624
	Chloromethane	µg/l	< 1.0	< 5.00			Acceptable	EPA 624
	DBCP	µg/l	< 5.0	< 5.00			Acceptable	EPA 624
	1,2-Dibromoethane (EDB)	µg/l	< 1.0	< 5.00			Acceptable	EPA 624
	Dibromomethane	µg/l	< 5.0	< 5.00			Acceptable	EPA 624
	1,2-Dichlorobenzene	µg/l	37.1	36.1	25.4 - 45.8	28.8 - 42.4	Acceptable	EPA 624
	1,3-Dichlorobenzene	µg/l	28.1	32.2	22.6 - 40.3	25.6 - 37.4	Acceptable	EPA 624
	1,4-Dichlorobenzene	µg/l	16.1	16.4	11.1 - 21.6	12.9 - 19.8	Acceptable	EPA 624
	Dichlorodifluoromethane	µg/l	< 10	< 5.00			Acceptable	EPA 624
	1,1-Dichloroethane	µg/l	< 1.0	< 5.00			Acceptable	EPA 624
	1,2-Dichloroethane	µg/l	57.9	52.5	36.3 - 69.9	41.9 - 64.3	Acceptable	EPA 624
	1,1-Dichloroethylene	µg/l	< 1.0	< 5.00			Acceptable	EPA 624
	cis-1,2-Dichloroethylene	µg/l	< 1.0	< 5.00			Acceptable	EPA 624
	trans-1,2-Dichloroethylene	µg/l	26.6	25.8	14.7 - 36.8		Acceptable	EPA 624
	1,2-Dichloropropane	µg/l	< 1.0	< 5.00			Acceptable	EPA 624
	cis-1,3-Dichloropropylene	µg/l	< 1.0	< 5.00			Acceptable	EPA 624
	trans-1,3-Dichloropropylene	µg/l	< 1.0	< 5.00			Acceptable	EPA 624
	Ethylbenzene	µg/l	66.7	58.1	38.7 - 76.0	44.9 - 69.8	Acceptable	EPA 624
	2-Hexanone	µg/l	< 50	< 5.00			Acceptable	EPA 624
	Methylene chloride	µg/l	28.4	21.8	13.8 - 30.6	16.6 - 27.8	Check for Error	EPA 624
	MIBK	µg/l	118	110	42.0 - 177		Acceptable	EPA 624
	Styrene	µg/l	18.2	20.7	11.7 - 27.9		Acceptable	EPA 624
	1,1,1,2-Tetrachloroethane	µg/l	106	93.4	55.2 - 138		Acceptable	EPA 624
	1,1,2,2-Tetrachloroethane	µg/l	< 1.0	< 5.00			Acceptable	EPA 624
	Tetrachloroethylene	µg/l	71.4	70.4	48.6 - 90.0	53.8 - 82.7	Acceptable	EPA 624
	Toluene	µg/l	31.4	30.5	21.7 - 38.4	24.5 - 35.6	Acceptable	EPA 624
	1,1,1-Trichloroethane	µg/l	31.8	30.7	20.0 - 40.5	23.4 - 37.1	Acceptable	EPA 624
	1,1,2-Trichloroethane	µg/l	< 1.0	< 5.00			Acceptable	EPA 624
	Trichloroethylene	µg/l	18.7	18.8	12.3 - 24.5	14.4 - 22.5	Acceptable	EPA 624
	Trichlorofluoromethane	µg/l	< 1.0	< 5.00			Acceptable	EPA 624

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WP-65 Final Customer Report

ERA Laboratory Code: E0051-01W EPA ID: MI00005 State ID: **Report Issued: 08/10/00**

ERA Standard	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Warning Limits	Performance Evaluation	Method Description
Volatiles (cont.)	1,2,3-Trichloropropane	µg/l	< 1.0	< 5.00			Acceptable	EPA 624
	Vinyl acetate	µg/l	< 1.0	< 5.00			Acceptable	EPA 624
	Vinyl chloride	µg/l	< 1.0	< 5.00			Acceptable	EPA 624
	Xylenes, total	µg/l	< 3.0	< 5.00			Acceptable	EPA 624

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WP-65 Final Customer Report

ERA Laboratory Code: E0051-01W EPA ID: MI00005 State ID: Report Issued: 08/10/00

ERA Standard	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Warning Limits	Performance Evaluation	Method Description
PCB's In H2O	Aroclor 1016/1242	µg/l	6.17	6.34	1.95 - 8.79	3.09 - 7.65	Acceptable	EPA 608
(Standard 1)	PCB Aroclor Identity	µg/l	1016/1242	1016	1016	1016	Acceptable	EPA 608
PCB's In H2O	Aroclor 1254	µg/l	3.29	3.90	1.79 - 5.16	2.35 - 4.60	Acceptable	EPA 608
(Standard 2)	PCB Aroclor Identity	µg/l	1254	1254	1254	1254	Acceptable	EPA 608
PCB's In Oil	Aroclor 1016/1242	mg/Kg	25.7	31.6	5.20 - 43.7	11.6 - 37.3	Acceptable	EPA 1982
(Standard 1)	PCB Aroclor Identity	mg/Kg	1016/1242	1242	1242	1242	Acceptable	EPA 1982
PCB's In Oil	Aroclor 1260	mg/Kg	18.5	22.4	4.19 - 31.9	8.82 - 27.3	Acceptable	EPA 1982
(Standard 2)	PCB Aroclor Identity	mg/Kg	1260	1260	1260	1260	Acceptable	EPA 1982

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WP-65 Final Customer Report

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ERA Standard	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Warning Limits	Performance Evaluation	Method Description
Pesticides	Aldrin	µg/l	1.93	2.10	0.537 - 2.84	0.920 - 2.45	Acceptable	EPA 608
	alpha-BHC	µg/l	2.81	2.93	1.25 - 3.96		Acceptable	EPA 608
	beta-BHC	µg/l	6.18	7.74	2.84 - 11.2		Acceptable	EPA 608
	delta-BHC	µg/l	< 1.0	< 0.100			Acceptable	EPA 608
	gamma-BHC(Lindane)	µg/l	6.17	7.54	2.51 - 10.9		Acceptable	EPA 608
	alpha-Chlordane	µg/l	< 1.0	< 0.100			Acceptable	EPA 608
	gamma-Chlordane	µg/l	3.80	3.83	1.17 - 5.40		Acceptable	EPA 608
	4,4'-DDD	µg/l	5.48	6.56	3.24 - 9.15	4.22 - 8.16	Acceptable	EPA 608
	4,4'-DDE	µg/l	3.34	3.51	1.66 - 4.79	2.19 - 4.27	Acceptable	EPA 608
	4,4'-DDT	µg/l	4.13	4.24	1.94 - 5.74	2.57 - 5.11	Acceptable	EPA 608
	Dieldrin	µg/l	3.69	3.82	1.97 - 5.27	2.52 - 4.72	Acceptable	EPA 608
	Endrin	µg/l	4.44	4.74	1.96 - 6.47		Acceptable	EPA 608
	Endrin aldehyde	µg/l	< 1.0	< 0.100			Acceptable	EPA 608
	Endrin ketone	µg/l	< 1.0	< 0.100			Acceptable	EPA 608
	Endosulfan I	µg/l	4.26	5.07	2.08 - 7.21		Acceptable	EPA 608
	Endosulfan II	µg/l	1.59	3.08	0.659 - 4.87		Acceptable	EPA 608
	Endosulfan sulfate	µg/l	1.76	1.82	0.626 - 2.77		Acceptable	EPA 608
	Heptachlor	µg/l	1.18	1.26	0.337 - 1.75	0.573 - 1.52	Acceptable	EPA 608
	Heptachlor epoxide	µg/l	2.32	2.48	1.26 - 3.19	1.58 - 2.87	Acceptable	EPA 608
	Methoxychlor	µg/l	6.92	8.24	3.24 - 12.1		Acceptable	EPA 608
Chlordane	Chlordane, technical	µg/l	3.28	3.37	1.48 - 4.79	2.03 - 4.24	Acceptable	EPA 608
Toxaphene	Toxaphene	µg/l	8.33	7.24	0.926 - 13.4		Acceptable	EPA 608
Herbicides	2,4-D	µg/l	4.69	5.71	D.L. - 8.93		Acceptable	EPA 8151
	Dicamba	µg/l	7.62	7.97	0.705 - 11.5		Acceptable	EPA 8151
	2,4,5-T	µg/l	5.85	8.87	1.00 - 12.9		Acceptable	EPA 8151
	Silvex	µg/l	7.61	8.96	0.513 - 11.8		Acceptable	EPA 8151

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WP-65 Final Customer Report

ERA Laboratory Code: E0051-01W EPA ID: MI00005 State ID: **Report Issued: 08/10/00**

ERA Standard	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Warning Limits	Performance Evaluation	Method Description
Base Neutrals	Acenaphthene	µg/l	23.4	20.4	8.92 - 26.1		Acceptable	EPA 625
	Acenaphthylene	µg/l	49.7	54.8	21.3 - 67.7		Acceptable	EPA 625
	Aniline	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	Anthracene	µg/l	50.4	57.2	23.3 - 74.0		Acceptable	EPA 625
	Benzidine	µg/l	< 50	< 10.0			Acceptable	EPA 625
	Benzo(a)anthracene	µg/l	29.2	31.2	18.5 - 35.8		Acceptable	EPA 625
	Benzo(b)fluoranthene	µg/l	22.4	22.0	11.3 - 28.3		Acceptable	EPA 625
	Benzo(k)fluoranthene	µg/l	10.1	10.5	1.39 - 19.9		Acceptable	EPA 625
	Benzo(g,h,i)perylene	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	Benzo(a)pyrene	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	Benzyl alcohol	µg/l	< 50	< 10.0			Acceptable	EPA 625
	4-Bromophenyl-phenylether	µg/l	140	142	60.0 - 182		Acceptable	EPA 625
	Butylbenzylphthalate	µg/l	48.4	56.6	0.170 - 90.6		Acceptable	EPA 625
	Carbazole	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	4-Chloroaniline	µg/l	< 20	< 10.0			Acceptable	EPA 625
	bis(2-Chloroethoxy)methane	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	bis(2-Chloroethyl)ether	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	bis(2-Chloroisopropyl)ether	µg/l		< 10.0				
	1-Chloronaphthalene	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	2-Chloronaphthalene	µg/l	26.6	30.2	11.4 - 38.8		Acceptable	EPA 625
	4-Chlorophenyl-phenylether	µg/l	23.4	29.0	16.4 - 36.4		Acceptable	EPA 625
	Chrysene	µg/l	38.2	40.4	17.9 - 52.2		Acceptable	EPA 625
	Dibenz(a,h)anthracene	µg/l	10.3	11.9	2.93 - 15.4		Acceptable	EPA 625
	Dibenzofuran	µg/l	87.8	88.1	8.30 - 130		Acceptable	EPA 625
	Di-n-butylphthalate	µg/l	150	143	16.3 - 200		Acceptable	EPA 625
	1,2-Dichlorobenzene	µg/l	113	121	58.2 - 121		Acceptable	EPA 625
	1,3-Dichlorobenzene	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	1,4-Dichlorobenzene	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	3,3'-Dichlorobenzidine	µg/l	< 20	< 10.0			Acceptable	EPA 625
	Diethylphthalate	µg/l	24.1	26.0	13.4 - 38.8		Acceptable	EPA 625
	Dimethylphthalate	µg/l	156	160	D.L. - 245		Acceptable	EPA 625
	2,4-Dinitrotoluene	µg/l	81.4	88.9	35.6 - 118		Acceptable	EPA 625
	2,6-Dinitrotoluene	µg/l	56.5	56.3	21.5 - 72.1		Acceptable	EPA 625
	Di-n-octylphthalate	µg/l	74.7	65.6	12.0 - 96.8		Acceptable	EPA 625
	bis(2-ethylhexyl)phthalate	µg/l	110	129	19.9 - 189		Acceptable	EPA 625
	Fluoranthene	µg/l	12.7	13.8	8.95 - 17.2		Acceptable	EPA 625
	Fluorene	µg/l	74.8	90.3	37.9 - 116		Acceptable	EPA 625
	Hexachlorobenzene	µg/l	28.9	29.3	12.7 - 38.2		Acceptable	EPA 625
	Hexachlorobutadiene	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	Hexachlorocyclopentadiene	µg/l	132	117	D.L. - 150		Acceptable	EPA 625
	Hexachloroethane	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	Indeno(1,2,3-cd)pyrene	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	Isophorone	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	1-Methylnaphthalene	µg/l	< 1.0	< 10.0			Acceptable	EPA 625
	2-Methylnaphthalene	µg/l	< 5.0	< 10.0			Acceptable	EPA 625

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WP-65 Final Customer Report

ERA Laboratory Code: E0051-01W EPA ID: MI00005 State ID: **Report Issued: 08/10/00**

ERA Standard	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Warning Limits	Performance Evaluation	Method Description
Base Neutrals (cont.)	Naphthalene	µg/l	57.3	64.0	18.0 - 83.8		Acceptable	EPA 625
	2-Nitroaniline	µg/l	< 20	< 10.0			Acceptable	EPA 625
	3-Nitroaniline	µg/l	< 20	< 10.0			Acceptable	EPA 625
	4-Nitroaniline	µg/l	< 20	< 10.0			Acceptable	EPA 625
	Nitrobenzene	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	N-Nitrosodiethylamine	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	N-Nitrosodimethylamine	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	N-Nitrosodiphenylamine	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	N-Nitroso-di-n-propylamine	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	Phenanthrene	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	Pyrene	µg/l	115	142	47.3 - 191		Acceptable	EPA 625
	Pyridine	µg/l	< 10	< 10.0			Acceptable	EPA 625
	1,2,4-Trichlorobenzene	µg/l	116	113	33.1 - 134		Acceptable	EPA 625

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ERA Standard	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Warning Limits	Performance Evaluation	Method Description
Acids	Benzoic acid	µg/l	< 50	< 10.0			Acceptable	EPA 625
	4-Chloro-3-methylphenol	µg/l	124	144	56.6 - 185		Acceptable	EPA 625
	2-Chlorophenol	µg/l	14.5	15.5	6.87 - 20.9		Acceptable	EPA 625
	2,4-Dichlorophenol	µg/l	56.3	64.4	23.3 - 79.2		Acceptable	EPA 625
	2,6-Dichlorophenol	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	2,4-Dimethylphenol	µg/l	17.3	20.5	1.18 - 28.8		Acceptable	EPA 625
	4,6-Dinitro-2-methylphenol	µg/l	165	166	16.9 - 243		Acceptable	EPA 625
	2,4-Dinitrophenol	µg/l	92.9	161	D.L. - 205		Acceptable	EPA 625
	2-Methylphenol	µg/l	132	171	5.00 - 234		Acceptable	EPA 625
	3-Methylphenol	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	4-Methylphenol	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	2-Nitrophenol	µg/l	28.4	28.0	9.28 - 35.9		Acceptable	EPA 625
	3-Nitrophenol	µg/l	< 5.0	< 10.0			Acceptable	EPA 625
	4-Nitrophenol	µg/l	44.9	77.6	D.L. - 109		Acceptable	EPA 625
	Pentachlorophenol	µg/l	66.9	111	28.8 - 153		Acceptable	EPA 625
	Phenol	µg/l	44.7	117	D.L. - 158		Acceptable	EPA 625
	2,4,5-Trichlorophenol	µg/l	59.7	64.8	28.2 - 81.9		Acceptable	EPA 625
	2,4,6-Trichlorophenol	µg/l	124	128	41.8 - 170		Acceptable	EPA 625

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WP-65 Final Customer Report

ERA Laboratory Code: E0051-01W EPA ID: MI00005 State ID: **Report Issued: 08/10/00**

ERA Standard	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Warning Limits	Performance Evaluation	Method Description
PAH's	Acenaphthene	µg/l	14.9	14.4	6.64 - 18.2		Acceptable	EPA 610
	Acenaphthylene	µg/l	1.98	2.51	0.930 - 3.33		Acceptable	EPA 610
	Anthracene	µg/l	< 5.0	< 0.100			Acceptable	EPA 610
	Benzo(a)anthracene	µg/l	< 5.0	< 0.100			Acceptable	EPA 610
	Benzo(b)fluoranthene	µg/l	< 5.0	< 0.100			Acceptable	EPA 610
	Benzo(k)fluoranthene	µg/l	10.8	15.0	6.35 - 20.1		Acceptable	EPA 610
	Benzo(g,h,i)perylene	µg/l	< 5.0	< 0.100			Acceptable	EPA 610
	Benzo(a)pyrene	µg/l	3.62	5.02	2.15 - 6.84		Acceptable	EPA 610
	Chrysene	µg/l	< 5.0	< 0.100			Acceptable	EPA 610
	Dibenz(a,h)anthracene	µg/l	< 5.0	< 0.100			Acceptable	EPA 610
	Fluoranthene	µg/l	< 5.0	< 0.100			Acceptable	EPA 610
	Fluorene	µg/l	< 5.0	< 0.100			Acceptable	EPA 610
	Indeno(1,2,3-cd)pyrene	µg/l	< 5.0	< 0.100			Acceptable	EPA 610
	Naphthalene	µg/l	< 5.0	< 0.100			Acceptable	EPA 610
	Phenanthrene	µg/l	< 5.0	< 0.100			Acceptable	EPA 610
	Pyrene	µg/l	11.6	15.1	4.23 - 23.4		Acceptable	EPA 610

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Study: **WP65**

ERA Laboratory Code: **E0051-01W**

Laboratory Name: **TRIMATRIX LABS**

Report Type: **Customer**

Report Method: **Method B**

5540 Marshall St., Arvada, CO 80002 1-800-372-0122 fax 303-421-0159 info@eraqc.com www.eraqc.com

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WP-65 Final Customer Report

ERA Laboratory Code: E0051-01W EPA ID: MI00005 State ID: Report Issued: 08/10/00

ERA Standard	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Warning Limits	Performance Evaluation	Method Description
Minerals	Total Solids at 105°C	mg/l		225	188 - 260			
	Total Dissolved Solids	mg/l		220	162 - 278	181 - 259		
	Alkalinity as CaCO3	mg/l		33.7	29.0 - 39.1	30.7 - 37.5		
	Conductivity at 25°C	µmhos		351	324 - 378	333 - 369		
	Chloride	mg/l	74.6	69.4	62.5 - 76.0	64.7 - 73.8	Check for Error	EPA 300.1
	Fluoride	mg/l	2.12	2.10	1.82 - 2.35	1.91 - 2.27	Acceptable	EPA 300.1
	Potassium	mg/l		16.7	14.3 - 19.2	15.1 - 18.4		
	Sodium	mg/l		59.8	53.9 - 65.7	55.9 - 63.8		
	Sulfate	mg/l	13.8	15.0	11.3 - 18.3	12.5 - 17.2	Acceptable	EPA 300.1
pH	pH	S.U.		6.10	5.96 - 6.24	6.01 - 6.20		
Hardness	Total Suspended Solids	mg/l		90.1	70.0 - 97.4	74.5 - 92.8		
	Calcium	mg/l		85.0	76.1 - 96.2	79.5 - 92.8		
	Magnesium	mg/l		5.27	4.54 - 5.99	4.78 - 5.75		
	Calcium hardness (CaCO3)	mg/l		212	180 - 244			
	Total Hardness (CaCO3)	mg/l		234	214 - 255	221 - 248		
Demand	BOD	mg/l		79.7	40.2 - 119	53.4 - 106		
	CBOD	mg/l		68.6	30.8 - 106	43.4 - 93.9		
	COD	mg/l		129	97.7 - 149	106 - 140		
	TOC	mg/l		51.0	42.6 - 58.8	45.3 - 56.1		
Nutrients - Simple	Ammonia as N	mg/l		16.4	12.8 - 19.9	13.9 - 18.7		
	Nitrate as N	mg/l	17.1	18.8	14.9 - 22.3	16.1 - 21.1	Acceptable	EPA 300.1
	Ortho-phosphate as P	mg/l	3.42	3.63	3.10 - 4.20	3.28 - 4.01	Acceptable	EPA 300.1
Nutrients - Complex	Total phosphorus as P	mg/l		2.51	1.91 - 2.97	2.08 - 2.79		
	Total kjeldahl nitrogen	mg/l		6.96	4.85 - 8.94	5.53 - 8.26		
Cyanide	Cyanide, total	mg/l		0.473	0.325 - 0.611	0.373 - 0.563		
Phenolics	Phenolics, total	mg/l		1.49	0.822 - 2.16	1.04 - 1.93		
Grease & Oil	Grease & Oil (Gravimetric)	mg/l		37.5	24.5 - 43.1	27.6 - 40.0		
	Grease & Oil (infrared)	mg/l		45.0	30.1 - 50.9	33.6 - 47.4		
TRC	Total Residual Chlorine	mg/l		1.06	0.823 - 1.30	0.902 - 1.22		

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WP-65 Final Customer Report

ERA Laboratory Code: E0051-01W EPA ID: MI00005 State ID: Report Issued: 08/10/00

ERA Standard	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Warning Limits	Performance Evaluation	Method Description
Hexavalent Chromium	Hexavalent Chromium	µg/l		178	145 - 205			
Trace Metals	Aluminum	µg/l		1920	1650 - 2180	1740 - 2090		
	Antimony	µg/l	533	527	369 - 635	413 - 590	Acceptable	EPA 200.8
	Arsenic	µg/l	412	439	367 - 515	392 - 490	Acceptable	EPA 200.8
	Barium	µg/l	296	271	237 - 312		Acceptable	EPA 200.8
	Beryllium	µg/l	183	185	156 - 209	165 - 200	Acceptable	EPA 200.8
	Boron	µg/l	559	548	400 - 714		Acceptable	EPA 200.8
	Cadmium	µg/l	103	106	89.7 - 121	95.0 - 116	Acceptable	EPA 200.8
	Chromium	µg/l	544	559	487 - 632	511 - 608	Acceptable	EPA 200.8
	Cobalt	µg/l	327	312	273 - 350	286 - 337	Acceptable	EPA 200.8
	Copper	µg/l	140	128	113 - 143	118 - 138	Check for Error	EPA 200.8
	Iron	µg/l		316	276 - 362	290 - 348		
	Lead	µg/l	263	249	213 - 284	225 - 272	Acceptable	EPA 200.8
	Manganese	µg/l	1700	1670	1500 - 1860	1560 - 1800	Acceptable	EPA 200.8
	Molybdenum	µg/l	78.7	79.1	65.5 - 91.7	69.8 - 87.3	Acceptable	EPA 200.8
	Nickel	µg/l	1360	1280	1160 - 1430	1200 - 1380	Acceptable	EPA 200.8
	Selenium	µg/l	96.8	111	84.4 - 130	92.0 - 122	Acceptable	EPA 200.8
	Silver	µg/l	133	128	109 - 147	116 - 141	Acceptable	EPA 200.8
	Strontium	µg/l		72.2	61.1 - 83.2	64.8 - 79.5		
	Thallium	µg/l	310	328	263 - 382	283 - 352	Acceptable	EPA 200.8
	Vanadium	µg/l	503	521	468 - 572	485 - 554	Acceptable	EPA 200.8
	Zinc	µg/l	227	222	193 - 254	203 - 243	Acceptable	EPA 200.8
Mercury	Mercury	µg/l	7.49	9.48	7.06 - 11.9	7.86 - 11.1	Check for Error	EPA 200.8
Tin and Titanium	Titanium	µg/l		82.1	69.5 - 93.7	73.5 - 89.6		
	Tin	µg/l		2130	1680 - 2590			

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TRIMATRIX LABORATORIES, INC.

CORRECTIVE ACTION PROTOCOL

TriMatrix Laboratories, Inc.

STANDARD OPERATING PROCEDURE

INORGANIC LABORATORY CORRECTIVE ACTIONS

UNCONTROLLED DOCUMENT

APPROVALS:

Inorganic Manager: _____ Date: 8/11/99

QA Manager: _____ Date: 8/11/99

Laboratory Manager: _____ Date: 8/11/99

Procedure Number: GR-10-106

Revision Number: 1.1 By: Rick D. Wilburn Effective Date: 8/11/99

Total Number of Pages: 14 Pages Revised: All

1.0 SUMMARY OF PROCEDURE

1.1 Sample results must conform to specified method quality control criteria. Every effort will be made to produce results that conform with those criteria. When this is not possible and an out of control data point occurs, it is important for the analyst to recognize the problem, then qualify and narrate the data correctly.

1.2 This SOP provides guidelines for corrective actions regarding out of control sample data points. It provides instructions on both the procedure to follow when a data point is out of control, and how to narrate and qualify the data when necessary. It is the responsibility of the analyst to inform the project chemist when a situation arises where he feels it is important to notify the client now, rather than when they receive the data package. The analyst must to do everything in his power to prevent the qualification of data when possible. Re-injections, re-digestions, and alternate cleanup methods will all be employed when practical to do so.

2.0 DETAILED PROCEDURE

2.1 The following is a detailed description of each QC type and its requirements:

2.2 METHOD QUALITY CONTROL TYPES

2.2.1 Initial Calibration Blank (ICB)

2.2.1.1 The initial calibration blank is a reagent blank that is analyzed as a sample once a calibration curve has been generated for a particular test. The ICB will check how close your curve passes through zero. Acceptance limits for an ICB is + or - the test ODL. If the ICB is outside these limits the instrument must be recalibrated and the ICB reanalyzed.

2.2.2 Initial Calibration Verification (ICV)

2.2.2.1 The initial calibration standard is a mid range standard. Generally one of your calibration curve standards or from the same stock. This standard is

analyzed as a sample and calculated against your standard curve. The ICV will check the precision of your curve. Acceptance limits for this standard are + or - 10% or as stated in a particular method. If the ICV falls outside these limits the instrument must be recalibrated and the process repeated. (An ICB must be performed prior to the ICV.)

2.2.3 Method Preparation Blank (MPB)

2.2.3.1 The method preparation blanks is a blank that has been carried through the entire analytical process including any sample pretreatment procedures. The MPB will monitor any contaminates that may affect the sample results. General acceptance limits for a MPB is + or - the test ODL. For some specific tests the MPB values may be subtracted from the regular sample results if outlined in the method. If contamination is detected in the MPB, the entire pretreatment batch must be flagged for re-extraction or digestion. If it is not possible to re-prep the samples then all analyses reported for that batch must be qualified.

2.2.4 Laboratory Control Sample (LCS)

2.2.4.1 The laboratory control sample is a known reference sample that is generally traceable to an outside source such as the USEPA, ERA, APG, etc. This standard may also be made from an independently prepared stock standard. An LCS may also be a fortified reagent blank that is used to monitor an extraction or digestion efficiency. The purpose of the LCS QC type is to validate the accuracy of your analysis. Acceptance limits for this QC type are based upon a 95% confidence limit generated from historical data for this test. A particular test may also have published method advisory limits for this QC type. If the LCS falls outside the established limits, the analytical batch must be flagged for re-extraction, re-digestion, or reanalysis. If it is impossible to repeat the analysis (i.e., BOD) all data for the batch must be qualified. (An MPB must be analyzed prior to the analysis of the LCS.)

2.2.5 Continuing Calibration Blank (CCB)

2.2.5.1 The continuing calibration blank is a reagent blank that is analyzed as a sample, generally after 10 samples have been tested. The CCB will validate whether significant instrument drift has occurred during the analytical run near the test ODL. Frequency of analysis is after every 15 sample determinations. General acceptance limits are the same as the ICB or + or - the test ODL concentration. If the CCB falls outside the control limits, the instrument must be recalibrated and the previous 15 samples reanalyzed. For automated tests where run data is generated after all analysis is complete, 15 samples prior and post the unacceptable CCB must be reanalyzed i.e., all sample results must be encased in acceptable CCB to be acceptable. This reanalysis must include the ICB and ICV QC types.

2.2.6 Continuing Calibration Verification (CCV)

2.2.6.1 The continuing calibration verification is generally the same midrange standard that was analyzed as the ICV. The standard is analyzed as a sample and calculated against your standard curve. The ICV will validate any significant drift of the curve. Acceptance limits for this QC type are + or - 10%, or as stated in a particular method. Frequency of analysis is after 15 regular sample analyses. If the CCV falls outside the acceptance window, the instrument must be recalibrated and the previous 15 samples reanalyzed. For automated tests where run data is generated after all analysis is complete, 15 samples prior and post the unacceptable CCV must be reanalyzed i.e., all sample results must be encased in acceptable CCV to be acceptable. This reanalysis must include the ICB and ICV QC types.

2.3 SUBSET QUALITY CONTROL TYPES

2.3.1 Matrix Spike (SPK)

2.3.1.1 The sample matrix spike is an aliquot of a sample that has been spiked with a known amount of a stock reference standard or spiking solution. A SPK will be required for each matrix type within the analytical batch at a frequency of 10%. The purpose of the SPK is to monitor sample matrix effects on the test. Acceptance limits for this QC type are based upon the 95% confidence limits established for a test and application (matrix).

2.3.2 Duplicate (DUP)

2.3.2.1 The sample duplicate is a replicate analysis of a particular sample that has been carried through the entire analytical process. A DUP is required for each matrix type within the analytical batch at a frequency equivalent to the SPK. The purpose of the duplicate is to monitor precision within the analytical process. Acceptance limits for this QC type are based on established confidence limits, with generally two levels or ranges. The first range covers from the test ODL to a level 10x the ODL. The second range encompasses all results above range 1. Acceptance limits are based upon historical data.

2.3.3 Matrix Spike Duplicate (MSD)

2.3.3.1 A matrix spike duplicate is an aliquot of the same sample used for the spike that has been spiked with a known amount of a stock reference standard or spiking solution. A spike duplicate is required for each matrix type within a digestion or distillation batch. A spike dup analysis may be required on a nondistilled or nondigested sample if the spike has indicated a matrix interference. Frequency for spike dups is 10% per matrix. The purpose of the duplicate spike is to confirm any matrix affects on the test. Acceptance limits for this QC type are based upon the 95% confidence limits established for a test and matrix.

2.3.4 Laboratory Fortified Blank (LFB)

2.3.4.1 A fortified method preparation blank is an aliquot of dionized water that has been spiked with a known amount of a stock reference standard or spiking solution. A blank spike is required for each digestion or distillation batch. The purpose of the blank spike is to verify the analyst's spiking procedure and assure that any matrix interference shown by the spike and spike duplicate is really matrix induced.

3.0 FLOW CHART/TABLE

3.1 ICV/CCV/ICB/CCB/LCS Corrective Action Flowchart.

3.2 CCV/CCB Corrective Action Flowchart.

3.3 Matrix Spike/Matrix Spike Duplicate Corrective Action Flowchart.

3.4 Duplicate Analysis Corrective Action Flowchart.

3.5 LFB Corrective Action Flowchart.

4.0 QUALITY ASSURANCE

4.1 Quality assurance procedures are covered in section 2.0 and the attached flowcharts.

5.0 RESPONSIBILITIES

5.1 The ultimate responsibility of running samples by the method and qualifying results when necessary belongs to the analyst. Other involved parties are the inorganic laboratory manager, and the quality assurance manager.

6.0 REFERENCES

6.1 For further information, consult the analyte specific SOPs, or the TriMatrix Laboratories, Inc. Quality Assurance Manual.

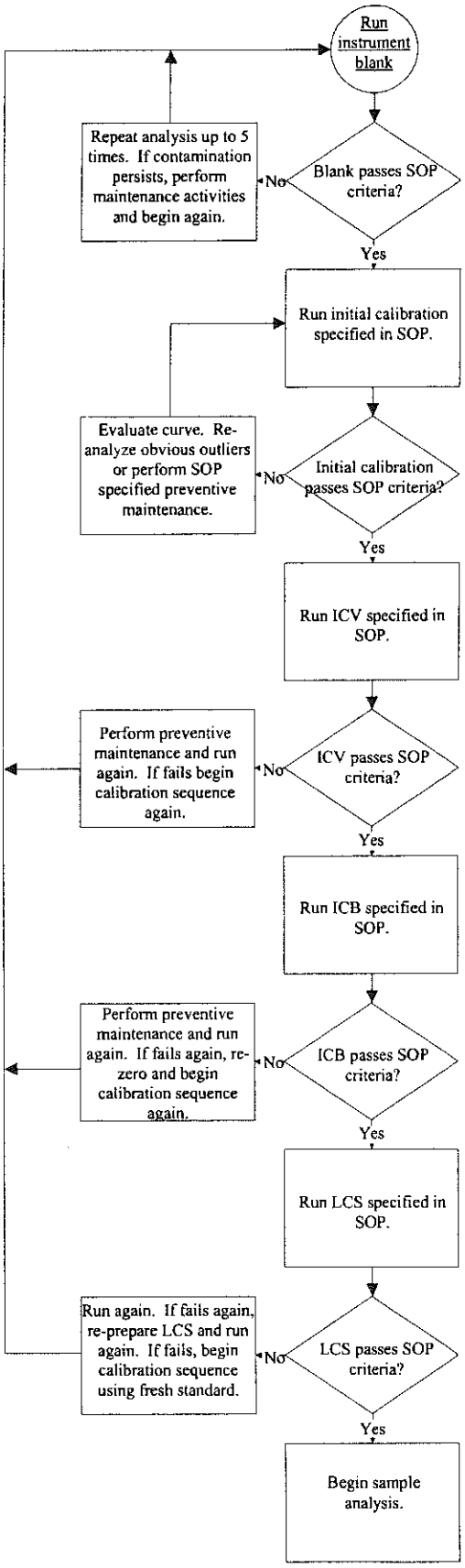
6.2 USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, DC 20460. Publication 9240.1-05, PB94-963501, EPA540/R-94/012, February, 1994.

7.0 APPENDICES

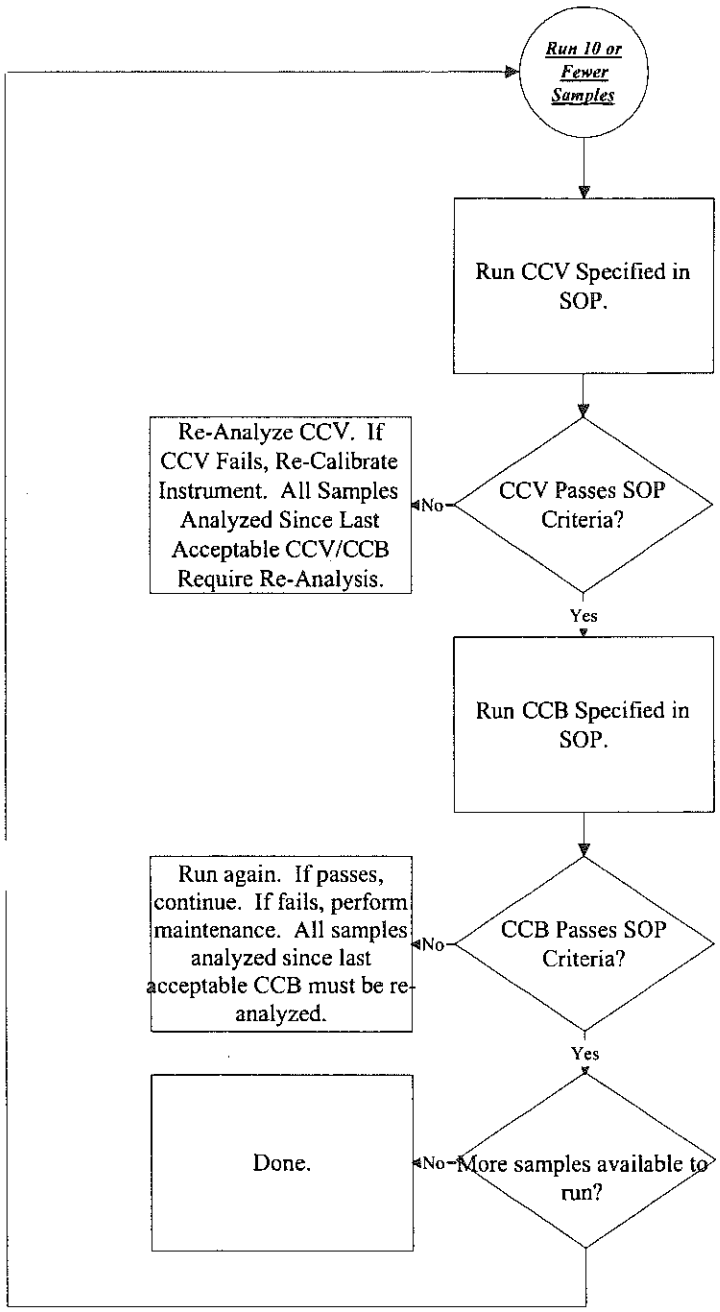
7.1 LIMS Narratives

7.2 LIMS Qualifiers

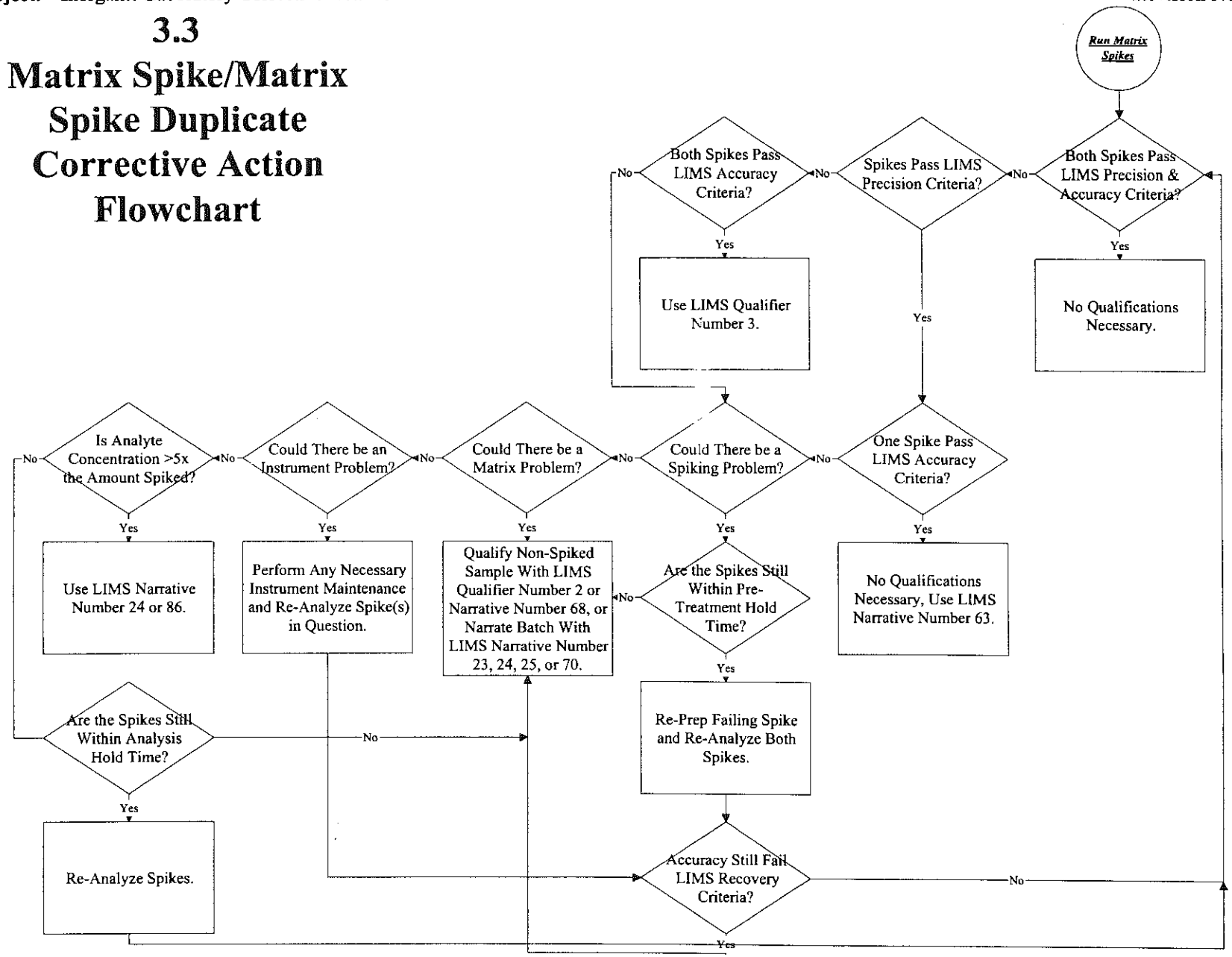
3.1 Curve/ICV/CCV/ ICB/CCB//LCS Corrective Action Flowchart



3.2 CCV/CCB Corrective Action Flowchart



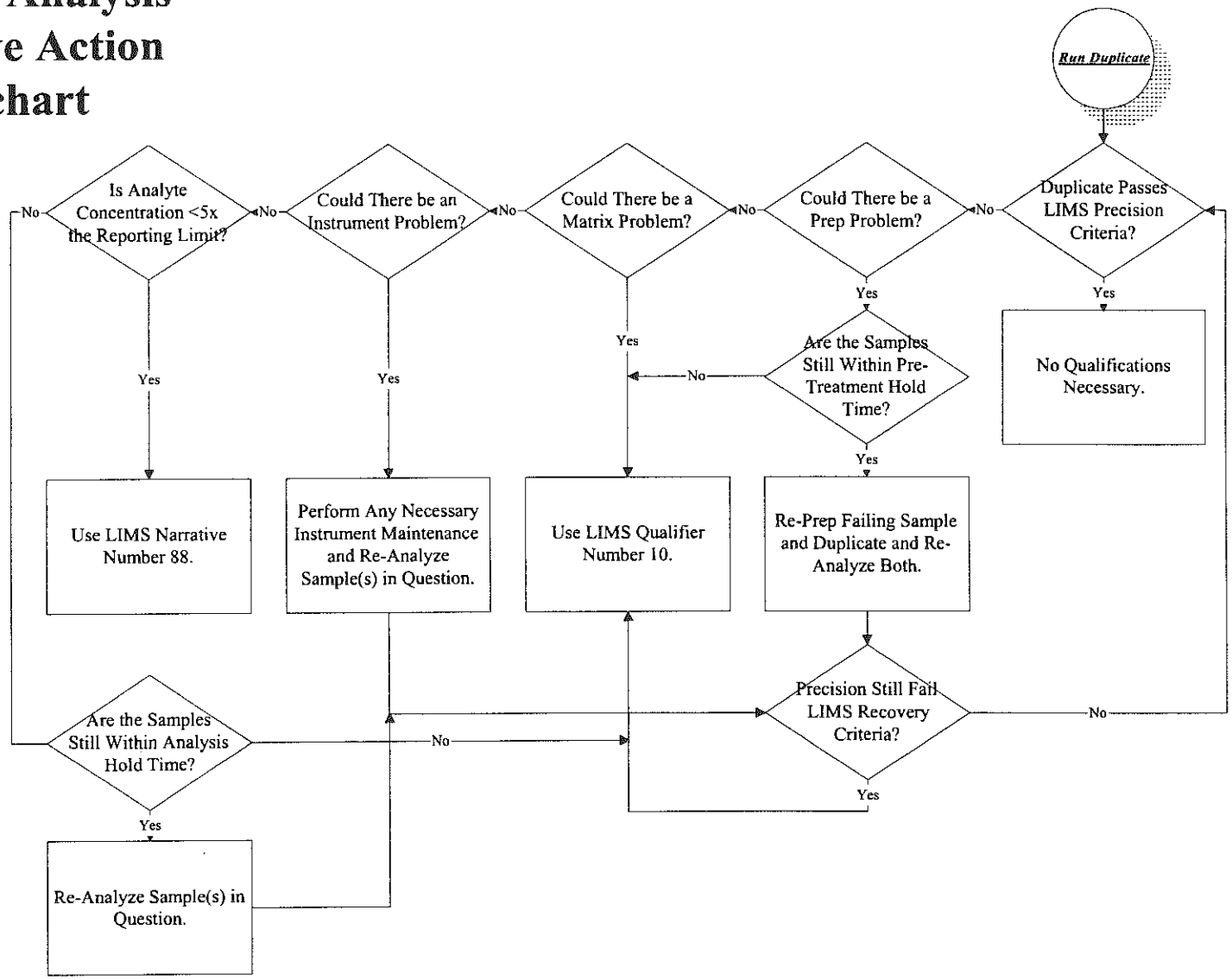
3.3 Matrix Spike/Matrix Spike Duplicate Corrective Action Flowchart



Approved By: 8/11/99
QA Manager

Approved By: 8/11/99
Area Manager

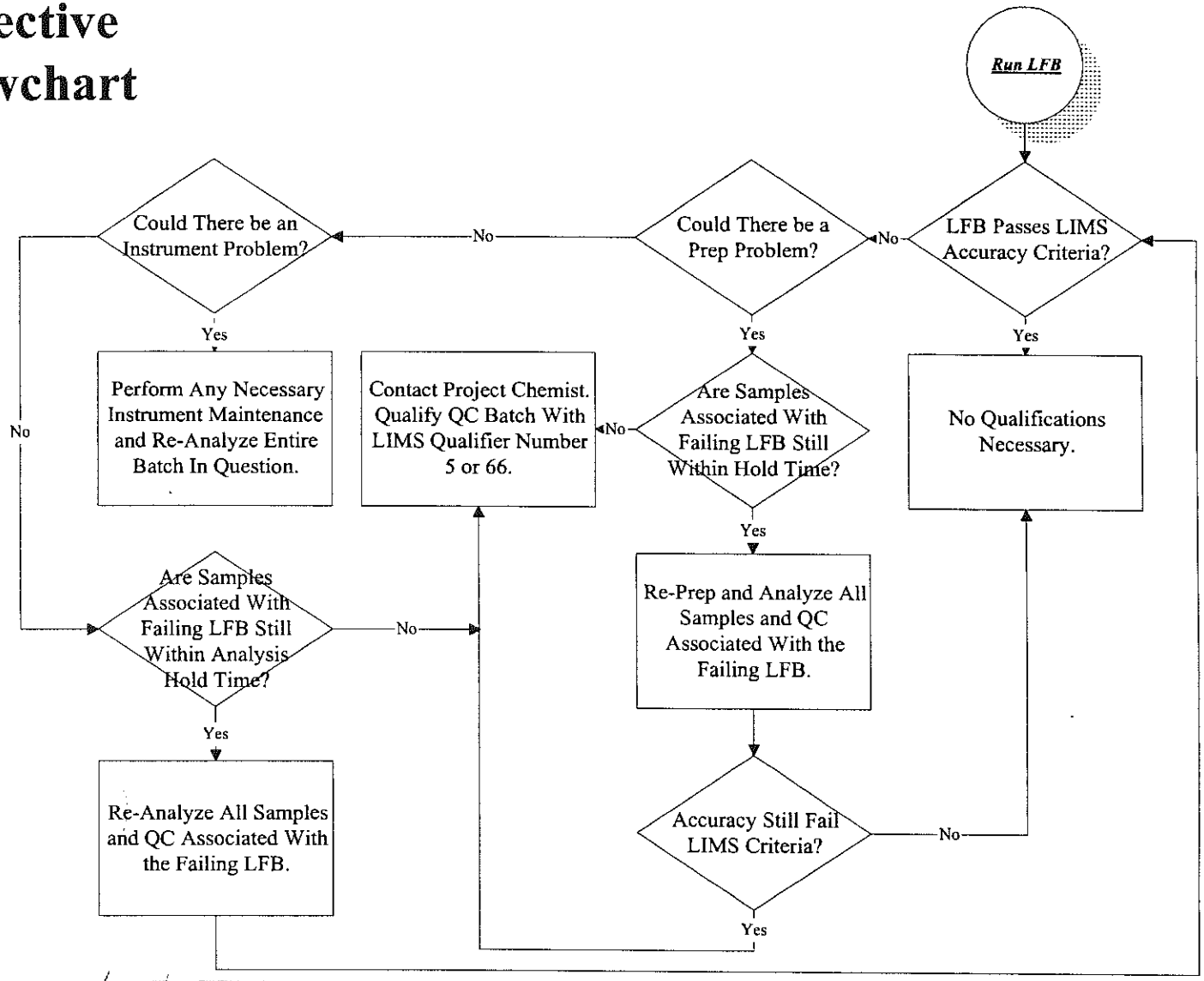
3.4 Duplicate Analysis Corrective Action Flowchart



Approved By: RL 8/11/99 **QA Manager**

Approved By: 8/11/99 **Area Manager**

3.5 LFB Corrective Action Flowchart



Approved By: RG 8/11/99
QA Manager

Approved By: 8/11/99
Area Manager

7.1 LIMS Narratives

#23 Matrix QC results (SPK and MSD) for this sample, QC batch, matrix and analysis were diluted out due to background matrix interferences.

#24 Matrix QC results (SPK and MSD) for this sample, QC batch, matrix and analysis are unavailable due to high analyte concentrations resulting in a dilution for this sample and/or it's extract.

#25 Matrix QC results (SPK and MSD) for this sample, QC batch, matrix and analysis are unavailable due to interfering peaks.

#63 One of the matrix spike accuracies fell outside of the established laboratory control limits, but the precision for MS/MSD is within the control limits for this matrix and method. The corresponding sample result is not considered estimated.

#68 The matrix spike and/or matrix spike duplicate percent recovery for this sample, matrix and compound was above the laboratory established control limit. Since the result for the sample was less than the reporting limit for this compound, no qualification is necessary.

#70 Matrix QC results (SPK and MSD) for this sample, QC batch, matrix and analysis are unavailable due to high analyte concentrations.

#86 The matrix spike and/or matrix spike duplicate recoveries were out of control when compared to the recovery window. Because the non-spiked version of the sample contained an analyte concentration greater than five times the spiked amount, no data requires qualification.

#88 The precision result between the sample and it's duplicate was out of control when compared to the precision window. Because the amounts found in both analyses were less than five times the reporting limit, no qualifications are necessary.

7.2 LIMS Qualifiers

#2 The Matrix spike recovery (SPK) for this sample, fell outside the laboratory established control limits for this method and matrix. The corresponding sample result must be considered estimated.

#3 The matrix spike duplicate (MSD) RPD for this sample, fell outside the laboratory established control limits for this method and matrix. The corresponding sample result must be considered estimated.

#5 The laboratory fortified blank (LFB) recovery for this analytical batch fell outside the laboratory established control limits. All samples in the associated pre-treatment batch must be considered estimated.

#6 The matrix duplicate (DUP) RPD for this sample, fell outside the laboratory established control limits for this method and matrix. The corresponding sample result must be considered estimated.

#66 The laboratory fortified blank (LFB) recovery for this batch was above the laboratory established control limit for this compound. All results greater than the detection limit should be considered estimated. All results less than the detection limit are acceptable and need no qualification.

TriMatrix Laboratories, Inc.

STANDARD OPERATING PROCEDURE

VOLATILE ORGANIC LABORATORY CORRECTIVE ACTIONS

UNCONTROLLED DOCUMENT

APPROVALS:

Organic Manager: _____ Date: 11/5/97
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Procedure Number: GR-03-124
Revision Number: 2.0

Date Initiated: 3/22/95
Effective Date: 11/5/97

Date Revised: 11/5/97
Pages Revised: All

By: Jeff Glaser

Total Number of Pages: 11

1.0 SUMMARY OF PROCEDURE

1.1 Sample results must conform to specified method quality control criteria. Every effort will be made to produce results that conform with those criteria. When this is not possible and an out of control data point occurs, it is important for the analyst to recognize the problem, then qualify and narrate the data correctly.

1.2 This SOP provides guidelines for corrective actions regarding out of control sample data points. It provides iustructions on both the procedure to follow when a data point is out of control, and how to narrate and qualify the data when necessary. It is the responsibility of the analyst to inform the project chemist when a situation arises where he feels it is important to notify the client now, rather than when they receive the data package. The analyst must to do everything in his power to prevent the qualification of data when possible. Re-injections, re-extractions, and alternate cleanup methods will all be employed when practical to do so.

1.3 Non-sample related quality control deviations such as out of control tunes or continuing calibrations are not covered in this SOP. Those items are covered in the appropriate analytical SOP. The more common instances where a sample will require qualification have been covered in this SOP. Analyst experience will govern the correct course of action in other situations.

2.0 DETAILED PROCEDURE

2.1 Surrogate Failure

2.1.1 When a surrogate fails recovery criteria, deciding on how to proceed is influenced by a number of factors. Is re-analysis required (ie. should the sample be re-run or a new methanol extract prepared)? Does the data require qualification, and if so how should the data be qualified? Analyst experience is critical in determining the correct course of action. Surrogate failures generally fall into three categories: sample matrix interference, preparation error, or instrument failure. The course of action taken is specific to those three categories, and by the following general rules.

a) If any surrogate has a percent recovery <10%, all data and detection limits for the corresponding fraction will be narrated and qualified as unusable. (See LIMS qualifier #17 and 18).

b) If any surrogate has a percent recovery of ≥10%, but the percent recovery is less than the laboratory generated recovery lower control limit, all positive hits and detection limits will be narrated and qualified as estimated for that fraction. All non-detectable results will be qualified as approximate. (See LIMS qualifier # 16).

c) If any surrogate has a percent recovery that exceeds the laboratory generated recovery upper control limit, all positive hits for that fraction will be qualified and

narrated as being estimated. No qualification is required on detection limits or on non-detectable results. (See LIMS qualifier # 15).

d) For all volatile water samples, non-diluted soil samples, and soil samples with less than a 1:500 dilution, surrogate recoveries will be calculated and reported, and data will be narrated and qualified when necessary. Surrogate recoveries will not be calculated, reported, or used to qualify data on soil samples run at a dilution of >1:500.

e) Surrogate recoveries outside of the laboratory generated windows will not be used to qualify quality control samples with acceptable spike compound recoveries. However, if a matrix spike or matrix spike duplicate has acceptable surrogate recoveries, and the non-spiked version of the sample has surrogate recoveries outside of the acceptable windows, the data will be narrated and qualified, or appropriate action will be taken according to rules outlined elsewhere in this section.

2.1.1.1 Sample Matrix

2.1.1.1.1 Surrogate failure due to sample matrix problems will be suspected when one or more of the following occur:

a) poor chromatography
b) raised baseline
c) only one or two surrogates are out of control
d) co-elution of the surrogate with another peak
e) recovery of all surrogates are low due to sample foaming while being purged.

If sample matrix <u>is</u> suspected to be the cause of a failed surrogate recovery and no dilution is required, the sample will not be re-run and the data will be narrated and qualified as estimated. If a dilution is required, the surrogates from the diluted run will be used to decide if qualifications are necessary. (See LIMS qualifier # 19).

2.1.1.1.2 If sample matrix <u>is not</u> suspected to be the cause of a failed surrogate recovery, then the sample should be re-run at the same preparation as the initial run, unless a dilution due to high analyte concentration is required. If a dilution is necessary, then the sample should be re-run at the least possible dilution. If a dilution >1:500 on a soil sample is necessary, surrogate results will not be reported and no data will be qualified. If a water sample was diluted or a soil sample was diluted ≤1:500, the surrogates from the diluted run only will be used and reported.

2.1.1.1.3 If a soil sample was run at a dilution of >1:500, surrogate recoveries will not be used in deciding if data should be qualified.

2.1.1.2 Preparation Error

2.1.1.2.1 If surrogates are out of the laboratory generated recovery windows, preparation error will be suspected if:

a) the analysis of samples run before and after the sample in question had acceptable surrogate recoveries
b) the internal standard areas are also unacceptable/mis-injection is assumed (with manual addition of standards)
c) base line sensitivity appears normal

2.1.1.2.2 If the sample is within hold time it will automatically be re-run or re-prepared. If the re-analysis works, the first run will not be used and no data will be qualified. If the re-analysis shows similar results, matrix interferences will be assumed and the data for that fraction will be narrated and qualified as estimated (see Section 2.1.1.1). The initial run will be the run that is reported. If the sample is out of its' hold time, the project chemist will be consulted and the analyst will proceed as instructed, by either qualifying the data for that fraction as estimated based on poor surrogate recoveries, or by having the sample re-analyzed. If the re-analysis works, the data will be narrated and qualified because it was re-analyzed outside of the hold time. (See LIMS qualifier # 1).

2.1.1.3 Instrument Failure

2.1.1.3.1 If surrogates are out of the laboratory generated recovery windows mis-injection or instrument failure will be suspected if:

a) other runs produced inconsistent results
b) the internal standard areas are not acceptable
c) base line sensitivity looks low
d) previously injected samples had poor matrixes which may have affected surrogate recoveries of the sample in question

2.1.1.3.2 If instrument failure is assumed the sample will automatically be re-run. If the re-run works the first run will not be used and no data will be qualified. If the re-run does not work matrix interferences will be assumed and the analyst will proceed according to Section 2.1.1.1 or 2.1.1.2 as appropriate.

2.1.2 Surrogates will also fail when the sample has been mis-spiked with internal standard. Corrective action for this is outlined in section 2.2.

2.1.3 If one or more of the surrogates are slightly out of control and none of the above situations appear to apply, the sample will be re-analyzed. If surrogates are still out of control, and there is no reason to assume the instrument is out of control, matrix interferences or preparation error will be assumed. Proceed as directed in 2.1.1.2.2.

2.2 Internal Standard Failure

2.2.1 Any time an internal standard fails the -50% +100% area criteria, the ability to accurately quantitate an analyte is lost. For that reason every effort will be made to prevent the failure of an internal standard. Internal standards can fail their area count criteria for the following reasons: software failure, matrix interferences, mis-spiked, or instrument failure.

2.2.1.1 Software Failure

2.2.1.1.1 Samples with poor matrixes or some sort of chromatographic interferences may cause the quantitation software to mis-integrate the peak. If an internal standard fails its area criteria under these circumstances, the data will be reviewed for mis-integration. If this solves the problem, no narration or qualification will be necessary, and the affected analytes will need to be requantitated; if not, proceed as directed below.

2.2.1.2 Matrix Interferences

2.2.1.2.1 If, even after manual integration, a matrix interference is preventing accurate internal standard area quantitation, the sample will be either:

a) re-analyzed, or most likely
b) diluted and re-analyzed

The correct course of action is dependent on the extent of the matrix interferences. Since specific compounds go with specific internal standards, if the sample is diluted, both the non-diluted and diluted runs will be combined and reported as one. The analysis date reported will be the date the initial run was made. The elevated detection limits reported for the compounds associated with the diluted run will be explained in a narration stating why the dilution was made. As long as the internal standard area is acceptable in the diluted run, no data qualifications will be made based on internal standard areas. Exceptions to the rule will exist when the non-

diluted run has matrix problems outlined elsewhere in this section. In these instances only the diluted run will be used.

2.2.1.3 Mis-Spiked

2.2.1.3.1 If surrogate recoveries and internal standard areas fail their respective criteria, the data will be reviewed for a possible mis-spike of the internal standard, if they were manually spiked. If upon review the analyst determines that the sample was mis-spiked with internal standard, the sample will be re-quantitated according to the concentration of the internal standard present in the sample. If the level of internal standard present in the sample cannot be determined, and the sample's hold time has not expired, the sample will be re-analyzed. No data will be qualified as long as the re-analysis works. If the sample is out of its' hold time, the project chemist will be consulted and the analyst will proceed as instructed, by either qualifying the data for that fraction as estimated based on poor internal standard recoveries, or by having the sample re-analyzed. If the re-analysis works, the data will be narrated and qualified because it was re-analyzed outside of the hold time. (See LIMS qualifier # 1).

2.2.1.4 Instrument Failure

2.2.1.4.1 If the internal standards and surrogate standards both fail their criteria, and the standards were added automatically by the instrument, the sample was probably mis-injected. Inspect the autosampler standard injection module to be sure that it is filled with the internal/surrogate standard mixture, as well as to verify that it is dispensing the mixture correctly. Once everything appears to be in functioning properly, then sample will be re-run. No narration or qualification will be necessary if the re-run works.

2.3 Dilution Procedures

2.3.1 Samples will be diluted when there is:

a) sufficient cause to believe that the ability to see the non-diluted detection limits is in question.

b) a chromatography problem from a matrix interference which may be interfering with the recovery of target analytes.

c) sufficient cause to believe that the matrix of the sample will be detrimental to the instrument.

2.3.2 Elevated detection limits will never be reported based on the belief that the non-diluted detection limits cannot be achieved. The sample will always be diluted and the elevated detection limits reported from the results of the diluted run.

2.3.3 The minimum dilution possible will be made that allows the analyte with the highest concentration to be kept near the upper half of the linear range of the instrument. If the dilution is being made based on matrix problems rather than elevated target analyte concentrations, the minimum dilution possible will be made. The sample will be re-run at a lesser dilution if initially over diluted to accomplish this.

2.3.4 Under normal operating conditions, if a sample was initially run straight and a dilution is required, all results and detection limits will be reported from the diluted run only (except as noted above in 2.2.1.2.1).

2.3.5 Diluted samples will be narrated explaining the reason for the elevated detection limits unless it is obvious due to the high target concentrations being reported. (See LIMS qualifier # 7).

2.4 Laboratory Fortified Blank (LFB) Failure

2.4.1 Failure of any part of an LFB requires qualification or when possible, re-analysis of the samples in that batch looking for the failed compound. If any compound or compounds in the Laboratory Fortified Blank (LFB) exceed the upper control limit for recovery, positive results for that analyte for every sample in the QC batch will be estimated. All results less than the detection limit are acceptable and need no qualification. Detection limits will not be qualified. (See LIMS qualifier # 66). However, if any compound or compounds in the LFB are out of control low, positive results for that analyte for every sample in the batch will be qualified as estimated and the detection limit for that analyte will be considered approximate. (See LIMS qualifier # 5). A batch narrative will be written any time a LFB analyte fails recovery criteria.

2.5 Matrix Spike (SPK1 and SPK2)/Matrix Spike Duplicate (MSD) Failure

2.5.1 If all analyte recoveries are within laboratory generated windows on both SPK1 and SPK2, but the precision for the MSD is out, the data for the failed compound in the non-spiked version of the sample will be qualified as estimated. (See LIMS qualifier # 3).

2.5.2 If the percent recovery for an analyte is in control in one SPK, out of control in the other SPK, and the MSD percent difference is in control, no data will be qualified, but a narrative will be written. (See LIMS qualifier # 63).

2.5.3 If any single analyte recovery is outside the laboratory generated windows on either or both SPK1 and SPK2, and the MSD precision is out, the data for the failed compound in the non-spiked version of the sample will be qualified as estimated. (See LIMS qualifier # 2).

2.5.4 If any spiked compound fails in the either or both SPK1 and SPK2, and in the LFB, the data for that analyte for every sample in the batch will be estimated. (See LIMS qualifier # 5).

2.5.5 If SPK1 and/or SPK2 percent recoveries for any analyte are above the upper control, and the results for that analyte in the sample are less than the reporting limit, then no qualification is required. (See LIMS qualifier # 68).

2.5.6 If a sample has a concentration of a spiked analyte that is greater than five times the spiked concentration, and the resulting spike recoveries for SPK1 and/or SPK2 and outside of the control limits, no qualification to sample results is necessary. (See LIMS qualifier # 86).

2.5.7 If the matrix spike recoveries are unable to be obtained due to high background matrix interferences, high analyte concentration, or interfering peaks, then the sample will be qualified for each analyte affected. (See LIMS qualifier # 23, 24, and 25 respectively.)

2.6 Method Preparation Blank (MPB) or Daily Instrument Blank (BLK) Failure

2.6.1 The MPB or BLK will fail for two reasons:

a) surrogate recoveries in the MPB or BLK are outside of the laboratory generated control limits
b) either the MPB or the BLK are contaminated with one or more target analytes

2.6.2 If the surrogate recoveries in the MPB or BLK are above the laboratory generated control limits, data will be narrated but not qualified. (See LIMS qualifier # 15). If surrogate recoveries are below the laboratory generated windows, the BLK must be viewed as mis-prepared and cannot be used to determine sample contamination from the purge and trap system. In this instance, the MPB or BLK must be re-prepared and re-analyzed.

2.6.3 If the BLK is contaminated with any target analytes above the reporting limits for that analyte, analysis may not begin. The problem must be corrected before sample analysis can re-commence.

2.6.4 Sample data will never be blank subtracted. Positive hits found in the BLK and the sample will be reported, and narrated in an analysis narrative. The data for that compound will be reported as estimated. (See LIMS qualifier # 21, 31, and 67.)

2.6.5 In most instances for volatiles, the BLK and the MPB will be reported using the same analysis. The exception to this is for highly concentrated methanol extracted samples. In this case the MPB is prepared and reported separately.

2.7 Missed Holding Times

2.7.1 All samples that are analyzed beyond their established USEPA maximum holding times must be qualified. All positive results must be qualified as estimated, and all non-detectable results must be qualified as approximate. (See LIMS qualifier # 1). If the hold time is missed due to laboratory error, a detailed explanation must be provided with the qualifier.

2.7.2 All samples that are received by the laboratory that have already exceeded their USEPA maximum allowable holding time must have their results qualified as estimated. (See LIMS qualifier # 12).

2.7.3 Trip blanks accompany the samples for many projects when volatile analysis is required. The purpose of the trip blank is to check for cross contamination from the samples in the project. For this reason, when a trip blank is analyzed outside of its USEPA maximum hold time, the sample will be narrated as having missed the holding time, but no qualifications are required to the results. (See LIMS qualifier # 59).

2.8 Improper Preservation of Samples

2.8.1 All volatile water samples are checked during analysis to see if they are properly preserved. Any samples found to have a pH of greater than 2 will be narrated as such, but no qualification of the results will be performed.

2.8.2 When analyzing for acrolein and acrylonitrile, samples will require special treatment.

2.8.2.1 When acrolein and acrylonitrile are requested for a 624 analysis, as specified in 40 CFR Part 136, Appendix A, the results should be considered as screening results only. All positive results will be qualified as estimated. (See LIMS qualifier # 29).

2.8.2.2 For analyses other than 624, samples collected for acrolein and acrylonitrile must be either preserved at a pH of 4-5 or analyzed within 3 days of collection. All results for these compounds are to be qualified or estimated if the above criteria are adhered to. (If only acrolein was requested LIMS qualifier # 30 is to be used. If both analytes are requested, then LIMS qualifier # 76 is used).

2.9 Storage Blanks

2.9.1 As a preventative check against cross contamination of samples by either samples in the same project, samples from another project, or background lab contaminants, a storage blank will be stored in all volatile refrigerators. The storage blanks will be removed after each week, and subsequently analyzed by GC/MS.

2.9.2 If any positive results are obtained for any analyte in the storage blanks, the Quality Assurance Office will be notified immediately.

Approved By: 11/5/97
QA Manager

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Area Manager

2.10 TCLP Blanks

2.10.1 For each Zero Headspace Extraction (ZHE) unit used for TCLP extraction, a blank must be tumbled and analyzed once for every twenty extractions performed.

2.10.2 The ZHE tumble blank will then be analyzed by GC/MS to determine if the ZHE unit is free from contamination. If any contamination is found, the unit must be thoroughly cleaned, and shown to be free of contamination before being put back into service.

2.11 4-Bromofluorobenzene (BFB) Failure

2.11.1 BFB must be successfully analyzed following the instructions and criteria provided in the volatile mass spectrometry SOP (GR-04-104) prior to the analysis of any samples. If BFB does not pass the required criteria, the following steps should be considered, in order, in an effort to solve the problem. Under no circumstances will analyses be performed until BFB passes the required mass abundance criteria.

2.11.1.1 Re-analyze the BFB run. This frequently works, especially when the instrument has set idle over the weekend.

2.11.1.2 Depending on the masses that have failed the abundance criteria, try a second re-analysis or re-tune the instrument.

2.11.1.3 Re-tune the instrument again.

2.11.1.4 Depending on the outcome of each analysis following the re-tune, the analyst may continue re-tuning and re-analyzing until a successful BFB is analyzed. Analyst experience will determine when the instrument is behaving such that re-tuning is the appropriate course of action vs. cleaning the source.

2.11.1.5 Shut down the instrument and clean the source.

3.0 REPORTING AND DELIVERABLES

3.1 All out of control data must be narrated or qualified as appropriate, using the conventions required by the laboratories LIMS system. It is extremely important that the end user of the data be informed of all data which requires some sort of qualification or narration.

4.0 QUALITY ASSURANCE

4.1 Quality assurance procedures are covered in section 2.0.

Approved By: 11/5/97
QA Manager

Approved By: 11/5/97
Area Manager

5.0 REFERENCES

5.1 For further information, consult appropriate volatile laboratory method SOP, or the TriMatrix Laboratories, Inc. Quality Assurance Manual.

5.2 USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, DC 20460. Publication 9240.1-05, PB94-963501, EPA540/R-94/012, February, 1994.

6.0 ATTACHMENTS/APPENDICES

6.1 Not applicable.

Approved By: _____ 11/5/97
QA Manager

Approved By: _____ 11/5/97
Area Manager

TriMatrix Laboratories, Inc.

STANDARD OPERATING PROCEDURE

SEMI-VOLATILE LABORATORY
GAS CHROMATOGRAPHY CORRECTIVE ACTIONS

UNCONTROLLED DOCUMENT

APPROVALS:

Organic Manager: _____ Date: 3/26/97

QA Manager: _____ Date: 3/26/97

Laboratory Manager: _____ Date: 3/26/97

Procedure Number: GR-03-101

Revision Number: 1.0 By: Jeff Glaser Effective Date: 3/26/97

Total Number of Pages: 10 Pages Revised: All

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1.0 SUMMARY OF PROCEDURE

This SOP provides guidelines for corrective actions regarding out of control sample data points. It provides instructions on both the procedure to follow when a data point is out of control, and how to narrate and qualify the data when necessary. Non-sample related quality control deviations such as continuing calibration standards or downfields that don't pass method criteria are not covered in this SOP. Those are covered in the corresponding analytical method SOP.

2.0 SAFETY PRECAUTIONS

N/A

3.0 GENERAL POLICIES

3.1. Samples results must conform to specified method quality control criteria. Every effort will be made to produce results that conform with those criteria.

3.2. When this is not possible and an out of control data point occurs, it is important for the analyst to recognize the problem, then qualify and narrate the data correctly.

3.3. The more common instances where a sample will require qualification have been covered in this SOP. Analyst experience will govern the correct course of action in other situations.

4.0 DETAILED PROCEDURE

4.1 Surrogate Failure

4.1.1 When a surrogate fails recovery criteria, deciding on how to proceed is influenced by a number of factors. Is re-injection required or should the sample be re-extracted? Does the data require qualification, and if so how should the data be qualified? Analyst experience is critical in determining the correct course of

action. Surrogate failures generally fall into three categories: sample matrix interference, extraction error, or instrument failure. The course of action the analyst takes is specific to those three categories, and by the following general rules. See also Figure 1.

a) For methods with only one surrogate, if that surrogate has a percent recovery <10%, all data and detection limits for the corresponding fraction will be narrated and qualified as unusable (see LIMS qualifier #'s 17 and 18).

b) For methods with only one surrogate, if that surrogate has a percent recovery of ≥10%, but the percent recovery is less than the laboratory generated recovery window, all positive hits and detection limits will be narrated and qualified as estimated for that fraction (see LIMS qualifier # 16).

c) For methods with only one surrogate, if that surrogate has a percent recovery that exceeds the laboratory generated recovery window, all positive hits for that fraction will be qualified and narrated as being estimated. No qualification is required on detection limits (see LIMS qualifier # 15).

d) For method 8081 which has two surrogates, the method allows for one surrogate to be out of control. When the primary surrogate, decachlorobiphenyl is out of control, the secondary surrogate, tetrachloro-m-xylene will be used. If the recovery for tetrachloro-m-xylene is in control, no qualifications are required. A narrative will be provided explaining why the secondary surrogate was used (see LIMS qualifier #45). If the secondary surrogate, tetrachloro-m-xylene, is out of control, only the primary surrogate, decachlorobiphenyl will be used. If the recovery of decachlorobiphenyl is in control no qualifications are required. A narrative will be provided explaining why only the primary surrogate was used (see LIMS qualifier #44). If both of the surrogates are in control, then the recoveries of both will be reported. No data will be qualified as long as one of the two surrogates is in control.

e) For all non-diluted runs, or runs with dilutions of ≤ 1:5, surrogate recoveries will be calculated and reported, and data will be narrated and qualified when necessary. Surrogate recoveries will not be calculated, reported, or used to

qualify data on samples run at a dilution of >1:5 (see LIMS qualifier #'s 19 and 20).

f) Surrogate recoveries outside of the laboratory generated windows will not be used to qualify quality control samples with acceptable spike compound recoveries. However, if a matrix spike or matrix spike duplicate has acceptable surrogate recoveries, and the non-spiked version of the sample has surrogate recoveries outside of the acceptable windows, the data will be narrated and qualified, or appropriate action will be taken according to rules outlined elsewhere in this section.

4.1.1.1 Sample Matrix

4.1.1.1.1 If sample matrix **is** suspected to be the cause of a failed surrogate recovery and no dilution is required, the sample will not be re-run and the data will be narrated and qualified as estimated (see LIMS qualifier 19). If a dilution of ≤1:5 is required, the surrogate from the diluted run will be used to decide if qualifications are necessary.

4.1.1.1.2 If sample matrix **is not** suspected to be the cause of a failed surrogate recovery, and a dilution of >1:5 is necessary, due to positive results in the sample, surrogate results will not be reported and no data will be qualified (see LIMS qualifier # 20). If the sample was diluted ≤1:5, the surrogate from the diluted run only will be used and reported.

4.1.1.1.3 If a dilution of >1:5 is required due to matrix interference, then the surrogate results will not be reported, and no qualifications are necessary (see LIMS qualifier # 53).

4.1.1.2 Extraction Error

4.1.1.2.1 If surrogates are out of the laboratory generated recovery windows extraction error will be suspected if:

a) the runs before and after worked fine
b) mis-injection is not assumed
c) base line sensitivity looks normal

4.1.1.2.2 If the sample is within hold time it will automatically be re-extracted. If the re-extraction works the first run will not be used and no data will be qualified. If the re-extraction shows similar results, matrix interferences will be assumed and the data for that fraction will be narrated and qualified as estimated (see Section 4.1.1.1). The initial run will be the run that is reported. If the sample is out of its' hold time, the project chemist will be consulted and the analyst will proceed as instructed, by either qualifying the data for that fraction as estimated based on poor surrogate recoveries, or by having the sample re-extracted. If the re-extract works, the data will be narrated and qualified because it was re-extracted outside of the hold time (see LIMS qualifier # 1).

4.1.1.3 Instrument Failure

4.1.1.3.1 If surrogates are out of the laboratory generated recovery windows mis-injection or instrument failure will be suspected if:

a) other runs produced inconsistent results
b) base line sensitivity looks low
c) previously injected samples had poor matrixes which may have affected surrogate recoveries of the sample in question

4.1.1.3.2 If instrument failure is assumed the sample will automatically be re-run. If the re-run works the first run will not be used and no data will be qualified. If the re-run does not work matrix interferences will be assumed and the analyst will proceed according to Section 4.1.1.1.

4.2 Dilution Procedures

4.2.1 Samples will be diluted when there is:

a) sufficient cause to believe that the ability to see the non-diluted detection limits is in question.
b) a chromatography problem from a matrix interference which may be interfering with the recovery of target analytes.
c) sufficient cause to believe that the matrix of the sample will be detrimental to the instrument.

4.2.2 Detection limits will never be raised based on the belief that the non-diluted detection limits cannot be achieved. The sample will always be diluted and the elevated detection limits reported from the results of the diluted run, with the following exception. If the initial run has a positive hit at the correct retention time at one concentration, and at the correct retention time in the confirmation run but at a substantially higher concentration, a matrix interference problem will be assumed and the detection limit will be raised to the level of the confirmation run. If the initial run had the highest concentration, the detection limit will be elevated to that level.

4.2.3 The minimum dilution possible will be made that allows the analyte with the highest concentration to be kept in the upper half of the linear range of the instrument. If the dilution is being made based on matrix problems rather than elevated target analyte concentrations, the minimum dilution possible will be made. The sample will be re-run at a lesser dilution if initially over diluted to accomplish this.

4.2.4 If a sample was initially run straight, and a dilution is required, all results and detection limits will be reported from the diluted run only.

4.2.5 Diluted samples will be narrated explaining the reason for the elevated detection limits (see LIMS qualifier # 7) unless it is obvious due to the high target concentrations being reported.

4.2.6 When looking for multiple response compounds in a dirty matrix and the sample requires dilution, it must be diluted so that the raised baseline is no higher than the smallest peak of the calibration curve's highest level standard. At this level it is assumed that the detector is not saturated, and in the absence of any analyte peaks, the low standard of the curve may be used to quantitate the raised D.L., assuming the low standard's concentration is equal to the vial concentration of a sample spiked at the MDL level. See method 8081 SOP for detailed description.

4.3 Laboratory Fortified Blank Failure

4.3.1 If any portion of the Laboratory Fortified Blank (LFB) fails its recovery parameters, and the Matrix Spike (MS) and the Matrix Spike Duplicate (MSD) pass theirs, no data will be qualified. A batch narrative will be written explaining why no data is qualified (see LIMS qualifier # 5). The purpose of the LFB is to verify that matrix interferences are what have caused a MS compound to have either a low or high percent recovery, not an extraction error. If the MS and MSD work, analyzing the LFB is technically not necessary, although for reporting purposes it will always be run. However, failure of any part of an LFB will require some sort of corrective action, depending on the failed parameter. Every effort will be made to determine the reason for the failure, mis-spiked, mis-extracted, etc., and appropriate actions will be taken.

4.3.2 If the LFB recovery for any analyte is above the upper control limit, all results for that analyte that are greater than the detection limit in the QC batch should be narrated and considered as estimated. All results less than the detection limit for that analyte can be considered as acceptable and need no qualification, but will also be narrated (see LIMS qualifier #66).

4.3.3 If any spiked compound fails in the LFB, and that same spiked compound fails in either the MS or the MSD, the data for that analyte for every sample in the batch will be estimated (see LIMS qualifier # 5).

4.4 Matrix Spike/Matrix Spike Duplicate Failure

4.4.1 If all analyte recoveries are within laboratory generated windows on both the MS and the MSD, but the precision is out, the data for the failed compound in the non-

spiked version of the sample will be qualified as estimated (see LIMS qualifier # 3).

4.4.2 If the percent recovery for an analyte is in control in SPK1 or SPK2, out of control in the other SPK, and the MSD percent difference is in control, no data will be qualified, but it will be narrated (see LIMS qualifier # 63).

4.4.3 If any single analyte recovery is outside the laboratory generated windows on either or both the MS or the MSD, and the MSD percent difference is out of control, the data for the failed compound in the non-spiked version of the sample will be qualified as estimated (see LIMS qualifier # 2).

4.4.4 If any spiked compound fails in the either or both the MS and MSD, and in the LFB, the data for that analyte for every sample in the batch will be estimated (see LIMS qualifier # 5).

4.4.5 If a dilution ≥1:5 was required on the non-spiked version of the sample, the MS and MSD will not be run. A batch narrative will be provided. No data will be qualified (see LIMS qualifier #'s 23, 24, and 25).

4.4.6 If the non-spiked sample has an analyte which has a concentration greater than five times the spiked amount, and the resulting spike recoveries for SPK1 and/or SPK2 are outside of the laboratory control limits, no qualifications are necessary to the sample results (see LIMS # 86).

4.5 Extracted Method or Daily Blank Failure

4.5.1 The extracted or daily blank will fail for two reasons:

a) surrogate recoveries in the extracted blank are outside of the laboratory generated windows
b) either the extracted blank or the daily blank are contaminated with one or more target analytes

4.5.2 If the surrogate recoveries in the MPB are above the laboratory generated windows, data will be narrated but not qualified (see LIMS qualifier #'s 15). If

surrogate recoveries are below the laboratory generated windows, the blank must be viewed as mis-extracted and cannot be used to determine sample contamination from the extraction process (see LIMS qualifier #'s 17 and 18). Any consistent positive hits from all the samples extracted that day must be narrated and qualified as estimated.

4.5.3 If the daily blank is contaminated with any target analytes, analysis may not begin. The problem must be corrected before sample analysis can re-commence.

4.5.4 Sample data will never be blank subtracted. Positive hits found in the extracted blank will be reported in an analysis narrative at both the level found in the blank, and if a dilution was performed on the sample, the dilution factor multiplied blank result. The data for that compound will be reported as estimated (see LIMS qualifier # 21).

4.5.5 A daily blank will not be run when a clean method blank is run. In this case the method blank is also the daily blank and will be reported both ways.

4.6 Missed Holding Times

4.6.1 All samples that are extracted or analyzed beyond their established USEPA maximum holding times must be qualified. All positive results must be qualified as estimated, and all non-detectable results must be qualified as approximate (see LIMS qualifier # 1). If the hold time is missed due to a laboratory error, a detailed explanation must be provided with the qualifier.

4.6.2 All samples that are received by the laboratory that have already exceeded their USEPA maximum allowable holding time must have their results qualified as estimated (see LIMS qualifier # 12).

5.0 QUALITY ASSURANCE

N/A

6.0 RESPONSIBILITIES

6.1. The ultimate responsibility of running samples by the method and qualifying results when necessary belongs to the analyst.

6.2. It is the responsibility of the analyst to inform the project chemist when a situation arises where he feels it is important to notify the client now, rather than when they receive the data package.

6.3. It is the responsibility of the analyst to do everything in his power to prevent the qualification of data when possible. Re-injections, re-extractions, and alternate cleanup methods will all be employed when practical to do so.

7.0 REFERENCES

For further information, consult the appropriate method SOP, or the TriMatrix Quality Assurance Manual.

8.0 APPENDICES

8.1 Not applicable.